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Abstract: SNAP is the cornerstone food assistance program in the United States and has been shown to reduce the risk of food insecurity. Most research on the causal effect of SNAP on food insecurity relies on the 12-month food insecurity scale along with usage of SNAP at any point during the year. However, recent social surveys ask about experiences with food insecurity in the 30 days prior to the survey. In this paper we examine whether similar protective effects of SNAP against food insecurity are obtained whether using the 30-day or 12-month food insecurity scale using the December Supplement of the Current Population Survey for 2002-2019. Results indicate comparable average treatment effects of SNAP in mitigating food insecurity across both 30-day and 12-month reference periods.

The prevalence of household food insecurity, the ability of all household members to regularly access adequate and nutritious food, in the United States was 12.8 percent in 2022 (Rabbitt et al. 2023). Previous research has demonstrated that food insecurity is negatively correlated with a wide array of negative outcomes throughout the life course ranging from negative physical, cognitive, mental, and academic outcomes during childhood to disability, cognitive decline, medication nonadherence, and chronic health conditions during adulthood (Gundersen and Ziliak 2022; Gundersen and Ziliak 2015). The US Department of Agriculture administers a set of food and nutrition programs, the largest of which is the Supplemental Nutrition Assistance Program (SNAP), and previous research has shown SNAP to be effective at reducing food insecurity.

While there is a large body of previous research on the relationship between food insecurity and SNAP (Gregory, Rabbitt, and Ribar 2015), with few exceptions of some older papers (Kabbani and Kmeid 2005; Yen et a. 2008), the vast majority relies on the 12-month measure of both food insecurity and SNAP participation. However, increasingly, social surveys only ask about experiences with food insecurity at higher frequency, most often in the 30 days prior to the survey (Arteaga and Wilde 2023). However, it is unclear if the general findings of the effect of SNAP on food insecurity are similar whether one uses a 12-month horizon or a shorter horizon such as the prior 30 days. There are compelling reasons to suggest that the results might differ related to measurement error and the timing of food insecurity relative to SNAP receipt, and the timing of policy and economic changes in local conditions. As elucidated in the next section, the balance of these concerns over measurement error and timing may if anything point to a stronger effect of SNAP on food insecurity in the 30-day horizon, but ultimately this is an empirical question.

In this paper, we examine whether similar protective effects of SNAP against food insecurity are obtained using the 30-day or 12-month food insecurity scale. Our results suggest that the effect of SNAP on food insecurity remains similar under both time horizons. For example, among households with annual incomes less than 200 percent of the federal poverty line, counterfactual policy simulations suggest that SNAP reduced food insecurity by 14 percentage points on the 12-month horizon and 12 percentage points on the 30-day horizon, which translates into a 40-55 percent reduction in baseline food insecurity.

In what follows below we begin by discussing the issues that may result in the 30-day and 12-month measures of food insecurity and SNAP participation producing different estimates of their relationship. We then review what is known from previous research using different time horizons of food insecurity and SNAP participation. Using the December Supplement of the Current Population Survey for 2002-2019, which contains both the 12 month and 30-day measures of both terms, we estimate bivariate probit models using state-level policy variation from the ERS SNAP Policy Database for identification. We also demonstrate the consistency of the two time periods to different subsamples including low education, low household income, older adults, and households with children.

II. Why the length of the reference period might matter?

There are several reasons why the protective effect of SNAP on food insecurity may differ when the reference period is 30 days instead of 12 months and we classify these as timing of the food insecurity experience and the timing of the change in local conditions. The timing of the food insecurity experience focuses on differences in the causal relationship between SNAP and food

insecurity due to potential differences in measurement error and temporal ordering. The timing of local conditions relates to the difference in the sample composition identified as food insecure under different time horizons, and differences in the policy and economic context of the conditions associated with both food insecurity and SNAP participation. Below we discuss the theoretical importance of each potential issue individually for this study but acknowledge that our current study does not causally add to the evidence base on these issues.

A. **Measurement error** and Temporal Ordering

There are several potential differences in the measurement error between the 30-day and 12-month measures that could affect the causal relationship between 30-day and 12-month measures of food insecurity and SNAP participation. Celhay, Meyer and Mittag (2022) compare CPS, ACS, and SIPP data to administrative records for SNAP and to examine potential errors in survey reports of program participation within a 12-month reference period. They find that the probability that a respondent provides a false negative (i.e. reports does not participate on the survey but appears as a participant in administrative records) of 12-month SNAP participation in the CPS increases by 3.6 percentage points per month passed since the last receipt of SNAP. On the other hand, they also document issues related to memory and correctly identifying the date of past events: the probability of false positives (i.e. reports does participate on the survey but does not appear as a participant in administrative records) increased for respondents who received SNAP prior to the 12-month recall period by about 0.9 percentage points in the CPS, although not statistically significant. Both of these cognitive factors should lead to the 30-day report of SNAP participation, and perhaps by extension food insecurity assuming all the errors align with that of SNAP participation, having less error (both fewer false negatives and false positives).

Given this issue alone, we might expect a more precisely measured relationship between SNAP participation and food insecurity in the 30-day measure than the 12-month measure.

However, Celhay et al. (2022) also provide evidence that stigma leads to false negatives in SNAP participation by examining the sensitivity of reporting to the local SNAP participation rate in the zip code under the assumption that residing in an area where others are also receiving SNAP may lessen the social stigma of participation. They find that a 10 percentage point increase in local SNAP participation is associated with a decrease of 0.8 percentage points in the probability of not reporting true program participation. However, it is unclear if the stigma associated with reporting recent events is higher than the negative social desirability associated with reporting events that might have occurred within a longer window of time. (Consider, for example, the stigma associated with reporting drug use or criminal activity within the last 30 days compared to the previous12 months). Additionally, given that the 30-day measure includes the Thanksgiving holiday, in which there is a cultural expectation that one eats a family feast, it is possible that stigma is further heightened. Therefore, it is likely that higher false negatives due to social stigma occur within the 30-day measure than in the 12-month measure.

Another issue is that while the 30-day measure imposes the condition that both FI and SNAP occur simultaneously within the same short time period, the two do not have to occur at the same point in the 12-month measure. That is, the experience of food insecurity may occur before, during, or after someone leaves SNAP when using the 12-month measures. While the temporal ordering of food insecurity and then SNAP is implicitly assumed in most models examining the protective effect of SNAP on food security, there are only a handful of studies that have examined how this plays out empirically, and they all indicate that timing matters (Castellari et al. 2016; Todd 2015; Todd and Gregory 2018; Gregory and Todd 2022; Gregory

and Smith 2019). For example, Gregory and Todd (2022) examine the timing of monthly SNAP receipt on both the 30-day and 12-month food security reports using data from the NHANES. They find that the probability of reporting more severe food security problems and of being classified as very low food secure both increase just prior to and after receipt of SNAP benefits by 3.2 percentage points. This suggests that timing issues change, but may not be reduced, when using a 30-day measure, providing no clear guidance on which of the short or long horizon relationship should be greater.

Furthermore, qualitative reports tell us that SNAP eases food insecurity, the commonly assumed pathway, but also sometimes SNAP may increase food insecurity and other negative health outcomes, if recipients face administrative churn or unexpected changes in the amount or access to their SNAP benefits (Heflin and Ziliak 2008; Ribar and Edelhoch 2008; Mills et al. 2014; Heflin, Hodges, and Ojinnaka 2020). This paper is not going to address this issue, but future work could using restricted access data with monthly SNAP receipt within a federal statistical research data center (Nguimkeu, Denteh, and Tchernis 2019; Courtemanche, Denteh, and Tchernis 2019).

