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United States
Department of
Agriculture

Food and
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Service

Office of
Analysis and
Evaluation

Evaluation of the Expanded EBT Demonstration in Maryland

Food Store Access and Its Impact on the Shopping Behavior of Food Stamp Households

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Food Store Access and Its Impact on the Shopping Behavior of Food Stamp Households

February 1997

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EXECUTIVE SUMMARY

The Food Stamp Program (FSP) provides assistance to low-income households by providing in-kind benefits that are redeemable for food items at program-authorized retailers. This report examines food stamp households' access to FSP-authorized retailers in the State of Maryland.

The study uses data from Maryland's statewide electronic benefits transfer (EBT) demonstration. The geographic locations of FSP households and FSP-authorized retailers were mapped to cartographic coordinates using Geographic Information System (GIS) software. Measures of proximity between households and retailers were derived from the cartographic data. Shopping destinations were then determined from the Maryland EBT transactions log, and measures of proximity between households and shopping destinations were constructed.

This report examines three main topics:

- Variation in food store access within the FSP caseload
- Variation in food stamp redemption patterns of FSP households
- Effect of food store access on shopping behavior.

Recognizing that the relationship between food store access and shopping behavior may vary by location, analyses are conducted both for the state's entire FSP caseload and for food stamp households living in three distinct areas of the state: Baltimore City, metropolitan counties, and non-metropolitan counties.

The main findings of the study are summarized below.

Food Store Access

FSP households in Maryland have good access to at least some program-authorized retailers, although variation in access exists across regions and store types. Overall, 85 percent of all FSP households are within one-half mile proximity of an FSP-authorized retailer, and 67 percent are within one-quarter mile of an authorized food retailer. By region:

- In Baltimore City, 99 percent of households are within one-half mile proximity of a retailer, and 77 percent are within one-half mile of a supermarket.

- In metropolitan counties, 71 percent of households are within one-half mile of a retailer, and 38 percent are within one-half mile of a supermarket.

- In non-metropolitan counties, 62 percent of households are within one-half mile of a retailer, and 27 percent are within one-half mile of a supermarket.

Relative access to different store types is the same in metropolitan and non-metropolitan counties. The type of store that is nearest to most FSP households is a convenience store (followed by supermarket, small and medium grocery store, and specialty store). In Baltimore City, however, the type of store that is nearest to most households is a grocery store (followed by convenience store, supermarkets, and specialty store).

Patterns of Food Stamp Redemptions

Food stamp households' redemption patterns vary between Baltimore City and the rest of the state. In both metropolitan and non-metropolitan counties, nearly 75 percent of all EBT transactions (representing about 85 percent of food stamp benefits) occur at supermarkets. In Baltimore City, in contrast, supermarket redemptions account for just 62 percent of benefits and 44 percent of transactions.

The data show that food stamp households are mobile in their shopping behavior:

- FSP households usually bypass the nearest program-authorized store when shopping; statewide, the average distance traveled is 2.7 miles, whereas the distance to the nearest store averages 0.3 miles.

- The above pattern holds for each store type: average distance traveled to a given type of store always exceeds average distance to nearest store of that type, and usually by a wide margin (e.g., although the statewide average distance between a FSP household and the nearest supermarket is 0.8 miles, the average distance traveled to a supermarket is 2.8 miles).

- Reinforcing the above findings, FSP households redeem only a small percentage of food stamp benefits at the nearest retailer: this percentage ranges from 5.8 in Baltimore City to 10.4 in non-metropolitan counties.

Considerable variation exists in distances travelled. For instance, in nearly every county outside of Baltimore City, there is at least one ZIP code area in which the average distance travelled to supermarkets exceeds 10 miles.

Effect of Food Store Access on Redemption Patterns

FSP households' allocation of their food stamp benefits across store types was modeled as a function of household demographics and distances to alternative shopping destinations. Key findings from this model are that:

- Throughout the state, spending at supermarkets is more sensitive to distance than spending at other store types.
- Shopping behavior is significantly influenced by household demographics.

With regard to the relationship between spending and distance, the effect is quite small even for supermarkets. For instance, a 10 percent increase in distance to the nearest supermarket decreases the percentage of FSP benefits redeemed at supermarkets by just 1.3 percentage points in Baltimore City, and 0.8 percentage points elsewhere.

As for demographic effects, the study finds that households with children spend a higher share of their food stamp benefits at supermarkets than other households. In addition, non-white households spend less at supermarkets (and more in specialty stores and grocery stores), and households in Baltimore City with senior citizens spend a higher share of their benefits at grocery stores.

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CHAPTER ONE

INTRODUCTION

The Food Stamp Program (FSP) is the largest food assistance program in the United States, disbursing over 23 billion dollars in benefits in 1993 (U.S. House of Representatives, 1994). Food stamp benefits provide assistance to low-income households to help them obtain "a more nutritious diet through normal channels of trade." Eligibility for benefits is determined primarily on the basis of household income; generally, households with gross income less than 130 percent of the federal poverty level are eligible for benefits.[1] Benefit levels are based on the estimated cost of the USDA Thrifty Food Plan—the cost of an adequate diet—and the expectation that households contribute 30 percent of their income to the food budget.[2,3] In theory then, food stamp allotments assure a food budget sufficient to purchase an adequate diet.

It is obvious that the FSP has a direct and measurable impact on household income; for example, a typical welfare family with children receives 25 percent of household resources from food stamps (U.S. House of Representatives, 1989). The program's impact on food consumption, however, is less direct and more difficult to measure. For at least two reasons, receipt of FSP benefits may not translate into adequate food consumption. First, food stamp benefits may displace spending on food from other income sources rather than absolutely increase the household food budget. Numerous studies have examined the effects of food stamps on food expenditures, and the findings suggest that,

[1] Households are also subject to a "liquid assets limitation" and work registration requirements (U.S. House of Representatives, Green Book, 1994).

[2] The Thrifty Food Plan specifies the quantities of food necessary for an adequate diet for a family of four with two children. The cost of the Thrifty Food Plan was estimated by the prices paid by households surveyed in the 1977-78 USDA Nationwide Food Consumption Survey (NFCS); these prices are updated using the "CPI Detailed Report." The costs of the Thrifty Food Plan for families of different sizes are obtained by applying "economies-of-scale adjustment factors" to the basic cost for a family of four; the adjustment factors were derived in a 1965 USDA study (U.S. Senate, 1985).

[3] Households must meet two income tests. First, gross income may not exceed 130 percent of the federal poverty level (FPL). Second, net income (gross income less allowable deductions) may not exceed 100 percent of FPL. The maximum allotment amount (for households with zero net income) is equal to the cost of the Thrifty Food Plan; the maximum is reduced by 30 cents for every dollar of household net income.

on the margin, food expenditures are increased by roughly 25 cents for every one dollar increase in food stamp benefits.[4] Second, variation in food consumption ***among*** FSP recipients may be due to differences in preferences, nutritional knowledge, and access to FSP-authorized retailers. These differences affect food consumption per dollar of food budget.[5]

This study examines food stamp recipients' access to food stores, particularly access to supermarkets. Limited access to large supermarkets—with low prices and a wide range of goods—is often considered a problem for residents of inner cities and rural areas. Evidence of this problem, however, is mostly anecdotal (U.S. House of Representatives, 1993). Nationwide, 77 percent of all food stamp benefits were redeemed at supermarkets in 1993 (USDA, 1994). Furthermore, evidence from the State of Maryland's EBT system shows that, within a given month, only 6 percent of FSP households ***never*** access a supermarket in redeeming their benefits (Cole, 1995).

Redemption patterns, however, do not tell us ***where*** supermarkets are located relative to FSP households; in other words, how accessible are they? Even among FSP recipients who utilize supermarkets, lack of proximity may affect food consumption. A simple model of consumer behavior predicts that access to food stores, or lack of it, has two effects on the budget constraint. The direct effect is an income effect: transportation costs reduce the income available for food expenditures. The indirect effect is a price effect: relative access to different types of food stores determines shopping destinations and the nominal prices paid for food. Households trade off travel costs and price differentials so that economizing on travel may imply acceptance of higher nominal prices or a limited range of goods.

This paper has two goals. The first goal is to provide a purely descriptive analysis of the variation in food store access and the variation in shopping behavior within a large caseload of FSP households. The second goal is to estimate the effect of food store access on shopping behavior. Data

[4] This is based on estimates of the marginal propensity to consume (MPC) food out of food stamp income; Beebout and Ohls (1993) review these studies. The estimates of MPC range from .20 to .70 due to study differences, and Beebout and Ohls conclude that "the weight of evidence ... indicates that the MPC is between .20 and .30."

[5] Geographic variations in food prices will also result in variation in nutrients per food stamp dollar. Price variations within the mainland United States are not reflected in the food stamp allotments; "maximum food stamp allotments vary for Alaska, Hawaii, the Virgin Islands, and Guam because food costs in those areas differ substantially from those in the 48 contiguous states and the District of Columbia" (U.S. Senate, 1985).

are from the USDA-sponsored evaluation of the Expanded Electronic Benefit Transfer (EBT) Demonstration in Maryland. In 1993, the State of Maryland converted the system of paper food stamp coupons to an electronic debit system. With EBT, food stamp households use ATM-like cards at the point of sale to deduct the value of food purchases from their food stamp allotment. These electronic transactions are centrally recorded, yielding a record of shopping behavior.

Variation in food store access is examined by measuring point-to-point distances between recipients and retailers ("shopping" options are described in terms of proximity). In order to measure distances, recipient and retailer locations are "mapped" to cartographic coordinates using address information from administrative files: the State of Maryland food stamp authorization files and USDA records of FSP-authorized retailers. Shopping behavior is analyzed using records of shopping transactions from Maryland's EBT system; shopping behavior is described in terms of estimated distances travelled and types of stores visited.[6]

The effect of food store access on shopping behavior is examined within a model of consumer demand in which allocation of the food budget among store types (supermarket, convenience store, etc.) depends on distance to each store type. Distance approximates a "price" of shopping at each store type, and demographics shift expenditures at each store type. For this analysis, EBT transactions data were merged to surveys of Maryland food stamp recipients conducted as part of the evaluation of the Expanded EBT Demonstration in Maryland. These surveys collected detailed demographic data as well as questions about shopping behavior (percent of food expenditures at different types of retailers) and food sufficiency.[7] Information about access to food stores was obtained by mapping the respondent addresses that were effective at the survey date and measuring distances to retailers, as described above.

The findings show that a surprisingly large percentage of Maryland food stamp recipients appear to have ready access to supermarkets. Eighty-five percent of all FSP households live within one

[6] Our measures of distance are estimates because distances are measured from point-to-point, and road networks are rarely straight lines from point-to-point. The extent to which distance only approximates "access" is discussed below.

[7] Many USDA surveys, including all national surveys administered by USDA since 1977, ask respondents a "food sufficiency" question designed to measure the quantity and quality of food consumption. A previous version of this paper examined the direct effect of food store access on food sufficiency, but the results were imprecise and unstable so they are not included here.

mile of a supermarket. In Baltimore City, however, vehicle ownership may be rare for this population, and one mile may be a great distance. Only 35 percent of FSP households in Baltimore City are within one-quarter mile of a supermarket, but 77 percent are within one-half mile proximity of a supermarket, and nearly 80 percent are within one-quarter mile proximity of ***either*** a grocery store or supermarket.

Analysis of the effect of food store access on shopping behavior shows that the percentage of FSP benefits redeemed at each store type is somewhat related to the types of stores within close geographic proximity. Among FSP households in Baltimore City, a 10 percent increase in distance to the nearest supermarket decreases the percent of FSP benefits redeemed at supermarkets by 1.3 percentage points; outside of Baltimore City, the effect is an 0.8 percentage point reduction. Proximity to other store types (e.g. grocery store, convenience store) likewise affects the percent of benefits redeemed at those store types, though to a lesser degree.

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CHAPTER TWO

DATA SOURCES

Four main sources of data are used for this study. The first two data sources are extracts of administrative data: the FSP caseload in Maryland and FSP-authorized retailers in Maryland.[8] The caseload extract contains address information for all FSP households. The information on household locations is combined with data for retailer locations and store type. The retailer information originates in the FSP retailer application process. Store type is self-reported by retailers; the main categories of store type used in this study are supermarket, small and medium grocery store, specialty store, and convenience store. Given the locations of both FSP recipients and retailers, we calculate distances between them, as described below.

The next source of data is the EBT system's transactions log. In an EBT system, every purchase transaction is electronically recorded within a central processing system. These data were previously examined in Cole (1995), "Patterns of Food Stamp and Cash Welfare Benefit Redemption." We use these data for two purposes: first, to examine the point-to-point distances between FSP households and stores where they shopped; and second, to measure shopping behavior in terms of the types of stores utilized, conditional on the household's choice set.

