

## Policy Retrospectives

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### AN ECONOMIC VIEW OF FOOD DESERTS IN THE UNITED STATES

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*Considerable policy and academic attention has been focused on the topic of food deserts. We consider this topic from an economic perspective. First, we consider how the components of a standard economic analysis apply to the study of food deserts. Second, using this economic lens, we revisit the empirical literature on food deserts to assess the progress that has been made regarding whether food deserts are problematic in the U.S. Overall, despite several studies documenting the existence of food deserts in local areas, shortcomings in available data have not allowed researchers to convincingly document the presence or absence of food deserts on a national scale, and virtually no research has provided insight as to why food deserts might exist. © 2010 by the Association for Public Policy Analysis and Management.*

### INTRODUCTION

Over the last two decades, numerous papers have been written about the existence of “food deserts” in a variety of different social science disciplines and with data from several different developed countries. The concern of these studies is that there may be insufficient quantity or quality of food or systematically higher food prices in particular geographic areas. For example, Lewis et al. (2005) find that there are fewer healthy restaurant options in poor Los Angeles neighborhoods as compared to more affluent Los Angeles neighborhoods. Powell et al. (2007), using national data, find that poor and minority neighborhoods have fewer chain supermarkets

than do more affluent, whiter neighborhoods. Rose and Richards (2004) find that food stamp recipients who live closer to supermarkets consume more fruit and vegetables. Larson, Story, and Nelson (2009) review 54 studies that examine neighborhood differences in food access in the United States (U.S.). White (2007) reviews numerous studies that examine whether food deserts exist in the United Kingdom (U.K.).

These studies have attracted the attention of policymakers. In the U.K., a government commission issued a report a decade ago stating that food deserts were a problem, which in turn led to the introduction of a bill to study and eradicate the problem (the 2001 Food Poverty Eradication Bill).<sup>1</sup> In the U.S., the 2008 Farm Bill defined a food desert as “an area in the United States with limited access to affordable and nutritious food, particularly such an area composed of predominately lower-income neighborhoods and communities” (Food, Conservation, and Energy Act of 2008, p. 2039). The 2008 Farm Bill further commissioned a report from the U.S. Department of Agriculture (USDA) that would assess the prevalence of food deserts in the U.S. and recommend measures to address their causes and effects (USDA, 2009). In February 2010, the Obama Administration proposed a \$400 million Healthy Food Financing Initiative that, in part, would promote healthy food retailers to move to underserved urban and rural communities; the announcement of the initiative directly cited the prevalence of food deserts as its motivation (U.S. Department of Health and Human Services, 2010).<sup>2</sup> Several states have also launched policy efforts aimed at increasing access to healthy food.<sup>3</sup>

Despite numerous empirical studies of food deserts and the interest these studies have attracted from policymakers, we are not aware of a systematic economic analysis of food deserts. This absence of an economic analysis is unfortunate given that economics is typically defined as the study of the allocation of scarce resources.

In this paper, we examine the public policy issue of food deserts by undertaking two tasks. First, we provide a systematic discussion of the economics of food deserts, paying particular attention to features that economic theory suggests would be important to establishing whether and why they exist.<sup>4</sup> Second, using this economic lens, we revisit the empirical literature on food deserts to assess the progress that has been made regarding whether food deserts are problematic in the U.S.

Overall, the food desert literature has called attention to several key issues regarding the assessment of whether food deserts exist and has clearly documented that some local areas can be thought of as food deserts. However, these local area studies also point to numerous problems with the data that have been used in large-scale studies. Additionally, almost no progress has been made in either the local area or the national studies on identifying why food deserts exist. For example, a food desert might arise in a geographic area in which there is insufficient supply of nutritious food or in an area in which there is insufficient demand. Based on these considerations, there is little basis at the present time for making overall statements about the existence of food deserts in the U.S., the reasons why they exist, or the

<sup>1</sup> See Cummins and Macintyre (2002) and Wrigley (2002) for a discussion of this policy debate in the U.K.

<sup>2</sup> One of the signature campaigns of First Lady Michelle Obama is “Let’s Move,” which lists its primary goal as solving “the epidemic of childhood obesity within a generation.” One of the campaign’s four pillars is “Access to Affordable Healthy Food,” which directly references food deserts. See <http://www.letsmove.gov/accessing/index.html> (accessed June 29, 2010).

<sup>3</sup> One example of a state intervention is Pennsylvania’s Fresh Food Financing Initiative, which is a public-private partnership to provide grants and loans to qualified food retail enterprises that provide fresh foods in underserved low-income areas. This funding is aimed at costs related to planning, assembly of land, construction, and training. No systematic evaluation of such state programs is available, as far as we know.

<sup>4</sup> Much attention has been paid to food deserts by researchers in public health, nutrition, and geography. For a recent summary of findings from the public health literature, see the Institute of Medicine and National Research Council (2009). Our approach here is explicitly an economic one.

policy options that might be effective in eliminating them. Given the potential importance of food deserts and the research opportunities that remain, however, further research is warranted.

## AN ECONOMIC VIEW OF FOOD DESERTS

The premise behind the term “food desert” is that there exist geographic areas with insufficient quantity or quality of food or where healthy food is available only at relatively high prices. The concern is primarily with the existence of such areas among the poor. Perhaps the most basic insight economics brings to such an issue is that the availability of a product is the result of the interaction of supply and demand forces, and these forces together determine what products are available, where they are available, and at what price they are available. We first discuss the components of this economic view, and then we discuss their implications for food desert research and policy.

### THE BASICS

Our economic analysis is comprised of four components: issues related to defining the relevant products, issues that mainly apply to consumers (the demand side), issues that mainly apply to food retailers (the supply side), and the interactions of these factors (the market). Based on this discussion, we then consider the role for policy intervention.

#### Defining the Relevant Products

The starting point for an economic analysis of product availability is the definition of the product. In the case of food deserts, the product of primary concern is healthy and nutritious food. However, this definition is far from complete, and making it more complete is challenging.

First, the analyst must define more precisely what products are included as healthy and nutritious food. This process is difficult for several reasons. A healthy and nutritious diet includes more than just fresh fruits and vegetables and requires an appropriate mix of nutritious food servings from several food groups.<sup>5</sup> In addition, within a particular food group, the designation of healthy and nutritious food falls along a continuum. For example, white bread is generally more nutritious than donuts, but less nutritious than whole-grain bread. Within a food group, healthy and nutritious food servings come in many forms. For example, a nutritious serving of vegetables might be comprised of fresh, canned, frozen, or dried vegetables or some prepared dishes from supermarkets and restaurants, and there is evidence that processing the same vegetables in different ways alters the nutritional content (Nicoli, Anese, & Parpinel, 1999; Xu & Chang, 2008). Additionally, these forms of nutritious food vary in their perishability, time costs associated with preparation and consumption, and price.

Second, as is clear from the name “food desert,” a key attribute of the product is place: Healthy and nutritious food must be geographically close enough to a consumer to be useful. A precise characterization of proximity is unlikely to be fixed, either across region or within region, because proximity is affected by factors such

<sup>5</sup> See <http://www.mypyramid.gov> for the USDA's current guidance on what constitutes a nutritious diet. We also discuss USDA's Healthy Eating Index in a later section. Maximum benefits for the Supplemental Nutrition Assistance Program (formerly known as the Food Stamp Program) are based in part on the Thrifty Food Plan, which is an estimate of the cost of a thrifty but nutritious diet (Gao et al., 2006; Wilde & Llobrera, 2009) that also takes into account existing consumption patterns. All of these sources recognize that a healthy diet includes many more foods than fruits and vegetables.

as transportation availability (e.g., access to private or public transportation and congestion) and individual travel patterns (e.g., the relative location of one's residence and workplace). If the analyst only considers stores near where individuals live, then important food sources may be missed, such as those near where people work or near their children's schools.

