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Final Report

Empirical Bayes Shrinkage Estimates of State Supplemental Nutrition Assistance Program Participation Rates in Fiscal Year 2016 to Fiscal Year 2018 for All Eligible People and Working Poor People

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CONTENTS

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Tables

EXHIBITS

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EXECUTIVE SUMMARY

The Supplemental Nutrition Assistance Program (SNAP) provides nutrition assistance to eligible, low-income individuals and households in need. SNAP is the largest of the domestic nutrition assistance programs administered by the Food and Nutrition Service (FNS) of the U.S. Department of Agriculture (USDA). During fiscal year 2020, the program served nearly 44 million people in an average month at a total annual cost of nearly $85 billion in benefits.

This report presents estimates that measure the need for SNAP and the program's effectiveness at reaching its target population in each state and the District of Columbia for fiscal years 2016 to 2018. Need for the program is measured by estimated numbers of people eligible for SNAP. The program's effective reach is measured by estimated SNAP participation rates. In addition to estimates that pertain to all eligible people, we derived estimates for "working poor" people—that is, people who were eligible for SNAP and lived in households in which someone earned income from a job.

The estimates for all eligible people and for working poor people were derived jointly using empirical Bayes shrinkage estimation methods and data from the Current Population Survey Annual Social and Economic Supplement (CPS ASEC), the American Community Survey (ACS), and administrative records. The shrinkage estimator averaged direct estimates of participation rates in each state with predictions from a regression model. The regression predictions were based on observed indicators of socioeconomic conditions in the states, such as the percentage of the total state population receiving SNAP benefits. Shrinkage estimators improve precision by "borrowing strength," that is, by using data for multiple years from all the states to derive each state's estimates for a given year and by using data from multiple sources, including sample surveys and administrative data. On average, 90 percent shrinkage confidence intervals for fiscal year 2018 participation rates for all eligible people were 45 percent narrower than the corresponding direct confidence intervals. This report describes our shrinkage estimator in detail.

Final shrinkage estimates for fiscal year 2016 and fiscal year 2017 presented in this report differ slightly from the estimates presented in Cunnyngham (2020a) and Cunnyngham (2020b) because of annual data updates. As a result, the estimates presented in this report should not be compared to those published in earlier reports.

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I. INTRODUCTION

The Supplemental Nutrition Assistance Program (SNAP) provides nutrition assistance to eligible, low-income individuals and households in need. SNAP is the largest of the domestic nutrition assistance programs administered by the Food and Nutrition Service (FNS) of the U.S. Department of Agriculture (USDA). During fiscal year (FY) 2020, the program served nearly 44 million people in an average month at a total annual cost of nearly $85 billion in benefits.

This report presents estimates that measure the need for SNAP and the program's effectiveness at reaching its target population in each state and the District of Columbia for FY 2016 to FY 2018. The estimates presented here are also reported and compared with one another in Cunnyngham (2021). Need for the program is measured by estimated numbers of people eligible for SNAP. The program's effective reach is measured by estimated SNAP participation rates—the percentage of eligible people who actually participate in the program. In addition to presenting estimates that pertain to all eligible people, we present estimates for "working poor" people, meaning people who are eligible for SNAP and live in households in which someone earned income from a job or self-employment.

We derived estimates for all eligible people and working poor people for each state in each of the three fiscal years using empirical Bayes shrinkage estimation methods. Specifically, we used a shrinkage estimator that optimally averaged direct estimates of SNAP participation rates with predictions from a regression model. We obtained the direct estimates by applying SNAP eligibility rules to households in the Current Population Survey Annual Social and Economic Supplement (CPS ASEC) to estimate numbers of eligible people and using SNAP Quality Control (QC) data to estimate numbers of participating people. The regression predictions drew on data from the American Community Survey (ACS), individual tax returns, population estimates, and administrative records.

