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Viewpoint: An assessment of recent SNAP benefit increases allowing for money *and* time variability

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ABSTRACT

The Supplemental Nutrition Assistance Program (SNAP) is one of the largest welfare safety nets in the United States. The purpose of SNAP is to provide low-income eligible families with sufficient funds to reach the cost of a nutritious diet. To mitigate the effects of COVID-19, the maximum SNAP benefits were temporarily increased through September 2021 by a total of 20.3%. On October 1, 2021 the maximum SNAP benefits were permanently increased by 21% from the pre-pandemic levels. A sizeable literature had shown that the pre-pandemic maximum benefit levels were insufficient to reach the full cost of a nutritious diet because individuals spent an insufficient amount of time in food production. This viewpoint considers the question: Are those increases in the maximum SNAP benefits enough to reach the full cost of a nutritious diet when we account for possible changes in home food production labor? In light of the recent pandemic-induced labor market disruptions, this research assesses the needs for additional time inputs to the pre-pandemic food production time amounts given different levels of maximum SNAP benefit adjustments in order to reach the 'full' cost of a nutritious diet. We evaluate the feasibility of meeting those additional time needs in the context of reallocating portions of the 'windfall' of time normally devoted to working and commuting before the pandemic. Focusing on single headed households we find the temporary 20.3% and the permanent 21% increase both would have to be matched by an increase of about 9 hrs per week in food production in order to reach the full cost of a nutritious diet. This increase seems very unlikely based on historical time allocation patterns. More is needed to be done to increase SNAP benefit adequacy either through further increases to benefit levels and/or through education and outreach efforts designed to improve skills of home meal preparation and time management.

1. Introduction

The Supplemental Nutrition Assistance Program (SNAP) is the largest nutrition social safety net program in the US (GAO 2021). The purpose of SNAP is to provide low-income eligible families sufficient funds to reach a minimum cost nutritious diet (U.S.C. 2011).

To mitigate the impacts of the COVID-19 pandemic, several *temporary* SNAP benefit increases were implemented and were to be discontinued on either September 30, 2021 or when the temporary Emergency Allotments end (which varies by states). For example, the Families First Coronavirus Response Act eliminated the standard deductions to allow all participants to effectively get the maximum SNAP benefits (USDA press release 4/22/2020). Also, the standard annual inflation adjustment factor to the maximum benefit was increased to 5.3%, more than double the past 20-year average. And the Consolidated Appropriations Act 2021 and the American Rescue Plan Act 2021 increased the maximum benefits by 15% for a total increase of 20.3% in response to the COVID-19 pandemic.

However, on October 1, 2021, maximum SNAP benefits were *permanently* increased by 21% to all SNAP participants, from their pre-pandemic levels. This amounts to an average of $36.24 per person each month, or $1.19 per day and is the largest -one-time increase in the

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maximum SNAP benefits in the history of the program (USDA 2021). This increase is unique because it is not directly tied to needs arising from the COVID-19 pandemic. Rather, it is a long overdue updating of the Thrifty Food Plan (TFP), which is the underlying diet cost estimate used in determining the maximum SNAP allotment levels. This viewpoint addresses the fundamental question: Is this increase in the TFP enough to reach the full cost of a nutritious diet when we account for possible changes in home food production labor?

The TFP is a nonlinear math programming model that estimates the minimum cost of a nutritious diet. The update in the TFP is in response to section 4002 of the 2018 Farm Bill which states "[b]y 2022 and at 5-year intervals thereafter, the Secretary shall re-evaluate and publish the market baskets of the thrifty food plan based on ***current*** [emphasis added] food prices, food composition data, consumption patterns, and dietary guidance.'' The October 1, 2021 TFP revision is the first update since 2006 and is the first major update reflecting current data since the creation of the TFP in 1975. These changes are needed in combating food and nutrition insecurity for those socially disadvantaged populations, which has been a widely documented problem (Davis, You, and Yang, 2020; Christensen and Bronchetti, 2019; Gundersen, 2021). USDA is therefore to be commended for this effort and its stated commitment to continue making "evidence-based" modifications to the SNAP benefit calculation. One area in particular need of more research is the accurate inclusion of labor cost in estimating the cost of a nutritious diet (p. 49 TFP report 2021).