The final data source is the surveys conducted under the USDA-sponsored evaluation of the Expanded EBT Demonstration in Maryland. As part of the evaluation, Abt Associates Inc. conducted surveys on random samples of food stamp recipients before and after EBT implementation and assessed the costs and benefits of EBT issuance.[9,10] These surveys collected demographic data including a complete household enumeration and characteristics of the head of household (education,

[8] Store Tracking and Redemption Subsystem (STARS), USDA Food and Consumer Service.

[9] A self-weighting sample was drawn based on a two-stage cluster design. In the first stage of sampling, ZIP code clusters were defined by urban/rural location and pre-EBT issuance system. Clusters were drawn with probability proportional to the number of FSP households in the cluster. The second stage drew a random sample of households from the chosen clusters.

[10] The main finding from this evaluation is that EBT issuance reduces FSP issuance costs by $0.79 per case month. Issuance costs are not reduced for cash assistance programs because the state bears the cost of ATM fees for each withdrawal, whereas under a check-issuance system the recipient bears the cost of check-cashing. Both food stamp recipients and cash assistance recipients expressed a preference for EBT (see Kirlin *et al.*, 1994).

employment status, race and gender). The EBT transactions data, for the surveyed households, were merged with the survey data so that we could examine the determinants of shopping behavior.

The several sources of data used for this study are not concurrent. The top panel of Table 1 provides a summary. The different timing of the extracts was necessitated by the original goals of the evaluation. The caseload extract was obtained in April 1993 for the purpose of constructing the sampling frame for the post-EBT survey. The EBT transactions log was obtained in September 1993 in order to examine the EBT system in steady-state operations—i.e., after EBT had been operational for some months. Each file alone is representative of an average monthly caseload. To examine access and shopping behavior together, we matched the April and September files (113,453 common cases), and thus do not observe shopping behavior for any case with a food stamp duration of less than six months. The sample was further restricted to cases that received a "regular" monthly disbursement (single disbursement at the beginning of the month and no supplements) and redeemed at least some of their benefits in September; this last restriction was imposed in processing these data for Cole (1995).[11] This reduces the "full caseload" to 100,657 cases.

The final piece of data assembled for this study—and the key piece of data for examining food store access—consists of measures of distance between food stamp households and authorized retailers. In order to measure distances, we assigned latitude and longitude coordinates to all food stamp recipients and FSP-authorized retailers in Maryland (Appendix A documents the "geocoding" procedure).[12] The full caseload and the post-EBT survey sample were "mapped" to April 1993 addresses; pre-EBT survey respondents were mapped according to the addresses that were current at the survey date. The coordinate information was then used to measure point-to-point distances

[11] The 'regular disbursement' rule was imposed for Cole (1995) because a major focus of that study was the timing of benefit exhaustion. Excluded are: (a) new cases receiving a disbursement after the first week of the month, and (b) cases receiving a supplementary disbursement due to a change in household circumstances or an emergency situation. Excluding (a) is appropriate for this study because we examine mean monthly behavior and new cases receive prorated benefits for less than one month. Cases receiving supplementary disbursements are likely to display different spending behavior if the share of spending by store type is influenced by the monthly disbursement cycle; hence, we exclude those cases as well, rather than examine them separately.

[12] In 1993, 39 retailers outside of Maryland were authorized and equipped to accept the Maryland EBT card for food stamp redemptions. These retailers are included in all analyses.

Table 1

DATA SOURCES AND SAMPLE SIZES

A. Data Sources

Data	Source	Data Collection Period	No. Food Stamp Cases	Data Items
Pre-EBT survey	Abt Associates Inc.	Summer 1992	1,110	Demographics, reported shopping behavior
Post-EBT survey	Abt Associates Inc.	Summer 1993	1,055	Demographics, reported shopping behavior
Caseload extract	State of Maryland, Dept. of Human Resources	April 1993	141,622	Demographics, address information
EBT transactions log	EBT vendor for State of Maryland	September 1993	155,646	Redemption behavior

B. Final Samples

Data	Description/Exclusions	No. Food Stamp Cases
Survey sample	Excludes cases not in EBT transactions log, and nine cases not geocoded.	1,732
Full caseload	Match of April extract to "regular" cases in September. Excludes 2,680 cases that could not be geocoded.	97,977

between (a) each FSP recipient and every ***potential*** shopping destination within a 40-mile radius,[13] and (b) each FSP recipient and every ***actual*** shopping destination recorded in the EBT transaction log for September 1993. For this paper, the samples of both survey data and the "full caseload" are restricted to FSP households that were assigned cartographic coordinates. The bottom panel of Table 1 shows the final sample sizes.

The study uses the above measures of point-to-point distance as a proxy for recipients' travel costs when shopping. There are several reasons (described below) why this distance measure may not

[13] Forty miles was chosen as an arbitrary cutoff to reduce the number of calculations. In fact, actual shopping destinations are rarely beyond a 40-mile radius.

serve as a good proxy for travel costs in all cases, but a better measure of travel costs between every recipient-retailer pair is simply not available.

One difficulty with a point-to-point measure of distance is that it is only an approximation of actual distance travelled when shopping. First, road networks do not provide straight-line routes between every recipient-retailer pair.[14] Second, shopping trips need not always originate from a recipient's residence (e.g., stores may lie between work and home). Finally, even when point-to-point distance does approximate actual distance, it may not correlate with travel costs. Both the out-of-pocket and time costs of travel depend on mode of transportation as well as distance. Mode of transportation could not be incorporated in the analysis because the Maryland FSP administrative files do not contain information on automobile ownership, even though automobiles are countable assets for the purpose of FSP eligibility determination. (The EBT surveys did not collect automobile ownership data and did not consistently collect information on mode of transportation.)

One methodological issue that arises in implementing the geocoding procedure and calculating distances is that some portion of addresses cannot be mapped to precise points. Nearly all survey respondents were successfully mapped to cartographic coordinates, as was 97 percent of the "full caseload." Among households with assigned cartographic coordinates, however, 86 percent were mapped to precise address points; 7 percent were mapped to ZIP+4 centroids; and 7 percent were mapped to ZIP code area centroids or ZIP+2 centroids (see Appendix Table A-1). Failure to assign precise address coordinates occurs either because: (a) the address information is incomplete, or (b) the cartographic information corresponding to the address does not exist in the address dictionary database from which we obtained coordinate data. Both of these problems occur disproportionately in rural areas.

The potential problem that arises with ZIP code centroid mapping is that a downward bias may be placed on measured distances if both recipients and retailers are assigned ZIP code centroid coordinates, i.e., the nearest store will be at a distance of zero miles. We considered limiting the sample by excluding all FSP households that were mapped to ZIP code centroids. Because this problem occurs mainly in rural areas, however, excluding households mapped to centroids results in a

[14] One adjustment incorporated in this simple measure of distance, however, is a factor to account for the added distance necessary to cross the Chesapeake Bay. See Appendix A for details.

decrease in average distances rather than an expected increase. The problem is that when we limit the rural sample to addresses that are assigned precise coordinates (instead of centroids), we are left with a sample that is disproportionately located within towns and near to retailers. We found, however, that 70 percent of households that are assigned centroids are located in ZIP code areas that either do not have any retailers or do not have retailers assigned to centroid coordinates. Therefore, although centroid mapping adds measurement error to the access variables, the measurement error seldom takes the form of zero calculated distances to retailers (this potential exists for only 1.6 percent of all households); on the other hand, an attempt to eliminate this bias would have resulted in even greater error. The full sample is therefore used for all analyses.

In the next chapter, we describe food store access for the full caseload of FSP households that were active in both April and September of 1993 and mapped to coordinates (97,977 households). Chapter Four describes food stamp redemption behavior, with particular emphasis on the distance that FSP households travel in redeeming their benefits. Chapter Five examines the effect of food store access on redemption patterns, and the study's main conclusions are presented in Chapter Six.

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CHAPTER THREE

FOOD STORE ACCESS

Two assumptions underlie the analyses throughout this study. The first assumption is that store type provides a reasonable proxy for average food prices and the range of goods available at alternative shopping destinations. It is assumed that shopping at supermarkets will maximize nutrients per food stamp dollar, relative to shopping at other store types.

The second assumption is that distance *per se* provides an adequate measure of geographic access. The correspondence between distance and access, however, may vary considerably over different areas of the state. In addition to variations in transportation alternatives, access depends on geographic barriers and variations in population and retailing density—these regional characteristics affect the distances that individuals are accustomed to travelling. For this reason, most analyses are done separately for metropolitan areas, non-metropolitan areas, and Baltimore City.

The top panel of Map 1 shows the configuration of metropolitan and non-metropolitan counties in Maryland (where "metro" is defined by location within a Metropolitan Area (MA)).[15] The lower panel of the map shows the population density for each ZIP code area. For the most part, the metro/non-metro distinction captures the difference in population density in different areas of the state; only one ZIP code area in a non-metro county contains a population of more than 50,000, for example. Map 2 shows the concentration of FSP households within each ZIP code, showing that FSP households are disproportionately located in Baltimore City and in non-metropolitan areas.

The variation in geographic access to food stores is shown in Table 2. Using data on the full caseload of FSP recipients, we characterize access in a number of ways: by the average distance to the nearest store of any type, by the average distance to the nearest store of ***each*** type, by the type of store that is nearest, and by the percent of households within walking distance to a retailer. Two main observations emerge from this table. First, the market for food retailers is fundamentally different in

[15] Metropolitan Areas are defined by the U.S. Office of Management and Budget as areas that include at least: (a) one city with 50,000 or more inhabitants, or (b) a Census Bureau-defined urbanized area of at least 50,000 inhabitants and a total MA population of at least 100,000 (United States Statistical Abstract, 1993).