The remainder of this introductory chapter provides an overview of indirect estimation and our shrinkage estimator. Chapter II describes, step by step, how we derived the shrinkage estimates presented here, and Chapter III presents state estimates for all eligible people and working poor people. Technical details and additional information about our estimation methods are provided in Appendix A. Appendix B contains data for the figures presented in Cunnyngham (2021).

Direct estimates. The principal challenge in deriving state estimates like those presented in this report is the small sample size of the CPS ASEC. The optimal survey for estimating state SNAP eligibility would (1) have a large sample for all states, (2) be representative at the state level, and (3) contain the detail on household relationships and income sources needed to estimate program eligibility. Among the three leading surveys, the CPS ASEC comes closest to meeting these standards despite its small sample sizes for most states. Another national household survey, the Survey of Income and Program Participation, contains more detail on relationships and income than the CPS ASEC but is not representative at the state level (and has even smaller state samples than the CPS ASEC). The third candidate, the ACS, is much larger than the CPS ASEC but has fewer details on relationships and income sources. Additionally, unlike the CPS ASEC's fixed reference period of the prior calendar year for all households, the ACS reference period is the prior 12 months and therefore varies across households by up to a year, depending on when respondents complete the survey. For these reasons, we use the CPS ASEC to estimate SNAP eligibility.

U.S. Census Bureau Data

The **Current Population Survey** is conducted monthly for the Bureau of Labor Statistics and is the primary source of current information on the labor force characteristics of the U.S. population. The CPS Annual Social and Economic Supplement includes additional data on work experience, income, and noncash benefits, and has a sample size of just under 100,000 households.

The **American Community Survey** is conducted monthly in every county, American Indian and Alaska Native Area, Hawaiian Home Land, and in Puerto Rico. Designed to replace the decennial census long form, it collects economic, social, demographic, and housing information on about 3 million households annually.

The Census Bureau develops annual **population estimates** using decennial census population estimates along with administrative records and other data on births, deaths, net domestic migration, and net international migration.

More information on these data sources is available at http://www.census.gov.

However, estimates of SNAP eligibility and participation rates based only on the CPS ASEC sample for the state and time period in question, or "direct" estimates, are imprecise for many states. For example, to directly estimate New Jersey's FY 2018 SNAP participation rate, we used only FY 2018 CPS ASEC data on households from New Jersey. Because of the potential errors introduced by the CPS ASEC surveying a small number of families in New Jersey, we can be confident—by a commonly used standard—only that New Jersey's SNAP participation rate in FY 2018 was between about 71 and 89 percent. This range is wide, although typical, reflecting our substantial uncertainty about what New Jersey's participation rate actually was.

Indirect estimators. To improve precision, statisticians have developed indirect estimators, which borrow strength by using data from additional states, time periods, or data sources. The assumption underlying indirect estimation is that what happened in other states and in other years is relevant to estimating what happened in a particular state in a particular year.

One type of indirect estimator is the shrinkage estimator, which averages estimates obtained from different methods. In an early application of shrinkage methods, Fay and Herriott (1979) developed a shrinkage estimator that combined direct sample and regression estimates of per capita income for small places that were used to allocate funds under the General Revenue Sharing Program. For FNS, Schirm and DiCarlo (1998) developed a shrinkage estimator to

derive estimates of state participation rates for the Food Stamp Program (the previous name for SNAP) and found that the shrinkage estimates were substantially more precise than the corresponding direct estimates—the shrinkage 90 percent confidence intervals were, on average, about 64 percent as wide as (or 46 percent narrower than) the corresponding sample confidence intervals. FNS has been publishing annual estimates of state Food Stamp Program/SNAP participation rates since Schirm (2000) estimated rates for September 1997.