B. Sample Composition and Local Conditions

In addition to the issues discussed above, there are a number of other issues to consider when using the 12-month measures of food insecurity and SNAP participation related to the generalizability of the population identified with the 30-day measure. Why might the relationship identified be different across the two-time horizons? First, the population identified as food insecure may differ on observable and unobservable characteristics between the 30-day and 12-month measures because the group who experienced food insecurity in the last 30 days is not a random draw from the group that experienced food insecurity in the last 12 months. As a result,

the generalizability of the 30-day relationship may not extend to the 12-month relationship and vice versa.

An additional concern is that the policy conditions that are present in the last 30 days may not be the dominant conditions over the 12-month period. Federal and state SNAP administrative rules and processes change in small ways on a monthly basis, such that participants may not be subject to the same administrative processes and policy conditions within a 12-month period. Of course, household economic conditions which determine eligibility for SNAP also change frequently for low-income populations due to changes in labor supply, wages, household composition, and disability. In addition, month to month changes in actual shelter expenses and medical deductions may occur over a 12-month period resulting in changes in SNAP eligibility, assuming consistent policy conditions.

Finally, there are many annual cycles of need related to school calendars, climate conditions, food and utility prices, and labor markets that may render the relationship between SNAP and food insecurity in November (assuming use of the CPS) of any given year quite different from that averaged over the previous 12 months. While each of these issues is conceptually important, it is beyond the scope of this paper where our aim is to first establish whether there might be cause for concern in utilizing the short 30-day or longer 12-month horizon framework for estimating the effect of SNAP on food insecurity. Taken as a whole, the issues discussed in this section lead us to hypothesize a priori that the 30-day measure will provide a tighter link between SNAP and food insecurity than the 12-month measure, but ultimately this is an empirical question. The next section discusses our framework for conducting these tests.

III. Estimating the Effect of SNAP on Food Insecurity

It is well established that in order to identify the causal effect of SNAP participation on food insecurity it is necessary to address the endogeneity of program participation (Wilde 2007; Gundersen, Kreider, and Pepper 2011; Meyerhoefer and Yang 2011; Bitler 2015; Gregory, Rabbitt, and Ribar 2015). This endogeneity can arise from either nonrandom self selection, or from joint determination of outcomes. The former emerges from the possibility that SNAP participants self select into the program based on observable and unobservable (to the researcher) factors correlated with food security status, while the latter arises in the situation where food insecure households seek assistance from SNAP and SNAP also has a direct effect on food insecurity. With the notable early exception of Gundersen and Oliveira (2001) who examine the simultaneous outcomes of food insufficiency and food stamp participation, most adopt the selection framework with linear instrumental variables or control function approach. We follow the selection approach, but rather than adopting a linear model, we estimate a recursive bivariate probit model akin to that used in Yen et al. (2008) and with notation drawing heavily from Ziliak and Tiehen (2022).

Specifically, the model for household *i* in time period *t* is given as

(1) $FI_{it} = 1(x_{it}\delta + w_{st}\theta + \alpha SNAP_{it} + u_{it} > 0)$

(2) $SNAP_{it} = 1(z_{it}\gamma + e_{it} > 0)$

where indicators for food insecurity (FI) and SNAP are one if the condition is true. The model is recursive in that SNAP is assumed to affect food insecurity, but not vice versa. We define $z_{it} = (x_{it}, w_{st}, p_{st})$, which contains person-level demographics (x_{it}), state-level economic and political factors (w_{st}), and state-level policy variables (p_{st}). We elaborate in the Data Section below on

what specific variables are included in each vector. We assume that u_{it} and e_{it} are independent of z_{it} and are jointly normally distributed with mean zero, unit variance, and correlation ρ_{ue}. If $\rho_{ue} \neq 0$, then u_{it} and $SNAP_{it}$ are correlated, which means that the univariate probit of (1) will yield inconsistent estimates. Under the stated assumptions, joint estimation of (1) and (2), is a bivariate probit model that produces consistent estimates of model parameters.

Some of the state-level variables z_{it} are allowed to affect both food insecurity and SNAP participation (w_{st}), while others are assumed to only affect the decision to participate in SNAP, but not food insecurity once we condition on SNAP participation (p_{st}). These latter additional regressors will assist in identifying the SNAP equation from the food insecurity equation, though they are not required for identification (Heckman 1978; Wilde 2000). Important for our purposes is that we have consistent time-dating of food insecurity, SNAP participation, and the additional policy variables (p_{st}) used to assist in identification for both the 12-month and 30-day reference period models, as described in the next section.

With the estimated model parameters, we compute the average treatment effect (ATE) of participation in SNAP on food insecurity as

$$(3) \qquad ATE = E[FI_{1i} - FI_{0i}|x_{it}] = \Phi(x_{it}\delta, SNAP = 1) - \Phi(x_{it}\delta, SNAP = 0),$$

which compares the counterfactual potential level of food insecurity under the assumption that everyone in the population receives SNAP against the counterfactual potential level of food insecurity under the assumption that no one receives SNAP. Because the magnitudes of the bivariate probit coefficients are not directly interpretable, the counterfactual difference provides a useful hypothetical baseline to assess the potential protective impact of SNAP against food insecurity.

IV. Data

The data on food insecurity and household demographics come from the 2002-2019 Household Food Security Supplement (HFSS) of the Current Population Survey (CPS). The HFSS serves as the official source of USDA statistics on household food insecurity. Since 2001 it has been fielded in December as a once per year supplement to the monthly CPS labor-force survey where households are asked a series of 18 questions if children are present, and a subset of 10 of these for households without children. The questions span two reference periods—the prior 12 months and the prior 30 days—with each question on the 12-month reference period preceding the corresponding 30-day question. In order to minimize respondent burden, only those households with annual incomes below 185 percent of the federal poverty guideline for their household size, or those responding in the affirmative to one of two screener questions on food hardship, are included in the HFSS sample universe. Following standards in the literature, we classify households (and all residents therein) as food insecure if they respond in the affirmative to at least three questions.

The other focal variable in the HFSS is participation in SNAP. The primary question references assistance in the prior 12 months, and since 2002 this 12-month question has been followed by a sequence of questions asking for monthly participation in the program. Because the HFSS is administered in the week of December that includes the 19th, the prior 30-day questions typically include the last 2 weeks of the month of November. Thus, we set the 30-day

measure of SNAP participation to 1 if the household reports receiving SNAP in November, and 0 otherwise.[1]

Our baseline sample consists of the reference person from all households in the HFSS regardless of age or income level. Because both food insecurity and SNAP participation are household concepts, we restrict to the reference person in the survey with their associated demographic characteristics and apply household level weights to make the sample representative of US households. Food insecurity is not restricted to the low-income population, and while SNAP is a means-tested program, as a base-case we are interested in understanding the population participation decision and its relation to food insecurity, and then subsequently we restrict the sample to various subsamples at greater risk of SNAP use including those with low education (high school or less) or low incomes (below 200 percent of the federal poverty line).