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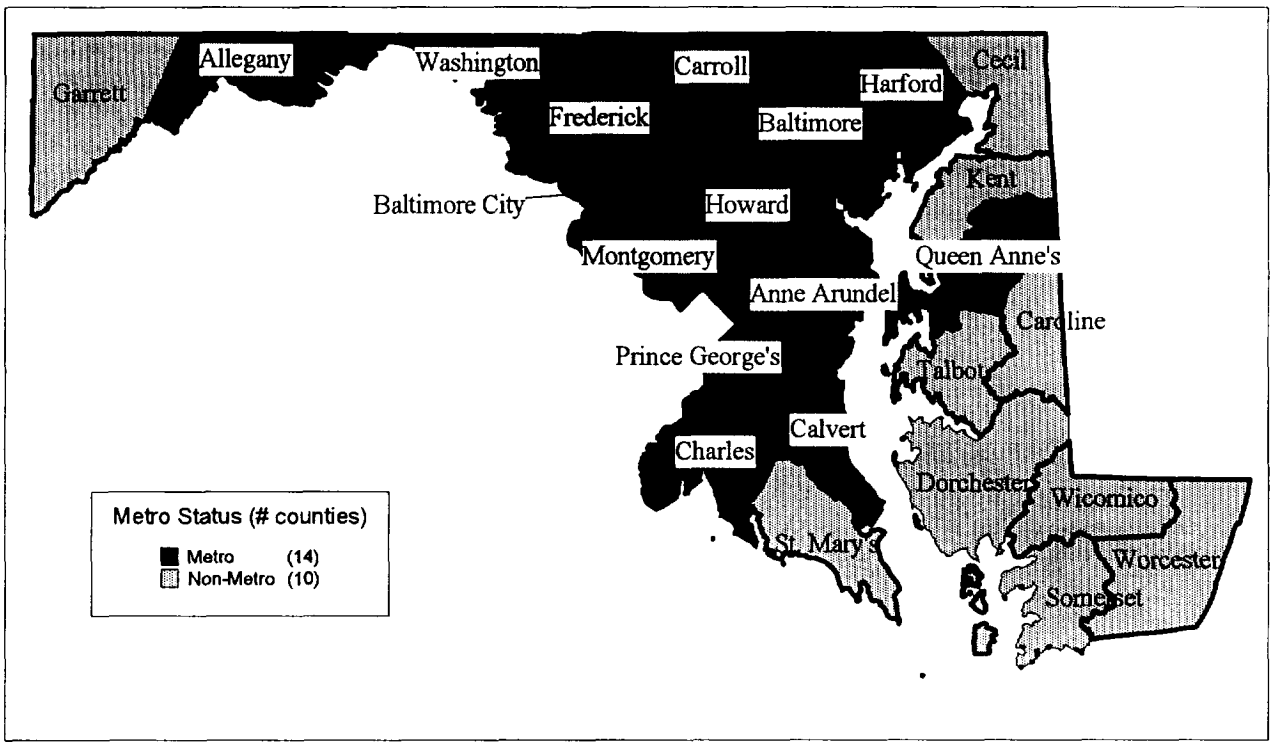
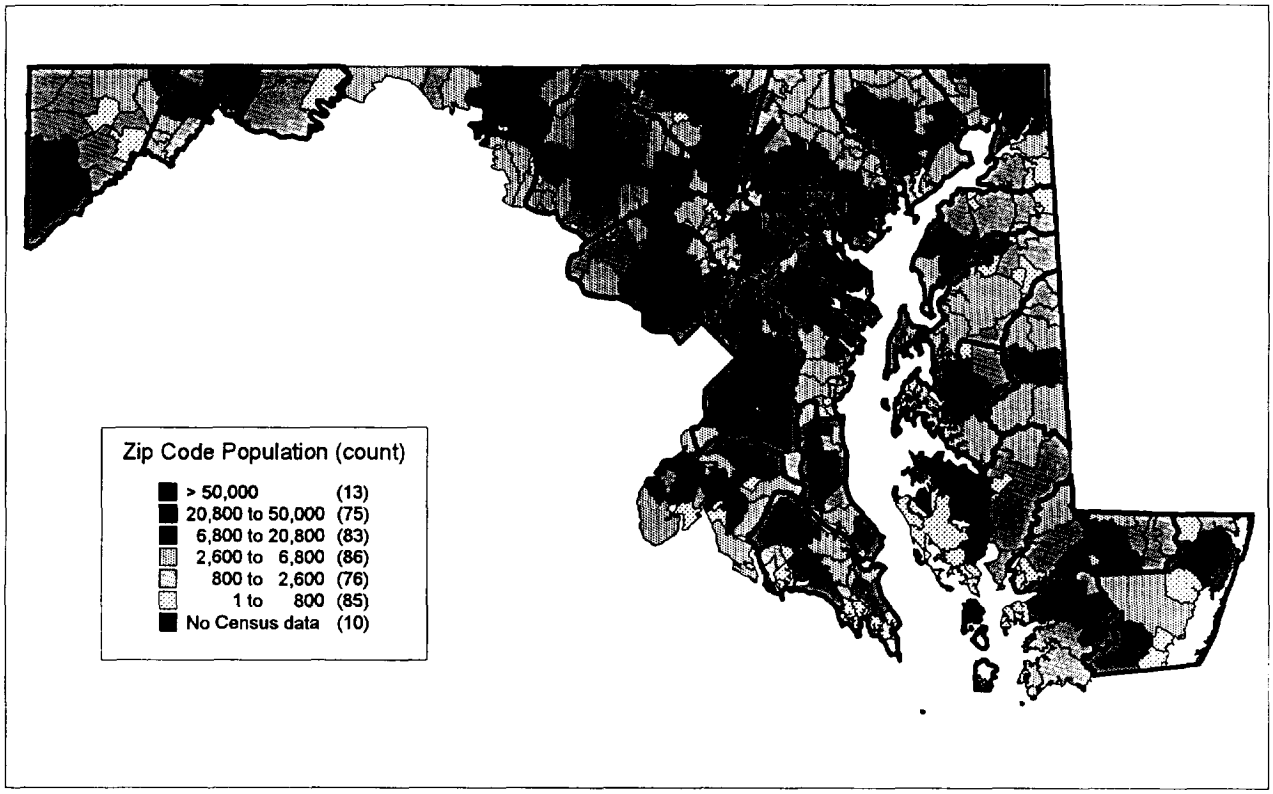
MAP 1

MARYLAND COUNTIES: METRO STATUS AND POPULATION DISTRIBUTION





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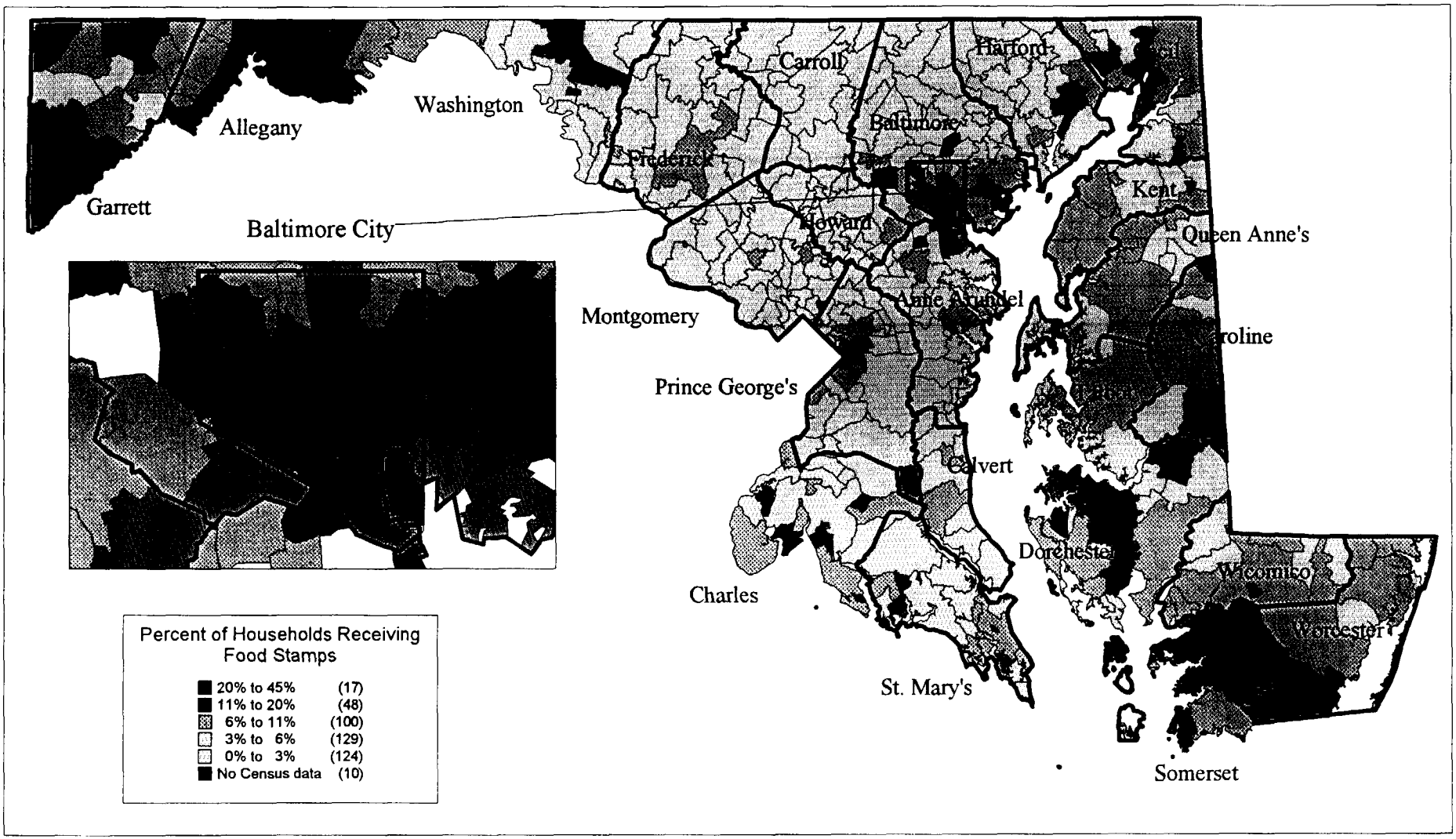
MAP 2

CONCENTRATION OF FOOD STAMP HOUSEHOLDS



Sources: Number of FSP households from Maryland caseload extract (April 1993).
Total number of households from 1990 Census of Population (STF3B CD-ROM).

Table 2

DISTANCE FROM FOOD STAMP HOUSEHOLDS TO NEAREST RETAILERS

	Non-Metro Counties	Metro Counties	Baltimore City	Statewide
Number of FSP households	7,823	39,617	50,537	97,977
Average distance (miles) to nearest:				
Grocery store	3.98	1.87	0.18	1.17
Supermarket	2.22	1.00	0.37	0.77
Specialty store	4.76	2.21	0.44	1.50
Convenience store	1.47	0.75	0.25	0.55
Other	3.90	1.82	0.24	1.17
Overall:				
Average distance to nearest store	0.84	0.51	0.10	0.33
Median distance to nearest store	0.29	0.31	0.07	0.19
Type of store that is nearest[a] (percent of households)				
Grocery store	20.1	14.0	52.3	34.2
Supermarket	22.9	25.9	7.5	16.2
Specialty store	9.6	6.6	4.2	5.6
Convenience store	48.6	46.4	16.1	30.9
Other	12.3	12.1	22.9	17.7
Percent of household within 1/4 mile of any retailer	45.5	40.2	91.7	67.2
Percent of households within 1/2 mile of any retailer	62.1	70.9	99.5	84.9

[a] Sum may exceed 100 if nearest store location contains multiple store types.

NOTE: Convenience stores include grocery/gas combinations.

Baltimore City *versus* the remainder of the state. Second, outside of Baltimore City, FSP households in metro and non-metro counties face the same relative access to different types of retailers.

In Baltimore City, grocery stores provide the nearest shopping opportunity for most FSP households, whereas convenience stores provide the nearest shopping opportunity for households in

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Table 3

PROXIMITY OF FOOD STAMP HOUSEHOLDS TO FOOD STAMP RETAILERS

	Percent of Households with Retailer Within:					Distance to Nearest Store (miles)	
Retailer Type	**1/4 mile**	**1/2 mile**	**1 mile**	**3 miles**	**5 miles**	**Mean**	**Median**
			Non-Metro Counties				
Grocery store	16%	33%	42%	56%	70%	3.98	1.89
Supermarket	13	27	49	73	83	2.22	1.01
Specialty store	8	14	32	56	67	4.76	2.30
Convenience store	27	44	61	85	91	1.47	0.60
Other	5	10	28	54	65	3.90	2.21
			Metro Counties				
Grocery store	13%	29%	47%	82%	93%	1.87	1.13
Supermarket	15	38	74	94	97	1.00	0.63
Specialty store	6	18	43	76	87	2.21	1.21
Convenience store	26	54	81	96	99	0.75	0.45
Other	9	24	45	84	93	1.82	1.09
			Baltimore City				
Grocery store	80%	91%	98%	100%	100%	0.18	0.10
Supermarket	35	77	99	100	100	0.37	0.32
Specialty store	27	65	97	100	100	0.44	0.40
Convenience store	57	93	100	100	100	0.25	0.22
Other	70	89	97	100	100	0.24	0.16

NOTE: Convenience stores include grocery/gas combinations.

within one-half mile of ***any*** retailer, Table 3 shows that substantially fewer than half are within one-half mile of a supermarket, and fewer than one-third are within one-half mile of a grocery store. It is notable that three-quarters of all metro households are within one mile of a supermarket, but we cannot say, *a priori*, that this measure of distance constitutes "access."

In contrast, FSP households in Baltimore City appear to have much better access to a wide range of goods: 80 percent of these households are within one-quarter mile of a grocery store, and 77 percent are within one-half mile of a supermarket.[18] Nearly all FSP households in Baltimore City are within one mile of every major type of food retailer, though one mile may be a considerable distance to travel for a population that is unlikely to own motor vehicles.[19]

[18] Macro International (1996) found that 97 percent of Baltimore City FSP households are within one-quarter mile of a ***small*** grocery store and only 10 percent are within one-quarter mile of a ***large*** grocery store.

[19] Unfortunately, information about vehicle ownership is not maintained in the automated system for the Maryland FSP caseload, so we could not quantify this supposition. Automobile ownership is taken into consideration in the FSP application process because automobiles are a form of liquid assets and applicants must pass an "assets test." Map 3 in Appendix B shows the distribution of households lacking motor vehicle ownership throughout the state, based on Census statistics. In the three central ZIP code areas in Baltimore City, more than 50 percent of all households do not own automobiles.

CHAPTER FOUR

PATTERNS OF FOOD STAMP REDEMPTION

In this chapter we examine patterns of food stamp redemption for the full caseload of Maryland FSP recipients, using data from the EBT transactions log for September 1993. Our three main questions are:

- How do households allocate FSP redemptions across store types?
- How far do households travel in redeeming FSP benefits?
- Does store proximity influence redemption patterns?

Previous studies have found little evidence that consumers shop at the nearest retailer for grocery items (Craig *et al.*, 1984).[20] Economic geographers have generally concluded that relative distances, rather than absolute distances, explain travel behavior. For example, Clark and Rushton (1970) found that the greater the distance to the nearest alternative store, the less the impact of distance on grocery store choice. Moreover, several factors influence store choice in addition to distance, including prices, quality of goods and service, range of goods, store image, opportunities for multipurpose travel, and—for FSP recipients—the degree of stigma associated with FSP redemption at different stores.

