Incorporating Time Costs into SNAP Allotment Calculation: A Home Food Production Time Use Analysis

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Introduction

The Supplemental Nutrition Assistance Program (SNAP), formerly known as the Food Stamp Program, serves as the largest hunger safety nest in the United States. The program aims at enabling low-income eligible people to purchase foods needed for a nutritionally adequate diet through providing monthly benefits pre-calculated for achieving the goal. In 2014, the program served about 47 million people with a total program cost of about $74 billion. The average monthly benefits in 2014 were around $125 per person and $256 per household (FNS, 2015a).

Thorough evaluations of the SNAP program effectiveness at achieving its goals (i.e., achieving food security and healthier diets) are wanted given the sizable program costs and are essential for utilizing the vast coverage of SNAP program to achieve the largest public health impact. The current literature has evaluated the SNAP program from program participation (e.g., FNS, 2015b; FNS, 2014a) to effectiveness at improving food security level (e.g., Ratcliffe et al., 2011; FNS 2014b) to effectiveness at improving specific food group and/or nutrient intakes (e.g., fruit and vegetable intakes) (e.g., Klerman et al., 2014; Nguyen et al, 2014). Generally studies agreed that SNAP program has significant positive effects on improving children's food security level and nutrient intake where mixed findings were found on adult participants' nutrient quality and food security improvement (e.g., Leung et al., 2012; Food Research and Action Center, 2013; FNS 2014b; Fey-Yensan et al., 2013).

Several proposals and calls for actions have been brought to the spotlight: such as proposing different versions of SNAP program modifications through imposing restrictions on food purchased using SNAP benefits (e.g., You et al., 2012; Pomeranz and Chriqui, 2015) and providing incentives for healthy food purchasing (e.g., Olshoa et al., 2015; FNS 2014c). The signature governmental action along this line is the 2009 American Recovery and Reinvestment Act (ARRA) which temporary increased SNAP maximum monthly benefits by 13.6% for a given household size. Several studies had set off to evaluate the effect of this increase and did not reach consensus on the effectiveness (e.g., Nord and Prell, 2011; Andrew et al., 2013; Waehrera et al., 2015). All of the above theoretical predictions and field experiments focused on whether or not the arbitrary chosen "boosts" (no matter it is in the form of rewards or punishment) have significant impact on SNAP participants' food security and health outcome improvements. However there is a remaining unanswered question: how much of the maximum SNAP allotment should be adjusted to address the majority of the potential inadequacy at reaching SNAP program goals?

In 2013, the Institute of Medicine/National Research Council committee published a report per the United States Department of Agriculture (USDA) request specifically on addressing the SNAP benefit adequacy. The report identifies a set of adequacy-relevant factors and calls for research to directly incorporate those factors into the SNAP allotment calculations (IOM/NRC, 2013). The three key factors identified by the committee that are currently absent from the benefit calculation are: time required to shop and prepare food at home, price variation across regions and unequal access to healthy food. The ignorance of time factor has been recognized in the literature as a significant road-block for SNAP to achieve its nutritional goals (Rose 2007; You et al., 2009; Davis and You 2010a, 2010b, 2011, 2013; Rashcke 2012; Davis 2014) and is the focus of this paper.

The SNAP maximum allotments by household size are updated annually based on outputs from a set of nonlinear mathematical programming models, developed by the USDA, called Thrifty Food Plan (TFP). The TFP aims at providing an economical dietary pattern recommendation that deviates the least from low-income consumers' consumption pattern and still meets dietary guidelines (see You et al., 2009 for detailed model descriptions). A key limitation of the TFP is that it assumes all foods consumed are prepared at home mostly from scratch with only some pre-prepared foods allowed in the recent modifications. As a result, labor (time) cost in food production is only partially considered in the model.

The time (labor) cost absent from the calculation is an important oversight since labor is an inseparable part of at-home food production. Ignoring labor (time) cost will lead to an overly optimistic evaluation of SNAP program's effectiveness of reaching nutrition goals: the number of people not reaching the SNAP program nutrition goals will be underestimated or stated alternatively, the number of people classified as meeting the target will be over estimated.

Rose (2007) first estimated that the actual food production time by SNAP participants is about 2 to 8 hours less per week than what is implicitly required by the TFP model assumptions. Turning to the cost aspect, it has been shown that the time (labor) cost share of the at-home food production total cost is substantial. The average time input cost share across methods is estimated to be about 28% for general population and is estimated to jump to about 58% when the target population is the SNAP participants (Davis and You, 2010a). This sizable cost share supports the importance of time in food production and the 30% increase in SNAP population signals the heightened relevance of time for SNAP benefit adequacy. Further SNAP program effectiveness evaluation taking time cost into consideration reveals that time is actually more constraining than money (Davis and You, 2010b, 2011, 2013). Davis and You (2011) found that when time is excluded 62% of the households spend enough money to reach the TFP target (poverty rate of 38%) but when time is included only 13% of the households spend enough money to reach the TFP target (poverty rate of 87%). These drastic differences may help explain why few households actually reach nutritional targets given current SNAP benefit levels. Examining from home meal production outcome perspective, Davis and You (2013) found that the estimated home meal poverty rate is also about 85% and confirmed the difficulty of substituting money for time in home meal production.