[Figures 1 and 2 here]

Figures 1 and 2 contain trends in the 12-month and 30-day rates of household food insecurity and SNAP participation, respectively. Both figures show that the 12-month and 30-day estimates track closely, with the 12-month rate much higher than the 30-day rate as expected. Food insecurity at the 12-month reference period was 11.1 percent in 2002 and again in 2007, and then leapt one-third to 14.9 percent with the onset of the Great Recession in 2008. It remained above 14 percent through 2014 but by 2019 was below the 2002 level at 10.5 percent. The 30-day rate in a typical year is half the 12-month rate, but follows a similar pattern of a spike in 2008 and steady decline after 2011, though the 2019 rate of 5.5 percent exceeds that in 2002. Figure 2 shows that SNAP participation increased through 2005, and then abated for two years,

[1] In 2001 the HFSS asked whether the last month someone received SNAP was November or December or some other month. Some households in December also received SNAP in November, and some were new entrants, but it is not possible to distinguish the two groups. In order to have a consistently measured series, we begin our sample in 2002 when the HSFF provided monthly dating of SNAP receipt.

prior to accelerating dramatically in the Great Recession, with the 12-month participation rate peaking in 2012 at 10.8 percent and then gradually declining to 7.6 percent, a level that is 2.3 percentage points higher than in 2002. The time-series pattern with the 30-day rate is similar, doubling from 4.3 percent in 2002 to 8.8 percent in 2013, and again steadily falling to 6.5 percent in 2019, a participation rate that is 50 percent higher than at the start of the period.

[Table 1 here]

Although the trends in food insecurity and SNAP participation are similar over the past two decades, the levels do differ significantly, and thus in Table 1 we explore whether some of these level differences may be reflected in differences in demographic composition. We present summary statistics for the sample overall, and by 12-month and 30-day food insecurity and SNAP participation. The table reveals few substantive differences in the demographic composition of household heads across the 12-month and 30-day scales of food insecurity and SNAP beyond employment rates and income to poverty ratios where the 30-day food insecure sample is slightly more disadvantaged. On the contrary, food insecure households relative to the sample overall are much younger, more likely to be female headed, more likely to have lower education attainment, more likely to be a member of a minority racial or ethnic group, more likely to be unmarried, more likely to be out of work, more likely to live in poverty, more likely to be a renter, and more likely to live in a city. These differences hold also when comparing SNAP households to the pooled sample. Moreover, SNAP households are further disadvantaged relative to those food insecure in that they have lower education attainment, lower incomes, lower employment rates, and lower rates of homeownership. The table also shows that about half of SNAP households were food insecure in the past year, and about one-third in the last 30 days.

The empirical results below condition on these demographics to hold constant their confounding influence on the decision to participate in SNAP and on the risk of food insecurity.

As indicated in the prior section, we also utilize extra regressors (p_{st}) to aid in identifying the SNAP participation decision separately from the food insecurity equation. These primarily draw from the Economic Research Service SNAP Policy Database, which provides monthly dating of state-by-year implementation of policies affecting access to and eligibility for SNAP.[2] This includes the maximum SNAP benefit for a 3-person household, and indicator variables reflecting if the state exempts the value of vehicles from eligibility determination, if the state requires finger printing at application, if the state uses short recertification periods for SNAP eligibility (1-3 months), if the state uses broad-based categorical eligibility, if the state operates a combined application project that allows SSI recipients to use a streamlined SNAP application process, if the state extends eligibility to all legal noncitizen adults ages 18+, and if the state uses simplified reporting. In order capture differences across states in the cost-of-living, we deflate the maximum SNAP benefit by a state-by-year price index developed by Berry, Fording, and Hanson (2000) and Carillo, Early, and Olsen (2014), and updated by Hartley, Lamarche, and Ziliak (2022). For the 12-month reference period we use the annual average of the SNAP policies, while for the 30-day models we use the policy that was in effect as of November of the calendar year to align with the food insecurity and SNAP participation reference period.

Supplementing the SNAP policy variables are a set of state-by-year variables that are assumed to affect both food insecurity and SNAP Participation (w_{st}). These include the state unemployment rate, the maximum of the state and federal minimum wage inflation adjusted

[2] Available at https://www.ers.usda.gov/data-products/snap-policy-data-sets/.

using the same state price index as the SNAP maximum benefit, the ratio of 90-10 income inequality in the state, and whether the state governor is a Democrat. We use the state unemployment rate as of the month of November for the 30-day models, and the annual average for the 12-month model, but the other three are only available annually in both reference-period models. The maximum SNAP benefit, unemployment rate, minimum wage, and political affiliation of the governor are obtained from the University of Kentucky Center for Poverty Research National Welfare Database, while 90-10 inequality is based on author's calculations from the CPS Annual Social and Economic Supplement.[3]

V. Results

Table 2 contains coefficients and standard errors from the bivariate probit model of equations (1) and (2) for the full population of households, with the first two columns for the 12-month reference period and the last two for the 30-day reference period. Each model includes controls for state and year fixed effects, and standard errors are clustered at the state level because variation of the SNAP policy variables is only at the state-year level.

[Table 2 here]

In both the 12-month and 30-day SNAP participation models the SNAP policy variables are strong and statistically significant, with the p-value of joint significance of 0.011 and $p< 0.001$ for each model respectively. A more generous SNAP benefit increases participation (only significant in the 30-day model), as does residing in states conferring broad-based categorical eligibility for the program, the convenience of a combined application with other safety net

[3] The UKCPR database is available at https://ukcpr.org/resources/national-welfare-data, while the CPS ASEC is available at https://www.census.gov/data/datasets/time-series/demo/cps/cps-asec.html .

programs, and simplified reporting for recertification. States that require fingerprinting at point of application have lower SNAP participation, all else equal. Examining the other variables in the SNAP participation equation reveals the participation increases in states with higher unemployment rates and higher income inequality. In terms of demographic characteristics, participation is increasing in age at a decreasing rate, it is higher among women than men, and among members of minority racial and ethnic groups, the unmarried, lower educated, renters, those living in larger households, and those residing in non-metropolitan areas. These patterns are identical for both the 12-month and 30-day reference period models, not only for SNAP but also the food insecurity equations.

The bottom rows of Table 2 contain the estimated correlation coefficient and its associated standard error, which is both large and highly statistically significant, indicating the importance of controlling for the endogeneity of SNAP in the food insecurity equation. We also report the key counterfactual ATE. For the 12-month model the ATE indicates that SNAP reduces food insecurity by 10.2 percentage points, and by 6.9 points in the 30-day model. This difference in magnitude between reference periods is consistent with the fact that annual food insecurity is higher than 30-day insecurity in a typical year, and indeed relative to baseline potential food insecurity in a hypothetical world of no SNAP the 30-day estimates result in 74 percent lower food insecurity compared to 66 percent lower in the 12-month. This is consistent with our prior that the link between SNAP and food insecurity is stronger in the 30-day reference period, but we view these hypothetical effect sizes to be similar in magnitude. In short, there is no diminution in ability to identify the protective effects of SNAP against food insecurity when the researcher only has access to 30-day reports.

[Table 3 here]

In Table 3 we present estimates of the ATE for various subsamples to examine whether the results in Table 2 are robust in that identification of the effect of SNAP on food insecurity is invariant to reference period. The corresponding point estimates are provided in Appendix Tables 1-4. We consider four subsamples: a low-income sample of households with income less than 200 percent of the federal poverty line; a sample of household heads with education attainment of high school or less; a sample restricted to households with children; and a sample whose head is age 60 or older. Because SNAP is means-tested, restricting to those with gross incomes below 200 percent of poverty captures the largest risk set for participation. The low education sample captures a set of households that proxy for those with low permanent incomes, where we also impose a minimum age of 19 to avoid those still in high school. The sample of households with children is of interest because of eligibility for other food assistance and safety net programs, while the sample of older persons captures the age group that face more liberalized eligibility criteria for SNAP.