Table 4 shows the percent of FSP redemptions by store type and the percent of benefits redeemed at the nearest store to each recipient. In both metro and non-metro counties, nearly 85 percent of all food stamp EBT benefits are redeemed in supermarkets, and 75 percent of EBT transactions occur in supermarkets. In Baltimore City, supermarket redemptions account for 62 percent of benefits and 44 percent of transactions. The difference between the Baltimore City and the rest-of-state samples is largely a reflection of the different composition of food retailers in these areas, as noted in the previous chapter.

[20] For example, among rural Iowans, only 35 percent of grocery purchases were made at the nearest store (Rushton, Golledge, and Clark, 1967); Thompson (1967) found that only 38 percent of his consumer sample in Worcester, Massachusetts patronized the nearest supermarket; and about half of surveyed consumers in Christchurch, New Zealand did not visit their nearest store in purchasing grocery items (Clark and Rushton, 1970). Also see Hubbard, 1978.

Table 4

PATTERNS OF FOOD STAMP REDEMPTION

	Non-Metro Counties	Metro Counties	Baltimore City	Statewide
Number of FSP households	7,823	39,617	50,537	97,977
Mean percent of EBT expenditures, by store type:				
Grocery store	5.30	4.29	15.29	10.04
Supermarket	84.87	83.86	62.14	72.74
Specialty store	2.76	6.14	12.78	9.29
Convenience store	4.51	3.24	3.40	3.43
Other	2.55	2.47	6.39	4.50
At nearest store	10.42	8.67	5.80	7.33
Mean percent of EBT transactions, by store type:				
Grocery store	8.26	6.56	28.91	18.23
Supermarket	73.73	75.00	44.04	58.93
Specialty store	2.51	5.66	10.72	8.02
Convenience store	11.51	9.73	7.61	8.78
Other	3.99	3.05	8.73	6.05
At nearest store	13.55	12.03	11.52	11.89

SOURCE: State of Maryland EBT transactions log, September 1993.

SAMPLE: See Table 2.

Consistent with the store choice literature, FSP households redeem only a small percentage of food stamp benefits at the nearest retailer; this percentage ranges from 5.8 in Baltimore City to 10.4 in non-metro counties. The fact that the nearest store accounts for a somewhat larger percentage of all transactions, compared to redemptions (11.5 vs. 5.8 in Baltimore City; 13.6 vs. 10.4 in non-metro counties), shows that the nearest store is disproportionately visited for small purchases. These results are not surprising because, first, the high density of retailers in Baltimore City is likely to make households indifferent between many shopping destinations on the basis of distance alone (economic geographers refer to this as spatial indifference). Second, outside of Baltimore City, the nearest store to almost half of all FSP households is a convenience store (see Table 3)—the store type that, on average, accounts for less than 5 percent of benefits redeemed.

The finding that FSP households usually bypass the nearest store provides evidence that the FSP population is mobile in its shopping behavior. Further evidence that FSP households "shop

around" can be seen in the mean distances travelled. The top panel of Table 5 shows the mean distance between FSP household and store where benefits were redeemed, calculated over all EBT transactions. The bottom panel of the table shows the mean distance between FSP household and nearest store, calculated over households. Table 5 shows that, on average, households in metro counties travel 3.5 miles to the store when shopping at supermarkets (for a round-trip of 7 miles), yet the average distance to the nearest supermarket is only one mile.[21] This pattern of a sizeable difference between distance traveled and distance to nearest store is repeated throughout the table.

Table 5

DISTANCES TRAVELLED AND ACCESS BY STORE TYPE

	Non-Metro Counties	Metro Counties	Baltimore City	Statewide
Number of FSP households	7,823	39,617	50,537	97,977
Average distance travelled (miles)				
Overall	5.0	3.6	1.6	2.7
By store type:				
Grocery store	6.5	3.8	1.1	1.8
Supermarket	5.1	3.5	1.8	2.8
Specialty store	9.9	6.1	1.8	3.1
Convenience store	4.6	3.1	1.5	2.4
Other				
Average distance to nearest store (miles)				
Overall	0.8	0.5	0.1	0.3
By store type:				
Grocery store	4.0	1.9	0.2	1.2
Supermarket	2.2	1.0	0.4	0.8
Specialty store	4.8	2.2	0.4	1.5
Convenience store	1.5	0.7	0.3	0.5
Other	3.9	1.8	0.2	1.2

SOURCE: State of Maryland EBT transactions log, September 1993.

NOTE: Distances are "one-way" and measured as a straight-line point-to-point distance.

Maps 3 and 4 display the variation in travel burdens for FSP households shopping at supermarkets. The average distance travelled to supermarkets is mapped by ZIP code, and the location

[21] The bottom panel of Table 5 is duplicated from Table 3.

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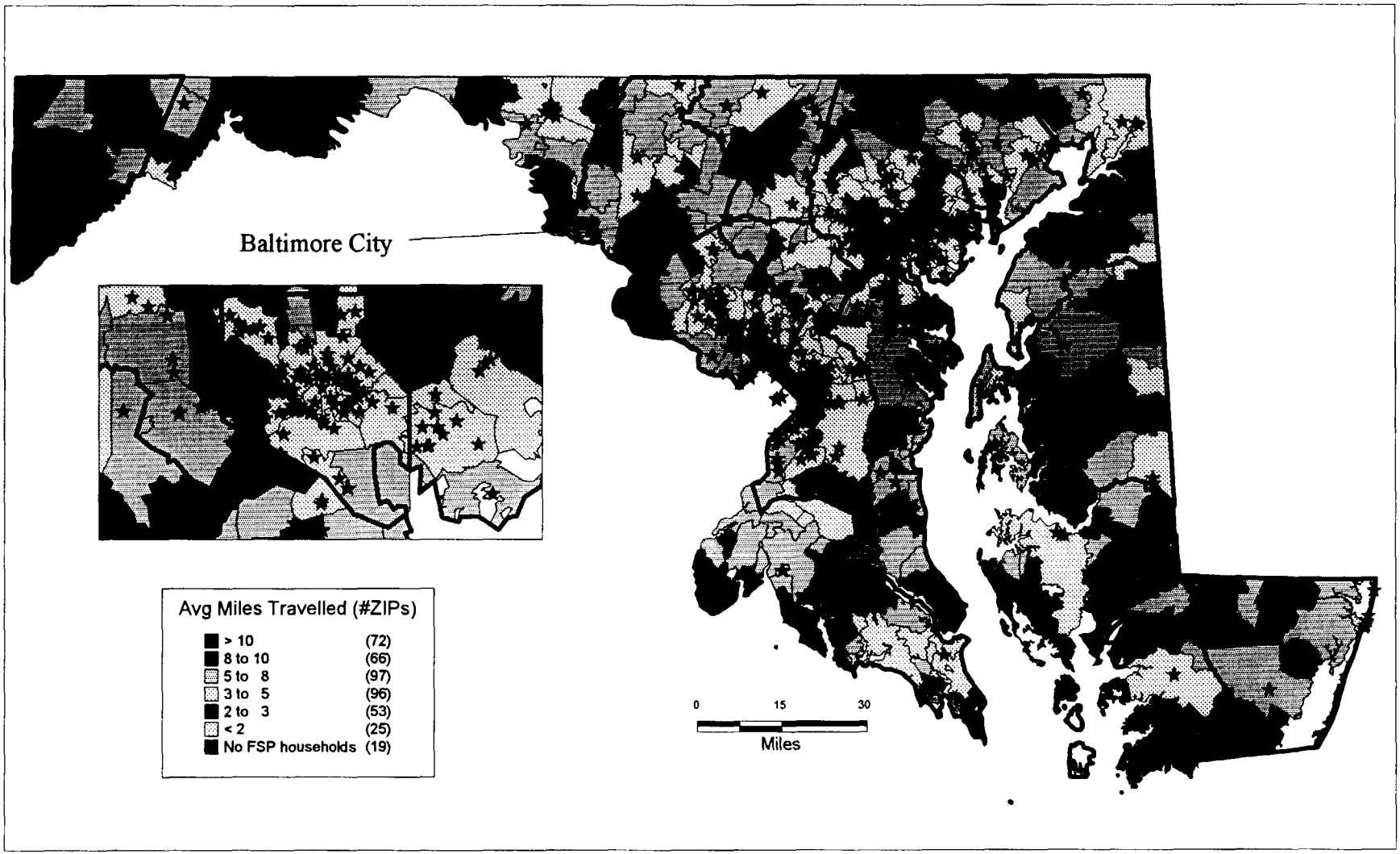
MAP 3

AVERAGE DISTANCE TRAVELLED TO SUPERMARKETS



Note: Stars indicate supermarket locations.

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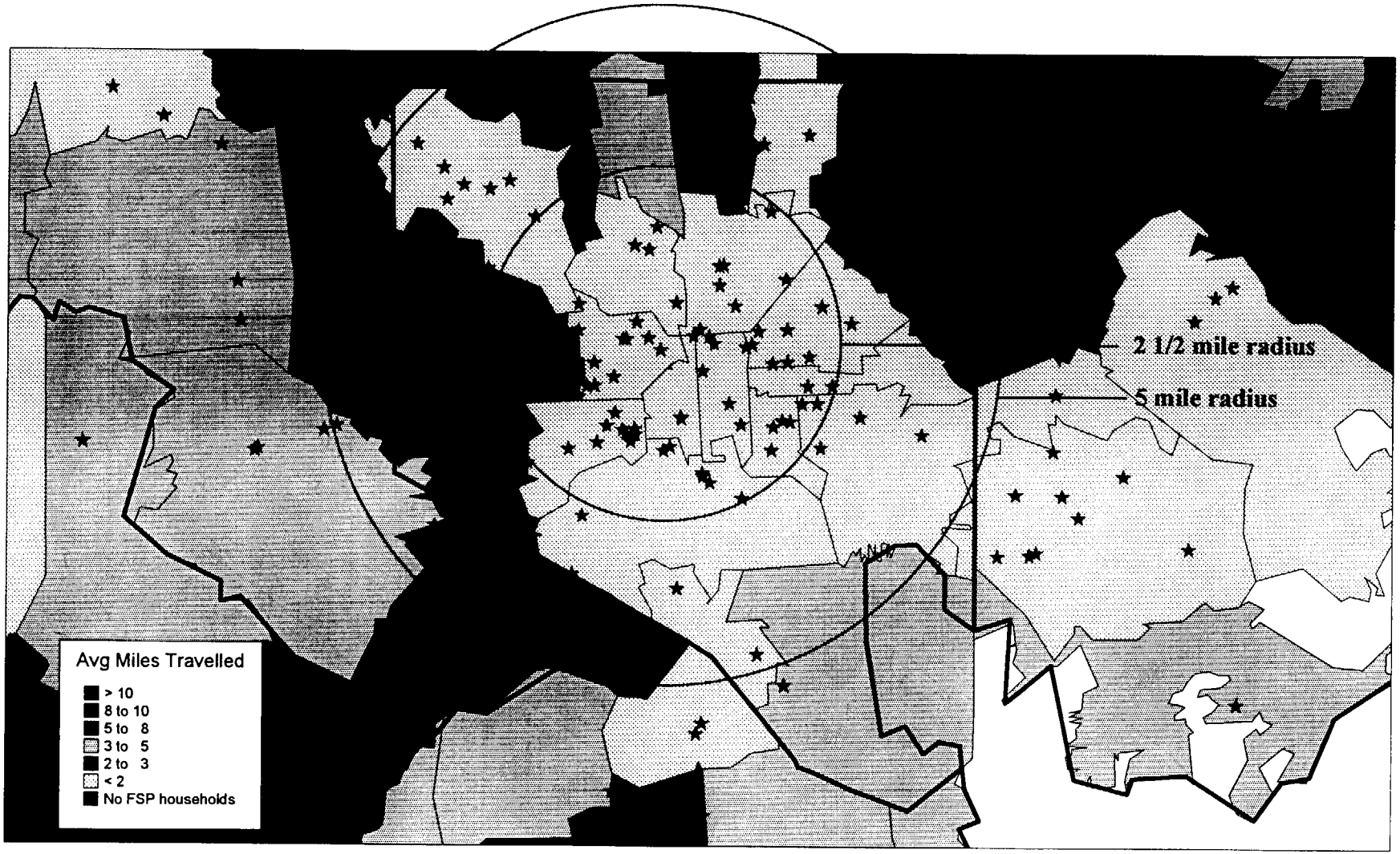
MAP 4

AVERAGE DISTANCE TRAVELLED TO SUPERMARKETS IN BALTIMORE CITY



Note: Stars indicate supermarket locations.

of supermarkets is denoted. (Similar maps displaying "access" measures are in Appendix B.) The maps provide a graphic picture of both the burden of location and the mobility of FSP households. Within nearly every county—metropolitan and non-metropolitan—there is at least one ZIP code area in which the average distance travelled to supermarkets exceeds 10 miles (Carroll County and Baltimore City are the exceptions). On the other hand, the mobility of households is demonstrated by the fact that the average distance travelled from residence to supermarket exceeds the diameter of the ZIP code area in many areas with supermarkets. This last observation tells us that not only do households pass by the nearest store, but they also pass by the nearest supermarket when shopping at supermarkets.[22]

The evidence thus far suggests that, although the overall market configuration of retailers influences redemption patterns, proximity to individual stores does not have a large effect on shopping behavior. In Tables 6 and 7 we investigate whether the effect of proximity varies by store type. The tables show redemption behavior for FSP households grouped according to the type of store in closest proximity. There are three main findings.

