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THREE ESSAYS ON HOUSEHOLD COMMITTED ACTIVITIES AND DIET QUALITY

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ABSTRACT

Obesity and diabetes are two very important diet-related issues in the U.S. Due to the strong connection between these diseases and diet quality, there is a large body of research investigating the connection between income, the food environment and diet quality. However, despite numerous studies and interventions addressing income and food-environment factors, the diet-quality gap between low-income and high-income households still persists. Therefore, researchers have begun to study the role of household time allocations on diet quality. In particularly, these three essays consider time spent in primary childcare, secondary childcare, adult care, and non-car transportation because 1) these are committed activities, i.e., activities that must be completed given past decisions, and 2) non-food activities may be more easily influenced by policy.

In the first essay I consider how the share of a household's day spent in childcare (secondary or primary), adult care, non-car transportation, and food-at-home (FAH) activities influence the share of household food expenditure in certain food groups, while in the second essay I consider how the share of time spent in childcare, adult care, and FAH activities affect the household's Healthy Eating Index (HEI). In the third essay I switch focus to food away from home (FAFH) and consider how time spent in primary childcare, secondary childcare, adult care, working, and FAH activities affect the probability and frequency of fast-food purchases. In general I find that secondary childcare and adult care are associated with lower diet quality, while primary childcare and FAH activities are associated with higher diet quality. In addition, income and the food environment influence the effect of time spent in these activities.

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Chapter 1

Introduction

The obesity rate in the U.S. is approximately 35%, the highest in the world, and the U.S. diabetes rate is 9.2% (Devaux 2014, CDC 2015). Although these diseases are prevalent in the general population, individuals with lower socioeconomic status are more likely to be obese, with adults in the lowest income group having higher BMI scores than the highest income group every year between 1986 and 2002 (Truong & Sturm, 2005, Kim & Leigh, 2010, Levi 2011). Diabetes has also been found to have an inverse relationship with income (Lysy et al. 2013), with the 2010 age-adjusted diabetes rate for low-income adults being 10.6%, while the rate for high-income adults was 6.4% (Beckles 2013).

Given their strong connection to diet quality, there is a large body of research investigating the connection between income and the food environment and diet quality (Caldwell et al., 2009; Castner and Mabli 2010; Chen, Jaenicke, and Volpe, 2016; Cummins et al., 2014; Cummins et al., 2005; Dunn, 2010; Moore and Diez-Roux, 2006; Rao et al., 2013; and Ver Ploeg et al., 2009). Higher-income households are more likely to consume foods with high nutritional quality, such as whole grains, fruits and vegetables, and lean meats (Darmon 2008). Moore and Diez-Roux (2006) show that households in poor neighborhoods have easier access to fast food restaurants and convenience stores than to supermarkets (Alviola et al 2013, Mancino, Todd, Lin 2009).

Despite extensive study and interventions addressing income and food environment factors, the diet quality gap still persists. Therefore, researchers have begun to study the role of

household time allocations on diet quality, with multiple studies showing low income families are particularly strained for food-activity time (Rose 2007, Davis and You 2010, Ver Ploeg et al. 2015, Davis and You 2011). Both Rose (2007) and Davis and You (2010) find cheaper, healthier foods take more time to prepare and purchase. While these studies show that low-income families must allocate more time to food activities, the opposite is actually occurring (Davis and You 2011, Beatty, Nanney, and Tuttle 2014).

For two main reasons, these three essays consider a number of non-food related activities rather than food-related activities even though there is a well-established link between time spent on food-related activities and dietary quality and health. First, time spent in primary childcare, secondary childcare, adult care, and non-car transportation are all committed activities, meaning they must be completed given past decisions (Kalenkoski et al. 2011). Although both low-income and high income households must complete these activities, low-income households must complete them by expending time rather than money. Second, these three non-food activities may be more easily influenced by policy. It is difficult to implement a policy requiring or incentivizing families to spend a certain amount of time per day cooking or grocery shopping; however, it may be possible to use a policy intervention to reduce the time necessary to complete these committed activities. For example, if the necessary amount of time spent in own childcare were reduced through an after school program, there could be more time for food–at-home (FAH) activities. In this way, should the link between these committed activities and dietary quality reveal itself to be strong, then policy can be used to indirectly affect diet quality increases through time allocations.

In each essay in this dissertation, I consider a different measure of household diet quality and different approach to the committed activities of interest. In the first essay, I consider how

the share of a household's day spent in childcare (secondary or primary), adult care, non-car transportation, and FAH activities influence the share of household food expenditure in certain food groups. I construct seven food groups for the estimation: fresh and frozen fruits and vegetables, canned and prepared fruits and vegetables, snacks, sugary beverages, packaged meals, processed meats, and all other foods. The food groups are chosen to account for foods that are suggested for increased and decreased consumption by the 2010 Dietary Guidelines for Americans. I next split the data into subsamples to investigate how the estimated marginal effects differ across household characteristics. I consider subsamples based on (i) three categories of income/food assistance, (ii) household vehicle access, and (iii) awareness of the MyPlate standards. In general, I find that increased time spent on own childcare and adult care decreases household expenditures on fresh fruits and vegetables, and increases expenditures on unhealthy food groups. In addition, I find that a household's ability to respond to changes in time allocations is restricted by lower income, no vehicle access, and living in a rural area.

In the second essay I consider how the share of time spent in childcare, adult care, and FAH activities affect the household's Healthy Eating Index (HEI). The HEI score ranges from 0 to 100 and is based on 12 components, including 9 adequacy components (e.g., whole fruit, whole grains, and dark green and orange vegetables) and 3 moderation components (e.g. empty calories, sodium, and refined grains). The HEI has been used extensively in dietary patterns research and to evaluate various aspects of the food environment using both food consumption and purchasing data (Guenther et al., 2013, Krebs-Smith et al., 2010; Volpe and Okrent, 2012, Guenther et al., 2014). While adult care and FAH activities are defined the same as in the first essay, I disaggregate primary and secondary childcare to allow for these two related but different time allocations to affect diet quality differently. Primary childcare includes activities where the

participant is actively engaged with the child, such as bathing, feeding, or helping with homework. Secondary childcare includes all activities where the participant is mainly focusing on another task while the child was present. In general, I find that increased time spent in secondary childcare decreases household diet quality as measured by the HEI score, while increased times spent in primary childcare and FAH activities increase household diet quality. In addition, we find that responsiveness to time-allocation changes is dependent on income, food security, and the food environment.

In the third essay, I switch focus to food away from home (FAFH) and consider how time spent in primary childcare, secondary childcare, adult care, working, and FAH activities affect the probability and frequency of fast-food purchases. I also consider how times spent in these activities affect the healthfulness of FAFH purchases and the share of FAFH expenditure at fast food restaurants. I compare results using actual and predicted values for time allocations by taking advantage of the American Time Use Survey's Eating and Health Module. I also consider how income, food assistance participation, and grocery store density affect the influence of time on the frequency of fast food purchases. In general, I find that secondary childcare, adult care, and working are associated with increases in fast-food events, while FAH activities are associated with a decrease. In addition, the effect of time allocations is influenced by income level and grocery store density.

Chapter 2

Diet Quality Literature Review

Diet-related Health Concerns in the U.S.

As noted above, obesity and diabetes are two chronic diseases that are strongly linked to diet. In addition, they are costly to the overall economy and individuals. Finkelstein (2009) estimates that obesity costs the U.S. economy a total of $147 billion, while the Center for Disease Control (2015) estimates diabetes costs $245 billion due to medical expenses and lost wages. Although these diseases are prevalent in the general population, rates differ by socioeconomic status and education level.

Individuals with lower socioeconomic status are more likely to be obese (Truong & Sturm, 2005, Kim & Leigh, 2010, Levi 2011). This trend has continued over time, with adults in the lowest income group having higher BMI scores than the highest income group every year between 1986 and 2002 (Truong & Sturm, 2005). In addition, looking across income groups, wages are negatively correlated with BMI scores (Kim & Leigh, 2010). More recently, Levi (2011) found that more than 33% of adults making $15,000 or less per year are obese, while 21.5% of adults making at least $50,000 per year are obese. Diabetes also has an inverse relationship with income (Lysy et al. 2013). The age-adjusted diabetes rate for low-income adults is 10.6%, while the rate for high-income adults is 6.4% (Beckles 2013).

The connection between these diseases and diet quality is a major reason that they are more prevalent in low-income individuals. While some studies have found no statistically significant differences in overall caloric or macro-level nutrient intake between the two income

groups, some researchers claim that exclusive focus on these indicators is a poor assessment of diet quality (e.g., Darmon 2008). Therefore, it may be more important to look at sources of nutrients and micronutrient intake. Higher-income households are more likely to consume foods with high nutritional quality, such as whole grains, fruits and vegetables, and lean meats, while low-income households are more likely to purchase refined grains and pastas, processed foods with added fats, and sweetened beverages (Darmon 2008). These last three food types are high in sodium, fats, and/or sugar, which all positively contribute to obesity and diabetes.

Income and Access/Availability

Research on the diet quality-health gap for low-income households has often focused on the impacts of income and the food retail environment (e.g., Caldwell et al., 2009; Castner and Mabli 2010; Chen, Jaenicke, and Volpe, 2016; Cummins et al., 2014; Cummins et al., 2005; Dunn, 2010; Moore and Diez-Roux, 2006; Rao et al., 2013; and Ver Ploeg et al., 2009). Rao (2013) conducts a meta-analysis of healthy versus unhealthy diets and shows that a healthy diet costs about $1.50 more per day. Although food assistance programs are shown to increase diet quality in a statistically significant way, their impact is minimal. Castner and Mabli (2010) find that a 10 percent increase in food expenditures results in a 0.3 percent increase in a household's Healthy Eating Index (HEI).

The retail food environment is thought to be another contributing factor because of the connection between low food access and low income (Ver Ploeg et al., 2009). Moore and Diez-Roux (2006) show that households in poor neighborhoods have easier access to fast food restaurants and convenience stores than to supermarkets. These store types negatively impact diet quality through less healthy food and higher prices (Alviola et al 2013, Mancino, Todd, Lin

2009). However, other studies suggest the food retail environment only plays a minor role (Ver Ploeg et al 2015, Ver Ploeg et al., 2009). Ver Ploeg et al. (2009) find that food purchases at convenience stores account for only 2-3% of food expenditures by low-income households. In addition, Ver Ploeg et al (2015) find that 86% of SNAP households have access to a vehicle for grocery shopping. Therefore, these studies suggest that although there are fewer grocery stores in low-income areas, many of the households still have access.

Household Time Allocations and Health

Economic research often employs the household health production function and focuses on time spent in healthy or unhealthy activities and diet quality to investigate and combat these health issues (Fletcher et al. 2011, Maruyama & Lin 2012, Castner and Mabli 2010). Much of this literature examines time spent in healthy activities, such as exercise, and unhealthy activities, such as being sedentary (Du & Yagahashi 2016, Fletcher et al. 2011, Brunello et al. 2016). For example, Meltzer and Jena (2010) find that individuals respond to a higher opportunity cost of time by exercising more intensely and decreasing overall exercise time. However, higher income individuals are found to exercise longer and more intensely when individual income, rather than household income, is examined (Maruyama & Lin 2012). In addition to the effect of time on health, the effect of health on time is also considered. Poor health decreases efficiency in both work and home production activities, but affects home activities more (Podor & Halliday 2012). In contrast to this body of research, our research focuses on the health production function's second main input, diet quality, which has received relatively less economic focus.

The role of household time allocations on diet quality is an understudied third factor, with multiple studies showing low-income families are particularly strained for food-activity time

(Rose 2007, Davis and You 2010, Ver Ploeg et al. 2015, Davis and You 2011). Rose (2007) finds cheaper healthier foods take more time to prepare and purchase. Davis and You (2010) estimate that the Thrifty Food Plan (TFP) requires between 13.1 and 16.1 hours per week of meal preparation time, while the national average for meal preparation is just 4.41 hours per week. While these studies show that low-income families must allocate more time to food activities, the opposite is actually occurring. Beatty, Nanney, and Tuttle (2014) find that SNAP participation reduces meal preparation time by 32%. Davis and You (2011) find that the time constraint is more restrictive than the budget constraint for SNAP households and that, on average, households spend 40 percent less time and money than the TFP target requires. This research suggests that time constraints should be given serious consideration when reforming food assistance programs.

However, solely focusing on food-related activities may not address why low-income households are more time constrained. In this dissertation, I consider childcare, adult care, and non-car transportation. As noted above, these activities are pre-committed (Kalenkoski et al. 2011) and they may also be more easily influenced by policy. Table 2.1 presents weighted mean time allocations for one food and five non-food related activities for households between 2003 and 2014 based on the American Time Use Survey. The lowest per capita income households spend the least amount of time on food activities, but also the most time on carpooling, public transportation, and secondary child care. Therefore, the time allocations in Table 2.1 suggest that low- income households' decisions around diet quality may be limited by increased time spent in committed activities.

Table 2.1. Average household minutes per day spent on selected activities for 2003-2014

Income per HH member	Food Activities	Adult Care	Time Carpooling	Time on Public Transportation	Childcare	Childcare as secondary activity
$0 - $16,000	106.3	9.93	14.53	3.76	62.62	239.88
	(0.461)	(0.273)	(0.222)	(0.132)	(0.620)	(1.72)
$16,001 - $24k	109.3**	9.87	13.87	2.33**	62.18	206.56**
	(0.560)	(0.377)	(0.288)	(0.126)	(0.898)	(2.15)
$24,001 - $32k	110.4**	8.33	13.72	2.28**	64.17	197.35**
	(0.738)	(0.618)	(0.399)	(0.180)	(1.21)	(2.91)
> $32,000	115.2**	8.52**	12.52**	2.75**	66.05**	186.50**
	(0.545)	(0.278)	(0.241)	(0.139)	(1.28)	(2.75)
Observations	146,239	146,239	146,239	146,239	69,002[1]	69,002[1]

[1] Households without children excluded
Standard errors in parentheses
** Significance from lowest income group at least at the 5% level

Measures of Diet Quality

Past diet-quality studies generally focus on specific aspects of the household diet, such as total caloric intake, servings of fruits and vegetables, or consumption of whole grains (Rickard, Okrent, and Alston 2012, Variyam 2008, Nordstrom & Thundstrom 2011, Darmon and Drewnoski 2008). For example, Beatty (2008) finds that spreading food expenditures over time, observed by increased shopping frequency, decreases the share of calories from saturated fats and increases the share of calories from fruits and vegetables. Therefore, in Essay 1 I consider FAH food group expenditures as a measure for diet quality. Food group categories are usually constructed in a way that are easily understood by consumers and grouped by similar food types. In addition, the USDA dietary guidelines are given in both consumption and purchasing allocations with recommendations on which food groups to increase and decrease consumption or purchase of (USDA and HHS 2010). Considering diet quality in this way allows for a detailed examination of a few components of nutrition, but is limited in its application to overall diet quality.

For Essay 2, I consider the household's FAH HEI score, which is a more inclusive measure. The 2010 HEI captures the key recommendations of the 2010 Dietary Guidelines and

has been used to assess the diet quality of the U.S. population and subpopulations in evaluating interventions, and to evaluate various aspects of the food environment using both food consumption and purchasing data (Guenther et al., 2013, Krebs-Smith et al., 2010; Volpe and Okrent, 2012, Guenther et al., 2014). As noted in the introduction, the HEI ranges from 0 to 100 and is based on nine adequacy components and three moderation components.

Finally, for Essay 3 I consider household FAFH diet quality. While obtaining food and eating are necessary activities, preparing nutritious food at home is not. Increased consumption of convenience foods and FAFH contributes to the lower diet quality (Scharadin, Todd, and Mancino 2017) and higher rates of negative health outcomes of low-income households (Truong & Sturm, 2005, Kim & Leigh, 2010, Levi 2011) because these foods often have lower nutritional value than meals prepared from fresh ingredients at home (Guthrie and Frazao 2002).

When FAFH is treated as a composite good, research finds mixed results for the impact of the household manager's time on FAFH expenditures (Byrne et al. 1996, Dong et al. 2000, Huffman 2011). However, when the FAFH expenditures are differentiated by establishment type, the value of the household manager's time has a positive impact on fast food demand, but a negative impact on sit-down food demand (Byrne 1998, Stewart and Yen 2004). Therefore, in addition to considering low-income household purchase patterns, I focus on fast food purchases instead of all FAFH.

Chapter 3

Data Description and Processing

Information on both food purchases and household time allocations is necessary for the analysis. In each of this dissertation's three main essays, the National Food Acquisition and Purchase Survey (FoodAPS) is used as the source of food purchasing information and the American Time Use Survey (ATUS) is used as the source of household time allocations. In addition, the Food Environment Atlas (FEA) is used to construct variables that would control for county food environment and cultural measures. A general data description for each data set is followed by a detailed description of how each data set is handled for each of the three main essays.

American Time Use Survey

The ATUS provides nationally representative estimates of how, where, and with whom Americans spend their time. It is the only federal survey providing data on the full range of nonmarket time activities, from childcare to volunteering. Information is gathered over a guided telephone survey from one household member, who is over 15 years old, about the previous 24-hour period (Hamermesh 2005). Time-use activities are characterized into over 400 specific activities that can be grouped into 17 main activities. All time-use activities are allowable as primary activities, while childcare and adult care are also allowed as secondary activities. An example of a primary adult-care activity would be taking an older family member to the doctor, while a secondary adult-care activity would be helping fold an adult adult's laundry while watching television. Primary childcare includes helping with homework, while secondary childcare includes cleaning the house while the child is under your watch. Secondary childcare and adult care are not counted for time activity codes that are included in other time allocation

groups in order to maintain exclusivity. Documenting childcare and adult care as a secondary activities allows the observations to be handled appropriately (Mullahy and Robert 2010).

In general, major time-use trends tend to be stable over time and therefore multiple years are often pooled together (Basner et al. 2007, Cawley and Liu 2012, Fox et al. 2013). We consider three different time periods for the ATUS data: years 2003 to 2014, which constitute our full sample; years 2010-2014, which limit the sample to two years before and after the year the FoodAPS sample was collected; and 2012 only, which matches the year when FoodAPS data were collected. There are no significant differences between the samples, so for Essay 1, the 2003 through 2014 sample is used to include the largest amount of information. Only time diaries that were marked as "No data quality problems identified" were used, resulting in 144,126 total observations.

Recent work has shown that certain trends, particularly around food have shifted as a result of the "Great Recession" (Hamrick and Okrent 2014, Aguiar, Hurst, and Karabarbounis 2012). Therefore, for Essay 2, although considering other time periods, we use household observations from the years 2010-2014. This allows for observations 2 years before and after the year the FoodAPS sample was collected. Only time diaries that were marked as "No data quality problems identified" were used, resulting in 59,463 total observations.

The detailed time activity codes are grouped into five mutually exclusive time-allocation groups. I label the first FAH, which includes grocery shopping, food preparation, eating meals at home, and others. The second is non-car transportation, which includes travel by walking, biking, public transportation, and carpooling with a non-family member. The third and fourth groups are childcare and adult care. For each of these groups, both primary activities and secondary activities are included. The final time-allocation group includes all other time

activities. The total amount of time spent in each time allocation group is divided by 1,440 minutes to obtain the share of daily time spent in each group. Table 3.1 presents demographic means for the 3 ATUS samples considered and the FoodAPS sample.

ATUS Eating and Health Module

The ATUS has three modules that gather more detailed information about the household than the general time-use survey. One of these modules, the Eating and Health Module (EHM) is available for 2006-2008, 2014, and 2015. This module collects increased information on food-safety practices, grocery shopping practices, secondary eating, and sugary beverage consumption. In addition, for the 2014 and 2015 samples, respondents were asked, "Thinking back over the last seven days, did you purchase any: prepared food from a deli, carry-out, delivery food, or fast food?" If the respondent answered affirmatively, then they were asked for the frequency. To make use of this information, 1,019 observations were removed because of missing data or because a "data quality problem" was identified with the observation. Therefore, 21,478 observations were used in the ATUS EHM sample.

National Household Food Acquisition and Purchase Survey (FoodAPS)

The FoodAPS dataset provides nationally representative survey data on U.S. household food purchases and acquisitions. Detailed information is collected about households and the foods purchased or otherwise acquired for consumption at home and away from home. The survey covers 4,826 households with over sampling of Supplemental Nutrition Assistance Program (SNAP) households and low-income households not participating in SNAP. The data include information about SNAP participation, job status information, health measures, and other key demographics. While the dataset is relatively new, there are several published works and a

number of funded projects already using the FoodAPS data with a second round of funding currently under way (Smith et al. 2016, Todd and Scharadin 2016, USDA ERS 2015).

For two reasons, FoodAPS is the most appropriate dataset for this dissertation: First, many food-purchasing datasets such as Nielsen Homescan and the IRI consumer panel only have information on FAH purchases; FoodAPS has both FAH and FAFH purchases and acquisitions. In addition, Nielsen Homescan and the IRI consumer panel do not have detailed nutrient information necessary to both accurately group foods and calculate household HEI. Lastly, while the National Health and Nutrition Examination Survey is an intake survey and therefore captures FAFH, it is more limited in its household demographic details than FoodAPS. Table 3.1 and Table 3.2 present and compare demographic means for the ATUS samples described previously and the FoodAPS sample.

For Essay 1, I make use of the food groups FoodAPS categorizes each item the household purchases throughout the week following the hierarchy found in Appendix A. The hierarchy follows a tier system, where the first tier denotes broad groupings such as dairy, meat, and vegetables. The second tier accounts for more detail within the general group and the third tier distinguishes between preparation types. For example, with chicken and poultry, the third tier distinguishes between fresh, frozen, and canned. From these food groups, I construct seven more aggregate food groups for the estimation: fresh and frozen fruits and vegetables, canned and prepared fruits and vegetables, snacks, sugary beverages, packaged meals, processed meats, and all other foods. Table 3.3 presents the average expenditure share in each food group for all households in the sample. The food groups of interest account for approximately 40 percent of all FAH purchases. (A list of example food items for each of the food groups can be found in Appendix B.)