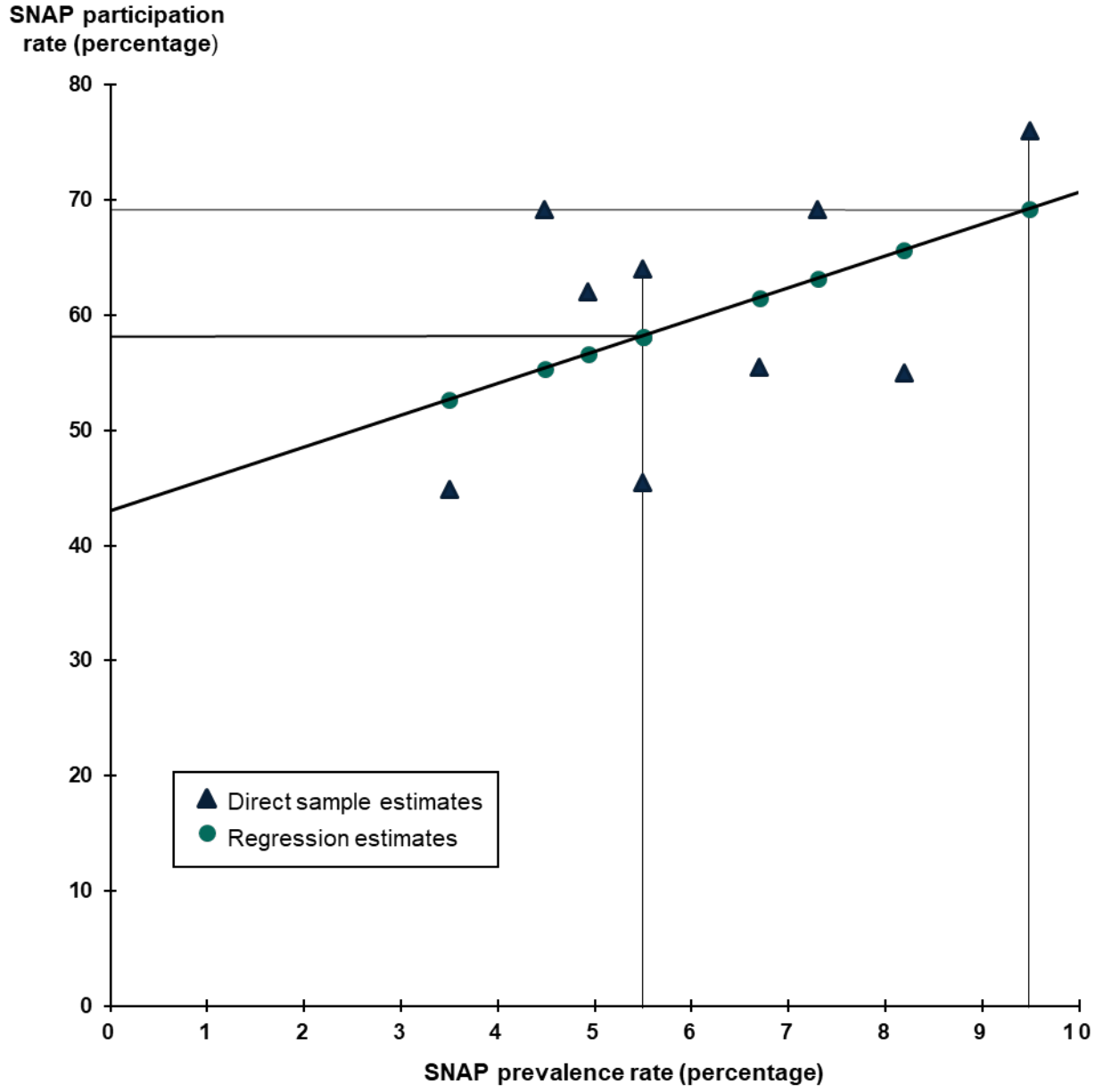
Regression estimates. The first step of our shrinkage estimator is to use data from outside the CPS ASEC to estimate a regression model and formulate a prediction for each group (all eligible people and working poor people) in each state in each year.