The TFP claims to be an estimate of the cost of a nutritious diet. However, it only directly captures the cost of the involving grocery ingredients. Surprisingly, labor cost is ignored. The total cost of any product produced in any economy includes not only material input cost but also labor cost. The production of a meal or nutrition is no different. Ingredients are only one input and are certainly not the final products (i.e., a meal, nutrition, or a diet). Producing a meal or a diet requires labor (time) in meal planning, grocery purchasing, related travel, food preparation, and clean up. For example, using an integer programming approach most closely comparable to the TFP model, Leung, et al., (1997) find that by including both a money constraint and a time constraint, the cost estimate of a nutritious diet is extremely sensitive to the time constraint: "In fact, the minimum cost is only compatible with meal preparation time more than three times greater than its minimum level, and the minimum time is only compatible with cost more than double its minimum level." (p. 210, Leung, et al., 1997). Using different complementary approaches, the more recent literature comes to the same general conclusion. Davis and You (2011) estimate that 87% of households do not reach the full nutritious diet cost threshold that includes labor cost, but if labor is ignored, it drops to 38%. Simply stated, ignoring the cost of labor will severely underestimate the full cost of a diet and therefore overestimate the adequacy of SNAP benefits (e.g., Gearing et al., 2021; Tribst et al., 2021; Vemireddy et al., 2021; Davis and You 2011; Yang, Davis, and You, 2019).

The USDA is certainly aware of this oversight and the recent TFP update *indirectly* and *partially* addresses the labor cost omission by allowing less time intensive ingredient options in the TFP model. Specifically, the price construction now considers the price of convenient and ready-to-eat foods via weights that are constructed to favor those more frequently purchased food items without the restricting assumptions that individuals will prepare all home food from scratch (USDA 2021). This approach is certainly an improvement, but it implicitly assumes this adjustment accounts for *all* labor cost when the best it can do is reduce the labor cost by some unknown amount. That is, though a consumer may choose some time-saving products, there is still labor required for planning, shopping, related travel, clean up, and even preparation time, though it may be less. Consequently, simple cost accounting indicates the diet cost is still underestimated.

It is of vital importance to recognize both the money and time components of the full cost of a nutritious diet in any evidence-based modifications of the SNAP benefit determination. Consequently, the recent temporary and permanent monetary increases should be evaluated in the context of the realistic real-world time allocations of SNAP participating households. The substitutability between money and time in healthy eating naturally results in a negative relationship between them: the more convenient and/or ready-to-eat grocery items involved in home food production process, the less time required but those products are relatively more expensive (exactly because they include the higher labor cost associated with someone substituting their labor for that of the household). Stated simply, by having more money to buy more time-saving items they are essentially purchasing labor to add to their own labor, thus increasing the total labor input in food production.

The purpose of this viewpoint is twofold: First, to clarify the implications of the basic input cost accounting math in the SNAP benefit update context. The simple math reveals several important features of dealing with labor cost in estimating the full cost of a nutritious diet that are often misunderstood, but once clarified are straightforward. It implies that the labor cost can be technically covered without being directly measured for each household, completely analogous to the households' expenditures on food.

Second, all the previous work examining the inclusion of labor cost assumed that time allocations to food production did not change in short term. However, the catastrophic labor market disruptions caused by the COVID-19 provide motivation to consider the case where time allocated to food production could potentially change significantly. Coibion, et al. (2020) estimate that 20 million jobs were lost relative to the pre-crisis labor force and if all those who lost jobs were still looking for jobs, the unemployed rate would have been around 16%. The index of weekly work hours also decreased from March to July of 2020 by about 10% (BLS 2020). These numbers are unprecedented in such a short time over the post WWII period. These averages do not tell the entire story. Lower socio-economic status individuals, such as those on SNAP, suffered greater effects. Those in the bottom quintile of the wage distribution saw a 30% reduction in employment compared to a decline of only 5% for those in the top quintile (NBER 2020) and Hispanic, African American and women workers' job loss were much larger than others (Groshen, 2020). These abrupt labor market changes provide motivations for examining the adequacy of the SNAP benefit changes, the temporary and permanent, in the context of potential changes in the time constraint. Specifically, we consider the counterfactual scenario that occurred for many during COVID-19, where they became unemployed, which represented an unfortunate but very generous time "windfall" from employment from which more time could be spent in food production at home.