Table 3.1. Demographics for ATUS Subsamples and FoodAPS Essays 1 and 2

VARIABLES	ATUS all	ATUS 2010-2014	ATUS 2012	FoodAPS
Ln of annual income	10.73	10.76	10.74	10.57
	(0.004)	(0.005)	(0.011)	(0.017)
Resides in metro area	0.822	0.833	0.833	0.865
	(0.005)	(0.006)	(0.007)	(0.036)
Resides in Midwest	0.239	0.234	0.232	0.314
	(0.002)	(0.003)	(0.005)	(0.030)
Resides in South	0.358	0.364	0.369	0.355
	(0.002)	(0.003)	(0.006)	(0.036)
Resides in West	0.226	0.224	0.222	0.178
	(0.0018)	(0.0027)	(0.0050)	(0.0248)
Rents residency	0.250	0.264	0.269	0.357
	(0.002)	(0.003)	(0.005)	(0.017)
Average Age of Household	44.52	45.38	45.42	49.04
	(0.029)	(0.043)	(0.103)	(0.280)
Avg. Age of HH squared	2,252.19	2,334.49	2,340.39	2,671.05
	(2.72)	(3.95)	(8.88)	(26.42)
Residency is Free	0.011	0.011	0.011	0.026
	(0.000)	(0.001)	(0.002)	(0.006)
Highest Educ is Post HS	0.506	0.508	0.501	0.537
	(0.002)	(0.003)	(0.005)	(0.011)
Highest Educ is Bachelors	0.237	0.242	0.241	0.221
	(0.001)	(0.002)	(0.005)	(0.011)
Highest Educ is Grad. Degree	0.169	0.179	0.181	0.171
	(0.001)	(0.002)	(0.004)	(0.012)
Child between 1 and 2	0.061	0.056	0.058	0.063
	(0.001)	(0.001)	(0.002)	(0.004)
Child between 3 and 5	0.085	0.080	0.077	0.094
	(0.001)	(0.001)	(0.002)	(0.005)
Child between 6 and 12	0.153	0.144	0.140	0.163
	(0.001)	(0.001)	(0.002)	(0.004)
Child between 13 and 17	0.111	0.106	0.107	0.131
	(0.001)	(0.001)	(0.002)	(0.006)
Black	0.117	0.120	0.120	0.125
	(0.000)	(0.000)	(0.001)	(0.001)
Asian	0.038	0.044	0.049	0.037
	(0.001)	(0.001)	(0.002)	(0.004)
Other	0.021	0.020	0.017	0.074
	(0.001)	(0.001)	(0.001)	(0.007)
Hispanic	0.143	0.150	0.152	0.125
	(0.000)	(0.000)	(0.000)	(0.001)
Married	0.523	0.506	0.502	0.441
	(0.001)	(0.002)	(0.004)	(0.009)
Observations	144,126	60,605	12,443	4,291

Standard errors in parentheses

*Significance at least at the 5% level

Table 3.1. Mean Comparison of Demographic Variables for ATUS Subsamples and FoodAPS

VARIABLES	ATUS all	ATUS 2010-2014	ATUS 2012	FoodAPS
Unemployed	0.084	0.088	0.083	0.094
	(0.001)	(0.001)	(0.003)	(0.007)
Not in Labor Force	0.306	0.324	0.328	0.381
	(0.001)	(0.002)	(0.004)	(0.009)
Self-employed	0.067	0.065	0.067	0.140
	(0.000)	(0.001)	(0.002)	(0.009)
Access to Vehicle	0.744	0.729	0.724	0.899
	(0.001)	(0.002)	(0.006)	(0.008)
HH member > 65	0.214	0.236	0.241	0.258
	(0.001)	(0.001)	(0.003)	(0.008)
Single Headed HH	0.179	0.179	0.180	0.378
	(0.001)	(0.001)	(0.003)	(0.004)
Female Single Headed HH	0.105	0.104	0.106	0.215
	(0.001)	(0.001)	(0.002)	(0.009)
Observations	144,126	60,605	12,443	4,291

Standard errors in parentheses, *Significance at least at the 5% level

In order to control for price, the average price per item within each food group is calculated for all food groups. The price variables within each food group are calculated for the entire year because purchasing behaviors across aggregate food groups are more likely to be affected by long-term price averages. Shorter-term price averages are more likely to affect purchasing behavior within an aggregate food group. The calculated average prices include both stores that were visited by FoodAPS households and a selection of stores that were not visited by FoodAPS households.

While the estimated time allocations are able to be estimated for all 4,826 households in FoodAPS, there 535 households are excluded because they had no FAH expenditures during the survey week or missing covariates. Given that FoodAPS is only collected for a week households with no FAH purchases may have shopped just before the sample week or just after. Therefore, it is possible that their food stocks were such that they did not need to shop at a FAH store location. Not collecting current food stocks is a short coming of all commonly used food purchasing data sets.

Table 3.2: Demographics for ATUS Subsamples and FoodAPS Essay 3

	EHM ATUS	ATUS 10-14	FoodAPS
Household Resides in Rural County	0.16	0.17	0.34
	(0.004)	(0.006)	(0.030)
Household Resides in USDA Northeast Region	0.18	0.18	0.15
	(0.003)	(0.002)	(0.024)
Household Resides in USDA Midwest Region	0.24	0.23	0.31
	(0.004)	(0.002)	(0.030)
Household Resides in USDA West Region	0.22	0.22	0.18
	(0.005)	(0.003)	(0.025)
Survey conducted in April, May, or June	0.25	0.25	0.28
	(0.000)	(0.000)	(0.013)
Survey conducted in July, August, or September	0.25	0.25	0.52
	(0.001)	(0.000)	(0.016)
Survey conducted in October, November, or December	0.25	0.25	0.20
	(0.000)	(0.000)	(0.016)
Respondent was White	0.81	0.81	0.70
	(0.002)	(0.002)	(0.003)
Respondent was Black	0.12	0.12	0.13
	(0.001)	(0.000)	(0.001)
Respondent was Hispanic	0.16	0.15	0.13
	(0.001)	(0.000)	(0.000)
Highest Household Education is Bachelor's Degree or Higher	0.44	0.42	0.32
	(0.004)	(0.003)	(0.018)
Highest Household Education is Some College or HS Diploma	0.51	0.51	0.48
	(0.005)	(0.003)	(0.017)
Respondent was Employed	0.59	0.59	0.55
	(0.004)	(0.002)	(0.009)
Log of Annual Household Income	10.84	10.77	10.58
	(0.008)	(0.005)	(0.017)
Average age of Household Members	46.07	45.41	49.78
	(0.077)	(0.045)	(0.343)
Household was SNAP recipient during survey week	0.10	NA	0.14
	(0.002)		(0.000)
Household had Access to Vehicle	0.74	0.73	0.90
	(0.003)	(0.002)	(0.009)
Household Owns the Place of Residence	0.28	0.27	0.38
	(0.004)	(0.003)	(0.018)
Observations	21,478	59,466	4,811

Source: American Time Use Survey and National Household Food Purchase and Acquisition Survey

Table 3.3. Weighted Means of Household Food Group Expenditure Shares

Food Groups	Mean Percent	Standard Error	95 % confidence interval	
Fresh and Frozen F&V	12.03	0.341	11.33	12.74
Canned and Juice F&V	3.04	0.153	2.73	3.36
Sweet and Salty Snacks	6.29	0.226	5.82	6.75
Sugary Beverages	6.27	0.284	5.68	6.85
Packaged Meals	7.73	0.223	7.28	8.19
Processed Meats	2.78	0.161	2.45	3.11
All Other Items	61.86	0.508	60.81	62.90

For Essay 2, food purchases must be converted to the HEI score. Thus each food item in FoodAPS is assigned both micro- and macronutrient information and Food Pattern Equivalent values. This detailed nutrition information is used to calculate the 2010 HEI, which measures diet quality in terms of conformance with Federal dietary guidance. The 12 HEI components are measured using a density approach to set standards, such as per 1,000 calories or as a percent of calories. Essay 2 also makes use of a household-level, average market price of a Thrifty Food Plan (TFP) basket. The TFP gives suggested consumption in pounds for 29 food groups to meet the federal dietary guidelines in a cost-efficient way. To calculate the market basket price, the FoodAPS items are first sorted into one of the 29 TFP groups. Then, for each item, the price per pound is calculated and the median price per pound is used to represent the entire TFP group. Finally, the price per pound multiplied by the pounds suggested by the TFP for each group is summed to calculate the full price of the basket.

In Essay 3, the FoodAPS data are also used to investigate how specific time allocations affect the probability and number of fast food events. While ATUS respondents were directly asked the number of fast-food events they participated in during the sample week, FoodAPS data has indirect data on fast-food purchases. More specifically, FoodAPS contains detailed location

information for all food-purchase events. Using both place-type and place-name information, purchase events can be characterized as either fast food or not fast food. This characterization limits FoodAPS fast-food events to FAFH events, a characterization that differs slightly from the ATUS definition, which includes prepared deli food from grocery stores. (Place names are used to distinguish between fast-food restaurants and sit-down restaurants. A list of the specific place names and key words used to identify fast food events is found in Appendix 1.)

Food Environment Atlas

The final dataset that is used in the analysis is the USDA Economic Research Service's Food Environment Atlas (FEA). The FEA contains information in three major areas: food choices, health and well-being, and community characteristics. It includes over 211 indicators of the food environment, many at the county level. Three specific indicators, county-level obesity rates for 2010, convenience store counts per thousand, and grocery store counts per thousand for 2012 are included from the FEA to control for the household food retail and health environment. In Essay 1, store-type counts are used as a measure of the food environment; In Essay 2, however, I use the ratio of grocery stores to convenience stores in order to account for the relative abundance of healthy to unhealthy FAH stores in an area. This ratio is similar to the Modified Food Retail Environment Index which is able to consider both "food deserts" and "food swamps" (CDC 2011).

Chapter 4

Theoretical Constructs

Both of the first two analyses, which correspond to the first two essays, are concerned with FAH purchases. On the other hand, the third analysis (the third essay) is most concerned with FAFH. In both cases, while the theoretical constructs are related, there are enough subtle differences to present the theoretical foundations separately.

Time Allocation and Household Health: Theory Essays 1 and 2

To consider how households FAH purchases and time allocations relate, I follow a health production theory similar to that developed by Houston and Finke (2003). They use elements of Becker's (1965) household utility framework and Lancaster's (1966) characteristic theory to view the nutritional characteristics of food as inputs into a diet production function, which ultimately influences health. A household seeks to maximize its utility function that can take the general form

$$U = U(Z_1, Z_2, \dots, Z_m)$$

where utility is a function of commodities, Z_i, that are produced by the household. One example of these commodities, Z_1, is the household diet-quality function. The household diet-quality function, like each household commodity, is produced according to a production function of the form

$$Z_i = f\left(y_i, t_{i(\delta,\theta)}, k, \theta, e\right)$$

where f is a function of characteristics of market goods, y_i, time allocations, $t_{i(\delta,\theta)}$, that are determined by the time preference rate, δ, and socio-cultural characteristics, θ, human capital *k*,

and exogenous factors, *e*. Within the diet-quality function, Z_1, the characteristics of market goods will be the nutrient characteristics of food products.

There are three major constraints. The consumption technology constraint translates each good into is characteristics and is represented by

$$y_i = \sum_{f=1}^{n} b_{ij} x_j$$

In the household diet quality function, the coefficient matrix b_{ij} translates food x_j into its nutritional characteristics. The income constraint ensures that a household's budget is balanced and is given by

$$\sum_{f=1}^{n} p_j \, x_j(y_i) = w t_w + V$$

where *p* is a vector of prices for each of the *j* goods, w is the wage rate, t_w is time spent working, and *V* is endowment income. Finally, the time constraint limits the household to using 24 hours per day and is given by

$$T = t_w + \sum_{i=1}^{m} t_i$$

where T is the total time in a day and t_i is time spent in commodity production. Optimizing the choice function with respect to the constraints gives

$$y_i = \left(p_j, w_i(\delta, \theta), V\right),$$

such that the demand for nutrition is a function of the price of the goods, unearned income, and the price of one's time in that activity. The focus of these essays is on elements of t_i and y_i. More specifically, I am interested in the t_i that reflect the time spent in primary childcare, secondary childcare, and adult care. I am also interested in y_i, which reflects the nutrient

attributes of FAH purchases of a household. The high discount rate for producing childcare or adult care in the future compared in the present, makes time spent in other activities very costly. Therefore, low-income households, who may be less able to substitute money for time by paying for day care or nurses for adult care, are expected to shift time from FAH activities to complete these committed activities.

Although similar theoretical constructs have been used extensively to investigate the association between time spent on food activities and both diet quality and health outcomes (Todd, Mancino, Lin 2010, Cutler et al. 2003, Philipson and Posner 2008, Thorp et al. 2011, Monsivais 2014), little work has been conducted on non-food related committed activities, to which this theoretical model can easily extend. In optimizing their utility, low-income households allocate time to committed activities first, leaving less time for non-committed activities. Although higher-income households consider the same tradeoffs, presumably they can more readily substitute paid services for their own time. Childcare is a clear example. A high income household can afford to outsource childcare, freeing time for other activities, while a low income household must allocate their time to own childcare. While eating is a necessary activity, eating healthfully is not. Therefore, time is substituted away from activities that increase diet quality and into committed activities, such as childcare, decreasing diet quality.

Time allocation and Household Health: Theory Essay 3

In Essay 3 the focus is on FAFH, specifically fast-food purchases. Therefore, the theory is slightly different from FAH and I present the household production framework for committed activities and household health in a similar fashion as Davis (2013). A common derived utility function in the literature takes the form

$$U = U(F_{home}, F_{away}, x_o, t; e),$$

where F_{home} is the FAH production function, F_{away} is the FAFH production function, x_o is a vector denoting all market goods not in food production, *t* is a vector denoting time spent on different activities, and *e* is exogenous environmental measures. Similar to each type of household commodity, FAH meals and FAFH meals are produced according to a production function. The household food production function has the following form

$$F_i(x_i, t_i, z_i)\ i = home, away$$

where the x_i is a vector of market good inputs (i.e. groceries), t_i is a vector time spent in that type of food production, and z_i is a vector of other factors that affect food production, such as household demographics. Within the FAFH production function, the focus of our paper is on *x* and *t*. The focus on *t* will look at the committed activities of primary childcare, secondary childcare, adult care, FAH activities, and work. The focus on *x* will be the number of fast food events and healthfulness of those fast food events. Given that there are both time and money inputs, the full income constraint has the following form

$$p_a x_a + p_h x_h + p_o x_o + w(k) \sum_{m=1}^{M} t_m = E + w(k)T$$

where *p* is a vector of prices for each of the market good inputs, *T* is the total time endowment of 1,440 minutes per day, *E* is endowment income, and *w* is wages, which are a function of human capital. Optimizing the choice functions with respect to the full income constraint gives general time activity *m* with form

$$t_m = t_m(x_i, z_i, k, E, p_i, e)$$

and food purchases *f* with form

$$f = f(x_i, z_i, k, E, p_i, e)$$

This theoretical construct has been used extensively to investigate the association between time spent on food activities and both diet quality and health outcomes (Todd, Mancino, Lin 2010, Cutler et al. 2003, Philipson and Posner 2008, Thorp et al. 2011, Monsivais 2014). However, little work has been conducted on non-food related "committed" activities and fast-food purchases. Similar to FAH, low-income households allocate time to committed activities first, leaving less time for discretionary activities, such as preparing their own meal. Although higher income households consider the same tradeoffs, they can more readily purchase services, freeing time for other activities, such as preparing a more nutritious meal. Therefore, time is substituted away from activities that increase FAH consumption. This reduction in FAH consumption leads to an increase consumption into convenient and cheap FAFH, fast food.

Potential Endogeneity

An important aspect to note about both of these theoretical constructs is that it suggest that households make time allocation and food purchasing decisions jointly. Therefore, endogeneity is a concern when investigating the impact of time allocations of food purchasing decision. One way I account for this is by using Two-Sample Instrumental Variables, which will be describe in detail in the methods section. I second way is by controlling for numerous household and geographic factors through the detailed demographic data in FoodAPS.

Chapter 5

Methods

Two-Sample Instrumental Variable Estimation

Angrist and Krueger (1992) developed Two-Sample Two-Stage Least Squares as an alternative to Two-Stage Least Squares in order to address the bias of IV estimators and the common data shortcoming when one dataset does not contain all the necessary variables. It is used in all three essays to overcome missing data and to address the potential endogeneity of food purchases and time allocations. Since its development, TSIV continues to be used in literature ranging from educational attainment to income inequality (e.g., Angrist and Krueger 1995, Dee and Evans 2003, Hamermesh 2007). TSIV estimates are unbiased if two major assumptions hold: The first assumption is that the two datasets are jointly independent; the second is that the two samples are drawn from the same population. These assumptions hold for FoodAPS and the ATUS because the survey samples were collected independently of each other and both surveys were developed to be nationally representative. The population for both datasets is the U.S. civilian noninstitutionalized population. Tables 3.1, 3.2, and 3.3, presented previously, show that the means of key demographic variables for FoodAPS and the ATUS are similar, supporting the assumption that the samples are drawn from the same population.

To directly illustrate the TSIV process consider the following equation, used in Essay 2, for estimating a household's HEI score

$$HEI_i = \alpha + \boldsymbol{\beta TA_i} + \boldsymbol{\gamma H_{i,FoodAPS}} + \boldsymbol{\delta GD_i} + \eta P_i + \varepsilon_i$$

where i indexes the household, *HEI* is the household HEI score for the sample week, $\boldsymbol{TA}$ is a vector of time allocations, $\boldsymbol{H}$ is a vector of household characteristics, $\boldsymbol{GD}$ is a vector of geographic dummy variables and food environment measures, P is the household TFP market

basket price, and ε is an error term. As mentioned in the data section, no dataset contains information for both $\boldsymbol{TA_i}$ and HEI_i. In addition, as implied in the theory section, $\boldsymbol{TA}$ is potentially endogenous. Therefore, alternatively the following second-stage equation will be estimated

$$HEI_i = \alpha + \boldsymbol{\beta}\widehat{\boldsymbol{TA}}_i + \boldsymbol{\gamma H_{i,FoodAPS}} + \boldsymbol{\delta GD_i} + \eta P_i + \varepsilon_i \quad (1)$$

where $\widehat{\boldsymbol{TA}}$ will contain estimated time-allocation shares of own childcare, own adult care, and time spent in FAH activities. The estimates will be calculated by estimating the following first-stage equation

$$\boldsymbol{TA}_{i,j} = \alpha_0 + \boldsymbol{\beta_0 H_{i,ATUS}} + \varepsilon_{i,j,0} \quad (2)$$

where *i* and *j* index the household and the time-use activity, $\boldsymbol{TA}$ is the share of the day in the time use activity, and is a vector of household demographics for the ATUS households. After this equation is estimated, $\boldsymbol{H_{i,ATUS}}$ will be replaced with $\boldsymbol{H_{i,FoodAPS}}^{\mathbf{1}}$, the same vector of household demographic as $\boldsymbol{H_{i,ATUS}}$ **,** but from FoodAPS, in order to calculate $\widehat{\mathbf{TA}}_i$, such that

$$\widehat{\boldsymbol{TA}}_{i,j} = \alpha_0 + \boldsymbol{\beta_0 H_{i,FoodAPS}}^{\mathbf{1}} + \varepsilon_{i,j,0}$$

As with all instrumental variable estimation, care must be given to choosing a proper instrument. Here my instruments must be correlated with the time activity, but not directly affect the nutrient attributes. For time spent in primary and secondary childcare, I use presence of children by age groups. I argue that this choice reflects a valid instrument given that the presence and age of a child is strongly correlated with childcare yet the presence and age of the child do not affect food purchasing except through the changes in time allocations. Three ways in which this second assumption could be violated are through nutritional needs, child preferences, and income changes. However, past literature lessens some of these concerns. For nutritional

differences, 24 of 29 Thrifty Food Plan-suggested group share expenditures have 2% or less difference between the average child and the average adult (USDA and HHS 2010). In addition, the HEI score is a density measure, meaning it is standardized by 1,000 calories. Childhood literature has found the children's food preferences are strongly correlated with the parents' food preferences (Patrick and Nicklas 2013). Finally, children may decrease the share of the food budget. However, this change in the food budget does not necessarily directly decrease diet quality, because it must also pass through the time constraint (Davis and You 2011).

For time spent in adult care, I use the presence of a person over 65 years old in the house as an excluded variable/instrument with a similar justification. For nutritional differences, 26 of 29 Thrifty Food Plan-suggested group share expenditures have 2% or less difference between the average child and the average adult (USDA and HHS 2010). For differences in preferences by age, the World Health Organization found that there was no difference in dietary compliance with the presence of an elderly adult (Rodrigues et al. 2008). Finally, while elderly adults may decrease the share of the food budget, this doesn't necessarily result in lower diet quality because time could be substituted if it were available (Davis and You 2011).

For time spent in FAH activities, I use a single-headed household status as an excluded variable/instrument. Households with two heads can share all household responsibilities. Thus this status can affect the amount of time spent in FAH activities. However, there is no a priori reason to believe that single parents would have different nutritional needs or food preferences.

In addition to the excluded variables, care is taken to prevent high levels of multicollinearity between the household demographics that remain in the second-stage estimation and the estimated time allocations. Although similar variables may be included in both stages, the construction of certain variables differ. For example, in equation (1), income is

constructed from a categorical variable due to the ATUS structure, while in equation (2) income is a continuous variable. Finally, (2) is estimated using a non-linear functional form, further reducing the risk.

Using predicted values as instruments has two main consequences. First, it is important to use replicate weights to simulate multiple samples within a single sample and still maintain the complex sampling design. Using repeated samples creates estimated standard errors that are less biased then a single point estimate. Following the suggested approach in each dataset's documentation, I use a successive difference replication method for the ATUS estimations, with 160 replications, and jackknife replication method for the FoodAPS estimations, with 57 replications (BLS 2012, ERS 2016). Second, predicted values introduce measurement error, which causes attenuation bias and increases the chance of a type one error (Charter 1997; Carroll and Stefanski 1994). Under certain assumptions, the correction for measurement error in linear models is relatively straightforward (Chen et al. 2011). However, due to data limitations the corrections are not calculated and the results are presented as lower bounds in terms of significance and magnitude.

Fractional Multinomial Logit

Essays 1 and 2 will rely on a fractional multinomial logit (FMNL) model, which estimates how the mean proportion or share is related to a group of explanatory variables. The seminal work in this area estimated 401k participation rates based on the demographics of the individual (Papke and Wooldridge 1996). Since then, the FMNL model has become widely used in a variety of fields and applications, such as the share allocation of either land, budget, or time (Koch 2010, Allen 2012, Mullahy 2012). While there are other fractional regression techniques,

such as the beta-distribution, zero-one inflated beta distribution and Dirichlet distribution, these models are not appropriate for this project's data. The beta and Dirichlet distributions are not well suited to handle extreme values of 0 and 1, while the zero-one inflated distribution does not estimate multiple proportions in a system (Garay 2015, Wieczoreck 2011).

These attributes are important in both the first- and second-stage estimation of Essay 1 and in the first-stage of Essay 2. In the first stages, a large number of households have no children and will therefore spend no time in childcare, so allowing for 0s is necessary. In addition, in the second stage a family could have no expenditure in a particular food group. Allowing multiple shares to be estimated in a simultaneous system is necessary because share data are naturally correlated: i.e., spending more time on one activity means spending less on another because of a fixed amount of time. FMNL allows for extreme values to be included and estimates multiple equations in a system. FMNL also focuses on the mean proportion instead of the distribution, which makes the estimation less susceptible to errors (Papke and Wooldridge 199 6). For all these reasons, we use FMNL to estimate the first and second stage.

A concern with using FMNL involves the independence of irrelevant alternatives criteria. In order to address the independence of irrelevant alternatives criteria, I vary the excluded group in estimation during both the first and second stage. In general, the sign, magnitude, and significance of the results are robust throughout the variations, suggesting the criteria is satisfied.

Additional Econometric Models

For Essay 3, I consider the effect of committed activities on household fast-food purchases in three separate ways. First, I investigate this relationship in the ATUS EHM. More specifically, I estimate a logit model to consider how time spent in these activities increases or decreases the probability that a household will have at least one fast-food event during the data collection

week. I also estimate both an uninflated and zero-inflated negative binomial (ZINB) regression to consider how the time allocations affect the number of fast-food events throughout the week. However, the theoretical model presented earlier suggests that time activities and food purchase decisions may be made jointly.

In order to account for this possible endogeneity and to compare results to the ATUS EHM results, where the endogeneity is not accounted for, I perform the same three estimations using the FoodAPS sample with predicted time allocations. Using TSIV, predicted values for the share of the day spent in the committed activities of interest are used as instruments for FoodAPS households. The first-stage equation, where the share of time in a given activity is regressed on household demographics, is estimated using a seemingly unrelated regressions approach. Allowing the errors of each time allocation equation to be correlated is important because the data are naturally correlated: i.e., spending more time on one activity means spending less on another because of a fixed amount of time. The results of this first-stage are presented in Appendix F.

In addition to comparing the results between the ATUS and FoodAPS samples, results are also compared for specifications that include time spent in FAH activities. Including FAH activities is justified on theoretical grounds because more time spent in FAH activities is likely to be strongly related to fast-food purchase events. It is also justified on practical grounds because there is an expected sign of the coefficient. Despite these benefits of inclusion, the close relationship between FAH activities and fast food purchases warrants careful endogeneity consideration. Therefore, I present the results for specifications that both include and exclude FAH activities.