Third, assessing the availability of any product in a type of store entails understanding the availability of other products and food sources. For example, our inference about whether the lack of fresh fruits and vegetables in grocery stores is problematic will be influenced by the availability of other sources (farmers' markets and specialty shops) and forms (canned, dried, and frozen) of fruits and vegetables. Restaurants may be an alternate source for some forms of healthy food, as may be some publicly subsidized programs (for example, National School Lunch and Breakfast programs; see Bhattacharya, Currie, & Haider, 2006).

## Demand

The most basic determinants of the demand for healthy food are income, prices, and preferences. Economic theory suggests that the quantity of healthy food demanded is decreasing in its own price and increasing in the price of substitute foods. Assuming healthy food is a normal good, the demand for healthy food will increase with income levels. This observation implies that there will be more food stores with healthy food in high-income areas when compared to low-income areas, even if there were sufficient food stores with healthy food in both. Preferences determine the degree to which prices and income affect food consumption.

Because the primary concern is the existence of food deserts among the poor, it is worth noting that the social safety net could affect the demand for food among the poor. For example, several programs seek to alleviate the negative effects of low income by increasing income (e.g., Temporary Assistance for Needy Families and Supplemental Security Income), while other programs provide food assistance directly through vouchers (now electronically provided in most states) that can be redeemed for certain food items (the Supplemental Nutrition Assistance Program [SNAP] or the Special Supplemental Nutrition Program for Women, Infants, and Children [WIC]) or through direct provision (the National School Lunch and Breakfast programs and the Senior Farmers' Market Nutrition Program).

Many economic analyses of demand allow for heterogeneity in preferences. Although simply allowing for differences in tastes for healthy food by race and ethnicity or educational level has the potential for "assuming" away the problem, heterogeneity in preferences should be considered carefully.<sup>6</sup> For example, ethnic cuisines often differ in key ingredients and cooking methods, and these differences can influence the extent to which canned, frozen, dried, and fresh ingredients are regarded as substitutable and the types of retail outlets one frequents.

Heterogeneity may also exist in discount rates, the formal way that economic models incorporate how individuals value the future. Some theorize that, due to higher discount rates, lower socioeconomic status (SES) individuals have worse health because they invest less in their health through seeing the doctor regularly and avoiding unhealthy behaviors (Fuchs, 1982). In our context, such heterogeneity might imply that lower SES individuals are less likely than others to invest in their health by consuming healthy foods.

<sup>6</sup> The analyst could always assume that, in places where healthy food is not available, the demand for healthy food is low because individuals in that area do not like healthy food. If such a situation existed, there would be less scope for policy intervention.

This simple discussion of food demand overlooks several issues that might be important for food choice among the poor. First, the potential time cost of obtaining ingredients and preparing meals could be important. Such time constraints could be more severe for families with children. This issue becomes relevant when a consumer decides to purchase relatively unhealthy prepared food (e.g., certain foods obtained from fast food restaurants) versus relatively healthier ingredients that then must be prepared. Second, individuals may have inadequate information about the relative merits of different food choices.<sup>7</sup> Third, other factors can affect demand like advertising and the information provided about products (e.g., price per serving size and organic labels). Fourth, behavioral economics—a field of economics that examines how actual behavior systematically deviates from the standard models of utility maximization—has provided numerous useful insights into the actual choices consumers make. Several behavioral factors that have been directly applied to food consumption are issues of self-control and time-inconsistent preferences (Shapiro, 2005) and the importance of habituation (Cohen & Farley, 2008). Mancino and Andrews (2007) provide a detailed discussion of how these and other behavioral concepts could be used to improve individual food choices.

### Supply

The most basic determinants of supply are the input costs to running a retail food outlet, which include labor, land, equipment, transportation, stocking, inventory, and wholesale product costs. Supply (weakly) decreases as each of these costs increases.

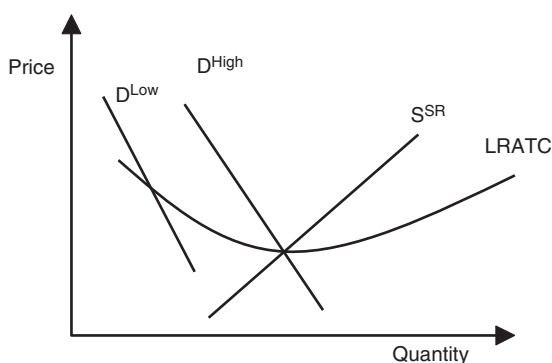
High land and labor costs are unlikely to be important determinants of food deserts because the poor often live in areas with low wages, high unemployment, and low land prices (we discuss the counterexample of certain urban settings below). To the extent that retail food outlets require initial investments, capital may be scarce among the poor, although it would remain an open question why larger retailers who had access to capital would not open a store in low-income areas. This latter question is also relevant for considering wholesale costs: Even if small-scale grocers are unable to secure low wholesale product prices because they do not make bulk purchases, it would remain an open question why large-scale retailers who purchase in bulk would not locate in low-income areas.

Another feature that affects firm behavior is fixed costs, which are firm operating expenses that are (largely) independent of the quantity of goods sold. These fixed costs could arise at the level of the retail outlet (e.g., rent or security) or at the level of offering particular products (e.g., specialized displays). In the face of the latter type, firms will limit the spectrum of goods that will be produced (Tirole, 1997). In both cases, a firm must charge higher prices to be profitable, and the effects of fixed costs on the firm will be greater for low-volume firms when compared to high-volume firms. Once again, however, it would need to be established why fixed costs are systematically higher in poor areas.

Issues with implications similar to those associated with fixed costs are economies of scale, economies of scope, and economies of agglomeration. Economies of scale refer to the situation where per unit operating costs decline with the size of a store. Economies of scope refer to the situation where per unit operating costs decline with the product variety. Economies of agglomeration refer to the situation where per unit operating costs decline when more stores are located nearby, an issue that is central to the economic geography literature (e.g., Krugman, 1991). Each of these cost issues could cause some areas to have concentrated product availability because

<sup>7</sup> For example, obesity may be associated with poor food choices (Bhattacharya & Currie, 2001).





*Note:* This picture depicts the long-run equilibrium in a competitive market. The traditional analysis is depicted by the high demand curve ( $D^{\text{High}}$ ), with the demand curve intersecting the long-run average total cost curve (LRATC) at its minimum. For short-run analysis, we would examine the intersection of the high demand curve and the short-run supply curve ( $S^{\text{SR}}$ ). In situations with sufficiently low demand, depicted by  $D^{\text{Low}}$ , the costs of providing the good are higher for the firm. Moreover, because costs would suggest that only one firm should serve the market, issues of market power in setting the price become relevant.

**Figure 1.** Perfect Competition and Food Deserts.

costs would be lower, which could lead to other areas having lower product availability. Thus, if such cost issues were relevant for food availability, then they would suggest that some areas might be replete with food options, while other areas might lack food availability—areas which could potentially be deemed food deserts. However, once again, such issues would be relevant to the extent that they can explain why the spatial concentration of food outlets occurs away from the poor.

### The Market

The market is where firms and consumers meet to exchange goods for money. Interactions among suppliers (the retail outlets that sell food) and demanders (consumers) in the market determine product availability and prices.

It is usually assumed that consumers in the retail food market have little market power, an assumption that would seem to be natural even in rural food markets.<sup>8</sup> This assumption implies that any one consumer can have little effect on the quantities, prices, and variety of products that are offered. Thus, individuals are “price takers,” simply purchasing those products that make them the best off.