The estimates in Table 3 are unequivocal that SNAP is effective at reducing food insecurity across socioeconomic characteristics of households and regardless of reference period for food insecurity. The ATE for the 12-month model ranges from -0.071 in older households to -0.15 in households with children, while the corresponding range for the 30-day model is -0.047 in older households to -0.115 in households with incomes under 200 percent of poverty. Again, because the baseline risk of food insecurity is much higher in the 12-month models we expect the ATE to be larger, but relative to baseline risk the effect sizes are comparable in magnitude (the 30-day reduction is slighter greater in all cases, but only trivially so). In general, as presented in Appendix Tables 1-4 the SNAP policy variables are consistent with the base-case estimates in Table 2 and are statistically significant. The notable exception is in the 12-month model of older

persons whose head is age 60 or above. While a couple of the policies are individually significant in Appendix Table 4, jointly they are zero with a p-value of 0.127. This is a result noted by Jones et al. (2022) who found that the SNAP policies were not effective in identifying SNAP. However, we do find the policies to be jointly significant in the 30-day model, suggesting that one or multiple channels of measurement error, temporal ordering, sample composition, and local economic and political conditions may be operating on the senior population not found among other subsamples.

VI. Conclusion

In this paper, we examine the sensitivity of the estimates of SNAP on food insecurity to a 30-day and 12-month reference period using bivariate probit models on 2002-2019 CPS data and SNAP policy data for identification. Despite theoretical reasons to expect otherwise, we find that SNAP has a similar protective effect on food insecurity under both time horizons and that this result is consistent across subsamples chosen by age, income, education level, and household compositions. While we do not empirically explore mechanisms for the common effect sizes across reference periods, one plausible explanation stems from the fact that the underlying observables between the two groups are quite similar and measurement error and temporal ordering concerns may not be severe enough to affect the underlying relationship between SNAP and food insecurity.

What are the practical implications of this finding for researchers? The finding that SNAP is protective to food insecurity across both 30-day and 12-month measures should reassure researchers that the time period of their study will not alter the final observed causal

relationship between SNAP and food insecurity and allow them to make the decision about the referenced time period in their study based on other concerns.

For example, in 2002, Nord noted that the 30-day measure might be preferred: "where its greater temporal specificity can help overcome temporal mismatch problems that complicate and obscure associations between the 12-month scale and variables measuring determinants and outcomes of food insecurity and hunger." In other words, the issues discussed above, particularly those related to timing, may be relevant to larger goals research goals, such as establishing how SNAP might influence health outcomes, healthcare utilization patterns, or health behaviors. In this case, using short-horizon measures that allow for greater specificity around the temporal ordering may be critical to properly interpretating the evaluation findings.

On the other hand, the 12-month measure might be more appropriate when examining outcomes that may not immediately move upon exposure to SNAP, such as behavioral health, mental health, school outcomes, or labor market changes. This study suggests that researchers could safely rely upon the 12-month measure to capture the protective of SNAP on food insecurity, enjoy the larger sample size and statistical power associated with using the measure, and allow for time for the theoretically variably delayed positive effect of SNAP to appear in the other measures.

References

Arteaga, Irma. and Parke E. Wilde. 2023. Measuring food security in the US for 25 years: History, methods, findings, and opportunities. *Journal of the Academy of Nutrition and Dietetics*. DOI: 10.1016/j.jand.2023.01.007.

Berry, William, Richard Fording, and Russell Hanson. 2000. An annual cost of living index for the American states, 1960–95. *Journal of Politics*, 62(2): 550–567.

Bitler, Marianne. 2015. The health and nutrition effects of SNAP: selection into the program and a review of the literature on its effects, In J. Bartfeld, C. Gundersen, T. Smeeding, and J. Ziliak, editors, *SNAP matters: how food stamps affect health and well-being*. Redwood City (CA): Stanford University Press, 134-60.

Carrillo, Paul, Dirk Early, and Edgar O. Olsen. 2014. A panel of interarea price indices for all areas in the United States 1982–2012. *Journal of Housing Economics*, 26(C): 81–93.

Castellari E, Cotti C, Gordanier J, and Ozturk O. 2016. Does the Timing of Food Stamp Distribution Matter? A Panel Data Analysis of Monthly Purchasing Patterns of U.S. Households. *Health Economics* 26: 1380–1393.

Celhay, Pablo, Bruce D. Meyer, Nikolas Mittag. 2022. What leads to measurement errors? Evidence from reports of program participation in three surveys. NBER Working Paper 29652. https://www.nber.org/system/files/working_papers/w29652/w29652.pdf

Courtemanche, C., Denteh, A. and Tchernis, R. 2019. Estimating the Associations between SNAP and Food Insecurity, Obesity, and Food Purchases with Imperfect Administrative Measures of Participation. *Southern Economic Journal*, 86: 202-228. https://doi.org/10.1002/soej.12364

Gregory, Christian A., Jessica E. Todd. 2021. SNAP timing and food insecurity. *PLoS One* 16(2):e0246946. doi: 10.1371/journal.pone.0246946. PMID: 33630866; PMCID: PMC7906471.

Gregory, Christian A., Matthew Rabbitt, and David Ribar. 2015. The Supplemental Nutrition Assistance Program and Food Insecurity, In J. Bartfeld, C. Gundersen, T. Smeeding, and J. Ziliak, editors, *SNAP matters: how food stamps affect health and well-being*. Redwood City (CA): Stanford University Press, 74-106.

Gregory, Christian A., and Travis A. Smith. 2019. Salience, Food Security, and SNAP Receipt. *Journal of Policy Analysis and Management*, 38: 124-154. https://doi.org/10.1002/pam.22093

Gundersen, Craig, Brent Kreider, and John Pepper. 2011. The economics of food insecurity in the United States. Applied Economic Perspectives and Policy 33(3):281–303.

Gundersen, Craig, and Victor Oliveira. 2001. The Food Stamp Program and Food Insufficiency, *American Journal of Agricultural Economics* 83(4): 875-887.

Hartley, Robert Paul, Carlos Lamarche, and James P. Ziliak. 2022. Welfare Reform and the Intergenerational Transmission of Dependence. *Journal of Political Economy* 103(3): 523-565.

Heflin, Colleen, and James P. Ziliak. 2008. Food Insufficiency, Food Stamp Participation, and Mental Health. *Social Science Quarterly* 89(3): 706-727.

Heflin, Colleen, Leslie Hodges, and Chinedum Ojinnaka. 2020. Administrative Churn in SNAP and Health Care Utilization Patterns. *Medical Care* 58(1): 33-37.

Heckman, James J. 1978. Dummy endogenous Variables in a Simultaneous Equation System, *Econometrica* 46: 931-959.

Jones, Jordan, Austin Denteh, James Marton, and Rusty Tchernis, R. 2022. Do State Supplemental Nutrition Assistance Program policies influence program participation among seniors? *Applied Economic Perspectives and Policy* 44(2) 591– 608.

Kabbani, Nader S., and Myra Yazbeck Kmeid. 2005. The Role of Food Assistance in Helping Food Insecure Households Escape Hunger. *Review of Agricultural Economics* 27(3): 439-445.

Meyerhoefer, Chad D., and Muzhe Yang. 2011. The Relationship between Food Assistance and Health: A Review of the Literature and Empirical Strategies for Identifying Program Effects, *Applied Economic Perspectives and Policy* 33(3): 304-344.