All of those studies reached a similar conclusion: labor (time) is a more constraining factor in reaching the TFP nutritional target than money. Those studies to date have focused on single headed households, which while circumventing some empirical difficulties, begs the question that whether or not those findings can carry over to dual headed households. There are reasons to believe that the situation for dual headed households may not be as bad simply because dual headed households have more opportunities for intra-household time substitution. But depending on households (with or without children and employment status of the couples) some households may experience increasing time constraints due to larger home production output demands and minimal spousal time inputs.

If the household operates under "separate spheres" and the dual headed household can be treated like a single headed household in that one individual is responsible for food production, many econometric hurdles, will be discussed in later section, can be avoided. Yet, the complementarity-substitutability of spouses' production time inputs and heterogeneity of domestic productivity across households have been shown to be influential in welfare analysis (e.g., Apps and Rees, 1996; Apps 2003; Donni 2008;). The time use literature has also documented both substitutability (Bloemen et al., 2010) and complementarity features of the time spouses devote to home production (Connelly and Kimmel, 2009). Gender-specific factors have exhibited influential power in determining the housework time input shares between husband and wife (e.g., education attainment and preschool age child presence) therefore the share is non-homogeneous across households (Alvarez and Miles, 2003). All those point to the importance of spousal time input in studying home production of multi-person households.

Due to the time use data limitations, several econometrics issues emerge when research angles get adjusted to include dual-headed households. One of the key issue is that most time use surveys only randomly select response person from a household and the respondent may or may not be the sole person of interest for research questions. For our context, the selected respondent may or may not be the main home food producer in the household. Even for those households with main food producer respondent, if the spouses shared the food production responsibilities the missing spousal home food production time information will result in underestimation of actual household time in home food production.

The purpose of this paper is three fold. First is to answer the recent call from the IOM to incorporate time dimension into the SNAP benefit formula in a tractable manner for both single-headed households and dual-headed households. Second is to present an algorithm that utilizes the food production role identification information to predict the missing spousal home food production time for the dual-headed households. This algorithm can be used in a broader context of time use analysis. Third is to determine whether or not the dual nature of the household makes a difference in the proposed SNAP benefit adjustment and compare the adjusted benefits with other food plans (i.e., Low Cost Food Plan and Moderate Cost Food Plan).

Methodology

The Time Cost Scaling Factor

Davis and You (2011) developed a counting procedure for classifying individuals as 'nutritionally poor' based on standard compensation theory from economics. Specifically, they utilized a cost difference approach (Malchup 1957) that can be used in conjunction with the market substitute approach for valuing time (Gronau 1986) to generate a money-time threshold that is effectively the relevant isocost required to be consistent with the nutrition target (i.e. the TFP target). The money-time threshold (implied by the TFP) (MT) is given by the following formula:

(1) $MT^i = M^i_{TFP} - p(T^i_{actual} - T^i_{TFP})$, i =1,2,…, N.

where M_{TFP} is the amount of dollar benefits associated with the TFP (which provides the lower money threshold that outline the money poverty level), p is the opportunity cost of time (a example can be the market price for food production services in the home), T_{actual} is the household's actual time spent in home food production, T_{TFP} is the TFP implied home food production time that is corresponding to M_{TFP} required to reach the TFP consistent isoquant, and i indexes the households. This formula effectively converts a two-dimensional poverty measurement issue into a uni-dimensional problem.

The IOM call for research is to elicit ways to scale SNAP benefit amounts reflecting the importance of the identified key factors in order to improve the SNAP program effectiveness at reaching its food safety and nutrition goals. Our study heads to the direction of incorporating time cost into the SNAP maximum benefit calculation through estimating a scaling factor to increase the SNAP maximum amount (M_{TFP}) by certain percentage so that the adjusted amount will equal to the money-time threshold (MT). This implies that the scaling factor, k, will satisfy the following relationship:

(2) $MT^i = M^i_{TFP} \times (1 + k_i)$.

The equation (2) naturally leads to that:

(3) $k_i = \frac{MT^i}{M^i_{TFP}} - 1$.

After substituting the definition of MT (equation (1)) into the scaling factor k's formula (equation (3)), we have the empirical equation for estimating the scaling factor k:

(4) $k_i = \frac{p \cdot (T^i_{TFP} - T^i_{actual})}{M^i_{TFP}}$.