The typical starting place for the analysis of firm behavior is that firms also have no market power, resulting in perfect competition. Under the usual assumptions regarding perfect competition (e.g., perfect information, homogenous goods, buyers and sellers are price takers, no increasing returns to scale or scope, no transaction costs or externalities, and free entry), the standard results are that (1) the short-run price and availability of a good is determined by the direct interaction of short-run supply and demand, and (2) the long-run price is determined by the minimum of the long-run average total cost curve. We depict the long-run static equilibrium in Figure 1 with the demand curve  $D^{\text{High}}$ .

Perhaps the simplest economic model that captures the essence of food deserts arises from a modification of this standard model. Suppose that the long-run average total cost curve remained as depicted in Figure 1, but instead demand was so much

<sup>8</sup> Market power is usually defined as the ability of a seller of a good (the firm in a product market) or buyer of a good (the consumer in the product market) to affect the price or quantity of goods being sold.

lower than it intersected the long-run average total cost curve to the left of its minimum. This situation is depicted in Figure 1 by the demand curve  $D^{\text{Low}}$ . Now, a small shift of the demand curve to the left (lower demand) increases the costs for providing the product. Importantly, this cost situation is termed a natural monopoly because we would expect the market to be served by only one firm, implying that market power should not be ignored.<sup>9</sup>

More generally, in settings where there are few firms serving a market, it is important to consider market power.<sup>10</sup> A firm with market power has the incentive to increase price and restrict quantity with respect to the competitive price and quantity levels in order to increase profits. Therefore, in an area where food retail firms have sufficiently high market power, the quantity of food available could be low enough or prices could be high enough that we might term the area a food desert. However, even if it were established that the lack of food availability and high food prices were related to supplier market power, the question would remain why such market power exists. Several supply-side factors already mentioned could lead to market power, including fixed costs, economies of scale, economies of scope, and economies of agglomeration.

Numerous papers examine the spatial aspect of competition directly (e.g., Capozza & Van Order, 1978). These models do not require the definition of specific geographic markets, but instead directly incorporate transportation costs that effectively make faraway products undesirable to a consumer. These models show that the combination of fixed costs and transportation costs can lead to the spatial distribution of consumers being important determinants of market prices. For example, firms will have more market power in areas with few consumers, and as before, an area where firms have sufficiently high market power could lead to a food desert.

Modern industrial organization theory provides a nuanced understanding of strategic firm decision making. Perhaps one of the central implications is the importance of firms trying to avoid the “Bertrand Paradox.” This paradox follows from the insight that the existence of even two firms, when offering the same product, can lead to “unbridled price competition” (Tirole, 1997, p. 278). To avoid such competition, firms have a strong incentive to differentiate themselves from each other. In the case at hand, this situation suggests retail outlets should try to locate in places where other retail outlets are not locating, and when locating near other retail outlets, they should offer different products.<sup>11</sup> Thus, in models with such stringent competition, food deserts should be less likely to arise.

There is also an industrial organization literature on endogenous fixed costs and the location and entry decisions of firms (e.g., Sutton, 1991). Such models suggest that firms, in response to competition or the threat of competition, undertake strategic actions (e.g., advertising) to force out or keep out competitors. In the case of retail food outlets, these endogenous fixed costs could include investing in larger stores, offering more and higher-quality product variety, and investing in prime retail locations. Ellickson (2006, 2007) suggests endogenous fixed costs can help explain why the retail food market has moved toward having a few large, high-quality chains and a large fringe of smaller stores.

The careful consideration of the interaction of supply and demand factors has led to the development of sophisticated models to explain observed behavior. For example, Waldfogel (2008) develops a model in which the existence of different preferences across groups and large fixed costs in production can result in some goods being available in only certain locales. This model predicts that such factors could

<sup>9</sup>For a more complete discussion of downward sloping supply curves, see Nicholson (2002, pp. 386–388).

<sup>10</sup>For example, Cotterill (1986) finds evidence that market concentration in the retail food industry had a positive effect on prices using data from Vermont. Smith (2004) finds evidence that market power for multi-store supermarket firms is enhanced by the cross-elasticities between stores of the same firm.

<sup>11</sup>For a discussion of research about such differentiated product models in the food processing and distribution industry, see Sexton and Lavoie (2001).

lead to the geographic sorting of firms and consumers. It might be relevant for explaining why certain types of food stores and restaurants may only appear in ethnic enclaves (in situations where an ethnic cuisine requires unique ingredients that can be made available only with sufficiently high fixed costs).

A final issue to consider with food retail outlets is that many of them carry thousands of products.<sup>12</sup> Modeling the decisions of firms that offer multiple products adds another significant layer of complexity and is also the topic of a large literature in industrial organization.

### Efficiency, Market Failures, and the Role for Government Intervention

Perhaps the most celebrated result in economics is that markets that meet the assumptions of perfect competition are efficient, and thus there is no role for government intervention. This powerful result deserves discussion because it is often misunderstood. The narrow objective of economic efficiency is an appropriate starting point for general policy evaluation because it does not require one to make trade-offs among different individuals: By definition, the movement from an inefficient outcome to an efficient outcome is one where some individuals benefit from the change and no individuals are harmed. Because perfectly competitive markets are efficient, any government intervention would necessarily harm some individuals.

Deviations from perfect competition, or market failures, can lead to inefficient outcomes and thus open up the possibility for government intervention on efficiency grounds. One example of a market failure is something that gives a firm appreciable market power. In terms of the discussion above, substantial fixed costs of operation or areas that lack enough firms for meaningful competition to exist could lead to appreciable market power for firms, allowing them to reduce quantity and raise price. Another example of a market failure is imperfect information. In terms of the discussion above, a lack of information among consumers about what constitutes a nutritious diet and its value could lead to consumer demand below what is socially optimal. A third example of a market failure is an externality, which is the situation when private entities do not bear the full costs and benefits of their actions. A potentially relevant externality is that, to the extent that poor individuals do not bear their full health care costs, they may have insufficient incentives to eat a healthy and nutritious diet. In such situations, it is possible that government interventions could move the market toward being more efficient (making at least some people better off and no one worse off), although the feasibility of any policy intervention would still need to be considered.<sup>13</sup>

There are limits to economic efficiency for policy evaluation. Although economists typically put forward efficiency as their objective, policymakers need not, and often do not, use efficiency as their only objective. For example, there are often trade-offs between efficiency and equity, and policymakers may determine that equity deserves consideration. Equity arguments were put forward to justify the New Deal's rural electrification program (see Nye, 1990, Chapter 7) and the more recent Universal Service Fund to provide affordable Internet and telecommunications access to schools and libraries.<sup>14</sup> Economic theory in no way precludes a decision maker from valuing these other objectives. Rather, economic theory is generally silent about how heavily these other objectives should be weighted.

<sup>12</sup> In 2008, the average supermarket carried 46,852 products. See [http://www.fmi.org/facts\\_figs/?fuseaction=superfact](http://www.fmi.org/facts_figs/?fuseaction=superfact) (accessed August 13, 2010).

<sup>13</sup> Often, improvements in overall welfare require that cash transfers be made that may not be feasible, either because of political considerations or because of fiscal pressures. Moreover, in the presence of many distortions, addressing only one of the distortions may not make the market more efficient and could even make it less efficient.

<sup>14</sup> See the Universal Service Fund Web site (<http://www.usac.org/sl/about/overview-program.aspx>) for more information.



## DO FOOD DESERTS EXIST?

The preceding economic analysis has important implications for identifying whether food deserts exist. In this section, we discuss these implications and use them to organize a critical review of the literature.