We find that for single headed households overall, to achieve adequacy of the pre-pandemic maximum SNAP benefits (no increase), they would have to spend about 26% of their freed-up time from working and commuting in food production. This amounts to about 9.63 additional hours per week in food production. With the temporary (20.03%) or permanent (21%) increase in maximum SNAP benefits, this percentage decreases slightly, but not much to 23% of their freed-up time reallocated to food production (8.56 additional hours per week). We find that in order for there to be no additional time added to pre-pandemic food production time amounts, the maximum SNAP benefits would have to be about twice as high. Limitations of the approach are discussed in the conclusions.

2. Analytical framework background: clarification for intuitive interpretation

To avoid misinterpretation of the approach taken and the policy implications of the results, it is important to be clear on two important points.

First, SNAP benefits are based on a simple formula that has two components: (i) an objective science-based approach to estimating the cost of a nutritious diet, which currently is the TFP and is equivalent to the maximum SNAP benefit. This approach is based on the disciplines of

accounting, economics, and nutrition. And (ii) a subjective welfare ideology deduction from this maximum amount which represents the political decision on how much the household should contribute of its own net income to reach the cost of the nutritious diet.[1] Basic accounting and economic principles indicate the science of calculating the average cost of any good should include labor if labor is an input, regardless of where the production occurs. The fact that the good (e.g., a meal) is produced in the home rather than away from the home does not change these basic accounting and economic principles of cost estimation. By ignoring labor cost, the TFP is effectively claiming that these basic principles do not apply to home meal production and the cost of a meal only consists of the cost of the ingredients. Claims that diet cost in the home should not include labor are conflating the science of diet cost estimation with welfare ideology (e.g., p. 49 TFP 2021). The question of *compensating* the household for labor cost is a second stage question that is irrelevant in terms of applying basic principles of accounting and economics to estimate the full cost of a diet. Most of all the cited research above regarding the need to include labor, and the focus here, is about using these basic scientific principles to get a more accurate estimate of the full cost of a nutritious diet and the implications of ignoring labor cost.

The second issue that needs to be clarified is there is nothing in the full cost math of a diet that implies compensating for labor in home food production (i.e., paying people directly for their time in home food production). The compensation is a second stage subjective question that comes after accurately estimating the right target. This may sound counterintuitive but is easily explained by showing the underlying full cost math.

The full cost of home meal production is simply the sum of the costs of the two main inputs: groceries and labor.[2] The existence of a nutritious diet cost threshold then implies there exist some target or fixed amount of the sum of these two costs that should be reached. Using the appropriate market substitute approach[3] to value labor in food production (see Gronau, 1986, Davis and You, 2011) implies a nutritious diet's full cost would be $M_{TFP} + pT_{TFP}$, where M_{TFP} is the TFP dollar amount for groceries *required* to reach a nutritious diet for the household (i.e., the maximum SNAP benefit), p is the market value of time in food production, and T_{TFP} is the amount of time in food production *required* to reach a nutritious diet for the household consistent with the TFP.

Of course, individuals may not spend the required amount of time in food production. Therefore, the following equation (1) represents a simple relationship between what is *required* for a nutritious diet in terms of money and time and what households *potentially* have in terms of money received from the program and time allocated to food production at home.

$$(1)\quad M_{TFP} + pT_{TFP} \geq M_p + pT_p$$

The left-hand side is the exogenous estimate of the full cost of a nutritious diet. This amount is technically policy independent, meaning it is simply the estimate of the target for households to reach. The right-hand side is the *potential* amount of the SNAP benefit received by the household, M_P, and the *potential* amount of the labor value provided by the household, pT_P. Given the fixed and exogenous left-hand side, there are three ways for the right-hand side to be adjusted to make equation (1) an equality: (1) increase the potential money value, holding the potential time constant (i.e., $\Delta M_P > 0$, $\Delta T_P = 0$), (2) hold the potential money constant but increase the potential time spent in food production (i.e., $\Delta M_P = 0$, $\Delta T_P > 0$), or (3) increase both money and time in some combination with varying magnitudes (i.e., $\Delta M_P > 0$, $\Delta T_P > 0$).