Mills, Gregory, Tracy Vericker, Kye Lippold, Laura Wheaton, and Sam Elkin. 2014. *Understanding the Rates, Causes, and Costs of Churning in the Supplemental Nutrition Assistance Program (SNAP)*. Washington, DC: Urban Institute.

Nguimkeu, Pierre, Augstine Denteh, and Rusty Tchernis. 2019. On the Estimation of Treatment Effects with Endogenous Misreporting. *Journal of Econometrics* vol 208, issue 2, 487-506.

Nord, Mark. 2002. A 30-Day Food Security Scale for Current Population Survey Food Security Supplement Data. US Department of Agriculture: Economic Research Service. EFAN-02-015. https://www.ers.usda.gov/webdocs/publications/43192/31177_efan02015_002.pdf

Rabbitt, M.P., Hales, L.J., Burke, M.P., & Coleman-Jensen, A. (2023). Household Food Security in the United States in 2022 (Report No. ERR-325), U.S. Department of Agriculture, Economic Research Service.

Ribar, David C., and Marilyn Edelhoch. 2008. Earnings Volatility and the Reasons for Leaving the Food Stamp Program. In *Income Volatility and Food Assistance in the United States*, D. Jolliffe and J. Ziliak (eds.). Kalamazoo, MI: W.E. Upjohn Institute. 63-102.

Todd, Jessica E. Revisiting the Supplemental Nutrition Assistance Program cycle of food intake: Investigating heterogeneity, diet quality, and a large boost in benefit amounts. *Applied Economics Perspectives and Policy* 37(3): 437–458.

Todd Jessica E., and Christian A. Gregory. 2018. Changes in Supplemental Nutrition Assistance Program real benefits and daily caloric intake among adults. *Food Policy* 79: 111–120.

Wilde, Joachim. 2000. Identification of Multiple Equation Probit Models with Endogenous Dummy Regressors, *Economics Letters* 69: 309-312.

Wilde, Parke. 2007. Measuring the Effect of Food Stamps on Food Insecurity and Hunger: Research and Policy Considerations. *Journal of Nutrition* 137: 307-310.

Yen, Stephen T., Margaret Andrews, Zhuo Chen, and David B. Eastwood. 2008. Food Stamp Program Participation and Food Insecurity: An Instrumental Variables Approach, *American Journal of Agricultural Economics* 90(1): 117-132.

Ziliak, James P. and Laura J. Tiehen. 2022. SNAP and the Food Security of Rural and Urban Households with Children, Unpublished manuscript.

Figure 1. Trends in Annual and 30-day Food Insecurity

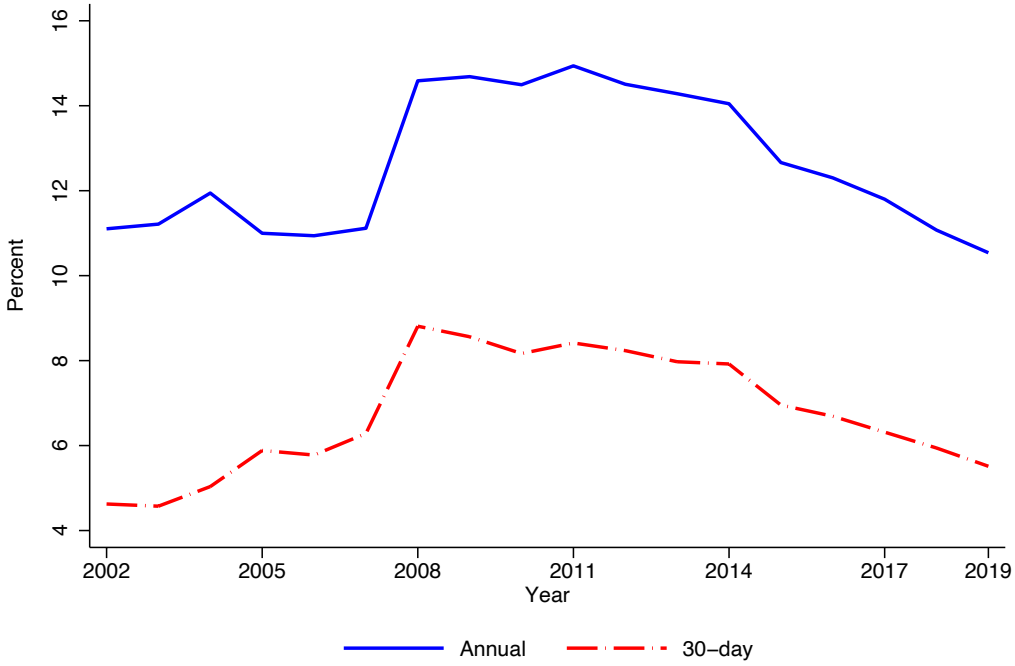

Figure 2. Trends in SNAP Participation in Past Year and Prior Month

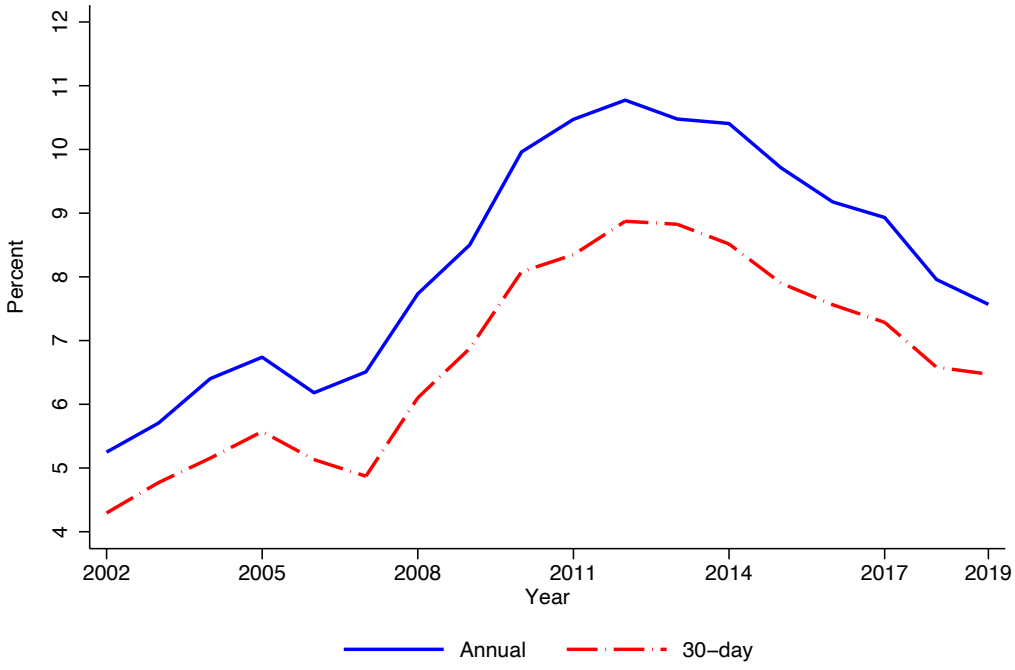

Table 1. Summary Statistics for Pooled Sample and by Food Insecurity and SNAP Status

