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THE USE OF A DISCRETE CHOICE MODEL TO ACHIEVE CONSISTENT ESTIMATES OF THE NUTRITIONAL EFFECT OF THE FOOD STAMPS PROGRAM

by

PETER SHIN-EN YU

A dissertation submitted to the Graduate Faculty in Economics in partial fulfillment of the requirements for the degree of Doctor of Philosophy, The City University of New York.

1988

This manuscript has been read and accepted for the Graduate Faculty in Economics in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

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Abstract

THE USE OF A DISCRETE CHOICE MODEL TO ACHIEVE CONSISTENT ESTIMATES OF THE NUTRITIONAL EFFECT OF THE FOOD STAMPS PROGRAM

by

Peter Shin-en Yu

Advisor: Professor Michael Grossman

This study examines and estimates the nutritional effect of the Food Stamp Program. According to the Food Stamp Act of 1977, "To alleviate such hunger and mal-nutrition, a food stamp program is herein authorized which will permit low-income households to obtain a more nutritious diet through normal channels of trade by increasing food purchasing power for all eligible households who apply for participation." The objective is to determine empirically whether the goal of the Food Stamp Act stated has been achieved for teenagers ages 12 to 18.

Normally, the ordinary least squares method is used to estimate the effect of the participating in the Food Stamp Program. However, if the particiapation variable is also capturing some unobservable phenonmenon related to nutrient demand, then the OLS estimates yield biased and inconsistent results. The econometric technique used is a standard approach to correct for selectivity bias problem. First, the probability of participation is

estimated by a probit equation. Then, the inverse of Mill's ratio LAMBDA obtained from the estimation of the participation equation enters into demand for nutrient equations.

The estimated results of the participation equation indicate that the major factors of decision to participate or not in the Food Stamp Program are the welfare status and sex of the head of household.

The empirical results on nutrient consumption from the NHANES II data used are surprising for those expecting positive nutritional effect from the Food Stamp Program. Even so, this study agrees with some of the earlier researches which showed little or no nutritional impact from the Food Stamp Program.

The implication of this type of result is apparent to people with preconceived notion about the Food Stamp Program. The results suggest attempts to improve nutrition by increasing consumer income do not seem to be effective. This implies that Food Stamp Program needs to improve on the means to achieve its primary objective on nutrition.

Acknowledgements

It would have been more difficult to accomplish this task without the helps and encouragements from different people that I know. My appreciation in two perspectives is extended to the people whom I respect and treasure. On the intellectual side, I am thankful for the guidance and constuctive comments from Professor Edwards, Professor Grossman, and Professor Nefci. I am especially grateful to my Committee Chairperson Professor Grossman for his admirable commitment and guidance through developmental stages of this paper. I also appreciate Professor Grossman's permission to use data and programs while I was a research assistant at the National Bureau of Economic Research. At the same time, I am grateful for my family and friends that make my life colorful and meaningful so as to provide a motivation for completing another learning stage in my life. I am deeply thankful to my mother, whom I admire and love, for bringing me to the U.S. to start a new education in 1972. I am also grateful for my father's spiritual support and his great expectations for my writing this paper. And I am forever indebted to my parents for babysitting my son so I can concentrate on my dissertation. Last but not the least, I am thankful for the joy I have with my beloved wife, Annie, and my son, Daniel, for completing this study.

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Chapter 1 INTRODUCTION

Objective

Some question the existence of the in-kind transfer program such as the Food Stamp Program. Nevertheless, the Food Stamp Program still exists and that warrants an examination on the program's effectiveness.

The objective of this study is to examine the effect of participation in the food stamp program prior to 1979 on nutrient intakes of teenagers. That is, the question frequently asked is "what would the average nutrition levels be for those who did not participate in the Food Stamps Program if they had participated instead?" This study emphasizes the effect of food stamps program on adolescents ages 12 to 18, since the teenage population may be more inclined to develop poor eating habits that would affect their future health of themselves and that of their children.

Normally, the ordinary least squares method is used to estimate the effect of the participation variable for the Food Stamp Program. However, if the particiapation variable is also capturing some unobservable phenonmenon, then the OLS estimates yield biased and inconsistent results. The econometric technique used in this study is a standard approach to correct for selectivity bias problem. First, the probability of participation is

estimated by a probit equation. Then, the inverse of Mill's ratio LAMBDA obtained from the estimation of the participation equation is entered into demand for nutrient equations.

At the beginning of this research in 1983, it was an innovative idea to endogenize the participation variable to study the effect of the Food Stamp Program. During the development of this study, however, there have been a few studies that examine the nutritional effect of the Food Stamp Program using the selectivity correction technique (see Akin, et al.[1] (1985), and Butler, et al.[2] (1985)).

The uniqueness of this study then is the incorporation of the school lunch variables (which will be discussed later) in the demand model for nutritions, in addition to studying a different demographic group namely the teenagers. The reason for selecting this group, as noted earlier, is that effects on teenagers are more important than on adults because the health status of teenagers will have more impacts throughout their lives. In addition, in 1985 about 52% of all Food Stamp Program

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[1] Akin, J. S., et al. "The Impact of Federal Transfer Programs On The Nutrient Intake of Elderly Individuals." The Journal of Human Resources, 20(3), Summer 1985.

[2] Butler, J. S., et al. "The Effect of the Food Stamp Program on the Nutrient Intake of the Eligible Elderly." The Journal of Human Resources, 20(3), Summer 1985.

participants are children. To be able to focus on this group is a definite improvement over many of the previous studies. As Dwyer (1982) commented "To date, all of the studies of the Food Stamp Program can be critized because they fail to focus on nutritional status and confine themselves to the effects of a single program."[3]

In sum, the contribution of this paper is to provide a consistent estimate of the nutritional effect of Food Stamp Program, holding the participation in the school lunch program constant, for teen-agers ages 12 to 18.

Why Food Stamps?

One of the two major objectives of the food stamp program according to the Food Stamp Act of 1977 is "To alleviate such hunger and malnutrition, a food stamp program is herein authorized which will permit low-income households to obtain a more nutritious diet through normal channels of trade by increasing food purchasing power for all eligible households who apply for participation."[4] Therefore this study sets out to examine one of the two important reasons for having the food stamp program.

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[3] Dwyer, Johanna "Food for Thought on Food Stamps" editorials, American Journal of Public Health, 72(8), August 1982.

[4] Public Law 95-113, 91 STAT. 958. "Food Stamps Act of 1977." U.S. Congress. 95th Congression, 29 September 1977.

Uniqueness of Food Stamp Program

The food stamps program is one of thirteen federal food assistance programs, ten of which are aimed at children (Bovard [5] (1983)). The food stamp program, like other welfare programs, is a means-tested benefit program which requires that the household's income or assets (resources) fall below specified guidelines in order for the family to qualify for benefits. The uniqueness of the Food Stamp Program among income maintenance programs is that Food Stamp benefits are paid not in the form of check, cash, or reimbursements to vendors, but rather in the form of specially printed stamps that eligible recipients obtain at certified disbursement outlets near their homes. The food stamps are in turn used to buy food commodities. Thus, Food Stamps have two economic functions: they can provide extra income to the participants, and they also function like money, that is, Food Stamps can be used as a medium of exchange for food transactions.[6]

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[5] Bovard, J. "Feeding Everybody: How Federal Food Programs Grew and Grew." Policy Review, 26, Fall 1983, pp 42-52.

[6] For a study of their role as a medium of exchange and how the food stamp coupons affect the money supply (M1) see Hammermesh and Johannes (1983).

A Brief History Of The Food Stamp Program

The first Federal Food Stamp Plan began as an experiment in early 1939. It was designed to increase food expenditures among participating families through the use of general (orange) and specific-purchase (blue) food stamps. More specifically, families exchanged money for food stamps of equal value to purchase regular food items. In addition, they also received additional stamps to buy designated surplus foods at retail stores. The Food Stamp Plan was first used in Rochester, New York and then expanded to 1700 counties and 80 cities. The program terminated in 1943 as World War II reduced unemployment and increased demand for for U.S. food. In addition, problems plaguing the operation of the Food Stamp plan led to its termination. From 1943 to 1961, surplus commodity distribution continued to be the primary federal food assistance program. In January 1961, President John F. Kennedy instructed the Secretary of Agriculture to establish a pilot food stamp programs for needy families. The preliminary results of the 1961 pilot food stamp project, which showed increased food purchases and improved diets for participating families, contributed to the passage of the Food Stamp Act of 1964. The Food Stamp Act of 1964 established the Food Stamps Program as a permanent program. Since then, the Food Stamp Act have been amended many times with respect to

the eligibility and purchase requirements of food stamps.[7] Notably, in 1971 national standards of eligibility were established and all States were required to inform low-income people about the availability of food stamps. In July of 1974, Congress required all States to offer food stamps to the poor.

Process Of Obtaining Food stamps

Applications to buy food stamps must be filled out by a member of each applicant household at a food stamp agency. The employable household members must register for work at the local employment office before the applicant is issued the identification and authorization to purchase (ATP) cards that certify the household's eligibility to buy its stamp quota from an issuing center.

Households included in a federally aided public assistance grant from AFDC or Supplemental Security Income (SSI) are automatically eligible for food stamps.[8] In many counties, information collected for the welfare

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[7]For examples, P.L. 88-573 (1964), P.L. 88-635 (1964), P.L. 89-316 (1965), P.L. 89-556 (1966), P.L. 90-91 (1967), P.L. 90-113 (1967), P.L. 90-463 (1968), P.L. 90-552 (1968), P.L. 90-608 (1968), P.L. 91-116 (1969), P.L. 91-127 (1969), P.L. 91-305 (1970), P.L. 91-671 (1971), P.L. 93-86 (1973), etc..

[8] However, the Food Stamp Act of 1977 prohibits the automatic eligibilities of all public assistance and supplemental security income (SSI) households.

case file may simultaneously certify households for public assistance and food stamps. In those counties, the cost of buying (or the purchase price of) food stamps is automatically deducted from the monthly assistance grant, and the stamps are mailed along with the welfare check to the recipient households.

The non-public assistance recipients and households living in counties without mail issuance of food stamps must get their stamps at a food stamps vending office (often located in banks or post offices.)

Under the Food Stamp Act, the food stamp agency must notify the applicant of its decision to certify or deny program eligibility within 30 days after the application is received.

On the average, the certification period, which is the duration of time the food stamp users must repeat the entire food stamp application in order to become re-certified as eligible to buy food stamps, is three months. However, the certification period can be as long as 6 months or a year until the food stamp agency determines that income changes are unlikely.

Primus[9] (1977) found the mean length of time a nonpublic assistance food stamp recipient stayed on the program was about 7.5 months in 1975. The average length

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[9] Primus, W. "A Note of Caseload Turnover Within The Food Stamp Program." Preliminary draft, Georgetown University, Washington, D.C., 1977.

of stay in the program for households with members registering for work and for elderly households was 7.5 months and 15.8 months, respectively.

Determinants Of Food Stamps Eligibility

Food stamp applicants must demonstrate that their household resources do not exceed either of two maxima,- one for assets and one for net income.[10] The limit on net income varies with household size whereas the limit on assets does not.

The food stamp means test for assets is that if the total value of certain liquid assets exceeds $1,500 (or $3,000 when two or more household members are over age 65), the household is denied eligibility. Important components of household wealth such as the home, one car, household and personal goods, insurance policies, pension funds, and any property essential to self-support are specifically excluded from the list of included assets. On the other hand, extra cars, recreational vehicles, and financial assets such as cash, bank accounts, stocks and bonds, and nonrecurring lump-sum payments are considered as countable assets.

The determination of countable net income is quite

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[10] The following information on eligibility requirement and benefit determination is relevant for time span covered in this study. For the most recent information, the reader is advised to contact U.S.D.A. or the local Food Stamps agencies.

complicated since a host of deductions can be subtracted from gross income. The essential deductions include 10% of wages and salary (with a maximum of $30 a month), income taxes, FICA taxes, union dues, any other mandatory payroll deductions, medical expenses, shelter costs in excess of 30% of gross income minus all other deductions, and other unusual expenses. The countable net income definition is to provide a standard for determining need for food stamp benefits that takes into account the various circumstances under which gross income is a misleading indicator of ability to acquire nutritional diets.

Benefit Determination Of Food Stamps

The present food stamp allotment has been based on the Thrifty Food Plan since 1976. Under the Thrifty Food Plan households above the lowest net income bracket must pay a purchase price for their food stamp allotment that is less than the redemption value of the allotment (obviously), but the purchase price rises with each net income bracket. The purchase price is set at the amount an average family would spent in absence of the food stamp program. For a given household size, the benefits decline roughly 30% for each additional net income dollar.

The variable purchase option was available to allow

food stamp users to buy any quarter-fraction of their food stamp bonus to accomodate those whose full purchase price was too high for their limited budget. The contraint on the variable purchase option is that the total bonus resulting from the purchases in any one calendar month may not exceed the entire monthly bonus.[11]

Growth Of The Food Stamp Program From 1970 To 1980

In 1970 the number of food stamp recipients was 6.5 million (which is 3.2 percent of the resident population in the U.S. in 1970).[12] The federal cost of the program was 0.6 billion dollars (which is 0.3 percent of total federal outlays and 0.5 percent of non-defense outlays). In the subsequent ten years the number of the recipients exploded to 22.0 million in 1980 (which was 9.7 percent of the 1980 U.S. resident population). At the same time, the federal cost of the program expanded to 8.7 billion dollars (which is 1.5 percent of total federal outlays). Therefore, the federal cost of the food stamp program dramatically increased by 1,350% from 1970 to 1980. During the same period, the recipients of aid to families

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[11] According to the Congressional Budget Office, only a small percentage of recipients households used the variable purchase option. More importantly, in NHANESII there is no indicator for participant choosing variable purchase option.

[12] U.S. Department of Commerce, Bureau of the Census. Statistical Abstract of the United States 1981.

with dependent children (AFDC) increased from 9.7 million to 11.1 million constituting only a 14 percent increase. Other major figures for federal social programs are: a 377% increase for Medicare (from 7.1 billion to 33.9 billion); a 385% increase for Medicaid (from 4.8 billion to 23.3 billion); and a 275% increase for social security (from 32 billion to 120 billion). This astronomical rise in the use and cost of the food stamp program underlines the importance of understanding the impact of this program.