The equation (4) defines the SNAP maximum benefit scaling factor that takes into account the home food production time deficiency cost. This scaling factor can vary across household subgroups whose time deficiencies differ significantly.

The Needs for Dual-Headed Household

As mentioned before, the time cost deficiency studies mainly focused on single-headed households. The main reasons are not only the fact that majority of SNAP participating households are single-headed but also the limitation of time use data sets. The time use data collection design usually only randomly selected one or two survey respondents from a household which results in missing time use information for dual-headed households.

Under the context of home food production, there is another layer of issue: the role of household members in home food production. Unlike leisure time or personal care time, not everyone contributes to home food production. Therefore, to capture the household time input into producing homemade food it is essential to identify those main home-food 'producers' in the household. The Eating and Health Module (EHM) of the American Time Use Survey (ATUS) provides this key piece of information (described in details in data section). For those households with the survey respondent as the main food producer, the actual household time input in equation (4), T^{i}_{actual}, consists of only the survey respondent nonmissing time use information. This is the straightforward case where no imputation or assumptions involved. However for those households with either non-food producer survey respondent or with dual-producers, the missing spousal time use information requires imputation. For those households, the above equation (4) actually takes the following form:

$$(5)\ k_i = \frac{p\cdot(T^{i}_{TFP} - T^{i,R}_{actual} - T^{i,S}_{actual})}{M^{i}_{TFP}},$$

where $T^{i,R}_{actual}$ and $T^{i,S}_{actual}$ are the actual home food production time input from the survey respondent (R) and his/her spouse (S). The difference between equation (4) and equation (5) will show the time deficiency cost scaling factor overestimation when ignoring the missing spouse time input:

$$(6)\ \Delta k_i = \frac{p\cdot T^{i,S}_{actual}}{M^{i}_{TFP}}.$$

The empirical testing of this difference as defined by equation (6) will reveal the statistical significance of accounting in missing spousal information in the benefit adjustment.

The Missing Spousal Time Use Information Imputation

The time use literature has proposed different imputation approaches for filling in the missing time use information. The two commonly used methodologies are the out-of-sample prediction and matching algorithms. Connelly and Kimmel (2009) used Tobit models to estimate three different non-paid time uses controlling for spouses' characteristics and then use the estimated models to predict missing spouse's time use (i.e., predict husband's time use for those wife respondent and predict wife's time use for those husband respondent). Days of the week dummies and spouse's demographic information serve the identification purpose. They also used propensity score matching to impute the spousal missing time use as a robustness check. Hamermesh (2008) employee nearest neighbor matching for filling in the missing spousal time use while using the out-of-sample prediction to impute wage rates and household net incomes in his household production function analysis.

Following the literature's trend, we present an out-of-sample prediction algorithm to be used to predict spousal food production time use information based on the respondent's food production time, spousal demographic and employment information along with the EHM food production role identification information. We chose the two-part model (TPM), preferable in health economics literature, instead of Tobit or Heckman selection model (Mullahy, 1998). The choice of TPM over Tobit model rests mainly on that the TPM generalizes the Tobit model to analyze those data sets with genuine zeros (i.e., those reporting zeros are truly results from no activity and there is no latent unobserved potential value). In other words, the TPM is better suited for those participation decision dominated (relative to the consumption decision) context which in our study it is more reasonable: the reported zeros are true zero minutes spent that day on food production and are unlike the labor supply problem where zero wage rates have relevant corresponding potential positive potential wage rates (Stewart, 2009). The choice of the two-part model over Heckman selection model rests on not only that we are interested in the actual production time (Dow and Norton, 2003), as opposed to potential production time, but also the empirical evidence of the robustness to collinearity problem where there are no extra identification information available (see Puhani 2000 for a detailed review).

Data

The ATUS and EHM

The key variables needed for calculating the time cost scaling factor, k, as shown in the equation (4) and (5) are the actual food production time input, T_{actual}. The most comprehensive data available for the United States, that is nationally representative, is the American Time Use Survey (ATUS) collected by the Bureau of Labor Statistics (BLS), which is a supplement to the Current Population Survey (CPS).

From each ATUS sample household, one individual age 15 or older is randomly chosen. This "respondent" person is interviewed by telephone and reports their activities for their single designated diary day. The ATUS sample is randomized by day, with 50 percent of the sample reporting about the weekdays (M–F) and 50 percent reporting about weekends (Sa–S). A 3-tier coding system consists of 17 broad activity categories, each with multiple second- and third-tier subcategories.

The estimated amount of time spent in food production depends on how food production is defined. A narrow definition may consist of only food preparation and cooking time. A broader definition would also include meal planning time, grocery shopping time, travel time to and from the grocery store, and meal clean-up time. In our study, we follow the broader definition in that time in food production is defined by summing time over five categories: Food and Drink Preparation (ATUS Code 020201), Food Presentation (ATUS Code 020202), Kitchen and Food Clean-up (ATUS Code 020203), Grocery Shopping (ATUS Code 070101), and Travel Related to Food and Drink Preparation, Clean-up, and Presentation (ATUS Code 180202).