	Pooled		12-month Food Insecure		30-day Food Insecure		12-month SNAP		30-Day SNAP	
Variable	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Age	50.15	17.10	45.32	15.49	45.68	15.13	44.85	16.50	45.51	16.67
Male	0.50	0.50	0.40	0.49	0.40	0.49	0.32	0.47	0.31	0.46
Less than high school	0.12	0.32	0.24	0.43	0.24	0.43	0.30	0.46	0.31	0.46
High school	0.28	0.45	0.34	0.47	0.34	0.47	0.36	0.48	0.36	0.48
Some college	0.28	0.45	0.31	0.46	0.32	0.46	0.27	0.44	0.26	0.44
College or more	0.32	0.47	0.12	0.32	0.11	0.31	0.07	0.25	0.06	0.24
Black	0.13	0.34	0.24	0.43	0.23	0.42	0.29	0.46	0.30	0.46
White	0.80	0.40	0.70	0.46	0.70	0.46	0.64	0.48	0.64	0.48
Other race	0.07	0.25	0.07	0.25	0.07	0.25	0.07	0.25	0.07	0.25
Hispanic	0.12	0.33	0.20	0.40	0.21	0.40	0.21	0.40	0.20	0.40
Married	0.51	0.50	0.33	0.47	0.31	0.46	0.26	0.44	0.24	0.43
Wid., div., sep.	0.28	0.45	0.37	0.48	0.39	0.49	0.39	0.49	0.40	0.49
Never married	0.21	0.41	0.30	0.46	0.30	0.46	0.35	0.48	0.36	0.48
Household size	2.50	1.44	2.73	1.68	2.66	1.67	3.01	1.81	2.97	1.81
Number of children	0.61	1.04	0.92	1.26	0.87	1.24	1.23	1.43	1.22	1.44
Employed	0.62	0.49	0.51	0.50	0.48	0.50	0.37	0.48	0.33	0.47
Income to poverty ratio	3.74	2.92	1.60	1.37	1.52	1.31	0.95	0.80	0.89	0.74
Own home	0.67	0.47	0.39	0.49	0.38	0.48	0.29	0.45	0.28	0.45
Live in non-metro	0.16	0.36	0.17	0.38	0.16	0.37	0.20	0.40	0.20	0.40
On SNAP, 12-month	0.08	0.28	0.34	0.47	0.37	0.48	1.00	0.00	1.00	0.00
On SNAP, 30 day	0.07	0.25	0.28	0.45	0.30	0.46	0.82	0.39	1.00	0.00
Number of Months SNAP	0.76	2.80	3.10	4.94	3.37	5.07	9.16	4.15	10.44	3.12
Food Insecure, 12-month	0.13	0.33	1.00	0.00	1.00	0.05	0.52	0.50	0.52	0.50
Food Insecure, 30 day	0.07	0.25	0.54	0.50	1.00	0.00	0.30	0.46	0.30	0.46
Observations	768,551		93,470		49,918		61,563		50,563	

Source: Authors calculations from Current Population Survey, Household Food Security Supplement, 2002-2019.

Table 2. The Effect of SNAP Participation on Food Insecurity of Households

VARIABLES	(1) 12-month Food Insecurity	(2) 12-month SNAP	(3) 30-day Food Insecurity	(4) 30-day SNAP
SNAP	-0.765***		-0.797***	
	(0.050)		(0.026)	
Age	0.043***	0.026***	0.050***	0.030***
	(0.001)	(0.002)	(0.002)	(0.002)
Age Squared/100	-0.049***	-0.028***	-0.055***	-0.031***
	(0.002)	(0.002)	(0.002)	(0.002)
Male	-0.218***	-0.285***	-0.207***	-0.291***
	(0.008)	(0.007)	(0.007)	(0.008)
Black	0.352***	0.400***	0.271***	0.364***
	(0.016)	(0.021)	(0.016)	(0.021)
Hispanic	0.136***	0.100***	0.105***	0.092**
	(0.021)	(0.038)	(0.022)	(0.040)
Other Race	0.149***	0.172***	0.133***	0.174***
	(0.031)	(0.030)	(0.028)	(0.030)
Widowed, Divorced, Separated	0.554***	0.659***	0.532***	0.649***
	(0.017)	(0.017)	(0.013)	(0.018)
Never Married	0.432***	0.596***	0.421***	0.608***
	(0.018)	(0.019)	(0.014)	(0.020)
Less than High School	1.045***	1.180***	0.975***	1.174***
	(0.027)	(0.027)	(0.021)	(0.028)
High School	0.682***	0.780***	0.641***	0.779***
	(0.017)	(0.018)	(0.014)	(0.019)
Some College	0.551***	0.574***	0.533***	0.573***
	(0.013)	(0.015)	(0.012)	(0.016)
Renter	0.637***	0.763***	0.607***	0.752***
	(0.013)	(0.018)	(0.012)	(0.019)
Household Size	0.134***	0.204***	0.108***	0.190***
	(0.007)	(0.005)	(0.005)	(0.005)
Non-Metro	0.106***	0.213***	0.086***	0.205***
	(0.017)	(0.019)	(0.017)	(0.020)
Real Minimum Wage	0.007	0.012	0.005	0.011
	(0.006)	(0.008)	(0.006)	(0.008)
State Unemployment Rate	0.032***	0.025***	0.029***	0.019***
	(0.005)	(0.006)	(0.004)	(0.007)
State 90/10 Inequality Ratio	0.004***	0.006***	0.004***	0.006***
	(0.001)	(0.002)	(0.002)	(0.002)
Democratic Governor	0.006	0.015	-0.000	0.018
	(0.010)	(0.014)	(0.010)	(0.013)
State Max SNAP Benefit, 3 People		0.064		0.089*

		(0.050)		(0.052)
Broad-based Eligibility		0.057***		0.041**
		(0.019)		(0.018)
Combined Application		0.031		0.036*
		(0.021)		(0.021)
Short Certification		0.028		0.062
		(0.058)		(0.058)
Finger Printing		-0.048*		-0.032
		(0.026)		(0.022)
Simple Reporting		0.041**		0.051***
		(0.018)		(0.018)
Vehicle Exclusions		0.018		0.020
		(0.015)		(0.021)
Constant	-3.565***	-4.674***	-4.029***	-4.985***
	(0.077)	(0.238)	(0.079)	(0.249)
Correlation Coefficient	0.879***		0.814***	
	(0.029)		(0.015)	
ATE	-0.102***		-0.069***	
	(0.006)		(0.003)	
P-value on SNAP Policies		0.011		0.000
Observations	761,906	761,906	761,877	761,877

Source: Authors calculations from Current Population Survey, Household Food Security Supplement, 2002-2019; ERS SNAP Policy Database; UKCPR National Welfare Database.
Notes: All models control for state and year fixed effects. Standard errors are clustered at the state level and reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 3. The Average Treatment Effect of SNAP on Food Insecurity, Alternative Samples

Sample	12-month Reference Period	30-day Reference Period
Income < 200% FPL	-0.143***	-0.115***
	(0.025)	(0.011)
High school or less	-0.141***	-0.092***
	(0.011)	(0.005)
Households with children	-0.150***	-0.097***
	(0.005)	(0.004)
Age 60 and older	-0.071***	-0.047***
	(0.009)	(0.004)

Source: Authors calculations from Current Population Survey, Household Food Security Supplement, 2002-2019; ERS SNAP Policy Database; UKCPR National Welfare Database.
Notes: The coefficient is the average treatment effect comparing the potential food insecurity with no one on SNAP against potential food insecurity with everyone on SNAP. Standard errors are clustered at the state level and reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Appendix Table 1. The Effect of SNAP Participation on Food Insecurity of Low-Income Households