First, Table 6 shows that the percent of benefits redeemed at each store type is influenced by proximity, but the effect is quite small (see shaded cells). For example, among all households in metro counties, 83.9 percent of benefits are redeemed at supermarkets. Among households for which the nearest store is a supermarket, however, 87.8 percent of benefits are redeemed at supermarkets; proximity yields a marginal effect of 4 percentage points on the share of redemptions at supermarkets. In Baltimore City the effect of supermarket proximity on supermarket redemptions is nearly 10 percentage points (71.1 percent compared to 62.1 percent). Proximity to other store types has a similar, though generally smaller, effect on redemptions at that store type. Table 7 shows that the effect of proximity is even more pronounced for shopping trips than for benefit redemption.

Second, households usually pass by the nearest store, regardless of its type. This is seen by comparing the percent of benefits redeemed at the nearest store (second column of data) with the percent of benefits redeemed at the store type that is nearest. In metro counties, 10,243 FSP

[22] It is important to note that there is heterogeneity within store type. Of the 563 supermarkets in Maryland in 1993, the top three chains (Giant, Safeway, and Superfresh) account for only 217 (38 percent) locations. Other chains with four or more locations account for an additional 195 (35 percent) locations, and the remaining 151 (27 percent) supermarkets appear to be mostly independently-operated stores.

households live nearest to a supermarket; these households redeem 87.8 percent of FSP benefits at supermarkets, but they redeem only 26.9 percent of benefits at the nearest store. For the majority of their supermarket shopping, these households do not shop at the supermarket that is nearest. The same is true for every other store type.

The third finding is that ***relative*** distance may matter. Households with "no store within 1/2 mile" behave differently than other households—suggesting that there is a fixed cost involved in overcoming distance. In metro and non-metro areas, households with no store within 1/2 mile are more likely to redeem benefits at the nearest store and more likely to redeem benefits at supermarkets than any other group of households except those nearest to supermarkets. This group either minimizes travel (shopping at the nearest location) or maximizes the benefits of travel (shopping at supermarkets). In Baltimore City, the effect on supermarket redemptions is especially pronounced, although the sample of "no store within 1/2 mile" is quite small.

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Table 6

FOOD STAMP REDEMPTIONS, BY STORE PROXIMITY

	No. FSP Households	Percent of Benefits Redeemed at					
		Nearest Store	Grocery Store	Supermarket	Specialty Store	Convenience Store	Other Store
State total	97,976	7.3	10.0	72.7	9.3	3.4	4.5
Households in Non-metro Counties							
Total	7,819	10.4	5.3	84.9	2.8	4.5	2.6
By nearest store type:							
Grocery store	1,504	6.2	10.4	81.3	2.7	4.3	1.4
Supermarket	1,789	33.9	3.4	89.1	2.1	2.9	2.5
Specialty store	361	0.4	3.1	87.4	3.8	4.1	1.6
Convenience store	3,420	3.1	4.4	84.1	3.2	5.7	2.7
Other	745	1.2	4.9	84.5	2.1	3.7	4.8
No store within 1/2 mile	2,958	9.5	4.4	86.1	2.2	3.6	3.7
Households in Metro Counties							
Total	39,621	8.7	4.3	83.9	6.1	3.2	2.5
By nearest store type:							
Grocery store	5,447	5.1	8.7	80.0	5.5	3.0	2.7
Supermarket	10,243	26.9	3.5	87.8	4.8	1.9	2.0
Specialty store	2,385	1.4	4.0	81.6	8.6	3.3	2.5
Convenience store	17,392	1.9	3.3	83.4	6.7	4.2	2.5
Other	4,154	0.9	4.7	82.5	6.6	3.0	3.3
No store within 1/2 mile	11,521	8.4	4.0	85.3	5.7	2.3	2.7
Households in Baltimore City							
Total	50,536	5.8	15.3	62.1	12.8	3.4	6.4
By nearest store type:							

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Table 7

SHOPPING TRIPS, BY STORE PROXIMITY

	No. FSP Households	Percent of Shopping Trips at					
		Nearest Store	Grocery Store	Supermarket	Specialty Store	Convenience Store	Other Store
State total	97,976	11.9	18.2	58.9	8.0	8.8	6.1
Households in Non-metro Counties							
Total	7,819	13.6	8.3	73.7	2.5	11.5	4.0
By nearest store type:							
Grocery store	1,504	10.9	17.2	68.2	2.5	9.5	2.5
Supermarket	1,789	34.3	4.9	81.7	1.8	7.8	3.8
Specialty store	361	0.7	4.2	78.3	3.6	11.5	2.3
Convenience store	3,420	7.6	6.9	71.8	2.9	14.7	3.7
Other	745	2.8	6.6	72.6	2.0	9.5	9.3
No store within 1/2 mile	2,958	11.6	6.3	76.7	1.9	9.3	5.9
Households in Metro Counties							
Total	39,621	12.0	6.6	75.0	5.7	9.7	3.1
By nearest store type:							
Grocery store	5,447	10.9	15.9	67.2	5.0	8.7	3.2
Supermarket	10,243	29.4	4.5	83.2	4.3	5.5	2.4
Specialty store	2,385	1.8	6.2	73.1	7.9	9.9	2.9
Convenience store	17,392	6.0	4.8	73.2	6.1	12.8	3.1
Other	4,154	1.9	6.9	73.8	6.5	8.4	4.5
No store within 1/2 mile	11,521	10.3	5.3	79.1	5.1	7.0	3.4
Households in Baltimore City							
Total	50,536	11.5	28.9	44.0	10.7	7.6	8.7
By nearest store type:							
Grocery store	26,136	12.6	36.1	39.7	10.4	5.8	8.1
Supermarket	3,804	31.3	15.4	61.8	10.6	5.9	6.3
Specialty store	1,823	2.5	20.5	50.1	13.5	8.4	7.6
Convenience store	8,100	9.7	17.9	49.1	10.0	16.7	6.3
Other	10,673	4.6	26.0	43.6	11.6	5.8	13.2
No store within 1/2 mile	278	1.5	14.1	61.9	10.2	7.7	6.1

SOURCE: State of Maryland EBT Transactions Log, September 1993.

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CHAPTER FIVE

THE EFFECT OF FOOD STORE ACCESS ON REDEMPTION PATTERNS

The previous chapters provide evidence that the majority of Maryland food stamp households have access to a variety of FSP-authorized retailers. Moreover, most food stamp benefits are redeemed at supermarkets or grocery stores where households will find a variety of goods. Yet it is difficult to draw conclusions about food store access from these observations because we cannot determine, *a priori*, a measure of distance that represents "reasonable" access. In this chapter we estimate the effect of geographic distance on FSP redemption patterns. The empirical work in this chapter is based on a simple model of store choice: redemption patterns are measured in terms of the shares of redemptions at each store type; store type is assumed to proxy for differences in prices and product availability; and households are assumed to choose among store types based on access (i.e., distance) to different store types. Store type shares (percent of benefits redeemed at each store type) sum to one for each household and are determined simultaneously.

Empirical Specification

Equation (1) specifies "spending by store type" as a function of household demographics and distances to alternative shopping destinations. This system is analogous to a system of demand equations for allocating the food budget, and follows the empirical specification for the Almost Ideal Demand System (AIDS) of Deaton and Muellbauer (1980). Each store type share is specified as a function of own price, price of alternative goods, total expenditure, and demographics that shift the demand curve.

$$\omega_{ij} = \alpha_j + \Sigma_j \gamma_{ij} \log p_j + \beta_j \log(y/P) + \Pi X_i, \; j=1, \ldots 4 \qquad (1)$$

where

ω_{ij} = share of spending by household *i* at store type *j*
$\log p_j$ = log of distance to the nearest store of type *j*
y = total food stamp redemptions
P = price index, calculated as $\log P = \Sigma_j (\log p_j * \omega_j)$
$\mathbf{X}$ = vector of household demographics

spending; and third, the EBT data, in contrast to the survey data, were not collected contemporaneously with the demographic data. Ideally we would like to observe total food spending on a monthly basis because food expenditures are more variable than food consumption (e.g., because food can be stored).[24]

We decided to use the EBT transactions log data rather than the survey data to construct measures of spending behavior by store type. It seems reasonable to assume that the bias from using FSP redemptions rather than total food spending is less severe than the bias from using weekly spending rather than monthly spending. The assumption here is that households allocate food stamp redemptions among different stores in proportion to the allocation of the total food budget. In addition, we are primarily concerned with the location of food shopping (by store type), and expect these preferences to be fairly stable over time (discounting the concern that the EBT transactions log is not contemporaneous with the interview). Finally, the EBT data are not subject to the measurement error that arises from recall error or from FSP recipients' misperceptions in reporting "store type."[25]

Table 8 shows the average percent of benefits redeemed at each store type. Spending behavior differs for Baltimore City versus the rest of the state; these measures are representative of the full caseload measures reported in Table 4. The total distance travelled in shopping trips by Baltimore City FSP households during September 1993 was about 17 miles, on average; for households outside Baltimore City, total distance travelled was 31 miles on average (the means are 24.8 and 52.8 miles in metro and non-metro areas, respectively).

Means of household demographics and "access" measures are shown in Table 9. Most variables are self-explanatory. Household characteristics that are expected to affect shopping behavior are the presence of children, elderly persons, or disabled persons; education, employment status, and

[24] Cole (1995) reports that, on average, FSP households redeem 70 percent of food stamp benefits during the week following disbursement. Therefore, weekly food expenditures will vary considerably over the month. In fact, 21 percent of survey respondents did not report expenditures "last week."

[25] To test these assumptions, we ran the store type share model using the measures of spending behavior reported in the survey, restricting the sample to households with non-zero food expenditures "last week" (we ran Table 10 using survey measures of spending). The system-weighted R-squares were only .039 for Baltimore City and .046 for the rest of the state. In addition, the own-price effects were statistically significant in only two of eight equations across the two geographic areas. The fact that the EBT transactions data fit the theoretical model of demand behavior better than the survey data confirms our assumptions about the relative severity of the potential biases in the two measures.

Table 8

MEANS OF ENDOGENOUS VARIABLES

Spending by Store Type	Baltimore City	Rest of State
Fraction of food stamps redeemed at:		
Small and medium grocery stores	0.158	0.046
Supermarkets	0.626	0.820
Specialty stores	0.124	0.061
Convenience stores	0.030	0.040
Total distance travelled (miles)	16.73	31.09
	(23.50)	(44.10)

NOTES: Standard deviations in parentheses.

SOURCE: September 1993 EBT transactions log.

race of the household head; whether the household is receiving cash welfare benefits; and the amount of monthly income and food stamp allotment. Monthly income and food stamp allotment are measured 'per male equivalent'—i.e., per 1,800 calories of food energy demand for the household, where caloric demand for each household member is determined on the basis of age and gender. Household resources are thus standardized by household size in a way that accounts for the nutritional demands on the food budget.[26] In addition to the usual demographics, we control for whether the household was surveyed in the summer months (July and August), because eating habits and food prices are likely to change significantly with the change of seasons.

The characteristics of the urban Baltimore City sample differ considerably from the less urban "rest of state" sample. Compared to Baltimore City, FSP households in the rest of the state are more likely to have children, more likely to consist of elderly individuals, are more educated, more likely to be employed, less likely to receive cash welfare benefits, and are less racially diverse.

The lower portion of Table 9 shows the distance measures that define food store access in our model. The survey sample in Baltimore City is representative of the full caseload in Baltimore City

[26] Allotment and income were not deflated for inflation. The CPI for food items rose only 1.5 percent from June 1992 to June 1993. Maximum food stamp allotments were constant over the sample period; they did not increase in fiscal year 1993.