Data Limitation and Our Solutions

While the ATUS data represent a significant step forward for conducting time allocation analysis, three limitations have to be confronted for our analysis. First, the respondent is not necessarily the person who does the food production in the home. Second, the data is collected for a single day, not for a week while the TFP outputs are usually in the unit of a week. Third, time use information is only collected from one individual in the household, and time expenditures by other household members are not directly captured.

To address the first limitation of the ATUS, we utilize the Eating and Health Module (EHM). The EHM is a supplement to the ATUS that was conducted from 2006 to 2008 and can be matched at the household level to the ATUS which resulted in our sample coverage is from 2006 to 2008. Among other questions, the EHM asked the respondent if they are (i) the main grocery shopper and (ii) the main meal preparer. There are three possible answers to each of these questions: (i) yes, (ii) no, and (iii) split equally. This identification information enables the classification of the survey respondents into four categories: main food producer (yes to both questions), not main food producer (no to both questions), share-load food producer (answer 'split equally' to both questions) and single role taker (answer 'split equally' to only one of the two questions). We focused on only the first two categories (i.e., those main food producers and those not main food producers). Those two types of respondents consist of the majority of our sample (about 76%). We excluded those shared-load food producers to avoid making further assumptions on the unspecified share load between spouses. Furthermore, we focus on those households with two or less adults since the combined ATUS and EHM will not provide any more information about other household adult members. About 85% of the sample consists of those dual-headed and single-headed households.

One of the main goal of this study is to estimate the time deficiency scaling factor for adjusting the SNAP maximum benefit calculation therefore we limit our sample to those households with incomes equal to or less than 185 percent of the poverty threshold, called "low income" for ease of communication. The SNAP eligibility is 130% of poverty however the data set only contain a total of 1,804 observations that are at or below 130% poverty threshold which is 18% of the total available sample. For low income, there are 2,961 observations or households and this sample size increase substantially boost the degrees of freedom in our prediction.

To address the second and third limitations of the ATUS, we not only predict spousal daily time use but also predict other non-survey days of the week for both respondent and his/her spouse. The ATUS data contains demographic information for not only respondent but also the spouse such as gender, race, age, educational attainment, marital status, the presence of children in the household, and employment status. Those information will be used in the time use imputations.

Given the daily sampling frame of the ATUS-EHM, there are days when individuals may not spend any time in food production; but this is just a sampling issue, so the model must account for two parts: (i) the probability of spending time in food production on a given day and (ii) the time spent in food production given time is greater than zero. As discussed above, we utilized the two-part model (TPM) technique where the first part is a probit model depicting the home food production update decisions on that day and the second part is a nonlinear logistics function on minutes spent. The explanatory variables included in both parts of the model are employment indicator(s), household composition indicators (1 adult with no children, 1 adult with children, 2 adults with no children, 2 adults with children), age of the respondent, ethnicity (e.g., Hispanic), race (e.g., White, Black), gender, SNAP participant, income category, metropolitan indicator, holiday indicator, day indicator, month indicator, and region indicator. The expected time in food production then comes from multiplying the predicted probability of positive time in food production by the predicted time in food production given non-zero time was spent in food production.

The implementation of the time use data imputation follows the algorithm depicted in Figure 1. First, using the EHM production role information, we divided our sample into Main Food Producer (MFP) subsample and Non-main Food Producer (NFP) subsample. Using each subsample, we estimated a TPM as described above and utilizes the day of the week dummies to predict the food production time use for those other days of the week that were not reported by the respondent. This step gives us seven days of time use for each respondent in the subsamples with six predicted daily time use and one actual reported daily time use: MFP daily food production time ($\hat{t}_{md}^{m}, d = 1,2, \dots 7$) and NFP daily food production time ($\hat{t}_{nd}^{n}, d = 1,2, \dots 7$). The superscripts denote the corresponding subsamples (*m* for MFP subsample and *n* for NFP subsample) and the subscripts denote the TPM sources (*md* for MFP daily TPM; *nd* for NFP daily TPM).

For those single-headed households, the TPM did not include the spouse's characteristic variables since it is not applicable and the estimated MFP and NFP daily food production time will be the total household daily home food production time. While for those dual-headed households, a second step is needed to fill in the missing spouse's time use for each of the seven days. The second step is to utilize the estimated MFP TPM that controls spousal characteristics to predict the spousal daily food production time use for those NFP respondents subsample ($\hat{t}_{md}^{n}, d = 1,2, \dots 7$) (i.e., the NFP subsample respondents indicated that they are not the main food producer through EHM information therefore it is reasonable to assume that their spouses take the MFP role since there are only two adults in the household). Similarly, the spousal daily food production time use for those MFP respondents subsample can be predicted by using the estimated NFP TPM ($\hat{t}_{md}^{m}, d = 1,2, \dots 7$).