The potential money value can be considered the scaled up temporary (or permanent) adjustment made to the base TFP amount or $M_P = M_{TFP}(1 + c_M)$, with $c_M \geq 0$. The c_M is the associated scaling factor and the two levels related to the existing policy changes are: the pandemic-induced temporary increase of 20.3% ($c_M = 0.203$) and the permanent increase (effective on October 1st 2021) of 21% ($c_M = 0.21$). The pandemic-induced job market disruption reveals an unfortunate but most generous 'windfall' time scenario related to unemployment. The potential time in food production could be increased by taking a percentage of the 'windfall' time, c_T, normally devoted to work T_w and commuting time T_c and adding it to the pre-pandemic actual time in food production T_a. So potential time is then defined as $T_P = [T_a + c_T(T_w + T_c)]$, with $c_T \geq 0$.

Now reconsider the above three possible ways to satisfy equation (1). Under case (1), the potential time change is held at zero (i.e., $c_T = 0$) and equation (1) will become an equality only if $c_M = p(T_{TFP} - T_a) \div M_{TFP}$. Under case (2), the potential money change is held at zero (i.e., $c_M = 0$) and equation (1) will become an equality only if $c_T = (T_{TFP} - T_a) \div (T_w + T_c)$. And under the most general case (3) where money and time are allowed to both vary we have the general condition $c_T = [(T_{TFP} - T_a) - c_M M_{TFP}/p] \div (T_w + T_c)$, which shows the inverse relationship between increasing money versus increasing time.

It is important to note that the three alternative ways of reaching the targeted left-hand side does ***not*** require paying for labor cost or changing time allocations. It simply requires giving the household enough money for groceries to *cover* this difference. A completely analogous argument would be the following. Suppose the TFP did not follow the science of nutrition and did ***not*** include vegetables initially in its food group list but they were later added in adherence with dietary guidelines. By simple addition, this would in turn increase the TFP estimate. The increase in the TFP and the resulting SNAP benefit amount received by the households would enable them to reach the more accurate and higher cost of a nutritious diet. However, the higher TFP amount does ***not*** require that they have to buy more vegetables.

While the literature has considered case (1) where only the TFP amount is scaled up, it has not considered case (2) or the more general case (3). Case (3) is of timely policy relevance because, as indicated, during the COVID-19 pandemic period many individuals had more time available for food production due to employment changes (i.e., $c_T > 0$). The inverse relationship between money and time indicates with the increase in the maximum SNAP benefits (i.e., $c_M > 0$) they may only need to reallocate a very small portion of the time 'windfall' to food production to reach the nutritious diet goal. Or alternatively, if they spent more time in food production the increase in the maximum SNAP benefits would not need to be as high.

With this background, there are two related specific questions we seek to answer quantitatively.

1. If the household did not reach the full cost of a nutritious diet prior to the pandemic due to a food production time deficit (i.e., $T_a < T_{TFP}$), what percentage of pandemic-induced 'windfall' time would have to be allocated to home food production to meet the full cost of a nutritious diet (i.e., satisfy equation (1)) given the pre-pandemic TFP amount.

[1] The stylized formula comes from this relationship: TFP diet cost estimate = SNAP benefit amount + Household net income contribution to a diet. Determining the SNAP benefit amount then is just rearranging this formula: SNAP benefit amount = TFP diet cost estimate – Household net income contribution (a.k.a. deduction). If there are no household deductions, then the household gets to maximum SNAP benefits = TFP diet cost estimate, so TFP and maximum SNAP benefit are synonymous terms. See Institute of Medicine and National Research Council, 2013.

[2] Yes, there are other more fixed inputs (e.g. capital items like stoves) that could be included, but ingredients and labor are the main variable inputs. Including these additional inputs would just reinforce the main points of this line of research since they are also ignored in TFP calculation.