VARIABLES	(1) 12-month Food Insecurity	(2) 12-month SNAP	(3) 30-day Food Insecurity	(4) 30-day SNAP
SNAP	-0.490***		-0.556***	
	(0.091)		(0.055)	
Age	0.072***	0.049***	0.075***	0.050***
	(0.002)	(0.003)	(0.002)	(0.003)
Age Squared/100	-0.081***	-0.053***	-0.083***	-0.053***
	(0.003)	(0.003)	(0.003)	(0.003)
Male	-0.148***	-0.256***	-0.134***	-0.257***
	(0.011)	(0.010)	(0.010)	(0.010)
Black	0.223***	0.320***	0.137***	0.284***
	(0.015)	(0.022)	(0.015)	(0.021)
Hispanic	-0.024	-0.073*	-0.050**	-0.058
	(0.019)	(0.042)	(0.020)	(0.042)
Other Race	0.062*	0.094***	0.042	0.097***
	(0.033)	(0.035)	(0.030)	(0.033)
Widowed, Divorced, Separated	0.345***	0.500***	0.325***	0.492***
	(0.017)	(0.015)	(0.012)	(0.015)
Never Married	0.207***	0.439***	0.198***	0.454***
	(0.017)	(0.016)	(0.013)	(0.017)
Less than High School	0.595***	0.753***	0.520***	0.749***
	(0.036)	(0.030)	(0.028)	(0.029)
High School	0.373***	0.483***	0.324***	0.475***
	(0.027)	(0.023)	(0.024)	(0.024)
Some College	0.347***	0.353***	0.320***	0.345***
	(0.021)	(0.019)	(0.020)	(0.020)
Renter	0.400***	0.585***	0.372***	0.569***
	(0.018)	(0.019)	(0.015)	(0.018)
Household Size	0.058***	0.152***	0.032***	0.136***
	(0.007)	(0.005)	(0.005)	(0.005)
Non-Metro	-0.005	0.131***	-0.017	0.126***
	(0.017)	(0.019)	(0.019)	(0.019)
Real Minimum Wage	0.012*	0.018*	0.010	0.018*
	(0.008)	(0.010)	(0.008)	(0.010)
State Unemployment Rate	0.029***	0.019***	0.028***	0.015**
	(0.006)	(0.007)	(0.006)	(0.007)
State 90/10 Inequality Ratio	0.004**	0.006**	0.003	0.006**
	(0.002)	(0.002)	(0.002)	(0.002)
Democratic Governor	-0.001	0.023	-0.013	0.023
	(0.012)	(0.018)	(0.014)	(0.016)

State Max SNAP Benefit, 3 People		0.098		0.121*
		(0.067)		(0.064)
Broad-based Eligibility		0.078***		0.052**
		(0.027)		(0.024)
Combined Application		0.054*		0.053*
		(0.033)		(0.028)
Short Certification		0.029		0.028
		(0.073)		(0.077)
Finger Printing		-0.067***		-0.046**
		(0.024)		(0.022)
Simple Reporting		0.057***		0.063***
		(0.021)		(0.022)
Vehicle Exclusions		0.014		0.011
		(0.022)		(0.029)
Constant	-3.058***	-4.265***	-3.549***	-4.516***
	(0.104)	(0.311)	(0.101)	(0.297)
Correlation Coefficient	0.633***		0.572***	
	(0.053)		(0.032)	
ATE	-0.143***		-0.115***	
	(0.025)		(0.011)	
P-value on SNAP Policies		0.001		0.000
Observations	209,236	209,236	209,221	209,221

Source: Authors calculations from Current Population Survey, Household Food Security Supplement, 2002-2019; ERS SNAP Policy Database; UKCPR National Welfare Database.
Notes: Sample is households with income less than 200% FPL. All models control for state and year fixed effects. Standard errors are clustered at the state level and reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Appendix Table 2. The Effect of SNAP Participation on Food Insecurity of Low-Education Households

VARIABLES	(1) 12-month Food Insecurity	(2) 12-month SNAP	(3) 30-day Food Insecurity	(4) 30-day SNAP
Prior Month SNAP Recipient = 1	-0.752***		-0.728***	
	(0.066)		(0.035)	
Age	0.036***	0.017***	0.045***	0.022***
	(0.002)	(0.002)	(0.002)	(0.003)
Age Squared/100	-0.044***	-0.023***	-0.052***	-0.026***
	(0.002)	(0.003)	(0.003)	(0.003)
Male	-0.211***	-0.310***	-0.186***	-0.318***
	(0.012)	(0.010)	(0.010)	(0.010)
Black	0.326***	0.372***	0.233***	0.342***
	(0.015)	(0.021)	(0.016)	(0.021)
Hispanic	0.078***	0.030	0.043*	0.031
	(0.026)	(0.045)	(0.025)	(0.047)
Other Race	0.154***	0.171***	0.137***	0.174***
	(0.036)	(0.032)	(0.036)	(0.032)
Widowed, Divorced, Separated	0.480***	0.596***	0.451***	0.590***
	(0.020)	(0.019)	(0.015)	(0.020)
Never Married	0.395***	0.583***	0.370***	0.594***
	(0.024)	(0.022)	(0.017)	(0.023)
Less than High School	0.391***	0.442***	0.357***	0.434***
	(0.015)	(0.015)	(0.011)	(0.015)
Renter	0.611***	0.741***	0.570***	0.728***
	(0.016)	(0.021)	(0.014)	(0.021)
Household Size	0.118***	0.184***	0.085***	0.167***
	(0.008)	(0.006)	(0.006)	(0.005)
Non-Metro	0.087***	0.196***	0.061***	0.188***
	(0.021)	(0.022)	(0.020)	(0.022)
Real Minimum Wage	0.006	0.006	-0.001	0.000
	(0.009)	(0.011)	(0.010)	(0.012)
State Unemployment Rate	0.034***	0.025***	0.029***	0.019***
	(0.006)	(0.007)	(0.006)	(0.007)
State 90/10 Inequality Ratio	0.007***	0.008***	0.006**	0.009***
	(0.002)	(0.003)	(0.002)	(0.003)
Democratic Governor	0.005	0.014	-0.003	0.012
	(0.015)	(0.018)	(0.015)	(0.017)
State Max SNAP Benefit, 3 People		0.082		0.111*
		(0.061)		(0.066)
Broad-based Eligibility		0.056***		0.047**
		(0.021)		(0.020)

Combined Application		0.030		0.031
		(0.024)		(0.025)
Short Certification		0.003		0.057
		(0.072)		(0.074)
Finger Printing		-0.039*		-0.025
		(0.023)		(0.023)
Simple Reporting		0.050**		0.040*
		(0.020)		(0.021)
Vehicle Exclusions		0.014		0.013
		(0.013)		(0.023)
Constant	-2.581***	-3.579***	-3.087***	-3.883***
	(0.093)	(0.273)	(0.111)	(0.302)
Correlation Coefficient	0.858***		0.757***	
	(0.038)		(0.019)	
ATE	-0.141***		-0.092***	
	(0.011)		(0.005)	
P-value on SNAP Policies		0.012		0.009
Observations	300,330	300,330	300,310	300,310

Source: Authors calculations from Current Population Survey, Household Food Security Supplement, 2002-2019; ERS SNAP Policy Database; UKCPR National Welfare Database.
Notes: Sample is household heads with high school diploma or less education. All models control for state and year fixed effects. Standard errors are clustered at the state level and reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Appendix Table 3. The Effect of SNAP Participation on Food Insecurity of Households with Children

