ESSAYS ON HEALTHY EATING AND AWAY FROM HOME FOOD EXPENDITURES OF ADULTS AND CHILDREN

A Dissertation

by

BENJAMIN LOUIS CAMPBELL

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

December 2009

Major Subject: Agricultural Economics

ESSAYS ON HEALTHY EATING AND AWAY FROM HOME FOOD EXPENDITURES OF ADULTS AND CHILDREN

A Dissertation

by

BENJAMIN LOUIS CAMPBELL

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

Approved by:

Co-Chairs of Committee,	Rodolfo M. Nayga
	John L. Park
Committee Members,	Ximing Wu
	Leonard L. Berry
Head of Department,	John P. Nichols

December 2009

Major Subject: Agricultural Economics

ABSTRACT

Essays on Healthy Eating and Away from Home Food Expenditures of Adults and Children. (December 2009)

Benjamin Louis Campbell, B.S., Auburn University; M.S., Auburn University

Co-Chairs of Advisory Committee: Dr. Rodolfo M. Nayga
Dr. John L. Park

Healthy eating and food away from home expenditures are gaining increasing notoriety within the U.S. These issues are not only a concern for businesses, but governmental policy makers have also shown interest in both increasing nutrition for children and better understanding the behaviors of those consuming food away from home. For this reason, a large amount of research has been devoted to better evaluating the effects of various governmental programs on nutrition, with an equal amount of work detailing which groups are eating away from home. The methodologies employed by past research have varied, as have the results and inferences that have been drawn.

For this reason, we incorporated new methodologies, consistent with theory, in order to explain the effects of an important governmental program, National School Lunch Program, on childhood nutrition. We further established consumer profiles and the effects of transactional variables, previous away from home behavior, and decision structure on food away from home expenditures.

In regards to the National School Lunch Program we found that meal nutritional quality is *not* higher for program participants, however, overall intake for most vitamins,

minerals, and other dietary components is higher compared to non-participants that attend a school which participates in the program. The reason for increased intake is due to the increased consumption of food for participants, not due to food quality. Furthermore, comparing children that participate in the program to those attending schools that do not participate indicates that both quality and quantity are insignificantly different. Examination of blood levels and healthy eating measures indicates few differences among the treatment groups.

Evaluating the effect of transactional variables and previous purchase behavior on food away from home expenditures by meal occasion indicates both play a significant role. Transactional variables consist of factors that are directly related to a meal, e.g. facility type, means of ordering, and age structure of meal participants. The effect of transactional variables is highly dependent on the variable being considered. Previous purchase behavior displays expected results with regards to past participation effects, however, past expenditure effects tended to increase spending on future meals with results being somewhat consistent across large meals.

Transactional variables were also evaluated to determine their effect on food away from home expenditures by facility type. A new decision structure chronology was also implemented. Past research has focused on modeling the decision process as either a two- or three-step process. The two-step structure is usually defined as the "participation at facility type" and "expenditure level" decisions, whereas the three-step structure is defined by the "participation," "facility type," and "expenditure level" decisions. We, however, propose a change to the three-step decision structure which we believe more adequately

defines the decision chronology. We, therefore, model the three-step decision structure in the following order: "participation," "expenditure level," and "facility type." Results showed that both the new decision structure and transactional variables are important to the expenditure amounts and who is eating away from home at each facility type.

DEDICATION

This dissertation is dedicated to my wife and son who have encouraged me throughout all of my pursuits both in school and outside-of-school.

ACKNOWLEDGEMENTS

I would like to thank my committee co-chairs, Dr. Nayga and Dr. Park, along with the rest of my committee members, Dr. Wu and Dr. Berry, for their guidance and support throughout the course of this research.

I also want to thank the Department of Agricultural Economics faculty and staff for not only giving me the chance to pursue my higher education in this great department, but also for encouraging and pushing me to achieve in the classroom and in research. Also, I would like to thank Dr. Hall in the Department of Horticulture for giving me the chance to work and collaborate on several research projects that have broadened my research horizons.

I would like to thank all of my friends within the department with whom I shared many late nights studying, researching, and praying. Without you guys, I would not have made it this far. A special thanks goes to Jared Wolfley, Ryan Larsen, Pete Alviola, and Tatevik Zohrabyan for all you have done for me over the past four years.

Finally, and most importantly, I want to thank my family. A special thank you goes to my parents for always believing in me. But, especially, a big thank you to my wonderful wife Julie that has helped me through both the easy and hard times. You have offered nothing but encouragement that has pushed me to where I am today. I could not have done it without you.

TABLE OF CONTENTS

LIST OF TABLES

Page

CHAPTER I

INTRODUCTION

During the middle of the 20th century, meals were typically consumed at home with away from home food consumption relegated to special occasions. This, in large part, was due to household makeup and expectations associated with working versus staying-at-home. As times have changed, especially with regards to the role of women in the workforce and household makeup, our society has moved away from the traditional family meal with everyone sitting around the kitchen table to a faster paced eat-on-the-go lifestyle.

The move toward the eat-on-the-go lifestyle has led directly to more food-away-from-home (FAFH) consumption. In general we think of FAFH consumption as coming from restaurants or other types of eateries, but we must also include schools in the mix since students are now purchasing products from the cafeteria as well as a la carte lines.

Why should we care about the consumption of FAFH? There are several reasons that make FAFH an interesting topic from both a familial (healthy eating and attitudes) and business point-of-view. First, increased FAFH consumption has led, in part, to a higher rate of obesity within the US for both adults and children. Second, consumption of foods outside the home can provide an interesting look as to what consumers are buying and what factors influence their decision to buy. The following chapters will focus on both the healthy eating and business aspects of FAFH consumption.

This dissertation follows the style of *American Journal of Agricultural Economics*.

The second chapter compares the National School Lunch Program (NSLP) and several alternatives in order to determine if the NSLP is providing higher nutritional quality meals for children. Examination of program effects can be difficult to model given the potential non-random nature of treatment assignments and, in some cases, the lack of definitive information with regards to treatment participation. The author utilizes a technique, propensity score matching, to account for the non-random nature of treatment assignment, while also incorporating more strenuous constraints on a respondent's inclusion into a treatment group. By accounting for non-random treatment assignment and incorporating stricter requirements to be a part of a treatment group, the author eliminates biases associated with selection and misspecification.

We then relaxed the assumptions associated with treatment assignment to determine whether failure to accurately identify the treatment group would have had any effect on overall results and inferences. Furthermore, given treatment groups could have significantly different nutritional preferences throughout the day; the author compared nutritional outcomes for the meal of interest (lunch), while also comparing outcomes for breakfast, dinner, and total.

The focus of Chapter III was to examine the effect transactional variables and previous away from home meal purchases had on FAFH expenditures by meal occasion. Given FAFH expenditures have increased drastically during the last couple of decades, there has been a large volume of literature aimed at better understanding both the effects of FAFH expenditures and explaining which consumers are more likely to eat away from home.

Therefore, the third chapter has three goals. First, we evaluate the effect of transaction specific variables (i.e. ordering characteristics, facility characteristics, and party composition) and previous away from home purchasing behavior on FAFH expenditures at various meal occasions (i.e., breakfast, morning snack, brunch, lunch, afternoon snack, dinner, and evening snack). Second, we model "snacks" as separate groups instead of as a combined group. The final objective was to formulate consumer profiles that can serve businesses or governmental policy makers.

The fourth chapter is similar to that of Chapter III; however, several major differences are present. The objective of the fourth chapter was not only to examine the effect of transactional variables on FAFH expenditures by facility type, but was also to evaluate how different a priori assumptions on the ordering of consumer decisions affects final results and inferences. Furthermore, we propose a new chronological ordering of the decision structure whereby consumers decide to go out to eat, *then* decide how much to spend, and finally make the decision as to the type of facility type. This alternative structure differs from previous decision orderings in that the amount to spend is usually considered to be the final step of the process.

CHAPTER II

DOES THE NATIONAL SCHOOL LUNCH PROGRAM IMPROVE CHILDREN'S DIETARY OUTCOMES?

2.1 INTRODUCTION

Governmental programs aimed at children are used extensively throughout the United States for a variety of reasons, most notably to provide *nutritious* meals to children. Such programs include the National School Lunch Program (NSLP), National School Breakfast Program (NSBP), Women, Infant and Children (WIC), and the Supplemental Nutrition Assistance Program (formerly the Food Stamp Program). The NSLP and NSBP, however, are different from their counterparts in that WIC and FTS are only available for qualified persons, whereas, the NSLP and NSBP are available, at a slightly higher cost, to all children given that their school participates in the program. Due to the young age of participants, the NSLP and NSBP also play a pivotal role in helping to define students' long term healthy eating behaviors.

Since the inception of the NSLP in 1946, daily student participation has grown from 7.1 million to 30.1 million in 2006, with approximately 100,000 schools currently participating (Food and Nutrition Service-B 2007; Bhattacharya, Currie, and Haider 2004). With regards to the NSBP, daily participation has grown from 0.5 million children in 1970 to 9.7 million children in 2007, with approximately 78,000 schools participating (Food and Nutrition Service-A 2007; Bhattacharya, Currie, and Haider 2004). In addition to public schools, non-profit private schools and residential child care facilities may also take part in these programs. Based on the large number of children using the NSLP and NSBP daily, the influence of these programs on nutrition, both in consumption and in establishing life-long behaviors, could be considerable.

The effectiveness of the NSLP and NSBP has come under increasing scrutiny due to the drastic rise in childhood obesity. During the period 2003-2004, 17% of children ages 2-19 were considered overweight and another 34% were at risk of becoming overweight. In comparison, in 1999-2000, 14% of 2-19 year olds were overweight and 28% were at risk of becoming overweight (Ogden et al. 2006). From the above numbers, we can see that in only three years there was a large increase in the percentage of overweight children. Since obesity is rising and a large number of children eat at least one meal (lunch) and perhaps two meals (lunch and breakfast) at school each day, measuring the effectiveness of the NSLP and NSBP is extremely important in order to determine if these programs are having an effect on healthy eating habits.

A thorough review of the literature by Bhattacharya, Currie, and Haider (2004) indicated that past studies examining the NSLP have found seemingly contradictory results on the nutritional benefits of the program. For example, recent studies by Gordon, Devaney, and Burghart (1995) and Gleason and Suitor (2003), found increased vitamin and mineral levels that would seem to be associated with increased dietary quality associated with the NSLP. However, NSLP participation has also been linked to higher fat and saturated fat intakes (Gordon, Devaney, and Burghart 1995; Gleason and Suitor 2003) which tends to question the nutritional quality of NSLP meals. More recently, Schanzenbach (2009) found that NSLP participation results in participants being more likely to be obese than non-participants. Given the conflicting results associated with the nutritional quality of NSLP meals (i.e. increases in vitamins and nutrients along with increases in fat intake), we reexamine the effect of NSLP participation on dietary quality of children by addressing the underlying complexities of the NSLP not accounted for in previous studies. Most notably, we compare results of NSLP participation and non-participation due to availability at the school while directly controlling for NSBP participation. Second, we examine whether the NSLP results in any "residual impact"[1] on children that choose not to participate compared to children that do not have an option given that their school does not participate. And third, we utilize both short term (i.e., total consumption, nutrient intake of select vitamins/minerals and the Healthy Eating Index (HEI) and its' component scores) and long term measures (i.e., blood levels of several dietary components) of dietary quality.[2] Nutrient intake levels along with blood levels have been previously utilized, with nutrient intake being the main indicator in past research. Bhattacharya, Currie, and Haider (2004) utilized the HEI as a measure of dietary quality to evaluate the effects of the NSBP, but not the NSLP. Based on these short term measures, we also examine whether NSLP's success or lack of success could be caused by differing food preferences or by quantity intakes.

Our findings indicate that NSLP participants do not consume a higher quality diet at lunch than children choosing not to participate even though the program is offered, but rather consume a higher quantity of foods at lunch while consuming similar

---

[1] Residual refers to any impact gained from the NSLP even though the participant does not participate.
[2] For this paper, long term implies a measure that takes into account total 24 hour consumption and blood levels, compared with short term measurements associated with specific meals and total day consumption.

amounts at other meals. Through increased quantities, NSLP participants are not only increasing vitamin and mineral intake, but are also increasing total fat, total saturated fat, and total poly unsaturated fat intakes along with caloric intake. Furthermore, we find that children attending schools not participating in the NSLP have dietary outcomes that are not significantly different from NSLP participants. However, children attending schools that do not participate have significantly different outcomes than those of children choosing not to participate. The rest of the paper discusses the literature, methodology, and results along with policy implications.

2.2 LITERATURE REVIEW

The literature examining the effectiveness of governmental food programs on children is quite extensive: Women Infant and Children's program (Havas et al. 1998), Supplemental Nutrition Assistance Program (Butler and Raymond 1996; Devaney and Moffitt 1991), and the NSLP and NSBP programs (Akin et al. 1983; Burghardt, Devaney, and Gordon 1995; Devaney, Gordon, and Burghardt 1995; Gleason 1995; Gordon, Devaney, and Burghardt 1995; Gleason and Suitor 2003; Bhattacharya, Currie, and Haider 2004). In regard to the NSLP and NSBP, most studies have utilized specific intake of certain nutrients to determine a program's effectiveness. For example, Gleason and Suitor (2003) examined the effect of the NSLP on intake of several vitamins and minerals, such as vitamin C and calcium. Their findings indicated that the NSLP provided a positive effect on several vitamins examined except vitamin C, which had a negative effect. Furthermore, they found increased consumption of total fat and saturated fat. A more recent study by Bhattacharya, Currie, and Haider (2004) utilized somewhat different measures to evaluate the NSBP, namely the HEI and respondent specific serum levels, however, their empirical methodology did not allow for evaluation of the NSLP. [3] Given these conflicting findings associated with NSLP nutritional quality, the true impact of the NSLP has not been ascertained since no study has examined both dietary component, healthy eating, and blood levels while thoroughly accounting for treatment groups and any selection biases.

As noted by Bhattacharya, Currie, and Haider (2004), several problems have arisen with these types of studies, including lack of exclusion restrictions within selection models and utilization of instrumental variables with poor predictive power. For example, failure to encompass exclusion restrictions within the first step of Heckman two-step models may lead to collinearity problems depending on the correlation between the inverse mill's ratio and step two explanatory variables (Puhani 2000). And when acceptable exclusion restrictions cannot be found, there are few alternatives. Estimation via ordinary least squares (OLS) without regard to the selection decision has been suggested. However, OLS estimates are biased if the error term for program participation and food consumption are correlated. Other problems associated with this type of analysis include a lack of an absolute indicator of treatment group, inclusion of potential endogenous variables (e.g., body mass index) in the models without accounting for their endogeneity, and failure to account for availability of the programs by grouping non-participants with and without access to the programs together

[3] Bhattacharya, Currie, and Haider (2004) found that the NSBP at best had a positive effect on dietary outcomes and at worst had no effect.

into one treatment group. Problems associated with treatment assignment can occur when respondents are placed into vaguely defined treatment groups. For instance, Burghardt et al. (1993) assigned respondents to the NSLP treatment group if they consumed three of the five meal pattern components from the cafeteria meal line.[4] Gleason and Suitor (2003) made further refinements to the Burghardt et al. (1993) study by taking into account partial consumption of the food components. Even though Burghardt et al. (1993) attempted to verify their classification assumptions, in select cases their assumptions may be violated, thereby, creating a misclassification of students into wrong treatment groups. For instance, misclassification could occur if a student purchased their foods from the a la carte line, but met the criteria of the NSLP treatment. In order to minimize the potential for misclassification, a direct indicator of treatment group is required. Therefore, in this paper, we instituted stricter restrictions, discussed below, for participants to be included in their respective treatment group. We then relaxed our restrictions in order to evaluate the effects of misclassification.

Numerous analytical techniques have been applied for the selection problem associated with this type of data, including: fixed effects modeling (Gleason and Suitor 2003), Heckman type two-step procedures (Long 1990), and difference-and-difference modeling (Bhattacharya and Currie 2001; Bhattacharya, Currie, and Haider 2004). The main issue with fixed effect modeling is the need for at least two observations (days of food intake) per respondent if individual fixed effects are to be accounted for. A problem that arises with fixed effects models, especially with the data typically utilized

[4] As described by Gleason and Suitor (2003), the five meal pattern component are meat/meat substitute, grain products, two servings of fruit/vegetables, and one serving of milk.

in this type of study, is determining treatment grouping. Since two days of intakes are needed, the potential to misclassify participants greatly increases. Utilization of difference-in-difference with only one time period can be performed; however, any fixed effect associated with an individual may not be accounted for in the analysis. Other problems with the difference-and-difference approach utilized in previous works emanate from selection bias associated with a lack of randomization of respondents into treatment groups. Recent work by Bhattacharya, Currie, and Haider (2004) has addressed randomization of respondents into treatments when applying difference-and-difference modeling.

Given the plausibility of fixed effect difference-and-difference modeling it would seem to be a logical choice. However, finding a nationally representative survey with both demographic and two days of food consumption data, with the further restriction of providing accurate treatment groups for two days is extremely difficult. At present, the NHANES survey tends to be the standard reference for this type of analysis. However, due to privacy concerns only one day of food intake is available for the survey years 1999-2000 and 2001-2002. The predecessor to NHANES was the NHANES-III (1994-1998), which gave two observations for each respondent, but the data is becoming outdated. The 2003-2004 and 2005-2006 NHANES surveys offer two consumption days, but identification of participation on the second day needs to be assumed, given that respondents were only asked if they participate in the NSLP and how many days they participate, not whether they participated on the specific intake day, which would then imply that an assumption needs to be made in treatment assignment. Based on the above data limitations, identification of a sound strategy to accurately represent NSLP participation with a large enough sample size is a major concern.

2.3 DATA

We use the National Health and Nutrition Examination Survey (NHANES)[5] dataset since it provides information on food intake, by individual food, and demographic information for each individual surveyed. We use data from survey years 1999-2000, 2001-2002, 2003-2004 and 2005-2006 in our analysis of nutrient intakes and blood levels; data from 1999-2000 and 2001-2002 survey years were utilized in HEI and component score analysis given 2003-2004 and 2005-2006 measures are not currently available. For the 1999-2000 and 2001-2002 survey years, only one day of consumption data is available. The NHANES responses were collected during random face-to-face interviews and a call-back 3-10 days later for day 2 dietary intakes. With regards to nutritional questions, a 24-hour recall was used to determine the type and amount of foods consumed, which was then analyzed for nutritional content.

As discussed earlier, accurately defining treatment groups is essential to reducing and eliminating biases. Separating children into appropriate treatment groups is often difficult given the survey instruments generally utilized. For instance, the NHANES

[5] The demographics and health data used in this paper can be found at the National Center for Health's website: <http://www.cdc.gov/nchs/nhanes.htm>>.
The HEI and its' component scores can be found at the Center for Disease and Policy Promotion's website: <<http://www.cnpp.usda.gov/HealthyEatingIndex.htm>>
Further information regarding the calculations of the HEI and component scores can be found by referring to Basiotis et al. (2002) or by accessing the Center for Disease and Policy Promotion's website: <<http://www.cnpp.usda.gov/HealthyEatingIndex.htm>>

surveys (1999-2006) asks children whether their school participates in the NSLP and NSBP, how many days per week they actually utilize the programs, whether school is currently in session and intake day of week. Given this information, it would be simple to look at whether school is in session and the day of the week to assign treatment membership for both dietary intake days. However, a key component is missing, namely whether the student participated on the intake day being measured. For instance, a student that participates in the NSLP three days per week has the potential to be misclassified. Suppose the student participates in the NSLP Monday-Wednesday but the intake day being measured is Thursday, then a misclassification would occur. The extent to which students would be misclassified is unknown, implying that an unknown bias may be present in this traditional treatment assignment methodology. Adding in two days of intakes further increases the probability of a misclassification. Consequently, to minimize the probability of treatment misclassification, our treatment assignment classifies students as NSLP participants if they participate five days a week and as nonparticipants if they participate zero days per week.

Since a main goal of this paper is to assess the effectiveness of the NSLP, only school-aged children attending school are used in the analysis. Consequently, we used the age groups of 6-18 years in the analysis, consistent with Gleason and Suitor (2003). Children between 6-18 years of age that did not provide adequate 24-hour food recall information or had other key demographic information missing were eliminated from the sample. First, we only utilized children that were in school and surveyed on a weekday. Second, those children passing this first test were further divided into groups based on school participation and child participation levels. In order to accurately isolate the program effects, treatment groups underwent another restriction for the NSLP comparisons by subdividing students who participated zero times and those participating five days a week. Those participating between one and four times per week were excluded from analysis since there was a chance of misclassification given the day they did not participate could have corresponded to the survey date, as previously discussed. As noted above, we relaxed the five day a week participation restriction and created a treatment for children that participated in the NSLP a majority (greater than or equal to 3 days per week) of the week. We then compared the results of the "five days a week" and "at least three days a week" participants and found that the magnitude and statistical significance of the estimates were sensitive to the treatment assignment scheme.

Given the above criteria, we develop an exhaustive list of treatment groups that have not been thoroughly examined in the literature. In this study, treatment one (T1) included children that participated in the NSLP all days during the week and whose school did not serve NSBP (see Table 2.1).[6] Treatment two (T2) included children whose school participated in the NSLP, but the child participated zero days per week and the school did not participate in the NSBP. The final treatment (T3) included schools that did not participate in the NSLP or NSBP. By comparing T1 versus T2, we can isolate the effect of directly participating in NSLP, whereas in comparing T2 to T3, we can isolate any residual effect that may occur from not participating directly. From a comparison of T1 and T3, we can determine if the NSLP offers any nutritional

[6] We did not conduct analysis for the NSBP since given the prevalence of the NSLP, it did not allow for a large enough treatment group to be formulated for the NSBP, while also controlling for the NSLP.

Table 2.1. Treatment Group Definitions and Frequencies

Treatment Number	Observations	School Part. NSLP (yes/no)	Student Part. NSLP (days)	School Part. NSBP (yes/no)	Student Part. NSBP (days)	Free/Reduced Lunch (yes/no)	Full Price Lunch (yes/no)
1	204	Yes	5	No	0	--	--
1A	95	Yes	5	No	0	Yes	No
1B	105	Yes	5	No	0	No	Yes
2	143	Yes	0	No	0	--	--
3	291	No	0	No	0	--	--

* NSLP = National School Lunch Program; NSBP = National School Breakfast Program

advantages compared to students attending schools that do not participate. Also, we examine whether free/reduced payment (T1A) for NSLP produce different nutritional outcomes than those paying full price (T1B).

In addition to the new treatment assignment scheme that has not been considered in previous studies, we also use various dietary outcome measures that include both short and long term measures. Short term measures are nutrient intakes and HEI and its' component scores. Nutrient intakes are compared to the Dietary Reference Intakes (Food and Nutrition Information Center 2009) and are converted to percent Recommended Dietary Allowances (RDA) or percent adequate intakes for nutrients with no specific RDA. Mean RDAs and adequate intakes are comparable to those of Gleason and Suitor (2003). In most cases RDA's were being exceeded by all treatment groups.[7]

According to You and Nayga (2005), the HEI provides a broad overview of the type, variety, and quantity of the foods consumed, especially in accordance with dietary recommendations. The HEI is calculated as the sum of all 10 component scores with a maximum score of 100. The component scores include: fat, saturated fat, meat, dairy, vegetable, fruit, grain, cholesterol, sodium, and variety. Meat, dairy, vegetable, grain, and fruit scores are based on conformity to the daily serving recommendations given by the USDA's Food Guide Pyramid. Fat and saturated fat scores are based on fat or saturated fat consumption as a percent of total food energy intake, while cholesterol, sodium, and variety are based on intakes of the component (You and Nayga 2005). The component scores range from 0 to 10. Using fruit as an example, a fruit score of 10

[7] For space reasons the overall means and treatment means for all dietary outcomes are not given, however, they are available from the authors upon request.

implies that the respondent consumed the recommended daily serving of fruit, whereas a score of 0 means that the respondent did not consume any of the daily recommended serving of fruit. Scores between 0 and 10 are scored proportionately based on amount consumed and amount recommended.

A HEI score greater than 80 means that a person is consuming a "good" diet, whereas scores between 51 and 80 means that a person needs to "improve their diet" (Basiotis et al. 2002). The average HEI score of the U.S. population in 1999-2000 was 63.8, which is clearly in the "improve diet category." Further examination of the population based component scores indicates that the cholesterol and variety scores have the highest average component scores near 7.7, while dairy and fruit scores were the lowest at 5.9 and 3.8, respectively (Basiotis et al. 2002). The mean HEI for our overall sample (62.3) is very close to the population average reported by Basiotis et al. (2002) and the low fruit and dairy scores are also similar at 6.0 and 3.6, respectively.

In regards to long term healthy eating measures, we utilized blood levels, notably levels of calcium, cholesterol, iron, phosphorus, protein, sodium, and potassium. These measures were collected during each two-year survey cycle and provide a wide basis to judge long term nutritional effects.

2.4 EMPIRICAL MODEL

In this study, we utilize the propensity score matching (PSM) technique to evaluate the effect of NSLP on children's dietary outcomes. We then compare our results to other studies utilizing different techniques. The literature regarding propensity score matching is quite extensive. According to Rosenbaum and Rubin (1984), treatment groups may not be comparable since the differences associated with treatments is not from the different treatment regimes, but from underlying characteristics that impact choice of treatment. For example, participation in the NSLP may be associated with students from different socioeconomic backgrounds even though schools that do not participate in these programs have been removed from the analysis. Failure to adjust for the nonrandom nature of the treatment groups leads to biased estimates in small samples and inconsistent estimates for large samples (Foster 2003).

To correct for selection bias, Rosenbaum and Rubin (1983, 1984) proposed utilizing propensity scores to adjust for non-randomization. The intuition behind propensity scores is to generate conditional probabilities of receiving a particular treatment given some explanatory variables (covariates) (Imbens 2000). These scores are unbiased, consistent with the nonrandom nature of the data and allow for having a common base to compare control and treated units. The use of propensity scores to circumvent selection bias has been used in various disciplines, including: health care (Foster 2003) and governmental program evaluation (Heckman and Hotz 1989). To our knowledge, the use of propensity score matching has not been applied to test for the effectiveness of the NSLP, while controlling for NSBP participation, using strict treatment requirement criterion.

We first evaluated the effectiveness of the NSLP by comparing T1 and T2. Since both treatments have participation by the school, the effects obtained are associated with NSLP participation unless the treatments may have varying preferences. In order to determine if preferences are the same, we not only evaluated nutritional outcomes at lunch but we also examined breakfast, dinner, and total outcomes to determine if any preference shifts are present. Difference in preferences was not the only concern so we also evaluated consumption intake (grams of food) by meal to determine if quantity rather than quality is driving any of the nutritional outcomes. We expect that T1 would have higher levels of nutrient intakes and HEI (and components) since schools are "forced" to follow governmental dietary guidelines which could lead to NSLP participating children having food of greater nutritional value. Also, preferences and grams of intake are hypothesized to not be significantly different between the treatment groups.

Second, we evaluated T2 versus T3 to test whether a student's nonparticipation in the NSLP when it is available has a benefit compared with a student that attends a school not participating in the NSLP. It is expected that a school participating will result in increased nutritional quality even if the student does not participate since schools will most likely be more informed about governmental nutritional information and regulations and thereby offer more nutritional meals in a la carte. We then compared T1 and T3 to gain a better understanding of the NSLP's effectiveness vis-à-vis students not having the opportunity to participate. It is expected that participation in the NSLP will lead to increases in vitamins, minerals and the fruit component of the HEI compared to non-participating schools since participating schools are obligated to follow strict guidelines not imposed on non-participating schools. Finally, we examined T1A versus T1B to determine if payment method plays a role in children's dietary quality. We expect to find no differences given that participants in either pay structure are exposed to the same foods and thereby same nutritional quality levels.

The first step in propensity score matching is to obtain propensity scores using either probit or logit. Even though we use multiple treatment groups, Lechner (2002) showed that similar results are obtained regardless of whether binary models are used instead of the more cumbersome multinomial models. Therefore, we estimated the propensity scores using a binary logit model. Propensity scores represent the probability of an individual being in a certain group. The binary logit model and propensity scores were estimated in STATA using the following formula:

$$\Pr ob(Y = 1 \mid X) = \frac{e^{\beta' X}}{1 + e^{\beta' X}} \qquad [2.1]$$

where, X represents the explanatory variables (Greene p.667). Explanatory variables, similar to those of Gleason and Suitor (2003) included demographics (gender, age, race, household size, and food security), household education and health indicators (household smoker, household reference education and marital status), and personal health indicators (supplemental usage, food away from home meals (FAFH) per week, and food consumption on intake day). The descriptive statistics of each explanatory variable by treatment can be found in Table 2.2.

Table 2.2. Descriptive Statistics Associated with the Explanatory Variables Used to Calculate Propensity Scores

Explanatory Variables	Means				
	TRT 1	TRT 1A	TRT 1B	TRT 2	TRT 3
Demographics					
Year: 1999 - 2000 [a]	0.19	0.16	0.22	0.13	0.15
Year: 2001 - 2002	0.31	0.28	0.33	0.41	0.22
Year: 2003 - 2004	0.22	0.26	0.17	0.22	0.29
Year: 2005 - 2006	0.28	0.29	0.28	0.24	0.34
Gender: Male	0.50	0.45	0.54	0.46	0.47
Race: White	0.42	0.26	0.55	0.41	0.33
Race: Black	0.17	0.17	0.17	0.15	0.30
Race: Other [a]	0.42	0.57	0.28	0.45	0.37
Age (years)	12.16	12.15	12.17	14.23	15.43
Household Size	4.41	4.91	3.97	4.15	4.31
Household Food Security: Full [a]	0.69	0.52	0.84	0.79	0.73
Household Food Security: Marginal	0.08	0.08	0.08	0.09	0.09
Household Food Security: Low	0.16	0.28	0.06	0.08	0.12
Household Food Security: Very Low	0.07	0.12	0.03	0.04	0.06
Household Education and Health Indicators [b]					
Household Smoker	0.19	0.24	0.15	0.17	0.12
Household Reference: Not High School Graduate or no GED [a]	0.24	0.41	0.09	0.25	0.22
Household Reference: High School Graduate or GED	0.23	0.29	0.17	0.21	0.33
Household Reference: Attend Some College	0.26	0.23	0.29	0.24	0.30
Household Reference: College Graduate or Above	0.27	0.06	0.45	0.29	0.15
Household Reference: Married	0.69	0.63	0.73	0.68	0.55
Household Reference: Not Married [a]	0.31	0.37	0.27	0.32	0.45
Personal Health Indicators					
Supplement Usage	0.26	0.12	0.39	0.33	0.30
FAFH Meals per Week	2.93	2.21	3.56	3.83	5.51
Food Consumption: Normal [a]	0.63	0.55	0.71	0.64	0.62
Food Consumption: Greater Than Normal	0.10	0.14	0.07	0.06	0.12
Food Consumption: Less Than Normal	0.26	0.32	0.22	0.31	0.26
Body Mass Index	21.47	21.30	21.63	22.54	23.97

[a] Assigned as base categories within logit models.

[b] Household reference is household member 18 years or older that owns / rents place of residence (NHANES codebook)

[*] TRT = Treatment

One of our main concerns in the estimation is to insure that the propensity scores are reliable and satisfy the balancing hypothesis. Heckman et al. (1997) recommends using “hit-or-miss” and pseudo-R^2 to measure the reliability of the propensity scores. The “hit-or-miss” criterion details how well our model correctly classifies students into the correct treatment, while the pseudo-R^2 is a relative measure of model variance estimation. As can be seen in Table 2.3, treatment comparisons associated with T1/T2, T2/T3, and T1/T3 have prediction accuracies of 63%, 68%, and 70%, respectively, whereas, the T1A/T1B comparison had a prediction accuracy of 81%. The Pseudo-R^2 values range from 10-20% for the main treatments to 49% for the payment comparison.

In order to insure that covariate balancing was achieved, we utilized the technique specified in Becker and Inchino (2002), whereby the sample was split into five equally spaced intervals and the average propensity scores within each interval for both the treated and controls were tested to see if they differed. In the case where a block had significant differences the block was divided in-half and re-tested. This procedure was followed until no differences were detected within blocks for the average propensity scores at which point each covariate mean was tested to insure that no differences were present between the treated and control covariate means. In our case, several model specifications were tested until a set of covariates (see Table 2.2) was found that not only satisfied the balancing hypothesis but also accurately represented the problem at hand.

Table 2.3. Covariate Balancing Statistics Utilized in Matching Algorithm Selection

Matching Algorithm [a]	Logit Prediction Accuracy (%)	Pseudo - R^2	Bias Reduction (%) (after matching)	R^2 Reduction (%) (after matching)	Chi^2 Reduction (%) (after matching)
Comparison: TRT 1 vs. TRT 2					
Kernel - Epanechnikov	62.5	10.1	-12.0	-22.5	-30.2
Kernel - Gaussian	62.5	10.1	-12.0	-22.5	-30.2
Radius .1	62.5	10.1	-33.5	-35.8	-38.5
Radius .01	62.5	10.1	-21.3	-6.6	-16.0
Radius .05	62.5	10.1	-26.8	-19.9	-23.6
K-nearest w repl. - no caliper	62.5	10.1	-30.6	27.8	21.5
K-nearest w/out repl. - no caliper	62.5	10.1	6.0	19.2	-22.6
Spline	62.5	10.1	-29.5	27.8	21.5
Local Linear Regression	62.5	10.1	-29.5	27.8	21.5
Comparison: TRT 2 vs. TRT 3					
Kernel - Epanechnikov	68.0	16.5	-7.5	-16.1	-23.7
Kernel - Gaussian	68.0	16.5	-7.5	-16.1	-23.7
Radius .1	68.0	16.5	-49.4	-19.7	-24.0
Radius .01	68.0	16.5	-7.5	-16.1	-23.7
Radius .05	68.0	16.5	-49.9	-16.1	-19.8
K-nearest w repl. - no caliper	68.0	16.5	-28.7	64.2	55.2
K-nearest w/out repl. - no caliper	68.0	16.5	-47.0	-35.0	-61.7
Spline	68.0	16.5	-25.1	64.2	55.2
Local Linear Regression	68.0	16.5	-25.1	64.2	55.2

[a] Radius with a .1 caliper is presented in the results given it is the best, close to the best, based on bias, pseudo R^2, and Chi^2 reduction.