[3] Since our main purpose is to estimate the cost of an input, the market substitute method is preferred over the opportunity cost method (See Hill 2009 and Schreyer and Diewert 2014 for underlying logic and theory). These values vary by household i, but the household index is ignored here for notational simplicity.

2. And how will this amount of time reallocation vary if individuals are given a scaled-up amount of the TFP (i.e., either the temporary or permanent increase)?

3. Data and empirical methods

We use the same data and empirical methods as in You and Davis (2019) with one exception and one extension. First, we only examine single headed households, the ones showing the largest financial needs in their findings. Second, we have to extend their work and estimate models not only for food production time, but also for work time and commute time for employed individuals.

We use the American Time Use Survey (ATUS) and associated Eating and Health Module (EHM) to estimate the food production related activity time use patterns following You and Davis (2019). We chose to stick with the same data used in You and Davis (2019) due to the availability of the EHM. The EHM provides important information for us to identify the main food producers of the households which enables us to better estimate food production time patterns (which is likely to be vastly different between main food producers of the home and non-main food producers). The food production time used in our paper and You and Davis (2019) consists of the 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).

Work time is defined by the categories: Work, Main Job (050101) and Work, Other Jobs (050102), and commute time by the categories Travel Related to Working (180501) and Travel Related to Work-Related Activities (180502). We use the labor force status information provided by the ATUS to define employment as either "at work" or "absent", and unemployment as either "on layoff" or "looking for a job".

We use Modified Two-Part models (M2PM: Mullahy, 1998) and estimate a separate M2PM for daily food production time for both employed and unemployed subsamples. Furthermore, for employed respondents, two separate M2PM are estimated for daily work time and commute time. Finally, as the highest frequency reporting of the maximum SNAP benefit (M_{TFP}) is weekly, weekly time in food production T_a, work T_w and commute T_c are predicted by using the daily dummies in the daily M2PM model to generate a daily time estimate for each day for each respondent and then aggregating over the days of the week to get weekly time allocation for each respondent (see You and Davis 2019 for more details). This process will generate weekly predicted time use for everyone in the sample for food production, work, and work-related commute. The percentage of time required is then based on the formula given above for case (3).[4]

The other components needed for the estimation of the percentage are the TFP time amount T_{TFP}, the market substitute price p, and the maximum SNAP benefit amount M_{TFP}. We used the same ones as in You and Davis (2019). The scaling factor for money will be set exogenously at three different values: $c_M = 0$, 0.203, 0.21, 0.25, 1, and 2 to provide insights on the implications of adjustments to the temporary and permanent maximum SNAP benefit. Finally, to represent low-income households that are to be on SNAP, the sample is limited to those who are below 185% of the poverty line because this is the maximum means test level for SNAP participation in some states. Our final sample consists of the same 2,065 single headed main meal producers as seen in You and Davis (2019) Table 1.

[4] A little math can be used to demonstrate that given a time constraint, which we all have, the time does not technically have to come directly from work and commuting, but could also come indirectly through reallocations in other activities as long as the time constraint slack is equal to the old work and commute hours.

4. Results and discussion

Overall, our sample is dominated by middle age (average age of 53) females (75% females) and contains 25% African American and 71% Caucasian. About 30% of the households have at least one child[5] in the household. Tables 1–3 give the summary statistics for the (pre-pandemic) time deficits ($T_{TFP} - T_a$), the predictions of weekly work time T_w, commute time T_c, and food production time T_a, and the percentage of time (i.e., c_T) needed to be reallocated to reach the full cost under different assumptions of TFP scaling factor (c_M), respectively. We focus on discussing the medians. The 95% probability intervals are discussed if there is some additional insight to be gained.