Table 9

MEANS OF EXPLANATORY VARIABLES

	Baltimore City	Rest of State
Household Demographics		
Any children in household	0.634	0.718
Any persons aged > 60	0.129	0.175
Any disabled persons	0.145	0.132
Head has high school education	0.455	0.591
Receiving cash welfare	0.618	0.534
Head is employed	0.110	0.175
Race is non-white	0.841	0.501
Interviewed in summer	0.387	0.260
Post-EBT interview	0.527	0.559
Log of monthly FSP allotment	4.598	4.491
	(0.580)	(0.687)
Log of monthly income	5.110	5.059
	(1.474)	(1.652)
Measures of Food Store Access		
Nearest store is:		
Small and medium grocery store	0.542	0.154
Supermarket	0.056	0.161
Specialty store	0.039	0.045
Convenience store	0.134	0.515
Distance (miles) to nearest:		
Small and medium grocery store	0.186	2.229
	(0.266)	(2.407)
Supermarket	0.384	2.232
	(0.262)	(3.026)
Specialty store	0.463	3.507
	(0.291)	(3.460)
Convenience store	0.255	1.397
	(0.167)	(2.489)

NOTES: Standard deviations in parentheses.

with respect to food store access (see Table 2). Outside Baltimore City, the survey sample is less representative: only 16 percent of survey households have a supermarket as the nearest store, compared to 25 percent of the full caseload.

Table 10 shows the results of the store type share model (Equation 1) estimated as unrestricted seemingly unrelated regressions (SUR). The own-price effects (i.e., log distance to nearest store) are significant and negative (as expected) for supermarkets, specialty stores, and convenience stores in Baltimore City, and for supermarkets and specialty stores outside Baltimore City. The own-

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Table 10
Determinants of Shopping Behavior

Dependent Variable = Percent of Food Stamp Redemptions by Store Type

	Baltimore City				Rest of State			
Store Type x:	Grocery	Supermkt	Specialty	Conven.	Grocery	Supermkt	Specialty	Conven.
Log Distance to nearest store, by type:								
Grocery store	-0.005	-0.009	0.004	0.006	0.000	0.004	0.000	0.005
	(0.62)	(0.85)	(0.62)	(1.68)	(0.10)	(0.64)	(0.08)	(1.89)
Supermarket	0.111	-0.114	0.007	0.024	0.046	-0.079	0.001	0.021
	(9.45)	(7.51)	(0.72)	(4.39)	(6.13)	(5.63)	(0.11)	(3.81)
Specialty store	0.019	0.014	-0.022	-0.013	0.001	0.017	-0.013	-0.003
	(1.77)	(0.92)	(2.25)	(2.56)	(0.31)	(2.03)	(2.13)	(0.76)
Convenience store	0.016	-0.001	-0.006	-0.014	0.007	-0.009	0.001	0.002
	(1.75)	(0.09)	(0.79)	(2.68)	(3.04)	(2.18)	(0.57)	(1.14)
Log(FSP benefit redemptions)*	0.138	-0.108	-0.010	0.014	0.046	-0.046	-0.015	0.019
	(15.85)	(8.64)	(1.32)	(3.36)	(8.09)	(4.54)	(2.41)	(4.43)
Household characteristics:								
Any children in household	-0.113	0.111	-0.017	-0.018	-0.090	0.079	0.047	-0.046
	(5.83)	(3.98)	(1.01)	(2.03)	(5.18)	(2.59)	(2.49)	(3.55)
Any persons age >60	0.048	0.039	-0.039	-0.001	0.009	-0.007	-0.005	-0.009
	(2.07)	(1.18)	(1.93)	(0.09)	(0.49)	(0.21)	(0.26)	(0.63)
Any disabled persons	0.050	-0.044	-0.019	0.032	-0.014	-0.004	0.008	0.002
	(2.39)	(1.49)	(1.05)	(3.32)	(0.90)	(0.14)	(0.43)	(0.16)
Head has HS education	-0.032	0.062	0.002	0.001	-0.020	0.036	-0.016	-0.008
	(2.23)	(3.07)	(0.18)	(0.16)	(1.74)	(1.78)	(1.31)	(0.92)
Receiving cash welfare	-0.054	0.006	0.036	0.003	0.008	-0.030	-0.001	0.001
	(2.88)	(0.21)	(2.17)	(0.34)	(0.64)	(1.31)	(0.08)	(0.07)
Head is employed	-0.059	0.058	0.016	0.001	0.060	-0.089	0.003	0.005
	(2.56)	(1.76)	(0.81)	(0.10)	(4.12)	(3.44)	(0.22)	(0.45)
Race is nonwhite	0.076	-0.127	0.072	-0.036	-0.004	-0.045	0.063	-0.008
	(3.93)	(4.57)	(4.16)	(3.88)	(0.40)	(2.35)	(5.37)	(0.96)
Interviewed in summer	-0.008	0.018	-0.011	0.006	-0.033	0.058	-0.020	-0.011
	(0.55)	(0.91)	(0.87)	(0.89)	(2.69)	(2.66)	(1.48)	(1.17)
Number of all stores within 1 mile	0.000	-0.001	0.000	0.000	0.000	-0.004	-0.002	-0.001
	(0.13)	(3.52)	(0.40)	(1.58)	(0.31)	(1.77)	(1.52)	(0.91)
If nearest store is type x**	0.006	0.013	-0.014	0.011	0.060	0.021	-0.023	0.025
	(0.63)	(0.55)	(0.65)	(1.06)	(4.63)	(1.40)	(1.09)	(3.36)
Number of stores of type x within 1 mile	0.001	0.001	0.001	0.002	0.007	0.007	0.009	0.011
	(1.29)	(0.27)	(1.67)	(2.63)	(1.91)	(1.33)	(1.35)	(3.53)
Nonmetro county					0.028	0.070	-0.053	-0.001
					(1.67)	(2.37)	(2.92)	(0.05)
Intercept	-0.543	1.214	0.108	-0.026	-0.132	0.989	0.116	-0.042
	(11.42)	(17.89)	(2.59)	(1.18)	(4.18)	(17.67)	(3.39)	(1.76)
System-weighted R-Squared		0.144				0.114		
Number of observations		974				758		

Notes: The four "store-type share equations" were jointly estimated as seemingly unrelated regressions.
Store shares were calculated from the September 1993 EBT Transactions log. T-statistics in parentheses.

* Log of FSP benefit redemptions is equal to the log of total redemptions deflated by a price index. The price index is the sum of distances to all store types, weighted by the store type budget shares.

** "Store type x" refers to the store share measured as the dependent variable in the equation.

price effects show that, throughout the state, spending at supermarkets is more sensitive to distance than spending at other store types. These effects are quite small, however; a 10 percent increase in the distance to the nearest supermarket reduces the share of supermarket spending by just 1.3 percentage points in Baltimore City and 0.8 percentage points outside Baltimore City.

The cross-price effects do not display a pattern of symmetric substitutability between store types. This result is consistent with the fact that store types are only partial substitutes; a nearby supermarket provides all the goods that a faraway convenience store provides, but the reverse is not true—a nearby convenience store substitutes for only a portion of the product offering of a faraway supermarket. It is not surprising, then, that supermarkets exert the largest "cross-price" effects on the shares spent at other store types. A 10 percent decrease in the distance to the nearest supermarket reduces the share spent at grocery stores by 1.11 percentage points in Baltimore City and 0.46 percentage points elsewhere. The share spent at convenience stores is reduced by 0.2 percentage points, in all areas of the state, due to a 10 percent decrease in distance to the nearest supermarket.

In our model, the β_j measure the effect of increased total food expenditures on the share of spending at store type *j*. More generally, in the AIDS demand system, $\beta_q > 0$ indicates that the budget share of good *q* increases with total expenditures and that good *q* is a luxury item; $\beta_q < 0$ indicates that the budget share of good *q* decreases as total expenditures increase, and that good *q* is a necessity. The results in Table 10 suggest that in both the Baltimore City and rest-of-state samples, supermarkets and specialty store items are necessities and grocery store and convenience store items are luxuries. We must be cautious in interpreting these "expenditure" effects, however, because our measure of expenditure is only the portion of the food budget that is financed with food stamp benefits, and not total food expenditures. The β_j in our model represent true expenditure effects only if the share of food stamp expenditures by store type is exactly proportional to the share of total food expenditures by store type.

Shopping behavior is significantly influenced by demographic characteristics. Households with children spend a higher share of their food budget at supermarkets than other households: 11 percentage points higher in Baltimore City and 8 percentage points higher outside Baltimore City. Non-white households spend less of their budget in supermarkets and more in specialty stores and grocery stores, compared to white households. Households with senior citizens in Baltimore City

spend a higher share of their food budget at grocery stores. Outside of Baltimore City, households in non-metro counties spend 7 percentage points more in supermarkets than households in metro counties.

The store share equations show that the influence of the "nearest store" is seldom significant. (This is consistent with the evidence presented in Table 6.) In Baltimore City, spending at each store type is not significantly influenced by whether that store type is the nearest store to the household. Outside Baltimore City, "closest proximity" influences spending at grocery stores and convenience stores: spending at grocery stores is 6 percentage points higher if the nearest store is a grocery store; spending at convenience stores is 2.5 percentage points higher due to proximity. Recall that the "own price" of distance does not influence spending at these store types, and the income effect suggests that this spending is "luxury" spending. The system-weighted R-squares for the store share model are .142 and .112 for Baltimore City and outside Baltimore City, respectively; the model explains 14 percent and 11 percent of the variation in spending by store type.[27]

[27] The R-squares on the individual OLS regressions for the grocery, supermarket, specialty, and convenience share equations, respectively, are: .27, .17, .04, .10 for the Baltimore City sample; .20, .11, .09, .09 for the outside Baltimore City sample.

CHAPTER SIX
CONCLUSION

Food store access potentially affects FSP redemption behavior—and therefore has the potential to affect food consumption—because (a) distance may be costly to overcome, and (b) relative access to different types of food retailers may induce households to economize on travel costs (in terms of time and money costs) rather than shop at low-price stores that maximize the return to their food stamp allotment. In fact, this research finds evidence that food store access affects the shopping behavior of FSP households, but the results suggest that ***relative*** access plays only a minor role in determining shopping destinations.

For the average food stamp household in Maryland, the impact of distance on shopping behavior is small. A 10 percent increase in distance to the nearest supermarket reduces the share of food stamps redeemed at supermarkets by only 1.3 percent in Baltimore City and 0.8 percent in the rest of the state. Compared to supermarkets, an increase in distance to grocery stores, specialty stores, and convenience stores induces even smaller "own-price" effects on the share of spending at those types of stores. In addition, the "cross-price" effects of distance on the share of spending at each store type supports the hypothesis that different types of retailers are only partial substitutes.

Although access is estimated to have only a small effect on shopping behavior for the average household, it should be kept in mind that, in our particular sample of Maryland food stamp recipients, the average household resides very near a supermarket. The average distance to the nearest supermarket is 0.4 miles in Baltimore City, 1.0 mile in metro counties, and 2.2 miles in non-metro counties. The impact of food store access on shopping behavior may not be small for households in remote areas within these regions.

Several assumptions and simplifications underlie the analysis, so there are several methodological issues to consider in interpreting the results. First, it is travel costs that affect the budget constraint (and thus shopping behavior), not distance *per se*. The correspondence between distance and travel costs may vary over households for many reasons; travel costs are affected by transportation options, regular commuting patterns, and the location of retailers relative to other

frequented sites. We confronted this issue simply by examining the Baltimore City and rest-of-state samples separately.

Second, price differentials between retailers play a key role in determining the effect of a given travel burden on shopping behavior. In this study, we use 'store type' as a proxy for price differentials, thereby simplifying the relationship between stores and constraining the relation between store types to be the same across all geographic areas. The descriptive evidence about shopping patterns, however, suggests that heterogeneity within store type is an important shopping determinant.

Third, the effect of proximity on shopping behavior depends on the full choice set of alternative shopping locations. Economic geographers have noted that estimates of the effects of distance in models of spatial choice are non-stationary (that is, the estimates cannot be used for out-of-sample predictions) because each observation point (each FSP household) faces a unique choice set of shopping destinations (Ghosh, 1984). Thus, we should not be surprised to find different results when examining a sample of households that faces a different configuration of retailer locations.

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APPENDIX A

GEOCODING PROCEDURES

This appendix documents the process used to match coordinate data to address information for all FSP households and retailers in Maryland.

Data

Coordinate data for all addresses in the State of Maryland were obtained from MapInfo® Corporation as part of the MapMarker™ software package that performs address matching.