National School Lunch Program

Since the effect of school lunch program is pertinent to the demand model for nutrition, a brief description of the program follows.

As early as 1932, some schools received federal loans and agricultural surpluses to cover the cost of the preparing and serving school lunches. That can be viewed as precursor to the National School Lunch Program. The National School Lunch Program started in 1946 which makes it the oldest and as well as the largest of the nutrtion programs operated by the Food and Nutrition Service of the Department of Agriculture.[13] The National School

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[13] The cornerstone of the National School Lunch Program is the National School Lunch Act of 1946 (Public Law 79-396) which states its objective as "to safeguard the health and well-being of the Nation's children and to encourage the domestic consumption of nutritious agricul-

Lunch Program is a federal subsidy program where the schools participating can offer school lunches at reduced price or free to qualified students. Within each State, the State's educational agency operates the program through agreements made with local school districts. To participate in the program, schools must agree to: (1) operate food service for all students without any discrimination with respect to race, color, national origin, sex, age, or handicap; (2) provide free and reduced price lunches to students unable to pay the full price based on income eligibility requirement; (3) serve lunches that would meet the nutritional standards established by the Secretary of Agriculture; (4) operate the food service on a nonprofit basis. In the federal fiscal year 1980, the average daily partcipation in the school lunch program was 26.6 millions which is about 62 percent of all public school students, and 38% of them received free lunches.

Ideally, the school lunch is designed to provide about one-third of a student's Recommended Dietary Allowance for key nutrients. As a result, the school lunch requires five items: a specific amount of meat or meat alternative, a combination of two or more vegetables or fruits, whole-grain or enriched bread or bread alternate, and fluid milk as a beverage. Therefore, the

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tural commodities."

school lunch program has inherent features which tend to insure the nutritional adequacy of program's participants.

CHAPTER 2 PREVIOUS STUDIES

Earlier Studies

There are a number of studies that have dealt with the effects of food stamp program. The first economic analysis of the food assistance program of any type is probably Coppock's "Indifference Curve Analysis Applied to The Food Stamp Plan."[14] Coppock found that there was considerable qualitative evidence that the Food Stamp Plan brought about changes in the taste pattern of individuals in favor of food.

The most well known study about Food Stamps Program is perhaps Maurice MacDonald's Food, Stamps and Income Maintence in 1977.[15] MacDonald concluded that although food stamps primarily provide unrestricted (i.e. freeing up some income for any expenditure) income supplementation they do not have substantial impact on family's nutrient intake. Sylvia Lane's[16] 1975 survey of Kern County, California, compared food expenditure amounts and

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[14] Coppock, J. D. "Indifference Curve Analysis Applied to The Food Stamp Plan." American Economic Review, March 1945.

[15] MacDonald, M. Food, Stamps, and Income Maintenance. Institute for Research on Poverty. Academic Press, New York, 1977.

[16] Lane, S. "Food Aid Program Effects on Food Expenditures and Levels Nutritional Achievement of Low-Income Households." Unpublished manuscript, University of California at Davis, Department of Agricultural Economics, 1975.

the dietary adequacy of nine important nutrients. However, her study had 151 food stamp participant and 178 nonparticipant program eligible households residing only in Kern County, California. Her results showed that more participating households were at 100% of the RDA[17] standards for calories, protein, calcium, thiamine, riboflavin, and niacin than were nonparticipaing households. This evidence was not conclusive, however, because there might be important differences in the characteristics of participating and nonparticipant households that were unrelated to the food stamp program and yet actually account for the observed difference in nutritional achievement. That is, in addition to the geographical confinement of her sample, her study did not use multivariate analysis and therefore could not incorporate the effects of other variables that affect nutrition.

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[17] Recommend Dietary Allowances(RDA) are the levels of intake of essential nutrients considered, in the judgment of the Food and Nutrition Board of National Science Academy on the basis of available scientific knowledge, to be adequate to meet the known nutritional needs of practically all healthy persons. RDA should not be confused with United States Recommended Daily Allowances (USRDA), a set of values derived from RDA by the Food and Drug Administration as standards for nutritional labeling. RDA(except for energy) are estimated to exceed the requirements of most individuals, and thereby ensure that the needs of nearly all are met.

The Madden and Yoder's (1972)[18] analysis of the determinants of overall nutritional achievement among 1969-1970 rural Pennsylvania participant and nonparticipant households was conducted in a multivariate setting. In particular, their analysis held constant income and food expenditure levels. There was no evidence in their data that nutritional efficiency varied between food stamp users and nonusers. (They defined nutritional efficiency as the amount of nutritional intake of the household divided by the total expenditure on food.) Furthermore they concluded that food stamp usage typically did not increase food expenditure, net of the effects of income adequacy and the other explanatory variables. MacDonald has argued that based on the evidence from the above surveys in Pennsylvania and California it would be hazardous, at best, to conclude that food stamps have a substantial impact on either nutritional efficiency or nutritional achievement.

In another study, Clarkson[19] (1975) argued that there is nothing inherent in the food stamp program that reequires, or even encourages, the purchase of nutritious

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[18] Madden, P. J., and Yoder, M. D. "Program Evaluation: Food Stamps and Commodity Distribution in Rural Areas of Central Pennsylvania." Pennsylvania State University Agricultural Experimental Station Bulletin 780, University Park, Pennsylvania, 1972.

[19] Clarkson, Kenneth Food Stamps and Nutrition, American Enterprise Institute for Public Policy Research, Washington, D.C., 1975.

foods. Since food stamps are considered to be nothing more than an income supplement, with the recipient required only to spend the supplement on food products, no improvement in nutrition necessarily results. Recipients may simply be using the food stamps to purchase expensive foods that are no more nutritious than the cheaper food they would have bought with a lower food budget. In fact, the substitution of soft drinks and snack foods for milk and fruits, or reallocate their own funds away from food and toward other goods, which common gossips insists is what some recipients families use the food stamp for, is a disservice to the recipients' children.

There also had been studies on the effects of the elimination of food stamp purchasing requirements in the 1977 Act and enacted since January 1979, (see Beebout and Kendall[20] (1979), Higa[21] (1981), and Salathe[22] (1980)). Basically, the new provisions in the 1977 Act reduced the net income limits, lowered the resource limits for most

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[20] Beebout, H. and Kendall, A. "Estimates of Food Stamp Eligibles and Participants Under Old Law and Eligibles Under New Law for July 1978." Mathematica Policy Research, Inc. and Social & Scientific Systems, Inc..

[21] Higa, T. "An Analysis on Structural Changes in the Food Stamp Program." American Economists, 25(2), Fall 1981.

[22] Salathe, L. E. "Impact of Elimination of the Food Stamp Program's Purchase Requirement on Participant's Food Purchase." Southern Journal of Agricultural Economics, 12(2), December 1980.

households, and eliminated most college students from the program. At the same time, the elimination of the purchasing requirement was to enable more eligible households to participate by eliminating the inablility to pay for the purchase requirement. The purchase requirement is the amount the participant had to pay to receive food stamp coupons worth greater value. For example, in 1977 a family of four may have to pay up to $142 to receive $166 worth of food stamp coupons. The effect of the elimination of the food stamp purchase requirement is not addressed in this study because the new paticipants since January 1979 cannot be identified from the data set. Even so, participation rate is another major issue as participation is much less than 100% of all eligible households. McDonald[23] (1977) reported a 38 percent participation rate. For other studies see Bichel and MacDonald[24] (1975) and Coe[25] (1976). It had been estimated that there were 32.8 million people eligible for food stamps in July 1978.

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[23] MacDonald, M. Food, Stamps, and Income Maintenance. New York: Academic Press, 1977.

[24] Bickel, G., and MacDonald, M. "Participation Rates in the Food Stamp Program: Estimated Levels, by States." Discussion Paper 253-75. Madison, Wisconsin: Institute for Research on Poverty, 1975.

[25] Coe, R. "Participation in the Food Stamp Program among the Poverty Population." In Five Thousand American Families- Patterns of Economic Progress, Volume V. Edited by G. J. Duncan and J. N. Morgan. Ann Arbor: Institute for Social Research, 1976.

Under the new law the eligible population declined 11% to 29.2 million in July 1979. In terms of participation, before the 1977 Act, only 40% of all eligible elderly persons (ages 65 and older) and approximately 50% of the nonelderly participated. With the 1977 Act, the number of elderly persons receiving food stamps increased by 42% between November 1978 and November 1979.[26]

Many of the previous researches have evaluated the Food Stamp Program from the prospective of its impact on household food expenditure behavior (Chavas and Yeung[27] (1982), Hu and Knaub[28] (1974), Huang, et al.[29] (1981), Knaub[30] (1981), Lane[31] (1975). In the above studies, the

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[26] Further details can be found in the Second Annual Report to the Congress by the Food and Nutrition Service of the U.S. Department of Agriculture in January 1981.

[27] Chavas, J. P., and Yeung, M. L. "Effects of the Food Stamp Program on Food Consumption in the Southern United States." Southern Journal of Agricultural Economics, 14, July 1982.

[28] Hu, T. and Knaub, N. "Effects of Cash and In-Kind Welfare Payments on Family Expenditures." Policy Analysis, 1974.

[29] Huang, C. L., et al. "Modeling the Effects of the Food Stamp Program on Participating Household's Purchases: An Empirical Application." Southern Journal of Agricultural Economics, 13(2), December 1981.

[30] Knaub, N. L. "The Impact of Food Stamps and Cash Welfare on Food Expenditures, 1971-1975." Policy Analysis, 7, 1981.

[31] Lane, S. "Food Aid Program Effects on Food Expenditures and Levels Nutritional Achivement of Low-Income Households." Unpublished manuscript, University of California, Department of Agricultural Economics, Davis. 1975.

researchers have typically found that the Food Stamp Program increases food purchasess of participating households or marginal propensity to consume out of food stamp bonus is greater than that of ordinary income. In another perspective, Basiotis, et al.[32] (1983) found that Food Stamp participation had a positive impact on diet availability levels. However, the linkage between increases in food expenditure and increases in nutrient intakes is not a direct one. Therefore, studies on the food expenditure effect of the Food Stamp Program per se can not be conclusive on the program's nutritional effect.

Recent Studies on Nutritional Effects of the Food Stamp Program

In the following section, I will summarize three recent studies that examined the nutritional effects of the Food Stamps Program. The first is a study by Whitfield[33] (1982). By using a random probability sample from a low-income area of Tulsa, Oklahoma in 1978, Whitfield concluded that the effects of the food Stamps are not uniformly positive. However, Whitfield finds

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[32] Basiotis, P., et al. "Nutrient Availability, Food Costs, and Food Stamps." American Journal of Agricultural Economics, November 1983.

[33] Whitfield, R. A. "A Nutritional Analysis of the Food Stamp Program." American Journal of Public Health, 72(1982).

that an increase in in-kind income does benefit some components of nutrition. More specifically, he found participation in the Food Stamp Program did have a strong positive effect on the nutritional adequacy of iron, and vitamin C. On the whole, differences in age, race, and sex all contribute more heavily to variations in nutrient intakes than does income or participation in the Food Stamp Program.

Butler, et al.[34] (1985) chose households whose members were 65 years or older as target population and used data from the Food Stamp Cashout Project from April 1980 through the summer of 1981. First, differences in average values of nutrient intakes in various categories for Food Stamp Program participants and eligible non-participants and formal difference of means tests were used to assess the statistical significance of observed differences. Of the nine nutrients, five nutrient intakes, calories, protein, iron, thiamin, and niacin, were lower among food stamp partcipants, while the other four (calcium, vitamin A, Vitamin A, Vitamin C, and riboflavin) were higher. However, the gross comparison did not yield any statistically significant results. Next, they used OLS regression technique to examine the

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[34] Butler, J. S., et al. "The Effect of the Food Stamp Program on the Nutrient Intake of the Eligible Elderly." The Journal of Human Resources, 20(3), Summer 1985.

effect of the Food Stamp Program by controlling for other explanatory variables. All of the estimated effects were positive, but statistically significant only for calcium. Also, surprisingly there was no positive income effect on nutrient intake. Lastly, they corrected the regressions for self selection into the grogram on the part of the eligibles. The basis for correction is their assumption that those who choose to accept food stamps may be different in unmeasurable ways from those who do not, thus causing disturbances in the model to be correlated. The correction factor was computed from a probit equation. Their finding was that the results were not substantially changed by the inclusion of the correction. Therefore, although the Food Stamp Program increases resuources for low-income, elderly households, the impact on their nutrient intake is either none or small if any.

Another study that focuses on the impact of Food Stamp Program participation on the daily nutrient nutrient intake of the elderly is by Akin, et al.[35] (1985). Their analysis was based on data from the National Food Consumption Surveys (NFCS) collected by the Consumer Nutrition Center of the U.S. Department of Agriculture between 1977 and 1980 for individuals aged 55 and

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[35] Akin, J. S., et al. "The Impact of Federal Transfer Programs On The Nutrient Intake of Elderly Individuals." The Journal of Human Resources, 20(3), Summer 1985.

over. Using the probit equation a correction term was calculated for each individual, and entered as an explanatory variable in the nutrient demand equations. This procedure controlled for the effect of self-selection; that is, households choose to participate according the perceived utility from the impact of Food Stamp Program. To emphasize the behavioral differences between participants and nonparticipants each was estimated separately. A test of the difference coefficients, ignoring the sample selectivity problem, showed they were significantly different at the 1 percent level of significance. Their findings was that participants had higher predicted consumption of caloies and all of the nutrients than those of a nonparticipants with identical attributes. However, the average participant did not consume as much of any nutrient as an average ineligible individual did.