Table 1 shows that the pre-pandemic food production time deficit is quite significant for all partitions. Perhaps not surprisingly, the deficit is greater for those employed than those unemployed, by about 2.40 hrs per week (i.e., 9.63–7.24). The differences between those with children is even greater at about 3.50 hrs per week. Looking at the 95% probability intervals reveals the time deficit is quite substantial over the entire range. For example, at the upper bound there are some employed households without children that are as much as 14.95 hrs per week below the time requirement and those with children are not much better falling below the required amount by 12.54 hrs per week. The upper bound situation is not much better for unemployed as those without children are 12.07 hrs per week short and those with children are 9.00 hrs per week short. For those who are doing relatively better (i.e., those at the lower 5%), there is still a substantial time deficit. Those employed without children are the farthest away by, almost an hour per day (i.e., 6.57 hrs/wk), whereas those unemployed with children are the closest at 1.33 hrs per week.

The median hours of work per week is about 35 hrs and the 95% probability intervals range around 27 hrs consistently across the overall, with child, and without child partitions (Table 2). There is a little more variability with respect to commute time. One would expect, *ceteris paribus*, that households would prefer a shorter commute time when they have children and that appears to be the case as the median hours in commute for those with children is about two hours per week with a 95% probability interval of 2.84 hrs, whereas the median for those without children is 2.34 hrs per week with a wider 95% probability interval of 3.47 hrs.

The estimated food production time shows substantial differences across all dimensions. The median weekly hours in food production for those employed with children is 4.41 hrs while the median for those employed without children is less by about two hours per week (2.49 hrs/wk). In effect, the without children distribution is centered to the left of the with children as would be expected: overall households with children devote more time in food production.

Similarly, the comparison between the employed and the unemployed shows an expected pattern. Those unemployed spend more time in food production than those employed. In fact, the median for unemployed with children is about four hours more per week than the

Table 1
Summary statistics for existing time deficits (in hours).

	N	5%	Median	95%
Employed	864	5.64	9.63	13.99
w/ child	404	4.24	8.18	12.54
w/o child	460	6.57	10.59	14.95
Unemployed	1201	3.36	7.24	11.58
w/ child	219	1.33	4.71	9.00
w/o child	982	3.74	7.72	12.07

[5] We define children as those household members age under 18 years old.

Table 2
Summary statistics of predicted weekly hours. Single headed households.

	Overall				With Child				Without Child			
	N	5%	Median	95%	N	5%	Median	95%	N	5%	Median	95%
Employed												
Work Time	864	21.93	34.82	48.70	404	22.47	34.14	47.70	460	21.29	35.27	49.35
Commute Time	864	1.03	2.20	4.33	404	0.97	2.02	3.81	460	1.14	2.34	4.61
Food Producing Time	864	1.23	3.44	7.16	404	2.19	4.41	7.87	460	0.97	2.49	5.87
Unemployed												
Food Producing Time	1201	3.09	5.66	10.46	219	5.51	8.48	13.46	982	2.98	5.22	8.64

Table 3
Percentage of employed work and commute time needed to allocate to food production to reach the full cost of a nutritious diet (c_T).

	N	Median	5%	95%
$c_M = 0$				
Overall	864	26	15	38
With Child	404	23	12	35
Without Child	460	28	18	40
$c_M = 0.203$ or 0.21				
Overall	864	23	12	35
With Child	404	18	7	31
Without Child	460	26	16	38
$c_M = 0.25$				
Overall	864	23	10	36
With Child	404	17	5	32
Without Child	460	26	13	40
$c_M = 1$				
Overall	864	13	5	24
With Child	404	4	0	13
Without Child	460	19	8	30
$c_M = 2.0$				
Overall	864	5	0	13
With Child	404	0	0	2
Without Child	460	9	0	21

employed (8.48 hrs/wk vs. 4.41 hrs/wk) and without children about 2.7 hrs per week more (5.22 hrs/wk vs. 2.49 hrs/wk). Perhaps not surprisingly, the 95% probability intervals of those unemployed are also further to the right of the employed for both households with children and households without children.