Finally, I consider how these time activities affect the healthfulness of FAFH purchases. Continuing to use the FoodAPS sample with the TSIV predicted time allocations, I investigate how these time allocations affect household FAFH HEI and the share of FAFH expenditures at fast food restaurants. Given that the FAFH HEI score is bounded between 0 and 100, the score is divided by 100 in order to scale it between 0 and 1. I then use a FMNL model to estimate the effect of the time allocations. Finally, I estimate a zero-inflated beta regression to consider how the time allocations affect the share of FAFH expenditure at fast food restaurants.

Chapter 6

Results

This chapter presents results from the three main investigations: (i) the link between total child care, a pre-committed time allocation, and the share of food expenditures in healthy and unhealthy food groups, (ii) the link between primary and secondary child care and the HEI, and (iii) the link between a number of pre-committed time allocations and the prevalence of fast-food purchase events. Before presenting these results, I first investigate the potential for high correlation and multi-collinearity among the covariates in the models, especially the predicted time allocations generated by the TSIV. One reason that correlation is expected is that time allocations are necessarily linked via the time constraint. However, the strength of the correlation is an empirical issue and may depend on which time allocations are being utilized in the model.

Correlation and Multicollinearity

Given that the predicted time allocations are produced from the same set of demographic variables, and given the household's non-yielding time constraint, there are concerns about high correlation and multicollinearity between each of the predicted time-allocation values and household demographic variables. In order to address these concerns, I first estimate a pair-wise correlation matrix and also perform a test for multicollinearity.

Table 6.1 presents the pair-wise correlation matrix for each of the five time allocations considered in the three essays. While some amount of correlation is expected, very high levels may cause high multicollinearity in the second stage estimation. After comparing the estimated pair-wise correlation coefficients for a wide range of covariates from the ATUS and FoodAPS datasets, I generally find a higher level of correlation for the predicted values of the time

allocations from the ATUS. Table 6.1, abridged from the full correlation matrix, presents the correlation coefficients for the predicted time allocations used in my three models. Primary and secondary childcare have the highest correlation coefficient, 0.88, among all the predicted time allocations. This strong connection between time spent in primary and secondary childcare is expected and consistent with the actual time allocations found in the ATUS sample as well.

A number of predicted time allocations show very low correlations. For example, a predicted time allocation for non-car travel seems to be virtually independent from primary and secondary childcare, and also FAH activities. One the other hand, FAH activities seem to be moderately correlated with primary and secondary childcare.

Table 6.1 Pair-wise Correlation Matrix for Time Allocation Variables

FoodAPS Time Allocation Predictions

	Primary Childcare	Secondary Childcare	Adult Care	Non-Car Travel	FAH Activities
Primary Childcare	1.00				
Secondary Childcare	0.88	1.00			
Adult Care	-0.37	-0.40	1.00		
Non-Car Travel	0.04	0.02	-0.8	1.00	
FAH Activities	0.42	0.35	0.32	-0.04	1.00

ATUS Time Allocations

Primary Childcare	1.00				
Secondary Childcare	0.30	1.00			
Adult Care	-0.03	-0.04	1.00		
Non-Car Travel	-0.03	-0.03	0.00	1.00	
FAH Activities	0.11	0.08	0.01	-0.10	1.00

Given the presence of some high correlation coefficients, I next conduct a test for multicollinearity in the full set of covariates using variance inflation factors (VIF). The mean VIF for the full set of covariates is 1.89. This value is well below a standard rule of thumb, 10, for diagnosing multicollinearity as an issue (Menard 1995). The highest individual VIF is 5.2, which is still well below the threshold for concern. In addition, O'Brien (2007) showed that VIFs as high as 40 do not by themselves discount regression analyses. Common symptoms of strong

multicollinearity are lack of statistical significance of individual covariates and non-robust coefficient estimates. These symptoms do not present themselves in any of the three essays and since the VIF diagnostics also fail to suggest a problem, I therefore conclude that multi-collinearity is not a strong concern and proceed with my planned analyses.

Essay 1 - Results

Essay 1 investigates the link between the predicted times allocated to childcare and other pre-committed activities and the expenditure shares of healthy and unhealthy food groups. The estimation results are presented in Tables 6.2 through 6.5, with detailed definitions of covariates presented in Appendix C. I first discuss the results from the first-stage estimation of equation (2) to better understand the overall significance and fit of the time-allocation estimates. Second, I discuss the results from the second-stage food group expenditure share estimation of equation (1). I present the marginal effect point estimates for all the covariates in the model, and also predicted changes in food-group expenditure shares for particular variables of interest such as the time activities, SNAP participation, and vehicle access.

First-Stage Time Allocation Estimation

Table 6.2 presents the results from the FMNL estimation for equation (2). In most cases, the coefficient estimates are significantly different from zero for many of the time activities and, for some cases, for all of them. Twenty-four of 29 estimates are statistically significant for at least two of the time activities, a result that shows that demographic variables are important factors in the allocation of time across the four activities.

Table 6.2 shows a significant negative relationship between income and the time allocated to FAH activities, childcare, and adult care. These results are expected and consistent with the summary statistics from the ATUS presented in Table 2.1. On the other hand, Table 6.2 shows a significant positive relationship between income and time spent in non-car travel. This positive relationship, generally unexpected and inconsistent with findings in Table 2.1, may stem from a link between income and increased commuting time.

The estimated coefficients for employment status follow expectations and previous results. Because working hours are a large portion of the day for the employed, individuals that are unemployed or not in the labor force spend more time in all four time-allocation categories. However, being self-employed is significant only for the non-car travel time allocation. This negative relationship is potentially explained by more self-employed individuals working from home or increased vehicle travel.

Household composition also significantly affects the time spent in FAH, childcare, adult care, and non-car travel activities. The average age of the household, calculated as the average age of all members over 17, is positively associated with time spend on FAH activities, childcare, and adult care, while average age is negatively associated with time spent on non-car travel. These age-time relationships are all non-linear, with a squared age term showing the opposite sign as the linear term. Therefore, as the average age of the household increases, the positive or negative relationship diminishes. A household-level variable reflecting the presence of children within different age ranges is found to be a significant factor in all four activities. As expected, children present in any age group increases time spent in childcare and FAH activities. However, I find that the magnitude of this relationship decreases with the child's age such that the presence of younger children leads to the most time spent in childcare and FAH activities.

Table 6.2. Coefficient Estimates for First-stage Time Allocation Estimation for ATUS 2003 – 2014.

VARIABLES	Food at Home Activities	Childcare	Adult care	Non-Car Travel
LN Annual Income	-0.03194***	-0.02524***	-0.12931***	0.02621**
	(0.00475)	(0.00854)	(0.02486)	(0.01119)
Metro	-0.01223	-0.03617**	-0.01699	-0.01246
	(0.00854)	(0.01643)	(0.05219)	(0.02600)
Midwest	-0.05012***	0.04747***	-0.01836	-0.26124***
	(0.00953)	(0.01822)	(0.06635)	(0.02630)
South	-0.07144***	0.03421*	0.07671	-0.30688***
	(0.00848)	(0.02019)	(0.06212)	(0.02426)
West	-0.02652**	-0.01816	-0.04792	-0.21433***
	(0.01098)	(0.01889)	(0.06918)	(0.02700)
Rents	0.04129***	-0.01107	0.01023	0.19132***
	(0.00847)	(0.01703)	(0.05313)	(0.02137)
Avg. Age of HH	0.02555***	0.07975***	0.04668***	-0.04233***
	(0.00111)	(0.00320)	(0.00696)	(0.00258)
Avg. Age of HH sq.	-0.00018***	-0.00127***	-0.00034***	0.00031***
	(0.00001)	(0.00004)	(0.00008)	(0.00003)
Housing free	0.04855	0.07044	-0.09194	0.17741**
	(0.02988)	(0.06268)	(0.17148)	(0.08555)
Kid between 1 and 2	0.41094***	1.09455***	-0.04559	0.01148
	(0.01265)	(0.01796)	(0.08828)	(0.03254)
Kid between 3 and 5	0.30305***	0.78300***	-0.18263***	-0.06136**
	(0.01042)	(0.01503)	(0.06941)	(0.02896)
Kid between 6 and 12	0.32891***	1.34249***	0.04983	0.07048***
	(0.00812)	(0.01311)	(0.06288)	(0.02248)
Kid between 13 and 17	0.10603***	0.08833***	-0.08963	-0.10164***
	(0.00894)	(0.01442)	(0.06401)	(0.02745)
Black	-0.13356***	0.05481**	-0.10854	0.17041***
	(0.01123)	(0.02144)	(0.07178)	(0.02660)
Asian	0.26650***	-0.00954	-0.34613***	0.17637***
	(0.01567)	(0.03072)	(0.11665)	(0.04308)
Other	-0.04092*	0.07060*	0.28980**	0.09938*
	(0.02249)	(0.04005)	(0.13861)	(0.05688)
Hispanic	0.13188***	-0.00170	-0.19596***	0.22915***
	(0.01000)	(0.01940)	(0.06276)	(0.02301)
Married	0.27791***	0.47617***	0.08806	-0.04491*
	(0.00997)	(0.01923)	(0.06377)	(0.02340)
PostHS	-0.00256	-0.01549	0.14700***	-0.01192
	(0.00821)	(0.01736)	(0.05038)	(0.02281)
Overall Wald chi-squared	58670.41			
R-squared	0.08	0.36	0.01	0.03
Observations	144,126	144,126	144,126	144,126

VARIABLES	Food at Home Activities	Childcare	Adult care	Non-Car Travel
Bachelors Deg.	0.01361	-0.06161***	-0.16288***	0.03456
	(0.00858)	(0.01645)	(0.05989)	(0.02404)
Advanced Deg.	0.04024***	-0.05925***	-0.09141	0.15074***
	(0.01003)	(0.02165)	(0.06173)	(0.02759)
Unemployed	0.22657***	0.66595***	0.83881***	0.30119***
	(0.01366)	(0.02183)	(0.07639)	(0.03003)
Not in Labor Force	0.29547***	0.67579***	0.52529***	0.30311***
	(0.00966)	(0.01527)	(0.05639)	(0.02436)
Self-employed	-0.00064	0.01662	0.07129	-0.10751**
	(0.01258)	(0.02318)	(0.07848)	(0.04214)
Owns a vehicle	-0.17588***	-0.19532***	0.36140***	-0.42886***
	(0.00764)	(0.01604)	(0.07019)	(0.02029)
Elderly HH	-0.01624	0.10735***	0.11450	0.01058
	(0.01208)	(0.03638)	(0.07553)	(0.03555)
Single headed HH	-0.09340***	-0.63658***	-0.32219***	-0.36884***
	(0.01186)	(0.03844)	(0.07747)	(0.03196)
Female Single headed HH	0.15190***	0.92431***	-0.23497***	0.15214***
	(0.01042)	(0.03765)	(0.06776)	(0.03728)
Constant	-3.30250***	-4.16564***	-5.46464***	-2.94674***
	(0.06071)	(0.11039)	(0.31344)	(0.14102)
Overall Wald chi-squared	58670.41			
R-squared	0.08	0.36	0.01	0.03
Observations	144,126	144,126	144,126	144,126

Second-stage Food Group Share Expenditure Estimation

Table 6.3 presents the average marginal effects for each covariate in equation (1) when all other data are held to at their means. Each of the columns represents one of the food groups simultaneously estimated in the FMNL system, and these six food groups collectively account for an average of about 45 percent of households' total food expenditures. The average marginal effects for the "all other" food group expenditures are not presented. Because some households have no FAH expenditures during the sampling week, 459 of the 4,826 households in FoodAPS are not included in the estimation. An additional 76 households are excluded because of missing data, leaving 4,291 households for the final sample used in the estimation. I next discuss the

average marginal effects on the six food group expenditure shares for each time-use activity and certain household characteristics.

Childcare

The share of time spent in childcare is found to be a significant factor in four of the six food group expenditure shares. Time spent in childcare negatively affects expenditures in healthy food groups, i.e., fresh and frozen fruits and vegetables, and positively affects expenditures in unhealthy food groups, i.e., sweet and salty snacks, sugary beverages, and processed meat. Estimated at -0.103, the average marginal effect is the largest (in absolute value) for the fresh and frozen fruits and vegetables group. This result makes sense if, as we might expect, preparing fresh and frozen fruits and vegetables takes more time and attention than other types of food listed in Table 6.3. The average marginal effect is a percentage point change in the food group expenditure for an instantaneous change in childcare time. Thus, assuming the effect remains constant, an after-school program reducing childcare by 3 hours, i.e., 0.125 share of one day, would be associated with a 1.29 percentage point increase[1] in expenditures on fresh and frozen fruits and vegetables. Considering that the mean share of expenditure in this food group is 12.03 percent, a 1.29 percentage point increase accounts for approximately an 11 percent increase in the level of the expenditure share on fresh and frozen fruits and vegetables.

[1] The marginal effect for a continuous variable measures the instantaneous rate of change. Although the share variable is bounded between 0 and 1, it is continuous over that interval. Therefore, given that the time activities are measured in the share of the day, 3 hours is 0.125 share of the day. The share of the day reduction in childcare is multiplied by the marginal effect giving the increase of 1.29 percentage points. (-0.125 x -0.103 = 1.29). The general method of multiplying the change in time allocation share by the marginal effect to calculate the percentage point change holds for other examples in this paper.

The results for the other food groups show that more time devoted to primary or secondary childcare lead to alternative and unhealthier food expenditures. The average marginal effects for sweet and salty snacks, sugary beverages, and processed meat are 0.047, 0.048, and 0.017, respectively. Foods in these groups take little to no time to prepare and acquire, which make them convenient for households who spend a larger share of their day in childcare. Although the effects are smaller than in the fruit and vegetable food group, the significance shows that time spent in childcare may reallocate food expenditures to unhealthier groups. Thus, the reduction in childcare associated with a hypothetical three-hour after-school program would be associated with an 8 percent reduction in expenditures on snacks, sugary beverages, and processed meats.

Adult Care and Non-Car Travel

The share of time spent in adult care is significant in only two of the six food groups. There are a few potential reasons for this relatively weaker outcome. The first is due to the nature of the activities. Adult care is more sporadic than daily activities such as childcare and FAH activities. Although large amounts of time may be spent in one adult-care event, the intermittency of adult-care events could prevent them from affecting overall daily or weekly food consumption patterns. The low R-squared value for the adult care, 0.01, in the first-stage estimation may also be a reason for the weaker outcome. Since the person participating in adult care and the recipient of the care do not have to reside in the same house, household demographics appear to be less accurate at estimating time spent in this activity.

However, time spent in adult care is significant for fresh and frozen fruits and vegetables, which has a marginal effect of -2.46, and for processed meats, which has a marginal effect of

1.39. The marginal effects follow a similar pattern to the childcare marginal effects, with time spent in a care-giving activity being associated with a decrease in healthy food-group expenditures and an increase in unhealthy food-group expenditures. The magnitudes of these marginal effects are larger than those of childcare. Here the magnitude is likely also tied to the nature of adult care. Since childcare is an everyday activity, households are able to adjust their planning and adapt to the time needed for the activity. Adult care could be less consistent, thereby causing the households to have a more difficult time adapting and possible altering food-purchasing habits more intensely.

The share of time spent in non-car travel is not significant for any of the food groups, and the reason may be similar to the reasons given for the relatively weaker adult-care results. Non-car travel is done out of both necessity and convenience. Households that live close to their work or grocery stores may choose to walk or ride a bike despite having access to a car. Therefore it is difficult to distinguish between households that are choosing non-car transportation because of time restrictions versus households that only have non-car transportation options. In addition, the R-squared value for non-car transportation is low (0.03), which may directly contribute to the lack of significance in the second estimation.

Table 6.3: Marginal Effects at Mean for Second-stage Food Group Expenditure Share Estimation

	Fresh and Frozen F&V	Canned and Juice F&V	Sweet and Salty Snacks	Sugary Beverages	Packaged Meals	Processed Meats
Share of Day in Childcare	-0.103***	0.007	0.047***	0.048***	0.023	0.017**
	(0.0236)	(0.0102)	(0.0152)	(0.0159)	(0.0152)	(0.0081)
Share of Day in Adult Care	-2.457**	0.061	-0.601	-0.942	0.896	1.385***
	(1.0995)	(0.4243)	(0.9155)	(0.8591)	(0.9136)	(0.4364)
Share of Day in Non-Car Travel	0.362	-0.201	0.078	0.076	-0.020	-0.227
	(0.5144)	(0.2247)	(0.5782)	(0.5477)	(0.4494)	(0.2025)
Share of Day in FAH Activities	0.964***	-0.064	-0.259**	-0.399**	-0.747***	-0.019
	(0.1699)	(0.0797)	(0.1313)	(0.1596)	(0.1322)	(0.0738)
Metro	0.015**	0.004	-0.005	0.008	0.001	0.003
	(0.0064)	(0.0055)	(0.0084)	(0.0106)	(0.0073)	(0.0027)
Rural	-0.010**	0.002	0.003	0.003	-0.002	0.003
	(0.0044)	(0.0023)	(0.0032)	(0.0044)	(0.0047)	(0.0020)
Midwest	-0.003	0.003	0.001	-0.002	0.010	0.001
	(0.0059)	(0.0028)	(0.0045)	(0.0061)	(0.0066)	(0.0021)
Northeast	-0.017**	-0.001	-0.002	0.002	0.006	-0.001
	(0.0067)	(0.0037)	(0.0071)	(0.0089)	(0.0082)	(0.0027)
West	-0.014**	-0.002	-0.004	0.002	-0.002	-0.006*
	(0.0071)	(0.0035)	(0.0056)	(0.0083)	(0.0081)	(0.0031)
Bachelors or more	0.019***	0.005**	0.010**	-0.022***	-0.010*	-0.008***
	(0.0057)	(0.0020)	(0.0049)	(0.0050)	(0.0055)	(0.0026)
LN annual income	-0.004**	0.000	0.001	-0.003	0.001	0.001
	(0.0016)	(0.0009)	(0.0016)	(0.0017)	(0.0015)	(0.0007)
HH Rents	-0.005	-0.003	0.000	0.012**	-0.003	-0.003
	(0.0045)	(0.0022)	(0.0043)	(0.0057)	(0.0046)	(0.0024)
Vehicle Access	0.028***	-0.004	0.005	0.010	-0.008	-0.007**
	(0.0079)	(0.0042)	(0.0078)	(0.0076)	(0.0078)	(0.0035)
Currently on SNAP	-0.011**	-0.002	0.005	0.009*	0.008*	0.003
	(0.0052)	(0.0018)	(0.0036)	(0.0051)	(0.0042)	(0.0024)
Heard of “MyPlate”	0.002	-0.003*	0.004	-0.010**	-0.001	0.001
	(0.0050)	(0.0016)	(0.0031)	(0.0040)	(0.0039)	(0.0020)
HH diet quality "good"	0.031***	-0.000	-0.014***	-0.006	-0.012**	-0.002
	(0.0058)	(0.0025)	(0.0043)	(0.0058)	(0.0047)	(0.0020)
HH diet quality "avg."	0.020***	-0.003	-0.008*	-0.009**	-0.003	0.005**
	(0.0049)	(0.0021)	(0.0047)	(0.0044)	(0.0047)	(0.0020)
Meals at Home	0.002***	0.000	-0.001**	-0.002**	0.000	0.000
	(0.0007)	(0.0003)	(0.0007)	(0.0010)	(0.0007)	(0.0003)
Observations	4,291	4,291	4,291	4,291	4,291	4,291

Table 6.3: Marginal Effects at Mean for Second-stage Food Group Expenditure Share Estimation (cont.)

	Fresh and Frozen F&V	Canned and Juice F&V	Sweet and Salty Snacks	Sugary Beverages	Packaged Meals	Processed Meats
HH member uses tobacco	-0.035***	-0.005***	-0.003	0.019***	0.011***	0.003*
	(0.0045)	(0.0017)	(0.0034)	(0.0035)	(0.0035)	(0.0019)
Use of Grocery List	0.001	0.001	-0.000	-0.004***	-0.002	0.000
	(0.0013)	(0.0006)	(0.0011)	(0.0013)	(0.0012)	(0.0004)
HH member > 65	0.007	0.003	-0.005	-0.013*	-0.010**	0.002
	(0.0044)	(0.0019)	(0.0050)	(0.0066)	(0.0047)	(0.0026)
Female Single headed	0.010	0.004	0.006	-0.009	0.010*	0.002
	(0.0059)	(0.0029)	(0.0058)	(0.0058)	(0.0056)	(0.0024)
Below 185% of poverty line	-0.009**	-0.000	0.005	0.002	0.002	0.003
	(0.0040)	(0.0021)	(0.0048)	(0.0040)	(0.0052)	(0.0022)
Fast Food Restaurants	0.014	-0.003	0.010	0.007	0.016	0.003
	(0.0131)	(0.0073)	(0.0094)	(0.0139)	(0.0155)	(0.0049)
Grocery Stores	0.014	-0.009	-0.007	-0.048***	-0.059***	-0.013
	(0.0141)	(0.0083)	(0.0210)	(0.0126)	(0.0165)	(0.0085)
Convenience Stores	-0.074***	-0.007	0.016	0.005	0.038**	-0.006
	(0.0140)	(0.0079)	(0.0125)	(0.0215)	(0.0164)	(0.0055)
Obesity Rate 2010	-0.003***	-0.000	0.000	0.002***	0.001*	0.000*
	(0.0006)	(0.0002)	(0.0004)	(0.0005)	(0.0006)	(0.0002)
Price ratio of Fresh to Canned	0.004	-0.001	-0.004	0.011	0.008	0.003
	(0.0095)	(0.0037)	(0.0075)	(0.0086)	(0.0083)	(0.0032)
Avg. Candy Price	-0.005	0.003	-0.010**	0.000	-0.000	0.007***
	(0.0058)	(0.0022)	(0.0048)	(0.0060)	(0.0053)	(0.0025)
Avg. Beverage Price	-0.001	-0.017*	-0.015	-0.067**	0.048***	0.021
	(0.0184)	(0.0091)	(0.0230)	(0.0244)	(0.0168)	(0.0131)
Avg. Prep. Food Price	0.000	-0.003	-0.009	0.032	-0.003	-0.021***
	(0.0129)	(0.0047)	(0.0112)	(0.0211)	(0.0112)	(0.0068)
Avg. Proc. Meat Price	0.002	0.000	0.005**	-0.001	-0.000	0.000
	(0.0023)	(0.0007)	(0.0019)	(0.0016)	(0.0023)	(0.0006)
Constant	-0.035***	-0.005***	-0.003	0.019***	0.011***	0.003*
	(0.0045)	(0.0017)	(0.0034)	(0.0035)	(0.0035)	(0.0019)
Observations	4,291	4,291	4,291	4,291	4,291	4,291

Food-at-Home Activities

While the focus of this research investigates how non-food related time allocations affect food group purchases, including the amount of time spent in FAH activities allows for a comparison to other literature and can help validate the first-stage estimation process. The estimated signs of the FAH marginal effects are consistent with expectations based on prior literature. Increased

time spent in FAH activities is positively associated with fresh and frozen fruits and vegetables, with a marginal effect of 0.96. Time spent in FAH activities is negatively associated with sweet and salty snacks, sugary beverages, and packaged meals with marginal effects of -0.26, -0.41, and -0.75, respectively. All of these types of food require very little preparation time and some are often bought at quick visits to convenience stores.

The Food Environment and Household Characteristics

Consistent with prior literature, the food environment shows mixed results for different food groups. The number of fast food restaurants is not significant for any of the food groups, while the number of convenience stores and grocery stores are significant for two food groups each. The number of grocery stores is negatively related to expenditure on sugary beverages and packaged meals, with average marginal effects of -0.048 and -0.059, respectively. The number of convenience stores is negatively related to fresh and frozen fruits and vegetable expenditures and positively related to packaged meal purchases. These results mimic previous research that often but not always find a connection between food environment and food purchases.