In sum, most of the previous studies mentioned did not examine the principle objective namely the nutritional effect of the Food Stamp Program. In fact, Whitfield (1982) claimed to be the first one to support by empirical data the major premise of the program that an increase in in-kind income benefits some components of nutrition. This study, which started in 1984, is incidentally similar to the approach Akin, et al. (1985) took in their research; however, the teenagers ages 12 to

18 instead of the elderly is the demographic target in this study. In addtion, this study incorporates information of another government food program the school lunch program in the nutrient demand model.

CHAPTER 3 THE EMPIRICAL DATA

Whereas some of studies mentioned in Chapter 2 are severely restricted geographically, the data set used in this study will be a recent national sample of civilian population from 1976 to 1980. The data source is the National Health and Nutrition Exmination Survey,[36] NHANES II, which started in February 1976 and was completed in February 1980. NHANES II is a nationwide probability sample of approximately 28,000 persons, aged 6 months to 74 years old, from the civilian noninstitutionalized population of the United States.

This paper chooses to study the nutritional effect of the Food Stamps Program prior to 1979, because beginning in January 1, 1979 there was a structural change in Food Stamps Program regarding the elimination of the food stamp purchasing requirements, which is the amount the participant had to pay to receive food stamp coupons worth greater value. As noted earlier, this structural change cannot be accounted for in the available data.

Once again, this study focuses on the effect of the Food Stamp Program on teenagers aged 12 to 18. Any

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[36] National Center for Health Statistics. Plan and Operation of the Second Health and Nutrition Examination Survey. U.S. Department of Health and Human Services Publication No. (PHS)81-1317, Series 1, No. 15, 1981.

inconsistent or missing data concerning any variable the regression model uses is deleted from the overall sample. For example, an inconsistency may occur when one claimed no participation in the Food Stamp Program but was classified as an occasional participant. If people are on special diets, their information is deleted. Only people with satisfactory diet data are selected for this study. That is, using an indicator from the interviewer who evaluate whether or not the diet data are reasonable and if not the individual's data are not satisfactory they are excluded from this study.

The nutrient intakes consist of summations of the food specific nutrient information from the 24-hour recall for calories, seven nutrients, and total gram ingested for each person. The 24-hour recall method was adminstered by trained dietary interviewers to record what the respondent has eaten in the last 24 hours. NHANES II took specific and quantitative detail of every food or drink consumed during the previous day recorded and then calculated consumptions of calcium, protein, carbohydrates, fat, and specific vitamins and minerals.

Finally, nutrient information obtained from the Dietary Intake Tape through the above procedure was merged with school lunch variables from the Medical History Tape (Ages 12-74 years olds). The Medical History Tape has information about whether or not there

is a school lunch program at the school the respondent attends and frequency of participation. The data were merged by a unique five-digits I.D. number assigned to individual respondent.

Table 1 lists and describes the variables used in this analysis. Noteably, the variable FSP which indicates whether or not an individual is in the Food Stamps Program is from the household data. The working sample is divided into three categories: FSP participants, FSP non-participants, and FSP ineligibles. The term FSP nonparticipants is defined as those eligible to participate but not participating in the Food Stamp Program. Similarly, the FSP ineligibles are those people considered to be ineligible for Food Stamps.

Concerning the National School Lunch Program, the variable LUNP simply indicates whether there is a school lunch program available to the individual. In 1978, the school lunch program was available to more than 90% of all children enrolled in elementary and secondary school (see Martin[37] (1978)). Among the FSP eligibles, 80.0% of them are at school which participates in the school lunch program.[38] Also, for the sample of the eligibles, if the

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[37] Martin, J. "School Nutrition Programs In Perspective." Journal of American Dietetic Association, 73, 1978.

[38] Even if the teenager pays for school lunch it is most likely that the school lunch program is being subsidized by the Federal Government.

teenager participate in the school lunch program then just about 50% of them do not usually pay anything for lunch.[39] As for the FSP ineligibles, 80.8% of them participate in the school lunch program but only 4.6% of them receive free lunch.[40]

Comparisons Of The Means From The Raw Data

The following comparisons of means and variances among the three subgroups-participants, eligible non-participants, and ineligibles serve as preliminary analysis.

For the comparison between the means of FSP eligibles (i.e. eligible participant and nonparticipant) versus the ineligibles (Table 2), the eligibles have significant lower nutrient intakes than the ineligibles except for Vitamin A, and Vitamin C. With respect to the variances, there is no significant difference between the FSP eligibles and ineligibles except for Vitamin C.

In Table 3, comparisons are made between the means

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[39] According to March 1986 Report by Food and Nutrition Service of U.S.D.A., for the fiscal year 1985, 42.2% of students participating in the school lunch program get free lunches.

[40] In theory, individuals not eligible for Food Stamps are not eligible for free lunch either. However, in the 1970's the USDA used their own poverty guideline which is a variation from that of Census Bureau, thereby allowing those kids to obtain free lunches. Only since 1981 did the National School Lunch Program begin to use the Office of Management and Budget's poverty guideline.

of FSP nonparticipants and those ineligible for the Food Stamp Program (Table 3), the nonparticipants have significantly lower nutrient intakes than the ineligibles except for Vitamin A. As for variances, there is no significant difference between the FSP nonparticipant and ineligibles except for Vitamin C.

For the comparison between the means of FSP participants versus the ineligibles (Table 4), the FSP participants have significant lower nutrient intakes than the ineligibles except

Table 1

Variable List

VARIABLE	DESCRIPTION
FSP	1 if the individual's family participate in the Food Stamp Program; 0 otherwise
WELFARE	1 if the family receives any welfare payment or other public assistance; 0 otherwise
HWORK	1 if the head of the household is working; 0 otherwise.
CARS	Number of cars the family uses on a regular basis (this serves as a proxy for family's asset.)
FAMSIZE	Number of persons in the household.
INCR	Gross annual family income in 1983 dollars.
PERINC	Gross income per capita in 1983 dollars or INCR/FAMSIZE.
HFEMALE	1 if the head of the household is female.
HBLACK	1 if the head of the household is Black.
OTHER	1 if the head of the household is a non-Black minority (e.g. Hispanics, Asians, etc.)
OVER55	1 if the age of the head of household is 55 or over; 0 otherwise.
RURAL	1 if the respondent lives in rural area; 0 otherwise.
LUNP	1 if there is a school lunch program at the school the individual attends.
VITAMIN	1 if vitamin supplements are used; 0 otherwise.

for Vitamin A, and Vitamin C. As for variances, there is no significant difference between the FSP participants and ineligibles except for Vitamin C.

Finally, for the comparison between the means of FSP participants versus the nonpartcipants (Table 5), there is no significant differences of nutrient intakes among the eligibles. However, as for variances, there are significantly greater degrees of variation among the FSP participants than the nonparticipants for: iron, niacin, protein, thiamin, total gram ingested, and Vitamin C.

The gross comparisons in Tables 2-4 indicate that the ineligibles have larger nutrient intakes than the eligibles wheather or not they are participating in the Food Stamp Program. What are the factors accounting for these differences? Table 6 indicates significant demographic and socioeconomic differences between those eligible and those ineligible for food stamps. The biggest difference is in real income (INCR); the ineligibles have on the average almost four times the amount of income reported by the eligibles. Also in Table 6 we can identify other factors contributing to the big difference in income. That is, higher eduction level and employment status of the head of the household for those ineligible for food stamps. Another factor could be that 41% of the eligibles while only 10% of the ineligibles reported having a female as head of house-

hold. Prior to 1980, that generally translates to having only one wage earner in the house or small likelihood of having two people earning wages thus reducing the income potential of the family.

Table 2

Comparisons Of Means And Variances Of
Nutrient Intakes Between Teenagers
Eligible And Ineligible For Food Stamp Program

	ELIGIBLES	INELIGIBLES	T-TEST	F-TEST
NIACIN	18.87	21.36	-3.08	
	(13.18)	(14.50)		0.83
VITAMIN A	4650	5250	-1.10	
	(7622)	(10275)		0.55
THIAMIN	1.408	1.568	-2.69	
	(1.002)	(1.048)		0.91
CALORIE	2100	2311	-3.39	
	(1063)	(1093)		0.95
PROTEIN	77.98	88.04	-3.46	
	(49.72)	(50.99)		0.95
CALCIUM	888.8	1134	-6.01	
	(642.7)	(740.2)		0.75
IRON	12.88	14.31	-2.90	
	(8.01)	(8.83)		0.82
VITAMIN C	91.79	102.4	-1.61	
	(119.4)	(111.8)		1.14
RIBOFLAVIN	1.970	2.426	-4.94	
	(1.338)	(1.724)		0.60
TOTAL GRAM	17481	19952	-4.42	
	(9596)	(9778)		0.96
OBSERVATIONS	454	905		

Notes: Standard deviations of the sample means are shown in parentheses. Formula used for T is

$$T = \frac{(y_1 - y_2)}{s\sqrt{((1/n_1)+(1/n_2))}} \quad \text{where} \quad s = \frac{\sqrt{((n_1-1)s_1^2+(n_2-1)s_2^2)}}{\sqrt{(n_1+n_2-2)}}$$

$F = s_1^2/s_2^2$ where s_1 and s_2 are standard deviations of the two sample.

Table 3

Comparisons Of Means And Variances Of Nutrient Intakes Between Teenagers Not Participating And Ineligible For Food Stamp Program

	NON-PART	INELIGIBLES	T-TEST	F-TEST
NIACIN	19.10	21.36	-2.39	
	(12.98)	(14.50)		0.80
VITAMIN A	4645	5250	-0.93	
	(8108)	(10275)		0.62
THIAMIN	1.389	1.568	-2.59	
	(0.991)	(1.048)		0.89
CALORIE	2130	2311	-2.50	
	(1065)	(1093)		0.95
PROTEIN	80.11	88.04	-2.34	
	(49.57)	(50.99)		0.95
CALCIUM	905.2	1134	-4.74	
	(667.1)	(740.2)		0.81
IRON	13.14	14.31	-2.04	
	(7.832)	(8.83)		0.79
VITAMIN C	86.88	102.4	-2.07	
	(114.4)	(411.8)		1.05
RIBOFLAVIN	2.012	2.426	-3.75	
	(1.421)	(1.724)		0.68
TOTAL GRAM	17782	19952	-3.34	
	(9574)	(9778)		0.96
OBSERVATIONS	298	905		

Notes: Standard deviations of the sample means are shown in parentheses. Formula used for T is

$$T=\frac{(y_1-y_2)}{s\sqrt{((1/n_1)+(1/n_2))}} \quad \text{where} \quad s=\frac{\sqrt{((n_1-1)s_1^2+(n_2-1)s_2^2)}}{\sqrt{(n_1+n_2-2)}}$$

$F=s_1^2/s_2^2$ where s_1 and s_2 are standard deviations of the two sample.

Table 4

Comparisons Of Means And Variances Of Nutrient Intakes Between Teenagers Participating And Those Ineligible For Food Stamp Program

	FSP PART	INELIGIBLES	T-TEST	F-TEST
NIACIN	18.43	21.36	-2.35	
	(13.57)	(14.50)		0.88
VITAMIN A	4660	5250	-0.69	
	(6622)	(10275)		0.42
THIAMIN	1.444	1.568	-1.37	
	(1.026)	(1.048)		0.96
CALORIE	2042	2311	-2.85	
	(1059)	(1093)		0.94
PROTEIN	73.9	88.04	-3.21	
	(49.91)	(50.99)		0.96
CALCIUM	857.4	1134	-4.43	
	(594.1)	(740.2)		0.64
IRON	12.39	14.31	-2.53	
	(8.351)	(8.83)		0.89
VITAMIN C	101.2	102.4	-0.12	
	(128.2)	(111.8)		1.31
RIBOFLAVIN	1.892	2.426	-3.72	
	(1.163)	(1.724)		0.46
TOTAL GRAM	16906	19952	-3.60	
	(9643)	(9778)		0.97
OBSERVATIONS	156	905		

Notes: Standard deviations of the sample means are shown in parentheses. Formula used for T is

$$T=\frac{(y_1-y_2)}{s\sqrt{((1/n_1)+(1/n_2))}} \quad \text{where} \quad s=\frac{\sqrt{((n_1-1)s_1^2+(n_2-1)s_2^2)}}{\sqrt{(n_1+n_2-2)}}$$

$F=s_1^2/s_2^2$ where s_1 and s_2 are standard deviations of the two sample.

Table 5

Comparisons Of Means And Variances Of
Nutrient Intakes Among Teenagers Eligible
For Food Stamp Program

	PARTICIPANT	NONPARTICIPANT	T-TEST	F-TEST
NIACIN	18.43	19.10	-0.51	
	(13.57)	(12.98)		1.09
VITAMIN A	4660	4645	0.02	
	(6622)	(8108)		0.67
THIAMIN	1.444	1.389	0.55	
	(1.026)	(0.991)		1.07
CALORIE	2042	2130	-0.84	
	(1059)	(1065)		0.99
PROTEIN	73.9	80.11	-1.26	
	(49.91)	(49.57)		1.01
CALCIUM	857.4	905.2	-0.75	
	(594.1)	(667.1)		0.79
IRON	12.39	13.14	-0.95	
	(8.351)	(7.832)		1.14
VITAMIN C	101.2	86.88	1.21	
	(128.2)	(114.4)		1.26
RIBOFLAVIN	1.892	2.012	-0.91	
	(1.163)	(1.421)		0.67
TOTAL GRAM	16906	17782	-0.92	
	(9643)	(9574)		1.01
OBSERVATIONS	156	298		

Notes: Standard deviations of the sample means are shown in parentheses. Formula used for T is

$$T=\frac{(y_1-y_2)}{s\sqrt{((1/n_1)+(1/n_2))}} \quad \text{where} \quad s=\frac{\sqrt{((n_1-1)s_1^2+(n_2-1)s_2^2)}}{\sqrt{(n_1+n_2-2)}}$$

$F=s_1^2/s_2^2$ where s_1 and s_2 are standard deviations of the two sample.