Examining Tables 1 and 2 clearly shows that a substantial reallocation of the previous work and commute time is going to be needed to make up the time deficit if there is no increase in the maximum SNAP benefits. However, as shown, the time reallocation will also depend on how much the maximum SNAP benefits are increased ($c_M > 0$). We present the percent of the time 'windfall' needed to be reallocated to food production under four different scaling up values $c_M = 0$, 0.203, 0.21, 0.25, 1.0, 2.0. We chose this large range of possible adjustments because ">25%" has been reported in the news media (e.g. Dorning and Bloomberg, 2021). When the scaling factor is zero ($c_M = 0$), consistent with the level of the pre-COVID maximum SNAP benefits, the median estimate of c_T for single headed households with children is 23%. This means that 23% of the hours normally devoted to work and commuting need to be reallocated to home food production to meet the full cost of a nutritious diet with no increase in SNAP benefits. Based on predicted work related time in Table 2, this amounts to 8.32 hrs per week [$0.23 \times (34.14 + 2.02)$] or an additional 1.19 hrs per day in food production. For those singles without children the need is even higher (28% or about 10.5 hrs per week or an additional 1.50 hrs per day).

The temporary 20.3% total increase of the maximum SNAP benefit due to COVID-19 (i.e., $c = 0.203$) and the permanent 21% increase both lead to a slightly smaller percentage of time reallocation needed. The results are not reported separately because they are identical at the two-digit level since the c_M values only differ by 0.007. With either increase, for single headed households with children the median estimate indicates a need to reallocate to food production 18% of the hours normally devoted to work and commuting or about 6.50 hrs per week or about an additional hour per day. For those without children the numbers are again higher, mainly because their time deficit is larger to begin with (26% or an additional 1.40 hrs per day). The 25% increase results in similar outcomes as well.

For completeness, the rest of the table shows what happens when the scaling factor is set at one and two which are much higher than the adjustments made either temporary or permanently. Under those two scenarios with significantly larger monetary support, the needs for time reallocation are greatly reduced. When the scaling factor is set at one (i.e., $c_M = 1$), the maximum benefits are doubled therefore the median estimate indicates only 4% of the time needs to be reallocated to food production, which amounts to about 13 more minutes per day. Those without children still have a larger amount to make up: i.e., need to reallocate about 19% or about one hour per day. When the money scaling factor is set at two (i.e., $c_M = 2$), the maximum benefits are tripled and this extremely high amount of monetary support results in no change in time allocation to food production for those single headed households with children. Similarly, those without children would only need to spend about 9% of the 'freed time' to food production or about 29 min per day to reach the full cost of a nutritious diet.

Given the permanent 21% increase to the maximum SNAP benefits, how likely is it that individuals would reallocate the needed portion of the time 'windfall' to food production? What we know from a couple of different angles, it seems unlikely. First, ignoring matching issues, those who were unemployed prior to employment changes due to COVID-19 are those who already had this 'extra' available time as compared to those who were employed pre-pandemic. However, as stated above, the unemployed, with this 'extra' available time, still fall short of the minimum TFP time requirement by 7.24 hrs per week (Table 1) or about an hour per day. From Table 3, just under an hour a day reallocated to food production is the least amount of time needed to be reallocated and most of the estimates are much greater. It seems extremely unlikely that those who newly became unemployed would spend more time than those observed allocations shown by those unemployed before.[6] Second, there are a handful of studies looking at different work arrangements especially those during the pandemic. Restrepo and Zeballos (2020) find that those working from home spend about 25 more minutes a day engaged in food production. Leukhina and Yu (2020) estimate that during COVID-19, "home production" activities increased by 2.1 hrs per week. Their definition of "home production" actually includes all childcare and non-market work activities. However, even if those were all devoted to food production, it still falls short of the minimum one hour a day needed as we estimated. Furthermore, single and less educated individuals reallocated less time in home production as compared to married individuals with children (Leukhina and Yu, 2020).

The key message of the Table 3 and these supplementary findings is

[6] Although it is also possible that those previously unemployed were positively selected into unemployment since they have comparative advantage in home production. Then those newly unemployed individuals will have to spend more time in home production to be as efficient. However, this is still a testable hypothesis.

that the temporary 20.3% increase and the permanent 21% increase in the maximum SNAP benefits along with the most optimistic time 'windfall' available due to unemployment are unlikely to be sufficient to help SNAP households reach the full cost of a nutritious diet. It would take doubling or even tripling the amount of the pre-pandemic maximum SNAP benefits (i.e., $c_M = 1, 2$, respectively) for single headed households to achieve this goal without significant reallocation of time.