[*] TRT = Treatment

Table 2.3 Cont'd.

Matching Algorithm [a]	Logit Prediction Accuracy (%)	Pseudo - R^2	Bias Reduction (%) (after matching)	R^2 Reduction (%) (after matching)	Chi^2 Reduction (%) (after matching)
Comparison: TRT 1 vs. TRT 3					
Kernel - Epanechnikov	69.5	20.3	-19.5	-23.7	-35.9
Kernel - Gaussian	69.5	20.3	-19.5	-23.7	-35.9
Radius .1	69.5	20.3	-64.7	-37.3	-42.2
Radius .01	69.5	20.3	-19.5	-23.7	-35.9
Radius .05	69.5	20.3	-66.6	-26.1	-32.0
K-nearest w repl. - no caliper	69.5	20.3	-51.6	0.0	-7.9
K-nearest w/out repl. - no caliper	69.5	20.3	-43.1	-53.9	-62.7
Spline	69.5	20.3	-51.5	0.0	-7.9
Local Linear Regression	69.5	20.3	-51.5	0.0	-7.9
Comparison: TRT 1A vs. TRT 1B					
Kernel - Epanechnikov	81.4	49.4	-23.4	-29.7	-56.3
Kernel - Gaussian	81.4	49.4	-23.4	-29.7	-56.3
Radius .1	81.4	49.4	-33.0	-24.5	-40.3
Radius .01	81.4	49.4	-23.4	-29.7	-56.3
Radius .05	81.4	49.4	-26.7	-22.7	-38.6
K-nearest w repl. - no caliper	81.4	49.4	-12.2	5.4	-19.1
K-nearest w/out repl. - no caliper	81.4	49.4	-26.6	-29.2	-46.5
Spline	81.4	49.4	-11.7	5.4	-19.1
Local Linear Regression	81.4	49.4	-11.7	5.4	-19.1

[a] Radius with a .1 caliper is presented in the results given it is the best, close to the best, based on bias, pseudo R^2, and Chi^2 reduction.

[*] TRT = Treatment

After confirming that the balancing hypothesis was satisfied for each treatment comparison, matching based on the propensity scores was used to test whether treatments generated significant differences in our dietary outcomes. A number of algorithms can be used to implement matching. We utilized several algorithms to implement and check the robustness of our matching results. The common support criterion was also imposed to insure that propensity scores used from the control group fit within the minimum and maximum propensity score from the treatment group. The matching results across all algorithms listed in Table 2.3, produced, for the most part, very similar results (both in magnitude and significance) across the dietary quality indicators. However, we selected the radius matching with 0.1 caliper since it was the best algorithm that lowered the mean standardized bias after matching compared to before matching across all treatment comparisons. 500 replications were used to bootstrap the standard errors for significance testing. For a detailed discussion of the various matching mechanisms, see Becker and Ichino (2002).

To further examine the robustness of our results, we utilized Rosenbaum bounds to evaluate the sensitivity of our results to hidden bias/unobserved heterogeneity. A full explanation of Rosenbaum bounds can be found in Rosenbaum (2002, pp. 110-117); however, the basic premise is as follows. If an unobserved variable, γ, plays a role, along with the observables, X_i, in determining the probability of obtaining the treatment, then depending on how much influence γ has on the participation decision our results may change. By utilizing a Wilcoxon signed rank test of the average treatment effects associated with the treated units, we can change the value of a coefficient, β, associated with γ in our model until our statistical significance inferences change, thereby, gaining an indication of the how sensitive our results are to hidden bias or unobserved heterogeneity. A magnitude of $\beta = 0$ implies that there is no hidden bias. The resulting β indicates how large the amount by which the hidden bias must raise the odds of participation to change the significance level from significant (insignificant) to insignificant (significant). The Rosenbaum bounds can only be calculated for 1x1 matched pairs. Therefore, the Rosenbaum bounds for the nearest neighbor with replacement are provided in the tables. Results indicate that most of our estimates are fairly robust for each treatment group comparison implying that a large amount of bias would be needed to change our inferences associated with the dietary outcomes.

2.5 RESULTS AND DISCUSSION

In the following section the results associated with each treatment comparison is detailed. Our main concerns are the effectiveness of the NSLP and whether any residual effects are present for non-participants in order to provide viable policy recommendations.

2.5.1 TREATMENT ONE VS. TREATMENT TWO

As noted previously, we not only evaluated lunch intakes but also intakes from other major meals along with total intake to assess the effect of NSLP participation throughout the day. Table 2.4 indicates that when we look at the meals that are not of key interest, i.e., breakfast and dinner, we see very little differences, using a significance level of 0.05 as a cutoff, in nutrient intakes when comparing T1 and T2. This finding was not unexpected since the NSLP should not significantly affect the nutritional quality of other major meals. Given these results, any differences at lunch should most likely be due to the treatment, i.e. program participation, and not due to different nutritional preferences. Also of note are the differences in sign and magnitude associated with the simple average differences and the propensity score results implying that a reliance on simple averages would have led to incorrect inferences being drawn.

When we examine the lunch meal, we see that T1 (NSLP participants) has higher levels of almost all dietary components than T2 (NSLP non-participants with school participation). This finding is consistent with those of Gleason and Suitor (2003) in regards to nutrient intakes in both sign and magnitude. These results seem to indicate that the NSLP is providing different nutrition than other alternatives, such as bringing a lunch from home. For instance, results indicate that NSLP participants consume 11.82% more calcium as a percentage of RDA at lunch than children that choose not to participate. However, of concern are the increased levels of total fat, total saturated fat, and caloric intake amongst NSLP participants.

Table 2.4. Average Treatment Effects Comparing Treatment 1 vs. Treatment 2 Using Propensity Score Matching for Major Daily Meals [abc]

	Breakfast					Lunch					Dinner					Total				
			PSM Diff.		RB Bounds [d]			PSM Diff.		RB Bounds [d]			PSM Diff.		RB Bounds [d]			PSM Diff.		RB Bounds
Nutritional Outcomes	SD	*p-value*	Radius	*p-value*	NNK	SD	*p-value*	Radius	*p-value*	NNK	SD	*p-value*	Radius	*p-value*	NNK	SD	*p-value*	Radius	*p-value*	NNK
Grams of food (grams)	-13.1	0.72	-10.4	0.74	1.22	76.4	0.11	**119.8**	0.00	**1.50**	59.6	0.20	46.6	0.35	1.12	56.7	0.63	156.4	0.12	1.20
Calories	-2.2	0.96	-1.4	0.97	1.33	**116.3**	0.02	**154.4**	0.00	**1.41**	50.9	0.35	70.1	0.24	1.09	81.3	0.46	**213.9**	0.05	1.30
Vitamins (Percentage of RDA)																				
Vitamin A	7.4	0.22	0.6	0.90	1.12	**12.0**	0.00	**10.6**	0.00	**2.74**	-0.2	0.97	-2.2	0.65	1.39	**24.0**	0.05	10.3	0.38	1.10
Vitamn C	-8.7	0.41	-11.4	0.22	1.17	-2.1	0.83	11.8	0.14	**1.33**	**20.2**	0.05	7.6	0.29	1.24	-10.4	0.67	-7.3	0.73	1.10
Thiamin	4.4	0.53	0.5	0.93	1.40	5.7	0.29	**13.0**	0.00	**1.48**	7.9	0.18	5.4	0.34	1.03	17.8	0.16	19.1	0.09	**1.28**
Riboflavin	8.1	0.42	1.5	0.86	1.31	**22.8**	0.00	**22.6**	0.00	**1.95**	11.5	0.12	9.4	0.15	1.07	**43.1**	0.01	**37.3**	0.02	**1.33**
Niacin	1.2	0.85	-1.6	0.76	1.10	**9.6**	0.04	**12.4**	0.00	**1.20**	2.8	0.67	9.0	0.15	1.10	11.7	0.33	20.5	0.06	1.28
Vitamin B_6	4.0	0.65	-2.8	0.70	1.11	6.3	0.16	**10.6**	0.00	**1.26**	7.0	0.28	**12.5**	0.04	**1.14**	15.5	0.28	19.9	0.11	**1.06**
Vitamin B_{12}	17.7	0.27	6.5	0.62	1.33	**29.9**	0.00	**28.4**	0.00	**1.93**	11.1	0.50	14.5	0.27	1.03	**69.3**	0.02	**58.0**	0.02	1.33
Vitamn K	**3.3**	0.05	**3.1**	0.04	**1.19**	4.9	0.12	**8.2**	0.01	**1.24**	-5.4	0.55	-2.1	0.77	1.09	8.6	0.46	10.9	0.20	1.33
Vitamin E (alpha-tocopherol)	-1.7	0.28	-0.7	0.47	1.03	1.2	0.58	2.8	0.14	1.16	3.7	0.12	4.5	0.06	1.20	-1.7	0.81	1.8	0.75	1.24
Minerals (Percentage of RDA)																				
Calcium	5.0	0.15	1.8	0.57	1.07	**11.8**	0.00	**10.6**	0.00	**2.19**	3.2	0.30	1.9	0.50	1.44	**20.1**	0.00	**14.9**	0.02	**1.46**
Phosphorus	5.9	0.12	4.2	0.17	1.13	**17.8**	0.00	**16.4**	0.00	**2.17**	4.7	0.30	5.6	0.21	1.10	**30.3**	0.00	**28.2**	0.00	**1.42**
Magnesium	0.9	0.74	1.9	0.39	1.46	**8.4**	0.00	**9.0**	0.00	**1.61**	**6.6**	0.03	**6.8**	0.03	**1.12**	**19.8**	0.01	**21.8**	0.00	**1.36**
Iron	-9.4	0.51	-7.6	0.39	1.08	5.6	0.07	**7.2**	0.02	**1.10**	**12.0**	0.02	**12.1**	0.01	**1.08**	10.1	0.54	14.0	0.24	1.06
Zinc	6.8	0.31	5.3	0.35	1.45	**10.8**	0.00	**12.1**	0.00	**1.67**	8.7	0.23	**11.8**	0.04	1.12	**27.0**	0.02	**30.8**	0.00	**1.36**
Copper	0.3	0.93	1.3	0.67	1.16	**9.6**	0.01	**12.0**	0.00	**1.49**	**9.0**	0.04	**9.6**	0.04	1.03	19.0	0.07	**23.1**	0.02	1.21
Sodium [e]	2.9	0.56	3.8	0.41	1.16	**21.7**	0.00	**27.8**	0.00	**1.67**	7.0	0.37	5.3	0.54	1.31	**31.6**	0.02	**40.2**	0.00	**1.49**
Potassium	-0.3	0.84	-0.2	0.87	1.45	**4.6**	0.00	**4.9**	0.00	**1.56**	0.9	0.64	1.6	0.38	1.13	3.7	0.30	**6.5**	0.04	1.36
Selenium	2.9	0.65	5.2	0.31	1.17	**21.8**	0.00	**22.0**	0.00	**1.48**	11.2	0.33	4.4	0.66	1.24	**47.2**	0.03	**43.7**	0.01	1.21
Other Dietary Components																				
Carbohydrates (% of RDA)	-0.1	0.99	-1.1	0.79	1.23	4.8	0.30	**10.7**	0.02	**1.24**	**9.7**	0.05	8.5	0.13	1.02	3.5	0.77	12.0	0.31	1.21
Dietary Fiber (% of RDA)	-1.8	0.32	-0.3	0.80	1.03	1.2	0.44	**3.0**	0.02	**1.23**	2.3	0.13	**3.2**	0.05	1.02	3.2	0.35	**7.7**	0.01	1.11
Protein (% of RDA)	4.7	0.34	5.0	0.24	1.21	**28.4**	0.00	**25.5**	0.00	**1.78**	12.9	0.20	11.4	0.21	1.09	**50.6**	0.00	**48.5**	0.00	**1.53**
Total Poly Unsaturated Fat (% of RDA)	0.7	0.76	1.4	0.46	1.25	4.8	0.91	**11.3**	0.01	**1.15**	-0.3	0.97	6.8	0.28	1.15	-6.2	0.62	14.1	0.14	1.06
Total Fat (gm)	0.0	0.99	0.2	0.87	1.17	**6.8**	0.01	**7.8**	0.00	**1.39**	-0.3	0.92	2.1	0.44	1.25	3.8	0.44	**12.0**	0.01	1.21
Total Saturated Fat (gm)	0.1	0.91	0.1	0.84	1.07	**3.1**	0.00	**3.0**	0.00	**1.54**	0.1	0.92	0.4	0.68	1.47	2.5	0.16	**4.4**	0.01	1.31
Energy (kcal)	1.3	0.98	0.6	0.99	1.32	**117.3**	0.02	**154.7**	0.00	**1.42**	49.3	0.37	67.8	0.25	1.09	75.0	0.50	205.1	0.06	1.31
Total Sugars (gm)	0.8	0.84	0.0	0.99	1.23	0.1	0.98	1.8	0.63	1.34	6.3	0.12	5.0	0.27	1.01	-1.8	0.87	0.2	0.98	1.48
Cholesterol (mg)	-14.6	0.42	-3.4	0.79	1.76	**33.4**	0.00	**28.9**	0.00	**1.65**	3.8	0.76	0.9	0.94	1.19	25.3	0.35	37.2	0.08	1.08
Caffeine (mg)	0.6	0.65	1.3	0.14	2.34	-3.0	0.43	-1.3	0.61	1.83	-2.5	0.49	0.7	0.84	1.29	-3.3	0.72	2.0	0.75	1.31

[a] Weighted according to NHANES analytic guidelines.

[b] Radius matching with a 0.1 caliper is shown, however, other matching algorithms produced similar results. Bold indicates significance at the 0.05 significance level.

[c] Standard errors bootstrap with 500 replications.

[d] Rosenbaum bounds are intrepreted as follows: if bold, then the unobserved bias must increase the odds of partipation in the treatment, given the same covariates, by the value of the bound to change the statisitical inference to insignificant at the 0.05 level; if non-bold, then the bound must increase the oddsof participation by the value of the bounds to change the inference to significant at the 0.05 level.

[e] Sodium has been adjusted for salt use in food preparation.

[*] PSM = Propensity score matching; SD = Simple difference; RB Bounds = Rosenbaum Bounds; NNK = Nearest-neighbor matching with replacement.

[*] Bold differences imply significance at the 0.05 level.

Several possibilities abound as to why there are higher nutrient intakes among NSLP participants. Based solely on the higher nutrient levels, it is possible that higher dairy consumption among NSLP participants is the cause of the increased nutrient levels. For instance, if there were increased milk intake by NSLP participants, we would expect to see a higher intake of calcium as a percent of RDA at lunch, but we would also see increased levels of protein, calcium, riboflavin, magnesium, phosphorus, niacin, vitamin B12, vitamin B6, vitamin A, which is what our results show. This hypothesis was shared by the Gleason and Suitor (2001) when they noted that NSLP participants consume roughly 0.6 servings more of milk and larger amounts of cheese than nonparticipants. Examining our results, we see that the difference in intake levels tend to closely mirror a one-serving increase in dairy. Furthermore, a cup of reduced fat milk (2%) provides 121.2 kcal of energy and 2.92 grams total saturated fat which is almost equivalent to our measured differences of 117.3 kcal and 3.07 grams, respectively (National Dairy Council).[8] All of our differences do not fall as close to the cup of milk levels noted above, but several do, which provides some evidence that dairy is causing the increased nutrient levels. If we assume that cheese is the dairy product increasing instead of milk, we again see that our differences are similar to a 0.5-1 ounce increase in cheese intake across all significant nutrients.

At first glance, these findings, on the whole, seem to support the argument that the NSLP is doing its job in providing increased consumption of key nutrients.

---

[8] The amount of nutrients and dietary components obtained from dairy products is dependent on the type of product; however, the interpretation does not change. For instance, saturated fat levels range from 1.48 to 5.07 for lowfat to whole milk, respectively, which fits closely with our measured difference.

However, a more in depth examination indicates that increased RDA's for the nutritional outcomes may not be coming from increased nutritional quality but rather increased quantity of food consumption during lunch. Examination of the amount of food consumed during lunch indicates that NSLP participants consumed approximately 120 grams more food than their non-participating counterparts, whereas for breakfast and dinner, food consumption is not significantly different between NSLP participants and non-participants. So the key question that needs to be answered is what is the cause of the increased nutrient intakes? Is it increased food consumption or increased nutritional quality of the NSLP.

To answer this question of quality or quantity, we divided each RDA by the grams consumed at lunch in order to see if quality differences were apparent on a per gram basis. Results indicate that very few of the dietary components still remained significant after controlling for amount consumed (Table 2.5). Several components, however, still remained significant, such as Vitamin A, calcium, phosphorus, potassium. These overall findings seem to indicate that participants of the NSLP are not exposed to higher nutritional quality foods than those choosing not to participate. In essence, NSLP participants are consuming higher quantities of foods instead of higher nutritional quality foods. This finding may imply that allowing students to make choices (e.g., whether at home or via a la carte lines) can provide the same quality meal as the NSLP, but are consumed at lower quantities. Our results seem to tie together past research findings of higher nutritional intakes, but increasing obesity levels of NSLP participants given consumption quantity may be the cause. In summary, NSLP participants tend to consume the same nutritional quality lunch meal as non-participants but just in larger quantities.

As noted earlier, we believe that treatment assignment is critical to making correct inferences regarding dietary outcomes. Examination of Tables 2.4 and 2.6 provides interesting results in that when we relax the “five days per week” participation requirement previously discussed (and move into the scheme that involves children participating “at least three days per week”, which could result in many misclassified cases), but controlled for NSBP participation, there are several variables that become statistically insignificant. Not only do the results become insignificant, but we also see lower magnitudes across all dietary outcomes, implying that treatment assignment is extremely important. Further examination also shows that when we rely on the

Table 2.5. Average Treatment Effects Using Propensity Score Matching for Dietary Quality at Lunch Accounting for Grams Eaten [abc]

	Treatment 1 vs. Treatment 2				Treatment 2 vs. Treatment 3				Treatment 1 vs. Treatment 3			
			PSM Diff.				PSM Diff.				PSM Diff.	
Nutritional Outcomes	SD	*p-value*	Radius	*p-value*	SD	*p-value*	Radius	*p-value*	SD	*p-value*	Radius	*p-value*
Calories	0.09	*0.46*	0.07	*0.65*	-0.150	*0.22*	0.014	*0.91*	0.086	*0.46*	0.07	*0.65*
Vitamins (Percentage of RDA)												
Vitamin A	**0.027**	*0.00*	**0.023**	*0.00*	-0.079	*0.10*	**-0.029**	*0.02*	-0.051	*0.28*	-0.023	*0.32*
Vitamn C	-0.028	*0.28*	-0.004	*0.84*	0.019	*0.47*	0.003	*0.87*	-0.009	*0.47*	-0.019	*0.42*
Thiamin	-0.024	*0.44*	-0.005	*0.73*	0.027	*0.40*	0.017	*0.38*	0.002	*0.83*	0.009	*0.34*
Riboflavin	0.006	*0.86*	0.013	*0.42*	0.010	*0.77*	0.006	*0.78*	0.013	*0.92*	0.006	*0.55*
Niacin	-0.020	*0.51*	-0.011	*0.51*	0.015	*0.63*	0.012	*0.55*	-0.005	*0.67*	-0.004	*0.71*
Vitamin B_6	-0.024	*0.48*	-0.007	*0.58*	0.012	*0.72*	0.008	*0.71*	-0.012	*0.21*	-0.008	*0.34*
Vitamin B_{12}	0.018	*0.73*	**0.043**	*0.03*	-0.011	*0.84*	-0.013	*0.68*	0.000	*1.00*	**0.008**	*0.00*
Vitamn K	0.013	*0.12*	0.009	*0.21*	**-0.035**	*0.01*	-0.019	*0.08*	-0.022	*0.13*	**-0.025**	*0.04*
Vitamin E (alpha-tocopherol)	0.004	*0.58*	0.002	*0.71*	-0.002	*0.63*	-0.002	*0.71*	0.000	*0.99*	0.000	*0.95*
Minerals (Percentage of RDA)												
Calcium	**0.020**	*0.01*	**0.02**	*0.00*	-0.011	*0.15*	-0.004	*0.44*	0.001	*0.83*	0.006	*0.26*
Phosphorus	**0.029**	*0.00*	**0.02**	*0.00*	**-0.019**	*0.04*	-0.010	*0.15*	0.009	*0.17*	0.000	*1.00*
Magnesium	0.006	*0.53*	0.01	*0.35*	-0.001	*0.95*	-0.003	*0.69*	0.010	*0.29*	-0.002	*0.69*
Iron	-0.009	*0.45*	-0.01	*0.35*	0.004	*0.77*	0.009	*0.39*	0.006	*0.40*	-0.001	*0.86*
Zinc	0.008	*0.54*	0.01	*0.12*	-0.015	*0.28*	-0.013	*0.21*	-0.005	*0.47*	-0.009	*0.28*
Copper	-0.005	*0.80*	0.00	*0.96*	0.008	*0.65*	0.006	*0.60*	-0.007	*0.41*	-0.001	*0.93*
Sodium [d]	0.032	*0.09*	0.02	*0.38*	-0.017	*0.33*	0.004	*0.82*	0.004	*0.68*	**0.027**	*0.04*
Potassium	**0.007**	*0.01*	**0.01**	*0.03*	**-0.006**	*0.02*	-0.002	*0.40*	0.014	*0.40*	0.002	*0.39*
Selenium	0.023	*0.23*	0.01	*0.43*	-0.023	*0.23*	-0.017	*0.23*	0.001	*0.56*	-0.004	*0.77*
Other Dietary Components												
Carbohydrates (% of RDA)	-0.011	*0.32*	-0.01	*0.54*	0.005	*0.67*	0.009	*0.41*	-0.006	*0.47*	-0.002	*0.80*
Dietary Fiber (% of RDA)	-0.003	*0.45*	0.00	*0.99*	0.002	*0.68*	0.000	*0.97*	-0.002	*0.62*	-0.002	*0.59*
Protein (% of RDA)	**0.042**	*0.00*	0.02	*0.10*	**-0.030**	*0.04*	-0.017	*0.18*	0.012	*0.40*	-0.002	*0.88*
Total Poly Unsaturated Fat (% of RDA)	0.015	*0.31*	0.02	*0.18*	-0.019	*0.13*	-0.014	*0.23*	-0.004	*0.77*	0.000	*0.99*
Total Fat (gm)	**0.013**	*0.05*	0.01	*0.09*	**-0.015**	*0.02*	-0.002	*0.75*	-0.002	*0.72*	0.007	*0.15*
Total Saturated Fat (gm)	**0.006**	*0.01*	**0.00**	*0.04*	**-0.005**	*0.02*	-0.001	*0.66*	0.000	*0.90*	**0.004**	*0.02*
Energy (kcal)	0.086	*0.46*	0.07	*0.59*	-0.152	*0.21*	0.017	*0.89*	-0.066	*0.52*	0.052	*0.58*
Total Sugars (gm)	-0.004	*0.53*	0.00	*0.77*	0.003	*0.71*	-0.002	*0.82*	-0.002	*0.80*	-0.011	*0.07*
Cholesterol (mg)	**0.055**	*0.00*	**0.04**	*0.01*	**-0.060**	*0.00*	**-0.038**	*0.01*	-0.005	*0.76*	0.007	*0.65*
Caffeine (mg)	-0.004	*0.39*	0.00	*0.51*	0.001	*0.91*	0.003	*0.38*	-0.004	*0.32*	0.000	*0.91*

[a] Weighted according to NHANES analytic guidelines.

[b] Radius matching with a 0.1 caliper is shown, however, other matching algorithms produced similar results. Bold indicates significance at the 0.05 significance level.

[c] Standard errors bootstrap with 500 replications.

[d] Sodium has been adjusted for salt use in food preparation.

[*] PSM = Propensity score matching; SD = Simple difference.

[*] Bold differences imply significance at the 0.05 level.

Table 2.6. Average Treatment Effects Comparing Majority Weekly NSLP Participation (≥ 3 Days Per Week), Varying NSBP Usage [abc]

	NSLP ≥ 3; NSBP = 0 [a]			NSLP ≥ 3; NSBP = N/A [b]	
	PSM Diff.			PSM Diff.	
Nutritional Outcomes	Radius	*p-value*		Radius	*p-value*
Grams of food (grams)	48.1	*0.10*	*	**51.9**	*0.02*
Calories	67.4	*0.06*	*	**60.0**	*0.00*
Vitamins (Percentage of RDA)					
Vitamin A	1.5	*0.61*	*	**6.9**	*0.00*
Vitamn C	3.5	*0.57*		-9.9	*0.15*
Thiamin	4.5	*0.15*	*	**5.6**	*0.05*
Riboflavin	**10.3**	*0.00*		**15.7**	*0.00*
Niacin	2.5	*0.47*	*	3.1	*0.28*
Vitamin B_6	3.2	*0.28*	*	4.8	*0.06*
Vitamin B_{12}	**13.0**	*0.01*		**19.4**	*0.00*
Vitamn K	-1.6	*0.64*	*	2.4	*0.42*
Vitamin E (alpha-tocopherol)	0.8	*0.56*		**2.5**	*0.03*
Minerals (Percentage of RDA)					
Calcium	**5.7**	*0.00*		**8.1**	*0.00*
Phosphorus	**6.6**	*0.02*		**8.5**	*0.00*
Magnesium	2.9	*0.11*	*	**5.0**	*0.00*
Iron	2.6	*0.26*	*	3.5	*0.13*
Zinc	3.7	*0.15*	*	**6.9**	*0.00*
Copper	**5.5**	*0.05*		**6.8**	*0.01*
Sodium [d]	**13.0**	*0.01*		6.7	*0.12*
Potassium	**2.5**	*0.01*		**3.3**	*0.00*
Selenium	6.6	*0.15*	*	**8.2**	*0.03*
Other Dietary Components					
Carbohydrates (% of RDA)	4.6	*0.18*	*	3.5	*0.26*
Dietary Fiber (% of RDA)	1.2	*0.21*	*	**1.6**	*0.05*
Protein (% of RDA)	**9.5**	*0.04*		**11.8**	*0.00*
Total Poly Unsaturated Fat (% of RDA)	0.2	*0.94*	*	2.4	*0.43*
Total Fat (gm)	**3.7**	*0.02*		**3.1**	*0.03*
Total Saturated Fat (gm)	**1.8**	*0.00*		**1.6**	*0.00*
Energy (kcal)	**67.8**	*0.05*		57.1	*0.06*
Total Sugars (gm)	0.4	*0.89*		1.0	*0.67*
Cholesterol (mg)	**13.0**	*0.03*		6.6	*0.17*
Caffeine (mg)	-0.2	*0.90*		-0.2	*0.90*

[a] Weighted according to NHANES analytic guidelines.

[b] Radius matching with a 0.1 caliper is shown, however, other matching algorithms produced similar results.

[c] Standard errors bootstrap with 500 replications.

[d] Sodium has been adjusted for salt use in food preparation.

[e] Treatment is comprised of children participating in NSLP greater than or equal to 3 days per week and school does nc participate in NSBP.

[f] Treatment is comprised of children participating in NSLP greater than or equal to 3 days per week with no restrictions made regarding schools participation in NSBP.

* PSM = Propensity score matching

* Bold differences imply significance at the 0.05 level.

* Asterisks incidate a diffence in significance levels between table 2.5 and the results given in table 2.7.

treatment assignment scheme that involves children participating at least three days per week, instead of five days per week, but fail to control for NSBP participation, we again see striking differences. Differences are less noticeable in regards to changing significance levels but are more evident on the magnitudes of the estimates, across the board. Given the above results, failure to accurately classify treatment groups can have significant effects on any inferences and, thereby, on any policy implications.

2.5.2 TREATMENT ONE VS. TREATMENT THREE

Examination of the nutrient and mineral intakes in Table 2.7 indicates that when we compare T1 (NSLP participation by the child) versus T3 (no NSLP participation at child or school level), controlling for NSBP, children in T1 and T3 have very few significant differences across any of the meals, including lunch. This result implies that for breakfast and dinner, nutritional preferences are very similar between the NSLP participants and schools not participating. Regarding lunch, the lack of increased nutritional levels for NSLP participants does not mean that the NSLP is not working compared to nonparticipating schools, but rather that those schools not participating in the NSLP maybe finding ways to offer foods with similar nutritional contents to their students. The goal of the NSLP has never been to offer more nutritious meals than any other alternative, but to offer nutritious meals to students that need it.[9] Our results tend to suggest that the same quality, whether bad or good, is offered at schools that participate and do not participate.

---

[9] By need we do not mean those that can afford it, but rather we mean offering a meal to those that may not have the time to bring an outside meal or afford another meal.

Table 2.7. Average Treatment Effects Comparing Treatment 1 vs. Treatment 3 Using Propensity Score Matching for Major Daily Meals [abc]

	Breakfast					Lunch					Dinner					Total				
			PSM Diff.		RB Bounds [d]			PSM Diff.		RB Bounds [d]			PSM Diff.		RB Bounds [d]			PSM Diff.		RB Bounds
Nutritional Outcomes	SD	*p-value*	Radius	*p-value*	NNK	SD	*p-value*	Radius	*p-value*	NNK	SD	*p-value*	Radius	*p-value*	NNK	SD	*p-value*	Radius	*p-value*	NNK
Grams of food (grams)	18.3	*0.55*	-10.5	*0.71*	1.14	-6.6	0.88	20.7	0.61	1.05	**-103.7**	*0.04*	-26.9	*0.59*	1.05	**-269.7**	*0.03*	-183.7	*0.21*	1.10
Calories	38.0	*0.29*	10.6	*0.74*	1.37	-18.3	*0.72*	34.3	*0.48*	1.01	**-151.0**	*0.01*	-40.2	*0.50*	1.03	**-245.0**	*0.03*	-60.5	*0.58*	1.04
Vitamins (Percentage of RDA)																				
Vitamin A	**12.8**	*0.01*	6.2	*0.11*	1.11	-11.3	*0.26*	-6.2	*0.29*	1.60	-1.7	*0.77*	-2.0	*0.74*	1.28	4.8	*0.72*	-4.1	*0.70*	1.29
Vitamn C	0.6	*0.95*	-6.5	*0.41*	1.19	-2.6	*0.70*	1.7	*0.83*	1.16	-16.5	*0.37*	-33.3	*0.07*	**1.23**	**-50.4**	*0.05*	**-60.1**	*0.04*	1.09
Thiamin	9.0	*0.16*	0.5	*0.93*	1.33	1.2	*0.78*	3.2	*0.51*	1.02	-13.1	*0.04*	-9.9	*0.15*	**1.17**	-8.8	*0.46*	-11.0	*0.37*	1.06
Riboflavin	14.6	*0.09*	3.8	*0.61*	1.21	**10.6**	*0.05*	5.5	*0.30*	1.04	0.5	*0.94*	-3.7	*0.59*	1.13	26.0	*0.10*	6.4	*0.67*	1.25
Niacin	9.3	*0.09*	0.2	*0.96*	1.25	-1.9	*0.70*	-2.5	*0.61*	1.29	-8.5	*0.16*	-0.8	*0.90*	1.03	-9.0	*0.39*	-5.7	*0.60*	1.11
Vitamin B_6	11.3	*0.15*	0.0	*1.00*	1.14	-3.2	*0.40*	-2.1	*0.61*	1.12	-0.5	*0.93*	0.2	*0.98*	1.12	0.8	*0.95*	-1.8	*0.89*	1.33
Vitamin B_{12}	**27.4**	*0.05*	8.3	*0.46*	1.07	8.3	*0.31*	3.8	*0.62*	1.09	-2.1	*0.95*	-6.8	*0.82*	1.30	47.3	*0.23*	11.3	*0.75*	1.60
Vitamn K	1.6	*0.40*	0.0	*0.99*	1.50	-11.7	*0.12*	-10.2	*0.09*	**1.19**	-40.4	*0.21*	-55.0	*0.29*	1.46	-51.7	*0.13*	-69.3	*0.19*	1.14
Vitamin E (alpha-tocopherol)	-1.7	*0.45*	-1.2	*0.37*	1.38	-0.8	*0.65*	0.2	*0.91*	1.19	-3.9	*0.24*	-2.1	*0.48*	1.16	-8.2	*0.16*	-5.1	*0.36*	1.14
Minerals (Percentage of RDA)																				
Calcium	5.4	*0.08*	1.0	*0.68*	1.21	4.7	*0.09*	2.9	*0.28*	1.11	-5.0	*0.15*	-1.5	*0.63*	1.01	3.9	*0.60*	-0.2	*0.98*	1.39
Phosphorus	6.6	*0.06*	2.4	*0.39*	1.20	5.1	*0.25*	-0.1	*0.99*	1.01	-4.1	*0.40*	-2.4	*0.61*	1.04	6.0	*0.60*	-2.3	*0.83*	1.30
Magnesium	2.2	*0.43*	0.1	*0.98*	1.37	4.0	*0.11*	0.5	*0.84*	1.02	-1.2	*0.75*	-3.0	*0.41*	1.08	5.7	*0.48*	-2.1	*0.79*	1.16
Iron	13.5	*0.13*	4.9	*0.49*	1.09	-1.7	*0.63*	0.2	*0.94*	1.31	-8.1	*0.18*	-4.6	*0.41*	1.01	1.3	*0.92*	-3.7	*0.76*	1.12
Zinc	8.2	*0.20*	0.9	*0.87*	1.16	-1.4	*0.70*	-3.9	*0.32*	1.25	0.0	*1.00*	0.0	*1.00*	1.16	7.3	*0.55*	-2.6	*0.82*	1.40
Copper	2.8	*0.43*	-0.6	*0.84*	1.06	2.6	*0.51*	2.2	*0.59*	1.02	-12.7	*0.05*	-10.0	*0.12*	1.17	-11.7	*0.30*	-12.8	*0.25*	1.03
Sodium [e]	**10.2**	*0.01*	6.5	*0.09*	1.12	5.4	*0.48*	7.9	*0.30*	1.12	-20.1	*0.03*	-7.9	*0.37*	1.15	-12.6	*0.36*	0.7	*0.96*	1.23
Potassium	0.8	*0.50*	0.4	*0.66*	1.34	0.4	*0.76*	1.5	*0.25*	1.14	-2.2	*0.27*	-1.4	*0.46*	1.20	-3.7	*0.29*	0.4	*0.90*	1.18
Selenium	**10.27**	*0.04*	6.92	*0.10*	1.19	1.2	0.86	-4.2	0.55	1.45	-1.1	*0.92*	0.3	*0.98*	1.02	20.8	*0.28*	7.6	*0.66*	1.09
Other Dietary Components																				
Carbohydrates (% of RDA)	3.2	*0.47*	-1.1	*0.77*	1.18	-0.7	*0.89*	3.1	*0.49*	1.09	-16.4	*0.00*	-4.4	*0.44*	1.03	**-28.1**	*0.01*	-11.8	*0.28*	1.07
Dietary Fiber (% of RDA)	1.1	*0.46*	0.3	*0.77*	1.37	-0.2	*0.89*	0.4	*0.74*	1.22	-4.9	*0.02*	-3.1	*0.14*	1.01	-4.7	*0.19*	-2.8	*0.41*	1.09
Protein (% of RDA)	**9.2**	*0.03*	4.8	*0.19*	1.19	8.0	*0.22*	-1.9	*0.78*	1.09	2.7	*0.77*	2.6	*0.76*	1.12	22.2	*0.12*	6.6	*0.64*	1.27
Total Poly Unsaturated Fat (% of RDA)	1.6	*0.43*	1.1	*0.58*	1.21	-6.7	*0.24*	-3.2	*0.61*	1.06	-7.7	*0.18*	-3.3	*0.60*	1.56	**-18.3**	*0.04*	-6.0	*0.55*	1.32
Total Fat (gm)	1.6	*0.23*	1.1	*0.36*	1.30	-1.4	*0.58*	2.6	*0.27*	1.24	-5.9	*0.04*	-2.5	*0.37*	1.02	-9.1	*0.07*	-0.4	*0.92*	1.19
Total Saturated Fat (gm)	0.8	*0.08*	0.6	*0.25*	1.24	0.3	*0.74*	**1.5**	*0.05*	1.26	-2.0	*0.07*	-0.9	*0.38*	1.04	-1.9	*0.32*	0.3	*0.86*	1.20
Energy (kcal)	39.3	*0.27*	12.1	*0.70*	1.36	-18.5	*0.71*	37.2	*0.45*	1.02	-147.7	*0.01*	-37.3	*0.52*	1.03	**-260.1**	*0.02*	-60.2	*0.56*	1.04
Total Sugars (gm)	-0.5	*0.90*	-1.0	*0.74*	1.44	-0.3	*0.94*	-0.4	*0.91*	1.21	-9.1	*0.03*	-5.4	*0.24*	1.24	**-22.5**	*0.02*	-14.8	*0.09*	1.16
Cholesterol (mg)	8.3	*0.40*	13.8	*0.11*	1.08	1.3	*0.88*	1.2	*0.89*	1.01	-2.0	*0.87*	-6.5	*0.62*	1.02	10.7	*0.59*	9.1	*0.66*	1.28
Caffeine (mg)	-0.9	*0.54*	-2.6	*0.15*	1.83	-5.9	*0.08*	-0.9	*0.64*	1.46	-5.3	*0.08*	-2.2	*0.43*	1.10	**-17.2**	*0.04*	-7.9	*0.16*	1.15

[a] Weighted according to NHANES analytic guidelines.