The MapMarker data consists of Census TIGER files of street address information and the corresponding coordinate information.[28] The TIGER files are structured by "line segment" so that

Round 1—Automatic matching. The geocoding software geocodes all addresses that match the Census files exactly on three key elements of the address: ***house number***, ***street name***, and ***ZIP code***. When a street prefix (east, west) or street type (St, Ave, Rd) does not match exactly, then a match occurs only if there is a ***single*** possible match. For example, if we have "300 Kirlin St" but MapMarker finds "300 Kirlin Ave" and "300 E Kirlin St," then a match is not found. If, on the other hand, the MapMarker address dictionary contains only "300 E Kirlin St," then a match is assigned because there is only a single possible match on house number, street name, and ZIP code.

The match is characterized by the cartographic coordinates assigned to the address, as follows:

Exact matches - point is located at the street address position
Close matches - point is located at the center of the street segment
ZIP+4 - point is located at the ZIP+4 centroid
ZIP+2 - point is located at the ZIP+2 centroid
ZIP - point is located at the ZIPCODE centroid

Nonmatches in this round consist of all addresses that do not find a unique match on the house number, street name, and ZIP code.

Round 2—Interactive matching. This round involves manual intervention in the matching process. In our experience, this round was primarily limited to identification and correction of spelling errors in street name. These corrections are dominated by (a) street names that contain erroneous embedded blanks, or fail to contain needed embedded blanks; (b) plural/singular errors; and (c) abbreviations that must be expanded. Misspellings due to key entry errors are the more rare occurrence, but the most time-consuming to investigate and repair. The misspellings were corrected via look-up to a master list of Maryland street names. Note that no changes were made to house number and ZIP code—that is, the address was required to match on house number, street name, and ZIP code after spelling corrections were made to street name.

Match of FSP Households to Geographic Coordinates

Table A-1 shows the results of the matching process for the full caseload (by round of matching), and the overall geocoding results for the survey sample used for estimation. Approximately 70 percent of all addresses for FSP households were mapped automatically to precise cartographic coordinates. An additional 15 percent of addresses were matched automatically to address information, but precise cartographic coordinates could not be assigned (these are the close matches,

Table A-1

GEOCODING RESULTS FOR FSP RECIPIENT SAMPLES

	Full Sample		Survey Sample	
Round 1—Automatic matching				
Sample to be geocoded	**113,453**	**100.0%**		
Exact match				
No uncertainty	81,696	72.0%		
Some uncertainty	3,963	3.5%		
Close match	40	0.0%		
Match to ZIP+4				
No uncertainty	6,478	5.7%		
Some uncertainty	331	0.3%		
Match to ZIP+2	1,065	0.9%		
Match to ZIP code	5,597	4.9%		
PO box/rural route	5,425			
Other	172			
No match	14,283	12.6%		
Round 2—Interactive Matching				
Sample to be geocoded	**14,283**	**100.0%**		
Exact match				
No uncertainty	5,341	37.4%		
Some uncertainty	3,766	26.4%		
Close match	253	1.8%		
Match to ZIP+4				
No uncertainty	555	3.9%		
Some uncertainty	506	3.5%		
Match to ZIP+2	172	1.2%		
Match to ZIP code	518	3.6%		
No match	3172	22.2%		
Overall				
Sample to be geocoded	**113,453**	**100.0%**	**2,165**	**100.0%**
Exact match				
No uncertainty	87,037	76.7%	1,624	75.0%
Some uncertainty	7,729	6.8%	175	8.1%
Close match	293	0.3%	22	1.0%
Match to ZIP+4	7,870	6.9%	114	5.3%
Match to ZIP+2	1,237	1.1%	28	1.3%
Match to ZIP code	6,115	5.4%	192	8.9%
No match	3,172	2.8%	10	0.5%

NOTE: The full sample contains all caess that appeared in ***both*** the April 1993 caseload extract and the September 1993 EBT transactions log, prior to restricting the September 1993 sample to cases receiving a single monthly disbursement. The survey sample consists of both the pre-EBT and post-EBT surveys.

and "other" matches to ZIP centroids). The latter group results from the limitations of the cartographic data, and not from any limitation in the quality of the FS recipients' postal information.

The second round of matching raises the "hit rate" to over 75 percent exact matches and leaves only 3 percent of all addresses unmatched. A "No Match" at the bottom of Table A-1 reflects the fact that the postal information that we have for the FS recipient does not match a postal entry in the MapMarker addresss dictionary.

Table A-1 tabulates the data according to the degree of measurement error in the assigned coordinates given the match and in terms of the uncertainty in the accuracy of address matches for addresses mapped to exact points. Uncertainty about a match occurs whenever the address information is incomplete or incorrect in some respect, but not so incomplete as to leave only ZIP code centroid matching as an option. For example, we might be missing the EAST,WEST prefix on the street. If the address that we have is "300 Kirlin St" but only "300 E Kirlin St" exists within the specified ZIP code, then we obtain a match—i.e., we map to "300 E Kirlin St." The accuracy of the match is uncertain because the real address may in fact be "W Kirlin St" and the ZIP code may be in error. Another common example is when the street type is wrong. "Kirlin St" may not exist in the ZIP code, but "Kirlin Ave" does exist. Matches of this type have a higher degree of uncertainty than exact matches, because an exact match will yield the wrong coordinates only if multiple parts of the address are in error in ways that yield valid postal information.

The overall geocoding results for the full caseload are shown by county in Table A-2. As expected, we had much greater success in geocoding, to precise coordinates, the addresses of food stamp recipients in urban areas. In five rural counties, the majority of food stamp recipients who could be geocoded were geocoded to ZIP code centers. The "no matches" are also disproportionately in rural counties. It is likely that the "no matches" are complete but simply insufficient (in the same way that a Rural Route address is insufficient to find an exact match).

Table A-2

GEOCODING RESULTS FOR FS RECIPIENTS, BY COUNTY

County	Exact Match		Close Match	Match to ZIP+4	Match to ZIP	No Match
	Certain	Uncertain				
Allegany	49%	5%	0%	6%	34%	6%
Anne Arundel	72%	11%	0%	10%	3%	4%
Baltimore	84%	9%	0%	6%	1%	1%
Calvert	29%	3%	0%	9%	55%	3%
Caroline	17%	2%	0%	8%	34%	38%
Carroll	25%	2%	1%	54%	13%	5%
Cecil	45%	4%	1%	20%	23%	7%
Charles	22%	5%	0%	9%	55%	8%
Dorchester	72%	5%	2%	7%	4%	10%
Frederick	57%	6%	0%	23%	4%	10%
Garrett	15%	2%	0%	5%	69%	9%
Harford	81%	6%	1%	8%	3%	1%
Howard	68%	11%	0%	17%	3%	2%
Kent	10%	3%	0%	20%	40%	27%
Montgomery	77%	7%	1%	14%	1%	1%
Prince George	78%	4%	0%	15%	1%	1%
Queen Annes	6%	1%	2%	16%	55%	21%
St Marys	19%	3%	2%	9%	56%	11%
Somerset	6%	3%	0%	19%	63%	8%
Talbot	33%	5%	1%	25%	25%	11%
Washington	41%	7%	3%	0%	27%	23%
Wicomico	56%	4%	1%	9%	21%	10%
Worcester	45%	5%	1%	19%	21%	8%
Baltimore City	90%	7%	1%	2%	0%	1%

Match of FSP-Authorized Retailers to Geographic Coordinates

There were 3,233 FSP-authorized retailers in Maryland in 1993, and 39 out-of-state retailers that accepted Maryland EBT food stamp redemptions.[29] Table A-3 summarizes the match quality that was acheived during the geocoding process. The retailer file was more troublesome to geocode than the recipient file: only 58 percent of addresses could be geocoded without manual intervention. About one-third of the problem was due to the fact that our FSP file of retailers from FCS was incomplete and we had to work with retailer address information from the EBT transactions log.[30] The latter source included a street address, but not a city or ZIP code; we determined the complete address via look-up to a CD-ROM phone directory of businesses.

Ttable A-3

GEOCODING RESULTS FOR FS RETAILERS

Store Type	Number of Retailers	Exact Match	Close Match	Match to ZIP+4	Match to ZIP	No Match
All Stores	3,272	69%	8%	16%	5%	3%
Small/medium grocery	802	84%	4%	7%	3%	3%
Supermarket	563	84%	4%	7%	3%	3%
Specialty food	326	73%	8%	13%	4%	2%
Convenience store	1,013	61%	9%	21%	6%	2%
Other	568	74%	5%	12%	4%	6%

Among retailer addresses obtained from the FCS file, a common problem was the presence of an incorrect ZIP code—we corrected those "incorrect" ZIP codes after manual look-up of city name in a master listing of Maryland cities. It is possible that the ZIP codes that we received pertained to the "mailing address" and not the "location" address. Another problem was due to addresses that

[29] Out-of-state retailers could not be geocoded with MapMarker because only the Maryland data were purchased for this study. MapMarker comes packaged with a regional "base map" layer of streets for display purposes, however; we manually looked up the approximate location of the out-of-state stores on the base map layer and read the coordinates off the video display.

[30] This was partly due to the fact that we had an outdated FCS retailer file, even as of September 1993. Approximately 470 retailers appeared in the EBT transactions file but did not appear in our FCS retailer file.

consisted of shopping center names and not street names. We looked up the locations of shopping centers on paper maps, manually found the approximate locations within MapInfo (via reference to street intersections), and read the coordinates off the video display.

Addresses that did not geocode precisely on the first round were investigated by searching a business phone directory (on CD-ROM) for the retailer name. This method allowed us to correct with confidence spelling errors in street names and transcription errors in street numbers.

ZIP Codes

A substantial number of addresses are matched to the coordinates of ZIP code centroids due to the limitations of the cartographic data. It is therefore useful to examine the distribution of the data across ZIP code areas. Table A-4 shows the number of ZIP codes by county, the percent of ZIP codes in which food stamp recipients or retailers reside, and the concentration of retailers and recipients in the "most populated" ZIP code.

Food stamp recipients are distributed across nearly all ZIP codes in the state. The fact that retailers are not as widely distributed is not surprising, because retailers are subject to zoning restrictions and businesses tend to cluster geographically. Rural counties are characterized by a much higher concentration of both recipients and retailers within a single ZIP code, but as mentioned in the text, only 1.6 percent of all households are mapped to a ZIP code centroid in a ZIP code area in which a retailer is also mapped to the ZIP code centroid.

Distance Measures

All distances calculated in this study are simple point-to-point distances. The formula used for calculating the distance between two points, defined by latitude and longitude coordinates, is as follows:

Define,
lat1,long1 == First coordinate pair (in radians)
lat2,long2 == Second coordinate pair (in radians)
PI == 3.1415927

Table A-4

CONCENTRATION OF FSP RETAILERS AND RECIPIENTS ACROSS ZIP CODES

County	Number of ZIP Codes[a]	Percent of ZIP Codes in Which There Are Any:		Percent in "Most Populated" ZIP Code[b]	
		Retailers	Recipients	Retailers	Recipients
Allegany	11	55%	100%	82%	81%
Anne Arundel	35	80%	94%	18%	22%
Baltimore	49	82%	98%	26%	42%
Calvert	14	86%	100%	26%	20%
Caroline	8	100%	100%	50%	88%
Carroll	18	83%	89%	38%	45%
Cecil	13	85%	100%	49%	47%
Charles	19	63%	100%	30%	25%
Dorchester	16	56%	94%	54%	74%
Frederick	28	79%	100%	30%	39%
Garrett	12	83%	92%	30%	39%
Harford	25	100%	100%	14%	27%
Howard	25	72%	92%	18%	31%
Kent	11	55%	100%	44%	44%
Montgomery	44	75%	100%	10%	12%
Prince Georges	36	89%	97%	10%	15%
Queen Annes	17	76%	100%	19%	30%
St Marys	25	48%	100%	21%	36%
Somerset	13	69%	69%	32%	39%
Talbot	14	43%	93%	38%	58%
Washington	15	87%	87%	60%	86%
Wicomico	12	67%	100%	68%	77%
Worcester	9	56%	100%	44%	39%
Baltimore City	30	100%	100%	11%	12%

[a] Source: Census STF ZIP code files.
[b] These columns show the percentage of the county's stores (or recipients) in the ZIP code with the greatest number of stores (or recipients). The ZIP code with the most retailers need not be the same as the ZIP code with the most recipients, though in 19 of 24 counties it is the same.

NOTE: There are 421 ZIP code areas in Maryland and 72 cross county lines. Retailers and recipients residing in ZIP codes that cross county lines were counted in both counties for the purpose of this table.