First, the data requirements for identifying the existence of food deserts are many and may not be satisfied with existing data sources. As noted, nutritious food is better thought of as one end of a continuum rather than a specific category, can come in a variety of forms (e.g., fresh vegetables, frozen vegetables, and prepared foods containing vegetables), and can be obtained at many places (e.g., supercenters like Sam's Club, supermarkets, large grocers, small grocers, restaurants, convenience stores, food stands, and private gardens). Standard data sources on the location and characteristics of firms selling food often include either broad industry classifications or detailed information only on a subset of the retail outlet types. For example, many quantitative studies using private-sector firm data often focus on the geographic distribution of supermarkets and large grocery stores (e.g., Moore et al., 2008; Zenk et al., 2005; Kaufman, 1998; Baker et al., 2006), making the assumption that proximity to grocery stores or supermarkets is a good proxy for access to nutritious food. Other studies that use private-sector firm data use a broader definition of outlets than just supermarkets, but still only have limited information about food availability. For example, Powell et al. (2007) use Dun and Bradstreet data that identifies businesses that are classified as chain supermarkets, non-chain supermarkets, grocery stores, and convenience stores.<sup>15</sup> Even the most comprehensive private sector sources will not provide information about the food actually available in the smaller stores and will miss sources of food such as farmers' markets, home-grown vegetables, and food from restaurants.<sup>16</sup>

Studies at a more local level often use much more complete data on food availability, looking at the presence of various types of stores and the availability of various types of products. Two useful examples are Rose et al. (2009) and Sharkey, Horel, and Dean (2010). Rose et al. (2009) examined food deserts in New Orleans. They began with a listing of retail outlets that are used in some national studies (lists of retail food outlets produced by InfoUSA, which are compiled from phone books, annual reports, business directories, and public records such as USPS change of address files), and then sent out teams to verify the accuracy of the listing by driving on all streets in New Orleans. In addition, for about a third of the stores, they sent research teams into the store to document the availability of pre-defined fruits, vegetables, and energy-dense snack foods, even measuring the shelf space devoted to these items. Similarly, Sharkey, Horel, and Dean (2010) sent out research teams to drive all roads in six rural counties in Texas. Larson, Story, and

<sup>15</sup> Several studies rely on firm-level data sources such as TDLinx data on retail tenants (formerly offered by Trade Dimensions, and currently offered by Neilsen). TDLinx collects store-level data from all retail food stores in the U.S. for use in retail measurement. Such data identify different classes of retail trade establishments along with detailed information on locations, sales, number of SKUs, and other information (not all of which is available for each retail class). In these data, supermarkets are defined as self-service grocery stores with annual sales volume of \$2 million per year and include all supercenters, chains, and independent stores that meet these requirements. Some of the other categories include the following: superettes or small groceries, which are stores with \$1–2 million in sales; convenience stores, which are stores with 500–1,500 SKUs and 800–3,000 square feet and include stores selling gasoline or fast food; drug stores, which are health and beauty care stores or independent pharmacies; and mass, general merchandiser, or dollar stores, which are another category. Although some stores that would fall into these other categories carry a broad line of healthy and nutritious food, many others would not.

<sup>16</sup> USDA (2009) reports that supermarkets and large grocery stores accounted for 14 percent of stores authorized to redeem SNAP benefits in 2008 and accounted for 49 percent of the redemptions. Superstores accounted for 8 percent of the authorized stores and 37 percent of redemptions. Grocery stores (stores with sales under \$2 million a year) accounted for 17 percent of stores and 6 percent of redemptions. Thus, at least for food stamp recipients, leaving out superstores runs the risk of missing a lot of food stamp purchases.

Nelson (2009) review 11 local studies that use in-store observation. Of course, such collection-intensive methods are not feasible for national studies.

These smaller-scale studies can provide important information about the quality of the data that are often used in the national studies. An important example of this type of analysis is Kowaleski-Jones et al. (2009). This study uses two business registries that are often used in national studies (Dun and Bradstreet, InfoUSA) and one state-level government registry for Salt Lake County, Utah. They show that the three registries have many discrepancies, with about one-third of businesses being unique in each. They then show that the identification of food deserts by geographic area is sensitive to the data source used, although statistical analyses of what predicts food deserts are not. Another useful example of such a sensitivity analysis is provided in Rose et al. (2009). For New Orleans, they found that about 20 percent of the stores located in InfoUSA were no longer in business and about another 30 percent of stores that existed were not found in InfoUSA.<sup>17</sup> They also show that the number of tracts that would be characterized as food deserts in New Orleans declines by almost two-thirds when actual fruit and vegetable availability information for small stores is included.<sup>18</sup>

Standard data sources on consumers, in contrast, often collect detailed information on food consumption, regardless of where or how the food is purchased. An example is the National Health and Nutrition Examination Survey (NHANES).<sup>19</sup> Other data sets collect expenditure data. The Consumer Expenditure Survey (CEX) collects detailed information on expenditures on food, including expenditures on raw ingredients, prepared foods for home consumption, and food eaten away from home. The Neilsen Homescan data contain information on food expenditures (prices and quantities) and the types of stores visited for a panel of individuals.<sup>20</sup> In general, consumption and expenditure data are useful because they are intended to include information on total food expenditures. At the same time, for studying food deserts, they have the drawback of reflecting individual preferences. Thus, in typical consumer data, the analyst cannot discern whether a respondent with a poor diet has limited access to healthy and nutritious food or lives next to a supermarket and simply chooses not to consume healthy and nutritious food. Moreover, these data are often unavailable at detailed levels of geography.

Another data challenge arises from the fact that most data are collected about where people live, but food can also be obtained in places where people work, go to school, and enjoy leisure. For example, decennial census data are commonly used in food desert research to characterize the neighborhood in which people live, measuring factors such as median household income or the percent poor. Publicly available data from the decennial census only report information about commute

<sup>17</sup> These numbers should not be taken as representative of the InfoUSA data quality overall. Part of the motivation of the Rose et al. (2009) study is to examine food availability in New Orleans in the wake of Hurricane Katrina, an event that clearly could have affected data quality.

<sup>18</sup> They compute that 46 percent of census tracts are food deserts based on a definition of there being no grocery store within 2 kilometers and at least 20 percent of the population is poor (Table 2). When they include the shelf space devoted to fruits and vegetables in smaller stores, this percentage declines to 17 percent (Table 4).

<sup>19</sup> The NHANES currently collects data that was previously collected by the Continuing Survey of Food Intakes by Individuals. Although the NHANES has the advantage of detailed data from physical exams, it has a smaller sample size and is collected in a more geographically concentrated manner, such that not all states are represented in every survey year.

<sup>20</sup> Relative to the NHANES or CEX, the Homescan data has the advantage of larger samples and price data. One possible drawback to the use of Homescan data to look at consumption by very low-income consumers is that it may underrepresent them (see the discussion of the Homescan panel in Committee on National Statistics, 2005; Einav, Leibtag & Nevo, 2009). Another type of data is point-of-sale scanner data that can be purchased from vendors such as Nielsen and IRI. These data have no demographic information and cannot provide complete purchasing decisions for individuals, but they have detailed information about purchases (e.g., volumes, unit values, outlet types, time, and brands) and are frequently used to calculate demand systems, where demand for a large set of products is simultaneously modeled.

time to work, not the location of where people work. Thus, most studies only describe food availability for neighborhoods where people live, not necessarily capturing true food availability.<sup>21</sup>

Overall, much progress has been made at understanding data quality issues. Several local area studies have collected remarkably detailed information on the food environment and carefully compared detailed food access measures to what would be available in national-level data sets. Unfortunately, the data typically available at the national level are shown to have serious deficiencies in that much of the actual food available is missing or measured with error.