[b] Radius matching with a 0.1 caliper is shown, however, other matching algorithms produced similar results. Bold indicates significance at the 0.05 significance level.

[c] Standard errors bootstrap with 500 replications.

[d] Rosenbaum bounds are intrepreted as follows: if bold, then the unobserved bias must increase the odds of partipation in the treatment, given the same covariates, by the value of the bound to change the statisitical inference to insignificant at the 0.05 level; if non-bold, then the bound must increase the odds of participation by the value of the bounds to change the inference to significant at the 0.05 level.

[e] Sodium has been adjusted for salt use in food preparation.

[*] PSM = Propensity score matching; SD = Simple difference; RB Bounds = Rosenbaum Bounds; NNK = Nearest-neighbor matching with replacement.

[*] Bold differences imply significance at the 0.05 level.

2.5.3 TREATMENT TWO VS. TREATMENT THREE

A comparison of T2 (child does not participate, but school participates) and T3 (no participation by either child or school) indicates no significant differences in nutritional quality at breakfast (Table 2.8). However, results indicate that several minerals and dietary components are significantly less for T2 than T3 from dinner meals. Interestingly, the significant outcomes from dinner meals tend to be insignificant from lunch meals. For instance, T2 has a significantly lower Vitamin C consumption at 26.8% of RDA at dinner but a non-significant lower vitamin C reduction of 5.2% of RDA at lunch than T3. The reason for these differences is unknown, but need to be considered when interpreting and making policy recommendations regarding the programs.

Examination of the lunch meal produces some interesting findings, namely that the results mimic the results from the T1 versus T3 comparison. For instance, Vitamin A intakes are significantly different between T1 and T2 and between T2 and T3 with differences of 10.6% RDA and -12.7% RDA, respectively. It is possible that non-participating schools are utilizing other programs, whether governmental or not, that work in a similar way as the NSLP, thereby, resulting in the same nutritional outcomes as the NSLP.

Also, we see lower total consumption (grams of food) by children that are exposed to the program but do not participate compared with students that do not have the option to participate. Specifically, children attending schools that do not participate consume 69 grams more food at lunch than their counterparts. Furthermore, the results

Table 2.8. Average Treatment Effects Comparing Treatment 2 vs. Treatment 3 Using Propensity Score Matching for Major Daily Meals [abc]

	Breakfast					Lunch					Dinner					Total				
			PSM Diff.		RB Bounds [d]			PSM Diff.		RB Bounds [d]			PSM Diff.		RB Bounds [d]			PSM Diff.		RB Bounds
Nutritional Outcomes	SD	*p-value*	Radius	*p-value*	NNK	SD	*p-value*	Radius	*p-value*	NNK	SD	*p-value*	Radius	*p-value*	NNK	SD	*p-value*	Radius	*p-value*	NNK
Grams of food (grams)	31.4	*0.40*	35.0	*0.30*	1.37	-83.0	*0.08*	**-69.0**	*0.05*	1.21	**-163.4**	0.00	-89.1	*0.08*	**1.15**	**-326.4**	*0.02*	**-327.2**	*0.04*	1.16
Calories	40.3	*0.31*	67.7	*0.07*	1.38	**-134.6**	*0.01*	**-97.8**	*0.04*	1.06	**-201.9**	0.00	-100.0	*0.09*	1.11	**-326.3**	*0.01*	-155.0	*0.17*	1.01
Vitamins (Percentage of RDA)																				
Vitamin A	5.4	*0.31*	5.27	*0.24*	1.43	**-23.3**	*0.02*	**-12.7**	*0.04*	1.29	-1.6	*0.81*	1.2	*0.73*	1.72	-19.2	*0.20*	-7.1	*0.55*	1.03
Vitamn C	9.3	*0.38*	6.50	*0.39*	1.3	-0.5	*0.96*	**-5.2**	*0.45*	1.12	**-36.7**	*0.03*	**-26.8**	*0.01*	**1.10**	-40.0	*0.18*	-26.0	*0.31*	1.26
Thiamin	4.5	*0.46*	5.98	*0.32*	1.25	-4.5	*0.43*	-6.8	*0.12*	1.02	**-21.1**	*0.00*	-9.5	*0.13*	1.20	**-26.6**	*0.03*	-15.0	*0.20*	1.02
Riboflavin	6.5	*0.47*	7.63	*0.36*	1.19	**-12.2**	*0.02*	**-11.1**	*0.01*	1.18	-10.9	*0.08*	-7.0	*0.22*	1.10	-17.1	*0.25*	-11.6	*0.40*	1.01
Niacin	8.1	*0.14*	6.58	*0.22*	1.34	**-11.6**	*0.01*	**-10.5**	*0.01*	1.20	-11.3	*0.07*	-8.4	*0.16*	1.16	-20.7	*0.07*	-13.7	*0.23*	1.17
Vitamin B_6	7.3	*0.37*	8.18	*0.26*	1.43	**-9.5**	*0.04*	**-9.0**	*0.02*	1.20	-7.5	*0.19*	-8.4	*0.13*	1.19	-14.7	*0.27*	-7.3	*0.56*	1.29
Vitamin B_{12}	9.6	*0.50*	7.81	*0.54*	1.09	**-21.6**	*0.01*	**-18.9**	*0.01*	1.06	-13.2	*0.67*	-19.9	*0.48*	1.15	-22.0	*0.55*	-34.0	*0.30*	1.20
Vitamn K	-1.69	*0.15*	-0.97	*0.41*	1.62	**-16.02**	*0.03*	**-8.65**	*0.02*	1.17	-35.07	*0.28*	-75.38	*0.22*	**1.02**	-60.3	*0.08*	-90.2	*0.16*	**1.01**
Vitamin E (alpha-tocopherol)	0.0	*0.99*	0.79	*0.52*	1.40	-2.0	*0.33*	-2.2	*0.19*	1.21	**-7.6**	*0.02*	**-5.2**	*0.01*	**1.33**	-6.5	*0.44*	-2.7	*0.68*	1.24
Minerals (Percentage of RDA)																				
Calcium	0.5	*0.87*	3.1	*0.41*	1.3	**-7.1**	*0.01*	**-5.0**	*0.03*	1.06	**-8.2**	*0.01*	-2.5	*0.30*	1.06	**-16.2**	*0.01*	-6.4	*0.33*	1.04
Phosphorus	0.7	*0.81*	3.3	*0.28*	1.36	-12.7	*0.00*	**-10.4**	*0.00*	**1.24**	-8.8	*0.07*	-4.1	*0.26*	1.15	**-24.3**	*0.01*	-13.1	*0.13*	1.14
Magnesium	1.2	*0.67*	1.6	*0.42*	1.4	-4.4	*0.06*	**-5.1**	*0.02*	1.03	**-7.7**	*0.02*	**-6.5**	*0.03*	**1.26**	-14.1	*0.07*	**-13.0**	*0.04*	1.03
Iron	22.9	*0.07*	19.9	*0.07*	1.48	**-7.3**	*0.04*	-4.9	*0.15*	1.13	**-20.1**	*0.00*	**-13.7**	*0.00*	**1.35**	-8.8	*0.58*	-4.0	*0.78*	1.02
Zinc	1.4	*0.80*	4.1	*0.40*	1.39	**-12.2**	*0.00*	**-12.0**	*0.00*	**1.20**	-8.7	*0.22*	-7.2	*0.23*	1.11	-19.7	*0.09*	-15.8	*0.14*	1.04
Copper	2.4	*0.46*	3.0	*0.24*	1.28	-7.0	*0.06*	-5.6	*0.13*	1.06	**-21.7**	*0.00*	**-12.8**	*0.01*	**1.34**	**-30.7**	*0.01*	-17.2	*0.10*	1.03
Sodium [e]	7.3	*0.07*	**7.4**	*0.05*	1.06	**-16.2**	*0.04*	**-15.3**	*0.02*	1.01	**-27.1**	*0.00*	-8.8	*0.27*	1.09	**-44.2**	*0.00*	-23.0	*0.08*	1.21
Potassium	1.0	*0.41*	1.9	*0.09*	1.26	**-4.2**	*0.00*	**-2.7**	*0.03*	1.05	-3.1	*0.08*	-2.0	*0.24*	1.06	**-7.3**	*0.03*	-1.9	*0.56*	1.39
Selenium	7.4	*0.16*	5.7	*0.15*	1.11	**-20.5**	*0.00*	**-19.7**	*0.00*	**1.27**	-12.3	*0.25*	-3.3	*0.71*	1.13	-26.5	*0.11*	-19.7	*0.19*	1.28
Other Dietary Components																				
Carbohydrates (% of RDA)	3.2	*0.52*	7.4	*0.11*	1.45	-5.5	*0.27*	-4.7	*0.30*	1.30	**-26.1**	*0.00*	**-11.7**	*0.04*	1.17	**-31.5**	*0.01*	-12.2	*0.34*	1.01
Dietary Fiber (% of RDA)	2.9	*0.07*	**2.7**	*0.03*	1.32	-1.4	*0.35*	-1.9	*0.11*	1.19	**-7.2**	*0.00*	**-5.2**	*0.01*	**1.26**	**-7.9**	*0.03*	-5.7	*0.09*	1.02
Protein (% of RDA)	4.4	*0.21*	3.6	*0.26*	1.21	**-20.4**	*0.00*	**-19.0**	*0.00*	**1.27**	-10.2	*0.24*	-7.7	*0.29*	1.06	**-28.5**	*0.04*	**-24.8**	*0.04*	1.04
Total Poly Unsaturated Fat (% of RDA)	0.9	*0.70*	2.0	*0.30*	1.3	-11.5	*0.08*	**-11.9**	*0.05*	1.08	-7.4	*0.32*	-7.6	*0.24*	1.07	-12.1	*0.33*	-11.8	*0.30*	1.27
Total Fat (gm)	1.6	*0.27*	2.2	*0.12*		**-8.1**	*0.00*	**-5.2**	*0.03*	1.06	-5.6	*0.07*	-3.9	*0.17*	1.11	**-12.9**	*0.01*	-7.5	*0.12*	1.02
Total Saturated Fat (gm)	0.8	*0.13*	0.9	*0.12*	1.39	**-2.8**	*0.00*	**-1.6**	*0.05*	1.02	**-2.1**	*0.05*	-1.2	*0.22*	**1.17**	**-4.5**	*0.02*	-2.5	*0.14*	**1.18**
Energy (kcal)	38.0	*0.32*	65.0	*0.08*	1.36	**-135.7**	*0.01*	**-98.5**	*0.05*	1.06	**-197.0**	*0.00*	-95.2	*0.10*	1.09	**-335.1**	*0.01*	-150.2	*0.18*	1.01
Total Sugars (gm)	-1.31	*0.73*	3.90	*0.28*	1.22	-0.37	*0.93*	-0.58	*0.89*	1.15	**-15.41**	*0.00*	**-10.13**	*0.02*	**1.56**	**-20.8**	*0.05*	-10.4	*0.36*	1.09
Cholesterol (mg)	22.9	*0.20*	19.9	*0.15*	1.11	**-32.0**	*0.00*	**-26.7**	*0.00*	**1.25**	-5.8	*0.59*	-11.8	*0.35*	1.25	-14.6	*0.58*	-16.9	*0.45*	1.57
Caffeine (mg)	-1.5	*0.27*	-2.1	*0.18*	1.18	-2.9	*0.50*	1.0	*0.71*	1.68	-2.7	*0.48*	-5.1	*0.17*	**1.66**	-13.9	*0.12*	-10.2	*0.14*	1.13

[a] Weighted according to NHANES analytic guidelines.

[b] Radius matching with a 0.1 caliper is shown, however, other matching algorithms produced similar results. Bold indicates significance at the 0.05 significance level.

[c] Standard errors bootstrap with 500 replications.

[d] Rosenbaum bounds are intrepreted as follows: if bold, then the unobserved bias must increase the odds of partipation in the treatment, given the same covariates, by the value of the bound to change the statisitical inference to insignificant at the 0.05 level; if non-bold, then the bound must increase the odds of participation by the value of the bounds to change the inference to significant at the 0.05 level.

[e] Sodium has been adjusted for salt use in food preparation.

[*] PSM = Propensity score matching; SD = Simple difference; RB Bounds = Rosenbaum Bounds; NNK = Nearest-neighbor matching with replacement.

[*] Bold differences imply significance at the 0.05 level.

show that there are basically no differences between T1 and T3, but significant differences between T1 and T2 and between T2 and T3. Given these results, it appears that there is no positive “residual impact” associated with offering and not participating in the NSLP except for lower consumption. Our hypothesis was that schools participating would offer higher quality foods than schools that do not participate, thereby, children choosing not to participate would gain from higher quality food standards associated with their school’s NSLP participation. Given the results from Table 2.5, children across all treatment groups consumed the same quality per gram, with the only difference being the amount consumed. From these results it appears that NSLP participants and school nonparticipants may be suffering from overconsumption of food at lunch, not less quality.

2.5.4 HEALTHY EATING INDEX AND BLOOD LEVELS

The HEI and its’ component scores are indicators of healthy eating. It should be noted that high vitamin, mineral, and dietary component levels may or may not lead to higher HEI scores depending on the foods consumed and amount consumed. For instance, if a person eats several items high in Vitamin A, then there may be extreme gains in Vitamin A RDA consumption, but only a minimal gain in component scores since the sources of Vitamin A are spread out. Table 2.9 shows that when comparing T1 and T2, there is no real gain in dietary quality for the NSLP participants; i.e., the HEI difference between T1 and T2 is insignificant. However, when comparing T1 and T3, the T1 treatment (NSLP participants) has higher scores in fat, dairy, and variety

Table 2.9. Average Treatment Effects Using Simple Differences and Propensity Score Matching for HEI and Components Along with Blood Levels [abc]

	Treatment 1 vs. Treatment 2				Treatment 2 vs. Treatment 3				Treatment 1 vs. Treatment 3			
			PSM Diff.				PSM Diff.				PSM Diff.	
Nutritional Outcomes	SD	*p-value*	Radius	*p-value*	SD	*p-value*	Radius	*p-value*	SD	*p-value*	Radius	*p-value*
HEI and Component Scores												
Fat Score	-0.24	*0.70*	-0.45	*0.45*	**1.93**	*0.01*	**2.16**	*0.00*	**1.69**	*0.01*	**1.27**	*0.04*
Saturated Fat Score	-0.55	*0.43*	-0.32	*0.67*	1.32	*0.10*	**1.72**	*0.01*	0.76	*0.30*	1.00	*0.16*
Sodium Score	-0.39	*0.62*	-0.58	*0.43*	**1.85**	*0.02*	1.18	*0.09*	1.46	*0.03*	0.54	*0.43*
Cholesterol Score	-0.67	*0.37*	-0.53	*0.39*	**1.55**	*0.05*	0.73	*0.31*	0.89	*0.27*	0.23	*0.74*
Grain Score	0.10	*0.85*	0.03	*0.95*	0.68	*0.29*	0.50	*0.37*	0.77	*0.24*	0.52	*0.36*
Fruit Score	-0.71	*0.29*	-0.29	*0.61*	0.27	*0.72*	0.19	*0.77*	-0.43	*0.54*	-0.41	*0.50*
Vegetable Score	0.24	*0.72*	0.37	*0.61*	-0.28	*0.70*	0.30	*0.62*	-0.04	*0.95*	0.28	*0.64*
Meat Score	0.18	*0.79*	0.83	*0.15*	**1.42**	*0.05*	0.29	*0.63*	**1.60**	*0.02*	1.12	*0.08*
Dairy Score	0.47	*0.48*	-0.08	*0.91*	**1.46**	*0.05*	**1.25**	*0.05*	**1.93**	*0.01*	**1.52**	*0.02*
Variety Score	0.29	*0.63*	0.44	*0.46*	1.18	*0.10*	0.56	*0.35*	**1.47**	*0.04*	**1.28**	*0.03*
HEI	-1.30	*0.61*	-0.84	*0.73*	**11.39**	*0.01*	**8.87**	*0.01*	**10.09**	*0.02*	**7.34**	*0.02*
Blood Levels												
Total calcium (mmol/L)	0.02	*0.22*	0.00	*0.87*	0.00	*0.86*	0.01	*0.49*	0.02	*0.16*	0.01	*0.35*
Total cholesterol (mmol/L)	0.05	*0.72*	0.07	*0.59*	-0.08	*0.53*	-0.16	*0.14*	-0.03	*0.75*	-0.08	*0.42*
Total iron (umol/L)	**2.69**	*0.04*	1.53	*0.16*	-0.51	*0.65*	0.12	*0.89*	2.18	*0.06*	1.54	*0.08*
Total phosphorus (mmol/L)	**0.10**	*0.01*	**0.06**	*0.03*	0.04	*0.24*	0.02	*0.30*	**0.14**	*0.00*	**0.08**	*0.00*
Total protein (g/L)	-0.67	*0.29*	-0.53	*0.37*	0.22	*0.72*	0.74	*0.16*	-0.45	*0.46*	0.07	*0.90*
Total sodium (mmol/L)	0.21	*0.53*	0.30	*0.32*	-0.32	*0.26*	-0.03	*0.91*	-0.11	*0.68*	0.34	*0.15*
Total potassium (mmol/L)	0.05	*0.31*	0.00	*0.98*	0.01	*0.75*	0.04	*0.31*	0.06	*0.13*	0.05	*0.17*

[a] Weighted according to NHANES analytic guidelines.

[b] Radius matching with a 0.1 caliper is shown, however, other matching algorithms produced similar results. Bold indicates significance at the 0.05 significance level.

[c] Standard errors bootstrap with 500 replications.

[*] PSM = Propensity score matching; SD = Simple difference; RB Bounds = Rosenbaum Bounds; NNK = Nearest-neighbor matching with replacement.

[*] Bold differences imply significance at the 0.05 level.

components as well as overall HEI. For instance, T1 has a 1.69 (or 16.9%) higher fat score than T3. Given that we did not see significant gains across meals for NSLP participants, these healthy eating gains could be coming from either an accumulation throughout the day or via snack consumption. A comparison of T2 and T3 indicates that T2 (school participation only) has higher scores in fat, saturated fat, and dairy components as well as HEI. These findings tend to fit with our previous results that children choosing not to participate have healthier eating habits than non-participants who do not have the option to participate or not.

Examining the results on blood levels in Table 2.9 indicates that, for the most part, there are few significant differences between treatment groups. The only exception is for phosphorus when comparing T1 and T2 and when comparing T1 and T3. In both cases, we see higher phosphorus levels for the NSLP participants. Phosphorus can be found in significant levels in dairy and meat (Linus Pauling Institute), which may indicate that prolonged exposure to dairy, approximately 0.6 servings per participation day, could be leading to increased phosphorus levels.

2.5.5 TREATMENT 1A VS. TREATMENT 1B

We also examined whether children paying free/reduced prices for a NSLP lunch (T1A) have different dietary quality than children paying full price for a NSLP lunch (T1B). We found no differences across the nutritional components, Table 2.10, implying that NSLP has no effect on dietary quality between these groups of children. This finding is expected given that governmental guidelines set forth contain certain standards as to food content, while also establishing how many foods must be chosen by participants.

2.6 CONCLUDING REMARKS

Previous studies have provided very mixed findings as to the NSLP's effect on dietary quality of school children. In this paper, we reexamined this issue and contributed to the literature in different ways. First, we addressed problems, which have been inherent with previous analyses, by designing a new treatment assignment scheme. Specifically, we defined NSLP participants as those that have participated in the program every day during a week and defined nonparticipants as those participating zero days, since including children who participated only one, two, three, or four days a week would have misclassified a number of the students. We further designated nonparticipants by school participation. We then expanded the examination of the NSLP by not only accounting for student participation, but also for school participation in both the NSLP and NSBP.

Table 2.10. Average Treatment Effects Comparing Children Paying Reduced/Free Price (Treated) vs. Children Paying Full Price [abc]

Nutritional Outcomes	SD	*p-value*	PSM Diff. Radius	*p-value*
Grams of food (grams)	**-132.6**	*0.02*	-27.0	*0.75*
Calories	**-129.2**	*0.05*	-26.5	*0.80*
Vitamins (Percentage of RDA)				
Vitamin A	-1.6	*0.66*	**9.7**	*0.01*
Vitamn C	3.1	*0.75*	11.3	*0.44*
Thiamin	-7.5	*0.17*	0.0	*1.00*
Riboflavin	-10.5	*0.21*	9.5	*0.33*
Niacin	**-12.7**	*0.05*	4.2	*0.54*
Vitamin B_6	-6.8	*0.17*	6.9	*0.36*
Vitamin B_{12}	**-21.7**	*0.03*	13.7	*0.18*
Vitamn K	-4.3	*0.46*	4.1	*0.32*
Vitamin E (alpha-tocopherol)	-4.8	*0.06*	0.7	*0.78*
Minerals (Percentage of RDA)				
Calcium	-3.6	*0.33*	4.2	*0.35*
Phosphorus	-10.2	*0.07*	3.2	*0.65*
Magnesium	-6.4	*0.08*	4.1	*0.38*
Iron	-7.7	*0.06*	2.1	*0.94*
Zinc	-5.5	*0.23*	7.5	*0.15*
Copper	-7.5	*0.16*	5.1	*0.51*
Sodium [d]	**-21.2**	*0.03*	6.5	*0.59*
Potassium	-3.0	*0.11*	0.3	*0.91*
Selenium	**-22.8**	*0.01*	8.5	*0.38*
Other Dietary Components				
Carbohydrates (% of RDA)	**-13.5**	*0.03*	-9.7	*0.37*
Dietary Fiber (% of RDA)	-2.4	*0.18*	1.5	*0.55*
Protein (% of RDA)	-15.6	*0.11*	14.4	*0.14*
Total Poly Unsaturated Fat (% of RDA)	-0.8	*0.92*	2.7	*0.76*
Total Fat (gm)	-3.8	*0.27*	1.1	*0.78*
Total Saturated Fat (gm)	-1.6	*0.18*	0.8	*0.56*
Energy (kcal)	**-128.7**	*0.05*	-26.0	*0.80*
Total Sugars (gm)	-7.0	*0.16*	-10.2	*0.24*
Cholesterol (mg)	-19.3	*0.09*	20.4	*0.08*
Caffeine (mg)	-3.1	*0.43*	-1.6	*0.52*

[a] Weighted according to NHANES analytic guidelines.

[b] Radius matching with a 0.1 caliper is shown, however, other matching algorithms produced similar results.

[c] Standard errors bootstrap with 500 replications.

[d] Sodium has been adjusted for salt use in food preparation.

[*] PSM = Propensity score matching; SD = Simple difference.

[*] Bold differences imply significance at the 0.05 level.

Comparing students participating in the NSLP versus students attending participating schools but choose to not participate produces results that are similar to previous studies in regards to finding increased vitamin and mineral intakes along with increases in fat intakes, thereby, lending credence to the fact that the NSLP, on the whole, does affect nutritional outcomes (good and bad). However, our results also indicate that the effect of NSLP on dietary outcomes is most likely due to quantity and not quality differences. Specifically, food grams consumed at lunch are significantly higher for NSLP participants and those schools not participating, while per gram vitamin and mineral intakes are not significantly different. Our results also showed that children in schools participating in the NSLP versus schools not participating have very similar vitamin, mineral and dietary component levels, while also having similar quantities consumed at lunch. Furthermore, we found no positive gain residual impact at lunch for children choosing not to participate compared with schools not participating, other than lower food consumption levels.

Hence, we can see that policies wanting to increase the impact of the NSLP program should not only place their efforts on increasing quality levels, but should also focus on efforts that lower quantity consumed. For instance if focus is placed on increasing nutritional quality, then guidelines may need to cut back on quantity and focus more on quality per serving. Schools not participating in the NSLP should also follow suit by increasing quality so as to increase the nutritional health of children.

CHAPTER III

ANALYSIS OF FOOD AWAY FROM HOME EXPENDITURES BY MEAL OCCASION: ARE TRANSACTIONAL VARIABLES IMPORTANT?

3.1 INTRODUCTION

Trends in U.S. consumer spending are constantly changing given evolving lifestyles. A quick look back four to five decades shows an extremely different household structure compared to today, namely a two parent, single income household where the wife was a stay-at-home mother. Given the norms in that era, the wife tended to prepare each meal at-home, eliminating much of the need to eat-away-from home. In 1960-1961, approximately 21% of the food allocated budget was spent away-from-home. However, by 1984-1985 and continuing until 2002-2003, approximately 40% of the food budget was spent away-from-home (Department of Labor 2006). As noted by Putnam and Van Dress (1984), numerous factors have contributed to increased consumption of food away-from-home (FAFH), most notably: more women in the workforce, more two income households, and advertising and promotion by food chains.

The factors described by Putnam and Van Dress (1984) continue to hold two-decades later as verified by numerous FAFH studies. For example, labor force participation rate of women as well as the number of two-income households have continued to increase, thereby making the need for convenience a necessity given the increased number of hours household members are away-from-home. Future projections indicate that FAFH expenditures will continue to increase through the next decade (Blisard, Variyam, and Cromartie 2003; Stewart et al. 2004).

If future projections are correct, then understanding consumer FAFH consumption and expenditure behavior will become increasingly important for a variety of reasons, namely business decision making and health issues. In other words, research exploring factors affecting FAFH expenditures can have a clear and direct impact on the business sector since it can facilitate more informed decision making by businesses. However, FAFH expenditures not only have an impact on business, but they could also have a direct effect on present health issues, such as increasing obesity rates. As has been widely reported, FAFH consumption can be a major contributor to obesity, which in turn may lead to other health issues (Binkley, Eales, and Jekanowski 2000; Bowman and Vinyard 2004). For instance, FAFH consumption, especially given the low time costs associated with FAFH, can lead to self-control problems (Cutler, Glaeser, and Shapiro 2003) and increased consumption of foods low in dietary quality (Lin, Guthrie, and Frazao 1999). Hence, gaining an understanding of the factors influencing FAFH expenditures and the profile of consumers who eat FAFH will be important not only for businesses but for governmental policy makers as well. For this reason, considerable energy has been devoted to determining the demographic and socio-economic factors that drive FAFH consumption. Results have generally found that wife's employment level, household size, and household income play pivotal roles in both the probability of meal participation and expenditure level (Jensen and Yen 1996; Nayga 1996; Mutlu and Gracia 2006).

However, these studies, and other similar studies, have focused only on the demographic and socio-economic factors with no attention paid to transactional level (e.g. promotions and facility characteristics) factors and past purchasing behavior that theoretically should be important to the expenditure decision. Failure to include these transactional level factors results in failure to accurately represent the expenditure decision, thereby, potentially leading to biased effects. The study by Hiemstra and Kim (1995) attempted to account for transactional level factors (e.g. travel time to facility, payment method, and coupon usage). However, the data they used were aggregated over a two week period and their analysis did not account for censoring, thereby, making it harder to accurately measure transactional factor effects. Also, their study was conducted in early 1990s and may not represent current market conditions.

Numerous studies (e.g. Hiemstra and Kim 1995; Jensen and Yen 1996; Nayga 1996; Mutlu and Gracia 2006) have focused on FAFH expenditures by meal occasion with the main goal of identifying the factors that influence both participation in and expenditures at each meal occasion. Despite the number of studies focusing on FAFH expenditures by meal occasion, to our knowledge no study has examined the effects of traditional demographic and socio-economic variables as well as transaction specific variables and past purchasing behavior on meal occasions using transactional level data.

Our paper differs from previous studies in three aspects. First, we evaluate the effect of transaction specific variables (i.e. ordering characteristics, facility characteristics, and party composition) and previous away from home purchasing behavior on FAFH expenditures at various meal occasions (i.e., breakfast, morning snack, brunch, lunch, afternoon snack, dinner, and evening snack). As noted above, inclusion of transactional and previous purchasing behavioral variables can lead to a more accurate representation of the consumers' participation and expenditure decisions, thereby, allowing for more accurate estimation of variable effects.

Second, we model snacks and brunch separately instead of being aggregated into one "super" category. Previous studies have condensed snacks into a single category, which loses important information especially when the timing of a meal may play a role in the amount spent later in the day. For example, a consumer eating a morning snack away from home may reduce the amount spent on lunch away from home due to budget constraints. By separately analyzing snacks and brunch and by incorporating prior FAFH expenditures into each model, we can garner new information that could not have been obtained from previous studies.

Third, we formulate profiles of consumers more likely to eat out at different meal occasions. Consumer profiles can work as key drivers of business decisions by allowing businesses to better target either those more likely to be eating away from home during a specific time period or to develop strategies to increase the consumption by those less likely to be eating out at specific meal occasions. For instance, if the profile of those less likely to eat out during lunch includes older consumers with higher incomes, then a business might develop a marketing strategy, such as targeted advertising, to target older, higher income consumers to add additional consumers to their customer base. Moreover, given the potential impact of FAFH consumption on health related outcomes, policy makers can utilize consumer profiles to identify groups that might be likely to consume less healthy food products from FAFH establishments and use these as a guide in the development of policies, i.e. a fat tax, to encourage healthier eating.

3.2 CONCEPTUAL FRAMEWORK

The decision to eat out is nestled in household production theory. Household production theory holds that a household is both a producer and consumer of goods (Becker 1965; Lanscaster 1971). Production/consumption of food within the home is influenced by time constraints, income, and preferences, which can be represented by the demographic and socio-economic make-up of the household. Furthermore, the decision to eat out is also influenced by the same factors, just in potentially different ways (Byrne, Capps, and Saha 1998). Stewart and Yen (2004) indicated that the costs of consuming food at-home include prices, time spent preparing and eating food, and time cleaning up. These implicit costs are calculated during the decision process to judge the value of eating away from home. For instance, if the cost of having to prepare, consume, and clean up the meal is greater than the expected cost of food purchased while eating out, then there is value in eating out. As further noted by Stewart and Yen (2004), the optimal decision must take into account household preferences as well as time and resource constraints. This implies that in order for eating away from home to be optimal, the value placed on eating out must be greater than eating at-home subject to time and resource constraints.