The last step is to simply sum over the daily time and for those dual-headed households the respondent and the spouse weekly time use will then be summed up to get the total household home food production time.

Other Data

The other variables needed for equation (4) and equation (5) are the USDA TFP maximum weekly amount by household sizes (M_{TFP}), the TFP consistent food production time (T_{TFP}) and the price (p). Follow Davis and You (2011), the USDA Food Plans reports' TFP tables by age and gender form 2006 to 2008 were used to calculate the M_{TFP} information by summing over the individual costs within the household and multiplying the adjustment scale given in the footnotes of the tables (USDA, 2015). The ATUS respondents participated in the CPS December interview therefore we used the data from the December reports for those years. The weekly TFP time (T_{TFP}) contains uncertainty due to the limited two meal plans provided by the USDA documents (see Davis and You 2011 for details). Therefore we used the same simulated empirical distribution derived in Davis and You (2011) which is: $T_{TFP} \sim N(13.13, 6.05)$.

Follow Davis and You (2011), the price, p, is assumed to follow the distribution of: $p \sim N(p_j^{median}, \sigma_j^2)$ where j is the year index. The median and variance information for the price comes from the hourly wage rate for "cooks, private household" (code: 35-2013) reported by the BLS for the month closest to December for 2006 to 2008 (BLS, 2013).

It is clear from the above data description, the variables in equation (4) and equation (5) can be grouped into three types: observed with no uncertainty and varied by household compositions (M_{TFP}); estimated with uncertainty and varied by household compositions (T_{actual} and T_{TFP}); measured with uncertainty and stayed constant across household compositions (p). Therefore, after imputing the missing time use information to get the total household actual food production time, we conducted a probabilistic sensitivity analysis using parametric bootstrapping to account for the uncertainties in the latter two types (Davidson and McKinnon, 1993; Davis and You, 2011). The T_{TFP} and p values are drawn N times from their above specified distributions and then N estimates of the scaling factor k are generated for each observation following equation (4) for single-headed households and equation (5) for dual-headed households. A selected central tendency measure (e.g., mean or median) will be calculated for each N replication and then the distribution of the tendency measure can reveal the resulting scaling factors' sensitivity to those uncertainties.

Results

After utilizing the TPMs to impute not only spousal daily time use but also the other six days of time use for respondents, a decision was made to drop the top 1% of the predicted weekly time use for the NFP subsample due to the limited variations observed in the actual positive production time, which is expected by the definition of NFP, as one way to minimize prediction errors.

The summary statistics of the reported actual food production (before imputations) by food production roles are reported in Table 1. Among different household compositions we focused on the presence of children as the grouping since the focus of our paper is to estimate a time-cost adjustment factor for SNAP benefits and having children in the household is a significant time-demand source. A clear pattern can be observed from the Table 1. Consistent with their definitions, majority of the respondents from the single-headed low-income households are the main food producer of the household (only 151 out of the total 2,216 single-headed households are not the main food producers; about 7%) while sizable dual-headed households' survey respondents are NFP (344 out of a total 1,100; about 31%). Those MFPs with children spend more time (about double the time looking at both the mean and the median) on food production as compared to those MFPs without children. Comparing just the respondent time use, those MFP respondents with spouses spend relatively more time than those MFP respondents with no spouses.

Yet having children or not does not seem to have much difference for those dual-headed households' respondent time use (with children: mean 76 min/day, median 60 min/day; without children: mean 73 min/day, median 52 min/day) as compared to those single-headed ones (with children: mean 55 min/day, median 35 min/day; without children: mean 40 min/day, median 20 min/day).

For those single-headed households, the respondents' reporting time use is equivalent to the household total. However this is not true for those dual-headed households. As described in the method and data section, we conducted out-of-sample prediction to fill in the missing spousal time use information for those dual-headed households and summed up the respondents' actual time use with the predicted spousal time use to derive the household total. Table 2 reports the summary statistics of the household total weekly food production time use in minute after the prediction. It shows the dual-headed household time use ignoring spousal time (dual-headed w/o SP time) and with predicted spousal time (dual-headed w/ SP time). The pattern of consistently underestimating the household total time use when ignoring spousal time information is observed for the dual-headed households as expected (the overall dual-headed household sample shows mean of 423 min/week (about 7 hr/week) and median of 437 min/week (about 7.3 hr/week) before incorporating spousal time use; after spousal predicted time use added in, it shows mean of 659 min/week (about 11 hr/week) and median of 624 min/week (about 10.4 hr/week). Another interesting finding is that the gap between dual-headed households with children and dual-headed household without children shrinks further after the incorporation of spousal time use which signals the intra-household food production time substitution flexibility as compared to the single-headed households. Furthermore, the distribution of household time use turns from negative skew to positive skew after the spousal predicted time added in. This further confirms the underestimation correction effect of the spousal time prediction.