A number of other household characteristics play a statistically significant role in food-group expenditures. Education plays a mixed role: Households with a Bachelor's degree or higher are associated with higher expenditures in both fruit and vegetable categories and snacks, although the magnitude of the average marginal effect is small. In addition, these households are likely to have lower expenditures on sugary beverages, packaged meals, and processed meats. Vehicle access is significant and positively associated with fruits and vegetable purchases with an average marginal effect of 0.028. This result is consistent with the notion that purchasing fresh fruits and vegetables requires more frequent shopping trips because they have a short shelf

life. Finally, having a tobacco user in the household is associated with unhealthier food purchases. Tobacco use is negatively associated with the two fruits and vegetable categories, with average marginal effects of -0.035 and -0.004, respectively, and positively associated with sugary beverages and packaged meals.

Subsample Analysis

I next split the data into subsamples and re-estimate equation (1) to investigate how the marginal effects differ across household characteristics. The subsample analysis will allow me to investigate how particular household characteristics affect the time allocation-food expenditure relationship. It also provides a robustness check to see how strong or stable the estimated relationships are. For these reasons, I consider subsamples based on (i) three categories of income/food assistance, (ii) household vehicle access, (iii) awareness of the MyPlate standards, and (iv) female single-headed households. Table 6.4 presents average marginal effects for time allocations in committed activities on fresh and frozen fruits and vegetables food group expenditures for each of the subsamples.

The three subsamples based on income/food assistance are non-SNAP households with income below 185 percent of the poverty line, SNAP-ineligible households with income greater than 185% of the poverty line, and SNAP participating households. In general, the results across different subsamples are robust. In other words, the average marginal effects do not vary substantially across groups. There are small differences, however. Higher-income SNAP-ineligible households are the most responsive in their fruit and vegetable purchases to changes in time activities, while SNAP households are the least responsive. These modest differences in average marginal effects highlight the flexibility that higher-income households have compared

to lower income households. Although the time spent in childcare can be reduced, a lower-income household remains constrained for fruit and vegetable purchases in other ways.

Table 6.4 also suggests that splitting the sample by vehicle access leads to only minor differences in the effects that time spent on childcare has on fruit and vegetable expenditures. Households with vehicle access have a slightly more negative effect from childcare time, with an average marginal effect of -0.10, whereas households without vehicle access have an average marginal effect of -0.9. This trend is also present in the other time activities. Fruits and vegetables, which require frequent shopping trips, may be easier to purchase with vehicle access, thus allowing those households to show a more negative effect from a time-activity change. Household subsamples split by whether households have heard of the new MyPlate servings suggestions to proxy education about nutrition also leads to very minor differences. Households that have heard of the MyPlate servings suggestions are more responsive to changes in time activities in relation to fruits and vegetables.

Table 6.4: Average Marginal Effects for Fresh and Frozen Fruits and Vegetables for Selected Sub-Samples

Sub-Sample	Time in Childcare		Time in Adult Care		Time in Non-Car Transportation		Time in FAH Activities	
Non-SNAP Income <185%	-0.10***	(0.02)	-2.36**	(1.08)	0.25	(0.52)	0.94***	(0.17)
Non-SNAP Income >185%	-0.12***	(0.03)	-2.74**	(1.26)	0.29	(0.60)	1.09***	(0.19)
SNAP	-0.08***	(0.02)	-1.85**	(0.85)	0.19	(0.41)	0.76***	(0.13)
No Vehicle Access	-0.09***	(0.02)	-2.05**	(0.93)	0.21	(0.45)	0.82***	(0.15)
Vehicle Access	-0.10***	(0.02)	-2.41**	(1.11)	0.25	(0.53)	0.97***	(0.17)
Has not heard of MyPlate	-0.10***	(0.02)	-2.30**	(1.07)	0.24	(0.51)	0.93***	(0.16)
Has heard of MyPlate	-0.11***	(0.03)	-2.57**	(1.18)	0.27	(0.56)	1.03***	(0.17)
Not female single head	-0.10***	(0.02)	-2.31**	(1.07)	0.24	(0.51)	0.93***	(0.16)
Female single head	-0.11***	(0.03)	-2.58**	(1.18)	0.27	(0.57)	1.05***	(0.18)

Standard errors in parentheses *** p<0.01, ** p<0.05

Although some differing effects of time allocations are exposed by the subsamples, most are quite small, which is likely because many factors affect food-purchasing decisions. Therefore, dividing the sample into coarse binary groups, such as by vehicle access or by single female headed households, does not allow for the detail needed to elicit strong differences. To see if strong differences might exist for particular household types, I examine some data subsamples based on a number of important defining.

Table 6.5 present the average marginal effects for urban and rural households refined further by vehicle access and then by the three income/food assistance groups defined in above. Table 6.5 shows that urban households' fruit and vegetable expenditures respond more to changes in time allocations than rural households' expenditures do. Comparing similar rural and urban households, the average marginal effect is less negative in rural households for all time use activities. Rural households are less likely to have easy access to grocery stores and therefore their fruit and vegetable purchases may be less responsive to time allocation changes. Households with vehicle access also have larger average marginal effects for similar income groups and residence location across all time use categories. This finding is a similar result presented for vehicle access in Table 6.4. While the differences are smaller than comparing urban and rural households, the larger (more negative) marginal effect for vehicle access households is consistent with the flexibility rationale. Having access to a vehicle increases flexibility and ease in grocery shopping, as well as other aspects of a household's daily routine.

A close examination of the new subsample groups shows that results in Table 6.5 are similar to those in Table 6.4. The average marginal effect for time spent in own childcare becomes more negative as income increases, with SNAP households having the least negative average marginal effect. The same is true in the other time activities, where the marginal effect is

very similar for the two non-SNAP low income groups. Overall the least negative average marginal effect for own childcare, at -0.06, is for rural SNAP households. The most negative marginal effect, -0.13, is for high-income urban households with vehicle access. The compound effect of rural vs urban, vehicle access, and income can double a household's fruit and vegetable expenditure responsiveness to a change in own childcare time.

For adult care, similar household groups have the largest and smallest average marginal effects: Fruit and vegetable purchases by rural SNAP households without vehicle access are least responsive to time spent in adult care (i.e., a marginal effect of -1.41), while fruit and vegetable purchases by high-income urban households with vehicle access are the most responsive (i.e., a marginal effect of -3.01).

Table 6.5: Average Marginal Effects for Fresh and Frozen Fruits and Vegetables partitioned by rural, vehicle access, and target group.

		Time in Childcare		Time in Adult Care		Time in Non-Car Transport		Time in FAH Activities	
Urban									
No car	Non-SNAP Income <185%	-0.10***	(0.03)	-2.56**	(1.19)	0.26	(0.57)	1.01***	(0.19)
	Non-SNAP Income >185%	-0.11***	(0.03)	-2.77**	(1.21)	0.28	(0.59)	1.05***	(0.19)
	SNAP	-0.08***	(0.02)	-1.91**	(0.84)	0.19	(0.41)	0.75***	(0.14)
Car	Non-SNAP Income <185%	-0.11***	(0.03)	-2.67**	(1.20)	0.26	(0.57)	1.04***	(0.18)
	Non-SNAP Income >185%	-0.13***	(0.03)	-3.01**	(1.18)	0.27	(0.57)	1.17***	(0.18)
	SNAP	-0.09***	(0.02)	-2.08**	(0.93)	0.20	(0.45)	0.83***	(0.15)
Rural									
No car	Non-SNAP Income <185%	-0.08***	(0.02)	-1.49**	(0.69)	0.16	(0.32)	0.60***	(0.12)
	Non-SNAP Income >185%	-0.09***	(0.02)	-2.13**	(0.98)	0.23	(0.46)	0.83***	(0.17)
	SNAP	-0.06***	(0.01)	-1.41**	(0.65)	0.14	(0.31)	0.58***	(0.11)
Car	Non-SNAP Income <185%	-0.08***	(0.02)	-2.03**	(0.92)	0.21	(0.44)	0.81***	(0.15)
	Non-SNAP Income >185%	-0.10***	(0.02)	-1.90**	(0.88)	0.20	(0.41)	0.96***	(0.14)
	SNAP	-0.07***	(0.02)	-1.54**	(0.71)	0.16	(0.34)	0.64***	(0.12)

Standard errors in parentheses *** p<0.01, ** p<0.05

The differences in how certain types of household are able to respond to a change in the amount of time spent in an activity suggest the importance of investigating the average marginal effects in a more detailed manner. With this complexity in mind, I next construct a number of hypothetical policy scenarios and predict food-group share expenditures for different household types to provide a more straightforward interpretation of potential policy differences. The main hypothetical policy I investigate is a three-hour after school program that was briefly mentioned above. Recall that Table 6.3 shows that an increase in time allocated to childcare leads to a statistical decrease in a household's expenditure share of fresh fruits and vegetables. Thus, or participating households, a three-hour after school program would generally decrease time allocated to childcare and thus increase fresh fruit and vegetable expenditures. To investigate the effects of this policy on specific household types, I examine its effect in conjunction the household's vehicle access, SNAP participation, and knowledge of the MyPlate standards.

A rural household with income less than 185 percent of the poverty threshold, no vehicle access, no awareness of the MyPlate standards, and mean childcare time allocation is predicted to spend about 6.10 percent of its FAH budget on fresh or frozen fruits and vegetables. If that same household was able to reduce childcare time by 3 hours as a result of the proposed policy, the expected fruits and vegetable expenditure would rise to 6.26 percent. Although this a positive shift towards more fruit and vegetable consumption, the magnitude of the change is rather small. However, the change becomes much larger for slightly different household types. If I were to assume the same rural low income household now has access to a car, is aware of the MyPlate standards, and participates in the SNAP program, then that household would be predicted to spend 9.61 percent of its FAH budget on fruits and vegetables. Predicting fruit and vegetable expenditures under the same scenario for an urban household gives similar results. An urban

household with income less than 185 percent of the poverty threshold, no vehicle access, no awareness of the MyPlate standards, and mean childcare allocation is predicted to spend about 6.88 percent on fruits and vegetables. Reducing the childcare time by 3 hours increases the expected fruit and vegetable expenditure to 7.80 percent, while additionally having vehicle access, SNAP participation, and MyPlate knowledge increases the expected fruit and vegetable expenditure to 9.51 percent. Thus addressing multiple aspects of the complex problem at once, rather than treating them as discrete parts, could increase the overall effectiveness of policies aimed at reducing childcare time.

Essay 2 - Results

This next section present the FMNL results for equation (1), where I investigate the link between predicted household time allocations and a household's FAH HEI score. The estimated coefficient results for first-stage estimation are presented in Appendix D. These results are important in that they create the predicted time allocation values; however, they are not the main focus of my investigation. First, I present the results for six specifications of equation (1) in Table 6.6, i.e., specification with primary and secondary childcare combined, primary and secondary childcare separated, only secondary childcare using both a continuous income and poverty threshold measure. I then present the results for the separated childcare specification for selected sub-samples (income, food security level, food environment, and TFP basket price level) in Tables 6.7 and 6.8.

Full Sample

Childcare

Table 6.6 shows that time allocated in a combined childcare category negatively impacts a household's HEI regardless of the form the income measure takes. In both specifications, the

estimated coefficient is approximately negative 7.0, meaning that a 2-hour reduction in daily childcare would be associated with a 0.6 unit improvement in a household's HEI[2]. As Table 2.1 shows, time spent in secondary childcare is significantly higher for low-income households. Therefore, I considered specifications that separated time spent in primary and secondary childcare and primary childcare excluded. When only secondary childcare is included, the negative effect on a household's HEI nearly doubles to an estimated coefficient of negative 12.5. Thus, the same 2-hour reduction in childcare would now be associated with an increase of 1.04 units in the household's HEI score.

When primary and secondary childcare are both included, Table 6.6 shows that increased time allocation in the two separate categories have opposing effects. In the separated childcare specification, time spent in primary childcare is positively associated with a household's HEI at the 95 percent confidence level (45.13 and 45.20), while time spent in secondary childcare is negatively associated with a household's HEI at the 99 percent confidence level (-28.64 and -28.99). Therefore, if the household reduced secondary childcare by 2 hours each day, their HEI would be expected to increase by 2.41.

Using the same FoodAPS data, Scharadin, Todd, and Mancino (2017) find that on average households with annual income greater than 185 percent of the poverty threshold have a higher HEI by 4.1 points compared to households with annual income less than 185 percent of the poverty threshold not participating in SNAP and by 7.9 compared to households participating in SNAP. Therefore, the Table 6.6 results suggest that a 2-hour reduction in secondary childcare would account for about 30 percent of the HEI gap between SNAP and higher income

[2] The time allocation variables are in share of day form. Therefore, to estimate a change in HEI based on a change in the share of the day, you simply multiple the change in share by the estimated coefficient. In this case, 2 hours/24hours = 0.083 x 7 = 0.58

households, and about 51 percent of the HEI gap between higher income households and non-SNAP low income households.

FAH and Adult Care

Table 6.6 shows that time spent in FAH activities leads to a significant positive increase in a household's HEI. The effect is largest when only secondary childcare is considered, about 66, and lowest when primary and secondary childcare are included separately, 42. These results imply that if a household increased time spent in FAH activities by 30 minutes, one would expect their HEI to increase by between 0.8 and 1.4. The positive relationship between FAH activities and household diet quality matches past literature, which has found that increased food preparation, meals eaten together, and grocery shopping all have positive relationships with diet quality (Larson et al. 2006, Liese et al 2013, Berge et al 2016, Larson et al 2007).

While the sign on the estimated coefficient for time spent in adult care is negative in all specifications, it is not significant at the 5 percent level in any of the specifications. There are two likely explanations for this result. First, while adult care does increase the time burden on low-income households, it is comparatively less common and more sporadic. Therefore, the time spent in adult care on any given day may be negligible. In addition, the variation in the time spent in adult care may be low because many households will have no time spent in the activity. Finally, the demographic variables available to construct the IV estimate for adult care are less accurate than for the other time allocation variables. The increase error introduced by a less accurate IV estimate will greatly increase the standard error and decrease the probability of finding statistical significance.

Table 6.6. Equation (1) Estimation Results for Full Sample.

	Continuous Income			Poverty Threshold		
VARIABLES	Combined Childcare	Separated Childcare	Secondary Childcare	Combined Childcare	Separated Childcare	Secondary Childcare
FAH Activities	54.96**	42.39*	66.81**	54.26**	41.63*	66.13**
	(23.28)	(22.92)	(25.04)	(23.61)	(23.37)	(25.36)
Combined Childcare	-6.89**			-7.11**		
	(2.87)			(2.78)		
Primary Childcare		45.13**			45.20**	
		(19.98)			(20.11)	
Secondary Childcare		-28.64***	-12.55***		-28.99***	-12.86***
		(8.09)	(3.99)		(8.20)	(3.87)
Adult care	-87.34	-59.94	-99.89	-78.75	-52.06	-91.79
	(75.18)	(76.59)	(74.41)	(73.71)	(75.45)	(72.97)
Residency is rural	-1.41*	-1.37*	-1.41*	-1.41*	-1.37*	-1.42*
	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)
Some post-HS education	-3.31***	-3.13***	-3.23***	-3.29***	-3.12***	-3.21***
	(1.09)	(1.08)	(1.09)	(1.09)	(1.07)	(1.08)
Only HS education	-3.99***	-3.80***	-3.95***	-3.95***	-3.77***	-3.92***
	(0.94)	(0.92)	(0.93)	(0.97)	(0.94)	(0.96)
HH member > 65	0.49	0.46	0.34	0.45	0.42	0.29
	(0.88)	(0.89)	(0.89)	(0.88)	(0.88)	(0.88)
SNAP household	3.89**	4.03**	4.00**	4.31**	4.47**	4.42**
	(1.74)	(1.77)	(1.76)	(2.02)	(2.05)	(2.04)
Ln of annual income	-0.23	-0.22	-0.22			
	(0.27)	(0.27)	(0.27)			
HH income <185% of PT				0.32	0.36	0.33
				(1.03)	(1.04)	(1.03)
HH Owns Residency	-2.18***	-2.14***	-2.16***	-2.11***	-2.08**	-2.09**
	(0.76)	(0.77)	(0.76)	(0.75)	(0.76)	(0.75)
HH has access to a vehicle	7.59***	7.45***	7.72***	7.49***	7.36***	7.63***
	(1.54)	(1.49)	(1.56)	(1.54)	(1.49)	(1.56)
HH stated "good" diet	2.35***	2.32***	2.34***	2.34***	2.32***	2.33***
	(0.68)	(0.69)	(0.69)	(0.69)	(0.69)	(0.69)
HH member uses tobacco	-5.79***	-5.74***	-5.75***	-5.81***	-5.76***	-5.78***
	(0.92)	(0.91)	(0.92)	(0.93)	(0.93)	(0.94)
Ratio of Grocery stores to Convenience stores	2.02**	2.06**	2.01**	2.02**	2.05**	2.01**
	(0.96)	(0.93)	(0.95)	(0.96)	(0.93)	(0.95)
County Obesity Rate	-0.32**	-0.32**	-0.32**	-0.32**	-0.31**	-0.31**
	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)
HH aware of MyPlate standards	1.26	1.28	1.26	1.25	1.27	1.24
	(0.88)	(0.88)	(0.88)	(0.88)	(0.88)	(0.88)
Observations	4,317	4,317	4,317	4,317	4,317	4,317
R-squared	0.148	0.150	0.149	0.148	0.150	0.149

Table 6.6. Equation (1) Estimation Results for Full Sample.

	Continuous Income			Poverty Threshold		
VARIABLES	Combined Childcare	Separated Childcare	Secondary Childcare	Combined Childcare	Separated Childcare	Secondary Childcare
Car/SNAP interaction term	-6.34***	-6.39***	-6.38***	-6.46***	-6.52***	-6.50***
	(2.09)	(2.10)	(2.11)	(2.14)	(2.14)	(2.15)
Midwest	1.52*	1.52*	1.50*	1.54*	1.54*	1.52*
	(0.88)	(0.89)	(0.88)	(0.89)	(0.89)	(0.88)
Northeast	-0.61	-0.64	-0.68	-0.61	-0.63	-0.68
	(1.70)	(1.70)	(1.70)	(1.71)	(1.71)	(1.71)
West	1.39	1.42	1.33	1.41	1.44	1.35
	(1.21)	(1.22)	(1.21)	(1.22)	(1.22)	(1.22)
Black	-2.76*	-2.52*	-2.61*	-2.75*	-2.52*	-2.60*
	(1.44)	(1.46)	(1.45)	(1.45)	(1.47)	(1.47)
Hispanic	-0.28	0.20	-0.23	-0.26	0.22	-0.20
	(1.04)	(1.08)	(1.04)	(1.02)	(1.06)	(1.03)
TFP backet price	-0.01	-0.01	-0.01	-0.02	-0.01	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Constant	61.29***	61.13***	60.35***	59.35***	59.24***	58.47***
	(7.64)	(7.66)	(7.73)	(6.33)	(6.37)	(6.43)
Observations	4,317	4,317	4,317	4,317	4,317	4,317
R-squared	0.148	0.150	0.149	0.148	0.150	0.149

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Confounding Effects: Income, Education, and the Food Environment

Income, education, and the food environment have been the focus of substantial household diet quality and health research (Hizza 2013, Kuczmarski 2016, Wang et al. 2014, Cummins 2014). While income was originally associated with better household diet quality and health, recent studies have shown that income may not play a significant role in diet quality after controlling for other important household characteristics (Hizza 2013, Aggarwal 2016). I do not find income to be significant when using a continuous measure, the natural log of annual household income, nor when using a poverty threshold measure of 185 percent of the poverty line. One possible implication of these results that income appears to be affecting diet quality via a household's time constraint rather than via its budget constraint. In other words, this result argues that for the importance of investigating the diet-quality gap with time allocations. Unlike income, education

is significant and positively related to household HEI. Compared to households that earned at least a B.A. degree, households with some post high school education are expected to have a lower HEI by three points and households with only a high school education by four points.

Two food environment variables included in the model, the ratio of convenience stores to grocery stores and the adult obesity rate at the county level. The ratio of grocery stores to convenience stores has a positive and significant effect on HEI. Therefore, households that have greater access to "healthy" food stores (grocery stores) relative to "unhealthy" food stores (convenience stores) are more likely to have a higher HEI. Literature is beginning to show that it is the ratio of healthy to unhealthy stores that matters rather than simple store-type counts (CDC 2011, Chen, Jaenicke, and Volpe 2014). In addition, the adult obesity rate has a negative and significant effect on HEI, suggesting individuals may be using social cues to make food decisions. Specifically, if obesity is more prevalent in a community, individuals may be more likely to see unhealthy food choices as normal, decreasing household HEI. This result matches past literature that finds social influence by communities and peers on food choices (Patrick and Nicklas 2013). With an estimated coefficient of -0.3, an increase in the county adult obesity rate of 5% would decrease a household's HEI by 1.5.

Sub Sample Analysis

To investigate how these confounding effects interact with our time allocations of interest, I conduct sub-sample analysis. My preferred specification includes both primary and secondary childcare. I first consider differences by income and food security, and second I consider differences based on the food environment by splitting the sample according to TFP basket price and the ratio of grocery stores to convenience stores.

Income, Food Assistance, and Food Security

Table 6.7 presents the results for income-, food assistance-, and food security-based sub-samples. Most importantly, the time allocations of interest have the same effects as the full sample; however, the magnitude of the effect varies by group. Time spent in secondary childcare impacts the HEI of households with income less than 185% of the poverty threshold that are not participating in SNAP more than both households with income above 185% of the poverty threshold and SNAP participants. An additional hour of secondary childcare for a low-income household is expected to decrease their household HEI score by about 1.6, while a higher income household's HEI score would only be expected to decrease by 1.26. SNAP participants are the least impacted by secondary childcare, with an expected decrease in HEI of 0.9 per hour increase. Time spent in primary childcare has positive and significant coefficients for all three groups that closely follow the full sample estimates. Time spent in FAH activities is significant only for households with income over 185% of the poverty threshold. The additional constraints faced by low-income households, both with and without food assistance, may negate the positive effects of spending more time in FAH activities. For example, if a household can only afford less nutritious calorie dense food, spending more time preparing it will not increase diet quality.

I also split the sample by household food security level measured by the USDA's 30-day Food Security Scale (Bickel et al 2000). Households with a raw score of two or less are considered to have high food security and households with a score of three or more are considered to have moderate or low food security. Table 6.7 shows that households with high food security benefit from increased time spent in FAH activities, while households without high food security do not have a statistically significant effect. The negative effect of secondary childcare is similar for both sets of households; however, lower food security households have a much higher increase in household HEI for additional time in primary childcare.