Table 6

Comparisons of Socioeconomic Characteristics Among the Eligibles and Ineligibles For Food Stamp Program

Variables	Ineligibles	Eligibles	T-test
INCR	10743 (3835)	2712 (2468)	40.60
SIZE	4.89 (2.39)	5.66 (2.39)	-6.98
HEDUC	12.41 (2.89)	9.85 (3.16)	14.92
HWORK	.948 (.22)	.597 (.49)	18.13
WELFARE	.002 (.05)	.231 (.42)	-16.12
CARS	2.35 (1.06)	1.30 (1.04)	17.33
HFEMALE	.101 (.30)	.407 (.49)	-14.16
OVER55	.073 (.26)	.134 (.34)	-3.67
BLACK	.063 (.24)	.344 (.48)	-14.43
RURAL	.357 (.48)	.289 (.45)	2.51
OTHER	.120 (.33)	.185 (.39)	-3.24
OBSERVATIONS	905	454	

Notes: Standard deviations of the sample means are shown in parentheses. Formula used for T is

$$T=\frac{(y_1-y_2)}{s\sqrt{((1/n_1)+(1/n_2))}} \quad \text{where} \quad s=\frac{\sqrt{((n_1-1)s_1^2+(n_2-1)s_2^2)}}{\sqrt{(n_1+n_2-2)}}$$

and s_1 and s_2 are standard deviations of the two sample.

CHAPTER 4 ANALYTICAL FRAMEWORK

Introduction To Analytical Framework

One of the innovations of this study is to make an indicator of participation in the Food Stamp Program an endogenous variable. The approach taken in this paper is sometimes called "HeckIt"; a technique prescribed in Heckman[41] (1980) to treat sample selection bias as a specification error. This method is a departure from most of the earlier studies where the participation is treated as an exogenous variable. For example: in earlier studies the benefit from the food stamp program is assessed by estimating an equation of the form,

$$N = Yb + aP + u$$

where N may be the nutrient intakes, Y is a vector of exogenous demographic and socioeconomic characteristics, and P is a dummy variable (P=1 for individuals participating in the program; P=0 otherwise). The nutritional effect of the food stamp program is then measured by the estimate of a. However, the dichotomous dummy variable P cannot be treated as exogeous if the decision of an individual to participate or not participate in the program is based on individual self selection. That is the decision to participate might also affect indivi-

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[41] Heckman, J. "Sample Selection Bias As A Specification Error With An Application To The Estimation of Labor Supply Functions." In J. P. Smith (ed.), Female Labor Supply. Princeton, New Jersey: Princeton University Press, 1980.

dual's demand for particular food groups or nutrients. In other words, factors affecting an individual's participation decision may be correlated with the factors determining the demand for nutrition. For example, Brozen[42] (1975) suggested that those who choose not to participate in the food stamp program are likely to be those who choose to spend less on food than the amounts that would have been required to purchase food stamps. He concluded; therefore, food stamps are more likely to be used by those who already have adequate diets and who join the program to obtain this income supplement.

Therefore, given the self selected nature of the participants, those individuals who have a comparative advantage (to use the term Maddala[43] (1983) uses in his book on limited dependent variables) in using the food stamp program will join the program and will benefit more from participating than would a randomly selected individual with the same characteristics. Thus, the food stamp program will produce greater benefit under self selection than under a random assignment.

In sum, how do people decide whether or not to participate in the food stamp program; and how do they

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[42] Brozen, Y. Forward in Food Stamps and Nutrition, American Enterprise Institute for Public Research, Washington, D.C., 1975.

[43] Maddala, G. S. Limited Dependent and Qualitative Variables in Econometrics. New York: Cambridge University Press, 1983.

determine how much nutrients to demand for their families? Using the household production of health approach, the demand for nutrients is derived from the demand for health, where nutrients are inputs in the health production function. Therefore, the decision to participate in the Food Stamp Program depends on whether or not health is enhanced if the family participates, given the family's budget constraints. Tastes are also relevant, as is stigma and other costs in the decision making.

The Model

The basic model behind all of the empirical work can be represented as

$$(1)\quad p = \alpha' X - u$$

$$(2)\quad n = \beta' Y + \Gamma d + v$$

$$(3)\quad d=1 \text{ if } p>0 \text{ and } d=0 \text{ if } p\leq 0.$$

However, p is not observed instead d is an indicator for participation in the Food Stamp Program. n is nutrient intake, X and Y are vectors of exogenous variables, and u and v are correlated error terms. They are correlated because for example a person with greater taste for nutrition may be more likely to participate than another person otherwise.

If the equation (2) for n is estimated by OLS method, then the coefficient of d is biased because d is correlated with v, the error term. Therefore, we apply

probit analysis to d to estimate α using the sample of persons eligible for food stamps. The inverse of Mill's ratio (LAMBDA) is obtained for each observation and is included as a regressor in the equation for n.

The following section shows the LAMBDAs for participants and nonparticipants from the pool of the eligibles.

For participants: $n_i=\beta_1'Y_{1i} + v_{1i}$ (A)

For nonparticipants: $n_i=\beta_2'Y_{2i} + v_{2i}$ (B)

Then,

$$E(v_{1i}|d_i=1)= E(\sigma_{1u}u_i|\ u_i\leq\alpha'X_i)$$
$$= -\sigma_{1u}(f(\alpha'X_i)/F(\alpha'X_i))$$
$$E(v_{2i}|d_i=0)= E(\sigma_{2u}u_i|\ u_i\geq\alpha'X_i)$$
$$= \sigma_{2u}(f(\alpha'X_i)/(1-F(\alpha'X_i)))$$

where f and F are respectively the probability and cumulative density function for the standard normal random variable.

Therefore, let $LAMBDA1_i=-f(\alpha'X_i)/F(\alpha'X_i)$

and $LAMBDA2_i=f(\alpha'X_i)/(1-F(\alpha'X_i))$,

then demand equation for nutrients becomes

$$n_i = \beta_1'Y_{1i} - \sigma_{1u}LAMBDA_{1i} + \epsilon_{1i} \text{ for } d_i=1. \quad (C)$$

$$n_i = \beta 2,Y_{2i} + \sigma_{2u}LAMBDA_{2i} + \epsilon_{2i} \text{ for } d_i=0. \quad (D)$$

where $\epsilon_{1i}=v_{1i} + \sigma_{1u}LAMBDA_{1i}$ and $\epsilon_{2i}=v_{2i} - \sigma_{2u}LAMBDA2_i$

Treatment Of Selection Bias As An Omitted Variable Case

The following is exposition of treatment of

selection bias as an omitted variable case by Barnow, et al.[44] (1981).

Suppose the "true" nutrient demand equation is

$$n = t + \Gamma d + \epsilon_0 \qquad (1)$$

where n is nutrient demand, t is taste for nutrition, d is an indicator for participation in the Food Stamp Program; therefore, d=1 if p>0 and d=0 if p≤0, $\epsilon_0 \sim N(0,\sigma_0^2)$ and ϵ_0 is independent of t and d.

Then, let us suppose prior to participation the model for taste for nutrition is (2) and the model for demand for food stamps is (3).

$$t = \alpha_1 x + \epsilon_1 \qquad (2)$$

$$p = \alpha_2 x + \epsilon_2 \qquad (3)$$

Note, t and p are unobserved variables which are not necessary determined but correlated with x a vector of exogenous variables. $\epsilon_1,\epsilon_2 \sim N(0,\sigma_1^2,\sigma_2^2,\sigma_{12})$ and are independent of x and of ϵ_0.

Now, to derive nutrient demand equation based on the observable substitue (2) into (1), and we get:

$$n = t + \Gamma d + \epsilon_0 = (\alpha_1 x + \epsilon_1) + \Gamma d + \epsilon_0$$

$$= \alpha_1 x + \Gamma d + \epsilon_3 \quad \text{where } \epsilon_3=\epsilon_1+\epsilon_0 \qquad (3)$$

Similar to ϵ_1 and ϵ_2, ϵ_2 and ϵ_3 are also bivariate-normal, independent of x, and $\epsilon_2,\epsilon_3 \sim N(0,\sigma_2^2,\sigma_3^2,\sigma_{23})$. Furthermore, $\sigma_3^2=\sigma_1^2+\sigma_0^2$ because ϵ_1 is independent of ϵ_0,

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[44] Barnow, B., et al. "Issues in the Analysis of Selectivity Bias" University of Wisconsin, Department of Economics, 1981.

and $\sigma_{23}=\sigma_{12}$ because ϵ_2 and ϵ_0 are independent of each other.

Since d=1 iff p>0 or $\epsilon_2>-\alpha_2 x$ (4)

d=0 iff p≤0 or $\epsilon_2\leq-\alpha_2 x$

then $E(d|x) = 0 * P(d=0|x) + 1 * P(d=1|x)$

$= P(d=1|x) = 1 - F(-\alpha x) = F(\alpha x)$ (5)

where $\alpha=\alpha_2/\sigma_2$, and F denotes the standard normal cumulative distribution function because (ϵ_2/σ_2) is a standard normal variable and independent of x.

It can be shown that

$$E[(\epsilon_2/\sigma_2)|x,d=1] = f(\alpha x)/F(\alpha x) \quad (6)$$

$$E[(\epsilon_2/\sigma_2)|x,d=0] = -f(\alpha x)/(1-F(\alpha x)) \quad (7)$$

where f denotes the standard normal probability distribution function. By combining (6) and (7) we have

$E[(\epsilon_2/\sigma_2)|x,d]$

$= d*[f(\alpha x)/F(\alpha x)] + (1-d)*[-f(\alpha x)/(1-F(\alpha x))]$

$= f(\alpha x)(d-F(\alpha x))/[F(\alpha x)(1-F(\alpha x))]$

= LAMBDA (8)

It can also be shown that

$E(\epsilon_3|x,d) = (\sigma_{12}/\sigma_2^2)\ E(\epsilon_2|x,d) = (\sigma_{12}/\sigma_2)*$LAMBDA (9)

Therefore,

$$E(n|x,d) = \alpha_1 x + \Gamma d + (\sigma_{12}/\sigma_2)\text{LAMBDA} \quad (10)$$

In sum, the classical regression of n on x and d produces biased estimate of Γ because of the omission of the LAMBDA variable. However, if $\sigma_{12}=0$ then the OLS estimate from regressing n on x and d will be unbiased. That is

if there is no correlation between taste for nutrient (t) and demand for participation in the Food Stamp Program (p) or between taste for nutrient (t) and the participation variable (d). Therefore, this conclusion is equivalent to Heckman's finding[45] (1976): if the disturbances affecting sample selection are independent of the disturbances affecting the behavioral functions of interest, LAMBDA may be omitted as a regressor. In addition, we can conclude if either LAMBDA or σ_{12} is zero, or both, then the OLS estimates are unbiased.

We observe that the regression coefficient of LAMBDA estimates the correlation coefficient between the error terms u and v multiplied by the standard deviation of v ($r_{uv}\sigma_v$.) An increase in LAMBDA is associated with a decrease in the probability of participating in the Food Stamp Program. Therefore, in the sample of participants, those with high LAMBDAs must also have high values of u, and the inclusion of LAMBDA controls for biases that arises because u and v are correlated. In addition, the value of LAMBDA falls in a smooth, nonlinear fashion as the probability to participate increases, and LAMBDA approaches zero as the individual probability to participate approaches one. Therefore, the total impact

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[45] Heckman, J. "The Common Structure of Statistical Models of Truncation, Sample Selection and Limited Dependent Variables and a Simple Estimator for Such Models." Annals of Economic and Social Measurements, 5, 1976.

of the selection bias term will tend to be numerically small for individuals with probabilities to participate close to one.

The Participation Equation

The decision whether or not to participate is made by comparing the level of utility attained in the absence of the Food Stamps Program with the perceived level of utility attained by participating in the program. If the level of utility associated with participation is higher than that of nonparticipation, then the individual will choose to participate; otherwise, the individual will choose not to participate.[46] Based on the above observations, the classical regression will yield a biased and inconsistent estimates of coefficients and standard errors because P and u will be correlated. If the participation variable is to be treated as endogenous, then the equation $N= aP +Yb +u$ must be estimated by an instrumental variable method.

To discuss the marginal probability in an easy manner, the participation equation will be estimated by the logit model instead of using discriminant

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[46] For a brief discussion of the theoretical foundation of discrete choice model see Appendix B.

analysis.[47,48]

For each individual, we define p=1 if the person choose to participate and p=0 otherwise. Basically, this logit model is a linear function of food stamp program's attributes. That is, the ratio of the odds of choosing food stamp program over none is

$$p_1 / p_0 = \exp(X_1 B)/\exp(X_0 B)$$

where X_1 is a vector of attributes of the participant (e.g. socioeconomic characteristics) and X_0 is a vector of attributes of the nonparticipant. Taking logs we get

$$\log (p_1/p_0) = (X_1 - X_0)B.$$

That is the log of the odds that food stamp program will be chosen over none is a linear function of the attributes of the participant in the food stamp program.

The selection probability function or the participation equation will be $P=f(Y,P_1,P_0,X)$ where P

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[47] In linear discriminant analysis we try to find a linear function that provides the best discrimination between two groups. The discriminant analysis estimator is the true maximumlikelihood and therefore is asymptotically efficient than the logit maximum likelihood estimator if and only if the independent variables are normally distributed. However, if the independent variables were dummy variables and thus the assumption of normality is violated, the discriminant analysis estimator is not even consistent; whereas the logit maximum likelihood estimator is consistent and therefore more robust. The greater drawback about using the discriminant analysis is that the discriminant model is based on a statistical structure that is incompatible with most choice model (McFadden (1976))[44]

[48] McFadden, D. "Quantal Choice Analysis: A Survey." Annals of Economic and Social Measurements, 5(4), 1976.

represents the decision to participate or not to participate in the food stamps program; Y is total income of the household; P_1 is the price of nutrition provided through food stamps, and P_0 is price of nutrition in the absence of the food stamps program; and X is a vector of demographic and socioeconomic characteristics added to allow for household difference.

Since it was not possible to obtain variables to represent all of the arguments in $P=f(Y,P_1,P_0,X)$, some proxies are used. Variables utilized in estimating the participation equation are given in Table 1. INCR is obviously Y. However, a direct measure of P_1 cannot be obtained from NHANES II, because the amount of food stamp subsidy is not given. Therefore, RURAL is a proxy for P_1, because on the average people in the rural area have a greater opportunity cost associated in obtaining the food stamps. Lastly, the identification of socioeconomic variables is trivial.