Now we turn the attention to the estimated time deficiency cost scaling factor for SNAP maximum benefits. Table 3 presents the estimated scaling factor, k, along with the USDA TFP amount (M_{TFP}) and the scaling factor adjusted TFP amount

(M_{TFP}•(1+k)). The median scaling factor for single-headed household is much larger than the dual-headed household even with or without considering spousal time use (2.08 for single-headed households versus 0.79 and 0.24 for dual-headed households without and with spousal time considered). In other words, the time cost adjusted SNAP benefit should increase by over 200% for single-headed households while it should increase by about 79% and 24% for dual-headed households without and with spousal time considered. The 95% confidence intervals further reveal that the 24% median increases suggested to dual-headed household with spousal time considered is not statistically significant different from zero while the other two are. All these show that the time deficiency costs play a much larger role in improving SNAP benefit efficiency for single-headed households which is consistent with the expectation of no intra-household substitution resulting in tightened time constraints. The spousal time is important to evaluate dual-headed household food production time inputs and the resulting dual-headed households on average did not need to have SNAP maximum amount adjusted. The single-headed household with children does not need to be adjusted as much as compared to single-headed household without children (1.05 with children (105% increase) vs. 2.47 without children (247% increase)). It seems to suggest that singles with children do not have as large of a time deficiency as those without children which may be the natural results of relatively more at-home food consumption when households have children present. These patterns therefore persist to the adjusted TFP amount as compared to the original TFP amount. The 95% confidence intervals reveal that for those dual-headed households with spousal time included the original TFP amount and the adjusted TFP amount are not actually different from each other statistically. The single-headed households adjusted TFP amounts are statistically different from the original TFP maximum amounts and the median amounts actually are higher than the dual-headed households with spousal time considered ($150/week for single-headed households vs. $123/week for dual-headed w/ SP time).

We further compare the adjusted TFP maximum amount with the other two USDA food plans: Low Cost Food Plan (LCFP) and Moderate Cost Food Plan (MCFP).

Those two food plans are the next step higher in terms of food budget as compared to TFP. The LCFP is used in bankruptcy cases food expenditure allowance determination while LCFP and MCFP are often used in setting child support and foster care payments (Carlson et al., 2007). Table 4 reports those side by side for comparison. Although the adjusted TFP amounts have a much larger median as compared to the other two food plans for single-headed households, those medians are not statistically different from each other for single-headed household overall and single-headed households with children. However, this is not the case for single-headed households without children. The time deficiency in those households are significantly large enough to result in statistically higher adjusted TFP as compared to both LCFP and MCFP (adjust TFP: $142/week as compared to LCFP: $48/week and MCFP: $60/week). For those dual-headed households with spousal time considered, none of the food plans are statistically different from each other. The spousal time consideration reduces the adjusted TFP amounts which again confirms the underestimation of household production time inputs when spousal time use is missing. The overall dual-headed households with spousal time considered have lower median adjusted TFP amount as compared to the other two food plans although the differences are not statistically significant.

Conclusion

This paper fills three gaps in the literature. First, a simple time adjustment multiplier is provided for the maximum SNAP benefit that would take into account time cost as called for a recent IOM report. Second, we demonstrate how household production role information from the Eating and Health Module can be exploited to estimate dual-headed household time in food production. Third, we find empirically that not taken into account spousal time in household production tends to overestimate the time deficit gap in home food production.

We find that ignoring spouse time in dual headed households tends to underestimate the amount of time in food production by about three hours per week, which amounts to almost 30 minutes per day. A consequence of this finding is that the time deficit between time required to meet the nutritional standard associated with the Thrifty Food Plan and actual time in food production is not as great as found in single headed households. This in turn means that the time adjustment multiplier for SNAP benefits does not need to be as great for dual headed households as it would need to be for single headed households. Dual headed households have more resources, in terms of time, than single headed households. As a practical implementation matter, the time adjustment multiplier varies by household and so technically a different multiplier exist for each household. However, as with other adjustments to the maximum SNAP benefit formula that are technically household specific one could use the medians derived here as constants, which would be better than no adjustment.

As with all research there are limitations, but one of particular interest that applies to all studies where time imputations are being made is some measure of accuracy. The out-of-sample prediction approach pursued here, and elsewhere, by definition prohibits an evaluation of accuracy given no measure of the dependent variable is available. Future work should consider ways to evaluate the accuracy of this and other methods for imputing time use. Regardless, the qualitative intuition empirically confirmed here would still stand: ignoring spousal time contribution to food production will tend to overestimate the time deficit in meeting the intended nutritional target of the SNAP

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Figure 1.