Table 6.7. Income and Food Security Sub-sample Results for the Separated Childcare Specification

VARIABLES	HH <185% of PT	HH >185% PT	SNAP HH	High food security	All others
FAH Activities	77.42	37.90*	66.51	58.95**	-41.27
	(57.89)	(19.59)	(48.27)	(27.14)	(67.06)
Primary Childcare	50.12**	44.54**	54.33***	41.78*	75.40***
	(19.71)	(19.11)	(14.50)	(21.42)	(27.05)
Secondary Childcare	-37.84***	-30.00***	-21.57***	-30.74***	-26.34*
	(11.13)	(8.16)	(6.28)	(8.38)	(13.68)
Adult care	16.64	-111.29	149.72*	-97.36	100.84
	(152.43)	(93.76)	(76.87)	(94.70)	(190.19)
Residency is rural	0.78	-1.84**	-0.59	-1.90**	1.11
	(1.72)	(0.74)	(1.39)	(0.84)	(1.80)
Some post-HA education	-0.49	-3.11***	-4.32**	-3.27***	-0.97
	(1.64)	(0.95)	(1.85)	(1.12)	(1.77)
Only HS education	-0.95	-4.18***	-4.27**	-4.13***	-0.83
	(1.51)	(0.98)	(2.01)	(0.99)	(2.15)
HH member > 65	-0.53	0.65	-0.54	0.32	-0.17
	(1.71)	(0.86)	(1.37)	(0.95)	(1.68)
SNAP participating household				7.11***	-1.80
				(2.37)	(2.63)
Ln of annual income	-0.22	-0.19	-0.26	-0.61	0.24
	(0.39)	(0.74)	(0.27)	(0.37)	(0.24)
HH Owns Residency	-0.87	-2.20***	-3.37***	-2.45**	-0.26
	(1.18)	(0.74)	(0.97)	(0.90)	(1.64)
HH has access to a car	7.94***	6.89***	0.27	9.13***	0.99
	(1.31)	(1.97)	(1.09)	(1.87)	(1.98)
HH stated "good" diet	4.18**	2.12***	0.36	2.33***	1.30
	(1.58)	(0.66)	(1.07)	(0.80)	(1.74)
HH member uses tobacco	-6.45***	-6.02***	-4.06***	-5.79***	-4.81***
	(1.04)	(0.98)	(0.81)	(1.14)	(1.32)
Ratio of Grocery stores to Convenience stores	2.98***	1.64	2.24	1.86*	4.03**
	(0.84)	(1.06)	(3.05)	(1.08)	(1.59)
County Obesity Rate	-0.32**	-0.37***	-0.17*	-0.25*	-0.67***
	(0.15)	(0.12)	(0.10)	(0.14)	(0.18)
HH aware of MyPlate standards	2.88*	0.90	3.43**	1.07	2.72
	(1.59)	(0.68)	(1.27)	(0.95)	(1.72)
Vehicle/SNAP interaction term				-9.74***	1.22
				(2.47)	(3.03)
Midwest	2.05	2.10**	-1.16	1.37	1.65
	(1.63)	(0.98)	(0.79)	(1.12)	(1.53)
Northeast	-2.19	-0.02	-0.97	-0.28	-4.69**
	(2.38)	(1.19)	(1.11)	(2.01)	(1.92)
Observations	1,065	1,850	1,402	3,155	1,162
R-squared	0.157	0.132	0.106	0.139	0.156

Table 6.7. Income and Food Security Sub-sample Results for the Separated Childcare Specification

VARIABLES	HH <185% of PT	HH >185% PT	SNAP HH	High food security	All others
West	0.67	1.25	2.57	1.24	1.53
	(1.95)	(1.25)	(1.60)	(1.47)	(2.18)
Black	1.00	-4.48***	-0.68	-2.88	-1.22
	(2.00)	(1.21)	(1.16)	(1.73)	(2.10)
Hispanic	1.88	0.53	-0.69	0.40	0.65
	(1.52)	(1.13)	(1.48)	(1.10)	(1.94)
TFP backet price	-0.04*	-0.01	-0.01	-0.01	-0.01
	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)
Constant	59.19***	62.72***	56.63***	61.03***	67.83***
	(8.75)	(9.02)	(5.81)	(8.81)	(10.17)
Observations	1,065	1,850	1,402	3,155	1,162
R-squared	0.157	0.132	0.106	0.139	0.156

Standard errors in parentheses,*** p<0.01, ** p<0.05, * p<0.1

The effect of the food environment varies by level of food security. A household's HEI score is expected to increase as the number of grocery store increases relative to the number of convenience stores for both low and high food security households. However, the effect for households with low food security is nearly double that of high food security households (4.03 vs. 1.86). The effect of the county obesity for low food security households is almost three times that of high food security households. A 5% increase in the obesity rate would decrease a household HEI by 3.35 for households with low food security, while a 5% increase for high food security households would only decrease household HEI by 1.25.

Food Environment: Store Density Ratio and TFP Basket Price

In order to consider the interaction between the time allocations of interest and the food environment, I again split the sample, this time according to grocery store to convenience store ratio and the price of a representative TFP basket. Households with a ratio below the mean, approximately 0.45 grocery stores for every convenience store, are considered to be in a poor food environment, while households with a ratio above the mean are considered to be in a good food environment. A household's HEI is more sensitive to changes in time spent in FAH and

both types of childcare for households in a good food environment. Time spent in FAH activities and primary childcare are positive and significant for households in a good food environment. However, neither are not significant for households in a poor food environment. In addition, time spent in secondary childcare has a larger effect for households in a good food environment (-32.7 vs. -23.9). Households in a poor food environment appear to be much more constrained and therefore respond less to changes in FAH and childcare.

There are also key differences in non-time related household characteristics. Having more education is more impactful in a poor food environment. Households in a poor food environment with at least a bachelor's degree are expected to have a higher HEI by 4 points, while the effect of a bachelor's degree in a good food environment is not statistically significant. Having access to a vehicle is also more impactful in a poor food environment. A household in a good food environment with access to a vehicle is expected to have a 6-point higher HEI compared to a similar household with access to a car. The difference increases to about 9.5 points for a household in a poor food environment. The mobility that vehicle access offers appears to be more important in a poor food environment, perhaps because there are fewer healthy food options available.

The price of a TFP basket is a rough measure of the price environment that households face. A household TFP basket price index above the mean, approximately 277, is considered to be high price, while a TFP basket price below the mean is considered to be low prices. Although all the coefficients for all the time activities have similar signs as in the full sample none are statistically significant for households that face high prices. In contrast, for households that face low prices, the coefficients are significant for time spent in FAH activities and both childcare activities. The magnitude of the coefficient for time spent in secondary childcare is larger than

any other comparison group at about -44. Therefore, while a reduction in secondary childcare is expected to have little to no effect on a household's HEI when facing high prices, a similar household would expect an increase in HEI of 1.8 points for each hour of reduced childcare. This result illustrates the multiple factors households face when trying to achieve a healthy diet.

Table 6.8. Food Environment and TFP basket price sub sample results for separated childcare specification

VARIABLES	Good Food Environment	Poor Food Environment	High TFP basket price	Low TFP basket price
FAH Activities	84.15**	5.89	42.65	47.31*
	(37.11)	(26.74)	(36.87)	-24.91
Primary Childcare	44.12*	43.33	9.83	72.92**
	(25.34)	(29.00)	(27.55)	(26.52)
Secondary Childcare	-32.66***	-23.90**	-10.66	-43.91***
	(10.29)	(11.57)	(12.20)	(9.97)
Adult care	-27.02	-64.31	-49.24	-65.23
	(93.48)	(108.17)	(65.36)	(120.83)
Residency is rural	-0.83	-1.39	0.83	-2.63***
	(1.59)	(1.26)	(1.54)	(0.84)
Some post-HA education	-2.34	-4.12***	-3.51**	-3.31**
	(1.58)	(1.38)	(1.60)	(1.53)
Only HS education	-3.70*	-4.14**	-4.02***	-4.11***
	(1.97)	(1.50)	(1.34)	(1.44)
HH member > 65	0.75	0.11	0.12	0.76
	(1.46)	(1.34)	(1.56)	(1.13)
SNAP participating household	5.47***	1.48	3.13	4.19*
	(1.94)	(3.66)	(2.81)	(2.35)
Ln of annual income	-0.15	-0.08	0.03	-0.38
	(0.39)	(0.26)	(0.48)	(0.28)
HH Owns Residency	-3.06***	-1.00	-3.58***	-0.78
	(0.86)	(1.20)	(0.97)	(1.20)
HH has access to a car	5.95***	9.43***	6.58***	7.70***
	(1.45)	(2.59)	(1.80)	(2.29)
HH stated "good" diet	2.64***	2.38**	2.28**	1.77
	(0.88)	(1.05)	(0.90)	(1.05)
HH member uses tobacco	-7.07***	-4.63***	-6.10***	-5.36***
	(1.12)	(1.15)	(1.32)	(1.13)
Ratio of Grocery stores to Convenience stores	2.73***	3.20	3.04**	-0.12
	(0.90)	(7.23)	(1.10)	(2.24)
County Obesity Rate	-0.12	-0.59***	-0.40*	-0.24
	(0.15)	(0.19)	(0.21)	(0.15)
HH aware of MyPlate standards	1.97	-0.04	1.07	1.27
	(1.30)	(1.19)	(1.35)	(1.13)
Observations	2,237	2,077	2,185	2,129
R-squared	0.170	0.151	0.147	0.162

Table 6.8. Food Environment and TFP basket price sub sample results for separated childcare specification

VARIABLES	Good Food Environment	Poor Food Environment		High TFP basket price	Low TFP basket price
Car/SNAP interaction term	-7.07***	-4.18		-4.30	-7.23***
	(1.89)	(4.02)		(3.73)	(2.41)
Midwest	2.49	0.83		0.91	1.85
	(2.71)	(1.28)		(1.78)	(1.28)
Northeast	-1.87	2.81		-4.33	1.95
	(3.58)	(1.69)		(2.93)	(1.34)
West	1.39	-2.01		0.12	1.22
	(3.53)	(1.57)		(2.11)	(3.34)
Black	-0.31	-4.91*		-0.89	-3.26*
	(1.51)	(2.44)		(2.37)	(1.63)
Hispanic	1.17	-0.92		0.16	0.32
	(1.20)	(2.06)		(1.17)	(2.54)
TFP basket price	0.01	-0.03*		-0.00	-0.04**
	(0.02)	(0.02)		(0.04)	(0.01)
Constant	45.87***	73.59***		58.56***	66.02***
	(10.89)	(8.97)		(16.59)	(8.21)
Observations	2,237	2,077		2,185	2,129
R-squared	0.170	0.151		0.147	0.162

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

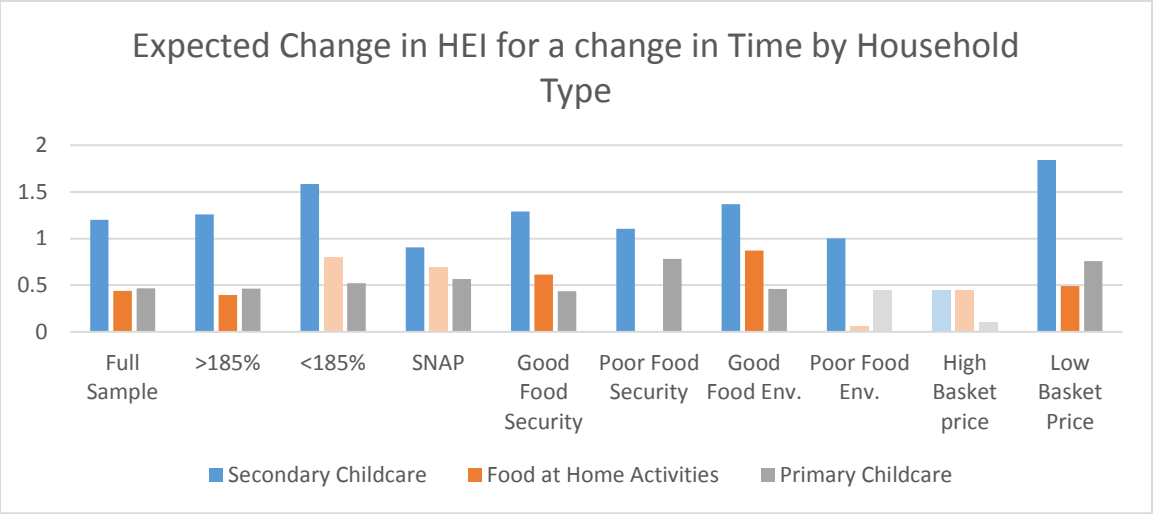
Discussion

Estimating multiple specifications with the full sample shows that it is important to deconstruct total childcare into primary childcare and secondary childcare. When estimated as total childcare or with primary childcare omitted, the negative effect on HEI scores by the time spent on secondary childcare is dampened. Data from the ATUS suggest that households with children, regardless of income level, spend approximately one hour in primary childcare. However, secondary childcare decreases significantly as income increases. Thus, a better understanding of the interaction of income and time allocations might require splitting child care into both primary and secondary child care.

Figure 1 shows the expected positive changes in household HEI for a one hour per day reduction in secondary childcare, 15 minute per day increase in primary childcare, and 15 minute per day increase in FAH activities. While the significance and magnitude of FAH activities and

primary childcare vary in the sub-sample analysis, time spent in secondary childcare remains negative and significant in every comparison.

Figure 1. The expected change in household HEI for a 1 hour per day reduction in secondary childcare (blue), 15 minute per day increase in primary childcare (grey), and a 15 minute per day increase in FAH activities (orange). Bolded columns are statistically significant.



A policy based on a free after school program would be one way to allow households participating in food assistance programs to reduce the time spent in secondary childcare. As mentioned above, a two-hour after school program that reduces secondary childcare would increase household HEI by 2.4 points, on average. However, the effect could be larger, up to 3.6 points, if the household is in a good food environment or faces low food prices. Given that the difference in the mean HEI between households participating in SNAP and households with income above 185 percent of the poverty threshold is 7.9, the 2.4 increase would account for 30 percent of the difference. If that household faces low prices, the two hour reduction could account for 45 percent of the difference. Table 3.1 showed that time spent in primary childcare remains consistent across income levels, while secondary childcare increased. Therefore, one might expect that the after school program would reduce secondary childcare and not both.

There are also multiple indirect benefits to a household's diet quality from a reduction in secondary childcare. First, if any of time is substituted to FAH activities or primary childcare,

then we can expect an additional increase in household HEI. For the average household, just a 15-minute increase in FAH activities per day is expected to increase a household's HEI by about 0.5, with the expected increase almost doubling if the house is in a good food environment. In addition, child development literature shows there are life-long benefits to participating in after school programs, including a higher level of educational attainment (Durlak and Weissberg 2010, Newell et al. 2015, Bouffard et al. 2016), which positively contributes a household's HEI. Therefore, the after school program could help break the poverty and diet quality gap cycle for the next generation.

Essay 3 - Results

Essay 3 investigates the link between the predicted times allocated to childcare and other pre-committed activities and the likelihood of FAFH fast-food events. There are three subsections of results presented: First, I present the results for the estimated probability of a fast-food event using a logit model and the estimated number of fast-food events during a week using negative binomial and zero-inflated negative binomial (ZINB) models, both for the ATUS and FoodAPS samples. The logit results are presented as odds ratios, while the negative binomial results and ZINB results are presented as incidence rate ratios. These results are presented for specifications including and excluding FAH activities. This last comparison allows us to test if any endogeneity concerns between time spent in FAH activities and the number of fast food events are valid. Second, I present the results of a subsample analysis by income and grocery store density in the FoodAPS sample consider how these aspects affect the time-allocation coefficients. Finally, I present the fractional logit and zero-inflated beta regression results to investigate how the time allocations affect the healthfulness of FAFH.

Logit Estimation

Table 6.9 presents the results from logit, negative binomial, and ZINB estimated for both the FoodAPS and ATUS samples. First considering the logit estimation, more time spent in secondary childcare, adult care, and work each increases the probability of a fast-food event during a given week in both samples. Adult care has the largest magnitude (1.06 and 4.82) and secondary childcare has the next highest (1.04 and 1.13) in both samples. Low-income households spend about an additional hour in secondary childcare compared to higher income households. Therefore, all else equal, low-income households are 4 to 13 percent more likely to purchase fast food in a given week. Finally, time spent in FAH activities decreases the probability of a fast-food purchase. These results match past literature and also make intuitive sense.

There are also non-time related household characteristics that affect the probability of a fast food event. A household that is 185% of the poverty line (where estimated coefficients are 1.54 and 1.27), has access to a vehicle (1.50 and 1.29), and having a bachelor's degree or higher (1.96 and 1.11) all increase the probability of having a fast-food event. In contrast, households that are older or are in a rural area are less likely to have a fast-food event. Although only available in the ATUS sample, a household member having multiple jobs leads to a 44 percent higher probability of having a fast-food event. Since work time is also considered in the model, this increased probability is in addition to just more time spent working. Multiple jobs likely means traveling to more than one employment location and not returning home between shifts. Both of these will increase the likelihood of choosing fast food for a meal.

Table 6.9: Multiple Specification Results for both the ATUS and FoodAPS

	ATUS			FoodAPS		
	Logit Odds Ratio	Negative Binomial IRR's	ZINB IRR's	Logit Odds Ratio	Negative Binomial IRR's	ZINB IRR's
Hours in Primary Childcare	1.03	0.99	0.99	1.00	1.05	1.04
	(0.016)	(0.009)	(0.009)	(0.112)	(0.060)	(0.060)
Hours in Secondary Childcare	1.04***	1.02***	1.02***	1.13***	1.08***	1.08***
	(0.008)	(0.005)	(0.005)	(0.047)	(0.023)	(0.022)
Hours in Adult care	1.06***	1.04***	1.04***	4.82**	3.99***	2.89***
	(0.019)	(0.013)	(0.015)	(3.286)	(1.564)	(0.964)
Hours in FAH Activities	0.90***	0.87***	0.86***	0.80	0.74***	0.70***
	(0.015)	(0.010)	(0.011)	(0.154)	(0.078)	(0.077)
Hours working	1.03***	1.03***	1.03***	1.08***	1.05***	1.03*
	(0.006)	(0.003)	(0.004)	(0.025)	(0.013)	(0.014)
rural	1.00	1.00	1.02	0.84**	0.90**	0.90**
	(0.053)	(0.043)	(0.051)	(0.068)	(0.040)	(0.042)
Avg. HH age	0.99***	0.99***	1.00***	0.98***	0.99***	0.99***
	(0.001)	(0.001)	(0.001)	(0.003)	(0.002)	(0.002)
SNAP participant	0.77***	0.82***	0.83***	0.90	0.93	0.92
	(0.054)	(0.039)	(0.045)	(0.081)	(0.049)	(0.052)
HH income >185% of Pt threshold	1.54***	1.34***	1.29***	1.27***	1.19***	1.16***
	(0.073)	(0.043)	(0.044)	(0.106)	(0.057)	(0.056)
Has vehicle access	1.50***	1.26***	1.23***	1.29***	1.29***	1.26***
	(0.069)	(0.037)	(0.041)	(0.119)	(0.083)	(0.073)
Bachelor's degree	1.96***	1.61***	1.52***	1.11	1.05	1.06
	(0.185)	(0.122)	(0.123)	(0.079)	(0.043)	(0.044)
Some post HS education	1.81***	1.55***	1.49***	1.09	1.10*	1.11*
	(0.161)	(0.118)	(0.116)	(0.098)	(0.053)	(0.061)
black	1.05	0.99	0.99	1.04	1.18***	1.16**
	(0.061)	(0.031)	(0.037)	(0.099)	(0.071)	(0.070)
hispanic	0.87**	0.88***	0.87***	1.23**	1.21***	1.20***
	(0.053)	(0.035)	(0.034)	(0.111)	(0.064)	(0.058)
County Obesity Rate	1.00	1.00	1.00	0.99	1.00	1.00
	(0.009)	(0.006)	(0.006)	(0.010)	(0.005)	(0.005)
Does not own home	0.97	0.99	1.02	0.78***	0.86***	0.87***
	(0.048)	(0.031)	(0.032)	(0.059)	(0.039)	(0.040)
Observations	21,478	21,478	21,478	4,811	4,811	4,811

	ATUS			FoodAPS		
	Logit Odds Ratio	Negative Binomial IRR's	ZINB IRR's	Logit Odds Ratio	Negative Binomial IRR's	ZINB IRR's
Grocery stores per 1000 people	0.55	0.70	0.71	0.52**	0.69**	0.70*
	(0.219)	(0.152)	(0.169)	(0.170)	(0.124)	(0.147)
HH food secure	0.88	0.88**	0.87**	1.05	0.92	0.93*
	(0.075)	(0.051)	(0.050)	(0.075)	(0.046)	(0.037)
Avg. fast meal price in USDA division	0.85	0.90	0.91	1.22	1.25*	1.24
	(0.091)	(0.071)	(0.074)	(0.310)	(0.166)	(0.166)
NE	0.82***	0.83***	0.84***	0.91	0.98	0.97
	(0.060)	(0.042)	(0.043)	(0.098)	(0.062)	(0.067)
MW	0.99	0.87**	0.87**	1.13	1.13	1.12
	(0.084)	(0.055)	(0.053)	(0.200)	(0.101)	(0.103)
west	0.90	0.85**	0.85**	0.97	1.14	1.13
	(0.104)	(0.068)	(0.069)	(0.215)	(0.126)	(0.123)
spring	0.99	1.03	1.03	1.05	0.98	0.97
	(0.053)	(0.035)	(0.035)	(0.288)	(0.149)	(0.143)
summer	1.02	1.06**	1.07*	1.13	1.03	1.02
	(0.055)	(0.032)	(0.036)	(0.308)	(0.156)	(0.139)
fall	0.91*	1.01	1.01	1.11	0.96	0.94
	(0.049)	(0.036)	(0.040)	(0.288)	(0.139)	(0.131)
ATUS diary is a week day	0.84***	0.84***	0.85***			
	(0.033)	(0.021)	(0.021)			
ATUS diary is a holiday	0.83	0.96	0.97			
	(0.125)	(0.096)	(0.103)			
Respondent works multiple jobs	1.44***	1.23***	1.23***			
	(0.129)	(0.070)	(0.071)			
Constant	2.47	2.67**	2.53**	2.28	0.90***	0.73***
	(1.454)	(1.142)	-1.078	(2.868)	(0.035)	(0.035)
Observations	21,478	21,478	21,478	4,811	4,811	4,811

Negative Binomial and Zero-Inflated Negative Binomial

In general I find consistent and similar results with a model that accounts for excess zeros. Hours spent in secondary childcare, adult care, and working increase the number of fast-food events in

a week, FAH activities decreases the number of fast-food events, and primary childcare has no effect. Table 6.9 presents the incidence rate ratios for both the ATUS and FoodAPS samples; however, the discussion will focus on the FoodAPS sample. Adult care has the largest effect on the number of fast-food events with an additional 15 minutes per day increasing the number fast-food events by about 75%. Given that the average household had about two fast food events per week, the additional 15 minutes of adult care is expected to increase monthly fast-food events from eight to 14. Secondary childcare has the second largest effect, with an additional hour increasing the number of events by 8 percent. This means that an additional 2 hours of secondary childcare per day is likely to lead to two additional fast-food events per month. Finally, increased time spent in FAH activities greatly reduces the number of fast food events. An additional hour in FAH activities will reduce monthly fast food events by about 2.5 events.

Household and food-environment characteristics also play an important role in determining the number of fast-food events. First, considering income and food assistance, a household with income above 185 percent of the federal poverty line is likely to have 20 to 30 percent more fast-food events in a week, while in contrast a household that is currently receiving food stamps is less likely to have a fast-food event. Access to a vehicle has a similar effect. Households that have access to a vehicle are expected to have about 25 percent more fast-food events compared to households that do not. Finally, increasing the density of grocery stores by 1 store per 1,000 people decreases the number of fast-food events by about 30 percent.

Time Spent in FAH Activities Concerns

As describe earlier, the amount of time spent in FAH activities is both highly related and potentially affected by similar shocks that may not have been able to be controlled for in the model. For example, a household may strongly dislike cooking for some reason not controlled in

the model. This would cause a term in the error to be correlated with FAH activities. In order to investigate the endogeneity concerns over the inclusion of time spent in FAH activities, similar specifications are estimated excluding the time spent in FAH activities. The results of the FAH-excluded specifications are presented in Table 6.10.

The results for all three models with FAH activities excluded are similar to the results with FAH included. Table 6.10 shows that time spent in adult care, secondary childcare, and at paid work are significant and positively associated with both the probability and frequency of fast food events, which are all consistent with the results presented in Table 6.9 where time spent in FAH is included. Time spent in primary childcare is significant the ATUS frequency specifications, with time spent in primary childcare being negatively associated for fast-food events. In addition to the signs and significance being similar, the magnitude of the odds ratios and incidence rate ratios are similar. Adult care has the largest association with the frequency of fast food events, with secondary childcare having the second largest.