Accordingly, FAFH meal occasion expenditures can be represented as:

$$E_{kj} = f(M_j, D_j, P_{jk}, T_{jk}, PC_{jk}, PM_{jr}) \qquad [3.1]$$

where E_{kj} is the expenditure at the k^{th} meal occasion by the j^{th} consumer, M represents the income of the j^{th} consumer's household, D represents the demographic variables of the j^{th} consumer and corresponding household, P_{kj} represents the promotional discounts used at the k^{th} meal occasion by the j^{th} consumer, T_{kj} represents the other transaction specific variables (i.e. facility characteristics) associated with the transaction at the k^{th} meal occasion by the j^{th} consumer, PC_{kj} represents the party composition at the k^{th} meal occasion attended by the j^{th} consumer, and PM represents both participation and expenditure at the r^{th} previous meals prior to the k^{th} meal occasion by the j^{th} consumer. Typically, previous studies have only utilized household income and demographic variables to explain expenditures. In our study, we add to the literature by also including the analysis of transaction specific variables and prior behavior on FAFH expenditures since these variables could play an important role especially given their direct relation to consumer preferences and the budget constraint.

3.3 DATA

The Consumer Reports on Eating Share Trends (CREST) for 2004 was utilized given the depth of information incorporated within the dataset. The CREST dataset comprised panelists that were randomly sampled from the U.S., but that are geographically balanced given U.S. census demographics and the nine census regions. Each day 3,000 adults and 500 teens were contacted via e-mail and asked to visit the questionnaire website. After agreeing to participate, panelists were asked to give demographic and socio-economic information along with information regarding "yesterday's" FAFH consumption. FAFH information corresponded to expenditures per meal/snack, facility characteristics, and promotional media used.

As noted above, the dataset consists of expenditures for every transaction made by each respondent for each meal eaten away from home. The percents and average expenditures for each meal occasion can be found in Table 3.1. Expenditures given by the panelists corresponded to the total bill without tip for each meal. In order to obtain per panelist expenditures per transaction, the total bill per transaction was divided by the number of persons in the party. This method was used by CREST in order to facilitate easier-to-remember, and thereby, more accurate expenditure information than could be obtained via asking for exact expenditure information.

Table 3.1. Summary Statistics by Meal Occasion Model

Meal Occasion	Percent of Observations [ab]	Avg. Exp. per Transaction ($)	Std. Dev. per Transaction
Eat-away-from-home (AFH)	56.9	--	--
Breakfast	13.0	4.4	5.2
Morning snack	4.0	2.5	2.8
Brunch	1.5	7.4	8.1
Lunch	35.9	6.5	5.5
Afternoon snack	7.8	3.1	3.5
Dinner	31.3	9.9	10.4
Evening snack	6.5	3.8	4.5
Eat at home (EAH)	43.1	--	--

[a] For AFH and EAH, the percent represents the percentage of observations (i.e. 56.9% of observations were classified as AFH), however, for each meal occasion the percent represents the percentage of observations within AFH (i.e. 13% of transactions AFH were at breakfast).

[b] Degree of censoring for each meal occasion can be found in two ways depending on which model is under consideration: 1) for censoring of only those eating AFH, 100 - % meal occasion of interest; 2) for total censoring, 100 - (% AFH * % meal occasion of interest / 100).

Demographic and socio-economic variables included in our analysis consisted of age, gender, education level, household income, region, household size, age structure of children within household, market size, and race of the responding panelist, along with survey specific variables such as time of survey (quarter of year) and day of week of survey. Transaction specific variables for each meal included: type of promotional item used[10], ordering location (i.e. at-table, drive-thru, etc), chain type, and party characteristics, along with FAFH purchasing behavior “yesterday”. Descriptions and

[10] Since the data only indicates whether a promotion was used and *not* whether a promotion was available but not used, interpretation of the promotion variables should be used with caution. Results detail the effect of a promotion if used, not the effect of promotion in general. For instance, a promotion may increase the number of consumers frequenting a business, but our estimates will not capture this effect, we are only capturing the effect of using a promotion during a transaction.

summary statistics for the transaction specific variables can be found in Tables 3.2 and 3.3, respectively. Approximately 2.4% of the observations were excluded due to missing values resulting in 696,089 observations in the final sample.[11]

The CREST dataset does not include prices, which can be considered a major component of FAFH expenditures. However, as noted by McCracken and Brandt (1987), Byrne, Capps, and Saha (1998) and Stewart and Yen (2004), indicator variables can be incorporated into a model to account for annual, seasonal and regional price differences. In our case, and consistent with Stewart and Yen (2004), respondent's region and survey quarter were included along with the additional variable of day of week in order to help control for price differences.

[11] Using table 2.1, 56.9% of the observations were FAFH transactions with the other 43.1% representing consumers that had no FAFH transaction the previous day. Accordingly, using the percentages in table 2.1 the amount of censoring ranged from 79.6% for lunch to 99.1% for breakfast.

Table 3.2. Variable Definitions of Transaction Specific Explanatory Variables

Variables [ab]	Definition
Chain type: major	Facility was a major chain store
Chain type: small	Facility was a small chain store
Chain type: independent [c]	Facility was an independent chain store
Age of Children in Party: <6 only	Meal party consists of adult plus kid[s] <6 years old only
Age of Children in Party: 6-12 only	Meal party consists of adult plus kid[s] 6-12 years old only
Age of Children in Party: 13-17 only	Meal party consists of adult plus kid[s] 13-17 years old only
Age of Children in Party: <6 and 6-12	Meal party consists of adult plus kids <6 and 6-12 years old
Age of Children in Party: <6 and 13-17	Meal party consists of adult plus kids <6 and 13-17 years old
Age of Children in Party: 6-12 and 13-17	Meal party consists of adult plus kids 6-12 and 13-17 years old
Age of Children in Party: all age groups	Meal party consists of adults plus kids of all age groups
Age of Children in Party: everyone >18 [c]	Meal party consists of only persons >18 years old
Order: walk-up	Meal ordered at a walk-up counter
Order: at table [c]	Meal ordered while sitting at a table or sit down counter
Order: drive thru	Meal ordered from car or through drive thru
Order: by phone	Meal ordered via telephone for pick-up at facility
Order: delivery	Meal ordered via telephone for delivery by facility
Order: internet	Meal ordered via internet for delivery
Order: cafeteria	Meal ordered in cafeteria line
Order: buffet	Meal ordered in buffet line
Order: other	Meal ordered via some other format
Facility type: Casual Dining (CD)	Meal ordered at a casual dining facility
Facility type: Mid-Service (MS)	Meal ordered at a mid-serve facility
Facility type: Quick Service (QS) [c]	Meal ordered at a quick-serve facility
Facility type: Fine Dining (FN)	Meal ordered at a fine-dining facility
Promotion: buy-one-get-one free (BOGO)	Panelist bought one item and get one (some) item(s) free
Promotion: combined item special	Panelist combined items to get discouted price
Promotion: daily special	Panelist received a discouted price on a certain offered item(s)
Promotion: discounted price	Panelist received a discounted price on item(s) that was not the daily special
Promotion: employee discount	Panelist received a discounted price for working at the facility
Promotion: free item	Panelist received a free item for partoning the facility
Promotion: merchandise offer	Panelist received a merchandise offer for patroning the facility
Promotion: dollar menu	Panelist ordered from the dollor menu
Promotion: senior citizen discount	Panelist received a senior citizen discount for there meal
Promotion: other deal	Panelist utilized some other type of promotion
Meals consumed: breakfast	Denotes if respondent ate breakfast "yesterday"
Meals consumed: morning snack	Denotes if respondent ate a morning snack "yesterday"
Meals consumed: brunch	Denotes if respondent ate brunch "yesterday"
Meals consumed: lunch	Denotes if respondent ate lunch "yesterday"
Meals consumed: afternoon snack	Denotes if respondent ate an afternoon snack "yesterday"
Meals consumed: dinner	Denotes if respondent ate dinner "yesterday"
Meals expenditure: breakfast	Denotes amount of expenditure at breakfast "yesterday"
Meals expenditure: morning snack	Denotes amount of expenditure at morning snack "yesterday"
Meals expenditure: brunch	Denotes amount of expenditure at brunch "yesterday"
Meals expenditure: lunch	Denotes amount of expenditure at lunch "yesterday"
Meals expenditure: afternoon snack	Denotes amount of expenditure at afternoon snack "yesterday"
Meals expenditure: dinner	Denotes amount of expenditure at dinner "yesterday"

[a] The meal consumed and meal expenditure variables are independent of each other; the promotion variables are independent of each other.

[b] Meal consumed and meal expenditures are seperated due to the nested nature of the effects (i.e. consuming must proceed expenditure).

[c] Denotes the category was used as the base in all analyses for categories with >2 options.

Table 3.3. Descriptive Statistics of Transaction Specific Variables for Meal Occasion

Variables	Breakfast	Morning Snack	Brunch	Lunch	Afternoon Snack	Dinner	Evening Snack
Chain type: major	57.9	53.7	50.4	55.5	52.3	49.9	53.4
Chain type: small	11.1	22.9	12.1	11.4	21.9	11.5	20.6
Chain type: independent [b]	31.0	23.4	37.5	33.1	25.8	38.6	26.0
Age of Children in Party: <6 only	6.1	5.7	10.1	6.8	10.7	11.0	11.8
Age of Children in Party: 6-12 only	2.8	1.6	3.7	3.0	3.8	6.3	3.4
Age of Children in Party: 13-17 only	1.1	0.7	2.2	1.4	1.7	3.5	2.1
Age of Children in Party: <6 and 6-12	0.4	0.4	1.2	0.5	0.6	1.0	0.8
Age of Children in Party: <6 and 13-17	3.1	2.5	4.9	4.7	3.7	6.2	3.0
Age of Children in Party: 6-12 and 13-17	0.3	0.2	0.6	0.4	0.5	0.8	0.6
Age of Children in Party: all age groups	1.1	0.8	1.8	1.6	1.7	3.1	1.6
Age of Children in Party: everyone >18 [b]	85.1	88.0	75.6	81.6	77.2	68.0	76.7
Order: walk-up	35.1	53.9	31.6	42.0	54.1	26.8	44.4
Order: at table [b]	24.0	2.2	37.2	22.8	3.7	35.2	8.3
Order: drive thru	23.3	9.0	11.7	18.7	12.5	15.2	14.9
Order: by phone	0.8	0.6	1.3	3.6	0.8	8.1	1.8
Order: delivery	0.6	0.5	1.2	2.5	0.7	6.3	2.1
Order: internet	0.1	0.2	0.1	0.1	0.1	0.3	0.2
Order: cafeteria	1.1	1.7	1.3	1.4	1.5	0.7	0.9
Order: buffet	3.1	0.6	7.6	3.7	0.5	3.7	0.6
Order: other	11.9	31.5	8.0	5.2	26.1	3.7	26.7
Facility type: Casual Dining (CD)	2.2	0.8	10.7	13.1	2.9	23.8	5.6
Facility type: Mid-Service (MS)	26.6	4.6	30.9	15.2	3.6	16.8	5.8
Facility type: Quick Service (QS) [b]	50.3	78.1	36.6	47.8	75.1	36.1	67.9
Facility type: Fine Dining (FN)	2.9	0.4	4.6	2.0	0.5	4.6	1.1
Promotion: buy-one-get-one free	1.0	1.3	1.3	1.1	1.3	1.4	1.8
Promotion: combined item special	5.3	2.2	4.1	6.8	2.3	5.3	2.4
Promotion: daily special	3.1	1.8	3.4	3.7	1.9	3.4	2.1
Promotion: discounted price	1.7	3.5	2.2	1.7	3.7	2.0	4.5
Promotion: employee discount	0.9	1.7	1.5	1.2	1.7	1.0	1.7
Promotion: free item	3.6	2.5	2.1	1.5	2.4	1.5	2.4
Promotion: merchandise offer	0.1	0.1	0.2	0.2	0.1	0.2	0.1
Promotion: dollar menu	1.7	1.2	2.3	3.6	2.8	2.2	3.0
Promotion: senior citizen discount	2.0	0.8	2.4	1.4	0.6	1.3	0.5
Promotion: other deal	2.7	2.7	4.0	4.1	2.7	6.4	3.5
Meals consumed: breakfast	--	13.7	6.6	13.3	12.4	12.4	11.0
Meals consumed: morning snack	--	--	5.7	3.9	10.3	2.6	6.7
Meals consumed: brunch	--	--	--	0.4	2.4	1.2	2.1
Meals consumed: lunch	--	--	--	--	23.7	26.8	23.7
Meals consumed: afternoon snack	--	--	--	--	--	4.9	13.7
Meals consumed: dinner	--	--	--	--	--	--	23.1
Meal Expenditure: Overall mean							
Meals expenditure: breakfast	--	$0.54	$0.33	$0.53	$0.53	$0.56	$0.47
Meals expenditure: morning snack	--	--	$0.23	$0.10	$0.27	$0.07	$0.18
Meals expenditure: brunch	--	--	--	$0.02	$0.14	$0.09	$0.12
Meals expenditure: lunch	--	--	--	--	$1.44	$1.73	$1.51
Meals expenditure: afternoon snack	--	--	--	--	--	$0.15	$0.45
Meals expenditure: dinner	--	--	--	--	--	--	$1.97
Meal Expenditure: Mean only if consumed							
Meals expenditure: breakfast	--	$3.93	$5.02	$3.95	$4.30	$4.51	$4.29
Meals expenditure: morning snack	--	--	$3.99	$2.56	$2.62	$2.62	$2.75
Meals expenditure: brunch	--	--	--	$5.41	$5.58	$7.08	$5.13
Meals expenditure: lunch	--	--	--	--	$6.09	$6.46	$6.36
Meals expenditure: afternoon snack	--	--	--	--	--	$3.16	$3.30
Meals expenditure: dinner	--	--	--	--	--	--	$9.48

[a] Meal expenditures are continuous and represent the average dollar amount spent away-from-home at a meal occasion for only those persons eating a particular meal (i.e. 11% of those eating an evening snack also ate breakfast away-from-home with those eating breakfast spending $4.29), whereas all other variables are dummies that represent percentages.

b Base categoriy of a set of dummy variables.

3.4 RESEARCH METHODOLOGY

Given the importance of FAFH consumption on dietary issues and on business strategies, the literature associated with FAFH expenditures is quite extensive. An examination of the FAFH literature indicates that numerous expenditure measurements, equation categories, modeling procedures, and model specifications have been utilized in an attempt to explain expenditures. With regard to expenditure measurements, weekly (Nayga 1996; Stewart and Yen 2004), biweekly (Stewart et al. 2004), and quarterly expenditures (Hiemstra and Kim 1995) have been extensively used throughout FAFH research. As expected, expenditure measurement has been dictated, in general, by data availability or the wanting to eliminate multiple responses. In contrast to previous studies, we are able to conduct detailed transactional level analysis as well as account for the intra-correlation associated with a respondent's multiple responses with the use of the CREST data and our estimation technique.

The composition and format of the data is a major factor in determining not only the most appropriate, but also the feasible means to model expenditures. Of central issue with the data used in this study was the high degree of censoring associated with FAFH expenditures by meal occasion (Table 3.1). Since for every meal occasion, some respondents did not have FAFH expenditures, the failure to account for self-selection could result in both biased and inconsistent results (Byrne, Capps, and Saha 1998). Previous studies that dealt with a high-degree of censoring in the data often used maximum likelihood techniques, notably tobit (McCracken and Brandt 1987), the double-hurdle model (Jensen and Yen 1996), and quasi-maximum likelihood (Yen, Lin, and Smallwood 2003). In our case, we were not able to use these estimation techniques since they continually failed to converge even with varying model specifications.

In order to avoid problems associated with convergence, a two-step Heckman model was utilized to model FAFH meal occasion expenditures. This technique has been utilized extensively in the past (Byrne, Capps, and Saha 1996; Nayga 1996; Byrne, Capps, Saha 1998; Jang, Ham, and Hong 2007). The two-step Heckman model was defined as having two separate decision steps, step 1 represented the "participation decision" and step 2 was the "expenditure decision." The first step is defined by modeling a binary probit model for whether a respondent ate FAFH for a specific meal or did not eat FAFH and can be characterized as follows:

$$P(MO_k = 1) = \frac{1}{\sqrt{2\pi}} e^{\frac{-(\beta' x)^2}{2}} \qquad [3.2]$$

where MO is the kth meal occasion and X represents a list of explanatory variables. Of note, in addition to traditional demographic variables, child age structure variables within a household were added as explanatory variables to account for the time constraints experienced by the household. Promotion usage for any meal during the day was also included to try to capture whether a panelist was a "smart" shopper that tried to find and utilized an away from home deal. Finally, past purchasing behavioral factors (prior meals within the same day) were included to see if earlier FAFH experiences had an effect on the decision to eat a present meal away from home. As discussed in detail later, prior meal effects are made up of two effects (meal and expenditure), and thereby, a nested structure was required.

Given the potential presence of heteroscedasticity and clustering within the probit model, a sandwich cluster estimator was applied to correct the standard errors. As noted by Rogers (1993) and Froot (1989), the sandwich cluster estimator is a relevant correction mechanism given heteroscedasticity and a large number of clusters (where we define clusters as responses by the same respondent). From each meal occasion probit model, the inverse mill's ratio (IMR) was calculated using the following formula, □ (β'x) / Φ(β'x), where □( ) is the probability density function of the standard normal distribution and Φ( ) is the cumulative distribution function of the standard normal distribution. The IMR can be thought of as a proxy for sample selection bias (Nayga and Capps 1994). If the IMR is significant, omitting the IMR term would have resulted in sample selection bias.

After estimating the probit models, marginal effects were then calculated to evaluate how changes in explanatory variables affected the probability of eating away from home for particular meals. However, typical statistical computer packages do not account for nested or interaction effects (Ai and Norton 2003). Hence, the marginal effects given were adjusted to account for the nested effects of several explanatory variables. This was done by computing the derivative: $\partial y_k/\partial x_i$, where k is the meal occasion and i denotes the explanatory variable of interest.

The second step, "expenditure decision," for each meal occasion only utilizes responses that are greater than zero, indicating FAFH expenditures. The specification of the ordinary least squares (OLS) models were as follows, keeping in mind that any previous meal expenditure is conditional on the respondent consuming the previous meal, which implies that a nested structure should be utilized:

$$Exp_{jk} = \beta_j + \sum_{d=1}^{n} X_{jd}\,\beta_d + \sum_{i=1}^{m} FC_{ji}\,\beta_i + \sum_{r=1}^{k-1} AFH_{jr}\,\beta_r + \sum_{r=1}^{7}[(AFH_{jr}{}'(PE_{jr})]\beta_w + \beta_t IMR_j \qquad [3.3]$$

where Exp equals expenditure at the k^{th} meal occasion by the jth respondent, X denotes the d^{th} demographic of the j^{th} respondent, FC is the i^{th} meal characteristic at the k^{th} meal occasion by the j^{th} respondent, AFH represents whether the r^{th} meal (in the following chronological order: breakfast, morning snack, brunch, lunch, afternoon snack, dinner, and evening snack) was away from home, and PE is the expenditure at the r^{th} meal, given the following constraints:

$$AFH_{jr} = 0 \text{ then } PE_{jr} = 0 \qquad [3.4]$$

$$B_r = 0 \text{ and } B_w = 0\text{, when } r > k \qquad [3.5]$$

Constraint (4) insures that meal expenditures is equal to zero if the consumer did not eat out, while constraint (5) restricts all future meals (r > k) to have zero effect on the present meal expenditures.

Since only the respondents consuming the k^{th} meal are utilized in the "expenditure" equations, there was no clustering, thereby allowing for the traditional

Huber/White sandwich estimator to be used to correct for heteroscedasticity. This general heteroscedasticity correction has been utilized in numerous previous studies. However, as noted by Saha, Capps, and Byrne (1997), the marginal effect for the "expenditure equation" can be composed of two parts: expected expenditure and change in probability of consuming, thereby requiring an adjustment to the expenditure equation coefficients for only the equations where the IMR is significantly different from zero and for variables that appear in both the "participation" and "expenditure" equations.

Furthermore, in order to generate credible estimates, an exclusion restriction needs to be incorporated to insure nonlinearity of the IMR. The exclusion restriction normally comes when theory relevant variables in the first step do not appear in the second step. For our analysis, an appropriate variable was available in that the household child structure was substituted by the structure of children within the party. Party composition was used since it is more relevant to know how much is spent given that those actually partaking in the meal will more directly influence expenditures than the household makeup. Correlation between these variables was low.

The marginal effects of the nested variables are not simply the coefficient; the effect of eating an earlier meal is then calculated as follows:

$$\frac{\partial Exp_k}{\partial Meal_r} = \beta_r + \beta_w * Expenditure_r \qquad [3.6]$$

where "Exp" is the expenditure, "Meal" is the meal we are interested in determining its effect, and k and r represent the present meal occasion and previous meal occasion, respectively. Substituting the mean expenditure associated with the appropriate meal from Table 3.3, the effect of eating a previous meal can be obtained. For instance, the effect of eating breakfast away from home on morning snack expenditures is -0.64 + (0.21) x (breakfast expenditure). However, the effect of previous expenditures only is calculated as follows:

$$\frac{\partial Exp_k}{\partial Exp_r} = \beta_w * Meal_r \qquad [3.7]$$

substituting the mean percentage of persons eating meal r into equation (3.7) and multiplying by β_w. For instance, if we want to determine the effect of breakfast expenditure on morning snack expenditure, at the mean, then $Meal_r$ would be equal to 0.137; however, if $Meal_r$ is set equal to one, then we obtain the full effect, β_w, of breakfast expenditures on morning snack expenditures.

3.5 RESULTS AND DISCUSSION

3.5.1 RESULTS: "PARTICIPATION" DECISION

The marginal effects of the probit models are exhibited in Table 3.4. For instance, eating major meals (breakfast, lunch, and dinner) in households making $25,000-$34,999 and households making greater than $100,000 are 1.63% and 3.32% more likely, respectively, to eat breakfast away from home than those in households with less than $25,000 in annual income. In comparison, the effect of income on the probability of eating FAFH is more for lunch than breakfast. Households with incomes between \$25,000-\$34,999 and greater than \$100,000 are 3.29% and 8.77% more likely, respectively, to eat lunch away from home than those in households making less than \$25,000.

As for age effects, younger consumers (e.g. less than 18 and 18-24 years of age) have a significantly higher probability of eating afternoon and evening snacks compared with the 25-34 base age group; however, these younger consumers have a lower probability associated with consuming lunch and breakfast away from home. Also of note is that the 18-24 age group is 1.71% more likely to eat dinner outside the home than 25-34 year olds, which is the only significantly positive likelihood for dinner. Comparing the base age group of 25-34 years of age to middle aged consumers (35-49 years of age) indicates that middle aged consumers have a higher probability of eating breakfast and morning snack away from home with lower probabilities associated with the other meals. Older consumers (50-64 and greater than 64) are less likely to eat out than those in the 25-34 age group across all meals, except brunch which is insignificant.

Table 3.4. Marginal Effects for Step 1 of the Meal Occasion Model: Demographic Variables [ab]

Variables[c]	Breakfast		Morning snack		Brunch		Lunch		Afternoon snack		Dinner		Evening snack	
	Marg. Eff.	p-value	Marg. Eff.	p-value	Marg. Eff.	p-value	Marg. Eff.	p-value	Marg. Eff.	p-value	Marg. Eff.	p-value	Marg. Eff.	p-value
Apr-June	0.43	*0.00*	0.14	*0.00*	0.08	*0.01*	0.87	*0.00*	0.67	*0.00*	0.81	*0.00*	0.31	*0.00*
July-Sept	0.51	*0.00*	0.06	*0.23*	0.06	*0.04*	0.67	*0.00*	0.69	*0.00*	1.08	*0.00*	0.55	*0.00*
Oct-Nov	0.47	*0.00*	0.15	*0.00*	0.03	*0.21*	0.30	*0.02*	0.22	*0.00*	-0.17	*0.15*	0.23	*0.00*
Age (yrs): <18	-2.41	*0.00*	-0.44	*0.00*	0.07	*0.37*	-4.98	*0.00*	1.26	*0.00*	-0.02	*0.96*	0.32	*0.04*
Age (yrs): 18-24	-1.12	*0.00*	-0.16	*0.02*	0.09	*0.03*	-0.85	*0.00*	0.64	*0.00*	1.71	*0.00*	1.29	*0.00*
Age (yrs): 35-49	0.43	*0.00*	0.28	*0.00*	-0.03	*0.28*	-2.19	*0.00*	-0.20	*0.00*	-2.88	*0.00*	-0.68	*0.00*
Age (yrs): 50-64	0.25	*0.01*	0.16	*0.01*	-0.04	*0.22*	-4.68	*0.00*	-0.58	*0.00*	-4.60	*0.00*	-0.96	*0.00*
Age: >64	-1.55	*0.00*	-0.89	*0.00*	0.02	*0.52*	-8.04	*0.00*	-2.11	*0.00*	-7.64	*0.00*	-1.99	*0.00*
Gender: male	0.17	*0.01*	-0.06	*0.13*	0.03	*0.21*	-0.37	*0.00*	-0.76	*0.00*	-1.16	*0.00*	-0.26	*0.00*
Education: HS grad.	0.49	*0.02*	0.23	*0.06*	-0.01	*0.89*	3.24	*0.00*	0.00	*0.97*	1.78	*0.00*	-0.19	*0.11*
Education: Some college	0.54	*0.01*	0.24	*0.03*	-0.02	*0.66*	3.94	*0.00*	0.28	*0.04*	3.25	*0.00*	-0.08	*0.50*
Education: College grad.	0.04	*0.83*	0.09	*0.42*	-0.05	*0.37*	4.31	*0.00*	0.28	*0.05*	3.75	*0.00*	-0.39	*0.00*
Monday	-1.46	*0.00*	0.97	*0.00*	-0.60	*0.00*	3.21	*0.00*	-0.64	*0.00*	-2.20	*0.00*	-0.21	*0.00*
Tuesday	-1.63	*0.00*	1.05	*0.00*	-0.64	*0.00*	4.30	*0.00*	-0.74	*0.00*	-0.94	*0.00*	-0.31	*0.00*
Wednesday	-1.26	*0.00*	1.06	*0.00*	-0.63	*0.00*	4.71	*0.00*	-0.61	*0.00*	0.26	*0.09*	-0.12	*0.09*
Thursday	-1.26	*0.00*	0.96	*0.00*	-0.59	*0.00*	4.58	*0.00*	-0.51	*0.00*	1.32	*0.00*	0.06	*0.43*
Friday	-1.21	*0.00*	0.85	*0.00*	-0.60	*0.00*	4.33	*0.00*	-0.54	*0.00*	7.52	*0.00*	0.84	*0.00*
Saturday	-0.47	*0.00*	0.33	*0.00*	-0.40	*0.00*	2.09	*0.00*	-0.08	*0.31*	6.66	*0.00*	1.04	*0.00*
Household Income: 25k-34k	1.63	*0.00*	0.44	*0.00*	0.00	*0.99*	3.29	*0.00*	0.27	*0.00*	2.16	*0.00*	0.02	*0.82*
Household Income: 35k-44k	1.99	*0.00*	0.46	*0.00*	-0.05	*0.12*	4.16	*0.00*	0.11	*0.21*	2.86	*0.00*	0.08	*0.30*
Household Income: 45k-60k	2.09	*0.00*	0.51	*0.00*	-0.06	*0.06*	5.15	*0.00*	0.30	*0.00*	3.86	*0.00*	-0.19	*0.01*
Household Income: 60k-74k	2.63	*0.00*	0.41	*0.00*	-0.08	*0.02*	6.24	*0.00*	0.16	*0.07*	4.82	*0.00*	-0.21	*0.01*
Household Income: 75k-99k	2.88	*0.00*	0.31	*0.00*	-0.14	*0.00*	7.15	*0.00*	0.02	*0.81*	5.31	*0.00*	-0.30	*0.00*
Household Inocme: >99k	3.32	*0.00*	0.21	*0.00*	-0.06	*0.05*	8.77	*0.00*	-0.09	*0.30*	6.94	*0.00*	-0.64	*0.00*
Household Size: 2	-0.21	*0.03*	0.02	*0.76*	0.01	*0.67*	-1.18	*0.00*	0.01	*0.93*	-0.16	*0.25*	-0.08	*0.25*
Household Size: 3-4	-0.86	*0.00*	-0.04	*0.55*	-0.02	*0.54*	-2.01	*0.00*	0.20	*0.03*	-1.11	*0.00*	0.14	*0.07*
Household Size: >4	-1.29	*0.00*	0.06	*0.48*	0.03	*0.57*	-3.01	*0.00*	0.39	*0.00*	-2.57	*0.00*	0.57	*0.00*

[a] Marginal effects are calculated at the sample means with estimates also having been multipled by 100 to obtain final percent changes.

[b] Traditional calculations of marginal effects are incorrect given interactions, thereby, the marginal effects for variables with interactions are adjusted via Ai and Norton (2003).

[c] Base categories: time period: Jan-March; age group: 25-34 years; gender: female; education: less than high school; day of week: Sunday; household income: less than $25,000; household size: 1 person; age of household children: only adults greater than 18 years; race: other than white; region: New England; market size: 1-2.5 MM; promotion used: none

Table 3.4 Cont'd. [ab]

Variables[c]	Breakfast		Morning snack		Brunch		Lunch		Afternoon snack		Dinner		Evening snack	
	Marg. Eff.	p-value	Marg. Eff.	p-value	Marg. Eff.	p-value	Marg. Eff.	p-value	Marg. Eff.	p-value	Marg. Eff.	p-value	Marg. Eff.	p-value
Age of Household Children: <6 only	0.27	*0.04*	0.02	*0.81*	-0.11	*0.01*	1.22	*0.00*	-0.22	*0.02*	-1.29	*0.00*	-0.85	*0.00*
Age of Household Children: 6-12 only	0.34	*0.01*	-0.11	*0.11*	-0.11	*0.00*	0.81	*0.00*	-0.24	*0.01*	-0.44	*0.01*	-0.73	*0.00*
Age of Household Children: 13-17 only	0.22	*0.05*	-0.04	*0.50*	-0.07	*0.03*	0.59	*0.00*	-0.24	*0.00*	-0.23	*0.14*	-0.43	*0.00*
Age of Household Children: <6 and 6-12	0.09	*0.61*	-0.05	*0.57*	-0.12	*0.02*	0.70	*0.01*	0.01	*0.92*	-1.38	*0.00*	-0.78	*0.00*
Age of Household Children: <6 and 13-17	0.67	*0.05*	-0.01	*0.97*	-0.11	*0.22*	1.71	*0.00*	-0.25	*0.24*	-1.18	*0.01*	-0.32	*0.08*
Age of Household Children: 6-12 and 13-17	0.21	*0.18*	-0.14	*0.11*	-0.13	*0.00*	0.69	*0.00*	-0.19	*0.09*	-0.74	*0.00*	-0.57	*0.00*
Age of Household Children: all child age groups	-0.40	*0.21*	-0.02	*0.92*	-0.15	*0.06*	0.73	*0.14*	0.08	*0.72*	-0.54	*0.23*	-0.69	*0.00*
Race: white	-0.71	*0.00*	-0.13	*0.01*	-0.31	*0.00*	-0.22	*0.10*	-0.71	*0.00*	1.58	*0.00*	-0.59	*0.00*
Region: Mid-Atlantic	-0.25	*0.08*	-0.56	*0.00*	0.07	*0.18*	0.86	*0.00*	-0.24	*0.03*	1.02	*0.00*	0.35	*0.00*
Region: East-North-Central	-1.06	*0.00*	-0.90	*0.00*	-0.03	*0.48*	2.09	*0.00*	-0.54	*0.00*	2.15	*0.00*	0.12	*0.24*
Region: West-North-Central	-1.01	*0.00*	-0.50	*0.00*	-0.08	*0.13*	2.97	*0.00*	-0.19	*0.12*	1.81	*0.00*	-0.13	*0.26*
Region: South-Atlantic	-0.41	*0.00*	-0.71	*0.00*	-0.01	*0.86*	3.66	*0.00*	-0.22	*0.04*	1.71	*0.00*	-0.20	*0.04*
Region: East-South-Central	0.25	*0.16*	-0.88	*0.00*	-0.10	*0.06*	5.11	*0.00*	-0.29	*0.03*	3.10	*0.00*	-0.31	*0.01*
Region: West-South-Central	-0.20	*0.18*	-0.72	*0.00*	-0.04	*0.41*	5.18	*0.00*	-0.16	*0.15*	2.32	*0.00*	-0.35	*0.00*
Region: Mountain	-1.08	*0.00*	-0.46	*0.00*	0.07	*0.24*	3.10	*0.00*	0.25	*0.06*	0.71	*0.00*	-0.27	*0.01*
Region: Pacific	-1.35	*0.00*	-0.27	*0.00*	0.13	*0.02*	3.47	*0.00*	0.26	*0.03*	0.96	*0.00*	-0.43	*0.00*
Market Size: >2.5 MM	0.53	*0.00*	0.12	*0.01*	0.09	*0.00*	0.77	*0.00*	0.18	*0.01*	0.66	*0.00*	0.06	*0.29*
Market Size: <1 MM	0.05	*0.56*	-0.04	*0.45*	-0.02	*0.44*	-0.25	*0.04*	0.05	*0.46*	-0.27	*0.02*	-0.02	*0.67*
Market Size: outside MSA	-0.12	*0.19*	0.22	*0.00*	-0.03	*0.34*	-0.58	*0.00*	0.39	*0.00*	-1.98	*0.00*	-0.29	*0.00*
Promotion used: yes	5.57	*0.00*	0.76	*0.00*	0.68	*0.00*	21.24	*0.00*	2.56	*0.00*	20.21	*0.00*	2.95	*0.00*

[a] Marginal effects are calculated at the sample means with estimates also having been multipled by 100 to obtain final percent changes.