Time Prediction Schematic

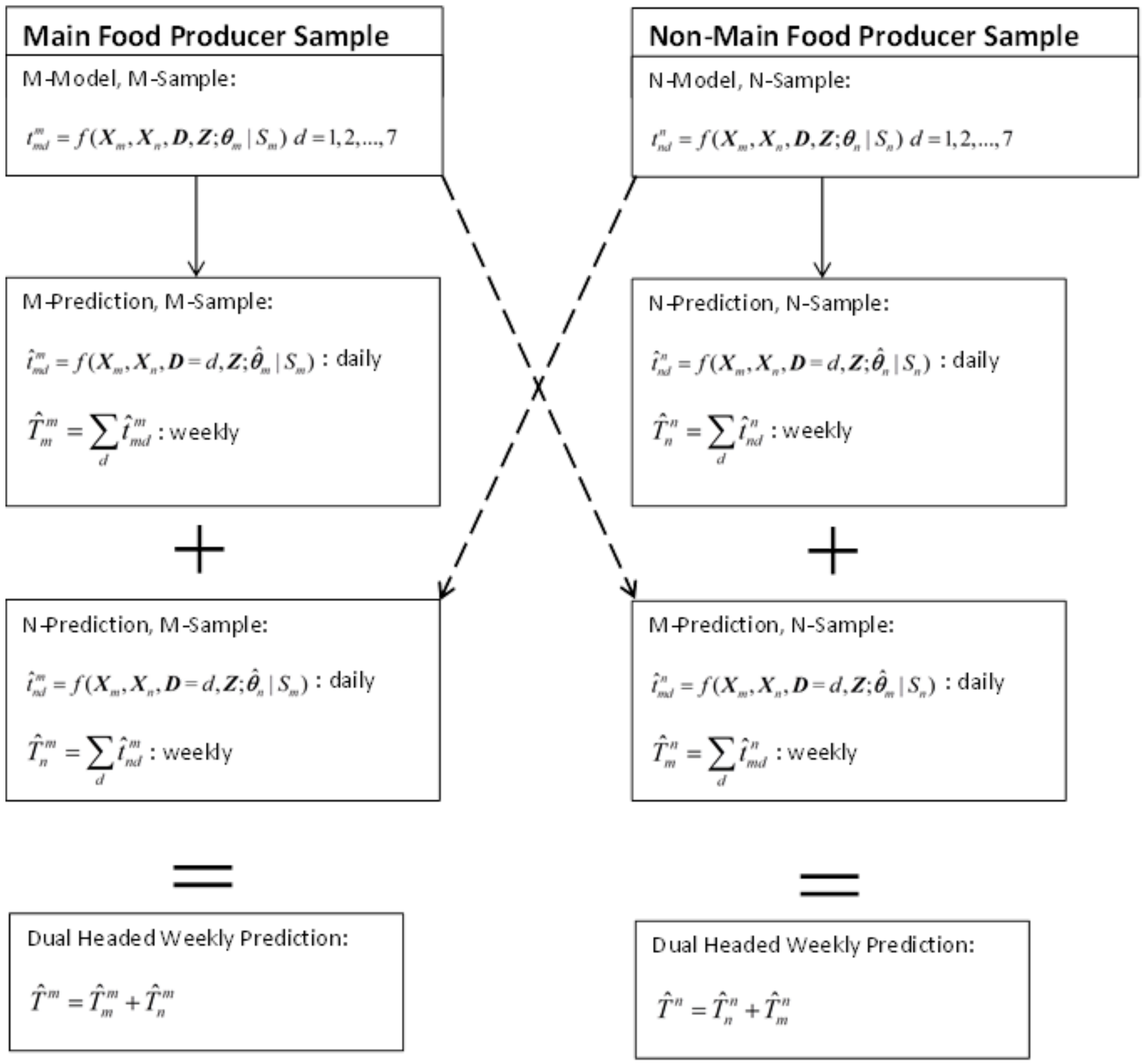

Table 1. Summary Statistics of Respondent-Reported Individual Food Production Daily Time Use by Household Composition (Unit: Min/Day)

	Main Food Producer				Non-main Food Producer			
	N	Mean	Median	[5%, 95%]	N	Mean	Median	[5%, 95%]
Single-Headed								
overall	2065	44.37	30	[0, 153.40]	151	16.07	0	[0, 98.00]
w/ Children	623	54.68	35	[0, 180.00]	85	10.04	0	[0, 68.50]
w/o Children	1442	39.92	20	[0, 139.55]	66	23.83	0	[0, 159.00]
Dual-Headed								
overall	756	74.74	60	[0, 203.20]	344	15.78	0	[0, 80.00]
w/ Children	552	75.51	60	[0, 204.80]	224	16.51	0	[0, 87.50]
w/o Children	204	72.63	51.5	[0, 202.50]	120	14.43	0	[0, 79.75]