Estimation Of The Participation Equation

The probability of participation is estimated for those whose Poverty Index Ratio (PIR) is 150 or less.[49]

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[49] Obviously, the eligibility can not be determined by PIR alone. The eligibility has to be determined under each individual circumstance as described in the section on eligibility requirement. However, the question "During the past 12 months, how much money did you and all members of your famly receive in wages or salries before deductions?" is asked fo those who claimed their

The rationale is that the Food and Nutrition Service of the U.S. Department of Agriculture in July 1982 reported that about 99.7% of the participating households with children fell below 150 percentage of the poverty line.[50] (The poverty line here is defined by the Office of Management and Budget's 1981 poverty income guidelines for nonfarm families.)

Among the FSP eligibles only 34.4% of the households participated in the Food Stamps Program prior to 1979.[51] This participation rate is in line with the finding by MacDonald[52] (1977). Even a recent study by MacDonald[53] (1985) using panel data from 1979 Income Survey Development Program showed that of the 12.4 million households eligibles for Food Stamps, 4.9 million

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total combined family income for the past 12 months is less than 7000. Therefore,the PIR variable used is the best indicator from the available data particularly when the level of income is not recorded in general.

[50] Office of Analysis and Evaluation, Food and Nutrition Service, U.S. Department of Agriculture, "Preliminary Report- Characteristics of Food Stamp Households: August 1981.", July 1982.

[51] By comparison, of all samples in NHANES II from 1976 to 1980, 12% of 19270 that responded to the question "Are you certified to participate in the Food Stamp Program?" said "yes." And, close to 80% of those identified as certified as eligibles were actually buying food stamps about the time of the NHANES II interview.

[52] MacDonald, M. Food, Stamps, and Income Maintenance. New York: Academic Press, 1977.

[53] MacDonald, M. "The Role of Multiple Benefits In Maintaining The Social Safety Net: The Case of Food Stamps." The Journal of Human Resources, 20(3), Summer 1985.

actually received them during their three-month reference period.

Based on the a priori economic assumption the major factors determining whether or not to participate are real income, size of household, and the proxy for family's asset, and whether or not head of the household is working or on welfare. Other demographic variables used are: whether the head of the household is a female, whether the head of the household is Black or other minority, whether the age of the head of household is over 55, and whether or not an individual resides in an rural area.

The participation equation can be examined from two perspectives: institutional and behavioral. Let us first discuss the institutional aspect of the participation equation. The expected sign for real income (INCR) is negative because the higher the income, the less is the potential benefit and the more difficult it is to qualify. The expected sign for the size of the household (SIZE) is positive, because the greater the family size, the more likely to qualify. As an indicator for asset (CARS), the more cars a family has, the less likely is the chance of passing the asset test of the Food Stamp Program. As an indicator for welfare and other public assistance payments, the variable WELFARE is expected to have a positive sign as the marginal transaction cost of

obtaining the food stamps is practically zero. It is especially the case for those welfare recipients who are automatically identified as eligible and receive food stamps through the use of federal agency's omputer.

The behavioral aspect of the participation equation can also be examined from other demographic variables. A negative coefficient is expected for OTHER, the race variable for minorities other than Blacks. Since many minority may not have a good command of the English language thus creating an obstacle in applying for Food Stamps. The OVER55 variable is used to test if older generation who grew up through the depression era have a stigma toward Food Stamp Program.

Although the above model can be used to estimate probability of participation, to determine ideally the cause of nonparticipation survey data should be used. For example, Coe[54] (1983) used Michigan Panel Study of Income Dynamics based on a sample of 949 households and found only about 45% of the households eligible to receive food stamps actually participate in the program in 1979. Coe[55] (1983) found that poor information concerning eligibility was the biggest barrier to

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[54] Coe, R. D. "Nonparticipation In Welfare Programs By Eligible Households: The Case of the Food Stamp Program." Journal Of Economic Issues., XVII, No. 4, December 1983.

[55] IBID.

participation; about 40% of the eligible nonparticipants did not think they were entitled to benefits.

CHAPTER 5 EMPIRICAL RESULTS

The empirical results are presented in three parts. The first part discusses the participation equation with its estimation presented in Table 7. The next section pertains to nutrient demand results for those teenagers whose families are ineligible to participate in the Food Stamp Program (Tables 8-16). Then, in the third section the nutrient demand results for the eligibles (Tables 8-16 also), the core of this study, are discussed. Finally, we compare results from OLS vs. results from using LAMBDA as correction factor in Tables 17-25.

Results Of The Participation Equation

The participation equation can serve dual purposes. One is to be used as an instrument in obtaining consistent estimates of the Food Stamp Program's effect on nutritional intake of the participants. Another is to identify the socioeconomic characteristics that may be important in determining the participation.

The participation equation is estimated by probit and logistic method. Logit estimates are used to discuss marginal probability, because it is much easier to take derivative of ligstic distribution than that of a normal distribution. Probit method is applied to avoid any distributional problem that may arise in the second stage; i.e., in estimating the nutrient demand

equation.[56]

From the estimation of participation equation (Table 7), we can see the assertion made by Amemiya[57] (1981) that the logit estimates are approximately 1.6 times the probit estimates is fairly decent. The t-statistics are almost identical in the logit and probit models.

All the independent variables in the participation equation have the expected signs. The obvious ones are those that constitute eligibility requirements for the Food Stamp Program. Real income (INCR) has a negative coefficient of -0.13E-3, family size (SIZE) has an estimated coefficient of 0.362, and welfare or public assistance status (WELFARE) has a positive estimated coefficient of 1.72.

The estimates of the participation equation in Table 7 indicate that the most important determinant in the odds ratio of Food Stamp Program participation is whether or not an individual participates in the public assistance program. The effect on odds ratio of a dichotomous independent variable can be shown to be $\exp(\beta)$. Therefore, the odds that welfare recipient gets food stamps is 5.6 times greater than odds that non-

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[56] If lambda is not normally distributed, then it is difficult to assure that the error terms in the second stage are normally distributed. Consequently, the t-statistic cannot be used in statistical inferences.

[57] Amemiya, T. "Qualitative Response Models: A Survey." Journal of Economic Literature, 19, December 1981.

welfare recipient gets food stamps.

Table 7

Estimates Of The Participation Equation

VARIABLE	PROBIT	LOGIT
INTERCEPT	-.9763 (3.44)	-1.686 (3.36)
BLACK	.0465 (.24)	.0622 (.18)
OTHER	-.1400 (.62)	-.2500 (.62)
INCR	-.783E-4 (1.77)	-.128E-3 (1.66)
SIZE	.2063 (5.64)	.3620 (5.47)
HWORK	-.7871 (4.66)	-1.356 (4.52)
WELFARE	1.016 (4.65)	1.724 (4.50)
CARS	-.3573 (3.27)	-.6463 (3.27)
OVER55	-.1746 (.78)	-.3285 (.82)
HFEMALE	.5163 (2.89)	.8949 (2.84)
RURAL	-.1771 (.88)	-.2921 (.81)
LOG-LIKELIHOOD	-166.9	-167.9
CHI-SQUARED (10)	250.4	248.3
N	454	454

Another important deciding factor for participation is whether or not the head of the household is working (HWORK). The logit estimate shows odds that non-working person getting food stamps is 26% greater than odds that working person gets food stamps. However, it is difficult to interpret from the variable HWORK whether an element of stigma dominates or the cost of time dominates the decision making, ceterus paribus.

The positive coefficient for the head of the household being a female (HFEMALE) may be indicative that women are either disadvantaged in the labor market or most female head of households are single therefore have fewer income sources. The odds that a female head of household gets food stamps is 2.4 times greater than odds that a male household head gets food stamps.

Nutrient Demand Among the Ineligibles

It may be worth mentioning for some readers that all of the following discussions are taken in light of ceterus paribus, i.e., holding all other variables in the model constant.

The estimated equation of demand for nutrient (Table 8-16) suggests that age contributed significantly to five nutrient intakes-calorie (Table 9), iron (Table 10), niacin (Table 11), protein (Table 12) , and riboflavin (Table 13) plus total gram ingested. However, age does

not have a significant positive effective on calcium (Table 8), thiamin (Table 14), and vitamin C (Table 16). In terms of elasticity of demand with respect to age, niacin (Table 11) has the highest estimate of +0.517. That means a 1% increase in age will increase the niacin intake by 0.517%.

In all nine estimated equations (in Tables 8-16) the female teenagers aged 12 to 18 (FEMALE) have significantly lower nutritional intakes than those of males. This difference is greatest for riboflavin intake (Table 13) where the estimated coefficient is -1.182. Therefore, this finding suggests, on the average, female teenagers consume 40% less riboflavin than male teenagers.[58]

Regarding the effect of the race variable, the result shows Blacks consuming significantly less nutrients than others (others includes Whites and other minorities) exclusive of four nutrients- iron (Table 10), niacin (Table 11), thiamin (Table 14), and vitamin C (Table 16). The nutrient most impacted by the race variable (BLACK) is calcium (Table 8), and its estimate of magnitude of effect shows Blacks consume 30.1% less

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[58] The percentage difference is computed from the formula

$$\beta/(YBAR-\beta*XBAR)$$

where YBAR is the mean of the dependent variable, XBAR is the mean of the dichotomous independent variable, and β is the coefficient estimate of that dichotomous independent variable.

than Whites.

The non-Black minorities (OTHER) have lower calcium intake (Table 8), with estimate of magnitude of effect of 10.4%, but higher intake of food containing vitamin C (Table 16), with estimate of magnitude of effect of 20.3%. However, no other conclusion concerning the variable OTHER can be drawn from other estimated models.

Per capita income in real term (PERINC) has positive effect on vitamin C (Table 16) alone. The income elasticity of demand for vitamin C is +0.163. This result is consistent with earlier findings that of all essential nutrients vitamin C has the highest income elasticity.

The effect of schooling of the head of household (HEDUC) is generally ambiguously positive and significant only for riboflavin with an estimated elasticity of +0.173. The estimated effect on calorie (Table 9) and total gram ingested (Table 15); however, is vaguely on the negative side.

The results in Tables 8 to 16 show teenagers ages 12 to 18 who lived in an rural area have less calcium (Table 8) and vitamin C (Table 16), but the difference in vitamin C is 12.5% while a difference of 9.4% in calcium. Those teenagers also eat less than their counterparts living in an non-rural area (Table 15).

Taking vitamin supplement helps demand more

nutrients especially for vitamin C. So, in effect, this indicator for efficiency enhances the consumption of nutrients.

Most interesting of all is that among the ineligibles those participating in the school lunch program (LUNP) has greater calcium intake (Table 8) with estimate of magnitude of effect of 12.3%. This result is consistent with Howe and Vaden's[59] (1980) finding that students participating in the school lunch consumed significantly more calcium than non-participants. It can be interpreted as institutional benefit since participants in school lunch program will always have milk as required by the school lunch program. Nevertheless, it shows the participants in the school lunch program are benefitting from the program.

Nutrient Demand Among the Eligibles

The estimates of nutrient demand among the eligibles are obtained based on the pooled sample of participants and eligible nonparticipants of the Food Stamp Program. The conclusion that lead to modelling all the eligibles together instead of participant versus nonparticipants is as follows. First, separate nutrient demand equations

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[59] Howe, S. M., and Vaden, A. G. "Factors Differentiating Participants and Non-participants of the National School Lunch Program." Journal of The American Dietetic Association, 76, 1980.

were estimated (1) for participants and (2) for eligible nonparticipants.

$$(1)\ n_1 = a_1 + b_1 y_1 + c_1 \text{LAMBDA}_1$$

$$(1)\ n_2 = a_2 + b_2 y_2 + c_2 \text{LAMBDA}_2$$

By definition, $\text{LAMBDA}_1 = f(x)/F(x)$ and $\text{LAMBDA}_2 = -f(x)/(1-F(x))$ where f and F are respectively the probability density and the cumulative density functions of the normal distribution. Then an F statistic was calculated to find out any significant differences between sets of estimates from participant and nonpartcipant equations. The F statistic is defined as

$$F = ((SS_R - SS_U)/R)/(SS_U/N_u)$$

where

SS_R=sum of squared residuals in the pooled sample

SS_U=sum of squared residuals from participant and nonparticipant regressions

N_u= sum of the degrees of freedom of residuals from participant and nonparticipant regressions

$R=N_u$ minus the degrees of freedom of residuals in pooled regressions (or the number of independent variables in the pooled equation minus one.)

The results not shown indicate none of the F statistics is significant at the 5% level. Therefore, the null hypothesis that slope coefficients but not

intercept were the same was accepted, and estimates of nutrient demand are done on the pooled eligibles.

The regression results based on the sample of the eligibles suggest that the age of an individual (AGE) does not matter in determining demand for all eight nutrients (Tables 8 to 15) but for how much a person eats (Table 16). The elasticity term in age for total gram ingested is 0.353. The above findings are contrary to the positive effects of age on nutrient intakes from the sample of the ineligibles.

The significant negative coefficient for the variable FEMALE indicates girls demand less nutritions in all categories (Tables 8 to 16) in this study. This may be because of physiological or behavioral differences between the opposite sexes. But, surprisingly, the greatest difference between the demand among the sexes is not in total gram ingested or how much they eat but in thiamin and iron.

Concerning the effect of the race variable (BLACK), Blacks have significantly lower nutritional intakes than others especially for calcium, except for four nutrients- iron (Table 10), niacin (Table 11), thiamin (Table 14), and vitamin C (Table 16). The estimated coefficient for the variable OTHER is generally negative and only significant in the model for calorie (Table 9).

Results from Tables 8 to 16 show that the education

of the head of the household (HEDUC) does not effect the demand for nutrition. However, ignoring the insignificant results the nutrient most responsive to HEDUC would be vitamin C.