5. Conclusion and policy implication

SNAP benefit adequacy has been greatly limited by the lack of consideration of labor cost in meal production (Institute of Medicine and National Research Council, 2013) and a sizeable literature now exists showing that most households spend far less time in food production than is required to reach a nutritious diet. This time deficit and labor input omission have been partially and indirectly accounted for in the largest average 21% increases to the SNAP benefits effective on October 1st, 2021. This viewpoint sought to be the first to answer the question: Is this increase enough once different time allocations to food production are considered?

We consider the overly optimistic time 'windfall' that would occur when an individual becomes unemployed, as happened to many during the COVID-19 pandemic. We then determine how much of this time 'windfall' would have to be reallocated to food production to reach the full cost of a nutritious diet under different increases of the maximum SNAP benefits. Of particular interest were the temporary COVID-19 increase to maximum SNAP benefits of 20.3% and the more recent permanent Oct. 1st increase of 21%. We find that in order to reach the full cost of a nutritious diet, even with these increases in maximum SNAP benefits, single headed households would still have to spend around 8.5 *more* hours per week in food production. Based on comparison to some other findings, this seems extremely unlikely.

Our estimates add to the growing literature that something greater than the existing maximum SNAP benefits is required for achieving SNAP benefit adequacy and the policy implications of this research are clear. If the goal of SNAP is to help individuals reach the full cost estimate of a nutrition diet based on realistic time allocation patterns consistent with revealed preferences, some combination of the following should be considered in the SNAP benefit design: more increases in the maximum benefits, more flexible buying options for participants such as hot-prepared meals, and more resources devoted to the SNAP-Ed program that aims at improving participants' time management and meal preparation skills given the local food accessibility and availability. Furthermore, higher reach and better retention of those outreach and education programs should be the key areas for improvement since time constraints are the top barriers for those very subgroups those programs are designed to help (Gearing et al., 2021). Those vulnerable populations are the ones face the largest time deficit as our current study and previous literature show.

Of course, these suggestions are easier to make than to accomplish. SNAP has always been one of the most politicized policies in the US and USDA is limited in its ability to address many of the criticisms without action from the Congress. For example, as several have pointed out, the simplest way to increase SNAP benefits that would not involve estimating time in home food production would be to use one of the other three higher cost meal plans *already* estimated by USDA: The low-cost plan, the moderate- cost plan, or the liberal plan (e.g., Children Health Watch, 2017; Healthy Eating Research. Strengthening the Public Health Impacts of SNAP: Key Opportunities for the Next Farm Bill. July, 2021; You and Davis, 2019). However, USDA cannot do this without Congressional approval and legislation proposed during the 116th Congress to use the low-cost plan instead of the Thrifty Food Plan did not pass (The Closing the Map Gap Act of 2019, H.R. 1368 & S.3719).

As with all analyses there are limitations. First, we only focus on single headed households. As You and Davis (2019) have clearly shown, the time deficit is much less severe for dual headed households therefore would expect the comparable results for dual headed households would be less severe, though probably not minor either. Second, the key factor in this analysis is the sizeable time deficit that exists between what is required to reach the full cost of a nutritious diet and what individuals actually spend in food production. The estimated required time for a nutritious diet is based on menu simulations. A lot more work needs to be done to get more accurate estimates on the amount of time needed to produce a nutritious diet. Note however, even if it were found that the minimum time needed is one-half of that used here, say seven hours per week, that would still be at the upper end of the distribution of time people actually spend in food production. These limitations notwithstanding, given the difficulty in changing people's time allocation decisions, the SNAP benefits need to be increased further to meet its stated objective. Hopefully as the evidence of the need to increase SNAP benefit adequacy continues to mount, the political will to act will follow the science.

Author contribution

Wen You: Conceptualization, Funding acquisition, Data curation, Methodology, Project administration, Supervision, Writing of the first draft, Review & editing. **George C. Davis:** Conceptualization, Funding acquisition, Data curation, Methodology, Project administration, Supervision, Writing of the first draft, Review & editing. **Jinyang Yang:** Data curation, Data analysis, Review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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