Given that the results for both the variables of interest and other variables included in bother specifications are similar, it appears that concerns about the endogeneity of the FAH time variable have not materialized. This is likely for two reasons: First, the data I use is very detailed and therefore I am able to control for many aspects that otherwise may be in the error terms. Second, many of the concerns that would cause endogeneity would be on the individual level, while this analysis is on the household level. Therefore, given that endogeneity does not seem to be present, the analysis continues with the model including time spent in FAH activities.

Table 6.10 Multiple Specification Results for both the ATUS and FoodAPS (FAH excluded)

	ATUS			FoodAPS		
	Logit Odds Ratio	Negative Binomial IRR's	ZINB IRR's	Logit Odds Ratio	Negative Binomial IRR's	ZINB IRR's
Hours in Primary Childcare	1.01	0.97***	0.97***	0.96	1.00	0.98
	(0.015)	(0.009)	(0.009)	(0.106)	(0.055)	(0.054)
Hours in Secondary Childcare	1.03***	1.02***	1.01***	1.12***	1.07***	1.06***
	(0.008)	(0.005)	(0.005)	(0.045)	(0.021)	(0.021)
Hours in Eldercare	1.06***	1.05***	1.04***	3.44*	2.52***	1.72*
	(0.019)	(0.014)	(0.016)	(2.245)	(0.896)	(0.562)
Hours working	1.03***	1.04***	1.03***	1.09***	1.06***	1.04***
	(0.006)	(0.004)	(0.004)	(0.022)	(0.012)	(0.012)
rural	1.00	1.00	1.01	0.84**	0.89***	0.89**
	(0.053)	(0.042)	(0.049)	(0.067)	(0.039)	(0.043)
Avg. HH age	0.99***	0.99***	0.99***	0.98***	0.99***	0.99***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
SNAP participant	0.76***	0.81***	0.81***	0.91	0.95	0.94
	(0.053)	(0.039)	(0.044)	(0.081)	(0.049)	(0.051)
HH income >185% of Pt threshold	1.56***	1.36***	1.31***	1.27***	1.19***	1.16***
	(0.074)	(0.043)	(0.045)	(0.105)	(0.057)	(0.055)
Has car access	1.52***	1.28***	1.25***	1.29***	1.29***	1.26***
	(0.070)	(0.038)	(0.042)	(0.119)	(0.083)	(0.073)
Bachelor's degree	1.94***	1.61***	1.52***	1.12	1.06	1.07*
	(0.183)	(0.123)	(0.126)	(0.080)	(0.044)	(0.044)
Some post HS education	1.82***	1.56***	1.50***	1.07	1.07	1.08
	(0.161)	(0.120)	(0.120)	(0.096)	(0.051)	(0.057)
black	1.08	1.03	1.02	1.07	1.23***	1.22***
	(0.063)	(0.033)	(0.039)	(0.095)	(0.072)	(0.071)
hispanic	0.86**	0.86***	0.86***	1.19*	1.17***	1.15***
	(0.052)	(0.035)	(0.034)	(0.109)	(0.060)	(0.055)
Observations	21,478	21,838	21,465	4,813	4,813	4,810

	ATUS			FoodAPS		
	Logit Odds Ratio	Negative Binomial IRR's	ZINB IRR's	Logit Odds Ratio	Negative Binomial IRR's	ZINB IRR's
County Obesity Rate	1.00	1.00	1.00	0.99	1.00	1.00
	(0.009)	(0.006)	(0.006)	(0.009)	(0.005)	(0.005)
Does not own home	0.98	1.00	1.02	0.77***	0.85***	0.86***
	(0.048)	(0.032)	(0.033)	(0.058)	(0.039)	(0.040)
Grocery stores per 1000 people	0.52*	0.67*	0.69	0.51**	0.68**	0.68*
	(0.205)	(0.149)	(0.165)	(0.169)	(0.122)	(0.144)
HH food secure	0.87	0.87**	0.86***	1.05	0.92	0.92**
	(0.074)	(0.052)	(0.051)	(0.075)	(0.046)	(0.037)
Avg. fast meal price in USDA division	0.85	0.90	0.91	1.22	1.26*	1.25*
	(0.091)	(0.069)	(0.074)	(0.310)	(0.168)	(0.168)
NE	0.82***	0.83***	0.83***	0.88	0.93	0.92
	(0.060)	(0.042)	(0.043)	(0.098)	(0.058)	(0.064)
MW	0.99	0.88**	0.87**	1.12	1.12	1.10
	(0.084)	(0.054)	(0.053)	(0.198)	(0.099)	(0.101)
west	0.90	0.85**	0.85**	0.95	1.10	1.09
	(0.104)	(0.067)	(0.069)	(0.208)	(0.121)	(0.116)
spring	0.99	1.03	1.04	1.06	0.98	0.97
	(0.053)	(0.035)	(0.036)	(0.291)	(0.149)	(0.144)
summer	1.02	1.07**	1.07**	1.14	1.03	1.02
	(0.054)	(0.033)	(0.036)	(0.310)	(0.157)	(0.140)
fall	0.92*	1.02	1.02	1.10	0.96	0.94
	(0.049)	(0.037)	(0.040)	(0.287)	(0.139)	(0.131)
ATUS diary is a week day	0.83***	0.83***	0.83***			
	(0.032)	(0.021)	(0.021)			
ATUS diary is a holiday	0.80	0.90	0.90			
	(0.118)	(0.090)	(0.097)			
Respondent works multiple jobs	1.46***	1.25***	1.24***			
	(0.130)	(0.071)	(0.072)			
Constant	2.11	2.27*	2.13*	1.83	0.81	0.82
	(1.237)	(0.956)	(0.919)	(2.258)	(0.504)	(0.497)
Observations	21,478	21,838	21,465	4,813	4,813	4,810

Sub-Sample Analyses

Income and the food environment are two common focuses of health and diet-quality research. In addition, variables reflecting both of these aspects are significant in the full sample estimations. To more fully investigate the role of income and the food environment, I therefore split the FoodAPS sample in two ways. First, I consider households in different income groups by splitting the sample into three income and food assistance participation groups: households currently receiving SNAP benefits, households not receiving SNAP that are below 185% of the poverty line, and households not receiving SNAP that above 185% of the poverty line. Second, I consider households in different food environments by splitting the sample into two groups by grocery-store density: households above the mean (0.18 grocery stores in a county per 1,000 people) and households below the mean. Table 6.11 presents the incidence-rate ratios for a ZINB regression using the FoodAPS sample.

Income and SNAP participation

There are differences in the significance of the time allocation variables across the three income and SNAP participation subsamples. The effect of the time allocations on the number of fast-food events becomes insignificant for households with the most restrictive food budget, those below 185% of the poverty threshold not participating in SNAP. This result suggests that for households that are constrained by their food budget, changing time allocations will not affect fast-food purchases because time is not the binding constraint. For non-SNAP participating households with income greater than 185% of the poverty line, the subsample estimation results are similar to those from the full-sample estimation. Adult care and secondary childcare increase

the number of fast-food events, while time spent in FAH activities decreases the number of events. However, none of these time allocations are significant for non-SNAP households that are below 185% of the poverty line. Furthermore, SNAP-participating households see a mix of these results. Secondary childcare increases and FAH activities decrease fast-food events, but adult care is not significant. These results suggest that higher income households may be more responsive to changing time allocations because they are less constrained by income, and because SNAP participation helps with this budget constraint, thus allowing the participating households to be more time flexible with respect to fast food events.

Grocery-Store Density

There are also large differences between the groups when the sample is split by grocery-store density. Table 6.11 generally shows that the time allocations play a statistically significant role in determining the number of fast-food events if they are in a food environment with greater access to grocery stores, but are not if the household is in a food environment with less access. Time spent in secondary childcare (1.12) and adult care (3.20) both increase the number of fast-food events in counties with an above-average number of grocery stores, but these variables are not significant for households in counties that have below-average counts. This result suggests that lowering the burden of these activities for low-income households may not change their fast-food behavior if there are limited grocery-store alternatives. In addition, time spent working is significant only in lower-than-average grocery-store areas. This result suggests that households may still be able to purchase non-fast food while working more if there are more grocery stores available. Finally, time spent in FAH activities is significant and negatively related to the number of fast-food events for both groups.

Table 6.11: Incidence Rate Ratios for Zero-Inflated Negative Binomial Regression for sub-sample analysis by income groups and grocery store density.

	Income Groups			Grocery Store Density	
	SNAP Households	Non-SNAP, <185% of PT	Non-SNAP, >185% of PT	Above Average	Below Average
Hours in Primary Childcare	1.03	1.12	1.01	0.94	1.13*
	(0.092)	(0.136)	(0.083)	(0.075)	(0.082)
Hours in Secondary Childcare	1.09***	1.04	1.10***	1.12***	1.04
	(0.033)	(0.045)	(0.033)	(0.031)	(0.027)
Hours in Adult care	1.43	2.62	5.99***	3.20**	1.77
	(0.938)	(2.174)	(3.371)	(1.684)	(0.948)
Hours in FAH Activities	0.67**	0.76	0.65***	0.70***	0.75**
	(0.131)	(0.142)	(0.085)	(0.094)	(0.099)
Hours working	1.02	1.06**	1.01	1.02	1.03*
	(0.023)	(0.025)	(0.017)	(0.018)	(0.016)
rural	0.85**	0.92	0.91	0.89*	0.92
	(0.069)	(0.089)	(0.056)	(0.058)	(0.056)
Avg. HH age	1.00	0.99***	0.99**	0.99***	1.00
	(0.003)	(0.004)	(0.002)	(0.002)	(0.002)
SNAP participant				0.85**	1.00
				(0.059)	(0.069)
HH income >185% of Pt threshold				1.07	1.26***
				(0.073)	(0.083)
Has vehicle access	1.31***	1.37***	1.07	1.27***	1.28***
	(0.105)	(0.150)	(0.133)	(0.094)	(0.110)
Bachelor's degree	1.21***	0.94	1.02	1.06	1.06
	(0.085)	(0.080)	(0.063)	(0.062)	(0.059)
Some post HS education	1.36**	0.93	1.10	1.22***	1.04
	(0.164)	(0.105)	(0.070)	(0.089)	(0.070)
black	1.05	1.38***	1.11	1.21***	1.12
	(0.093)	(0.153)	(0.098)	(0.090)	(0.091)
hispanic	1.28***	1.10	1.18**	1.28***	1.09
	(0.120)	(0.118)	(0.090)	(0.092)	(0.081)
County Obesity Rate	1.00	1.00	1.01	1.00	1.01
	(0.009)	(0.011)	(0.007)	(0.008)	(0.008)
Does not own home	0.87*	0.84*	0.89*	0.86**	0.89*
	(0.066)	(0.074)	(0.054)	(0.051)	(0.052)
Grocery stores per 1000	0.91	1.07	0.50**	0.44***	0.26
	(0.299)	(0.443)	(0.145)	(0.129)	(0.230)
Observations	1,581	1,189	2,041	2,427	2,384

Table 6.11: Incidence Rate Ratios for Zero-Inflated Negative Binomial Regression for sub-sample analysis by income groups and grocery store density.

	Income Groups			Grocery Store Density	
	SNAP Households	Non-SNAP, <185% of PT	Non-SNAP, >185% of PT	Above Average	Below Average
HH food secure	0.95	0.85**	0.98	1.01	0.86***
	(0.060)	(0.065)	(0.078)	(0.060)	(0.048)
Avg. fast meal price in USDA division	0.95	1.60*	1.30	1.07	1.09
	(0.222)	(0.437)	(0.211)	(0.225)	(0.201)
NE	0.78**	1.04	1.10	1.08	0.84**
	(0.091)	(0.152)	(0.091)	(0.109)	(0.075)
MW	0.93	1.38*	1.16	0.95	1.08
	(0.163)	(0.265)	(0.137)	(0.158)	(0.134)
west	0.80	1.61**	1.28*	1.00	1.07
	(0.154)	(0.387)	(0.188)	(0.199)	(0.143)
spring	1.26	0.90	0.90	0.92	1.08
	(0.388)	(0.249)	(0.190)	(0.194)	(0.232)
summer	1.40	0.94	0.89	0.94	1.14
	(0.432)	(0.252)	(0.187)	(0.196)	(0.242)
fall	1.26	0.87	0.83	0.90	1.02
	(0.039)	(0.237)	(0.177)	(0.189)	(0.220)
Constant	2.19	0.51	1.37	2.56	1.48
	(2.484)	(0.660)	(1.107)	(2.576)	(1.382)
Observations	1,581	1,189	2,041	2,427	2,384

Healthfulness of FAFH

Finally, to consider how the time allocations affect the healthfulness of FAFH purchases, I calculate the HEI score for FAFH purchases and investigate the relationship between the time allocations and this new score as well as the share of FAFH expenditure on fast food. Table 6.12 presents these results. First, considering the FAFH HEI score, time spent in secondary childcare is the only committed activity that is statistically significant. However, despite being significant, the magnitude of the effect is quite small. A one-hour decrease in secondary childcare would increase the FAFH HEI score by about 1 point. Given a mean score of 44.2, the one point increase would amount to 2.25% increase. Although there are other covariates that are significant, they also have a relatively low magnitude. This lack of impact is likely attributable to

the HEI score being a poor FAFH measure. The HEI score was developed to rate household diets to the 2010 Dietary Guidelines, which will pertain mostly to FAH and not FAFH. In addition, on the nutrient level FAFH is less varied and higher in sodium and fat. Therefore, there is likely little difference in FAFH HEI despite differences in the price and convenience of the FAFH.

Another way to assess the healthfulness of FAFH is to consider what share of FAFH expenditure is on fast-food items. Using this measure, the time-allocation variables are again significant. Time spent in secondary childcare (0.01), adult care (0.10), and working (0.004) all increase the share of FAFH expenditure on fast-food items. A one-hour increase in adult care would increase the share on fast food by about 10 percentage points, while an additional hour of secondary childcare would increase the share by just over 1 percentage point. Time spent in FAH activities decreases the share of FAFH expenditure on fast food, with an increase of one hour decreasing the share by 3 percentage points. Finally, access to a vehicle increases the share of fast food by about 5 percentage points, while greater access to grocery stores decreases the share of fast food by 4 percentage points.

Table 6.12: Coefficient Estimates for Multiple Specifications for the Healthfulness of FAFH purchases

	Fractional Regression for FAFH HEI	Zero-Inflated Beta Regression for Fast Food Share
Hours in Primary Childcare	-0.00	0.01
	(0.005)	(0.006)
Hours in Secondary Childcare	0.01***	0.01**
	(0.002)	(0.002)
Hours in Adult care	0.02	0.10***
	(0.038)	(0.035)
Hours in FAH Activities	-0.00	-0.03***
	(0.009)	(0.012)
Hours working	0.00	0.00**
	(0.001)	(0.002)
rural	0.00	0.01*
	(0.005)	(0.004)
Avg. HH age	0.00**	-0.00***
	(0.000)	(0.000)
Observations	4,811	4,811

	Fractional Regression for FAFH HEI	Zero-Inflated Beta Regression for Fast Food Share
SNAP participant	0.00	0.01
	(0.005)	(0.006)
HH income >185% of Pt threshold	0.01**	-0.01**
	(0.005)	(0.005)
Has vehicle access	0.01**	0.05***
	(0.006)	(0.010)
Bachelor's degree	0.01***	-0.00
	(0.005)	(0.004)
Some post HS education	0.01**	-0.00
	(0.005)	(0.004)
black	0.01***	0.02***
	(0.006)	(0.007)
hispanic	-0.00	0.02***
	(0.005)	(0.006)
County Obesity Rate	-0.00***	-0.00
	(0.001)	(0.001)
Does not own home	-0.00	0.01**
	(0.004)	(0.004)
Grocery stores per 1000	-0.00	-0.04*
	(0.024)	(0.020)
HH food secure	0.01**	-0.01**
	(0.005)	(0.005)
Avg. fast meal price in USDA division	-0.00	0.00
	(0.013)	(0.013)
NE	0.01	0.01
	(0.005)	(0.007)
MW	0.01	0.01
	(0.008)	(0.009)
west	0.00	0.01
	(0.011)	(0.012)
spring	-0.04***	-0.02
	(0.014)	(0.017)
summer	-0.03**	-0.02
	(0.014)	(0.016)
fall	-0.02*	-0.01
	(0.014)	(0.017)
Constant	2.47	2.67**
	(1.454)	(1.142)
Observations	4,811	4,811

Chapter 7

Concluding Discussion

Each of these three essays employs a similar approach and considers a similar question. In general, the ATUS is used to create predicted values of committed household activities in order to investigate how they relate to household diet quality.

Three measures of Diet Quality

In the first essay, household diet quality is measured by food-group expenditure shares, while in the second essay a broader definition is considered by using the HEI score. Finally, in the third essay, FAFH is considered by looking at the probability of any fast-food purchase event in a given week, the frequency of fast-food purchase events in a given week, and healthfulness of FAFH home purchases. Considering these three measures of diet quality accomplishes multiple goals that separately they would not. First, only considering food-group expenditures may miss important nutrition consideration in areas such as the fatty-acid ratio that the HEI captures. However, only considering the total HEI score may miss what particular components are affected by the changes in time allocations. Therefore, both are needed for a complete assessment. In addition, the first two essays only consider FAH purchases. Therefore, the third essay is necessary to consider how these time allocations affect FAFH purchases and fast food purchases in particular.

Committed Household Time Activities

Time Spent in Food At Home Activities

Although present in all three essays, time spent in FAH activities in not particularly a focus of the paper. Given that in each of the papers TSIV is implemented to predict time-use values for

FoodAPS households, time spent in FAH activities is used as a check for instrument validity. There is a large body of literature linking increased time spent in FAH activities to better diet quality (Seguin et al. 2016, Ong et al. 2016, Trofholz et al. 2016). Therefore, one reason for the inclusion of FAH activities was to check if the predicated value matched past literature results. In the first essay, predicted values for increased time spent on FAH activities are associated with increased fruit and vegetable consumption and decreased sweet and salty snack, sugary beverage, and packaged meal consumption. In the second and third essay, predicted values for time spent on FAH activities are positively associated with household HEI score and negatively associated with fast-food purchases. The results I find for FAH activities are consistent throughout all three papers, as well as with past literature, therefore lending validity to the TSIV process.

Childcare

Time spent on childcare took on multiple forms throughout the three essays. In the first essay, both primary and secondary childcare were combined to form one aggregate time allocation. While I found that time spent in childcare has a negative effect on expenditures in healthy food groups, i.e., fresh and frozen fruits and vegetables, and a positive effect on unhealthy food groups, i.e., sweet and salty snacks, sugary beverages, and processed meat, continuing with the combined measure would not allow the analysis to reflect fundamental differences between primary and secondary childcare. Therefore, in the second and third essays, times spent in primary and secondary childcare are included as separate terms. I find that time spent in secondary childcare is highly negatively associated with household HEI, while primary childcare is positively associated with household HEI. Comparing these findings to those from a similar specification with combined childcare shows that the positive effect of time spent in primary childcare mitigates the true negative effect of secondary childcare. Finally, time spent in

secondary childcare is positively associated with fast-food events and the share of FAFH spending on fast food, while primary childcare is not.

Adult Care

In general, time spent in adult care is negatively associated with household diet quality for both FAH and FAFH; however, its significance is less robust than childcare. In the first essay, time spent in adult care is significant in two of the six food groups, decreasing the share of expenditures on fruit and vegetables while increasing the share on processed meats. However, when considering the household HEI score, the effect is not statistically significant despite the sign still being negative. Finally, adult care is consistently positively associated with fast-food events. The larger effect on fast-food events likely makes sense because of the nature of adult care. Although some forms of adult care, such as always visiting an elderly parent on Sundays, may be routine or consistent, it is likely that a significant portion of adult-care time may be unplanned.

Reducing adult care time by implementing free or subsidized adult care as part of the SNAP benefits could help decrease fast-food events. A 30-minute decrease in adult care per day would decrease fast-food events from about 8 to 5 events per month. Similarly, introducing an after school program for children of SNAP participating households could decrease the time spent in secondary childcare. A 2-hour reduction in secondary childcare would decrease fast-food events by 1.5 events per month. In addition, if any of the extra time was spent in FAH activities, then the number of fast-food events could drop even more. With multi-generational households becoming more permanent and an important support network for adult care (Cook, Alford, and Conway 2012, Gjesfjeld, Weaver, and Schommer 2012), a more in-depth look on the effects of elder care on diet quality should be considered.

Non-Car Travel

Non-car travel was considered only in the first essay. The creation of this time-allocation group attempts to capture the increased time spent traveling because of the increased rigidity of non-car travel, i.e., traveling on a bus or subway schedule versus a personal schedule. Unfortunately, the demographic variables available and the lack of an appropriate instrument do not allow for accurate predictions to be created. Time spent in non-car travel is not significant in determining any of the food group expenditure shares. For both these reasons, the time allocation is not continued in the second and third essay. Instead, an indicator variable for whether a household has access to a vehicle is included to help account for the flexibility of own vehicle travel.

Policy Implications

While each of these essays addresses a valuable component on the topic on its own, the collection of all three allows for a more comprehensive look at how committed household activities affect household diet quality. In particular, as was the intention, the collection allows for policy implications to address the diet-quality income gap. The most significant and robust result across the three essays is the negative effect from secondary childcare on both FAH and FAFH diet quality. In addition, considering how the amount of time spent in these activities differs by income, secondary childcare has the largest gap with low-income household spending nearly an additional 1.5 hours in secondary childcare per day.

One way to allow food assistance program participating households to reduce the time spent in secondary childcare would be to offer a free after-school program for the children in those households. From Essay 2, I find that a two-hour after school program (that reduces secondary childcare by that same amount) would increase household HEI by 2.4 points, on average. However, the effect could be larger, up to 3.6 points, if the household is in a good food

environment or faces low food prices. Given that the difference in the mean HEI between households participating in SNAP and households with income above 185 percent of the poverty threshold is 7.9, the 2.4 increase would account for 30 percent of the difference. If that household faces low prices, the two-hour reduction could account for 45 percent of the difference. Table 2.1 shows that time spent in primary childcare remains consistent across income levels, while secondary childcare increased. Therefore, I expect the after school program to reduce secondary childcare and not both.

There are also multiple indirect benefits to a household's diet quality from a reduction in secondary childcare. First, if any of newly freed-up time is substituted to FAH activities or primary childcare, I would expend an additional increase in household HEI. For the average household, just a 15-minute increase in FAH activities per day is expected to increase a household's HEI by about 0.5, with the expected increase almost doubling if the household is in a good food environment. In addition, child development literature shows there are life-long benefits to participating in after school programs, including a higher level of educational attainment (Durlak and Weissberg 2010, Newell et al. 2015, Bouffard et al. 2016), which positively contributes a household's HEI.

The goal of SNAP is to increase food security and reduce hunger by increasing access to food, a healthful diet, and nutrition education. Currently, the program increases knowledge about healthy diets and relaxes the income constraint to purchasing healthy foods by providing monetary assistance for food purchases. Some previous research has encouraged food assistance programs to give consideration to the time constraint of low-income households (Beatty, Nanney, and Tuttle 2014, Davis and You 2011). My findings are consistent with this prior research, but they further suggest that the consideration be expanded to time spent in non-food

activities that disproportionally burden low-income households. Building in a childcare and adult care subsidy to the SNAP program could help relax the time constraint without burdening the household with additional program requirements. In other words, using this multifaceted approach could provide low-income households with the knowledge, income, and time necessary for vulnerable households to prepare a healthy diet.