The estimated effect of real income per capita (PERINC) is generally, oddly enough, negative. This suggests that among the group of those eligible for food stamps nutrients are not considered to be normal goods. However, of all negative estimates they are significant only for niacin (Table 11), with income elasticity estimate of -0.075, and protein (Table 12), with income elasticity estimate of -0.068. From Table 11 and Table 12, we see higher elasticity with respect to real income per household size (PERINC) for niacin than for protein. On the contrary, the estimated beta for vitamin C (Table 16) is positive but inconclusive. This brings up the following interesting hypothesis. It is said that the major sources of niacin, which is a vitamin B_3 complex, are whole grains, and liver; while, the major source of vitamin C is citrus fruits. The estimated results among the eligibles could be suggesting as real income per household size increase people tend to move away from the less tasty food like liver in favor of more tasty food like oranges.

The estimated effect for living in an rural area (RURAL) is mostly negative except for iron (Table 10),

niacin (Table 11), thiamin (Table 14), and vitamin C (Table 16). The nutrient most adversely effected by the variable RURAL is calcium (Table 8). It is estimated that teenagers living in rural area demand 16.5% less calcium than those teenagers living in an non-rural area. This is somewhat puzzling because the major source of calcium is milk, and it would be counter-intuitive to think that those teenagers living in an rural area consume less milk than their counterpart in a non-rural area.

Surprisingly and interestingly, no conclusion can be drawn from the estimated effect of the participation in the school lunch program (LUNP) on the nutrient intakes. The positive estimates for calcium (Table 8), calorie (Table 9), protein (Table 12), riboflavin (Table 13), and thiamin (Table 14) are insignificant. The inconclusive results seem to suggest that school lunch program does not seem to significantly add to the daily total nutrient intake. However, there is the significant negative result for total gram ingested (Table 15) which implies teenagers ages 12 to 18 who participate in the school lunch program generally eat less than those who do not; but it is only about 0.8% less.

The nutrient demand models (Tables 8 to 16) indicate that taking vitamin supplements (VITAMIN) increase the nutrient intakes except for calcium (Table 8), calorie

(Table 9), protein (Table 12) and total gram ingested (Table 15). Vitamin C (Table 16) is the nutrient most responsive to the variable VITAMIN. If the variable VITAMIN can be treated as a knowledge or taste variable for nutrition, then that fact alone says by taking vitamin supplements an individual increases demand for nutrition.

Lastly and most importantly, the effect of the Food Stamp Program (FSP) does not seem to have positive effect on the participants. The results only show marginal positive nutritional effect for calcium (Table 8), thiamin (Table 14), and vitamin C (Table 16). At the same time, the finding shows negative but inconclusive effects for calorie (Table 9), iron (Table 10), niacin (Table 11), protein (Table 12), riboflavin (Table 13), and total grams ingested (Table 15). Therefore, even by introducing the inverse of Mill's ratio (LAMBDA) which corrects for selectivity bias does not have a significant improvement on the estimates either. However, at least, by including LAMBDA in the equation, we have the peace of mind that we are getting consistent estimates.

Comparison Between Eligibles And Ineligibles

In comparing regression results between the eligibles and ineligibles (Tables 8 to 16), first note is that the t ratios are smaller for the eligibles because

they are a smaller group.[60] There are similarities in signs of the estimated coefficients for the variables FEMALE, BLACK, and VITAMIN. More specifically, females ages 12 to 18 (FEMALE) have significantly lower nutrient intakes than males. This, as mentioned earlier, may be because of physical or eating behavioral differences between the sexes. And Blacks have significantly poorer nutritional diet than Whites and other minorities except for iron (Table 10), niacin (Table 11), thiamin (Table 14), and vitamin C (Table 16) where the estimated coefficients have negative signs but lack statistical significance. Among the two groups, the eligibles versus the ineligibles, the nutrient most negatively impacted by the race variables BLACK and OTHER is calcium (Table 8). The models for total gram ingested (Table 15) suggest also Blacks eat less than Whites and minorities other than Blacks. Finally, the estimated effect of VITAMIN is most pronounced in the nutrient intake of vitamin C among the eligibles and the ineligibles (in Table 16).[61]

As for differences in the estimates for the eligibles and the ineligibles, there are three variables

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[60] It can be shown for a one variable case
$$t^2=(r^2/(1-r^2))*(n-2)$$
where r is the partial correlation between the independent and dependent variable.

[61] Incidentally, a separate run shows models without the variable VITAMIN have lower adjusted R^2 but no significant changes in estimates of coefficients of FSP and other variables.

whose estimates have opposite signs. The other minorities (OTHER) has a positive effect on the intake of vitamin C for the in eligibles (Table 16); while producing a negative effect on the calorie intake of the eligibles. For the ineligibles, there is a significant positive income effect (INCR) on vitamin C (Table 16). On the contrary, the negative income effect on the nutrient intakes of niacin (Table 11) and protein (Table 12) suggest they are not normal goods for the group of the eligibles. Lastly, participation in the school lunch program (LUNP) greatly improves nutrient intake of calcium (Table 8) for the ineligibles but reduces the total gram ingested (Table 15) for the eligibles.

Results With Correction Factor Taken Into Account

The following discussion compares results from correction technique being used versus the simple ordinary least square (OLS) method for those eligible for food stamps (Tables 17 to 25). First, we will examine the regression coefficients of the correction factor, LAMBDA. Then we will make comparisons, without significant statistical inferences, between estimates of models with correction factor and without it.

As noted earlier, the regression coefficient of LAMBDA estimates the correlation coefficient between the error term in the selection equation- the participation

equation and the error term in the behavior equation- the nutrient demand equation. This study finds positive coefficient of LAMBDA for all nutients (Tables 17 to 25) except for calcium (Table 17) and vitamin C (Table 25). Therefore, finding seems to suggest that there is

Table 8

Result of Nutrient Demand Equation: Calcium
Food Stamp Eligibles vs. Ineligibles

VARIABLES	ELIGIBLES	INELIGIBLES
INTERCEPT	1249	912.3
	(3.91)	(3.89)
AGE	-7.788	18.47
	(.46)	(1.50)
FEMALE	-375.4	-484.1
	(6.52)	(10.56)
BLACK	-300.4	-342.2
	(4.24)	(3.54)
OTHER	-115.0	-119.1
	(1.41)	(1.67)
PERINC	-.0234	.0040
	(.26)	(.17)
HEDUC	6.064	5.502
	(.63)	(.66)
RURAL	-153.9	-109.9
	(2.17)	(2.22)
LUNP	51.22	127.3
	(.64)	(2.08)
FSP	13.98	
	(.12)	
VITAMIN	76.79	249.5
	(1.09)	(4.82)
LAMBDA	-8.015	
	(.10)	
R-SQUARED	.12	.15
F-STATISTIC	5.74	17.95
OBSERVATIONS	454	905

Notes: Absolute values of t-statistic are in parentheses. The critical t-scores for a one-tailed test at the 5 % and 10 % significance levels are 1.64 and 1.28 respectively. The F statistic is significant at the 5 % level.

Table 9

Result of Nutrient Demand Equation: Calorie
Food Stamp Eligibles vs. Ineligibles

VARIABLES	ELIGIBLE	INELIGIBLES
INTERCEPT	2607.	1657.
	(4.99)	(4.87)
AGE	14.74	64.76
	(.54)	(3.61)
FEMALE	-768.5	-856.4
	(8.16)	(12.86)
BLACK	-287.1	-233.2
	(2.48)	(1.66)
OTHER	-246.2	-31.29
	(1.84)	(.30)
PERINC	-.1788	.0355
	(1.23)	(1.01)
HEDUC	-4.486	-1.885
	(.29)	(.16)
RURAL	-194.3	-48.16
	(1.68)	(.67)
LUNP	.6854	1.351
	(.01)	(.02)
FSP	-123.5	
	(.64)	
VITAMIN	128.0	233.9
	(1.11)	(3.11)
LAMBDA	43.22	
	(.32)	
R-SQUARED	.14	.18
F-STATISTIC	6.82	22.06
OBSERVATIONS	454	905

Notes: Absolute values of t-statistic are in parentheses. The critical t-scores for a one-tailed test at the 5 % and 10 % significance levels are 1.64 and 1.28 respectively. The F statistic is significant at the 5 % level.

Table 10

Result of Nutrient Demand Equation: Iron
Food Stamp Eligibles vs. Ineligibles

VARIABLES	ELIGIBLE	INELIGIBLES
INTERCEPT	17.23	10.18
	(4.41)	(3.62)
AGE	.0135	.2806
	(.07)	(1.89)
FEMALE	-6.258	-6.237
	(8.90)	(11.34)
BLACK	-.9388	-1.359
	(1.08)	(1.17)
OTHER	-1.330	-.5898
	(1.33)	(.69)
PERINC	-.0015	.0002
	(1.34)	(.52)
HEDUC	.0739	.1445
	(.63)	(1.44)
RURAL	-.7684	.7442
	(.89)	(1.25)
LUNP	-.7927	.0985
	(.81)	(.14)
FSP	-1.086	
	(.75)	
VITAMIN	1.548	1.937
	(1.79)	(3.12)
LAMBDA	.3019	
	(.30)	
R-SQUARED	.16	.14
F-STATISTIC	7.64	16.75
OBSERVATIONS	454	905

Notes: Absolute values of t-statistic are in parentheses. The critical t-scores for a one-tailed test at the 5 % and 10 % significance levels are 1.64 and 1.28 respectively. The F statistic is significant at the 5 % level.

Table 11

Result of Nutrient Demand Equation: Niacin
Food Stamp Eligibles vs. Ineligibles

VARIABLES	ELIGIBLE	INELIGIBLES
INTERCEPT	20.59	11.47
	(3.15)	(2.48)
AGE	.3167	.7395
	(.92)	(3.03)
FEMALE	-9.127	-9.895
	(7.76)	(10.92)
BLACK	-.5629	-2.053
	(.39)	(1.07)
OTHER	-1.374	-.1230
	(.82)	(.09)
PERINC	-.0030	.0002
	(1.67)	(.35)
HEDUC	.1459	.2576
	(.74)	(1.56)
RURAL	-2.073	.2573
	(1.43)	(.26)
LUNP	-.3727	-.8168
	(.23)	(.68)
FSP	-3.040	
	(1.25)	
VITAMIN	2.403	2.261
	(1.67)	(2.21)
LAMBDA	1.816	
	(1.08)	
R-SQUARED	.13	.14
F-STATISTIC	6.03	15.84
OBSERVATIONS	454	905

Notes: Absolute values of t-statistic are in parentheses. The critical t-scores for a one-tailed test at the 5 % and 10 % significance levels are 1.64 and 1.28 respectively. The F statistic is significant at the 5 % level.

Table 12

Result of Nutrient Demand Equation: Protein
Food Stamp Eligibles vs. Ineligibles

VARIABLES	ELIGIBLE	INELIGIBLES
INTERCEPT	90.56	28.29
	(3.75)	(1.77)
AGE	1.396	3.776
	(1.10)	(4.48)
FEMALE	-37.78	-36.71
	(8.67)	(11.72)
BLACK	-11.70	-11.28
	(2.18)	(1.71)
OTHER	-7.729	-1.275
	(1.25)	(.26)
PERINC	-.0113	.0021
	(1.68)	(1.29)
HEDUC	.1144	.9045
	(.16)	(1.58)
RURAL	-11.89	-1.057
	(2.21)	(.31)
LUNP	.4677	3.736
	(.08)	(.90)
FSP	-10.57	
	(1.18)	
VITAMIN	8.744	9.582
	(1.64)	(2.71)
LAMBDA	3.434	
	(.55)	
R-SQUARED	.16	.17
F-STATISTIC	7.86	20.07
OBSERVATIONS	454	905

Notes: Absolute values of t-statistic are in parentheses. The critical t-scores for a one-tailed test at the 5 % and 10 % significance levels are 1.64 and 1.28 respectively. The F statistic is significant at the 5 % level.

Table 13

Result of Nutrient Demand Equation: Riboflavin
Food Stamp Eligibles vs. Ineligibles

VARIABLES	ELIGIBLE	INELIGIBLES
INTERCEPT	2.819	1.743
	(4.27)	(3.18)
AGE	-.0239	.0473
	(.69)	(1.64)
FEMALE	-.9066	-1.182
	(7.62)	(11.00)
BLACK	-.2804	-.4962
	(1.92)	(2.19)
OTHER	-.2727	-.1357
	(1.62)	(.81)
PERINC	-.0002	-.44E-4
	(1.37)	(.78)
HEDUC	.0164	.0338
	(.82)	(1.72)
RURAL	-.2655	-.0130
	(1.81)	(.11)
LUNP	.1449	.1617
	(.87)	(1.13)
FSP	-.2117	
	(.86)	
VITAMIN	.4474	.5001
	(3.07)	(4.13)
LAMBDA	.0742	
	(.44)	
R-SQUARED	.14	.14
F-STATISTIC	6.47	16.67
OBSERVATIONS	454	905

Notes: Absolute values of t-statistic are in parentheses. The critical t-scores for a one-tailed test at the 5 % and 10 % significance levels are 1.64 and 1.28 respectively. The F statistic is significant at the 5 % level.

Table 14

Result of Nutrient Demand Equation: Thiamin
Food Stamp Eligibles vs. Ineligibles

VARIABLES	ELIGIBLE	INELIGIBLES
INTERCEPT	1.756	1.386
	(3.56)	(4.10)
AGE	.0039	.0231
	(.15)	(1.30)
FEMALE	-.7404	-.6967
	(8.34)	(10.54)
BLACK	-.0242	-.1682
	(.22)	(1.21)
OTHER	-.1188	-.0436
	(.94)	(.42)
PERINC	-.0001	-.60E-5
	(.93)	(.17)
HEDUC	-.0034	.0144
	(.23)	(1.20)
RURAL	-.0848	.0367
	(.78)	(.52)
LUNP	.0552	-.0658
	(.44)	(.75)
FSP	.0023	
	(.01)	
VITAMIN	.3056	.1996
	(2.81)	(2.68)
LAMBDA	.0312	
	(.25)	
R-SQUARED	.14	.12
F-STATISTIC	6.80	13.90
OBSERVATIONS	454	905

Notes: Absolute values of t-statistic are in parentheses. The critical t-scores for a one-tailed test at the 5 % and 10 % significance levels are 1.64 and 1.28 respectively. The F statistic is significant at the 5 % level.