[b] Traditional calculations of marginal effects are incorrect given interactions, thereby, the marginal effects for variables with interactions are adjusted via Ai and Norton (2003).

[c] Base categories: time period: Jan-March; age group: 25-34 years; gender: female; education: less than high school; day of week: Sunday; household income: less than $25,000; household size: 1 person; age of household children: only adults greater than 18 years; race: other than white; region: New England; market size: 1-2.5 MM; promotion used: none

For instance, those who are in the 50-64 age group and those greater than 64 years of age are 4.68% and 8.04% less likely, respectively, to eat lunch out than those in the 25-34 age group. A potential explanation of younger consumers being more likely to participate in FAFH meals is that FAFH meals might be social conventions which may not be as important to older consumers.

With regard to presence of children in the household, households with children tend to have a higher probability of eating breakfast and lunch away from home but lower likelihood of consuming snacks, brunch, and dinner out. This is most likely due to breakfast and lunch being convenience meals, while snacks can be packed and carried at-home, thereby, eliminating the need to purchase them away from home. A possible reason for a decreased probability of eating out at dinner could be due to the hardships associated with either finding a babysitter or taking the child out to a more time consuming meal.

Also, the inclusion of a variable indicating promotion usage at any point during the day indicates that if a coupon was used, then there is an increased probability to eat away from home, especially in regards to the major meals. For instance, if a consumer was classified as a “smart” shopper (utilized deal at any point during the day), then there was a 21.24% increase in the probability of eating out at lunch and 20.21% increase in the probability of eating out at dinner.

Examining the effects of previous meals shows that, as expected, prior meals away from home have varying effects, depending on meal timing throughout the day (Table 3.5). For instance, eating out at morning snack and brunch increases the probability of consuming FAFH at afternoon snack by 4.96% and 2.42%, respectively, whereas, morning snack and brunch consumption away from home results in a decrease in the probability of eating out at lunch by 6.21% and 12.98%, respectively. Examining the effects of expenditures from the mean indicates that large meals (breakfast, lunch and dinner) tend to have negative expenditure effects on future meals, while snacks tend to have positive effects.

3.5.1.1. CONSUMER PROFILES

A cursory overview of the marginal effects provides interesting results; however, a clear picture can be gained by developing customer profiles. The breakfast and lunch consumer appears to be non-white with higher incomes, with lower household sizes, *with* children and increased education between a high school diploma and college degree, while the profile of consumers more likely to eat out at dinner is almost identical to breakfast and lunch except that these individuals tend to be from households *with no* children. However, snack occasion profiles differ depending on the time of day. For instance, younger consumers are more likely to eat snacks later in the day (afternoon and evening), while higher income consumers can be associated with early and mid-day snacks (morning and afternoon).

Table 3.5. Marginal Effects for Step 1 of the Meal Occasion Model: Purchase Behavior Variables [ab]

Variables	Breakfast		Morning snack		Brunch		Lunch		Afternoon snack		Dinner		Evening snack	
	Estimate	p-value	Estimate	p-value	Estimate	p-value	Estimate	p-value	Estimate	p-value	Estimate	p-value	Estimate	p-value
Ate Breakfast (BR)	--	--	0.015	0.827	-0.489	0.000	-2.092	0.000	-0.513	0.000	-2.647	0.000	-0.664	0.000
Interaction: Ate BR * BR Expenditure	--	--	-0.005	0.005	0.001	0.186	-0.032	0.000	0.000	0.972	0.012	0.001	0.000	0.931
Ate Morning Snack (MS)	--	--	--	--	0.079	0.124	-6.208	0.000	4.957	0.000	-8.448	0.000	0.417	0.004
Interaction: Ate MS * MS Expenditure	--	--	--	--	0.003	0.000	0.007	0.026	0.001	0.534	0.005	0.126	0.001	0.190
Ate Brunch (BC)	--	--	--	--	--	--	-12.977	0.000	2.420	0.000	-3.274	0.000	0.946	0.000
Interaction: Ate BC * BC Expenditure	--	--	--	--	--	--	-0.011	0.000	-0.002	0.000	0.001	0.290	-0.001	0.003
Ate Lunch (LN)	--	--	--	--	--	--	--	--	-1.901	0.000	-6.154	0.000	-1.532	0.000
Interaction: Ate LN * LN Expenditure	--	--	--	--	--	--	--	--	-0.007	0.006	0.012	0.002	0.006	0.002
Ate Afternoon Snack (AS)	--	--	--	--	--	--	--	--	--	--	-7.903	0.000	1.827	0.000
Interaction: Ate AS * AS Expenditure	--	--	--	--	--	--	--	--	--	--	-0.001	0.812	0.003	0.009
Ate Dinner (DN)	--	--	--	--	--	--	--	--	--	--	--	--	-0.944	0.000
Interaction: Ate DN * DN Expenditure	--	--	--	--	--	--	--	--	--	--	--	--	-0.002	0.000
Probit model characteristics														
Number of observations	696,089		696,089		696,089		696,089		696,089		696,089		696,089	
Number of clusters	596,561		596,561		596,561		596,561		596,561		596,561		596,561	
Wald Chi2	6,664		1,589		3,044		31,148		7,793		32,342		7,643	
Prob > Chi2	0.000		0.000		0.000		0.000		0.000		0.000		0.000	
Log Pseudoliklehood	-180,855		-74,758		-32,094		-337,109		-123,530		-309,701		-105,605	
Mcfadden Pseudo R2	1.64		1.04		4.19		4.28		2.66		5.04		3.52	

[a] Marginal effects are calculated at the sample means with estimates also having been multipled by 100 to obtain final percent changes.

[b] Traditional calculations of marginal effects are incorrect given interactions, thereby, the marginal effects for variables with interactions are adjusted via Ai and Norton (2003).

[c] Base categories: time period: Jan-March; age group: 25-34 years; gender: female; education: less than high school; day of week: Sunday; household income: less than $25,000; household size: 1 person; age of household children: only adults greater than 18 years; race: other than white; region: New England; promotion used: none

3.5.2 RESULTS: "EXPENDITURE" DECISION

Analyzing the coefficients associated with the expenditure models show some interesting results. Since our focus will be specifically on the transaction specific variables, only the results of these variables will be discussed. However, all results associated with the demographic and socio-economic variables that were used as "controls" are presented in Table 3.6.

3.5.2.1 FACILITY CHARACTERISTICS

The effects of facility characteristics on expenditures by meal occasion are for the most part significant (Table 3.7). Major and small chain stores had higher expenditures per transaction than their independent counterparts, regardless of meal occasion. The only exceptions are for small chain stores at afternoon snack and evening snack where the effect was insignificant. Also as expected, expenditures at casual dining (CD), mid-service (MS), and fine dining (FN) facilities were significantly higher than at QS facilities with FN expenditures being \$5.32 and \$26.47 higher for breakfast and dinner, respectively. Examination of the magnitudes for MS and CD, as compared to the QS base, indicates that CD expenditures almost triple the amount of expenditures at MS with the largest differences occurring at brunch and dinner, \$4.53 (for CD) vs. \$1.53 (for MS) and \$4.62 (for CD) vs. \$1.79 (for MS), respectively.

Table 3.6. Regression Coefficient Estimates for Meal Occasion Expenditures: Demographic Variables [a]

Variables [b]	Breakfast Expenditures OLS Coeff.	p-value	SCB Coeff.	Morning Snack Expenditures OLS Coeff.	p-value	SCB Coeff.	Brunch Expenditures OLS Coeff.	p-value	SCB Coeff.	Lunch Expenditures OLS Coeff.	p-value	SCB Coeff.	Afternoon Snack Expenditures OLS Coeff.	p-value	SCB Coeff.	Dinner Expenditures OLS Coeff.	p-value	SCB Coeff.	Evening Snack Expenditures OLS Coeff.	p-value	SCB Coeff.
Apr-June	0.15	*0.03*	0.06	0.10	*0.15*	--	0.56	*0.06*	0.38	0.09	*0.01*	0.05	0.15	*0.05*	--	0.00	*0.93*	-0.06	-0.01	*0.92*	-0.07
July-Sept	0.02	*0.72*	-0.08	0.01	*0.86*	--	0.22	*0.40*	0.09	0.07	*0.04*	0.04	0.14	*0.07*	--	0.09	*0.15*	0.01	0.15	*0.04*	0.03
Oct-Nov	0.23	*0.00*	0.13	0.18	*0.02*	--	0.11	*0.68*	0.03	0.07	*0.05*	0.06	0.19	*0.00*	--	-0.05	*0.39*	-0.04	0.19	*0.02*	0.14
Age (yrs): <18	-0.60	*0.00*	-0.05	0.23	*0.41*	--	-0.71	*0.25*	-0.86	-0.90	*0.00*	-0.65	-0.27	*0.21*	--	-0.45	*0.00*	-0.45	-0.17	*0.39*	-0.23
Age (yrs): 18-24	-0.20	*0.06*	0.03	-0.03	*0.75*	--	0.14	*0.68*	-0.07	-0.14	*0.00*	-0.10	-0.05	*0.55*	--	-0.56	*0.00*	-0.68	0.21	*0.15*	-0.05
Age (yrs): 35-49	-0.12	*0.16*	-0.20	-0.07	*0.43*	--	0.00	*0.99*	0.07	-0.29	*0.00*	-0.19	-0.11	*0.06*	--	-0.19	*0.01*	0.02	-0.18	*0.04*	-0.02
Age (yrs): 50-64	-0.33	*0.00*	-0.37	-0.17	*0.03*	--	-0.35	*0.25*	-0.26	-0.62	*0.00*	-0.39	-0.19	*0.01*	--	-0.53	*0.00*	-0.17	-0.43	*0.00*	-0.21
Age: >64	-1.16	*0.00*	-0.83	-0.58	*0.05*	--	-0.53	*0.07*	-0.59	-1.15	*0.00*	-0.74	-0.54	*0.03*	--	-1.31	*0.00*	-0.68	-0.94	*0.00*	-0.39
Gender: male	0.34	*0.00*	0.30	0.18	*0.00*	--	0.38	*0.03*	0.32	0.31	*0.00*	0.33	0.29	*0.00*	--	0.23	*0.00*	0.32	0.32	*0.00*	0.38
Education: HS grad.	0.06	*0.58*	-0.03	-0.10	*0.61*	--	0.17	*0.69*	0.19	-0.02	*0.84*	-0.17	-0.20	*0.08*	--	0.15	*0.22*	0.03	0.08	*0.55*	0.12
Education: Some college	0.07	*0.54*	-0.04	-0.15	*0.47*	--	-0.07	*0.87*	-0.01	0.03	*0.74*	-0.15	-0.23	*0.05*	--	0.15	*0.24*	-0.08	-0.09	*0.45*	-0.08
Education: College grad.	-0.15	*0.19*	-0.16	-0.22	*0.27*	--	0.08	*0.85*	0.21	0.07	*0.49*	-0.13	-0.32	*0.01*	--	0.29	*0.03*	0.02	-0.24	*0.07*	-0.15
Monday	-0.68	*0.00*	-0.38	0.05	*0.85*	--	-2.95	*0.00*	-0.86	-0.38	*0.00*	-0.53	-0.32	*0.00*	--	-0.39	*0.00*	-0.22	-0.32	*0.00*	-0.27
Tuesday	-0.80	*0.00*	-0.46	-0.01	*0.98*	--	-3.17	*0.00*	-0.91	-0.36	*0.00*	-0.55	-0.40	*0.00*	--	-0.34	*0.00*	-0.27	-0.28	*0.00*	-0.21
Wednesday	-0.78	*0.00*	-0.52	0.06	*0.82*	--	-3.51	*0.00*	-1.32	-0.36	*0.00*	-0.57	-0.41	*0.00*	--	-0.09	*0.26*	-0.11	-0.14	*0.16*	-0.11
Thursday	-0.75	*0.00*	-0.48	0.10	*0.70*	--	-3.01	*0.00*	-0.94	-0.32	*0.00*	-0.52	-0.29	*0.00*	--	0.01	*0.86*	-0.08	-0.15	*0.10*	-0.16
Friday	-0.51	*0.00*	-0.26	-0.01	*0.97*	--	-3.48	*0.00*	-1.34	-0.31	*0.00*	-0.50	-0.20	*0.02*	--	0.58	*0.00*	0.08	0.16	*0.15*	-0.02
Saturday	-0.21	*0.00*	-0.11	0.16	*0.20*	--	-1.94	*0.00*	-0.73	-0.11	*0.03*	-0.21	0.05	*0.45*	--	0.83	*0.00*	0.38	0.25	*0.05*	0.04
Household Income: 25k-34k	0.28	*0.00*	-0.02	0.02	*0.86*	--	0.07	*0.76*	0.07	0.22	*0.00*	0.07	-0.01	*0.93*	--	0.27	*0.00*	0.11	0.02	*0.79*	0.02
Household Income: 35k-44k	0.21	*0.03*	-0.16	0.07	*0.65*	--	0.20	*0.64*	0.33	0.27	*0.00*	0.08	-0.04	*0.56*	--	0.40	*0.00*	0.20	-0.13	*0.12*	-0.15
Household Income: 45k-60k	0.38	*0.00*	-0.01	-0.01	*0.93*	--	-0.34	*0.21*	-0.19	0.39	*0.00*	0.16	-0.06	*0.37*	--	0.54	*0.00*	0.27	-0.09	*0.26*	-0.05
Household Income: 60k-74k	0.42	*0.00*	-0.06	0.00	*0.98*	--	-0.03	*0.92*	0.17	0.52	*0.00*	0.25	0.00	*0.99*	--	0.66	*0.00*	0.33	-0.05	*0.59*	0.00
Household Income: 75k-99k	0.44	*0.00*	-0.07	0.00	*1.00*	--	0.12	*0.73*	0.49	0.61	*0.00*	0.30	-0.05	*0.42*	--	0.75	*0.00*	0.39	0.04	*0.71*	0.11
Household Inocme: >99k	0.89	*0.00*	0.29	0.08	*0.44*	--	0.98	*0.01*	1.14	1.01	*0.00*	0.63	0.10	*0.15*	--	1.88	*0.00*	1.41	0.05	*0.72*	0.20
Race: white	-0.35	*0.00*	-0.22	-0.38	*0.00*	--	-0.99	*0.00*	-0.34	-0.13	*0.00*	-0.12	-0.41	*0.00*	--	-0.18	*0.01*	-0.30	-0.45	*0.00*	-0.33
Region: Mid-Atlantic	0.04	*0.66*	0.09	-0.11	*0.54*	--	0.69	*0.14*	0.53	-0.18	*0.01*	-0.22	-0.02	*0.88*	--	-0.11	*0.34*	-0.18	-0.04	*0.74*	-0.11
Region: East-North-Central	-0.27	*0.00*	-0.06	-0.21	*0.48*	--	-0.13	*0.79*	-0.05	-0.54	*0.00*	-0.64	-0.24	*0.02*	--	-0.88	*0.00*	-1.04	-0.20	*0.08*	-0.23
Region: West-North-Central	-0.18	*0.08*	0.03	-0.30	*0.09*	--	-0.21	*0.68*	-0.02	-0.49	*0.00*	-0.62	-0.28	*0.00*	--	-0.90	*0.00*	-1.03	-0.34	*0.00*	-0.32
Region: South-Atlantic	0.07	*0.50*	0.15	-0.08	*0.73*	--	0.56	*0.22*	0.58	-0.24	*0.00*	-0.40	-0.06	*0.49*	--	-0.44	*0.00*	-0.56	-0.19	*0.09*	-0.14
Region: East-South-Central	-0.03	*0.78*	-0.08	-0.36	*0.23*	--	0.39	*0.53*	0.66	-0.16	*0.07*	-0.38	-0.30	*0.01*	--	-0.56	*0.00*	-0.77	-0.08	*0.57*	-0.01
Region: West-South-Central	0.04	*0.65*	0.08	-0.11	*0.63*	--	0.40	*0.53*	0.50	-0.18	*0.03*	-0.41	-0.25	*0.01*	--	-0.65	*0.00*	-0.82	-0.25	*0.07*	-0.17
Region: Mountain	0.26	*0.07*	0.48	0.02	*0.92*	--	0.53	*0.26*	0.37	-0.24	*0.00*	-0.38	-0.08	*0.42*	--	-0.77	*0.00*	-0.82	-0.20	*0.12*	-0.13
Region: Pacific	0.46	*0.00*	0.74	0.24	*0.04*	--	0.98	*0.03*	0.68	-0.03	*0.71*	-0.18	0.07	*0.46*	--	-0.20	*0.07*	-0.27	-0.10	*0.41*	0.00
Market Size: >2.5 MM MSA	0.20	*0.01*	0.09	0.06	*0.41*	--	0.24	*0.32*	0.03	0.23	*0.00*	0.19	-0.07	*0.20*	--	0.36	*0.00*	0.31	0.24	*0.00*	0.23
Market Size: <1 MM MSA	-0.11	*0.03*	-0.12	-0.07	*0.21*	--	-0.15	*0.55*	-0.10	-0.13	*0.00*	-0.12	-0.12	*0.03*	--	-0.28	*0.00*	-0.26	-0.16	*0.01*	-0.16
Market Size: outside MSA	-0.27	*0.00*	-0.25	-0.13	*0.14*	--	-0.61	*0.01*	-0.55	-0.27	*0.00*	-0.24	-0.22	*0.00*	--	-0.52	*0.00*	-0.37	-0.33	*0.00*	-0.26
Household Size: 2	-0.15	*0.01*	-0.11	-0.07	*0.31*	--	-0.28	*0.35*	-0.32	-0.26	*0.00*	-0.20	-0.08	*0.17*	--	-0.27	*0.00*	-0.26	-0.18	*0.02*	-0.17
Household Size: 3-4	-0.33	*0.00*	-0.16	-0.06	*0.41*	--	-1.05	*0.00*	-1.00	-0.36	*0.00*	-0.26	-0.07	*0.27*	--	-0.53	*0.00*	-0.44	-0.23	*0.00*	-0.26
Household Size: >4	-0.19	*0.14*	0.08	-0.02	*0.81*	--	-0.86	*0.01*	-0.92	-0.47	*0.00*	-0.33	-0.11	*0.12*	--	-0.81	*0.00*	-0.62	-0.26	*0.01*	-0.38
Inverse mill's ratio	3.20	*0.00*	--	1.06	*0.50*	--	5.04	*0.02*	--	1.69	*0.00*	--	0.97	*0.30*	--	2.37	*0.00*	--	1.87	*0.01*	--

[a] SCB = Saha, Capps, Byrne corrections, which is only necessary if the inverse mill's ratio is significantly different from zero and the variable appears in both the selection and expenditure equation.

[b] Base categories: time period: Jan-March; age group: 25-34 years; gender: female; education: less than high school; day of week: Sunday; household income: less than $25,000; household size: 1 person; age of household children: only adults greater than 18 years; race: other than white; region: New England; market size: 1-2.5 MM.

3.5.2.2 ORDERING

For the most part, ordering food at the table has a larger effect on expenditures than any other ordering means, Table 3.7. The major exceptions were for delivery and internet for certain meal occasions. For instance, expenditures at lunches ordered through a drive-thru or walk-up are lower by $3.21 and $2.68 than lunches ordered at a table. After controlling for facility type, which should capture any effects associated with service and/or convenience, a possible explanation associated with ordering at a table having higher expenditures is that more food to be ordered compared with the once and go nature of the drive thru and walk-up. Expenditures using delivery ordering are higher across all meals than expenditures using at the table ordering, except for lunch and dinner, with the largest difference occurring at breakfast ($3.39) and brunch ($2.11). Expenditures on meals ordered through the internet, on the other hand, are not statistically different at the 0.01 level from expenditures ordered at the table.

3.5.2.3 PROMOTION

With regards to promotions, Richards and Padilla (2009) show that different promotional media can have both positive and negative effects on demand. Our results, Table 3.8, support their findings in that different promotional media, when utilized, displayed positive and negative effects on expenditures. For instance, redemption of a buy-one-get-one free (BOGO) offer increases expenditures at breakfast ($0.97), afternoon snack ($0.79), and evening snack ($0.71), with BOGO having insignificant effects at other meals. However, use of a free item results in large significant expenditure decreases across all meals, with breakfast and dinner experiencing the largest decreases at $3.03 and $3.96, respectively. Of note is that use of a daily special promotion does not significantly affect expenditures for the larger meals but positively affects expenditures for all snacks.

3.5.2.4 PARTY COMPOSITION

Examination of the party composition variables, Table 3.8, indicates that party composition can significantly affect FAFH expenditures. Specifically, expenditures are lower for parties with children than parties without children. For instance, the expenditures at dinner of parties with children of all ages (<6, 6-12, and 13-17) are lower by $2.88, ceteris paribus, than that of parties without children. This relatively large difference in dinner expenditures is common across all children age combinations. The reason for the negative effect is most likely due to parties with children having to lower per person meal expenditures in order to meet their time and resource constraints.

Table 3.7. Regression Coefficient Estimates for the Meal Characteristics of Each Meal Occasion Expenditure [a]

	Breakfast Expenditures			Morning Snack Expenditures			Brunch Expenditures			Lunch Expenditures			Afternoon Snack Expenditures			Dinner Expenditures			Evening Snack Expenditures		
	OLS		SCB	OLS		SCB	OLS		SCB	OLS		SCB	OLS		SCB	OLS		SCB	OLS		SCB
Variables [b]	Coeff.	p-value	Coeff.	Coeff.	p-value	Coeff.	Coeff.	p-value	Coeff.	Coeff.	p-value	Coeff.	Coeff.	p-value	Coeff.	Coeff.	p-value	Coeff.	Coeff.	p-value	Coeff.
Chain type: major	1.01	*0.00*	--	0.48	*0.00*	--	0.41	*0.05*	--	0.72	*0.00*	--	0.17	*0.00*	--	0.88	*0.00*	--	0.21	*0.00*	--
Chain type: small	0.59	*0.00*	--	0.31	*0.00*	--	0.53	*0.07*	--	0.93	*0.00*	--	-0.05	*0.35*	--	1.62	*0.00*	--	0.01	*0.92*	--
Facility type: Casual Dining (CD)	2.61	*0.00*	--	1.07	*0.02*	--	4.53	*0.00*	--	3.28	*0.00*	--	2.63	*0.00*	--	4.62	*0.00*	--	2.38	*0.00*	--
Facility type: Mid-Service (MS)	1.56	*0.00*	--	0.45	*0.00*	--	1.57	*0.00*	--	1.34	*0.00*	--	0.61	*0.00*	--	1.79	*0.00*	--	0.68	*0.00*	--
Facility type: Fine Dining (FN)	5.32	*0.00*	--	1.21	*0.12*	--	16.66	*0.00*	--	13.36	*0.00*	--	10.57	*0.00*	--	26.47	*0.00*	--	10.97	*0.00*	--
Order: walk-up	-2.69	*0.00*	--	-1.81	*0.00*	--	-2.38	*0.00*	--	-2.68	*0.00*	--	-2.25	*0.00*	--	-4.13	*0.00*	--	-2.65	*0.00*	--
Order: drive thru	-2.73	*0.00*	--	-1.49	*0.00*	--	-2.39	*0.00*	--	-3.21	*0.00*	--	-2.03	*0.00*	--	-4.75	*0.00*	--	-2.53	*0.00*	--
Order: by phone	-1.15	*0.00*	--	0.93	*0.21*	--	0.65	*0.62*	--	-1.94	*0.00*	--	0.05	*0.91*	--	-3.21	*0.00*	--	-0.45	*0.14*	--
Order: delivery	3.39	*0.00*	--	0.83	*0.33*	--	2.11	*0.03*	--	-0.74	*0.00*	--	0.75	*0.06*	--	-1.50	*0.00*	--	0.53	*0.08*	--
Order: internet	-0.32	*0.76*	--	4.94	*0.06*	--	6.17	*0.06*	--	1.12	*0.12*	--	0.64	*0.79*	--	-0.45	*0.14*	--	0.51	*0.66*	--
Order: cafeteria	-2.49	*0.00*	--	-1.90	*0.00*	--	-2.61	*0.00*	--	-2.17	*0.00*	--	-2.08	*0.00*	--	-3.51	*0.00*	--	-2.34	*0.00*	--
Order: buffet	-1.22	*0.00*	--	-0.46	*0.48*	--	0.43	*0.39*	--	-0.80	*0.00*	--	-0.04	*0.97*	--	-1.20	*0.00*	--	-1.47	*0.01*	--
Order: other	-3.74	*0.00*	--	-2.57	*0.00*	--	-3.40	*0.00*	--	-4.14	*0.00*	--	-3.01	*0.00*	--	-4.81	*0.00*	--	-3.42	*0.00*	--
Number of observations	51,592			15,831			5,790			142,014			31,051			123,981			25,534		
R2	18.2			12.0			34.2			32.2			19.5			47.6			23.1		
Adjusted R2	18.1			11.6			33.3			32.2			19.3			47.5			22.8		
F-Value	176.2			19.9			36.1			512.2			37.8			807.2			43.8		
p>F	0.000			0.000			0.000			0.000			0.000			0.000			0.000		

[a] SCB = Saha, Capps, Byrne corrections, which is only necessary if the inverse mill's ratio is significantly different from zero and the variable appears in both the selection and expenditure equation.

[b] Base categories: time period: chain type: independent; facility type: quick service; ordering: at-table.

Table 3.8. Regression Coefficient Estimates for the Party Charcteristics of Each Meal Occasion Expenditure [a]

	Breakfast Expenditures			Morning Snack Expenditures			Brunch Expenditures			Lunch Expenditures			Afternoon Snack Expenditures			Dinner Expenditures			Evening Snack Expenditures		
	OLS		SCB	OLS		SCB	OLS		SCB	OLS		SCB	OLS		SCB	OLS		SCB	OLS		SCB
Variables [b]	Coeff.	p-value	Coeff.	Coeff.	p-value	Coeff.	Coeff.	p-value	Coeff.	Coeff.	p-value	Coeff.	Coeff.	p-value	Coeff.	Coeff.	p-value	Coeff.	Coeff.	p-value	Coeff.
Promotion: buy-one-get-one free	0.97	*0.00*	--	0.32	*0.19*	--	0.80	*0.19*	--	0.29	*0.39*	--	0.79	*0.00*	--	-0.20	*0.29*	--	0.71	*0.00*	--
Promotion: combined item special	0.89	*0.00*	--	0.28	*0.19*	--	1.85	*0.00*	--	0.75	*0.00*	--	1.13	*0.00*	--	0.86	*0.00*	--	1.39	*0.00*	--
Promotion: daily special	0.21	*0.30*	--	0.90	*0.01*	--	1.23	*0.02*	--	0.29	*0.18*	--	0.57	*0.02*	--	0.00	*0.98*	--	1.04	*0.00*	--
Promotion: discounted price	0.22	*0.31*	--	-0.15	*0.47*	--	0.88	*0.29*	--	-0.10	*0.53*	--	-0.13	*0.52*	--	-0.08	*0.66*	--	0.03	*0.91*	--
Promotion: employee discount	-0.02	*0.93*	--	-0.04	*0.85*	--	1.04	*0.30*	--	-0.92	*0.00*	--	-0.25	*0.30*	--	-2.03	*0.00*	--	0.05	*0.85*	--
Promotion: free item	-3.03	*0.00*	--	-1.64	*0.00*	--	-2.74	*0.00*	--	-2.74	*0.00*	--	-2.07	*0.00*	--	-3.96	*0.00*	--	-2.43	*0.00*	--
Promotion: merchandise offer	2.33	*0.02*	--	1.52	*0.11*	--	-0.06	*0.95*	--	1.31	*0.05*	--	1.62	*0.01*	--	0.96	*0.00*	--	1.76	*0.06*	--
Promotion: dollar menu	-0.11	*0.57*	--	-0.08	*0.77*	--	0.01	*0.98*	--	-0.79	*0.00*	--	-0.58	*0.00*	--	-0.55	*0.00*	--	-0.24	*0.25*	--
Promotion: senior citizen discount	0.39	*0.09*	--	0.03	*0.93*	--	0.31	*0.62*	--	0.06	*0.72*	--	0.49	*0.14*	--	-0.16	*0.43*	--	0.87	*0.12*	--
Promotion: other deal	0.20	*0.37*	--	0.09	*0.70*	--	0.56	*0.33*	--	0.25	*0.14*	--	0.49	*0.04*	--	0.46	*0.01*	--	0.52	*0.02*	--
Age of Children in Party: <6 only	-0.28	*0.00*	--	-0.36	*0.01*	--	0.68	*0.15*	--	-0.33	*0.00*	--	-0.06	*0.65*	--	-1.08	*0.00*	--	-0.38	*0.03*	--
Age of Children in Party: 6-12 only	-0.40	*0.01*	--	-0.35	*0.01*	--	0.83	*0.50*	--	-0.70	*0.00*	--	-0.27	*0.00*	--	-1.81	*0.00*	--	-0.76	*0.00*	--
Age of Children in Party: 13-17 only	-1.03	*0.00*	--	-0.76	*0.00*	--	-0.98	*0.06*	--	-0.91	*0.00*	--	-0.76	*0.00*	--	-1.76	*0.00*	--	-1.19	*0.00*	--
Age of Children in Party: <6 and 6-12	-1.52	*0.00*	--	-0.95	*0.01*	--	-2.97	*0.00*	--	-1.38	*0.00*	--	-0.36	*0.40*	--	-3.21	*0.00*	--	-1.43	*0.00*	--
Age of Children in Party: <6 and 13-17	-0.94	*0.00*	--	-0.53	*0.00*	--	-0.92	*0.05*	--	-1.27	*0.00*	--	-0.79	*0.00*	--	-2.25	*0.00*	--	-1.05	*0.00*	--
Age of Children in Party: 6-12 and 13-17	-1.02	*0.00*	--	-0.10	*0.87*	--	-1.99	*0.00*	--	-1.22	*0.00*	--	-0.81	*0.00*	--	-2.36	*0.00*	--	-1.09	*0.00*	--
Age of Children in Party: all age groups	-1.17	*0.00*	--	-0.80	*0.00*	--	-0.62	*0.49*	--	-1.60	*0.00*	--	-0.86	*0.00*	--	-2.88	*0.00*	--	-1.31	*0.00*	--
Number of observations	51,592			15,831			5,790			142,014			31,051			123,981			25,534		
R2	18.2			12.0			34.2			32.2			19.5			47.6			23.1		
Adjusted R2	18.1			11.6			33.3			32.2			19.3			47.5			22.8		
F-Value	176.2			19.9			36.1			512.2			37.8			807.2			43.8		
p>F	0.000			0.000			0.000			0.000			0.000			0.000			0.000		

[a] SCB = Saha, Capps, Byrne corrections, which is only necessary if the inverse mill's ratio is significantly different from zero and the variable appears in both the selection and expenditure equation.

[b] Base categories: promotion has only two dummies so either used or not used; age of children in party: everyone greater than 18 years of age.

3.5.2.5 PRIOR FAFH EFFECTS

When examining the effect of prior meals, during the same day, on present meal expenditures, we need to remember that there are two effects: meal effect (the simple task of going out to eat for a prior meal) and expenditure effect (how much was spent during a prior meal). For the most part, as can be seen in Table 3.9, going out to eat at a previous meal have a negative effect on present meal expenditures. For instance, participating in breakfast results in a decreased lunch expenditure of $0.10, [-0.89 + (0.20 x $3.95)]. However, when examining the expenditure effect we see that this effect tends to be positive. For example, for every dollar increase in expenditure, from the mean of $3.95, there is a $0.20 increase in lunch expenditures.