Table 2. Summary Statistics of Estimated Household Production Weekly Time Use by Household Composition (Unit: Min/Week)

	N	Mean	Median	[5%, 95%]
Single-Headed				
overall	2215	295.51	283.29	[86.77, 552.87]
w/ Children	708	345.22	323.50	[61.55, 649.95]
w/o Children	1507	272.15	265.12	[88.92, 484.23]
Dual-Headed (w/o SP time)				
overall	1093	422.76	437.43	[28.05, 868.22]
w/ Children	770	435.63	450.97	[28.32, 875.80]
w/o Children	323	392.06	401.33	[27.26, 831.35]
Dual-Headed (w/ SP time)				
overall	1093	658.61	623.97	[370.52, 1040.21]
w/ Children	770	667.52	631.65	[392.12, 1040.76]
w/o Children	323	637.38	616.70	[324.36, 1059.10]

Note: SP time refers to the predicted spousal food production time.

Table 3. Time Deficiency Cost Scaling Factor and Thrifty Food Plan Amount before and after the Scaling by Household Composition

		Scaling Factor k		Thrifty Food Plan M_{TFP} ($/week)		Adjusted Thrift Food Plan $(1+k)^* M_{TFP}$ ($/week)	
	N	Median	[5% - 95%]	Median	[5% - 95%]	Median	[5% - 95%]
Single-Headed							
overall	705	2.08	[1.08, 3.08]	39.36	[36.24, 115.70]	149.84	[103.63, 195.55]
w/ Children	216	1.05	[0.48, 1.62]	85.89	[53.57, 146.88]	173.35	[127.65, 218.40]
w/o Children	489	2.47	[1.31, 3.62]	37.80	[36.24, 44.52]	141.18	[94.40, 187.11]
Dual-Headed (w/o SP time)							
overall	509	0.79	[0.30, 1.27]	101.85	[67.21, 165.06]	173.98	[128.88, 218.66]
w/ Children	353	0.57	[0.19, 0.96]	118.40	[82.40, 172.53]	189.22	[144.57, 233.72]
w/o Children	156	1.10	[0.46, 1.72]	70.95	[40.57, 81.56]	151.39	[105.52, 196.15]
Dual-Headed (w/ SP time)							
overall	509	0.24	[-0.25, 0.69]	101.85	[67.21, 165.06]	123.14	[77.30, 165.26]
w/ Children	353	0.14	[-0.25, 0.50]	118.40	[82.40, 172.53]	138.52	[93.19, 180.59]
w/o Children	156	0.39	[-0.25, 0.98]	70.95	[40.57, 81.56]	101.45	[55.04, 144.02]

Note: The distribution of M_{TFP} is constant across the 1000 simulation replications and the variation is merely across households within the simulation. The distribution of both the scaling factor k and the adjusted M_{TFP} amount are results of variations across households and the 1000 simulation replications.

Table 4. The Adjusted Thrifty Food Plan as Compared to Low-Cost Food Plan and Moderate Cost Food Plan

		Adjusted Thrifty Food Plan $(1+k)*M_{tfp}$ ($/week)		Low-Cost Food Plan M_{lfp} ($/week)		Moderate Cost Food Plan M_{mfp} ($/week)	
	N	**Median**	**[5% - 95%]**	**Median**	**[5% - 95%]**	**Median**	**[5% - 95%]**
Single-Headed							
overall	705	149.84	[103.63, 195.55]	50.64	[44.40, 152.11]	62.40	[55.32, 187.87]
w/ Children	216	173.35	[127.65, 218.40]	108.96	[66.88, 187.37]	132.11	[80.41, 233.13]
w/o Children	489	141.18	[94.40, 187.11]	48.48	[44.40, 57.36]	60.36	[55.32, 71.04]
Dual-Headed (w/o SP time)							
overall	509	173.98	[128.88, 218.66]	129.47	[86.46, 211.52]	158.87	[107.14, 261.25]
w/ Children	353	189.22	[144.57, 233.72]	152.00	[102.55, 222.73]	186.40	[123.98, 274.99]
w/o Children	156	151.39	[105.52, 196.15]	89.76	[52.00, 108.13]	110.99	[64.72, 133.78]
Dual-Headed (w/ SP time)							
overall	509	123.14	[77.30, 165.26]	129.47	[86.46, 211.52]	158.87	[107.14, 261.25]
w/ Children	353	138.52	[93.19, 180.59]	152.00	[102.55, 222.73]	186.40	[123.98, 274.99]
w/o Children	156	101.45	[55.04, 144.02]	89.76	[52.00, 108.13]	110.99	[64.72, 133.78]