Let,

diff = abs(long1-long2)
if diff > PI then diff = 2*PI - diff

Then,

distance in miles = arcos(sin(lat2)*sin(lat1)+cos(lat2)*cos(lat1)*cos(diff))*3958.754

We adjusted the point-to-point distance measures to account for the location of the Chesapeake Bay. The Chespeake Bay Bridge connects western Maryland, just north of Annapolis, to eastern Maryland near the town of Chester. (The bridge connects Anne Arundel County to Queen Anne's County.) We constructed a matrix of adjustment factors as follows. First, we measured the direct distance (point-to-point) between every pair of counties by measuring the shortest distance between county boundaries (distance A). Second, for all county pairs with point-to-point distances that cross the Bay, we measured "distance B" as the sum of the distance from county boundaries to the bridge on both sides of the Bay. All county pairs separated by the bay were assigned an adjustment factor equal to the difference between B and A. We added the adjustment factors to all distances calculated between recipients and retailers on opposite sides of the Bay.

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APPENDIX B

SUPPLEMENTARY MAPS

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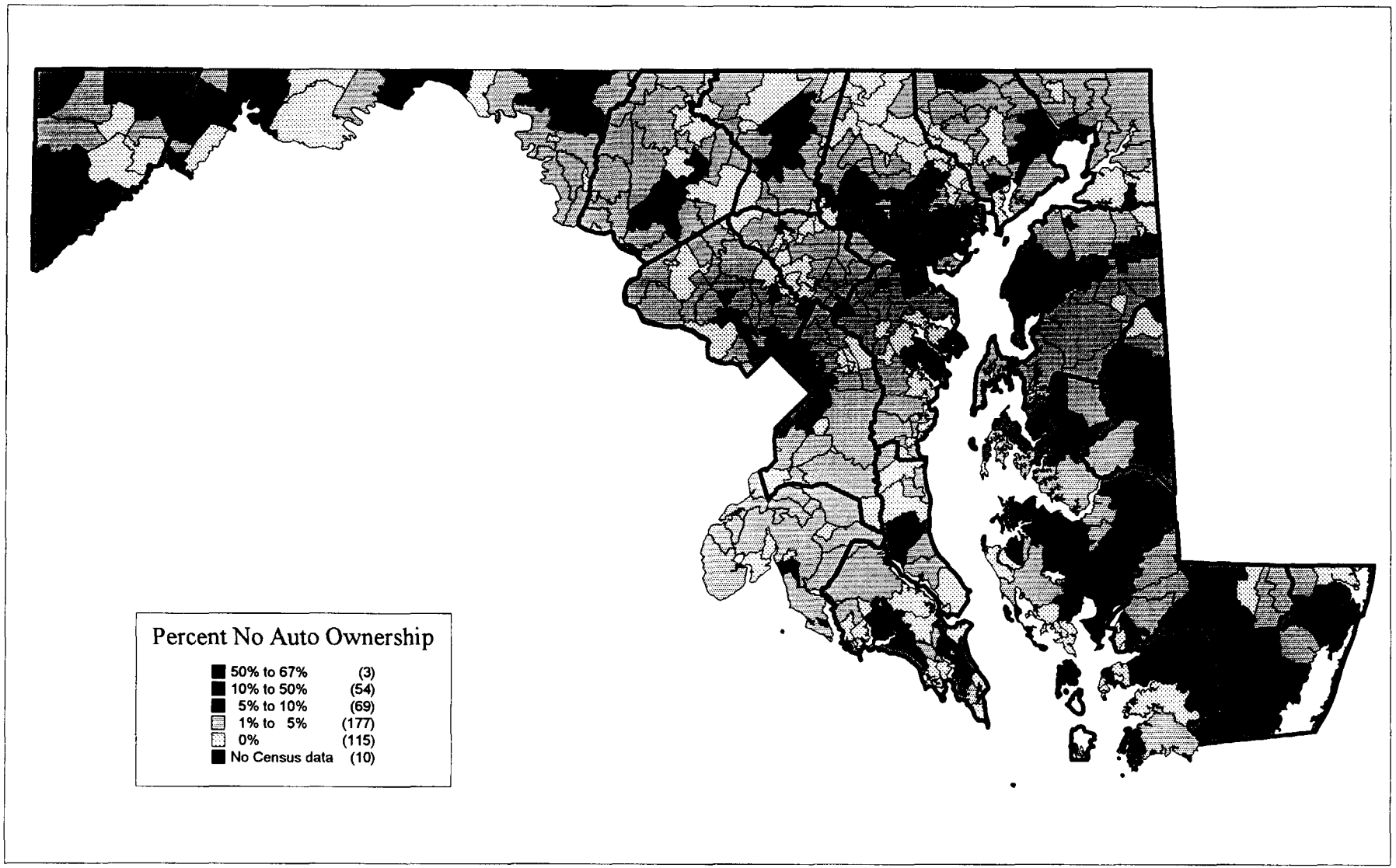
MAP B.1

PERCENT OF HOUSEHOLDS WITHOUT AUTOMOBILES



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MAP B.2

AVERAGE DISTANCE TRAVELLED TO REDEEM FOOD STAMPS

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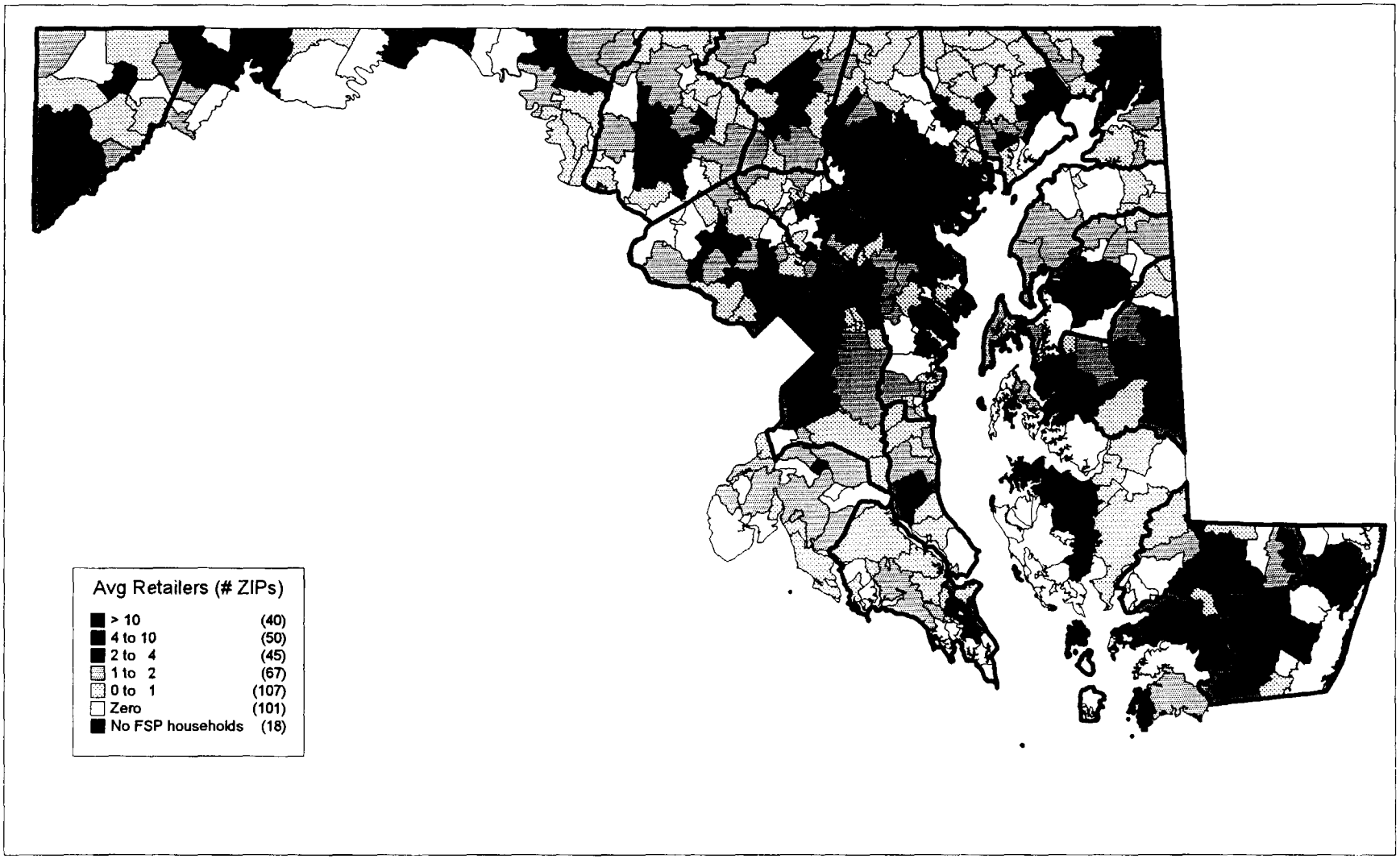
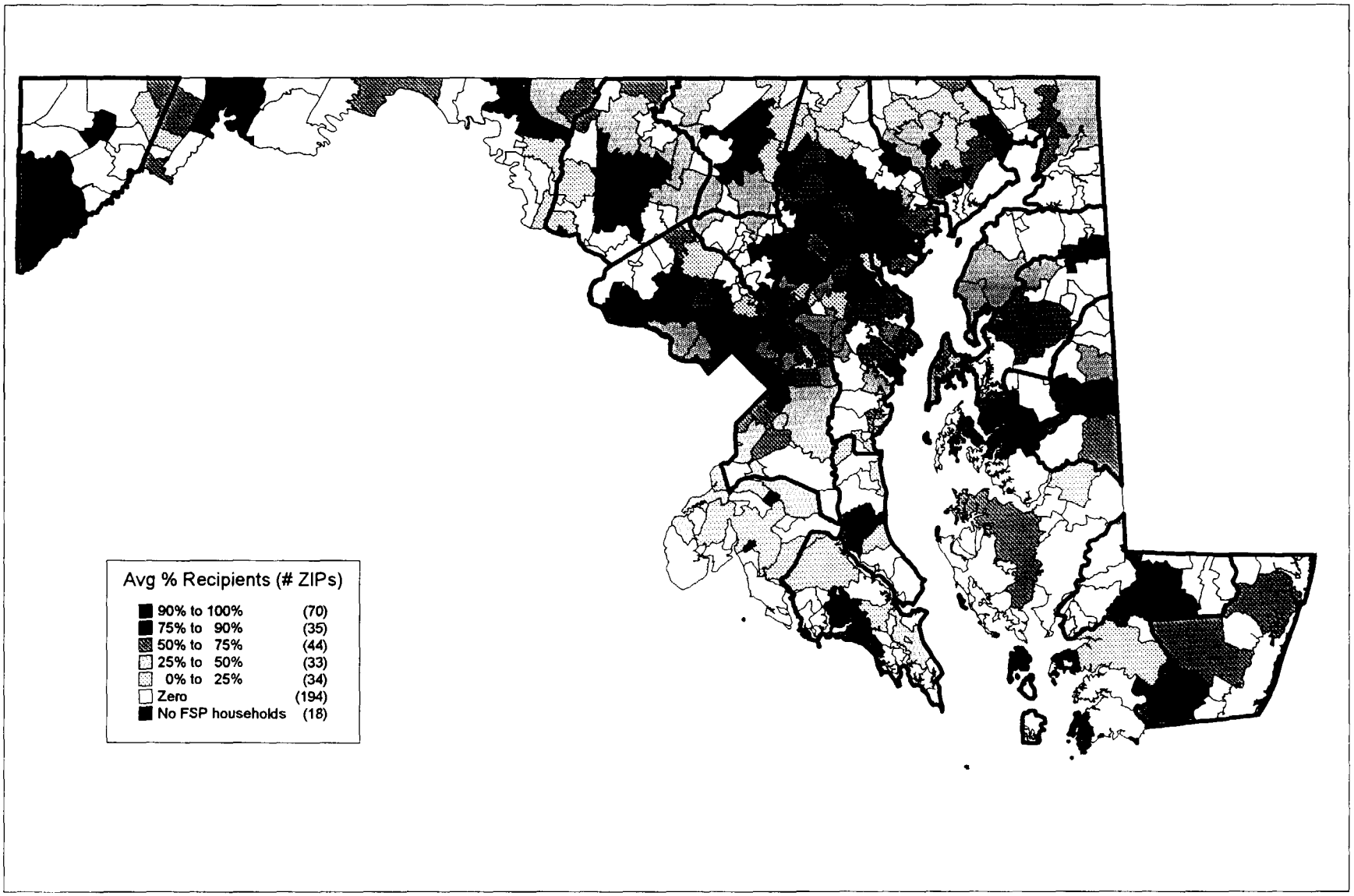
MAP B.3

AVERAGE NUMBER FSP RETAILERS WITHIN 1 MILE RADIUS OF RECIPIENT



MAP B.4

PERCENT OF FSP RECIPIENTS WITHIN 1 MILE OF SUPERMARKETS



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