Second, it is useful to consider whether a food desert is meant to be an absolute concept, implying that an area has an insufficient quantity of nutritious food, or a relative concept, implying that an area has less nutritious food than do other areas.<sup>22</sup> Such a distinction has many implications for studying whether food deserts exist. Perhaps the most important implication rests with defining the relevant product. If the analyst were interested in studying whether relative food deserts exist, then she would primarily need a definition for healthy and nutritious food that could be applied consistently across areas. For example, if the definition were “too narrow” in the sense that only the most nutritious foods were included (e.g., fresh fruits and vegetables), then such a systematic “mistake” might be less problematic to a relative measure because the similar too narrow measure would be applied to all areas.<sup>23</sup>

If instead the analyst were interested in absolute food deserts, then she must develop a measure that meaningfully corresponds to nutritional deprivation. This task is very difficult, even if the data constraints detailed above did not exist. As discussed above, a proper definition of healthy and nutritious food is multifaceted, and a healthy and nutritious diet can be achieved with a variety of food items. As a further complication, a stringent notion of a healthy and nutritious diet may not be that relevant to daily food choices. For example, the USDA uses the Healthy Eating Index (HEI) to monitor whether Americans are meeting appropriate nutrition targets (Basiotis et al., 2002). According to this report, in 1999–2000, about 90 percent of the population age 2 and older had a diet that was poor or needed improvement.

Most studies of food deserts use a measure of food access that is, at least to some extent, relative in nature. For example, Powell et al. (2007), using Dun and Bradstreet and decennial census data, find that there are fewer chain supermarkets in low-income zip codes as compared to higher-income zip codes, and this relationship holds in a multiple regression analysis when a variety of other factors are controlled for (race/ethnicity, population size, urbanicity, and region). However, this conclusion does not imply that there are insufficient chain supermarkets in low-income areas, just that there are fewer in low-income areas than in higher-income areas. Similarly, Bader et al. (in press) document how the density of food stores varies across the racial and income characteristics of neighborhoods, again showing relatively less access in poor neighborhoods, not insufficient access in poor neighborhoods. Papers by Wrigley, Warm, and Margetts (2003) and Cummins et al. (2005) examine relative consumption changes with the entrance of a food store into an area. Such a study design attempts to isolate the effects of changing supply, but

<sup>21</sup> For example, recent tabulations of the American Time Use supplement to the Current Tabulation survey suggest that 26 percent of an adult’s waking time is spent at work. USDA (2009) uses the American Time Use Survey to examine trip chaining, finding for a subset of the population that time spent shopping at grocery stores is less if done from work than from home. They also find that individuals in low-income areas with low access were the most likely to access stores bunched with other activities, or from work.

<sup>22</sup> Similar issues arise in the measurement of poverty. See Citro and Michael (1995) for a useful discussion of these issues in the context of poverty measurement.

<sup>23</sup> We do not mean to imply that the precise measure does not matter if the analyst is interested in relative food deserts. For example, if the measure includes only some types of equally nutritious food and the consumption of particular types is related to income, then focusing only on a subset of nutritious foods might lead her to erroneously identify income differences in consumption patterns.

the authors still only examine whether consumption changes, not whether consumption is sufficient or insufficient.

Only a few studies construct an absolute measure of access, usually specifying the distance within which stores need to be present (e.g., a store within 1 or perhaps 2 kilometers). Perhaps the most sophisticated of such measures is developed in Rose et al. (2009). This study calculates absolute access to a subset of goods necessary to meet the USDA's Thrifty Food Plan, thereby allowing them to effectively aggregate across very different store types. Their absolute measure of access requires much more data than are typically available to researchers, requiring information about what each food store carries.

Overall, several sophisticated measures of food access have been developed, and several studies provide detailed comparisons of these measures. Importantly, researchers have not routinely been clear in delineating whether these measures are absolute or relative, but this distinction is likely to be very important to policymakers.

Third, the study of food deserts usually defines a geographic area as the relevant market, and there is unlikely to be an answer that is uniformly correct across areas or within areas. Quite simply, the appropriate geographic area will depend on travel patterns and transportation options, both of which will vary by person.

It is useful to recognize that different mistakes in the definition of the size of geographic markets are likely to cause different types of errors. If the area is too small, then some areas will be defined as food deserts despite there being food readily available in a nearby geographic area. If the area is too large, then some areas might inappropriately be deemed as having sufficient food available, when in fact some parts of the area have insufficient food.

The literature tends to focus on access to food outlets within geographic entities defined by the Census Bureau or, alternatively, within radial or network buffers. For example, Morland et al. (2002) focus on census tracts, and Kowaleski-Jones et al. (2009) and Rose et al. (2009) focus on census block groups. Census block groups contain between 600 and 3,000 people and never cross state or county borders, and census tracts are made up of one or more block groups. Census tracts are designed to be relatively homogeneous with respect to population characteristics, economic status, and living conditions and on average contain about 4,000 people (Iceland & Steinmetz, 2003). Powell et al. (2007) focus on zip codes linked to Zip Code Tabulation Areas, a geographic concept used by the Census Bureau in the 2000 decennial census, which are often even larger. USDA (2009) uses 1-kilometer grids constructed from the 2000 census.

Use of these definitions to delineate the relevant geographic areas is due in part to data constraints: It is exceedingly difficult to obtain national data on neighborhood characteristics at finer levels than those of block groups due to confidentiality requirements.<sup>24</sup> There are at least two drawbacks to these census definitions for geographic access: Using such a specific boundary ignores stores just outside the boundary, and there could be substantial variation in the distance to retail food outlets within the geographic area.

A related method for defining the relevant retail outlets is to calculate radial or network buffers around the centroid of a census tract (Rose et al., 2009; Bader et al., in press). Either method entails specifying that the relevant retail outlets are within a fixed distance of the tract centroid (within 1 kilometer), with the radial method measuring this distance as a fixed Euclidean distance (straight line distance) and the network method measuring this distance along existing roads. Network methods approximate actual travel time better than radial methods, but network methods are also more costly to compute and diverge from radial methods very little when streets

<sup>24</sup> Most neighborhood data are based on the decennial censuses. Currently, the detailed income and other information previously collected on the decennial census long form will no longer be available at such detailed geography for a single year. Instead, American Community Survey data will be pooled across multiple years to provide such detailed geographic information.



follow a regular, gridded pattern, as is common in urban areas (Bader et al., in press). Such methods can improve upon a census unit–based definition of geographic access because the size of the boundary can be varied fairly easily, thereby examining the extent to which there are stores just outside any given boundary. However, radial and network buffers around a tract centroid could still overlook important variation within a tract and the relevant distance to consider must still be chosen.<sup>25</sup>

The relevant geographic size of the market is likely to be systematically larger for rural areas as compared to urban areas. This conclusion is based on the likely travel patterns related to work, school, or other shopping needs, as well as the ubiquity of cars in rural settings. Sharkey, Horel, and Dean (2010) argue that, for rural areas, using too small an area leads to the underestimation of availability of retail outlets. For urban areas, the relevant geographic area is likely to be smaller, and access to public transportation is likely to be much more important. Urban and suburban households are more likely to rely on public transportation options, and such reliance can restrict access to stores. Moreover, a consumer's transportation options are also likely to affect shopping behavior along the dimension of shopping frequency, the quantity of goods bought per shopping trip, and the substitutability of restaurants and other food outlets.<sup>26</sup>

As discussed previously, economic models of spatial competition generally do not require the definition of specific geographic markets, but instead directly incorporate transportation costs that effectively make faraway products undesirable to a consumer (Capozza & Van Order, 1978). These models shift the focus from product availability in a geographic area to the “full price” of product availability for an individual, where full price includes the list price of a product and the individual-level transportation costs to purchase it. Thus, these models reduce the analytic burden of defining a geographic market but increase the data burden in that individual-specific transportation costs must be evaluated for every product. Importantly, the USDA (2009) has taken a step in the direction of measuring these costs by examining the time spent shopping and how it varies by characteristics such as individual and neighborhood income, vehicle access, and the number of stores in an area.<sup>27</sup>

Overall, much progress has been made in developing sophisticated measures of geographic area, as well as understanding the benefits and drawbacks of these methods. However, two methodological issues require additional research. First, the appropriateness of the radial and network measures depend on the distance chosen to define access. There exists suggestive evidence that distances closely linked to easy walking access, as is standard in many studies, may be too small for the U.S. context.<sup>28</sup> Future research should systematically collect information on the distances people travel to obtain food and where they shop. Second, current studies ignore variation in food access within the geographic areas because they assume all individuals within an area have similar access. However, spatial demand models incorporate

<sup>25</sup> Additional challenges arise because neighborhood characteristics are only available nationally by place of residence and only for specific geographic entities. For example, Hellerstein, Neumark, and McInerney (2008) show that only about one-third of workers work in the same or adjacent zip codes as the one where they live in 2000 census data.