VARIABLES	(1) 12-month Food Insecurity	(2) 12-month SNAP	(3) 30-day Food Insecurity	(4) 30-day SNAP
SNAP	-0.860***		-0.842***	
	(0.021)		(0.025)	
Age	-0.002	-0.034***	0.010***	-0.026***
	(0.002)	(0.003)	(0.002)	(0.003)
Age Squared/100	0.001	0.034***	-0.010***	0.028***
	(0.002)	(0.003)	(0.002)	(0.003)
Male	-0.255***	-0.293***	-0.244***	-0.307***
	(0.008)	(0.010)	(0.009)	(0.011)
Black	0.274***	0.330***	0.191***	0.299***
	(0.015)	(0.019)	(0.018)	(0.019)
Hispanic	0.110***	0.046	0.078***	0.032
	(0.020)	(0.036)	(0.021)	(0.038)
Other Race	0.138***	0.164***	0.101***	0.166***
	(0.027)	(0.034)	(0.021)	(0.032)
Widowed, Divorced, Separated	0.575***	0.663***	0.531***	0.636***
	(0.017)	(0.017)	(0.016)	(0.016)
Never Married	0.504***	0.669***	0.457***	0.657***
	(0.019)	(0.020)	(0.018)	(0.020)
Less than High School	0.986***	1.099***	0.886***	1.090***
	(0.018)	(0.024)	(0.018)	(0.025)
High School	0.717***	0.796***	0.647***	0.784***
	(0.014)	(0.018)	(0.015)	(0.020)
Some College	0.577***	0.599***	0.542***	0.591***
	(0.013)	(0.016)	(0.013)	(0.018)
Renter	0.662***	0.777***	0.602***	0.753***
	(0.013)	(0.018)	(0.015)	(0.019)
Household Size	0.105***	0.154***	0.086***	0.144***
	(0.005)	(0.005)	(0.005)	(0.005)
Non-Metro	0.097***	0.201***	0.061***	0.182***
	(0.018)	(0.022)	(0.019)	(0.022)
Real Minimum Wage	0.001	0.004	0.000	0.002
	(0.008)	(0.010)	(0.007)	(0.010)
State Unemployment Rate	0.037***	0.032***	0.036***	0.023***
	(0.006)	(0.007)	(0.007)	(0.008)
State 90/10 Inequality Ratio	0.003	0.003	0.003	0.004
	(0.002)	(0.003)	(0.002)	(0.003)
Democratic Governor	0.004	0.011	-0.013	0.011
	(0.010)	(0.014)	(0.011)	(0.015)

State Max SNAP Benefit, 3 People		0.039		0.075
		(0.054)		(0.056)
Broad-based Eligibility		0.058**		0.053**
		(0.024)		(0.026)
Combined Application		0.041		0.033
		(0.026)		(0.029)
Short Certification		0.045		0.071
		(0.063)		(0.089)
Finger Printing		-0.051*		-0.016
		(0.028)		(0.028)
Simple Reporting		0.063**		0.063**
		(0.026)		(0.028)
Vehicle Exclusions		0.002		0.015
		(0.019)		(0.032)
Constant	-2.350***	-2.820***	-3.061***	-3.213***
	(0.082)	(0.229)	(0.085)	(0.228)
Correlation Coefficient	0.898***		0.776***	
	(0.014)		(0.014)	
ATE	-0.150***		-0.097***	
	(0.005)		(0.004)	
P-value on SNAP Policies		0.007		0.002
Observations	241,982	241,982	241,976	241,976

Source: Authors calculations from Current Population Survey, Household Food Security Supplement, 2002-2019; ERS SNAP Policy Database; UKCPR National Welfare Database.
Notes: Sample is households with children. All models control for state and year fixed effects. Standard errors are clustered at the state level and reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Appendix Table 4. The Effect of SNAP Participation on Food Insecurity of Senior Households

VARIABLES	(1) 12-month Food Insecurity	(2) 12-month SNAP	(3) 30-day Food Insecurity	(4) 30-day SNAP
SNAP	-0.757***		-0.775***	
	(0.110)		(0.050)	
Age	0.091***	0.100***	0.075***	0.110***
	(0.012)	(0.015)	(0.016)	(0.016)
Age Squared/100	-0.084***	-0.083***	-0.073***	-0.090***
	(0.009)	(0.010)	(0.011)	(0.011)
Male	-0.098***	-0.144***	-0.092***	-0.150***
	(0.012)	(0.014)	(0.012)	(0.016)
Black	0.435***	0.408***	0.354***	0.371***
	(0.025)	(0.029)	(0.025)	(0.029)
Hispanic	0.307***	0.307***	0.288***	0.301***
	(0.033)	(0.061)	(0.030)	(0.058)
Other Race	0.289***	0.288***	0.285***	0.289***
	(0.048)	(0.042)	(0.050)	(0.036)
Widowed, Divorced, Separated	0.562***	0.685***	0.545***	0.684***
	(0.027)	(0.028)	(0.021)	(0.029)
Never Married	0.516***	0.704***	0.485***	0.706***
	(0.034)	(0.032)	(0.029)	(0.033)
Less than High School	0.901***	0.970***	0.829***	0.952***
	(0.044)	(0.036)	(0.039)	(0.038)
High School	0.496***	0.524***	0.444***	0.515***
	(0.028)	(0.025)	(0.026)	(0.028)
Some College	0.406***	0.369***	0.378***	0.358***
	(0.021)	(0.024)	(0.025)	(0.025)
Renter	0.674***	0.807***	0.652***	0.793***
	(0.023)	(0.022)	(0.018)	(0.022)
Household Size	0.161***	0.220***	0.136***	0.194***
	(0.011)	(0.012)	(0.008)	(0.012)
Non-Metro	0.111***	0.190***	0.098***	0.188***
	(0.021)	(0.017)	(0.020)	(0.018)
Real Minimum Wage	0.019**	0.015	0.020**	0.018
	(0.008)	(0.010)	(0.009)	(0.012)
State Unemployment Rate	0.018***	0.012	0.017**	0.003
	(0.007)	(0.010)	(0.007)	(0.011)
State 90/10 Inequality Ratio	0.006**	0.009**	0.005	0.009***
	(0.003)	(0.003)	(0.003)	(0.003)
Democratic Governor	0.016	0.022	0.016	0.016
	(0.017)	(0.021)	(0.016)	(0.021)
State Max SNAP Benefit, 3 People		0.050		0.076

		(0.069)		(0.078)
Broad-based Eligibility		0.051**		0.037*
		(0.023)		(0.022)
Combined Application		0.059**		0.070**
		(0.027)		(0.028)
Short Certification		0.124		0.268**
		(0.098)		(0.107)
Finger Printing		-0.051		-0.053
		(0.040)		(0.035)
Simple Reporting		0.056		0.089***
		(0.034)		(0.033)
Vehicle Exclusions		0.027		0.022
		(0.026)		(0.051)
Constant	-5.239***	-7.034***	-4.863***	-7.527***
	(0.418)	(0.575)	(0.551)	(0.607)
Correlation Coefficient	0.884***		0.845***	
	(0.060)		(0.030)	
ATE	-0.071***		-0.047***	
	(0.009)		(0.004)	
P-value on SNAP Policies		0.127		0.003
Observations	245,406	245,406	245,401	245,401

Source: Authors calculations from Current Population Survey, Household Food Security Supplement, 2002-2019; ERS SNAP Policy Database; UKCPR National Welfare Database.
Notes: Sample is households headed by a person age 60 and older. All models control for state and year fixed effects. Standard errors are clustered at the state level and reported in parentheses.
*** p<0.01, ** p<0.05, * p<0.1