This finding of a negative participation effect and positive previous meal expenditure effect is consistent across all meal occasions. Varying explanations can be associated with this phenomenon, but this increase in expenditures tends to fit the results of Cawley (1999) that people become addicted to food consumption. Further work by Wang et al. (2004) show that brain responses of obese consumers presented with external food stimuli are similar to responses of cocaine addicts. Richards, Patterson, and Tegene (2007) extend their work and found that people are especially susceptible to carbohydrate addiction. Even though consumption and expenditures are not 100% correlated, a high degree of correlation is logical and expected especially since any quality effects associated with food choice and expenditures is controlled for by the facility characteristics. Furthermore, it seems reasonable to assume given the probit marginal effects and OLS effects, that the budgetary and resource constraint concerns

Table 3.9. Regression Coefficient Estimates for the Past Behavior of Each Meal Occasion Expenditure [ab]

Variables	Breakfast Expenditures			Morning Snack Expenditures			Brunch Expenditures			Lunch Expenditures			Afternoon Snack Expenditures			Dinner Expenditures			Evening Snack Expenditures		
	OLS Coeff.	p-value	SCB Coeff.	OLS Coeff.	p-value	SCB Coeff.	OLS Coeff.	p-value	SCB Coeff.	OLS Coeff.	p-value	SCB Coeff.	OLS Coeff.	p-value	SCB Coeff.	OLS Coeff.	p-value	SCB Coeff.	OLS Coeff.	p-value	SCB Coeff.
Ate Breakfast (BR)	--	--	--	-0.64	*0.00*	--	-3.21	*0.00*	-1.61	-0.89	*0.00*	-0.79	-0.59	*0.00*	--	-0.89	*0.00*	-0.69	-0.22	*0.05*	-0.06
Interaction: Ate BR * Break Expenditure	--	--	--	0.21	*0.00*	--	0.24	*0.03*	0.22	0.20	*0.00*	0.21	0.12	*0.00*	--	0.20	*0.00*	0.20	0.02	*0.24*	0.02
Ate Morning Snack (MS)	--	--	--	--	--	--	-0.31	*0.41*	-0.47	-0.99	*0.00*	-0.75	-0.43	*0.26*	--	-0.72	*0.00*	-0.14	-0.43	*0.01*	-0.65
Interaction: Ate MS * MS Expenditure	--	--	--	--	--	--	0.29	*0.00*	0.13	0.29	*0.00*	0.29	0.31	*0.00*	--	0.15	*0.02*	0.15	0.24	*0.00*	0.24
Ate Brunch (BC)	--	--	--	--	--	--	--	--	--	-1.69	*0.00*	-0.87	-0.31	*0.38*	--	-1.10	*0.01*	-0.84	0.63	*0.04*	0.44
Interaction Ate BC * BC Expenditure	--	--	--	--	--	--	--	--	--	0.11	*0.04*	0.15	0.15	*0.01*	--	0.14	*0.02*	0.14	-0.03	*0.53*	-0.01
Ate Lunch (LN)	--	--	--	--	--	--	--	--	--	--	--	--	-0.94	*0.00*	--	-1.54	*0.00*	-1.06	-0.65	*0.00*	-0.28
Interaction Ate LN * LN Expenditure	--	--	--	--	--	--	--	--	--	--	--	--	0.10	*0.00*	--	0.17	*0.00*	0.17	0.05	*0.05*	0.05
Ate Afternoon Snack (AS)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	-1.43	*0.00*	-0.74	-0.45	*0.10*	-0.79
Interaction: Ate AS * AS Expenditure	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.22	*0.00*	0.22	0.28	*0.00*	0.27
Ate Dinner (DN)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	-0.57	*0.00*	-0.37
Interaction: Ate DN * DN Expenditure	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.02	*0.09*	0.02
Number of observations	51,592			15,831			5,790			142,014			31,051			123,981			25,534		
R2	18.2			12.0			34.2			32.2			19.5			47.6			23.1		
Adjusted R2	18.1			11.6			33.3			32.2			19.3			47.5			22.8		
F-Value	176.2			19.9			36.1			512.2			37.8			807.2			43.8		
p>F	0.000			0.000			0.000			0.000			0.000			0.000			0.000		

[a] SCB = Saha, Capps, Byrne corrections, which is only necessary if the inverse mill's ratio is significantly different from zero and the variable appears in both the selection and expenditure equation.

[b] The presented second-stage regression coefficients presented have *not* been adjusted to account for the interactions within the model. The formula by which to calculate the correct marginal effects can be found in equation three.

are answered in the "participation" decision process. However, once the decision to consume AFH is made then the addiction to food takes over leading to increases in expenditures even if prior meals were consumed AFH, thereby, leading to increased expenditures at the "present" meal.

3.6 SUMMARY AND CONCLUSIONS

The amount of a household food budget devoted to FAFH expenditures is now considerable and can be ascribed to numerous factors such as an increasing need for convenience and affordability. Several studies have attempted to determine the factors affecting FAFH expenditures with most focusing on the effects of demographic and socio-economic variables. However, factors such as facility type characteristics, ordering characteristics, and promotional items have not been analyzed in previous studies in relation to their effects on FAFH expenditures. In this study, we included these new types of variables in our model and found that they do play a significant role in both the "participation" and "expenditure" decisions. Specifically for the participation decision the results generally suggest that:

- Certain groups are more likely to "participate" at specific meal occasions.
    - Breakfast and lunch profile is non-white with higher incomes, higher education levels, and lower household sizes *with* children.
    - Dinner profile is non-white with higher incomes, higher education levels, and lower household sizes *without* children.

    - Snacks have varying profiles: afternoon and evening are for younger consumers while morning and afternoon are for those with higher incomes.
- The timing (and amount of expenditure) of past FAFH meals plays a significant role in the probability of future FAFH meals with snacks, in general, having a negative effect on the next meal but positive effects on meals in the “distant” future especially for snacks on “distant” larger meals. However, large meals negatively affect the probability of future larger meals.

In regards to the expenditure decision, the results generally suggest that transactional and past purchasing variables have a significant effect on FAFH expenditures.

- Expenditures at independent stores are less than at major and small chain stores.
- CD, MS, and FN expenditures are significantly larger than expenditures at QS facilities. Consumers spend the most in FN, followed by CD, MS, and then QS stores.
- Ordering food at-table is positively associated with FAFH expenditures across all meals compared with all other food ordering types except ordering food via delivery and through the internet.
- Presence of children, of any age group, within the eating party had a significantly negative effect on FAFH expenditures across all meals.

- Promotions have both positive and negative effects on meal expenditures with the results being highly dependent on type of promotion and meal occasion. Specifically,
    - Free item promotion redemption has negative expenditure effects across all meal occasions.
    - Combined item promotion redemption has positive expenditure effects across all meal occasions.
    - Daily special promotion redemption has a positive effect on snack expenditures but no significant effect on the "major" meals.
- Past FAFH participation has a negative effect on present meal expenditures. However, past FAFH expenditures is positively related to present meal expenditures.

Based on our results it is clear that facility characteristics, ordering characteristics, promotional item usage and away from home purchasing behavior are significant variables that affect FAFH expenditures across all meal occasions. Studies that fail to include these variables could then suffer from omitted variable bias.

CHAPTER IV

ANALYSIS OF FOOD AWAY FROM HOME EXPENDITURES BY FACILITY: DO TRANSACTIONAL VARIABLES AND DECISION STRUCTURE MATTER?

4.1 INTRODUCTION

The prevalence of food away from home (FAFH) consumption has increased drastically over the last several decades. Increased consumption has resulted in a larger percentage of the average household food budget being devoted to FAFH expenditures. Recent estimates show that approximately 40% of the household food budget is devoted to FAFH expenditures (Department of Labor 2006). Given FAFH consumption and expenditures are now a major staple of most households within the U.S., there is a need for policy makers and businesses to not only better understand who is eating away from home, but also how business and governmental decisions will affect FAFH expenditures.

Businesses, especially food related, have a vested interest in understanding FAFH expenditures since their actions and/or inactions can result in significant changes in sales. For instance, it is obvious that understanding clientele through such things as demographic make-up is important; however, party composition and ordering means can have significant effects on sales and ultimately profitability. On the other hand, policy makers, whether federal, state, or local, also have an interest in FAFH expenditures given the health issues associated with increased FAFH consumption. As noted by previous research, on the whole FAFH meals tend to be of lower nutritional quality compared with at-home meals. Furthermore, increased consumption of FAFH meals has been associated with increased obesity and health related issues (Binkley, Eales, and Jekanowski 2000; Bowman and Vinyard 2004).

Lower quality meals are of prime concern given the rise in obesity amongst both adults and children. Quick service meals have long been blamed for providing low quality meals; however, other facility types may be just as culpable if consumers are making bad choices in either quality or quantity. Given the varying make-up in clientele of the different facility types, governmental policies designed to improve the consumption of nutritional foods may or may not have the desired effect depending on the facility type targeted. For example, if improving child nutritional quality is needed, imposing quality guidelines on up-scale facilities may not have any effect on child nutritional quality, while potentially having a negative effect on the sales of up-scale businesses. By having a more in-depth understanding of the clientele associated with various facility types, both businesses and policy makers can make more informed decisions.

This study is not the first study to analyze FAFH expenditures by facility type, see Table 4.1, however, past studies have generally assumed the decision process is made-up of two-steps, commonly termed the “participation” and “expenditure” decisions. This a priori assumption of a two-step decision structure, however, could incorrectly specify the relationships associated with the decision process, thereby, potentially rendering results as misleading. Previous research also has tended to forgo the use of transactional level data in favor of more aggregated data, which has the potential for model misspecification.

Given the limitations of previous studies, the objectives of this paper are two-fold. First, we model and compare the FAFH expenditure decision by facility type in several ways, in order to evaluate how a priori assumptions of model structure affect results and explanatory power. More specifically, we utilize the standard two-step structure, made up of a "participation" (facility type choice) and "expenditure" decision, along with the little used three-step decision structure comprised of the "participation at FAFH meal," "facility type" choice, followed by the "expenditure" amount. Furthermore, we propose an alternative decision structure that seems to more logically apply to the problem at hand. Notably, we utilize a three-step structure with the following decision ordering: 1) "participation" decision (eat away from home or not), 2) "expenditure" decision (how much to spend), and 3) facility type decision. We believe the new structure more appropriately mirrors the facility type expenditure problem. By comparing each of these three methods, we can better understand how structure assumptions affect our results. In addition, we incorporate transactional level variables (chain type, party structure, means of ordering, promotion, and meal occasion) that have not been examined in the FAFH literature, to more correctly represent how consumers make their decisions.

Table 4.1. Examination of Food Away from Home (FAFH) Literature [a]

Paper	Data Source [b]	Data Year	Dependent Variable	Analysis Category	Estimation Method
McCracken and Brandt, 1987	NFCS	1977-1978	Total household expenditure	Facility type	Tobit
Nayga and Capps, 1994	NFCS	1987-1988	Frequency of occasion	Facility type	Heckman
Hiemstra and Kim, 1995	NPD	1989	Quarterly expenditures	Meal occasion and facility type	OLS regression
Byrne et al., 1998	NPD	1982-1989	Quarterly two-week expenditures	Facility type	3 step "Heckman" procedure
Stewart and Yen, 2004	CES	1998-2000	Weekly expenditures	Facility type	FIML procedure
Stewart et al., 2004	CES	1998-2000	Two-week period expenditures	Facility type	Shonkwiler and Yen, 1999

[a] A detailed examination of the FAFH literature can be found in Kim and Geistfeld (2003).

[b] NFCS = Nationwide Food Consumption Survey; NPD = National Panel Diary; CES = Consumer Expenditure Survey; SNECS = Spanish National Expenditure Continual Survey

4.2 DATA

In order to gain a complete picture of the facility expenditure problem, we need a dataset that contains transactional level data with corresponding transactional level variables. We utilized the 2004 Consumer Reports on Eating Share Trends (CREST) because it contained demographics and both transactional level variables and expenditures. CREST participants were e-mailed an invitation to participate in the survey; however, sampling was random across census demographics and census regions. Participants were then asked to provide demographic and socio-economic information, while also answering a variety of questions regarding FAFH meal consumption during the previous day. Demographic and socio-economic variables included in both the survey and in our subsequent analyses included participant's age, gender, education level, household income, household size, age structure of children in household, region, and market size, along with consumption day of the week. Transactional level variables included facility type, age structure of children attending meal, ordering information, promotion, and meal occasion along with expenditure by meal.

Facility type was broken down into four categories: fine dining, casual dining, mid-scale, and quick serve. Fine dining and casual dining have at-table service and serve alcohol, whereas mid-scale facilities do not serve alcohol. The differentiating factor between fine and casual dining is per person expenditures with fine dining having expenditures at lunch and dinner equal to or exceeding \$14 and \$22, respectively.

Descriptions and summary statistics by facility type for both FAFH expenditures and the other transactional level variables can be found in Tables 4.2-4.4.[12] After eliminating approximately 2.4% of the observations due to missing data, our final sample consisted of 696,089 observations of which 56.9% were away from home meal transactions.

Table 4.2. Summary Statistics by Facility Type Model

Facility Type	Percent of Observations [ab]	Avg. Exp. per Transaction ($)	Std. Dev. per Transaction
Eat-away-from-home (AFH)	56.9	--	--
Casual Dining (CD)	13.2	12.22	8.46
Mid-Scale (MS)	15.5	8.07	6.46
Quick Serve (QS)	68.6	4.50	3.37
Fine Dining (FN)	2.8	27.34	23.14
Eat at home (EAH)	43.1	--	--

[a] For AFH and EAH, the percent represents the percentage of observations (i.e. 57% of observations were classified as AFH), however, for CD, MS, QS, and FN the percent represents the percentage of observations within AFH (i.e. 13.2% of transactions of AFH were at CD).
[b] Degree of censoring for CD, MS, QS and FN can be found in two ways depending on which model is under consideration: 1) for censoring of only those eating AFH, 100 - % facilty type of interest; 2) for total censoring, 100 - (% AFH * % facility type of interest / 100)

Respondent specific expenditures for each meal were calculated by dividing the total bill by the number of persons in the meal party. This methodology was employed by CREST due to the ease of remembering the amount of the total bill compared to individual bill totals, thereby, leading to more accurate per person expenditure

[12] Descriptions and summary statistics for demographic and socio-economic variables are not presented for space reasons; however, they are available from the authors upon request.

information. Previous research has utilized prices as an important indicator of expenditures. However, prices are not available in our data. A number of studies have suggested that indicator variables can be used as price proxies (e.g., McCracken and Brandt 1987; Byrne, Capps, and Saha 1998; and Stewart and Yen 2004). Consistent with Stewart and Yen (2004), we then utilize respondent's region and survey quarter along with an additional indicator day of week as pricing proxies.

4.3 RESEARCH METHODOLOGY

As noted above, a number of studies have examined and analyzed the factors affecting FAFH expenditures. As can be seen in Table 4.1, a wide array of decision structures and estimation methods have been used to model FAFH expenditures by facility type.

Table 4.3. Variable Definitions of Transaction Specific Explanatory Variables

Variables [a]	Definition
Promotion used: yes	A promotion of any type was used in at least one transaction
Chain type	
Chain type: major	Facility was a major chain store
Chain type: small	Facility was a small chain store
Chain type: independent	Facility was an independent chain store
Party Structure	
Age of Children in Party: <6 only	Meal party consists of adult plus kid[s] <6 years old only
Age of Children in Party: 6-12 only	Meal party consists of adult plus kid[s] 6-12 years old only
Age of Children in Party: 13-17 only	Meal party consists of adult plus kid[s] 13-17 years old only
Age of Children in Party: <6 and 6-12	Meal party consists of adult plus kids <6 and 6-12 years old
Age of Children in Party: <6 and 13-17	Meal party consists of adult plus kids <6 and 13-17 years old
Age of Children in Party: 6-12 and 13-17	Meal party consists of adult plus kids 6-12 and 13-17 years old
Age of Children in Party: all age groups	Meal party consists of adults plus kids of all age groups
Age of Children in Party: everyone >18	Meal party consists of only persons >18 years old
Ordering	
Order: walk-up	Meal ordered at a walk-up counter
Order: at table	Meal ordered while sitting at a table or sit down counter
Order: drive thru	Meal ordered from car or through drive thru
Order: by phone	Meal ordered via telephone for pick-up at facility
Order: delivery	Meal ordered via telephone for delivery by facility
Order: internet	Meal ordered via internet for delivery
Order: cafeteria	Meal ordered in cafeteria line
Order: buffet	Meal ordered in buffet line
Order: other	Meal ordered via some other format
Promotion	
Promotion: buy-one-get-one free (BOGO)	Panelist bought one item and get one (some) item(s) free
Promotion: combined item special	Panelist combined items to get discouted price
Promotion: daily special	Panelist received a discouted price on a certain offered item(s)
Promotion: discounted price	Panelist received a discounted price on item(s) that was not the daily special
Promotion: employee discount	Panelist received a discounted price for working at the facility
Promotion: free item	Panelist received a free item for partoning the facility
Promotion: merchandise offer	Panelist received a merchandise offer for patroning the facility
Promotion: dollar menu	Panelist ordered from the dollor menu
Promotion: senior citizen discount	Panelist received a senior citizen discount for there meal
Promotion: other deal	Panelist utilized some other type of promotion
Meal Occasion	
Meal occasion: breakfast	Denotes that the *transaction* was for breakfast
Meal occasion: morning snack	Denotes that the *transaction* was for a morning snack
Meal occasion: brunch	Denotes that the *transaction* was for brunch
Meal occasion: lunch*	Denotes that the *transaction* was for lunch
Meal occasion: afternoon snack	Denotes that the *transaction* was for an afternoon snack
Meal occasion: dinner	Denotes that the *transaction* was for dinner
Meal occasion: evening snack	Denotes that the *transaction* was for an evening snack

[a] The meal consumed variables are independent of each other; the promotion variables are independent of each other.

* Denotes the category was used as the base in all analyses for categories with >2 options.

Table 4.4. Descriptive Statistics of Transaction Specific Variables for Facility Type

Variables[a]	CD	MS	QS	FN	EAFH [b]	EAH [c]	Total [d]
Promotion used: yes	17.3	21.3	23.9	4.0	22.1	0.0	12.6
Chain type							
Chain type: major	34.1	26.4	65.3	5.3	53.5	0.0	30.4
Chain type: small	14.2	9.0	14.5	2.2	13.3	0.0	7.6
Chain type: independent	51.7	64.7	20.2	92.5	33.2	0.0	18.9
Party Structure							
Age of Children in Party: <6 only	7.9	6.9	9.4	4.5	8.7	0.0	4.9
Age of Children in Party: 6-12 only	4.3	4.4	4.0	2.0	4.1	0.0	2.3
Age of Children in Party: 13-17 only	2.1	1.9	2.1	1.3	2.1	0.0	1.2
Age of Children in Party: <6 and 6-12	0.6	0.6	0.7	0.7	0.7	0.0	0.4
Age of Children in Party: <6 and 13-17	5.2	4.7	4.7	1.8	4.7	0.0	2.7
Age of Children in Party: 6-12 and 13-17	0.6	0.5	0.6	0.2	0.6	0.0	0.3
Age of Children in Party: all age groups	2.1	1.8	2.1	0.6	2.0	0.0	1.1
Age of Children in Party: everyone >18	77.3	79.2	76.4	89.0	77.3	0.0	44.0
Ordering							
Order: walk-up	5.3	15.8	50.5	1.4	37.8	0.0	21.5
Order: at table	81.3	59.0	2.5	81.5	23.8	0.0	13.5
Order: drive thru	0.3	1.4	24.4	0.1	17.0	0.0	9.7
Order: by phone	6.0	5.6	3.6	0.9	4.1	0.0	2.4
Order: delivery	1.5	2.6	3.7	1.2	3.2	0.0	1.8
Order: internet	0.0	0.1	0.2	0.0	0.2	0.0	0.1
Order: cafeteria	0.2	2.1	1.1	0.2	1.1	0.0	0.6
Order: buffet	1.5	9.5	1.8	7.4	3.1	0.0	1.8
Order: other	3.9	3.9	12.3	7.3	9.8	0.0	5.5
Promotion							
Promotion: buy-one-get-one free	0.8	0.7	1.5	0.5	1.2	0.0	0.7
Promotion: combined item special	2.6	3.8	6.2	1.3	5.2	0.0	3.0
Promotion: daily special	3.9	5.2	2.7	2.3	3.2	0.0	1.8
Promotion: discounted price	1.3	1.2	2.6	1.0	2.2	0.0	1.2
Promotion: employee discount	1.6	1.0	1.2	0.7	1.2	0.0	0.7
Promotion: free item	2.4	3.2	1.5	4.7	1.9	0.0	1.1
Promotion: merchandise offer	0.0	0.0	0.2	0.0	0.2	0.0	0.1
Promotion: dollar menu	0.1	0.1	3.9	0.0	2.7	0.0	1.5
Promotion: senior citizen discount	0.7	3.2	1.0	0.3	1.3	0.0	0.7
Promotion: other deal	5.0	3.9	4.4	4.0	4.4	0.0	2.5
Meal Occasion							
Meal occasion: breakfast	2.2	22.4	13.0	13.8	13.0	0.0	7.4
Meal occasion: morning snack	0.3	1.2	5.5	0.6	4.0	0.0	2.3
Meal occasion: brunch	1.2	2.9	1.1	2.4	1.5	0.0	0.8
Meal occasion: lunch	35.6	35.2	36.5	26.2	35.9	0.0	20.4
Meal occasion: afternoon snack	1.7	1.8	10.6	1.4	7.8	0.0	4.5
Meal occasion: dinner	56.3	34.0	25.0	52.8	31.3	0.0	17.8
Meal occasion: evening snack	2.7	2.4	8.2	2.7	6.5	0.0	3.7

[a] All explanatory variables are dummy variables meaning the descriptive statistics are percentages.

[b] EAFH = Eat Away-From-Home.

[c] EAH = Eat-at-Home

[d] Total represents averages across all observations (AFH+EAH).

4.3.1 ESTIMATION

Numerous econometric techniques can be utilized to model data with large amounts of censoring. In general, either Heckman or maximum likelihood techniques have been used, with maximum likelihood techniques tended to be preferred given they are more efficient than other regression based counterparts. However, given the high degree of censoring associated with our data, maximum likelihood techniques continually failed to converge. We then attempted to utilize the quasi maximum-likelihood (QML) estimator developed by Yen, Lin, and Smallwood (2003) that is less sensitive to censoring; however, the system also failed to converge due to high levels of censoring even with varying model specifications. Consequently, we used Heckman-type procedures for our econometric analyses.

4.3.2 DECISION STRUCTURE

4.3.2.1 TWO-STEP

The common means by which to model the decision to consume a meal away from home has been to utilize a two-step structure where the first step is the "participation" decision. Given the data being used, the "participation" decision is either whether to eat away from home or where to eat out. Assuming the person decides to eat away from home, the next decision to solve is how much to spend or the "expenditure" decision.

Within the "participation" step we utilized a binary probit to model each of the facility types:

$$P[FC_i = 1] = \frac{1}{\sqrt{2\pi}} e^{\frac{-(\beta`x)^2}{2}} \qquad i = 1, 2, 3, 4 \qquad [4.1]$$

where FC represents the decision to eat away from home at facility type i and X is a set of demographic and socio-economic variables, discussed above. As noted by Byrne, Capps, and Saha (1998), demographic and socio-economic variables can be used to describe the decision to eat away from home. In order to account for time constraints experienced by the household, numerous children age structure combinations were used since each age structure might present different advantages and disadvantages to eating out at a specific facility type. As noted by Kim and Geistfeld (2003), a household with a small child may not choose to eat at a fine dining establishment because either the atmosphere is not appropriate for young children or because the meal will take longer, thereby, potentially increasing the amount of time away from the child. However, an older child may result in increased quick-serve usage given they have a busy schedule (i.e. school/sporting events). Explanatory variables utilized in the "participation" decision probit model did not include any of the transactional level variables.

From the probit models we calculate the inverse mill's ratio (IMR) via φ (β'x) / Φ(β'x) whereby φ( ) is the probability density function of the standard normal distribution and Φ( ) is the cumulative distribution function of the standard normal distribution. The IMR can then be added as an explanatory variable in the "expenditure" decision as a proxy for sample selection bias (Nayga and Capps 1994). Finally, marginal effects were calculated from the probit model by taking the derivative: $\partial Y/\partial X_k$, where k denotes the explanatory variable of interest.

For each facility type the "expenditure" decision was then estimated via ordinary least squares (OLS) using only the observations consuming at the facility type of interest. The "expenditure" decision was specified as follows:

$$Exp_{vk} = \sum_{j=1}^{71} X_{ij}\,\beta_j + \beta_w IMR_v + \varepsilon_i \qquad [4.2]$$

where Exp denotes expenditure during the v^{th} transaction at the k^{th} facility type, X represents the i^{th} respondent's j^{th} explanatory variable and IMR is the selection bias indicator. Given a significant IMR, selection bias would have occurred without the inclusion of the IMR term (Byrne, Capps, and Saha 1998).

Ordinarily in an OLS equation, the OLS coefficient estimates represent the marginal effects. However, as shown by Saha, Capps, and Byrne (1997), the marginal effect in a Heckman type model is composed of two parts: expected expenditure and change in probability of consuming. When the IMR coefficient is statistically equal to zero, the change in probability of consuming is also equal to zero, thereby, leaving the regression coefficient as the marginal effect. However, when the IMR is statistically different from zero the coefficient estimates need to be adjusted for variables having appeared in both the "participation" and "expenditure" steps.

Given the potential presence of heteroscedasticity and clustering within the probit and regression models, a sandwich cluster estimator was applied to correct the standard errors. As noted by Rogers (1993) and Froot (1989), the sandwich cluster estimator is a relevant correction mechanism given heteroscedasticity, and a large number of clusters, where we define clusters as responses by the same respondent.

4.3.2.1 THREE-STEP

The two-step decision above is very simplistic in structure; especially given Nelson (1979) found that the decision by a family to eat away from home can be thought of as a six-step process. Byrne, Capps, and Saha (1998) argued that the decision can be defined and modeled as a three-step process where Step 1 is the "participation" decision of whether to eat out or not, Step 2 is the "facility type" decision or where to go, and Step 3 is the "expenditure" decision. Given Nelson (1979) and Byrne, Capps, and Saha (1998), the three-step process seems to more accurately mirror decision making than the two-step structure. Even though the three-step structure fits the facility type problem better, it has received little attention from more recent literature dealing with facility type expenditures in favor of more statistically complex techniques that gain efficiency. However, increased efficiency has little importance if results are biased due to incorrect model specification.

Our modeling of the three-step decision making process follows that of Byrne, Capps, and Saha (1998). The first step is modeled as a binary probit model similar to equation 4.1, except that the dependent variable is not the facility type utilized, but rather whether the person ate out or not. As with the first step of the two-step model above, we calculate the IMR in the same manner in order to test for selection bias in the second step. The sandwich cluster estimator was used to correct the standard errors. Marginal effects were then calculated from the probit model by again taking the derivative: $\partial Y/\partial X_k$.

The second step, "where to eat," was also modeled as a binary probit model with several new variables entering into the model, namely meal occasion indicators and promotion usage (yes/no). Promotion usage, utilization of a promotion by a respondent at any point during the day, served as a proxy for a respondent being a "smart" shopper (looked for deals). The second step probit takes on the same form as equation 1 with the addition of the IMR term as an explanatory variable. A second step IMR was then calculated from the second step probit model using $\varphi(\beta'x) / \Phi(\beta'x)$. As with the first step, the sandwich cluster estimator was applied to correct standard errors for heteroscedasticity and clustering.

The final step was the expenditure equation consisting of the demographics and socio-economic variables and the second step IMR term, along with several new variables. New variables included transaction specific variables and child age categories within the meal party. Within party child age structure replaced household child age structure as an explanatory variable since attendance at a meal should have a greater effect on expenditures than the age structure of those not present.

The final step was estimated via ordinary least squares (OLS) and followed the same specification as equation 4.2. Even though the Saha, Capps, and Byrne (1997) correction was specified for a two step model, Byrne, Capps, and Saha (1998) generalize the procedure to the three-step problem. Therefore, the corrected regression coefficients are presented along with the uncorrected coefficients. Also, the sandwich cluster estimator was applied to correct for heteroscedastictiy and for intra-cluster correlation.

4.3.2.3 THREE-STEP ALTERNATIVE

As discussed above, we believe that the true decision process may not take on the traditional form generally utilized in past research. Our reasoning is as follows. Consider household production theory where a household not only produces, but consumes goods (Becker 1965). As noted by Stewart and Yen (2004), the decision as to consume at-home or away from home is driven not only by preferences, commonly accounted for through demographics, but also via prices and the amount of time to prepare, consume, and clean-up. Hence, the decision to eat away from home is dependent on the value (e.g., monetary and time) of eating away from home being greater than eating at-home. However, Stewart and Yen (2004) further state that budget and resource constraints must also be satisfied.

So the question now becomes, do we decide on an expenditure level before or after we choose a facility type. We propose that an expenditure level is established and then the decision of facility type is decided upon. Given the budget constraint must be satisfied, we would not choose to frequent a facility type inconsistent with our budget constraint. For example, if my budget allows for $10 to be spent on a meal, would I more likely go to a fine dining establishment or somewhere less costly? Thereby, we believe the first step is determining whether to eat out or not, then satisfaction of the budget constraint as to how much can be spent, followed by the decision as to where to spend the money allotted to eating out.

The first step is consistent with the three-step method of Byrne, Capps, and Saha, (1998), evaluating whether to eat away from home or at-home. We model step one via a binary probit model and identify the marginal effects, while also calculating the IMR in order to test for selection bias in step two. However, our second step differs in that we now model the expenditure decision as shown in equation two, including the transactional variables. We include the transactional variables because they are integral to satisfying household constraints. For instance, the use of a promotion is key to determining how much can be spent at a meal. Furthermore, the age structure of children can be viewed as a critical component in solving the time constraint. From the "expenditure" decision, equation two, we calculated expenditure predictions, adjusted via Saha, Capps, Byrne (1997), as a measure of the respondent's projected expenditure level.

The final step, three, consists of the facility type decision. This final step mirrors equation one with the addition of our expenditure predictions from step two as an additional explanatory variable. As with all previous steps, we utilize the sandwich cluster estimator. We then calculate marginal effects associated with each explanatory variable.

4.4 RESULTS AND DISCUSSION

The first step to comparing the results from the three decision structures is to examine the accuracy associated with facility type assignment within the probit model, see Table 4.5. A quick glance indicates that the probit models associated with each structure have good success in prediction accuracy and in regards to sensitivity and specificity. However, a closer examination reveals that our newly proposed three step structure has a decided advantage over the traditional two-step and Byrne, Capps, and Saha, (1998) structures in overall accuracy, sensitivity and specificity. For instance, our structure correctly classifies 82.6% of casual dining participants compared to 79.1% and 60.5% for the other decision structures. The only case where our three step structure does not outperform the other structures is for the mid-scale facility type. However, for the important sensitivity measure, correct classification of those eating at a specific facility type compared to total eating at the facility type, our model outperforms all other models.

4.4.1 PROPOSED THREE-STEP DECISION STRUCTURE RESULTS

Given the better performance of our three step decision structure, we focus the detailed discussion of the results on this model. However, results for the other models can be found in Tables 4.6 - 4.11 for quick reference and comparison.

Table 4.5. Prediction Accuracy of the Probit Models Associated with Each of the Models of Interest

Variables	Percentage of correct predictions	Sensitivity (%) [a]	Specificity (%) [b]	Cutoff value [c]
Two-step model (probit/ols)				
Step 1: Where to eat				
Casual Dining (CD)	79.1	62.1	80.5	7.5
Mid-Scale (MS)	74.7	62.0	75.9	8.8
Quick Serve (QS)	77.2	69.8	81.9	39.0
Fine Dining (FN)	74.5	76.7	74.5	1.6
Three-step Model (probit/probit/ols)				
Step 1: Participation				
Away from home	58.8	60.5	56.5	57.0
Step 2: Where to eat				
Casual Dining (CD)	60.5	77.2	57.9	13.2
Mid-Scale (MS)	60.3	64.0	59.6	15.5
Quick Serve (QS)	63.4	59.9	71.2	68.6
Fine Dining (FN)	68.9	76.5	68.7	2.8
Three-step model (probit/ols/probit)				
Step 3: Where to eat				
Casual Dining (CD)	82.6	87.0	81.9	13.2
Mid-Scale (MS)	72.6	73.0	72.5	15.5
Quick Serve (QS)	88.1	91.2	81.3	68.6
Fine Dining (FN)	76.7	85.1	76.4	2.8

[a] Sensitivity is interpreted as the percentage of transactions correctly classified as eating away from home out of the total eating away from home; or as the percentage of transactions correctly classifed as eating at a certain facility type out of the total eating at the facility type (i.e. for the two-step model: 76.7% of those eating at FN were correctly classified as eating at a FN).

[b] Specificity is the percentage of transactions correctly classified as eating at-home out of the total eating at-home (i.e. for the two-step model: 74.5% of those eating at-home were correctly classified as eating at-home).

[c] The conventional cutoff values of 50% were changed to more accurately reflect the frequencies displayed within the categories.

4.4.1.1 STEP 1: "PARTICIPATION" DECISION

Examination of the first step probit model, see "step one" in Table 4.9, indicates that higher educated non-white females with higher incomes and smaller household sizes without children are more likely to eat away from home than others. For example, females are 23.3% more likely to eat out than their male counterparts, while non-whites are 1.6% more likely to eat away from home. Furthermore, increasing incomes result in a higher probability of eating out. Specifically, those with incomes between $25k-$34k and greater than $99k are 6.2% and 13.3% more likely to eat out than those making less than $25k, respectively. Also, as household income increases, the probability of eating away from home increases. This is most likely due to an increasing value of time; implying quick (not only in preparation, but also in clean-up) meals associated with eating out are more valuable than at-home meals.