<sup>26</sup> Shopping behavior is also likely to be affected by storage space available, which is likely also less substantial in urban than rural areas.

<sup>27</sup> The USDA is continuing their research in this area with an important data collection effort. It has awarded a contract for the National Household Food Purchase and Acquisition Study (NHFPAS), which will collect information on food acquisition and purchases for low-income individuals (including SNAP recipients and eligible nonrecipients). NHFPAS will collect data on food prices and quantities (including non-priced foods), dietary knowledge, food choices and nutritional quality, where food was purchased, income, and source of payments (including cash, credit, SNAP, and WIC).

<sup>28</sup> Ohls et al. (1999) find that, even among food stamp recipients or eligible nonparticipants, more than 75 percent use a car to shop, with 31 percent getting a ride from someone else. Cole (1997) reports that a large share of food stamp participants bypass the nearest store of a particular type. Both findings suggest that a measure tied to walking to the nearest store may be too short.



such variation by computing the “full price” for individuals, reflecting both the purchase price and transportation costs (e.g., Capozza and Van Order, 1978).

Fourth, examining geographic variation in one aspect of nutritious food, whether that aspect is related to the type of food or where the food is purchased, may or may not identify true food deserts. If the particular food aspect studied was indicative of other food availability (complements, in economic terms), then studying one aspect would be sufficient. However, in many cases, we would expect one aspect of food availability to be a substitute for other aspects. For example, with all else equal, the simplest models predict that there would be fewer small grocers in an area that is served by larger grocers and fewer grocers in areas that have many restaurants. In such situations, the focus on only part of the spectrum of nutritious food may be identifying differences in shopping and consumption patterns rather than the real lack of nutritious food.

Several local area studies document that inferences about the existence of food deserts vary according to the definition of healthy foods. For example, Rose et al. (2009) define availability to be within a set distance of a New Orleans census tract centroid and consider several different measures of healthy food availability, including (1) the presence of a supermarket, (2) the presence of each of six groups of fruits and vegetables contained in the Thrifty Food Plan in any type of store, and (3) the cumulative shelf space devoted to fresh fruits and vegetables in any type of store. They find that the share of tracts identified as food deserts varied considerably depending on the definition of healthy food access. Similarly, Sharkey, Horel, and Dean (2010) consider fresh, canned, and frozen fruit and vegetable availability for a rural area in Texas. They find all three sources of fruits and vegetables are almost always available at traditional food retailers (supercenters, supermarkets, and groceries), while there is wider availability of canned and frozen items at non-traditional food stores like convenience stores, dollar stores, mass merchandisers, and pharmacies.

There is some evidence that one type of food availability is a substitute for other types of food availability. Bader et al. (in press) conclude that the existing literature has shown:

Neighborhoods with higher income levels and higher proportions of white residents tend to have greater access to supermarkets or large chain food stores, while poorer neighborhoods and those with higher proportions of black or Hispanic residents may have relatively high access to small grocery stores. . . . A few studies consider access to convenience stores, with most finding that low-income or predominantly minority neighborhoods have more access to such stores.

In their own study in New York City, the authors find differences in the associations between neighborhood characteristics and density of healthy food establishments depending on whether they only look at supermarkets or whether they incorporate fruit and vegetable markets and farmers’ markets. Similarly, Raja, Ma, and Yadav (2008), in a study of Erie County, NY, find that a focus on supermarkets would suggest minority neighborhoods have less access to healthy food, but the inclusion of small grocery stores overturns this initial finding.

Importantly, concerns about substitutability likely vary by population density. For example, the non-market or informal market availability of healthy food may be more prevalent in rural areas.<sup>29</sup> Such non-market or informal market healthy foods are not easily captured in existing data, and thus some rural areas might incorrectly

<sup>29</sup> Systematic historical data about the location of farmers’ markets and stands is not available, to the best of our knowledge. USDA has created a Food Environment Atlas Web site, which allows users to examine county-level counts of farmers’ markets per capita and direct farm sales to consumers per capita. Both measures indicate that informal market food availability is higher in non-metro counties.

be deemed food deserts if the analyst were only to consider more formal market measures of food availability. At the same time, another potential source of healthy food—prepared healthy food—may be more important for urban areas. Thus, for a study of rural areas, firm-level data on grocery stores might be best supplemented with individual-level data on food consumption. In contrast, for the study of food deserts in urban areas, firm-level information on restaurant locations and menu offerings is likely to be more important.

Overall, due to the substitutability of retail food outlets, examining only a piece of food availability will likely provide misleading results regarding food deserts. This conclusion implies even further limitations of typical national studies to date, very few of which consider food sources beyond supermarkets.

Fifth, examining price variation is likely to be very important. Because the typical definition of food deserts includes areas in which nutritious food is available only at prohibitively high prices, the focus on availability alone could miss many food deserts. Despite the obvious importance of prices, few studies directly incorporate prices into their definition of food deserts. There are several explanations for this apparent oversight. Few studies attempt to define an absolute food desert. Even if they did, it is difficult to define operationally what is meant by “prohibitively high.” Moreover, price data are not available with the same geographic detail as data on neighborhood characteristics or retail store locations.<sup>30</sup>

Several types of studies have examined whether the poor pay higher prices for food, but the overall evidence is mixed. A national study of urban areas by Hayes (2000) uses the underlying price data collected for the Consumer Price Index and finds the poor pay less. Local-level studies like Andreyeva et al. (2008), Block and Kouba (2006), and Chung and Myers (1999) tend to focus on price differences across stores in low- and higher-income areas. Although some studies find that prices are higher in poor neighborhoods than nonpoor neighborhoods, such differences may not be reflected in prices paid if individuals shop outside their neighborhood. Broda, Leibtag, and Weinstein (2009) use nationally representative individual data from the Nielsen Homescan panel and find that individuals in low-income areas pay less for food compared to individuals in other areas. Hausman and Leibtag (2007) show that proximity to a Walmart is associated with lower prices using the Nielsen Homescan data.

Studies also examine how prices paid vary with individual-level income. Broda, Leibtag, and Weinstein (2009) examine the relationship between individual income and purchases and find that the poor pay less for food compared to the nonpoor for a variety of reasons, including that the poor shop in cheaper stores and buy more goods on sale. They also find that, while the poor are more likely to shop at higher-priced convenience stores as compared to the nonpoor, the poor are also more likely to shop at lower-priced supercenters when compared to the nonpoor. The USDA (2009) examines price differentials for milk, ready-to-eat cereals, and bread by store type using Homescan data and a hedonic pricing model and finds that income is positively associated with prices paid. An important challenge in addressing price differentials for produce and similar goods is whether price varies due to quality differences.

Overall, there seems to be very little concrete evidence that the poor pay more for food on average. However, this does not imply that no poor people pay systematically more. Future studies should further analyze food prices and heterogeneity in food prices.