Limitations and Future Extensions

These three essays attempt to start a new conversation topic in addressing the long-established diet quality gap. Because they are a starting point, the essays have several limitations of the essays in their current form. First, although the methods employed in the three essays likely establish the relationship between committed activities and household diet quality, the magnitude of the impact may be less precisely estimated because key variables are measured using predicted values. To obtain more precise estimates for policy recommendations, future work may involve the use of additional data or identification methods. First, I believe there may be an opportunity to exploit differences in the school calendars by school district, or whether a child is currently in school or not, to investigate how time spent in childcare more precisely affects diet quality. Using this type of method, I could see investigate the role that school attendance has on secondary childcare, and then how this role affects household diet quality. Second, New Zealand recently established a policy that gives all households with children 20 hours of free early childhood education. Because this policy creates an exogenous shift in own-childcare time, I believe that future research could exploit this policy to more precisely identify the relationship between childcare and household diet quality. Finally, to obtain greater variation over time, and to exploit repeated observations in a panel setting, future research could potentially make use of a larger food purchasing data set such as IRI or Nielsen consumer panel.

Another current limitation of the analysis involves the sub-sample analyses. Currently, I use the full ATUS sample to create the time allocation samples, but I split the sample into subsamples for the second-stage analysis that examples how time allocations affect diet quality. However, accuracy might be improved if I split the ATUS sample into subsamples for the first stage. This data method might improve the accuracy of the first-stage time-allocation predictions, thereby allowing for differences in the second-stage sub-samples to be more apparent.

One last limitation is the inability to accurately compare average marginal effects after estimating nonlinear models, such as those in the first essay. When using extreme value estimation (like in the first essay), the reported coefficients are standardized by the estimated standard error. Given that this error is different across sub-samples, the reported coefficients are not directly comparable. A solution for this problem might involve the use of variable interactions rather than relying on splitting the full sample into subsamples.

As the above paragraphs imply, there is a large amount of future work to be done in this area before we can be confident in accurately quantifying the effect of committed time activities. However, despite these limitations these essays show that there is a relationship between childcare, adult care and household diet quality. In addition, the sub-sample analysis of the second essay echoes the results of literature in that time, income, and the food environment interact with each other.

References

Aggarwal, Anju, Colin D. Rehm, Pablo Monsivais, and Adam Drewnowski. "Importance of taste, nutrition, cost and convenience in relation to diet quality: Evidence of nutrition resilience among US adults using National Health and Nutrition Examination Survey (NHANES) 2007–2010." Preventive Medicine 90 (2016): 184-92.

Aguiar, M., E. Hurst, and L. Karabarbounis. 2013. "Time Use During the Great Recession," American Economic Review 103(5): 1664-1696.

Allen, James. "Determinants of Land Allocation in a Multi-Crop Farming System: An Application of the Fractional Multinomial Logit Model to Agricultural Households in Mali." (2012). Doctoral dissertation, Michigan State University.

Alviola, P. A., Nayga, R. M., & Thomsen, M. (2013). Food deserts and childhood obesity. Applied Economic Perspectives and Policy, 35(1), 106-124.

Angrist, Joshua D. and Alan B. Krueger, "The Effect of Age at School Entry on Educational Attainment: An Application of Instrumental Variables with Moments from Two Samples," Journal of the American Statistical Association 87 (June 1992), 328–336.

Angrist, Joshua D. and Alan B. Krueger, "Split-Sample Instrumental Variables Estimates of the Return to Schooling," Journal of Business and Economic Statistics 13 (April 1995), 225–235.

Basner M; Fomberstein KM; Razavi FM; Banks S; William JH;Rosa RR; Dinges DF. American time use survey: sleep time and its relationship to waking activities. SLEEP 2007; 30(9):1085-1095.

Becker, Gary S. "A Theory of the Allocation of Time." The Economic Journal, vol. 75, no. 299, 1965, pp. 493–517. www.jstor.org/stable/2228949.

Beckles, G., & Chou, C. "Diabetes 2006 to 2010". Supplements, 62(3). (2013), 99-104.

Beatty, Timothy K. "Expenditure Dispersion and Dietary Quality: Evidence from Canada". Health Economics (2008). 17: 1001-1014.

Beatty, Timothy KM; Nanney, M Susie; Tuttle, Charlotte. "Time to eat? The relationship between food security and food-related time use". Public Health Nutrition 17.1 (Jan 2014): 66-72.

Berge, Jerica M., and Et Al. "Family Food Preparation and Its Effects on Adolescent Dietary Quality and Eating Patterns." Journal of Adolescent Health 59 (2016): 530-36.

Bickel, Gary, Mark Nord, Cristofer Price, William Hamilton, and John Cook: Guide to Measuring Household Food Security, Revised 2000. U.S. Department of Agriculture, Food and Nutrition Service, Alexandria VA. March, 2000. Or in short form as USDA, Guide 2000.

Bouffard, S., Wimer, C., Caronongan, P., Little, P., Dearing, E., & Simpkins, S. (2016). Demographic Differences in Patterns of Youth Out-of-School Time Activity Participation. *Journal of Youth Development, 1*(1), 24-40.

Brunello, Giorgio, Fort, Margherita, Schneeweis, Nicole, and Winter-ebmer, Rudolf. "The Causal Effect of Education on Health: What is the Role of Health behaviors?". Health Economics. (2016) 25: 314-336.

Byrne, P. J., Capps, O., & Saha, A. (1996). Analysis of food-away-from-home expenditure patterns for U.S. households, 1982-89. American Journal of Agricultural Economics, 78, 614–627.

Byrne, P. J., Capps, O., & Saha, A. (1998). “Analysis of Quick service, Mid-Scale, and Up-scale Food away from home expenditures.” International Food and Agribusiness Management Review 1(1): 51-72.

Caldwell, E. M., Kobayashi, M. M., DuBow, W. M., & Wytinck, S. M. “Perceived access to fruits and vegetables associated with increased consumption”. Public Health Nutrition, 12(10). (2009), 1743-1750.

Carroll, R.J., and L.A. Stefanski. "Measurement Error, Instrumental Variables, and Correction for Attenuation with Applications to Meta-Analyses." Statistics in Medicine 13.12 (1994): 1265-282

Castner, L, and Mabli, J. (2010). Food Expenditures and Diet Quality Among Low Income Households and Individuals. Mathematica Policy Research.

Cawley, John, and Feng Liu. "Maternal Employment and Childhood Obesity: A Search for Mechanisms in Time Use Data." Economics and Human Biology 10 (2012): 352-54.

Charter, RA. "Effect on Measurement Error on Tests of Statistical Significance." Journal of Clinical and Experimental Neuropsychology 19.3 (1997): 458-62

Center for Disease Control. (2011) Census Tract Level State Maps of the Modified Retail Food Environment Index. CS227663-B

Chen, D. E.C. Jaenicke, and R. Volpe. (2016) “Food Environments and Obesity: Household Diet Expenditure Versus Food Deserts.” American Journal of Public Health. 106(5), 881-888.

Chen, Xiaohong et al. “Nonlinear Models of Measurement Errors.” *Journal of Economic Literature*, vol. 49, no. 4, 2011, pp. 901–937.

Cohen, P.N. (1998) “Replacing housework in the service economy: Gender, class, and race-ethnicity in service spending” Gender and Society, 12 (2) (1998), pp. 219–231

Cook, J. F., Alford, K. A., & Conway, P. (2012). “Introduction to rural families and reshaping human services”. Journal of Family Social Work, 15(5), 351-358.

Cummins, S., Flint, E., & Matthews, S. A. (2014). New neighborhood grocery store increased awareness of food access but did not alter dietary habits or obesity. Health Affairs, 33(2), 283-291.

Cummins, S., Petticrew, M., Higgins, C., Findlay, A., & Sparks, L. (2005). Large scale food retailing as an intervention for diet and health: quasi-experimental evaluation of a natural experiment. Journal of Epidemiology and Community Health, 59(12), 1035-1040.

Cutler, D. M., Glaeser, E. L., & Shapiro, J. M. (2003). Why have Americans become more obese? Journal of Economic Perspectives, 17, 93–118.

Darmon, N., & Drewnowski, A. (2008). Does Social Class Predict Diet Quality? American Journal for Clinical Nutrition, 87(5), 1107-1117.

Davis, G. C. & You, W. (2010). The Thrifty Food Plan is not thrifty when labor cost is considered. Journal of Nutrition, 140(4), 854-857.

Davis, G. C. & You, W. (2011). Not Enough Money or Not Enough Time to Satisfy the Thrifty Food Plan? A Cost Difference Approach for Estimating a Money-Time Threshold. Food Policy, 36, 101-107.

Dee, Thomas S. and Evans, William N. “Teen Drinking and Educational Attainment: Evidence from Two-Sample Instrumental Variables Estimates,” Journal of Labor Economics 21 (January 2003), 178–209.

Department of Health and Human Services: Center for Disease Control. “Children’s Food Environment State Report, 2011”. Retrieved May 30, 2017, from https://www.cdc.gov/obesity/downloads/ChildrensFoodEnvironment.pdf

Department of Health and Human Services: Center for Disease Control: Heart Disease Facts. (2015, August 1). Retrieved November 1, 2015, from http://www.cdc.gov/heartdisease/facts.htm

Devaux, M., Cecchini, M., & Sassi, F., Wilson, S. (2014). Obesity Update. Organization for Economic Co-operation and Development. http://www.oecd.org/health/Obesity-Update-2014.pdf

Dong, Diansheng., Byrne, Patrick J., Saha, Atanu., Capps, Oral. (2000) "Determinants of Food Away From Home visit frequency: A count Data approach." Journal of Restaurant and foodservice marketing. Vol. 4(1).

Douthitt, R.A. (1998). "Replacing housework in the service economy: Gender, class, and race-ethnicity in service spending." Gender and Society, 12(2) pp. 219-231

Du, Juan and Yagihashi, Takeshi. "Goods-time Elasticity of Substitution in Health Production". Health Economics. (2016) DOI: 10.1002/hec.3446

Dunn, R. A. "The effect of fast-food availability on obesity: an analysis by gender, race, and residential location". American Journal of Agricultural Economics: 92(4), (2010). 1149–1164.

Durlak, Joseph A., Weissberg, Roger P. (2010) "A Meta-Analysis of After-School Programs That Seek to Promote Personal and Social Skills in Children and Adolescents." American Journal of Community Psychology. 145(3). 294-309.

Finkelstein, E., Trogdon, J., Cohen, J., & Dietz, W. "Annual Medical Spending Attributable to Obesity: Payer and Service Specific Estimates". Health Affairs, 28(5), (2009). 822-831.

Fletcher, Jason M., Sindlear, Jody L., and Yamaguchi, Shintaro. "Cumulative Effects of Job Characteristics on Health". Health Economics. 20 (2011): 553-570.

Fox, Liana, and Et Al. "Time for Children: Trends in the Employment Patterns of Parents, 1967–2009." Demogrpahy 50 (2013): 25-49.

Garay, Aldo M., Victor H. Lachos, and Heleno Bolfarine. "Bayesian Estimation and Case Influence Diagnostics for the Zero-inflated Negative Binomial Regression Model." Journal of Applied Statistics (2015): 1148-165. Print.

Gjesfjeld, C. D., Weaver, A., & Schommer, K. (2012). "Rural women's transitions to motherhood: Understanding social support in a rural community". Journal of Family Social Work, 15(5), 435-448.

"Grant Awards Descriptions." USDA ERS - FoodAPS National Household Food Acquisition and Purchase Survey. Web. 9 Dec. 2015.

Grossman, M. "On the concept of health capital and the demand for health". Journal of Political Economy, 80, (1972). 225–255.

Guenther, P.M., Casavale, K.O., Kirkpatrick, S.I., et al. Update of the Healthy Eating Index: HEI-2010 Journal of the Academy of Nutrition and Dietetics, 113 (2013), pp. 569–580

Guenther, P.M., Kirkpatrick, S.I., et al. "The Healthy Eating Index-2010 is a valid and reliable measure of diet quality according to the 2010 Dietary guidelines for Americans". Journal of Nutrition. Mar. 2014. 144(3): 399-407.

Guthrie, J., Lin, B., Frazao, E. (2002) "Role of food prepared away from home in the American diet, 1977–78 versus 1994–96: Changes and consequences." Journal of Nutrition Education and Behavior, 34 (3), pp. 140–150

Hamermesh, D.S. 2007. "Time to Eat: Household Production Under Increasing Income Inequality," American Journal of Agricultural Economics 89(4): 852-863.

Hamrick, Karen., Okrent, Abigail. “The Role of Time in Fast-Food Purchasing Behavior in the United States”. USDA Economic Research Service. Economic Research Report No. (ERR-178) 52 pp, November 2014.

Hiza, Hazel, and Et Al. "Diet Quality of Americans Differs by Age, Sex, Race/ Ethnicity, Income, and Education Level." Journal of the Academy of Nutrition and Deitetics 113.2 (2013): 297-306.

Huffman, W. E. (2011). Household production models and the demand for food and other inputs: U.S. evidence. Journal of Agricultural and Resource Economics, 36, 465–487.

Jabs, J., and Devine, CM. (2006) “Time Scarcity and food choices: an overview.” Appetite. Sep;47(2): 196-204.

Kalenkoski, C.M., and K.S. Hamrick. 2013. “How Does Time Poverty Affect Behavior? A Look at Eating and Physical Activity,” Applied Economic Perspectives and Policy 35(1): 89-105.

Kalenkoski, C.M., K.S. Hamrick, and M. Andrews. 2011. “Time Poverty Thresholds and Rates for the US Population,” Social Indicators Research 104(1): 129-155.

Kim, D., and JP Leigh. "Estimating the Effects of Wages on Obesity." Journal of Occupational and Environmental Medicine 52.5 (2010): 495-500.

Kinsey, J. (1983). “Working Wives and the Marginal Propensity to Consume Food Away from Home.” American Journal of Agricultural Economics 65(1): 10-19.

Koch, Steve. "Fractional Multinomial Response Models with an Application to Expenditure Shares." Johannesburg Conference (2010). Print.

Krebs-Smith SM, Guenther PM, Subar AF, Kirkpatrick SI, Dodd KW. Americans do not meet federal dietary recommendations. The Journal of Nutrition. 2010;140(10):1832–8.

Kuczmarski, Marie F. "Health Literacy and Education Predict Nutrient Quality of Diet of Socioeconomically Diverse, Urban Adults." Journal of Epidemiology and Preventive Medicine 02.01 (2016): 1-16.

Larson, Nicole I., and Et Al. "Food Preparation by Yound Adults Is Associated with Better Diet Quality." Journal of American Dietetic Association 106 (2006): 2001-007.

Larson, Nicole I., Dianne Neumark-Sztainer, Peter J. Hannan, and Mary Story. "Family Meals during Adolescence Are Associated with Higher Diet Quality and Healthful Meal Patterns during Young Adulthood." Journal of the American Dietetic Association 107.9 (2007): 1502-1510

Levi, J., & Segal, L. (2011). F as in Fat: How Obesity Threatens America's Future. Robert Woodson Foundation.

Liese, Angela D., Bethany A. Bell, Timothy L. Barnes, Natalie Colabianchi, James D. Hibbert, Christine E. Blake, and Darcy A. Freedman. "Environmental influences on fruit and vegetable intake: results from a path analytic model." Public Health Nutrition 17.11 (2013): 2595-604.

Lysy, Z., Booth, G., Shah, B., Austin, P., Luo, J., Lipscombe, L., "The Impact of Income on the Incidence of Diabetes: A Population-based Study." Diabetes Research and Clinical Practice 99.3, (2013). 372-79.

Mancino, Lisa, Todd, Jessica, Lin, Biing-Hwan. (2009). Separating What We Eat From Where: Measuring the Effect of Food Away From Home on Diet Quality. Food Policy, 34, 557-562.

Maruyama, Shiko and Yin, Qing. “The Opportunity Cost of Exercise: Do Higher-Earning Australians Exercise longer, harder, or both?”. Health Policy. 106 (2012):187-194.

Meltzer, David O., and Jena, Anupam B. “The economics of intense exercise”. Journal of Health Economics. (2010). 29:347-352.
Menard, S. (1995). Applied Logistic Regression Analysis: Sage University Series on Quantitative Applications in the Social Sciences. Thousand Oaks, CA: Sage
Monsivais, Pablo, Anju Aggarwal, and Adam Drewnowski. "Time Spent on Home Food Preparation and Indicators of Healthy Eating." American Journal of Preventive Medicine 47.6 (2014): 796-802.
Moore, L. V., and Diez Roux, A. V. (2006). Associations of neighborhood characteristics with the location and type of food stores. American Journal of Public Health, 96(2), 325-331.
Mullahy, John. "Multivariate Fractional Regression Estimation of Econometric Share Models." (2012). Journal of Econometric Methods. *4*(1), 71-100.
Mullahy, John, and Stephanie Robert. (2010) "No Time to Lose? Time Constraints and Physical Activity." Review of the Economics of the Household, *8*(4), 409-432.
Newell, A. D., Zientek, L. R., Tharp, B. Z., Vogt, G. L. and Moreno, N. P. (2015), Students' Attitudes Toward Science as Predictors of Gains on Student Content Knowledge: Benefits of an After-School Program. Sch Sci Math, 115: 216–225. doi:10.1111/ssm.1212
Nordstrom, Jonas and Thunstrom, Linda. “Economic Policies for Healthier Food Intake: the Impact on Different Household Categories”. European Journal of Health Economics. (2011). 12: 127-140.
O’brien, Robert M. (2007). A Caution regarding Rules of Thumb for Variance Inflation Factors. Quality and Quantity 41:673-690.
Ong, Jia Xin, Ullah, Shahid, Magarey, Anthea, and Leslie, Eva. (2016) “Positive Influences of Home Food Environment on Primary-school Children’s Diet and Weight Status: a Structural Equation Model Approach”. Public Health Nutrition: 19(14), 2525-2534.
Papke, Leslie E., and Jeffrey M. Wooldridge. "Econometric Methods for Fractional Response Variables with an Application to 401(k) Plan Participation Rates." Journal of Applied Econometrics 11.6 (1996): 619-32. Print.
Patrick, Heather, and Theresa A. Nicklas. “A Review of Family and Social Determinants of Children’s Eating Patterns and Diet Quality”. Journal of the American College of Nutrition 24.2 (2005): 83-92.
Philipson, T., & Posner, R. (2008). Is the obesity epidemic a public health problem? A decade of research on the economics of obesity. NBER w.p. 14010.
Podor, Melinda and Halliday, Timothy J. “Health Status and the Allocation of Time”. Health Economics (2012). 21: 514-527.
Powell, Lisa M., Bao, Yanjun. Food prices, access to food outlets and child weight, Economics & Human Biology, Volume 7, Issue 1, March 2009, Pages 64-72, ISSN 1570-677X
Rao, M., Afshin, A., Singh, G., & Mozaffarin, D. (2013). Do Healthier Foods and Diet Patterns Cost More than Less Healthy Options? A systematic review and meta-analysis. Public Health, 3(4277).
Rickard, Bradley J., Okrent, Abigail M., Alston, Julian M. “How Have Agricultural Policies Influenced Caloric Consumption in the United States?”. Health Economics (2013) 22: 316-339.
Rose, D. “Food Stamps, the Thrifty Food Plan, and meal preparation: the importance of the time dimension for US nutrition policy”. Journal of Nutrition Education and Behavior, 39, (2007). 226-232.

Scharadin, Benjamin, Todd, Jessica, and Mancino, Lisa. How Households Allocate Their Food-at-Home Budget, U.S. Department of Agriculture, Economic Research Service, *Forthcoming.*

Seguin, Rebecca A., Aggarwal, Anju, Vermeylen, Francoise, and Drewnoski, Adam. (2016) "Consumption Frequency of Foods Away from Home Linked with Higher Body Mass Index and Lower Fruit and Vegetable Intake among Adults: A Cross-Sectional Study. Journal of Environmental and Public Health. http://dx.doi.org/10.1155/2016/3074241.

Smith, Travis, and Et Al. "The Effects of Benefit Time and Income Fungibility on Food Purchasing Decisions Among Supplemental Nutrition Assistance Program Households." American Journal of Agricultural Economics 98.2 (2016): 564-80.

Stewart, H., and Yen, S.T. (2004). "Changing Household Characteristics and the Away-From-Home Food Market: A Censored Equation System Approach." Food Policy 29: 643-658

Tashiro, S. 2009. "Differences in Food Preparation by Race and Ethnicity: Evidence From the American Time Use Survey." The Review of Black Political Economy 36(3-4): 161-180

Thorp, AA, and Et Al. "Sedentary Behaviors and Subsequent Health Outcomes in Adults a Systematic Review of Longitudinal Studies, 1996-2011." American Journal of Preventative Medicine 41.2 (2011): 207-015. Web.

Todd, Jessica Erin, Lisa Mancino, and Biing-Hwan Lin. "The Impact of Food Away from Home on Adult Diet Quality." SSRN Electronic Journal SSRN Journal (2010). Print.

Todd, Jessica, and Benjamin Scharadin. Where Households Get Food in a Typical Week: Findings From USDA's FoodAPS, EIB-156, U.S. Department of Agriculture, Economic Research Service, July 2016.

Trofholz, Amanda C., Tate, Allan D., Draxten, Michelle L., Neumark-Sztainer, Dianna, and Berge, Jerica M. (2016). "Home Food Environment Factors Associated with the Presence of Fruit and Vegetables at Dinner: A Direct Observational Study". Appetite 96: 526-532.

Troung, Khoa Dang, and Roland Sturm. "Weight Gain Trends Across Sociodemographic Groups in the United States." American Journal of Public Health 95.9 (2005): 1602-1606.

U.S. Department of Agriculture, Economic Research Service (ERS). National Household Food Acquisition and Purchase Survey: User's Guide to Survey Design, Data Collection, and Overview of Datasets. (2016) May 2017

U.S. Department of Labor, Bureau of Labor Statistics (BLS). American Time Use Survey User's Guide: Understanding ATUS 2003 to 2011. (2012) May 2017

U.S. Department of Agriculture and U.S. Department of Health and Human Services. (2010). Dietary Guidelines for Americans, 2010. 7th Edition, Washington, DC: U.S. Government Printing Office.

University of California at Irvine, Department of Education, in cooperation with California Department of Education, Healthy Start and After School Partnerships Office. "Evaluation of California's After School Learning and Safe Neighborhoods Partnerships Program: 1999-2001. "Sacramento, CA: California Department of Education. (2002).

Van Der Lippe, T., Tijdens, K., and de Ruijter, E. (2004). "Outsourcing of Domestic Tasks and Time-Saving Effects." Journal of Family Issues 25(2): 216-240

Vandell, D.L. and Pierce, K.M. "Can After-School Programs Benefit Children Who Live in High-Crime Neighborhoods? Children's Out-of-School Time: The Next Generation of Research". Biennial Meeting of the Society for Research in Child Development in Albuquerque, New Mexico. (1999).

Variyam, Jayachandran N. “Do Nutrition Labels Improve Dietary Outcomes?” Health Economics (2008). 17: 695-708.

Venn, Danielle and Strazdins, Lyndall, (2017), Your money or your time? How both types of scarcity matter to physical activity and healthy eating, Social Science & Medicine, 172, issue C, p. 98-106.

Ver Ploeg, M. et al. (2009). Access to Affordable and Nutritious Food: Measuring and Understanding Food Deserts and Their Consequences. Economic Research Service, Report to Congress.

Ver Ploeg, M., Mancino, L., Todd, J., Clay, D., & Scharadin, B. (2015). Where Do Americans Usually Shop for Food and How do they Travel to Get There? Economic Research Service.

Volpe, R.J., and A. Okrent. 2012. "Assessing the Healthfulness of Consumers’ Grocery Purchases." EIB-102, U.S. Department of Agriculture, Economic Research Service, November 2012.