Table 4.6. Marginal Effects for the Probit Model Associated with the Two-Step Heckman Model [a]

Variables	Two-Step Probit Marginal Effects							
	Casual Dining		Mid-Scale		Quick Service		Fine Dining	
	Estimate	p-value	Estimate	p-value	Estimate	p-value	Estimate	p-value
Apr-June	-0.001	0.196	0.001	0.169	0.021	0.000	0.000	0.035
July-Sept	-0.003	0.000	0.000	0.903	0.025	0.000	0.001	0.012
Oct-Nov	-0.005	0.000	-0.003	0.003	0.016	0.000	0.001	0.000
Age (yrs): <18	-0.009	0.000	-0.014	0.000	-0.037	0.000	-0.003	0.000
Age (yrs): 18-24	0.001	0.438	-0.005	0.000	0.011	0.000	-0.002	0.000
Age (yrs): 35-49	-0.008	0.000	0.010	0.000	-0.042	0.000	0.000	0.209
Age (yrs): 50-64	-0.010	0.000	0.022	0.000	-0.101	0.000	0.001	0.062
Age: >64	-0.005	0.000	0.034	0.000	-0.211	0.000	0.002	0.000
Gender: male	-0.004	0.000	-0.003	0.000	-0.006	0.000	0.000	0.278
Education: HS grad.	0.010	0.000	0.005	0.025	0.032	0.000	0.001	0.473
Education: Some college	0.018	0.000	0.005	0.019	0.038	0.000	0.003	0.002
Education: College grad.	0.025	0.000	0.009	0.000	0.016	0.000	0.006	0.000
Monday	-0.011	0.000	-0.013	0.000	0.064	0.000	-0.002	0.000
Tuesday	-0.010	0.000	-0.010	0.000	0.075	0.000	-0.002	0.000
Wednesday	-0.007	0.000	-0.009	0.000	0.080	0.000	-0.001	0.000
Thursday	-0.006	0.000	-0.007	0.000	0.080	0.000	-0.001	0.037
Friday	0.002	0.070	0.000	0.773	0.082	0.000	0.000	0.647
Saturday	0.004	0.000	0.001	0.459	0.044	0.000	0.002	0.000
Household Income: 25k-34k	0.015	0.000	0.008	0.000	0.029	0.000	0.003	0.000
Household Income: 35k-44k	0.020	0.000	0.013	0.000	0.028	0.000	0.004	0.000
Household Income: 45k-60k	0.029	0.000	0.015	0.000	0.031	0.000	0.006	0.000
Household Income: 60k-74k	0.042	0.000	0.016	0.000	0.029	0.000	0.008	0.000
Household Income: 75k-99k	0.049	0.000	0.019	0.000	0.023	0.000	0.013	0.000
Household Inocme: >99k	0.061	0.000	0.023	0.000	0.009	0.000	0.022	0.000
Household Size: 2	-0.007	0.000	0.000	0.830	-0.009	0.000	-0.001	0.000
Household Size: 3-4	-0.014	0.000	-0.006	0.000	0.002	0.398	-0.004	0.000
Household Size: >4	-0.019	0.000	-0.009	0.000	-0.002	0.537	-0.004	0.000
Age of Household Children: <6 only	-0.003	0.007	-0.006	0.000	0.022	0.000	-0.001	0.000
Age of Household Children: 6-12 only	-0.005	0.000	-0.007	0.000	0.026	0.000	-0.002	0.000
Age of Household Children: 13-17 only	-0.002	0.114	-0.005	0.000	0.017	0.000	0.000	0.825
Age of Household Children: <6 and 6-12	-0.008	0.000	-0.012	0.000	0.030	0.000	-0.002	0.000
Age of Household Children: <6 and 13-17	-0.010	0.001	-0.009	0.009	0.040	0.000	-0.002	0.072
Age of Household Children: 6-12 and 13-17	-0.006	0.000	-0.011	0.000	0.029	0.000	-0.001	0.033
Age of Household Children: all age groups	-0.014	0.000	-0.009	0.006	0.034	0.000	-0.002	0.029
Race: white	0.008	0.000	0.001	0.519	-0.020	0.000	0.001	0.000
Region: Mid-Atlantic	-0.010	0.000	0.016	0.000	0.008	0.021	-0.001	0.053
Region: East-North-Central	0.000	0.944	0.011	0.000	0.021	0.000	-0.003	0.000
Region: West-North-Central	0.002	0.125	0.005	0.011	0.036	0.000	-0.003	0.000
Region: South-Atlantic	0.001	0.526	0.017	0.000	0.028	0.000	-0.002	0.000
Region: East-South-Central	-0.003	0.039	0.019	0.000	0.063	0.000	-0.004	0.000
Region: West-South-Central	0.001	0.488	0.019	0.000	0.054	0.000	-0.004	0.000
Region: Mountain	0.004	0.014	0.009	0.000	0.022	0.000	-0.002	0.000
Region: Pacific	-0.010	0.000	0.015	0.000	0.037	0.000	-0.001	0.000
Market Size: >2.5 MM	-0.001	0.137	-0.005	0.000	0.020	0.000	0.001	0.000
Market Size: <1 MM	-0.002	0.000	-0.001	0.095	0.004	0.033	-0.001	0.000
Market Size: MSA	-0.012	0.000	0.001	0.152	0.002	0.481	-0.002	0.000
Promotion used: yes	0.009	0.000	0.037	0.000	0.344	0.000	-0.007	0.000
Meal occasion: breakfast	-0.028	0.000	0.233	0.000	0.434	0.000	0.023	0.000
Meal occasion: morning snack	-0.043	0.000	-0.005	0.033	0.612	0.000	-0.002	0.002
Meal occasion: brunch	0.071	0.000	0.297	0.000	0.314	0.000	0.043	0.000
Meal occasion: dinner	0.172	0.000	0.122	0.000	0.298	0.000	0.033	0.000
Meal occasion: afternoon snack	-0.017	0.000	-0.016	0.000	0.619	0.000	-0.001	0.315
Meal occasion: evening snack	0.018	0.000	0.015	0.000	0.571	0.000	0.009	0.000
Number of observations	696,089		696,089		696,089		696,089	
Number of clusters	596,561		596,561		596,561		596,561	
Prob > chi2	0.000		0.000		0.000		0.000	
Mcfadden pseudo R^2	0.14		0.10		0.24		0.17	

[a] Calculated at the sample means.

Table 4.7. Regression Coeffcient Estimates for Facility Type Expenditures Associated with the Two-Step Heckman Model and Non-Transactional Variables

	CD Expenditure			MS Expenditure			QS Expenditure			FN Expenditure		
Variables	OLS Coefficient	p-value	SCB Coefficient	OLS Coefficient	p-value	SCB Coefficient	OLS Coefficient	p-value	SCB Coefficient	OLS Coefficient	p-value	SCB Coefficient [a]
Apr-June	0.203	*0.045*	0.194	0.218	*0.002*	0.230	0.067	*0.000*	0.027	-1.920	*0.000*	-1.954
July-Sept	-0.161	*0.118*	-0.193	0.002	*0.968*	0.003	0.148	*0.000*	0.099	-0.615	*0.283*	-0.656
Oct-Nov	-0.024	*0.830*	-0.070	0.263	*0.000*	0.237	0.139	*0.000*	0.108	-1.628	*0.006*	-1.706
Age (yrs): <18	-1.146	*0.001*	-1.230	-0.025	*0.915*	-0.177	-0.346	*0.000*	-0.273	-7.811	*0.013*	-7.542
Age (yrs): 18-24	-0.723	*0.000*	-0.715	-0.322	*0.003*	-0.372	-0.201	*0.000*	-0.223	-1.306	*0.228*	-1.147
Age (yrs): 35-49	0.076	*0.567*	0.000	-0.259	*0.004*	-0.158	-0.181	*0.000*	-0.099	-0.967	*0.109*	-0.945
Age (yrs): 50-64	-0.016	*0.914*	-0.111	-0.619	*0.000*	-0.409	-0.443	*0.000*	-0.240	-1.844	*0.003*	-1.878
Age: >64	-0.512	*0.000*	-0.557	-1.028	*0.000*	-0.719	-0.970	*0.000*	-0.517	-2.178	*0.003*	-2.294
Gender: male	0.300	*0.000*	0.260	0.311	*0.000*	0.284	0.347	*0.000*	0.359	0.965	*0.021*	0.952
Education: HS grad.	-0.373	*0.248*	-0.288	-0.069	*0.664*	-0.019	0.070	*0.108*	0.008	-4.417	*0.134*	-4.459
Education: Some college	-0.237	*0.490*	-0.072	-0.005	*0.976*	0.046	0.042	*0.314*	-0.031	-6.398	*0.027*	-6.575
Education: College grad.	-0.335	*0.344*	-0.111	0.107	*0.516*	0.197	-0.021	*0.626*	-0.052	-5.051	*0.090*	-5.427
Monday	-0.569	*0.000*	-0.676	-0.753	*0.000*	-0.897	-0.174	*0.000*	-0.298	0.726	*0.436*	0.920
Tuesday	-0.798	*0.000*	-0.898	-0.820	*0.000*	-0.925	-0.197	*0.000*	-0.341	0.830	*0.242*	0.962
Wednesday	-0.786	*0.000*	-0.848	-0.673	*0.000*	-0.766	-0.188	*0.000*	-0.342	1.511	*0.038*	1.590
Thursday	-0.699	*0.000*	-0.760	-0.692	*0.000*	-0.766	-0.133	*0.000*	-0.287	1.031	*0.130*	1.073
Friday	-0.552	*0.000*	-0.536	-0.534	*0.000*	-0.531	-0.047	*0.058*	-0.204	0.639	*0.354*	0.631
Saturday	-0.037	*0.740*	0.001	-0.206	*0.020*	-0.197	0.043	*0.073*	-0.042	2.149	*0.000*	2.038
Household Income: 25k-34k	0.220	*0.144*	0.347	0.011	*0.929*	0.086	0.071	*0.002*	0.015	-0.942	*0.499*	-1.116
Household Income: 35k-44k	-0.049	*0.753*	0.121	0.105	*0.314*	0.234	0.050	*0.034*	-0.004	-0.424	*0.736*	-0.674
Household Income: 45k-60k	0.137	*0.417*	0.369	0.110	*0.254*	0.251	0.077	*0.000*	0.017	-0.438	*0.702*	-0.749
Household Income: 60k-74k	0.220	*0.275*	0.540	0.165	*0.093*	0.322	0.084	*0.000*	0.027	0.338	*0.768*	-0.063
Household Income: 75k-99k	0.291	*0.183*	0.655	0.273	*0.007*	0.454	0.076	*0.001*	0.031	0.382	*0.764*	-0.193
Household Inocme: >99k	1.074	*0.000*	1.519	0.809	*0.000*	1.027	0.225	*0.000*	0.207	4.124	*0.008*	3.276
Race: white	-0.601	*0.000*	-0.527	-0.258	*0.002*	-0.252	-0.220	*0.000*	-0.180	-0.163	*0.814*	-0.239
Region: Mid-Atlantic	-0.417	*0.010*	-0.516	-0.577	*0.000*	-0.426	-0.127	*0.000*	-0.142	2.327	*0.001*	2.373
Region: East-North-Central	-1.706	*0.000*	-1.707	-1.314	*0.000*	-1.207	-0.186	*0.000*	-0.227	-0.456	*0.592*	-0.192
Region: West-North-Central	-1.887	*0.000*	-1.866	-1.103	*0.000*	-1.054	-0.183	*0.000*	-0.252	-0.157	*0.885*	0.132
Region: South-Atlantic	-1.046	*0.000*	-1.038	-0.839	*0.000*	-0.677	-0.030	*0.327*	-0.085	1.272	*0.098*	1.447
Region: East-South-Central	-1.168	*0.000*	-1.199	-1.049	*0.000*	-0.872	-0.047	*0.195*	-0.167	-1.100	*0.372*	-0.709
Region: West-South-Central	-1.499	*0.000*	-1.490	-1.014	*0.000*	-0.837	-0.026	*0.420*	-0.129	0.593	*0.570*	0.939
Region: Mountain	-1.277	*0.000*	-1.242	-0.522	*0.001*	-0.431	-0.045	*0.194*	-0.088	0.639	*0.582*	0.793
Region: Pacific	-0.405	*0.017*	-0.499	-0.005	*0.972*	0.137	0.147	*0.000*	0.075	1.429	*0.042*	1.502
Market Size: >2.5 MM	0.543	*0.000*	0.533	0.333	*0.000*	0.284	0.123	*0.000*	0.084	0.144	*0.781*	0.062
Market Size: <1 MM	-0.215	*0.010*	-0.238	-0.174	*0.014*	-0.188	-0.092	*0.000*	-0.100	-1.628	*0.008*	-1.538
Market Size: outside U.S.	-0.214	*0.082*	-0.329	-0.447	*0.000*	-0.433	-0.212	*0.000*	-0.215	-2.419	*0.004*	-2.253
Inverse mill's ratio	-1.240	*0.067*	--	-1.710	*0.017*	--	1.367	*0.000*	--	1.447	*0.516*	--
Constant	14.350	*0.000*	--	13.814	*0.000*	--	6.979	*0.000*	--	21.845	*0.006*	--
Number of observations	52,275			61,190			271,455			10,873		
Std. Errors adjusted for clusters:	50,186			57,231			215,144			10,326		
R^2	0.199			0.145			0.233			0.248		
Adjusted R^2	0.198			0.144			0.232			0.243		
p>F	0.000			0.000			0.000			0.000		

[a] The inverse mill's ratio for fine dining category is not significantly different from zero so the original OLS estimates are correct. The SCB corrected estimates are given as a reference.

Table 4.8. Regression Coeffcient Estimates for Facility Type Expenditures Associated with the Two-Step Heckman Model and Transactional Level Variables

	CD Expenditure			MS Expenditure			QS Expenditure			FN Expenditure		
	OLS		SCB	OLS		SCB	OLS		SCB	OLS		SCB
Variables	Coefficient	p-value	Coefficient	Coefficient	p-value	Coefficient	Coefficient	p-value	Coefficient	Coefficient	p-value	Coefficient[a]
Meal occasion: breakfast	-1.341	0.006	-1.670	-3.144	0.000	-1.759	-0.499	0.000	-1.370	-6.736	0.000	-7.522
Meal occasion: morning snack	-2.113	0.001	-2.783	-3.195	0.000	-3.246	-0.650	0.000	-2.361	-10.943	0.000	-10.799
Meal occasion: brunch	0.903	0.071	1.365	-1.794	0.007	-0.223	0.309	0.000	-0.297	6.916	0.002	5.864
Meal occasion: dinner	2.613	0.000	3.591	1.259	0.002	2.181	1.393	0.000	0.823	16.428	0.000	15.353
Meal occasion: afternoon snack	-1.426	0.000	-1.601	-2.239	0.000	-2.423	-0.222	0.003	-1.855	-3.653	0.008	-3.616
Meal occasion: evening snack	-1.824	0.000	-1.676	-2.200	0.000	-2.058	0.018	0.788	-1.342	-2.731	0.021	-3.144
Chain type: major	3.894	0.000	--	0.891	0.000	--	-0.299	0.000	--	-3.390	0.000	--
Chain type: small	3.993	0.000	--	0.566	0.000	--	-0.223	0.000	--	10.299	0.000	--
Age of Children in Party: <6 only	-1.208	0.000	--	-0.739	0.000	--	-0.476	0.000	--	-1.005	0.398	--
Age of Children in Party: 6-12 only	-2.388	0.000	--	-1.404	0.000	--	-0.810	0.000	--	-1.006	0.547	--
Age of Children in Party: 13-17 only	-1.907	0.000	--	-1.615	0.000	--	-1.235	0.000	--	-1.105	0.654	--
Age of Children in Party: <6 and 6-12	-3.030	0.000	--	-2.811	0.000	--	-1.931	0.000	--	-6.015	0.096	--
Age of Children in Party: <6 and 13-17	-2.891	0.000	--	-2.019	0.000	--	-1.226	0.000	--	-1.630	0.179	--
Age of Children in Party: 6-12 and 13-17	-2.973	0.000	--	-1.646	0.000	--	-1.432	0.000	--	-5.529	0.073	--
Age of Children in Party: all age groups	-3.683	0.000	--	-2.478	0.000	--	-1.710	0.000	--	-3.965	0.029	--
Order: walk-up	-4.150	0.000	--	-2.537	0.000	--	-3.065	0.000	--	-4.116	0.019	--
Order: drive thru	-3.393	0.000	--	-2.378	0.000	--	-3.240	0.000	--	1.537	0.780	--
Order: by phone	-3.378	0.000	--	-1.937	0.000	--	-2.020	0.000	--	-5.289	0.059	--
Order: delivery	-2.452	0.000	--	0.333	0.355	--	-0.583	0.000	--	0.347	0.887	--
Order: internet	3.217	0.319	--	4.681	0.012	--	0.444	0.110	--	7.510	0.206	--
Order: cafeteria	-2.320	0.052	--	-2.015	0.000	--	-2.887	0.000	--	-0.759	0.915	--
Order: buffet	-1.628	0.000	--	-0.365	0.001	--	-0.727	0.000	--	-3.339	0.000	--
Order: other	-3.557	0.000	--	-3.069	0.000	--	-4.213	0.000	--	-1.785	0.120	--
Promotion: buy-one-get-one free	-1.096	0.174	--	-1.176	0.000	--	0.355	0.000	--	-8.046	0.000	--
Promotion: combined item special	-0.429	0.021	--	-0.776	0.000	--	0.902	0.000	--	-2.050	0.095	--
Promotion: daily special	-0.879	0.000	--	-1.017	0.000	--	0.410	0.000	--	-1.670	0.213	--
Promotion: discounted price	-1.225	0.000	--	-0.841	0.019	--	-0.066	0.155	--	-2.820	0.122	--
Promotion: employee discount	-3.723	0.000	--	-2.078	0.000	--	-0.561	0.000	--	-6.709	0.002	--
Promotion: free item	-5.375	0.000	--	-4.449	0.000	--	-1.847	0.000	--	-10.405	0.000	--
Promotion: merchandise offer	7.713	0.020	--	3.298	0.002	--	1.067	0.003	--	9.708	0.000	--
Promotion: dollar menu	-4.594	0.000	--	0.145	0.885	--	-0.660	0.000	--	-32.597	0.000	--
Promotion: senior citizen discount	-2.131	0.000	--	-1.359	0.000	--	0.294	0.000	--	2.258	0.669	--
Promotion: other deal	-1.049	0.000	--	-0.792	0.000	--	0.356	0.000	--	0.219	0.905	--

[a] The inverse mill's ratio for fine dining category is not significantly different from zero so the original OLS estimates are correct. The SCB corrected estimates are given as a reference.

Table 4.9. Marginal Effects for the Three-Step Model Given by Byrne, Capps, and Saha (1998)

Variables	Step 1 Away from Home		Step 2 Casual Dining		Mid-Scale		Quick Service		Fine Dining	
	Estimate	p-value	Estimate	p-value	Estimate	p-value	Estimate	p-value	Estimate	p-value
Apr-June	0.031	0.000	0.007	0.012	0.009	0.010	-0.016	0.000	0.002	0.058
July-Sept	0.035	0.000	0.004	0.208	0.008	0.033	-0.013	0.012	0.002	0.039
Oct-Nov	0.011	0.000	-0.006	0.001	-0.002	0.233	0.006	0.016	0.003	0.000
Age (yrs): <18	-0.066	0.000	-0.026	0.000	-0.032	0.000	0.072	0.000	-0.007	0.000
Age (yrs): 18-24	0.024	0.000	0.013	0.000	0.000	0.998	-0.009	0.055	-0.003	0.000
Age (yrs): 35-49	-0.064	0.000	-0.031	0.000	0.006	0.334	0.031	0.000	-0.002	0.147
Age (yrs): 50-64	-0.120	0.000	-0.045	0.000	0.017	0.122	0.030	0.035	-0.002	0.470
Age: >64	-0.233	0.000	-0.058	0.000	0.020	0.393	0.026	0.372	-0.002	0.679
Gender: male	-0.020	0.000	-0.013	0.000	-0.009	0.000	0.022	0.000	0.000	0.628
Education: HS grad.	0.047	0.000	0.031	0.000	0.016	0.010	-0.048	0.000	0.003	0.222
Education: Some college	0.069	0.000	0.054	0.000	0.020	0.012	-0.079	0.000	0.008	0.006
Education: College grad.	0.067	0.000	0.064	0.000	0.025	0.001	-0.109	0.000	0.014	0.000
Monday	-0.017	0.000	-0.030	0.000	-0.036	0.000	0.086	0.000	-0.006	0.000
Tuesday	0.005	0.048	-0.024	0.000	-0.026	0.000	0.067	0.000	-0.004	0.000
Wednesday	0.026	0.000	-0.012	0.000	-0.021	0.000	0.046	0.000	-0.003	0.002
Thursday	0.036	0.000	-0.008	0.012	-0.014	0.000	0.033	0.000	-0.001	0.298
Friday	0.105	0.000	0.034	0.001	0.019	0.072	-0.048	0.001	0.003	0.363
Saturday	0.086	0.000	0.036	0.000	0.021	0.018	-0.063	0.000	0.007	0.034
Household Income: 25k-34k	0.062	0.000	0.047	0.000	0.024	0.001	-0.075	0.000	0.008	0.004
Household Income: 35k-44k	0.075	0.000	0.062	0.000	0.036	0.000	-0.104	0.000	0.012	0.002
Household Income: 45k-60k	0.088	0.000	0.082	0.000	0.040	0.000	-0.129	0.000	0.015	0.001
Household Income: 60k-74k	0.105	0.000	0.114	0.000	0.046	0.000	-0.166	0.000	0.020	0.001
Household Income: 75k-99k	0.114	0.000	0.129	0.000	0.051	0.000	-0.195	0.000	0.031	0.000
Household Inocme: >99k	0.133	0.000	0.156	0.000	0.060	0.000	-0.254	0.000	0.051	0.000
Household Size: 2	-0.007	0.001	-0.013	0.000	0.000	0.834	0.013	0.000	-0.002	0.000
Household Size: 3-4	-0.025	0.000	-0.030	0.000	-0.012	0.000	0.057	0.000	-0.008	0.000
Household Size: >4	-0.044	0.000	-0.042	0.000	-0.020	0.000	0.084	0.000	-0.009	0.000
Age of Household Children: <6 only	-0.023	0.000	-0.015	0.000	-0.020	0.000	0.042	0.000	-0.003	0.000
Age of Household Children: 6-12 only	-0.014	0.000	-0.014	0.000	-0.019	0.000	0.041	0.000	-0.003	0.000
Age of Household Children: 13-17 only	-0.006	0.024	-0.006	0.002	-0.012	0.000	0.021	0.000	0.000	0.545
Age of Household Children: <6 and 6-12	-0.027	0.000	-0.024	0.000	-0.030	0.000	0.064	0.000	-0.005	0.000
Age of Household Children: <6 and 13-17	-0.006	0.408	-0.022	0.000	-0.021	0.000	0.049	0.000	-0.004	0.049
Age of Household Children: 6-12 and 13-17	-0.016	0.000	-0.018	0.000	-0.027	0.000	0.052	0.000	-0.002	0.010
Age of Household Children: all age groups	-0.018	0.012	-0.031	0.000	-0.024	0.000	0.065	0.000	-0.005	0.015
Race: white	-0.016	0.000	0.009	0.000	-0.003	0.137	-0.010	0.001	0.002	0.016
Region: Mid-Atlantic	0.013	0.000	-0.016	0.000	0.032	0.000	-0.008	0.062	-0.001	0.183
Region: East-North-Central	0.029	0.000	0.007	0.041	0.026	0.000	-0.017	0.003	-0.006	0.000
Region: West-North-Central	0.037	0.000	0.014	0.002	0.014	0.006	-0.011	0.111	-0.006	0.000
Region: South-Atlantic	0.041	0.000	0.010	0.015	0.037	0.000	-0.036	0.000	-0.004	0.001
Region: East-South-Central	0.067	0.000	0.009	0.187	0.044	0.000	-0.031	0.003	-0.007	0.000
Region: West-South-Central	0.059	0.000	0.014	0.013	0.042	0.000	-0.035	0.000	-0.007	0.000
Region: Mountain	0.031	0.000	0.014	0.000	0.022	0.000	-0.025	0.000	-0.003	0.001
Region: Pacific	0.029	0.000	-0.013	0.000	0.031	0.000	-0.007	0.224	-0.001	0.144
Market Size: >2.5 MM	0.022	0.000	0.004	0.052	-0.004	0.099	-0.004	0.226	0.003	0.000
Market Size: <1 MM	-0.006	0.001	-0.006	0.000	-0.003	0.056	0.014	0.000	-0.003	0.000
Market Size: MSA	-0.031	0.000	-0.030	0.000	-0.004	0.213	0.045	0.000	-0.005	0.000
Promotion used: yes	--	--	-0.032	0.000	-0.011	0.000	0.076	0.000	-0.018	0.000
Meal occasion: breakfast	--	--	-0.104	0.000	0.097	0.000	-0.001	0.637	0.005	0.000
Meal occasion: morning snack	--	--	-0.103	0.000	-0.102	0.000	0.246	0.000	-0.012	0.000
Meal occasion: brunch	--	--	-0.024	0.000	0.138	0.000	-0.144	0.000	0.016	0.000
Meal occasion: dinner	--	--	0.077	0.000	0.013	0.000	-0.138	0.000	0.015	0.000
Meal occasion: afternoon snack	--	--	-0.087	0.000	-0.115	0.000	0.239	0.000	-0.011	0.000
Meal occasion: evening snack	--	--	-0.059	0.000	-0.088	0.000	0.169	0.000	-0.005	0.000
Number of observations	696,089		395,793		395,793		395,793		395,793	
Number of clusters	596,561		296,265		296,265		296,265		296,265	
Prob > chi2	0.000		0.000		0.000		0.000		0.000	
Mcfadden pseudo R^2	0.03		0.11		0.06		0.11		0.14	

[a] Calculated at the sample means.

Table 4.10. Regression Coeffcient Estimates for Facility Type Expenditures Associated with the Byrne, Capps, and Saha (1998) Model and Non-Trasactional Level Variables

	CD Expenditure			MS Expenditure			QS Expenditure			FN Expenditure		
Variables	OLS Coefficient	p-value	SCB Coefficient	OLS Coefficient	p-value	SCB Coefficient	OLS Coefficient	p-value	SCB Coefficient	OLS Coefficient	p-value	SCB Coefficient [a]
Apr-June	0.236	*0.022*	0.215	0.249	*0.000*	0.245	0.057	*0.001*	0.062	-1.933	*0.000*	-1.963
July-Sept	-0.114	*0.277*	-0.126	0.042	*0.477*	0.038	0.155	*0.000*	0.159	-0.628	*0.271*	-0.664
Oct-Nov	0.012	*0.914*	0.029	0.294	*0.000*	0.295	0.170	*0.000*	0.168	-1.634	*0.006*	-1.676
Age (yrs): <18	-1.186	*0.000*	-1.101	-0.017	*0.941*	0.000	-0.186	*0.000*	-0.208	-7.753	*0.013*	-7.616
Age (yrs): 18-24	-0.733	*0.000*	-0.770	-0.287	*0.010*	-0.287	-0.168	*0.000*	-0.165	-1.297	*0.232*	-1.243
Age (yrs): 35-49	0.074	*0.561*	0.169	-0.424	*0.000*	-0.427	-0.150	*0.000*	-0.159	-0.939	*0.116*	-0.900
Age (yrs): 50-64	-0.082	*0.523*	0.065	-1.000	*0.000*	-1.010	-0.500	*0.000*	-0.510	-1.786	*0.004*	-1.750
Age: >64	-0.779	*0.000*	-0.573	-1.771	*0.000*	-1.782	-1.277	*0.000*	-1.285	-2.040	*0.016*	-1.999
Gender: male	0.304	*0.000*	0.344	0.300	*0.000*	0.305	0.378	*0.000*	0.371	0.970	*0.020*	0.975
Education: HS grad.	-0.369	*0.247*	-0.453	-0.006	*0.970*	-0.015	-0.024	*0.578*	-0.009	-4.435	*0.132*	-4.480
Education: Some college	-0.262	*0.435*	-0.413	0.104	*0.501*	0.093	-0.122	*0.004*	-0.098	-6.429	*0.026*	-6.549
Education: College grad.	-0.396	*0.251*	-0.578	0.192	*0.224*	0.179	-0.291	*0.000*	-0.258	-5.084	*0.088*	-5.295
Monday	-0.468	*0.008*	-0.371	-0.573	*0.000*	-0.553	0.019	*0.481*	-0.007	0.702	*0.464*	0.817
Tuesday	-0.672	*0.000*	-0.597	-0.625	*0.000*	-0.610	-0.029	*0.255*	-0.050	0.791	*0.283*	0.869
Wednesday	-0.662	*0.000*	-0.626	-0.454	*0.006*	-0.443	-0.055	*0.029*	-0.068	1.461	*0.054*	1.505
Thursday	-0.571	*0.000*	-0.547	-0.482	*0.002*	-0.474	-0.018	*0.470*	-0.029	0.980	*0.158*	0.999
Friday	-0.440	*0.000*	-0.531	-0.338	*0.007*	-0.348	-0.038	*0.122*	-0.023	0.576	*0.403*	0.531
Saturday	0.020	*0.855*	-0.076	-0.093	*0.370*	-0.104	-0.002	*0.932*	0.017	2.115	*0.000*	2.020
Household Income: 25k-34k	0.229	*0.112*	0.106	0.088	*0.412*	0.075	-0.043	*0.054*	-0.021	-0.982	*0.476*	-1.090
Household Income: 35k-44k	-0.041	*0.776*	-0.198	0.179	*0.055*	0.160	-0.102	*0.000*	-0.070	-0.476	*0.701*	-0.624
Household Income: 45k-60k	0.130	*0.384*	-0.072	0.204	*0.012*	0.182	-0.121	*0.000*	-0.081	-0.497	*0.657*	-0.679
Household Income: 60k-74k	0.188	*0.297*	-0.078	0.289	*0.000*	0.264	-0.171	*0.000*	-0.120	0.269	*0.807*	0.039
Household Income: 75k-99k	0.252	*0.193*	-0.044	0.407	*0.000*	0.379	-0.235	*0.000*	-0.176	0.308	*0.800*	-0.007
Household Inocme: >99k	1.023	*0.000*	0.670	0.968	*0.000*	0.936	-0.225	*0.000*	-0.147	4.037	*0.007*	3.587
Race: white	-0.651	*0.000*	-0.677	-0.273	*0.001*	-0.272	-0.276	*0.000*	-0.273	-0.163	*0.814*	-0.189
Region: Mid-Atlantic	-0.336	*0.046*	-0.286	-0.684	*0.000*	-0.701	-0.134	*0.000*	-0.131	2.317	*0.001*	2.333
Region: East-North-Central	-1.666	*0.000*	-1.686	-1.347	*0.000*	-1.361	-0.197	*0.000*	-0.192	-0.473	*0.589*	-0.362
Region: West-North-Central	-1.841	*0.000*	-1.879	-1.056	*0.000*	-1.064	-0.174	*0.000*	-0.171	-0.181	*0.869*	-0.060
Region: South-Atlantic	-0.983	*0.000*	-1.013	-0.879	*0.000*	-0.899	-0.097	*0.001*	-0.086	1.243	*0.116*	1.310
Region: East-South-Central	-1.043	*0.000*	-1.067	-1.036	*0.000*	-1.059	-0.072	*0.044*	-0.063	-1.142	*0.375*	-0.986
Region: West-South-Central	-1.405	*0.000*	-1.445	-1.011	*0.000*	-1.033	-0.078	*0.015*	-0.067	0.552	*0.612*	0.692
Region: Mountain	-1.246	*0.000*	-1.286	-0.531	*0.000*	-0.543	-0.083	*0.016*	-0.075	0.616	*0.598*	0.677
Region: Pacific	-0.296	*0.105*	-0.258	-0.052	*0.725*	-0.068	0.141	*0.000*	0.143	1.404	*0.048*	1.429
Market Size: >2.5 MM	0.568	*0.000*	0.556	0.401	*0.000*	0.403	0.133	*0.000*	0.134	0.134	*0.796*	0.086
Market Size: <1 MM	-0.207	*0.014*	-0.189	-0.177	*0.010*	-0.175	-0.058	*0.001*	-0.062	-1.623	*0.008*	-1.579
Market Size: outside U.S.	-0.167	*0.183*	-0.071	-0.500	*0.000*	-0.498	-0.124	*0.000*	-0.138	-2.404	*0.004*	-2.311
Inverse mill's ratio	-1.799	*0.012*	--	-2.827	*0.002*	--	2.937	*0.000*	--	1.379	*0.539*	--
Constant	14.520	*0.000*	--	14.480	*0.000*	--	7.624	*0.000*	--	22.751	*0.001*	--
Number of observations	52,275			61,190			271,455			10,873		
Std. Errors adjusted for clusters:	50,186			57,231			215,144			10,326		
R^2	0.199			0.145			0.233			0.248		
Adjusted R^2	0.199			0.144			0.233			0.245		
p>F	0.000			0.000			0.000			0.000		

[a] The inverse mill's ratio for fine dining category is not significantly different from zero so the original OLS estimates are correct. The SCB corrected estimates are given as a reference.