<sup>30</sup> The Bureau of Labor Statistics collects data on prices for specific items in urban areas for creating the Consumer Price Index. Todd et al. (2009) create price indices at the regional level from Nielsen Homescan panel data, but these data are not large enough in sample to provide estimates at a more detailed geographic level. Store scanner data is not publicly available, can be quite expensive, and only covers a subset of chains (for example, Walmart does not participate in some scanner data sets). The Council for Community and Economic Research (formerly ACCRA) price data are only available for MSAs and are intended to be representative of prices paid by the relatively well off (see C2ER 2009).

## WHY DO FOOD DESERTS EXIST?

Even if it were established that certain areas lacked nutritious food, the analyst must still understand why this scarcity exists to determine whether a policy intervention is warranted and which intervention might be effective. In this section, we discuss the implications of our economic discussion for assessing why food deserts exist, and again use these implications to provide a critical review of the literature. Overall, very little progress has been made at understanding why food deserts exist, a conclusion that should not be surprising given the substantial difficulties in establishing whether they exist.

First, it is important to distinguish between supply and demand factors that may lead to food deserts. Simply noting that certain places have little nutritious food available tells us nothing about whether the underlying causes are related to supply, demand, or both. Although most researchers who study food deserts are aware of this distinction, separating the effects of supply and demand factors is rarely addressed, presumably due to the empirical difficulties involved.

To see the importance of the distinction between supply and demand for designing policy interventions, consider the following scenario. Suppose there were little nutritious food available in an area primarily comprised of the working poor—an area that would be deemed a food desert. Further, suppose the local population valued nutritious food but was unable to afford regular nutritious, home-cooked meals because of the ingredient and time costs required. If the government mandated the opening of retail outlets in poor areas that sold fresh fruits and vegetables at the same prices as those charged by large-scale suburban grocery stores, it might not affect the food purchases of the working poor because budget and time constraints would be unaffected. Instead, given that low income is the reason why the food desert exists in this example, increasing SNAP benefit levels or cash assistance to the poor would likely be more effective.<sup>31</sup>

In contrast, if the existence of food deserts were driven by supply factors, then government interventions on the supply side might be effective. For example, suppose that wholesale prices were systematically higher in poor areas or that the fixed costs of operating a retail outlet were higher in poor areas. Regarding this latter possibility, a trade association publication (Food Marketing Institute, 1998) lists various challenges faced by firms locating in urban areas, including infrastructure, zoning, crime, and traffic patterns. Such factors might deter firms from locating in certain areas even when demand is no different than in other areas. In these circumstances, a government program that subsidizes higher fixed costs or higher operating costs of retailers might be more effective at increasing the consumption of nutritious food.<sup>32</sup>

The issues relating to supply and demand should be expected to vary between rural and urban areas. If fixed costs related to the retailing of healthy and nutritious food are important, then these fixed costs would raise food prices more in rural areas to the extent that there are fewer people to spread these costs over. For example, if there are fixed costs to stocking a variety of goods, smaller retailers might need to restrict the variety of goods that are offered or offer a similar variety at higher prices. Many of the other supply factors discussed above, such as economies

<sup>31</sup> SNAP (formerly the Food Stamp Program) and similar programs are often referred to as “in kind transfer” programs because the transfer must be spent on specific items. Cash assistance to the poor, on the other hand, does not restrict the items that may be purchased. Of course, standard economic theory suggests there is no distinction in practice whenever the SNAP benefits are less than what the household would otherwise spend on the designated items (Gunderson & Ziliak, 2003). If households would like to spend less than their SNAP benefits on the designated items, then the SNAP benefits can change the consumption patterns of such households.

<sup>32</sup> In a study of stores that redeem food stamps, King, Leibtag, and Behl (2004) find that overall operating costs for stores with high food stamp redemption rates are not significantly different from stores with moderate food stamp redemption rates.

of scope, economies of scale, and economies of agglomeration, could also appreciably affect the product price and product variety in rural areas. A different set of supply side factors, however, are likely to be important in urban and suburban areas. As previously discussed, a trade publication suggests that infrastructure, zoning, and traffic costs could affect some urban areas. Another challenge for urban areas put forward by this publication is the paucity of large parcels of land. This factor can affect both the existence of retail food outlets and also the type of food outlets that exist.

Overall, it appears that much of the existing research implicitly assumes that supply-side factors cause any food deserts that exist. While there may be supply-side explanations (higher costs for firms that locate in some low-income areas), there are also demand-side explanations, including the simple explanation that healthy food is a normal good. We are unaware of any study that has systematically examined whether supply or demand factors explain the existence of food deserts.

Second, policy interventions are more likely to be effective if they are linked to specific problems and goals. To justify a policy intervention in terms of economic efficiency, it is useful to identify the market failure that exists. For example, the supply issues discussed above from the trade publication (fixed costs related to infrastructure and zoning) could lead to barriers to entry in poor, urban areas. These barriers to entry could lead to appreciable market power for firms that exist, and then there might be reasonable scope for government intervention from an efficiency perspective. A potential demand-side market failure already discussed is the lack of information: There would be too little demand for healthy food if the poor systematically misunderstood the importance of a nutritious diet. Another demand-side market failure might be that poor individuals do not face the full costs and benefits of their consumption patterns. Of course, government interventions could also be justified on equity grounds.

With the justification for intervention in mind, it is still useful to link an intervention back to specific market conditions because such linkages can suggest policy options that are more likely to be effective. As discussed above, increases in SNAP benefits are more likely to be effective if demand is insufficient due only to low resources among the poor, and firm subsidies are likely to be more effective if operating costs are relatively high.<sup>33</sup> If demand is insufficient due to the poor not understanding the benefits of a nutritious diet, then a public health campaign promoting the importance of a good diet or increases in SNAP benefits targeted at healthy food might be more effective.<sup>34</sup> Another potential justification for increases in targeted SNAP benefits is the presence of externalities in which the poor do not face the full costs of an unhealthy diet.

<sup>33</sup> It is clear that food stamps increase food spending based on experiments with cashing out food stamps (reviewed in Fox, Hamilton, & Lin, 2004). Studies looking at program rollout find the same (Hoynes & Schanzenbach, 2009).

<sup>34</sup> The evidence is mixed on whether information provision changes diets. For example, Lee (2006) reviews a number of studies of workplace and community interventions to affect obesity, concluding that there is little systematic evidence that providing information is effective. Concerns that unconditional increases in SNAP benefits might not lead to increases in healthy food consumption have led the USDA to test various methods to increase the consumption of fruits, vegetables, and other nutritious items. Potential options for doing this include targeted incentives, nutrition education, and increased access (expanding EBT at farmers' markets). The GAO (2008) reviews existing knowledge about such targeted incentives. Recently, USDA introduced extra vouchers in the WIC program for purchase of fruits and vegetables, and in general, the WIC program only subsidizes foods that contain specific micronutrients. USDA is conducting a pilot (the Healthy Eating Pilot) to assess the effect of encouraging SNAP recipients to consume more fruits and vegetables through targeted allotment increases. Reed, Frazee, and Itskowitz (2004) use Homescan data and find that it would be possible to meet current guidelines of three servings of fruit and four of vegetables for \$0.64, or about 12 percent of daily food purchases. Dong and Lin (2009) estimate that a 10 percent discount for fruits and vegetables for low-income Americans would lead to increases in fruit consumption of 2.1–5.2 percent and increases for vegetables of 2.1–4.9 percent.



Another example of an interesting policy option that could be linked to specific supply conditions is transportation vouchers to facilitate food shopping. Suppose it was determined that food deserts exist in certain locales because, due to economies of scale, scope, or agglomeration in the retail food industry, it was efficient to have large stores clustered in certain areas, leaving other areas underserved. In this situation, encouraging smaller stores to open in the underserved areas might result in high prices because, for example, economies of scale could not be exploited. However, providing transportation vouchers to those individuals who live far from the food retail centers, especially for those with limited mobility (e.g., those who lack transportation, the disabled, and the elderly), could be effective.<sup>35</sup>

Still another example is government mandates for those stores that participate in food assistance programs. Suppose that high fixed costs lead small stores to offer a limited selection of nutritious food. Current policy requires that stores can participate in food assistance programs such as SNAP only if they offer a sufficient variety of food types.<sup>36</sup> Expanding these requirements or more vigorously enforcing the existing requirements could improve the selection of food exactly where the poor shop. At the same time, such a policy might also make it harder for stores to operate profitably in low-income neighborhoods, inducing less availability.