Wang, Dong D., Cindy W. Leung, Yanping Li, Eric L. Ding, Stephanie E. Chiuve, Frank B. Hu, and Walter C. Willett. "Trends in Dietary Quality Among Adults in the United States, 1999 Through 2010." JAMA Internal Medicine 174.10 (2014): 1587.

White House Task Force on Childhood Obesity Report to the President. 2010. Solving the Problem of Childhood Obesity Within a Generation, Executive Office of the President of the United States http://www.letsmove.gov/sites/letsmove.gov/files/TaskForce_on_Childhood_Obesity_May2010_ FullReport.pdf

Wieczoreck, Jerzy, and Sam Hawala. "A Bayesian Zero-One Inflated Beta Model for Estimating Poverty in U.S. Counties." Economics and Housing Division (2011). In Proceedings of the American Statistical Association, Section on Survey Research Methods, Alexandria, VA: American Statistical Association 2011.

Appendix A
ERS Food Group Hierarchy

Food Type			
	Food Category		
		Food group	Food group code
1 - Grains			
	101- Whole grain breads, cereal, rice, pasta, and flours		
		Breads (bread, rolls, pita, bagels, tortillas)	10101
		Rice and pasta	10102
		Breakfast cereal	10103
		Flour/bread mixes/frozen dough	10104
	102 - Non-whole grain breads, cereal, rice, pasta, and flours		
		Breads (bread, rolls, pita, bagels)	10201
		Rice and pasta	10202
		Breakfast cereal	10203
		Flour/bread mixes/frozen dough	10204
2 - Vegetables			
	201 - Potatoes		
		Fresh	20101
		Frozen	20102
		Canned	20103
	202 - Tomatoes		
		Fresh	20201
		Frozen	20202
		Canned	20203
	203 - Dark green vegetables		
		Fresh	20301
		Frozen	20302
		Canned	20303
	204 - Orange vegetables		
		Fresh	20401
		Frozen	20402
		Canned	20403
	205 - Beans, lentils, and peas or legumes		
		Fresh/Dried	20501

		Frozen	20502
		Canned	20503
	206 - Other/Mixed vegetables		
		Fresh	20601
		Frozen	20602
		Canned	20603
3 - Fruit			
	301 - Whole Fruit		
		Fresh	30101
		Frozen	30102
		Canned	30103
		Dried	30104
	302 - 100% Fruit and Vegatable juices		30201
4 - Milk products			
	401 - Whole milk, yogurt, and cream		
		Milk	40101
		Cream	40102
		Yogurt	40103
	402 - Low-fat and skim milk and low-fat yogurt		
		Milk	40201
		Cream	40202
		Yogurt	40203
	0403 - All cheese, incl cheese soups and sauces		
		Cheese	40301
		Processed	40302
	404 - Milk drinks and milk desserts		40401
5 - Meat and beans			
	501 - Beef, pork, veal, lamb, and game		
		Fresh	50101
		Frozen	50102
		Canned	50103
	0502 - Chicken, turkey, and game birds		
		Fresh	50201
		Frozen	50202
		Canned	50203
	503 - Fish and seafood		
		Fresh	50301

		Frozen	50302
		Canned	50303
	504 - Nuts, nut butters, and seeds		
		Nuts and Seeds	50401
		Nut and Seed Butters and Spreads	50402
	505 - Bacon, sausage, and lunch meats including spreads		50501
	506 - Egg and egg substitutes		50601
	507 - Tofu and meat substitutes		50701
6 - Other foods			
	601 - Table fats, oils, and salad dressings		
		Fats and oils	60101
		Salad dressing	60102
	602 - Gravies, sauces, condiments, and spices		
		Condiments, Gravies, and Sauces	60201
		Dry Spices	60202
	603 - Beverages		
		Sweetened Coffee and Tea	60301
		Unsweetened Coffee and Tea	60302
		Low-calorie Beverages	60303
		All Other Caloric Beverages	60304
		Alcohol	60305
		water	60306
	604 - Desserts, sweets, and candies		
		sweetners	60401
		jellies/jams	60402
		candy	60403
		Baked Goods (including packaged)	60404
		Cake Mixes	60405
		All other desserts	60406
	605 - Salty Snacks		
		whole grain snacks	60501
		all other snacks	60502
	606 - Prepared Meals (Frozen/refrigerated entrees incl pizza, fish sticks, and frozen meals)		
		Ready to eat	60601
		Frozen	60602

		Canned	60603
		Packaged	60604
	607 - Vitamins and Meal Supplements		60701
	608 - Baby food		60801
	609 - Infant formula		60901
9-Not coded			
	999-Not coded		99999

Appendix B
Food Group Construction

1. FV_FF contains fresh and frozen fruits and vegetables: specifically categories 20201, 20202, 20301, 20302, 20401, 20402, 20601, 20602, 30101, 30102, and 30104.
2. FV_CJ contains canned fruits and vegetables and 100% fruit and vegetable juices: specifically categories 30201, 20203, 20303, 20403, 20603, and 30103.
3. Snacks contains sweet and salty snacks, potato chips and candy: specifically categories 60501, 60502, 60403.
4. Sugary beverages contains both carbonated and non-carbonated sugary beverages such as soda, juice cocktails, flavored water: specifically categories 60303 and 60304.
5. Packaged meals includes canned, frozen, and dry packed meals, sides, and salads. This includes canned soup. The specific categories are 60602, 60603, and 60604.
   Processed meats contains sausage, bacon, lunchmeat, etc. and is category 50501.

Appendix C
Variable Definitions

1. LN annual income – The natural log of the households annual income
2. HH Rents – a binary variable that equals 1 if the household rents their residency
3. HH Free - a binary variable that equals 1 if the household lives their residency for free
4. Vehicle Access - a binary variable that equals 1 if the household answered they have access to a vehicle when needed.
5. Currently on SNAP - a binary variable that equals 1 if the household was receiving SNAP benefits during the sampling week.
6. Heard of "My Plate" - a binary variable that equals 1 if the household answered they had were aware of the "My Plate" standards.
7. HH Diet Status – A self-reported diet status of the household by the primary respondent. It is on a scale from 1-5 with 1 being the best health.
8. Meals at Home – The number of meals the family ate at home during the sampling week.
9. HH member uses tobacco - a binary variable that equals 1 if anyone in the household uses any tobacco products.
10. Use of Grocery List - A self-reported measure of how often the primary respondent uses a grocery list. It is on a scale from 1-5 with 1 being the least often.
11. HH member > 65 - a binary variable that equals 1 if anyone in the household is older than 65.

Appendix D
Essay 2 First Stage Results

Table D.1. Combined Childcare Specification

VARIABLES	FAH Activities	Childcare	Adult care
Annual Income	0.000***	-0.000*	-0.000***
	(0.000)	(0.000)	(0.000)
Resides in Metro	-0.010	-0.061**	0.043
	(0.013)	(0.030)	(0.075)
Resides in MW	-0.053***	0.076**	-0.042
	(0.014)	(0.030)	(0.101)
Resides in South	-0.081***	0.058	0.040
	(0.013)	(0.038)	(0.094)
Resides in West	-0.035*	-0.001	-0.113
	(0.019)	(0.029)	(0.105)
Rents Residency	0.038***	0.004	-0.054
	(0.012)	(0.025)	(0.081)
Avg. HH Age	0.023***	0.080***	0.049***
	(0.002)	(0.005)	(0.010)
Avg. HH Age sq.	-0.000***	-0.001***	-0.000***
	(0.000)	(0.000)	(0.000)
Residence is Rent Free	0.092*	0.144	0.084
	(0.050)	(0.099)	(0.268)
Child Aged 1-2	0.403***	1.101***	-0.288
	(0.018)	(0.026)	(0.181)
Child Aged 3-5	0.318***	0.819***	-0.186*
	(0.017)	(0.023)	(0.107)
Child Aged 6-12	0.342***	1.385***	0.103
	(0.013)	(0.020)	(0.104)
Child Aged 13-17	0.113***	0.093***	0.055
	(0.014)	(0.022)	(0.098)
Black	-0.133***	0.025	-0.136
	(0.018)	(0.033)	(0.107)
Asian	0.296***	-0.056	-0.544***
	(0.022)	(0.045)	(0.173)
Other Race	-0.070**	0.010	0.158
	(0.034)	(0.062)	(0.177)
Hispanic	0.126***	0.025	-0.172*
	(0.014)	(0.034)	(0.088)
Married	0.258***	0.440***	0.055
	(0.016)	(0.028)	(0.105)
Some Post HS Education	-0.003	-0.054**	0.161**
	(0.013)	(0.026)	(0.071)
Bachelor's Degree	0.032**	-0.035	-0.078
	(0.014)	(0.025)	(0.091)
Graduate Degree	0.053***	-0.046	-0.110
	(0.015)	(0.035)	(0.086)
Unemployed	0.229***	0.680***	0.920***
	(0.022)	(0.033)	(0.117)

Observations	59,463	59,463	59,463

Table D.1. Combined Childcare Specification cont.

VARIABLES	FAH Activities	Childcare	Adult care
Not in Labor Force	0.289***	0.658***	0.485***
	(0.015)	(0.023)	(0.081)
Self-Employed	0.031	-0.001	0.066
	(0.020)	(0.041)	(0.116)
Access to Car	-0.166***	-0.196***	0.191**
	(0.011)	(0.024)	(0.092)
HH member > 65 years old	-0.028*	0.101*	0.178*
	(0.017)	(0.055)	(0.101)
Single-Head of Household	-0.108***	-0.626***	-0.387***
	(0.017)	(0.060)	(0.124)
Female Single-Head of Household	0.148***	0.884***	-0.258***
	(0.015)	(0.058)	(0.094)
Constant	-3.521***	-4.451***	-6.685***
	(0.053)	(0.106)	(0.268)
Observations	59,463	59,463	59,463

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table D.2. Separated Childcare Specification

VARIABLES	FAH Activities	Primary Childcare	Secondary Childcare	Adult care
Annual Income	-0.000***	0.000	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Resides in Metro	-0.010	-0.026	-0.075**	0.043
	(0.013)	(0.039)	(0.033)	(0.075)
Resides in MW	-0.053***	0.067*	0.081**	-0.042
	(0.014)	(0.038)	(0.034)	(0.101)
Resides in South	-0.081***	-0.000	0.083*	0.040
	(0.013)	(0.040)	(0.045)	(0.094)
Resides in West	-0.035*	-0.041	0.016	-0.113
	(0.019)	(0.040)	(0.034)	(0.105)
Rents Residency	0.038***	0.005	0.002	-0.054
	(0.012)	(0.030)	(0.029)	(0.081)
Avg. HH Age	0.023***	0.081***	0.080***	0.049***
	(0.002)	(0.006)	(0.006)	(0.010)
Avg. HH Age sq.	-0.000***	-0.001***	-0.001***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Residence is Rent Free	0.093*	0.247*	0.097	0.084
	(0.050)	(0.129)	(0.106)	(0.268)
Child Aged 1-2	0.402***	1.368***	0.968***	-0.288
	(0.018)	(0.032)	(0.030)	(0.181)
Child Aged 3-5	0.318***	0.926***	0.769***	-0.187*
	(0.017)	(0.028)	(0.027)	(0.107)
Child Aged 6-12	0.341***	1.025***	1.539***	0.103
	(0.013)	(0.025)	(0.023)	(0.104)
Child Aged 13-17	0.113***	0.159***	0.064**	0.055
	(0.014)	(0.032)	(0.027)	(0.098)
Black	-0.133***	-0.177***	0.104***	-0.136
	(0.018)	(0.042)	(0.038)	(0.107)
Asian	0.296***	-0.015	-0.078	-0.544***
	(0.022)	(0.051)	(0.052)	(0.173)
Other Race	-0.070**	-0.117	0.059	0.158
	(0.034)	(0.076)	(0.070)	(0.177)
Hispanic	0.126***	-0.076*	0.064*	-0.172*
	(0.014)	(0.040)	(0.038)	(0.088)
Married	0.258***	0.517***	0.401***	0.055
	(0.016)	(0.039)	(0.032)	(0.105)
Some Post HS Education	-0.003	-0.053	-0.054*	0.161**
	(0.013)	(0.034)	(0.030)	(0.071)
Bachelor's Degree	0.032**	0.074**	-0.081***	-0.078
	(0.014)	(0.034)	(0.028)	(0.091)
Graduate Degree	0.053***	0.111**	-0.119***	-0.110
	(0.015)	(0.049)	(0.036)	(0.086)
Unemployed	0.229***	0.767***	0.644***	0.920***
	(0.022)	(0.044)	(0.036)	(0.117)
Not in Labor Force	0.289***	0.837***	0.580***	0.484***

Observations	59,463	59,463	59,463	59,463

Table D.2. Separated Childcare Specification cont.

VARIABLES	FAH Activities	Primary Childcare	Secondary Childcare	Adult care
	(0.015)	(0.030)	(0.027)	(0.081)
Self-Employed	0.031	0.016	-0.006	0.066
	(0.020)	(0.047)	(0.047)	(0.116)
Access to Car	-0.166***	-0.162***	-0.212***	0.191**
	(0.011)	(0.036)	(0.027)	(0.092)
HH member > 65 years old	-0.028*	0.106*	0.098	0.178*
	(0.017)	(0.060)	(0.065)	(0.101)
Single-Head of Household	-0.107***	-0.565***	-0.650***	-0.387***
	(0.017)	(0.074)	(0.069)	(0.124)
Female Single-Head of Household	0.149***	1.056***	0.803***	-0.258***
	(0.015)	(0.070)	(0.068)	(0.094)
Constant	-3.520***	-5.921***	-4.711***	-6.684***
	(0.053)	(0.140)	(0.125)	(0.268)
Observations	59,463	59,463	59,463	59,463

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table D.3 Secondary Childcare Only Specification

VARIABLES	FAH Activities	Secondary Childcare	Adult care
Annual Income	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)
Resides in Metro	-0.010	-0.075**	0.044
	(0.013)	(0.032)	(0.075)
Resides in MW	-0.055***	0.077**	-0.043
	(0.014)	(0.033)	(0.101)
Resides in South	-0.081***	0.084*	0.041
	(0.013)	(0.044)	(0.094)
Resides in West	-0.035*	0.018	-0.102
	(0.019)	(0.034)	(0.106)
Rents Residency	0.038***	0.003	-0.056
	(0.012)	(0.028)	(0.080)
Avg. HH Age	0.022***	0.078***	0.050***
	(0.002)	(0.006)	(0.010)
Avg. HH Age sq.	-0.000***	-0.001***	-0.000***
	(0.000)	(0.000)	(0.000)
Residence is Rent Free	0.085*	0.087	0.078
	(0.050)	(0.101)	(0.268)
Child Aged 1-2	0.296***	0.829***	-0.386**
	(0.017)	(0.030)	(0.181)
Child Aged 3-5	0.252***	0.687***	-0.249**
	(0.016)	(0.026)	(0.108)
Child Aged 6-12	0.291***	1.476***	0.058
	(0.013)	(0.023)	(0.104)
Child Aged 13-17	0.109***	0.056**	0.050
	(0.014)	(0.027)	(0.098)
Black	-0.128***	0.116***	-0.134
	(0.018)	(0.038)	(0.107)
Asian	0.298***	-0.073	-0.550***
	(0.022)	(0.051)	(0.172)
Other Race	-0.066**	0.066	0.157
	(0.033)	(0.069)	(0.177)
Hispanic	0.129***	0.070*	-0.175**
	(0.014)	(0.037)	(0.088)
Married	0.250***	0.387***	0.042
	(0.016)	(0.031)	(0.105)
Some Post HS Education	-0.002	-0.051*	0.161**
	(0.012)	(0.029)	(0.071)
Bachelor's Degree	0.030**	-0.086***	-0.071
	(0.013)	(0.028)	(0.090)
Graduate Degree	0.050***	-0.124***	-0.113
	(0.014)	(0.035)	(0.086)
Unemployed	0.204***	0.595***	0.903***
	(0.022)	(0.035)	(0.117)
Not in Labor Force	0.262***	0.518***	0.474***

Observations	59,463	59,463	59,463

Table D.3 Secondary Childcare Only Specification cont.

VARIABLES	FAH Activities	Secondary Childcare	Adult care
	(0.015)	(0.027)	(0.081)
Self-Employed	0.029	-0.007	0.065
	(0.020)	(0.046)	(0.116)
Access to Car	-0.162***	-0.203***	0.198**
	(0.011)	(0.027)	(0.092)
HH member > 65 years old	-0.026	0.105	0.190*
	(0.017)	(0.064)	(0.101)
Single-Head of Household	-0.108***	-0.657***	-0.390***
	(0.017)	(0.069)	(0.124)
Female Single-Head of Household	0.140***	0.791***	-0.265***
	(0.015)	(0.067)	(0.094)
Constant	-3.502***	-4.658***	-6.701***
	(0.052)	(0.124)	(0.269)
Observations	59,463	59,463	59,463

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Appendix E
FoodAPS Fast Food Event Creation

In the FoodAPS event file two variables were used to denote a fast food event. First PLACETYPE was used to identify FAFH events that take place at a restaurant. Events with PLACETYPE value 6 are considered. Second with in this PLACETYPE 6 group, the variable PLACENAME was used to identify fast food establishments. The list below identifies the key words used to denote a fast food event by PLACENAME.

A&W, Pizza, Custard, Deli, Arby's, Bon Pain, Pretzels, Pizzeria, Baskin, Taco, Burger, Blimpie, Bojangle, Boston, Ice Cream, Carl's, Checkers, Chick-Fil, Chipotle Church's, Cold Stone, Cook Out, Culver's, DQ, Dairy Queen, Del Taco, Dunkin', El Pollo Loco, Firehouse, Five Guys, McDonalds, Great Wall, Hardee's, In-N-Out, Fast Food, Jack In The, Jack-In-The, Jimmy John's, KFC, Long John Silver, McDonald's, Moe's, Noodles & Panda Express, Panera Bread, Popeye's, Potbelly, Pret A Manger, Qdoba, Quiznos, Rally's, SUBWAY, Saladworks, Soup Company, Sbarro, Hot Dog, Sonic Drive, Steak 'n Shake, Tim Hortons, Togo's, Wendy's, Whataburger, White Castle

Appendix F
Essay 3 First Stage Estimation Results

Table F.1: First Stage Results for Demographics on Time Allocations for a Seemingly Unrelated Regression Model

	Adult Care	Secondary Childcare	Work	FAH Activities	Primary Childcare
Annual Income	-0.00***	-0.00***	0.00***	-0.00***	0.00***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Resides in metropolitan county	0.38	-6.28***	-1.19	-0.91	0.47
	(0.620)	(1.653)	(2.295)	(0.855)	(0.821)
Resides in Midwest	-0.21	4.54**	-0.08	-6.30***	0.41
	(0.722)	(1.923)	(2.670)	(0.995)	(0.956)
Resides in South	0.66	6.74***	3.73	-8.73***	-1.32
	(0.670)	(1.786)	(2.479)	(0.924)	(0.887)
Resides in West	-0.38	1.22	1.92	-3.91***	-2.76***
	(0.738)	(1.968)	(2.732)	(1.018)	(0.978)
Rents Residency	-1.40**	5.87***	7.67***	2.09***	3.03***
	(0.577)	(1.538)	(2.135)	(0.796)	(0.764)
Resides for Free	1.32	7.83	10.90	2.63	5.57**
	(2.119)	(5.646)	(7.839)	(2.922)	(2.806)
Household size	0.87***	8.85***	-2.22***	1.58***	3.30***
	(0.217)	(0.578)	(0.802)	(0.299)	(0.287)
Child 1 to 2 years old	-4.07***	106.65***	0.10	15.31***	84.58***
	(0.956)	(2.549)	(3.539)	(1.319)	(1.267)
Child 3 to 5 years old	-3.90***	94.80***	1.68	11.73***	49.42***
	(0.818)	(2.179)	(3.025)	(1.127)	(1.083)
Child 6 to 12 years old	-2.70***	187.10***	-8.43***	11.45***	32.18***
	(0.669)	(1.784)	(2.476)	(0.923)	(0.886)
Child 13 to 17 years old	-2.13***	-10.90***	-0.58	5.46***	-1.45
	(0.771)	(2.054)	(2.851)	(1.063)	(1.020)
Head of Household Black	-1.74**	-0.56	-0.55	-7.86***	-7.50***
	(0.686)	(1.827)	(2.537)	(0.946)	(0.908)
Head of Household Asian	-2.93**	-15.27***	9.02**	31.40***	-0.39
	(1.194)	(3.182)	(4.417)	(1.646)	(1.581)
Head of Household Other Race	2.38	0.78	-1.56	-3.12	-2.80
	(1.608)	(4.285)	(5.950)	(2.217)	(2.129)
Head of Household Hispanic	-1.39**	0.54	-1.03	10.10***	-8.16***
	(0.705)	(1.878)	(2.608)	(0.972)	(0.933)
Head of Household Married	2.93***	15.71***	1.37	16.35***	5.51***
	(0.548)	(1.460)	(2.027)	(0.755)	(0.725)
Highest Education some college	1.41**	-3.17**	2.22	0.93	-0.32
	(0.601)	(1.603)	(2.225)	(0.829)	(0.796)
Highest Education Bachelors	-0.64	-1.78	-3.89	2.35***	4.20***

	(0.654)	(1.744)	(2.421)	(0.902)	(0.867)
Highest Education Graduate	0.27	-7.13***	-2.81	6.22***	6.56***
	(0.765)	(2.038)	(2.830)	(1.055)	(1.013)
Head of Household Unemployed	6.77***	41.26***	-230.79***	15.16***	18.42***
	(0.854)	(2.276)	(3.160)	(1.178)	(1.131)
Head of Household NILF	2.40***	28.23***	-253.66***	19.83***	21.41***
	(0.591)	(1.574)	(2.186)	(0.815)	(0.782)
Head of Hosuehold Self-employed	-0.20	-1.38	2.29	1.42	1.26
	(0.931)	(2.481)	(3.445)	(1.284)	(1.233)
Average age of HH	0.43***	1.35***	2.19***	1.53***	1.27***
	(0.081)	(0.215)	(0.298)	(0.111)	(0.107)
Average age of HH squared	-0.00***	-0.02***	-0.02***	-0.01***	-0.02***
	(0.001)	(0.002)	(0.003)	(0.001)	(0.001)
Constant	-5.63**	0.38	219.76***	20.42***	-22.05***
	(2.242)	(5.975)	(8.296)	(3.092)	(2.969)
Observations	59,466	59,466	59,466	59,466	59,466
R-squared	0.008	0.363	0.282	0.074	0.242

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B.A. in Economics, Minor in Applied Mathematics
Franklin & Marshall College '10

Publications

- Michele Ver Ploeg, Lisa Mancino, Jessica E. Todd, Dawn Marie Clay, and **Benjamin Scharadin.** "Where Do Americans Usually Shop for Food and How Do They Travel To Get There? Initial Findings from the National Household Food Acquisition and Purchase Survey", Economic Information Bulletin No. (EIB-138) 27 pp, March 2015.
- Jessica E. Todd and **Benjamin Scharadin.** "Where Households Get Food in a Typical Week: Findings from USDA's FoodAPS", Economic Information Bulletin No. (EIB-156) 33 pp, July 2016
- **Scharadin, Benjamin**. Principal Component Analysis of State Level Food System Indicators. University of Minnesota Digital Conservancy. February 2012. http://purl.umn.edu/123113.

Teaching

Courses Taught

- AGBM101 (Spring 2016) - Introduction to microeconomic principles and their application to real world examples of agribusiness management issues.
- AGBM302 (Spring 2017) - Analysis of economic and psychological determinants of the demand for food; marketing decisions in an increasingly consumer-driven food system.

Experience

Economist (May '16 – August '17) USDA Economic Research Service

Research Assistant (August '13 – August '17) Pennsylvania State University
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