Table 4.11. Regression Coeffcient Estimates for Facility Type Expenditures Associated with the Byrne, Capps, and Saha (1998) Model and Trasactional Level Variables

	CD Expenditure			MS Expenditure			QS Expenditure			FN Expenditure		
	OLS		SCB	OLS		SCB	OLS		SCB	OLS		SCB
Variables	Coefficient	p-value	Coefficient	Coefficient	p-value	Coefficient	Coefficient	p-value	Coefficient	Coefficient	p-value	Coefficient [a]
Meal occasion: breakfast	-0.284	0.655	0.190	-2.590	0.000	-2.796	-1.502	0.000	0.000	-7.377	0.000	-7.453
Meal occasion: morning snack	-0.877	0.339	-0.229	-1.682	0.001	-1.323	-1.108	0.000	-1.433	-11.540	0.000	-11.205
Meal occasion: brunch	1.606	0.000	1.683	-1.305	0.000	-1.572	-1.028	0.000	-0.910	6.241	0.000	6.056
Meal occasion: dinner	3.040	0.000	2.835	2.069	0.000	2.038	0.071	0.014	0.190	15.778	0.000	15.572
Meal occasion: afternoon snack	-0.449	0.386	-0.056	-0.633	0.285	-0.221	-0.729	0.000	-1.020	-4.255	0.013	-3.967
Meal occasion: evening snack	-1.008	0.004	-0.784	-0.836	0.035	-0.556	-0.642	0.000	-0.823	-3.350	0.002	-3.263
Chain type: major	3.896	0.000	--	0.893	0.000	--	-0.295	0.000	--	-3.390	0.000	--
Chain type: small	3.994	0.000	--	0.569	0.000	--	-0.225	0.000	--	10.299	0.000	--
Age of Children in Party: <6 only	-1.196	0.000	--	-0.715	0.000	--	-0.423	0.000	--	-1.002	0.399	--
Age of Children in Party: 6-12 only	-2.364	0.000	--	-1.367	0.000	--	-0.720	0.000	--	-1.000	0.549	--
Age of Children in Party: 13-17 only	-1.877	0.000	--	-1.558	0.000	--	-1.097	0.000	--	-1.099	0.655	--
Age of Children in Party: <6 and 6-12	-2.992	0.000	--	-2.773	0.000	--	-1.788	0.000	--	-6.009	0.096	--
Age of Children in Party: <6 and 13-17	-2.874	0.000	--	-1.989	0.000	--	-1.151	0.000	--	-1.627	0.180	--
Age of Children in Party: 6-12 and 13-17	-2.939	0.000	--	-1.613	0.000	--	-1.316	0.000	--	-5.524	0.073	--
Age of Children in Party: all age groups	-3.649	0.000	--	-2.426	0.000	--	-1.561	0.000	--	-3.961	0.029	--
Order: walk-up	-4.147	0.000	--	-2.533	0.000	--	-3.058	0.000	--	-4.115	0.019	--
Order: drive thru	-3.381	0.000	--	-2.372	0.000	--	-3.220	0.000	--	1.536	0.780	--
Order: by phone	-3.375	0.000	--	-1.931	0.000	--	-2.020	0.000	--	-5.289	0.059	--
Order: delivery	-2.450	0.000	--	0.340	0.345	--	-0.580	0.000	--	0.348	0.887	--
Order: internet	3.239	0.316	--	4.711	0.012	--	0.439	0.114	--	7.510	0.206	--
Order: cafeteria	-2.305	0.054	--	-2.011	0.000	--	-2.880	0.000	--	-0.758	0.915	--
Order: buffet	-1.621	0.000	--	-0.359	0.001	--	-0.725	0.000	--	-3.338	0.000	--
Order: other	-3.555	0.000	--	-3.061	0.000	--	-4.207	0.000	--	-1.785	0.120	--
Promotion: buy-one-get-one free	-0.791	0.345	--	-0.805	0.001	--	0.116	0.040	--	-8.043	0.000	--
Promotion: combined item special	-0.109	0.613	--	-0.381	0.000	--	0.581	0.000	--	-2.049	0.096	--
Promotion: daily special	-0.554	0.038	--	-0.612	0.000	--	0.137	0.002	--	-1.669	0.213	--
Promotion: discounted price	-0.952	0.001	--	-0.488	0.153	--	-0.274	0.000	--	-2.819	0.122	--
Promotion: employee discount	-3.430	0.000	--	-1.694	0.000	--	-0.781	0.000	--	-6.710	0.002	--
Promotion: free item	-5.066	0.000	--	-4.061	0.000	--	-2.071	0.000	--	-10.405	0.000	--
Promotion: merchandise offer	7.987	0.015	--	3.454	0.001	--	0.781	0.033	--	9.706	0.000	--
Promotion: dollar menu	-4.401	0.000	--	0.392	0.695	--	-0.970	0.000	--	-32.596	0.000	--
Promotion: senior citizen discount	-1.839	0.000	--	-0.969	0.000	--	-0.017	0.828	--	2.269	0.667	--
Promotion: other deal	-0.725	0.000	--	-0.393	0.024	--	0.058	0.091	--	0.129	0.948	--

[a] The inverse mill's ratio for fine dining category is not significantly different from zero so the original OLS estimates are correct. The SCB corrected estimates are given as a reference.

4.4.1.2 STEP 2: "EXPENDITURE" DECISION

Examination of Table 4.12 shows that respondents greater than the 25-34 age range tend to have higher projected spending than those below this age range, but have lower projected spending than respondents within a higher age range. For example, a respondent between the ages of 50-64 is projected to spend $0.83 more at a meal, whereas, a respondent 18-24 years of age is likely to spend $0.61 less at a meal than someone 25-34 years of age. Furthermore, males, non-whites, and lower educated respondents are projected to spend more than their counterparts.

Taking a closer look at the transactional level variables, Table 4.13, indicates that meal occasion plays a significant role in projected expenditures. For example, dinner expenditures are expected to be $2.58 more than lunch expenditures, while breakfast expenditures are $2.10 less. Examining age structure of children, results indicate that presence of children in the party, on the whole, can result in decreased projected expenditures, with older age children lowering expenditures than younger children. For instance, expenditures of an individual in a party with children less than six years old are $0.92 lower than expenditures of an individual in a party of adults only. Similarly, expenditures of an individual in a party with children between the ages of 13-17 are $1.80 lower than expenditures of an individual in a party of adults only. .

Table 4.12. Regression Coeffcient Estimates for the Non-Transactional Variables in the Proposed Three-Step Decision Structure

	Expenditure Regression		
	OLS		SCB
Variables	Coefficient	p-value	Coefficient
Apr-June	-0.141	0.000	-0.172
July-Sept	-0.161	0.000	-0.196
Oct-Nov	0.026	0.416	0.015
Age (yrs): <18	-0.044	0.600	0.022
Age (yrs): 18-24	-0.587	0.000	-0.611
Age (yrs): 35-49	0.133	0.006	0.197
Age (yrs): 50-64	0.222	0.003	0.342
Age: >64	0.590	0.000	0.826
Gender: male	0.422	0.000	0.442
Education: HS grad.	-0.339	0.000	-0.387
Education: Some college	-0.474	0.000	-0.545
Education: College grad.	-0.259	0.001	-0.326
Monday	-0.420	0.000	-0.403
Tuesday	-0.607	0.000	-0.612
Wednesday	-0.670	0.000	-0.696
Thursday	-0.659	0.000	-0.696
Friday	-0.893	0.000	-1.002
Saturday	-0.284	0.000	-0.373
Household Income: 25k-34k	-0.280	0.000	-0.343
Household Income: 35k-44k	-0.337	0.000	-0.415
Household Income: 45k-60k	-0.333	0.000	-0.424
Household Income: 60k-74k	-0.327	0.000	-0.436
Household Income: 75k-99k	-0.201	0.006	-0.320
Household Inocme: >99k	0.619	0.000	0.480
Race: white	-0.186	0.000	-0.170
Region: Mid-Atlantic	-0.345	0.000	-0.358
Region: East-North-Central	-1.085	0.000	-1.115
Region: West-North-Central	-1.104	0.000	-1.142
Region: South-Atlantic	-0.668	0.000	-0.710
Region: East-South-Central	-1.072	0.000	-1.140
Region: West-South-Central	-1.024	0.000	-1.085
Region: Mountain	-0.730	0.000	-0.762
Region: Pacific	-0.357	0.000	-0.387
Market Size: >2.5 MM	0.177	0.000	0.155
Market Size: <1 MM	-0.237	0.000	-0.231
Market Size: outside U.S.	-0.313	0.000	-0.282
Inverse mill's ratio	-3.824	0.000	--
Constant	16.516	0.000	--
Number of observations	395,793		
Std. Errors adjusted for clusters:	296,265		
R^2	0.289		
Adjusted R^2	0.288		
p>F	0.000		

Table 4.13. Regression Coeffcient Estimates for the Transactional Variables in the Propsed Three-Step Decision Structure

	Expenditure Regression	
	OLS	
Variables	Coefficient	p-value
Meal occasion: breakfast	-2.092	*0.000*
Meal occasion: morning snack	-2.345	*0.000*
Meal occasion: brunch	-0.188	*0.057*
Meal occasion: dinner	2.578	*0.000*
Meal occasion: afternoon snack	-1.697	*0.000*
Meal occasion: evening snack	-1.316	*0.000*
Chain type: major	-0.406	*0.000*
Chain type: small	-0.219	*0.000*
Age of Children in Party: <6 only	-0.922	*0.000*
Age of Children in Party: 6-12 only	-1.607	*0.000*
Age of Children in Party: 13-17 only	-1.797	*0.000*
Age of Children in Party: <6 and 6-12	-2.448	*0.000*
Age of Children in Party: <6 and 13-17	-1.976	*0.000*
Age of Children in Party: 6-12 and 13-17	-2.176	*0.000*
Age of Children in Party: all age groups	-2.603	*0.000*
Order: walk-up	-6.793	*0.000*
Order: drive thru	-6.971	*0.000*
Order: by phone	-5.756	*0.000*
Order: delivery	-4.639	*0.000*
Order: internet	-3.294	*0.000*
Order: cafeteria	-6.125	*0.000*
Order: buffet	-3.475	*0.000*
Order: other	-7.326	*0.000*
Promotion: buy-one-get-one free	-0.520	*0.000*
Promotion: combined item special	-0.207	*0.000*
Promotion: daily special	-1.033	*0.000*
Promotion: discounted price	-0.814	*0.000*
Promotion: employee discount	-1.430	*0.000*
Promotion: free item	-3.347	*0.000*
Promotion: merchandise offer	0.635	*0.087*
Promotion: dollar menu	-1.295	*0.000*
Promotion: senior citizen discount	-1.190	*0.000*
Promotion: other deal	-0.495	*0.000*

We also see significant effects of variables representing ordering type and promotion usage on projected expenditures. The ordering effects are all negative compared to ordering from a table. For example, ordering via walk-up and drive thru result in decreases in projected expenditures of $6.80 and $6.97, respectively, compared to ordering at a table. Promotion usage also has mostly a negative effect on projected expenditures. Using a buy-one-get-one free offer results in $0.52 decrease in projected expenditures, whereas, utilizing a daily special results in a decrease of $1.03.

Our concerns regarding selection bias causing a problem were not unfounded, see Table 4.12. The IMR was statistically different from zero; implying that failure to incorporate the IMR would have resulted in potentially biased results.

4.4.1.3 STEP 3: “FACILITY TYPE” DECISION

Examination of the facility type decision provides some interesting results, Table 4.14. For instance, males were 1.6% less likely to choose a CD, but 5.8% more likely to choose QS. In regards to household income, we see that increased incomes generally result in higher probabilities in consuming at CD, MS, and FN compared to QS. However, we do see that, compared to the less than $25k base group, households with incomes greater than $99k have a lower probability of eating at a CD and MS than those with between $25k and $99k. Household size has a negative effect on the probability of eating at a CD and FN. Furthermore, education has a positive effect on the probability of eating at a CD and FN, but has a negative effect on the probability of eating at a QS facility.

Table 4.14. Marginal Effects for Step 3 in the Proposed Decision Structure [a]

Variables	Step 3 CD Estimate	CD p-value	MS Estimate	MS p-value	QS Estimate	QS p-value	FN Estimate	FN p-value
Apr-June	0.004	0.000	0.007	0.000	-0.020	0.000	0.001	0.000
July-Sept	0.001	0.191	0.006	0.000	-0.015	0.000	0.001	0.000
Oct-Nov	-0.005	0.000	-0.003	0.063	0.007	0.004	0.002	0.000
Age (yrs): <18	0.019	0.000	0.012	0.009	-0.046	0.000	-0.001	0.372
Age (yrs): 18-24	0.022	0.000	0.013	0.000	-0.054	0.000	-0.001	0.080
Age (yrs): 35-49	-0.012	0.000	0.019	0.000	-0.003	0.284	0.000	0.317
Age (yrs): 50-64	-0.018	0.000	0.037	0.000	-0.019	0.000	0.000	0.465
Age: >64	-0.023	0.000	0.044	0.000	-0.029	0.000	0.000	0.650
Gender: male	-0.016	0.000	-0.018	0.000	0.058	0.000	-0.001	0.000
Education: HS grad.	0.015	0.000	0.008	0.040	-0.039	0.000	0.001	0.267
Education: Some college	0.027	0.000	0.006	0.082	-0.061	0.000	0.004	0.000
Education: College grad.	0.023	0.000	0.001	0.849	-0.063	0.000	0.007	0.000
Monday	-0.001	0.390	-0.004	0.061	0.010	0.002	-0.001	0.000
Tuesday	0.000	0.962	0.004	0.065	-0.007	0.031	0.000	0.720
Wednesday	0.005	0.000	0.003	0.113	-0.017	0.000	0.001	0.077
Thursday	0.004	0.002	0.006	0.002	-0.022	0.000	0.001	0.001
Friday	0.014	0.000	0.017	0.000	-0.056	0.000	0.002	0.000
Saturday	0.004	0.002	0.002	0.319	-0.024	0.000	0.003	0.000
Household Income: 25k-34k	0.017	0.000	0.006	0.009	-0.041	0.000	0.003	0.000
Household Income: 35k-44k	0.020	0.000	0.010	0.000	-0.056	0.000	0.005	0.000
Household Income: 45k-60k	0.026	0.000	0.006	0.003	-0.061	0.000	0.006	0.000
Household Income: 60k-74k	0.037	0.000	0.001	0.626	-0.075	0.000	0.008	0.000
Household Income: 75k-99k	0.034	0.000	-0.006	0.005	-0.072	0.000	0.012	0.000
Household Inocme: >99k	0.012	0.000	-0.034	0.000	-0.016	0.000	0.016	0.000
Household Size: 2	-0.007	0.000	0.003	0.054	0.009	0.002	-0.001	0.000
Household Size: 3-4	-0.011	0.000	0.003	0.168	0.029	0.000	-0.004	0.000
Household Size: >4	-0.016	0.000	0.003	0.274	0.042	0.000	-0.005	0.000
Age of Household Children: <6 only	0.019	0.000	0.013	0.000	-0.048	0.000	0.001	0.305
Age of Household Children: 6-12 only	0.011	0.000	0.007	0.003	-0.024	0.000	0.000	0.812
Age of Household Children: 13-17 only	0.004	0.010	-0.001	0.824	-0.005	0.114	0.001	0.083
Age of Household Children: <6 and 6-12	0.023	0.000	0.014	0.000	-0.059	0.000	0.000	0.618
Age of Household Children: <6 and 13-17	0.006	0.195	0.010	0.125	-0.031	0.004	0.000	0.898
Age of Household Children: 6-12 and 13-17	0.010	0.000	0.001	0.825	-0.019	0.000	0.001	0.126
Age of Household Children: all age groups	0.007	0.159	0.017	0.013	-0.042	0.000	0.000	0.950
Race: white	0.009	0.000	0.000	0.853	-0.021	0.000	0.001	0.001
Region: Mid-Atlantic	-0.005	0.010	0.040	0.000	-0.040	0.000	0.000	0.684
Region: East-North-Central	0.038	0.000	0.057	0.000	-0.128	0.000	-0.002	0.000
Region: West-North-Central	0.052	0.000	0.055	0.000	-0.149	0.000	-0.001	0.012
Region: South-Atlantic	0.023	0.000	0.054	0.000	-0.109	0.000	-0.001	0.020
Region: East-South-Central	0.028	0.000	0.076	0.000	-0.137	0.000	-0.003	0.000
Region: West-South-Central	0.039	0.000	0.075	0.000	-0.151	0.000	-0.003	0.000
Region: Mountain	0.039	0.000	0.046	0.000	-0.123	0.000	0.000	0.669
Region: Pacific	0.004	0.058	0.045	0.000	-0.068	0.000	0.000	0.686
Market Size: >2.5 MM	-0.006	0.000	-0.013	0.000	0.025	0.000	0.001	0.000
Market Size: <1 MM	0.003	0.001	0.006	0.000	-0.009	0.000	-0.001	0.001
Market Size: MSA	-0.008	0.000	0.016	0.000	0.000	0.894	-0.002	0.000
Promotion used: yes	0.018	0.000	0.039	0.000	-0.054	0.000	-0.009	0.000
Meal occasion: breakfast	-0.046	0.000	0.219	0.000	-0.298	0.000	0.020	0.000
Meal occasion: morning snack	-0.015	0.000	0.023	0.000	-0.101	0.000	0.005	0.000
Meal occasion: brunch	-0.028	0.000	0.111	0.000	-0.127	0.000	0.009	0.000
Meal occasion: dinner	-0.037	0.000	-0.091	0.000	0.183	0.000	-0.003	0.000
Meal occasion: afternoon snack	0.019	0.000	-0.024	0.000	-0.038	0.000	0.002	0.006
Meal occasion: evening snack	0.030	0.000	-0.015	0.000	-0.055	0.000	0.009	0.000
Predicted meal expenditure	0.026	0.000	0.031	0.000	-0.098	0.000	0.003	0.000
Number of observations	395,793		395,793		395,793		395,793	
Number of clusters	296,265		296,265		296,265		296,265	
Prob > chi2	0.000		0.000		0.000		0.000	
Mcfadden pseudo R^2	0.18		0.18		0.44		0.23	

[a] Calculated at the sample means.

When examining our main variable of interest, predicted meal expenditure, we see results that are consistent with our a priori expectations. In regards to CD and MS participation, as the predicted income increases from the mean by $1, we see a 2.6% and 3.1% increases in the probability of eating at a CD and MS, respectively. However, we see a 9.8% reduction in the probability of eating at QS. This implies, consistent with previous research, that consumers eating at a QS want a quick, fast, and *cheap* meal. If a higher expenditure meal is wanted, then the consumer is more likely to go to a CD or MS facility type.

Also of interest is the marginal effect associated with the FN facility type. As the predicted meal expenditure increases by $1 from the mean, the probability of eating at a FN facility type only increases by 0.3%. Our a priori expectations were that increased predicted meal expenditures would lead to a large shift in the probability of eating at a FN facility. However, our results may imply that FN may not all be about expenditures, but about the experience of eating at a FN facility. For instance, whether I have $10 to spend or $20 to spend on a meal, my probability of eating at a FN only rises by 3% (0.3%*10) for the $20 expenditure level compared to the extremely larger probability changes associated with CD, MS, and QS.

4.5 SUMMARY AND CONCLUSIONS

We proposed a new decision structure to the problem of facility type expenditures. We believe that the decision process is a three-step structure that allows for the participation (eating out or not) in the first step, followed by the expenditure decision (solving of the budget constraint), and conclude with the facility type decision. Comparing our results with previous works, namely the two-step and Byrne, Capps, and Saha, (1998) models, we find that our proposed three-step model provides different results and superior prediction power than the previously used alternatives.

Evaluating the results associated with each decision step we find some interesting results. Notably, we find that in the "participation" decision several variables are significantly influential. Our results show that higher educated non-white females with higher incomes and smaller household sizes without children are more likely to eat away from home than others. In the second step "expenditure" decision we find that it is not only the demographic and socio-economic variables that play a role in predicted expenditures but also the transactional level variables. As expected, we found that meal occasion plays a significant role in predicted expenditures. We also found that parties with no children, ordering from a table and not using promotional items have a positive effect on predicted expenditures.

We also found that in the final step associated with facility type choice that males and lower incomes are more likely to choose a QS facility type, while higher incomes with and lower household sizes are associated with an increased probability of eating at both CD and FN facilities. When examining the effect of predicted meal expenditures on facility type choice we find that our results are similar to our a priori expectations. Most notably, we find that increased predicted expenditures lead to an increased probability of eating at a CD and MS, but a decreased probability of eating at QS.

However, the increased probability of eating at FN given higher expected expenditures was not as high as expected.

The results can be used by businesses and governmental policy makers to better understand how consumers are making their FAFH choices. For example, businesses and/or governmental policy makers can use our findings to better target ad campaigns or policies to the intended audience in a more efficient fashion.

CHAPTER V

CONCLUSIONS

Understanding the effects of governmental nutritional programs and FAFH expenditures is essential for policy makers and businesses. Research that provides improved information that allows decision makers to better plan and enact strategies to improve overall welfare is of vital need. This research attempts to expand on previous studies through the use of new analytical techniques and through the incorporation of new variables in order to provide more accurate results.

In Chapter II, the primary results indicate that the NSLP does not provide more nutritional meals than its counterparts. However, we do see consumption differences in regards to total food consumption that causes not only increased vitamin and mineral levels, but also increased intake of fats. Based on these results, policies wanting to increase nutritional quality should focus on guidelines that lower a child's total food consumption, while increasing the overall nutritional quality of food. Further findings indicate that the assumptions made regarding treatment assignment can have a tremendous impact on results and any inferences drawn from the results.

In Chapter III we see that individual characteristics play an important role in the decision to eat away from home. Through the development of consumer profiles, policy makers and business can more easily target specific groups. For instance, policies or promotions directed toward children are most likely to have an increased effect at breakfast or lunch, given consumers with households having children are more likely to eat away from home at these meals. Furthermore, the likelihood of eating away from home is impacted by the consumption of previous FAFH meals.

Closely examining the effects of transaction level variables indicates that expenditures are significantly related to how the meal was ordered, where it was ordered, and promotion usage. This implies that business strategies need to account for these transactional level variables in their decision making. We also see that both previous FAFH meal consumption and expenditures play a role in current meal expenditures. Previous FAFH meal consumption tends to have a negative impact on current FAFH expenditures; however, the effects of previous FAFH meal expenditures tend to have a positive effect on current FAFH expenditures.

The fourth chapter examines the role of decision structure and transactional level variables on FAFH expenditures by facility type. Results indicate that how the decision process is structured has direct implications on results and inferences. Our proposed decision structure tends to have increased explanatory power compared with the traditional alternatives, implying our structure deserves serious consideration in modeling the facility type expenditure problem. Also, in regards to the effect of transactional level variables, we see that the transactional variables do play a significant role in projected expenditures.

Given the results presented above, this research makes a significant contribution to not only the academic literature as a whole, but also by improving the information available to decision makers. Through these results, decisions regarding the NSLP program can be more directly tailored to providing increased nutritional meals.

Regarding expenditures, businesses can more effectively target key consumers to help their business' sales, while policy makers can target key groups that may be at more risk for certain health issues associated with FAFH consumption.

REFERENCES

Ai, C., and E.C. Norton. 2003. "Interaction Terms in Logit and Probit Models." *Economic Letters* 80:123-129.

Akin, J. S., D.K. Guilkey, P.S. Haines, and B.M. Popkin. 1983. "Impact of the School Lunch Program on Nutrient Intakes of School Children." *School Food Service Research Review* 7:13-18.

Basiotis, P.P., A. Carlson, S.A. Gerrior, W.Y. Juan, and M. Lino. 2002. *The Healthy Eating Index: 1999-2000*. Alexandria, VA: U.S. Department of Agriculture, Center for Nutrition Policy and Promotion. CNPP-12.

Becker, G. 1965. “A Theory of the Allocation of Time.” *Economic Journal* 75: 493-517.

Becker, S.O., and. A. Inchino. 2002. "Estimation of Average Treatment Effects Based on Propensity Scores." *The Stata Journal* 2:358-377.

Bhattacharya, J., and J. Currie. 2001. “Youths at Nutritional Risk: Malnourished or Misnourished,” in *Risky Behavior Among Youths: An Economic Analysis*, J. Gruber (ed.), Chicago: The University of Chicago Press.

Bhattacharya, J., J. Currie, and S.J. Haider. 2004. *Evaluating the Impact of School Nutrition Programs: Final Report*. Washington DC: U.S. Department of Agriculture, Economic Research Service, Final Report, July.

Binkley, J.K., J. Eales, and M. Jekanowski. 2000. “The Relation Between Dietary Change and Rising US Obesity.” *International Journal of Obesity* 24:1032-1039.

Blisard, N., J.N. Variyam, and J. Cromartie, 2003. *Food Expenditures by U.S. Households: Looking Ahead to 2020*. Washington, D.C.: Economic Research Service, U.S. Department of Agriculture, Agricultural Economic Report No. 821.

Bowman, S.A., and B.T. Vinyard. 2004. "Fast Food Consumption of U.S. Adults: Impact on Energy and Nutrient Intakes and Overweight Status." *Journal of the American College of Nutrition* 23:163-168.

Burghardt, J. B.L. Devaney and A.R. Gordon. 1995. "The School Nutrition Dietary Assessment Study: Summary and Discussion." *The American Journal of Clinical Nutrition* 61(suppl.):252S-257S.

Burghardt, J.A., A.R. Gordon, N. Chapman, P.M. Gleason, and T.M. Fraker. 1993. *The School Nutrition Dietary Assessment Study: School Food Service, Meals Offered, and Dietary Intakes*. Princeton, NJ: U.S. Department of Agriculture, Food and Nutrition Service, Final Report, October.

Butler, J. S., and J. E. Raymond. 1996. "The Effect of the Food Stamp Program on Nutrient Intake." *Economic Inquiry* 34:781-798.

Byrne, P.P., O. Capps, Jr., and A. Saha. 1996. "Analysis of Food-Away-from-Home Expenditure Patterns for U.S. Households, 1982-1989." *American Journal of Agricultural Economics* 78:614-627.

Byrne, P.P., O. Capps, and A. Saha. 1998. "Analysis of Quick-Serve, Mid-Scale, and Up-Scale Food Away from Home Expenditures." *International Food and Agribusiness Management Review* 1:51-72.

Cawley, J. *Rational Addiction, the Consumption of Calories and Body Weight*. Ph.D. Dissertation, Department of Economics, University of Chicago, 1999.

Cutler, D., E. Glaeser, and J. Shapiro. 2003. "Why Have Americans Become More Obese?" *Journal of Economic Perspectives* 17:93-118.

Department of Labor. 2006. *100 Years of U.S. Consumer Spending: Data for the Nation, New York City, and Boston*. Washington, D.C.: Report 991.

Devaney, B. L., A. R. Gordon, and J. A. Burghardt. 1995. "Dietary Intakes of Students." *American Journal Clinical Nutrition* 61:205S-212.

Devaney, B., and R. Moffitt. 1991. "Dietary Effects of the Food Stamp Program." *American Journal of Agricultural Economics* 73:202-211.

Food and Nutrition Information Center, United States Department of Agriculture. 2009. *Dietary Reference Intakes (DRIs): Recommended Intakes for Individuals, Vitamins*. Accessed April 2, 2009. >http://www.iom.edu/Object.File/Master/21/372/0.pdf<

Food and Nutrition Service-A, United States Department of Agriculture. 2007. *National School Breakfast Program*. Revised: July 2007. Accessed: April 2, 2009. >http://www.fns.usda.gov/cnd/breakfast/AboutBFast/SBPFactSheet.pdf<

Food and Nutrition Service-B, United States Department of Agriculture. 2007. *National School Lunch Program*. Revised: July 2007. Accessed: April 2, 2009. >http://www.fns.usda.gov/cnd/Lunch/AboutLunch/NSLPFactSheet.pdf<

Foster, E. M. 2003. "Propensity Score Matching: An Illustrative Analysis of Dose Response." *Medical Care* 41:1183-1192.

Froot, K.A. 1989. “Consistent Covariance Matrix Estimation with Cross-Sectional Dependence and Heterskedasticity in Financial Data.” *Journal of Financial and Quantitative Analysis* 24:333-355.

Gleason, P. 1995. “Participation in the National School Lunch Program and the School Breakfast Program.” *The American Journal of Clinical Nutrition* 61(suppl.):213S-220S.

Gleason, P., and C. Suitor. 2001. *Children’s Diets in the Mid-1990s: Dietary Intake and Its Relationship with School Meal Participation* . Nutrition Assistance Program Report Series, Report No. CN-01-CD1, January.

Gleason, P., and C. Suitor. 2003. "Eating at School: How the National School Lunch Program Affects Children's Diets." *American Journal of Agricultural Economics* 85:1047-61.

Gordon, A.R., B.L. Devaney, and J.A. Burghardt. 1995. “Dietary Effects of the Natinal School Lunch Program and the School Breakfast Program.” *The American Journal of Clinical Nutrition* 61(suppl.):221S-231S.

Greene, W. *Econometrics Analysis*. Second ed: New York: Pearson Education, 2003.

Havas, S. K. Treiman, P. Langenberg, M. Ballesteros, J. Anliker, D. Damron, and R. Feldman. 1998. “Factors Associated with Fruit and Vegetable Consumption Among Women Participating in WIC.” *Journal of the American Dietetics Association* 98:1141-1148.

Heckman, J. J., H. Ichimura, and P. E. Todd. 1997. “ Matching as an Econometric Evaluation Estimator: Evidence from Evaluating a Job Training Programme.” *The Review of Economic Studies* 64:605-654.

Heckman, J. J., and V. J. Hotz. 1989. "Choosing among Alternative Nonexperimental Methods for Estimating the Impact of Social Programs: The Case of Manpower Training." *Journal of the American Statistical Association* 84:862-874.

Hiemstra, S.J., and W.G. Kim. 1995. “Factors Affecting Expenditures for Food Away from Home in Commercial Establishments by Type of Eating Place and Meal Occasion.” *Hospitality Research Journal*, 19:15-31.

Imbens, G. W. 2000. "The Role of the Propensity Score in Estimating Dose-Response Functions." *Biometrika* 87:706-710.

Jang, S., S. Ham, and G. Hong. 2007. “Food-Away-from-Home Expenditure of Senior Households in the United States: A Double-Hurdle Approach.” *Journal of Hospitality and Tourism Research* 31:147-167.

Jensen, H.H., and S.T. Yen. 1996. “Food Expenditures Away from Home by Type of Meal.” *Canadian Journal of Agricultural Economics* 44:67-80.

Kim, E., and Geistfeld, L.V. 2003. “Consumers’ Restaurant Choice Behavior and the Impact of Socio-Economic and Demographic Factors.” *Journal of Foodservice Business Research* 6:3-24.

Lancaster, K. *Consumer Demand*. New York: Columbia University Press. 1971.

Lechner, M. 2002. “ Program Heteogeneity and Propensity Score Matching: An Application to the Evaluation of Active Labor Market Policies.” *The Review of Economics and Statistics* 84:205-220.

Lin, B.H., J. Guthrie, and E. Frazao. 1999. “Nutrient Contribution of Food Away from Home.” *America’s Eating Habits: Changes and Consequences*. Washington, DC: USDA Economic Research Service Bulletin AIB-750, May.

Linus Pauling Institute. *Micronutrient Information Center*. Accessed July 14, 2009. > http://lpi.oregonstate.edu/infocenter/minerals/phosphorus/<

Long, S. 1990. “Do the School Nutrition Programs Supplement Household Food Expenditures?” *Journal of Human Resources* 26: 654-678.

McCracken, V., and J. Brandt. 1987. “ Household Consumption of Food Away from Home: Total Expenditure and by Type of Food Facility.” *American Journal of Agricultural Economics* 69:274-284.

Mutlu, S., and A. Gracia. 2006. “Spanish Food Expenditure Away from Home (FAFH): by Type of Meal.” *Applied Economics* 38:1037-1047.

National Dairy Council. *Newer Knowledge of Dairy Foods*. Accessed July 14, 2009. > http://www.nationaldairycouncil.org/NationalDairyCouncil/Nutrition/ Products/milkPage2.htm<

Nayga, R.M., Jr. 1996. “Analysis of Food Away from Home Expenditures by Meal Occasion.” *Agribusiness* 12:421-427.

Nayga, Jr., R.M. and O. Capps, Jr. 1994. “Impact of Socio-economic and Demographic Factors on Food Away from Home Consumption: Number of Meals and Type of Facility.” *Journal of Restaurant and Foodservice Marketing* 1:45-69.

Nelson, J.E. 1979. “Children as Information Sources in the Family Decision to Eat Out.” *Advances in Consumer Research* 6:419-423.

Ogden, C.L., M.D. Carroll, L.R. Curtin, M.A. McDowell, C.J. Tabak, and K.M. Flegal. 2006. “Prevalence of Overweight and Obesity in the United States, 1999-2004.” *Journal of the American Medical Association* 295:1549-1555.

Puhani, P.A., 2000. “The Heckman Correction for Sample Selection and Its Critique.” *Journal of Economic Surveys 14*:53-68.

Putnam, J.J., and M.G. Van Dress. 1984. “Changes Ahead for Eating Out.” *National Food Review* 26:15-17.

Richards, T.J., and L. Padilla. 2009. "Promotion and Fast Food Demand." *American Journal of Agricultural Economics* 91:168-183.

Richards, T.J., P.M. Patterson, and A. Tegene. 2007. "Obesity and Nutrient Consumption: A Rational Addiction?" *Contemporary Economic Policy* 25:309-324.

Rogers, W. 1993. “Regression Standard Errors in Clustered Samples.” *Stata Technical Bulletin Reprints*, 3:88-94.

Rosenbaum, P.R. 2002. *Observational Studies*, 2nd ed. New York: Springer-Verlag.

Rosenbaum, P. R., and D. B. Rubin. 1983. "The Central Role of the Propensity Score in Observational Studies for Causal Effects." *Biometrika* 70:41-55.

Rosenbaum, P. R., and D. B. Rubin. 1984. "Reducing Bias in Observational Studies Using Subclassification on the Propensity Score." *Journal of the American Statistical Association* 79:516-524.

Saha, A., O. Capps, and P.J. Byrne. 1997. “Calculating Marginal Effects in Dichotomous-Continuous Models.” *Applied Economic Letters* 4:181-185.

Schanzenbach, D.W. 2009. “Do School Lunches Contribute to Childhood Obesity?” *The Journal of Human Resources* 44:684-709.

Stewart, H., N. Blisard, S. Bhuyan, and R.M. Nayga, Jr. 2004. *The Demand for Food Away from Home: Full-Service or Fast Food?* Agricultural Economic Report No. 829, Washington D.C.

Stewart, H., and S.T. Yen. 2004. “Changing Household Characteristics and the Away-from-Home Food Market: A Censored Equation System Approach.” *Food Policy* 29:643-658.

Wang, G.-J., N. D. Volkow, F. Telang, M. Jayne, J. Ma, M. Rao, W. Zhu, C. T. Wong, N. R. Pappas, A. Geliebter, and J. S. Fowler. 2004. ‘‘Exposure to Appetitive Food Stimuli Markedly Activates the Human Brain.’’ *NeuroImage* 21:1790–1797.

Yen, S.T., B. Lin, and D.M. Smallwood. 2003. “Quasi- and Simulated-Likelihood Approaches to Censored Demand Systems: Food Consumption by Food Stamp Recipients in the United States.” *American Journal of Agricultural Economics* 85:458-478.

You, W., and R.M. Nayga, Jr. 2005. “Household Fast Food Expenditures and Children’s Television Viewing: Can They Really Significantly Influence Children’s Dietary Quality?” *Journal of Agricultural and Resource Economics* 30:302-314.

VITA

Name: Benjamin Louis Campbell

Address: Department of Agricultural Economics, Room 341A Blocker Building, Texas A&M University, College Station, TX 77843-2124

Email Address: BLCampbell@ag.tamu.edu

Education: B.S., Agricultural Economics, Auburn University, 2001
M.S., Agricultural Economics, Auburn University, 2003
Ph.D., Agricultural Economics, Texas A&M University, 2009