Table 15

Result of Nutrient Demand Equation: Total Gram Ingested
Food Stamp Eligibles vs. Ineligibles

VARIABLES	ELIGIBLE	INELIGIBLES
INTERCEPT	16738.	8615.
	(3.54)	(2.88)
AGE	416.5	943.4
	(1.68)	(5.98)
FEMALE	-5639.	-7350.
	(6.73)	(12.56)
BLACK	-4242.	-3792.
	(4.04)	(3.07)
OTHER	-1980.	-388.4
	(1.64)	(.43)
PERINC	-1.039	.4712
	(.79)	(1.53)
HEDUC	74.30	-7.536
	(.52)	(.07)
RURAL	-1829.	-1386.
	(1.74)	(2.20)
LUNP	-413.6	-194.9
	(1.74)	(.25)
FSP	-972.1	
	(.89)	
VITAMIN	931.5	2315.
	(.89)	(3.51)
LAMBDA	1011.2	
	(.83)	
R-SQUARED	.14	.21
F-STATISTIC	6.48	26.34
OBSERVATIONS	454	905

Notes: Absolute values of t-statistic are in parentheses. The critical t-scores for a one-tailed test at the 5 % and 10 % significance levels are 1.64 and 1.28 respectively. The F statistic is significant at the 5 % level.

Table 16

Result of Nutrient Demand Equation: Vitamin C
Food Stamp Eligibles vs. Ineligibles

VARIABLES	ELIGIBLE	INELIGIBLES
INTERCEPT	25.08	47.62
	(.40)	(1.29)
AGE	2.440	1.590
	(.75)	(.82)
FEMALE	-29.98	-44.22
	(2.68)	(6.14)
BLACK	9.842	-4.297
	(.72)	(.28)
OTHER	20.03	20.27
	(1.26)	(1.81)
PERINC	.0228	.0071
	(1.32)	(1.86)
HEDUC	2.002	1.934
	(1.07)	(1.47)
RURAL	-8.894	-13.36
	(.64)	(1.72)
LUNP	-6.917	9.009
	(.44)	(.94)
FSP	30.87	
	(1.34)	
VITAMIN	25.32	23.78
	(1.85)	(2.92)
LAMBDA	-8.860	
	(.56)	
R-SQUARED	.04	.06
F-STATISTIC	1.78	6.98
OBSERVATIONS	454	905

Notes: Absolute values of t-statistic are in parentheses. The critical t-scores for a one-tailed test at the 5 % and 10 % significance levels are 1.64 and 1.28 respectively. The F statistic is significant at the 5 % level.

positive correlation between the nutrient demand and the decision whether or not to participate in the Food Stamp Program. That is, the decision to participate in the FSP is likely to increase the demand for nutrients. Although, the relationship need not to be causal but it would be correlated one. However, none of the estimated coefficients of LAMBDA is significant so some definitive conclusion can be drawn.

For demand models for calcium (Table 17), thiamin (Table 23), and vitamin C (Table 25), the indicator for participating in the Food Stamp Program (FSP) have larger coefficients for results with correction factor. For calorie's model (Table 18) sign of FSP turns positive and LUNP also turns positive, when nutrient demand equation is estimated with the correction factor. In estimating demand for iron (Table 19), niacin (Table 20), protein (Table 21), and riboflavin (Table 22) the variable FSP have larger negative coefficients for estimates with correction factor taken into account. As for the demand model for total gram ingested (Table 24) with the correction factor included, we have larger negative coefficient for PERINC, and a larger positive coefficient for FSP. Generally speaking, the standard errors of the estimates for FSP and PERINC all increase in connection with correction factor technique being used.

Table 17

Result of Nutrient Demand Equation: Calcium
Result with Correction Factor vs. OLS

VARIABLES	ELIGIBLES	OLS
INTERCEPT	1249	1258.
	(3.91)	(4.05)
AGE	-7.788	-7.967
	(.46)	(.47)
FEMALE	-375.4	-375.4
	(6.52)	(6.44)
BLACK	-300.4	-299.5
	(4.24)	(4.21)
OTHER	-115.0	-115.2
	(1.41)	(1.39)
PERINC	-.0234	.0277
	(.26)	(.35)
HEDUC	6.064	5.988
	(.63)	(.62)
RURAL	-153.9	-155.7
	(2.17)	(2.24)
LUNP	51.22	51.56
	(.64)	(.63)
FSP	13.98	4.456
	(.12)	(.06)
VITAMIN	76.79	76.47
	(1.09)	(1.07)
LAMBDA	-8.015	
	(.10)	
R-SQUARED	.12	.12
F-STATISTIC	5.74	6.32
OBSERVATIONS	454	454

Notes: Absolute values of t-statistic are in parentheses. The critical t-scores for a one-tailed test at the 5 % and 10 % significance levels are 1.64 and 1.28 respectively. The F statistic is significant at the 5 % level.

Table 18

Result of Nutrient Demand Equation: Calorie
Result with Correction Factor vs. OLS

VARIABLES	ELIGIBLE	OLS
INTERCEPT	2607.	2560.
	(4.99)	(5.04)
AGE	14.74	15.70
	(.54)	(.57)
FEMALE	-768.5	-768.0
	(8.16)	(8.06)
BLACK	-287.1	-291.9
	(2.48)	(2.51)
OTHER	-246.2	-245.0
	(1.84)	(1.81)
PERINC	-.1788	-.1558
	(1.23)	(1.21)
HEDUC	-4.486	-4.072
	(.29)	(.26)
RURAL	-194.3	-184.7
	(1.68)	(1.63)
LUNP	.6854	-1.116
	(.01)	(.01)
FSP	-123.5	-72.14
	(.64)	(.64)
VITAMIN	128.0	129.7
	(1.11)	(1.11)
LAMBDA	43.22	
	(.32)	
R-SQUARED	.14	.14
F-STATISTIC	6.82	7.50
OBSERVATIONS	454	454

Notes: Absolute values of t-statistic are in parentheses. The critical t-scores for a one-tailed test at the 5 % and 10 % significance levels are 1.64 and 1.28 respectively. The F statistic is significant at the 5 % level.

Table 19

Result of Nutrient Demand Equation: Iron
Result with Correction Factor vs. OLS

VARIABLES	ELIGIBLE	OLS
INTERCEPT	17.23	16.89
	(4.41)	(4.45)
AGE	.0135	.0203
	(.07)	(.10)
FEMALE	-6.258	-6.254
	(8.90)	(8.78)
BLACK	-.9388	-.9720
	(1.08)	(1.12)
OTHER	-1.330	-1.321
	(1.33)	(1.31)
PERINC	-.0015	-.0013
	(1.34)	(1.36)
HEDUC	.0739	.0768
	(.63)	(.65)
RURAL	-.7684	-.7010
	(.89)	(.83)
LUNP	-.7927	-.8053
	(.81)	(.81)
FSP	-1.086	-.7272
	(.75)	(.87)
VITAMIN	1.548	1.560
	(1.79)	(1.79)
LAMBDA	.3019	
	(.30)	
R-SQUARED	.16	.16
F-STATISTIC	7.64	8.42
OBSERVATIONS	454	454

Notes: Absolute values of t-statistic are in parentheses. The critical t-scores for a one-tailed test at the 5 % and 10 % significance levels are 1.64 and 1.28 respectively. The F statistic is significant at the 5 % level.

Table 20

Result of Nutrient Demand Equation: Niacin
Result with Correction Factor vs. OLS

VARIABLES	ELIGIBLE	OLS
INTERCEPT	20.59	18.59
	(3.15)	(2.93)
AGE	.3167	.3574
	(.92)	(1.04)
FEMALE	-9.127	-9.105
	(7.76)	(7.63)
BLACK	-.5629	-.7623
	(.39)	(.52)
OTHER	-1.374	-1.324
	(.82)	(.78)
PERINC	-.0030	.0021
	(1.67)	(1.29)
HEDUC	.1459	.1633
	(.74)	(.82)
RURAL	-2.073	-1.667
	(1.43)	(1.17)
LUNP	-.3727	-.4484
	(.23)	(.27)
FSP	-3.040	-.8817
	(1.25)	(.63)
VITAMIN	2.403	2.475
	(1.67)	(1.69)
LAMBDA	1.816	
	(1.08)	
R-SQUARED	.13	.13
F-STATISTIC	6.03	6.52
OBSERVATIONS	454	454

Notes: Absolute values of t-statistic are in parentheses. The critical t-scores for a one-tailed test at the 5 % and 10 % significance levels are 1.64 and 1.28 respectively. The F statistic is significant at the 5 % level.

Table 21

Result of Nutrient Demand Equation: Protein
Result with Correction Factor vs. OLS

VARIABLES	ELIGIBLE	OLS
INTERCEPT	90.56	86.78
	(3.75)	(3.70)
AGE	1.396	1.472
	(1.10)	(1.15)
FEMALE	-37.78	-37.74
	(8.67)	(8.56)
BLACK	-11.70	-12.08
	(2.18)	(2.24)
OTHER	-7.729	-7.633
	(1.25)	(1.22)
PERINC	-.0113	.0095
	(1.68)	(1.59)
HEDUC	.1144	.1473
	(.16)	(.20)
RURAL	-11.89	-11.12
	(2.21)	(2.12)
LUNP	.4677	.3246
	(.08)	(.05)
FSP	-10.57	-6.486
	(1.18)	(1.25)
VITAMIN	8.744	8.880
	(1.64)	(1.64)
LAMBDA	3.434	
	(.55)	
R-SQUARED	.16	.16
F-STATISTIC	7.86	8.63
OBSERVATIONS	454	454

Notes: Absolute values of t-statistic are in parentheses. The critical t-scores for a one-tailed test at the 5 % and 10 % significance levels are 1.64 and 1.28 respectively. The F statistic is significant at the 5 % level.

Table 22

Result of Nutrient Demand Equation: Riboflavin
Result with Correction Factor vs. OLS

VARIABLES	ELIGIBLE	OLS
INTERCEPT	2.819	2.737
	(4.27)	(4.27)
AGE	-.0239	-.0222
	(.69)	(.64)
FEMALE	-.9066	-.9057
	(7.62)	(7.52)
BLACK	-.2804	-.2886
	(1.92)	(1.96)
OTHER	-.2727	-.2706
	(1.62)	(1.58)
PERINC	-.0002	-.0002
	(1.37)	(1.31)
HEDUC	.0164	.0171
	(.82)	(.85)
RURAL	-.2655	-.2489
	(1.81)	(1.74)
LUNP	.1449	.1418
	(.87)	(.84)
FSP	-.2117	-.1235
	(.86)	(.87)
VITAMIN	.4474	.4503
	(3.07)	(3.05)
LAMBDA	.0742	
	(.44)	
R-SQUARED	.14	.14
F-STATISTIC	6.47	7.11
OBSERVATIONS	454	454

Notes: Absolute values of t-statistic are in parentheses. The critical t-scores for a one-tailed test at the 5 % and 10 % significance levels are 1.64 and 1.28 respectively. The F statistic is significant at the 5 % level.

Table 23

Result of Nutrient Demand Equation: Thiamin
Result with Correction Factor vs. OLS

VARIABLES	ELIGIBLE	OLS
INTERCEPT	1.756	1.722
	(3.56)	(3.60)
AGE	.0039	.0046
	(.15)	(.18)
FEMALE	-.7404	-.7400
	(8.34)	(8.24)
BLACK	-.0242	-.0276
	(.22)	(.25)
OTHER	-.1188	-.1179
	(.94)	(.92)
PERINC	-.0001	-.0001
	(.93)	(.92)
HEDUC	-.0034	-.0031
	(.23)	(.21)
RURAL	-.0848	-.0779
	(.78)	(.73)
LUNP	.0552	.0539
	(.44)	(.43)
FSP	.0023	.0393
	(.01)	(.37)
VITAMIN	.3056	.3068
	(2.81)	(2.79)
LAMBDA	.0312	
	(.25)	
R-SQUARED	.14	.14
F-STATISTIC	6.80	7.49
OBSERVATIONS	454	454

Notes: Absolute values of t-statistic are in parentheses. The critical t-scores for a one-tailed test at the 5 % and 10 % significance levels are 1.64 and 1.28 respectively. The F statistic is significant at the 5 % level.

Table 24

Result of Nutrient Demand Equation: Total Gram Ingested
Result with Correction Factor vs. OLS

VARIABLES	ELIGIBLE	OLS
INTERCEPT	16738.	15627.
	(3.54)	(3.40)
AGE	416.5	439.1
	(1.68)	(1.76)
FEMALE	-5639.	-5727.
	(6.73)	(6.63)
BLACK	-4242.	-4353.
	(4.04)	(4.12)
OTHER	-1980.	-1952.
	(1.64)	(1.59)
PERINC	-1.039	-.4995
	(.79)	(.43)
HEDUC	74.30	83.99
	(.52)	(.58)
RURAL	-1829.	-1603.
	(1.74)	(1.56)
LUNP	-413.6	-455.8
	(1.74)	(.38)
FSP	-972.1	229.7
	(.89)	(.23)
VITAMIN	931.5	971.7
	(.89)	(.92)
LAMBDA	1011.2	
	(.83)	
R-SQUARED	.14	.14
F-STATISTIC	6.48	7.07
OBSERVATIONS	454	454

Notes: Absolute values of t-statistic are in parentheses. The critical t-scores for a one-tailed test at the 5 % and 10 % significance levels are 1.64 and 1.28 respectively. The F statistic is significant at the 5 % level.