Overall, little effort is made to link policy responses to the underlying causes of food deserts. For example, several studies discuss existing and potential policy responses (see Rose et al., 2009; Bader et al., in press), but they do not directly consider the underlying cause of food deserts or the economic arguments that motivate the policy responses. Without knowing the underlying causes, policy runs the risk of being ineffective. As an important step toward identifying effective policy, some studies are stressing the need for systematic evaluations of policies that have been implemented (e.g., McCormack et al., 2010).

Third, ascertaining why food deserts exist will likely require even more data and more sophisticated methods. Not only must all of the measurement issues discussed so far be handled effectively, but the analyst must then further identify exogenous changes in supply and demand to identify the underlying supply and demand curves. This identification problem represents a fundamental empirical difficulty in economic research: Without exogenous changes, the analyst only observes the equilibrium quantities and prices. Moreover, researchers should carefully consider models that include the possibility of appreciable market power; economies of scale, scope, and agglomeration; various types of fixed costs; and transportation costs.

Despite these substantial difficulties, there are several useful avenues for future research that could be followed relatively easily. Once again, just as food product prices are fundamental to identifying whether food deserts exist, prices are also fundamental to identifying why food deserts exist. Quite simply, if any existing nutritious food or near substitutes (or even other products that face similar input costs to those faced by food retailers) are available cheaply, then this would suggest that insufficient demand for healthy food may be the explanation. Similarly, data on costs could help us understand why food deserts exist. For example, data could be collected on the costs of operating food and nonfood stores in an area, including wholesale costs, labor costs, land costs, and fixed costs. If costs were appreciably higher in areas where retail food products were scarce, then such a finding would suggest that supply factors may be more important.

<sup>35</sup> The possibility that transportation is problematic for the poorest individuals has been well explored in the “spatial mismatch hypothesis” literature, which examines the access to jobs for poor and minority populations (e.g., Wilson, 1987; Holzer, 1987).

<sup>36</sup> Specifically, to accept SNAP benefits, a store must offer on a daily basis at least three varieties of each staple food group (breads and grains; dairy; fruits and vegetables; and meat, poultry, and fish), with two categories including perishables. Stores that have a majority of their sales in a specific staple category are exempt.



Overall, relatively little information has been used to shed light on why food deserts exist. There would seem to be many research opportunities regarding the “why,” although focusing on the “whether” sensibly comes first.

Fourth, it is important to differentiate between general issues about low-income neighborhoods and issues that are only relevant to assessing the adequate supply of healthy foods. For example, generally high costs of running a business (infrastructure, zoning, access to suppliers) could also mean a dearth of other products and services such as medical care and housing. In such cases, poor-quality food may not be the most important problem facing a neighborhood, and it may be more efficient to tackle the source of high business costs more generally. For example, policy options could be considered that focus on general development rather than just food store development. Policies such as tax abatements and the federal Empowerment Zone and Enterprise Communities programs are often discussed as candidates for encouraging general development in such areas.<sup>37</sup>

We are not aware of any U.S. food desert studies that try to ascertain whether the causes of inadequate availability are food specific. See MacIntyre, MacDonald, and Ellaway (2008) for a useful descriptive study of more general deprivation in Glasgow, Scotland.

## CONCLUSION AND DISCUSSION

Considerable policy and academic attention has been focused on the topic of food deserts. In this paper, we consider this topic from an economic perspective. First, we provided an economic analysis of food deserts. Second, using this economic lens, we revisited the empirical literature on food deserts to assess the progress that has been made regarding whether food deserts are problematic in the U.S.

We draw seven conclusions based on our analysis and selective literature review. The first five pertain to the assessment of whether food deserts exist.

- The data requirements for identifying whether food deserts exist are many and may not be satisfied with existing data sources. Researchers have made progress on data issues by carefully comparing what can be learned from a variety of sources. Unfortunately, the results suggest that the data typically available at the national level have serious deficiencies in that many of the types and sources of healthy food actually consumed are missing.
- One should explicitly consider whether the food desert concept of interest is absolute or relative. Many researchers use definitions of food deserts that are relative measures. Although these definitions may be appropriate for their research purposes, policymakers are likely to be interested primarily in a food desert concept that is absolute.
- Food desert research often defines geographic areas as the relevant market, but any definition is unlikely to be uniformly correct across areas or even within areas for different individuals. For example, the relevant geographic area for individuals with limited mobility may be smaller than for others. Researchers have assessed the sensitivity of findings to different definitions of the relevant geographic area, but they have provided little information as to which measure should be preferred.
- Examining geographic variation in one source of nutritious food may or may not identify true food deserts, depending on whether that one source is a substitute or complement for the other relevant sources. Unfortunately, much research suggests that food sources are often substitutes, implying that studies that focus on only one food source (e.g., supermarkets) provide a misleading view of food deserts.

<sup>37</sup> For example, recent work by Neumark and Kolko (2009) suggests little effect of enterprise zones on employment in California.

- Food desert research should routinely monitor prices. Of the studies that do, there is little evidence that the poor pay more for food on average.

The last two pertain to the assessment of why food deserts might exist.

- The formulation of appropriate public policy requires an understanding of why food deserts exist, especially in terms of supply factors, demand factors, or potential market failures. Determining why food deserts exist likely requires even more data and even more sophisticated econometric methods.
- The literature on food deserts has made little progress on assessing why they exist.

Overall, the food desert literature has made much progress. There are numerous innovative studies that collect detailed data at the local level and provide insightful analyses of key issues regarding the assessment of whether food deserts exist. These studies have documented that some areas have less access to nutritious food than other areas, and at least in some studies (e.g., Rose et al., 2009), it has been shown that this access is sufficiently restricted that it could be difficult to purchase the food necessary for an objectively defined healthy diet. However, these studies also reveal numerous problems that exist with the data that have been used in large-scale studies—so much so that there is little basis for making general statements about the existence of food deserts in the U.S. Moreover, very little progress has been made on understanding why food deserts exist. Taken together, these conclusions imply that it is difficult to formulate policy well supported by research.

We stress two points about this overall conclusion. The first point is that we have not concluded that there are no food deserts in the U.S. Several small-scale studies suggest there are areas that are usefully described as food deserts, and numerous studies have shown the poor tend to eat unhealthy diets (e.g., Bhattacharya & Currie, 2001; Basiotis et al., 2002). Rather, we conclude that we do not have sufficient evidence to determine whether food deserts are systematically the cause of the larger problem, making it difficult to formulate an effective policy. For example, if poor diets among the poor were generally caused by insufficient resources to purchase nutritious food rather than insufficient access to nutritious food, a more effective policy change might be to increase SNAP allotments or other needs-based transfers. We do not believe sufficient evidence exists to choose definitively either of these recommendations.

The second point is that we conclude there is a great need for additional research. Indeed, we find the progress on understanding food deserts to be impressive, and we believe there are numerous fruitful avenues for additional research. One example is further research on price variation, perhaps directly linked to explicit models of spatial demand. Another example is direct research on the factors that are thought to lead to high food prices, such as high wholesale costs, labor costs, land costs, or entry costs. A final example is direct research targeted at resolving some of the ambiguities in measurement, such as those related to shopping and travel patterns. Of course, additional research on some of these topics will require the collection of more data.

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