Table 25

Result of Nutrient Demand Equation: Vitamin C
Result with Correction Factor vs. OLS

VARIABLES	ELIGIBLE	OLS
INTERCEPT	25.08	34.82
	(.40)	(.58)
AGE	2.440	2.241
	(.75)	(.68)
FEMALE	-29.98	-30.09
	(2.68)	(2.66)
BLACK	9.842	-10.82
	(.72)	(.78)
OTHER	20.03	19.78
	(1.26)	(1.23)
PERINC	.0228	.0181
	(1.32)	(1.18)
HEDUC	2.002	1.917
	(1.07)	(1.02)
RURAL	-8.894	-10.87
	(.64)	(.81)
LUNP	-6.917	-6.548
	(.44)	(.41)
FSP	30.87	20.34
	(1.34)	(1.53)
VITAMIN	25.32	24.96
	(1.85)	(1.80)
LAMBDA	-8.860	
	(.56)	
R-SQUARED	.04	.04
F-STATISTIC	1.78	1.93
OBSERVATIONS	454	454

Notes: Absolute values of t-statistic are in parentheses. The critical t-scores for a one-tailed test at the 5 % and 10 % significance levels are 1.64 and 1.28 respectively. The F statistic is significant at the 5 % level.

CHAPTER 6 CONCLUSION AND REMARK

Conclusion And Remark

The proposed objective of obtaining the consistent estimate of the nutritional effect of participation in the Food Stamp Program is achieved by including the inverse of Mill's ratio LAMBDA which corrects for the selectivity bias. The "bias" refers to the potential misestimate of the effect of the Food Stamp Program on the nutrient intake. Selectivity bias is a concern whenever the assignment to the Food Stamp Program is not random, conditional on some observable explanatory variables that are used in the analysis. Broadly speaking, selectivity bias can be viewed as a specification error in statistical models in which behavioral outcomes are functions of explanatory variables.

The selectivity correction factor is necessary to account for any correlation between the participation variable and the error term in the demand for nutrient equation. This correlation arises due to the similarity between taste for food or nutrition and the probability to participate.

There are several contributions as well as uniqueness of this study on the effect of the Food Stamp Program. First, a study of the nutritional effects of the program is in its own way unique, because many studies have mainly looked at the expenditure effects

rather than the nutritional effects, and there is no definite link between food expenditures or consumption and nutrient intake. Also, this study is an analysis of a demographic group--adolescents ages 12 to 18-- that has not previously been analyzed. This target group is important because effects on teenagers are more important than on adults because the health status of teenagers will have more impacts throughout their lives. Thirdly, this study incorporates information of another government food program--the school lunch program in the nutrient demand model. It is an improvement over the previous studies that examines the effect of either the Food Stamp Program (e.g. Whitfield[62] (1983)) or the School Lunch Program alone (e.g. Akin, etc. [63] (1983)) Finally, the utilization of an improved statistical technique that takes into account the effects of unmeasured family characteristics which have an impact both on chidren's nutrition and the family's decision to participate in the food stamp program.

What are the significance and policy implications if any of the findings presented? The result of the

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[62] Whitfield, R. A. "A Nutritional Analysis of the Food Stamp Program." American Journal of Public Health, 72(1982).

[63] Akin, J. S., etc. "The Demand For School Lunches: An Analysis of Individual Participation In The School Lunch Program." The Journal of Human Resources, XVII, No. 2, 1983.

participation equation shed light on the behavior of those eligible for food stamps. First, the Food Stamp Program has induced generally lower income families of the low income families to participate. However, the participation model predicted more "should-be" non-partcipants, 47 out of 156, actually in the program than the "should-be" participant, 30 to be exact, not in the program; therefore, it seems the program is more susceptible to error of abuse than the error of nonparticipation. The estimated participation agrees with the findings by Epperson, et al.[64] (1980) that the important determinants of participation include sex of the household head, family size, household income, and sources of income. That is, female head of the household is more likely to participate than their male counterpart. The positive coefficient for family size and negative coefficient for household income were anticipated because they constitute eligibility criteria. Notably, this study found an important factor affecting the decision to participate is associated with a change in the employment status of the household head which is consistent with their finding of a change in source of income.

Concerning the nutrient demand model, the insignificant coefficients suggest attempts to improve

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[64] Epperson, J. E., et al. "The Determinants of Food Stamp Program Participation." Southern Journal of Agricultural Economics, 12(2), December 1980.

nutrition by increasing consumer incomes does not seem and will not be effective.[65] At the same time, the negative income coefficients of niacin and protein models for those eligible for food stamp imply that those nutrients are not considered to be normal goods; therefore, increasing income would only lessen cosumption of those nutrients. This ineffective result conforms with finding by Butler, et al.[66] (1985) which suggests that for the elderly households, Food Stamp Program has either little or no impact on the nutrient intake of the participants.

However, there are two significant findings concerning the nutrient demand models. It is encouraging to find that among those ineligible for food stamps the participation in the school lunch program increases the consumption of calcium significantly. It could be because participants in school lunch program will always have milk, a major source of calcium, as required by the school lunch program. Nevertheless, it shows the participants in the school lunch program are benefitting from the program. Also, at the 10% significance level, this

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[65] Although the Food Stamp Program obviously enhances the opportunity for the eligible to get more nutritious diets.

[66] Butler, J. S., et al. "The Effect of the Food Stamp Program on the Nutrient Intake of the Eligible Elderly." The Journal of Human Resources, 20(3), Summer 1985.

study finds that Food Stamp Program does increase Vitamin C intakes. That is encouraging because some empirical estimates showed that Vitamin C whose major source is citrus fruits has the highest income elasticity among the major nutrients. So, there is an indication that the program is helping people to obtaining the more expensive nutrient.

Although other studies have found food expenditure increase associated with the Food Stamp Program, this study did not find any significant nutritional effect. It could be because there is no definite linkage between expenditure or consumption of food and the nutrient intakes. As Clarkson[67] (1975) pointed out that there is nothing inherent in the Food Stamp Program that requires, or even encourages, the purchase of nutritious food. Another way of saying it is that people who are eligible but do not participate have other means of achieving the same if not superior (to the dismay of some people) nutritional status.[68] Consequently, the policy implication is that attempts to imporve nutrition by increasing consumer income does not seem to be effective. Therefore, if nutrition is to be the primary objective of

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[67] Clarkson, K. Food Stamps and Nutrition, American Enterprise Institute for Public Policy Research, Washington, D.C., 1975.

[68] One way to address the issue is to examine the data where indicators or measurements of efficiency of the nutrient production is available.

the Food Stamp Program then the program needs to improve on the means to achieve that goal.

APPENDIX A

The Theoretical Foundation Of Discrete Choice Model

The problem presented in this study, as well as in general, is that the econometrician cannot observe or control all the factors influencing behavior. Therefore, testing hypotheses that are formed on the nature of decision processes by examining the observed behavior is a cumbersome task because the observed may include some unobservable phenonmenon. When the model of choice behavior depends on some unobserved characteristics, for examples, stigma, or lack of information, the testable implications of the individual choice model may be muddled but not impossible.

In conventional consumer analysis with continuous dependent variables, one can plausibly assume that all individual in a population have a common behavior rule, e.g. all consumers are rational, except for purely random "optimization" error. Thus symmetric variations in aggregate choice reflect common variations in individual choice at the margin. However, systematic variations in aggregate choice among the finite qualitative alternatives must reflect shifts in individual choice resulting from a distribution of decision rules in the population. That is one can only observe a discrete change but not an infitesimal change.

A study of choice behavior consists of (1) the

objects of choice and sets of alternatives available to decision-makers, (2) the observed characteristics of decision-makers, and (3) the model of individual choice and behavior and distribution of behavior patterns in the population. Thus, observed data are generated by a random drawing of individuals from the population with records of his attributes, his alternative choices, and his actual choice.

Let X be the universe of objects of choice, S the universe of vectors of measured attributes of decision--makers. And let B be a set of finite available alternatives, so B is a subset of X. Let $P(x|S,B)$ be the conditional probability that an individual drawn randomly will choose alternative x, given that he has measured attributes S and faces the alternative set B.

Let us start with the basic assumption that consumers are rational, that is, they make choices that maximize their perceived utility subject to budget constraints. Suppose an individual with a vector of measurable attributes S has a random utility function of the form $U=V(S,x) + E(S,x)$, where V is nonstochastic and reflects the "representative" tastes. The stochastic element E reflects the idiosyncracies of this individual in tastes for the alternative with attributes x. Therefore, $V(S,x)$ is intended to capture the attractiveness of alternative is to an average decision-maker with at-

tribute vector s. (Sometimes, the term "attractiveness" is used by the engineers instead of the term "utility" to emphasize that V(s,x) need not meet any specific properties of utility for many demand forecasting applications.)

Reasons For The Random Utility Model

If it were possible to define V(s,x) perfectly, it would be possible to predict unequivocally the choice of the decision maker with known attributes. However, since individuals with identical observed attributes do not always make the same decision, we define for each decision-maker (in the population) a set of unobservable but perceived utility U upon which individuals base their decisions. Since the perceived utility vector will obviously vary across the population, even within groups of people with the same attributes, U is modeled as a random variable.

If the measured utility functions V are properly selected, they will be close to the true U's for each individual. Furthermore, the error terms E(s,x), or unobserved disturbances, which represent the difference between U(s,x) and V(s,x) will be small. These random errors can be interpreted as measurement errors and neglected attributes (unobservable attributes and attributes that, although observed, are not specified in

V(s,x).)

Let h denotes an individual behavior rule which is function that maps each vector of measured attributes s and possible alternative set B into a chosen member of B. Let H be a set of behavior rules or a model of individual behavior. Hence, a behavior rule h can be thought of as demand function resulting from maximization of a specific utility function (e.g. U=N*F where N and F represents nutrient and all goods other than nutrient respectively), and H may be the set of demand functions which result from maximizing some set of utility function (e.g. $U=(N*F)^X$ where x=1,2,3,...). If a behavior model H truly describes a population, then there exists a probability Pi defined on the subsets of H specifying the distribution of behavior rules in the population. Given the above assumptions, we can then say the selection probability that a randomly chosen individual will chose x, given measured attributes s and alternative set B, equals the probability of occurrence of a decision rule yielding this choice from a set of behavior rules H. That is,

$$P(x|s,B) = Pi[\{h(H|\ h(s,B)=x)\}]$$

The selection probability is sometimes called choice function by the engineers. If we have alternatives i and j, then the probability that a randomly chosen individual, with attributes s and alternative set B, will

choose i equals

$$P(i|s,B)=P[E(s,j)-E(s,i)<V(s,i)-V(s,j)].$$

The above equation is the fundamental equation of random utility models and satisfies the requirements of a choice function. This is because if the distribution of error terms E(s,x), or that of U, is known, it is possible to obtain choice function by specifying the utility function V. It is possible to obtain the choice function by calculating the probability that alternative i yield the highest utility.

The powerful axiom of "independence of irrelevant alternatives" on the selection probabilities introduced by Luce[69] (1959) states that the relative odds of one alternative being chosen over a second should be independent of the presence or absence of unchosen third alternative. This means that the odds of i being chosen over j in a multiple choice situation B equals the odds of a binary choice i over j.

If the values of E(s,x) are independently, identically distributed with a Weibull distribution whose probability density function is

$$f(E)= \exp(-E -e^{-E})$$

and whose cumulative distribution function is

$$F(E<t)= \exp(-e^{-E})$$

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[69] Luce, R. Individual Choice Behavior. New York: Wiley, 1959.

then we can show (see Maddala[70] (1983))

$$\text{Prob}(Y=1|s,B) = (\exp(V_1))/\Sigma \exp(V_i)$$

This formula then readily allows an interpretation of the selection probabilities in terms of the relative representative utilities of the alternatives. This formula, as McFadden[71] (1974) points out, makes it simple to ascertain the effect of introducing a new alternative to an "alternative set"; the proportional decrease in the selection probability of each old alternative equal the selection probability of the new alternative. This second point is a general caveat and often considered a primary limitation of the conditional logit model. That is, the independence of irrelevant alternatives is implausible for alternative sets containing choices that are close substitutes. Since the logit model is a case of a strict utility model, this model, as pointed out by Debreu[72] (1960), predicts too high a joint probability of selection for two alternatives which are in fact perceived as "similar" rather than "independent" by the decision maker.

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[70] Maddala, G. S. Limited Dependent and Qualitative Variables in Econometrics. New York: Cambridge University Press, 1983.

[71] McFadden, D. "Conditional Logit Analysis of Qualitative Choice Behavior." In Frontiers In Econometrics, edited by P. Zarembka. New York: Academic Press, 1974.

[72] Debreu, G. "Review of R. Luce, Individual Choice Behavior." American Economic Review, vol. 50.

Policy Implication Of Independence Of Irrelevant Alternatives

Let us look at an example: Suppose initially participant in the Food Stamp Program purchase food with food stamp given to them.

Let FSP1= fraction of eligible population in the food stamp program=1/3

NONFSP= fraction of eligible population chosen not to participate=2/3

Now, if we introduce an additional choice between a cash bene&it and in-kind benefit food stamp program. The axiom of "independence of irrelevant alternatives" tells us that the odds ratio for FSP1 to NONFSP is irrespective of the presence or absence of cash benefit program. That is

$$FS1/NONFS = (1/3)/(2/3)= 1/2$$

will not change. This means FSP1 can become 1/4 and NONFSP can become 1/2, so the ratio of FSP1 to NONFSP is still 1/2.

To figure out the selection probability of the new alternative, a cash benefit, it is necessay to compute the proportional decrease in the selection probability of FSP1. That is, suppose we let FSP2 be the fraction of population participating in the food stamp program through cash benefit then

$$FSP2 = ((1/3)-(1/4))/(1/3) = 1/4$$

This model suggests then if there is stigma or other undesirable attributes in using food stamps, then by making the alternative of cash benefit available we will be able to increase the participation rate in the food stamp program.[73] The notion of a stigma attached to using food stamps was suggested by Albin and Stein[74] (1967). They claim the stigma generates disutility which consist of (1) loss of self or community respect associated with dependence on charity; (2) a loss of utility due to the restriction on consumer choice-making that are inherent in the household budget calculations that establish case benefit levels; (3) disutility stemming from the general unpleasantness connected with the welfare process.

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[73] However, the argument works in the opposite way as well. That is, suppose we gold plate Food Stamp coupons we also receive the same result.

[74] Albin, P. S., and Stein, B. "The Constrained Demand For Public Assistance." The Journal of Human Resources, III (1968).

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