Regression estimates are predictions based either on nonsample or on highly precise sample data. Exhibit I.1 illustrates how a regression estimator works. The simple example in the exhibit has only nine states and data for just one year on one predictor—the SNAP "prevalence" rate—that will be used to predict each state's SNAP participation rate for eligible people. The SNAP prevalence rate is the percentage of all people (eligible and ineligible combined) who received SNAP benefits, in contrast to the SNAP participation rate, which is the percentage of eligible people who received SNAP benefits. The triangles in the exhibit correspond to direct sample estimates; a triangle shows the prevalence rate in a state (horizontal axis) and the sample estimate of the participation rate in that state (vertical axis).

Not surprisingly, the graph suggests that prevalence and participation rates are systematically associated. States with higher percentages of all people participating in the program tend to have higher percentages of eligible people participating, although the relationship is far from perfect. To measure this relationship between prevalence and participation rates and derive predictions, we can use a technique called "least squares regression" to draw a line through the triangles. Regression estimates of participation rates are points on that line, the circles in Exhibit I.1. The predicted participation rate for a particular state is obtained by moving up or down from the state's direct sample estimate (the triangle) to the regression line (where there is a circle) and reading the value from the vertical axis. For example, the regression estimator predicts a participation rate of just under 60 percent for both states with prevalence rates of about 5.5 percent. In contrast, for the state with about 9.5 percent of people receiving SNAP benefits, the predicted participation rate is nearly 70 percent.

Comparison of direct and regression estimators. A comparison of how the direct and regression estimators use data illustrates how the regression estimator borrows strength to improve precision. Using New Jersey as an example again, we used only one year of CPS ASEC sample data from the state to estimate New Jersey's participation rate in that year. To derive regression estimates, we estimated a regression line from sample, administrative, and ACS data for multiple years and all the states and used the estimated line (with administrative and ACS data for New Jersey) to predict New Jersey's participation rate in a given year. In other words, the regression estimator not only uses the direct estimates from every state for multiple years to develop a regression estimate for a single state in a single year but also incorporates data from outside the sample—namely, data in administrative records systems and the ACS. To improve precision even further, the estimator borrows strength across groups—all eligible people and working poor people—by deriving estimates for the groups jointly.

Exhibit I.1. An illustrative regression estimator

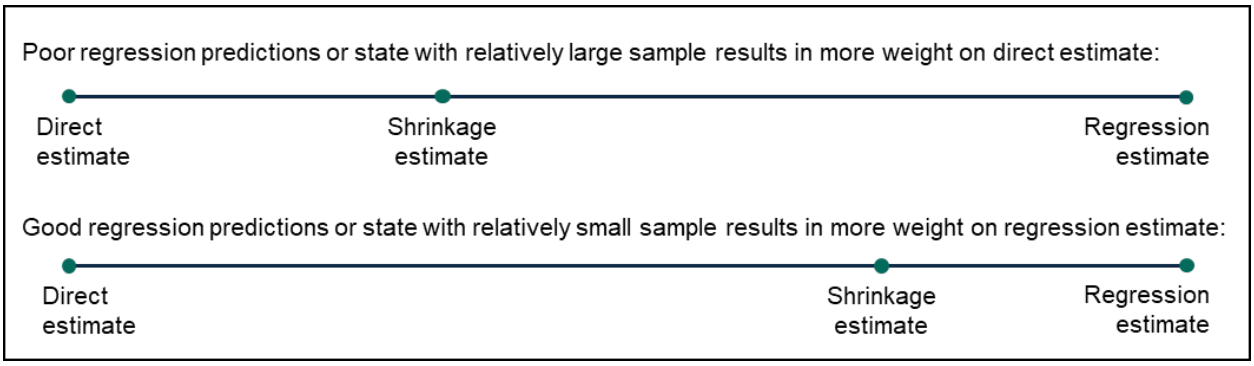


The regression estimator can improve precision by using additional data to identify states with direct estimates that seem too high or too low because of sampling error (error from drawing a sample of the population that has a higher or lower participation rate than the entire state population has). For example, when a state has a low SNAP prevalence rate and values for other predictors that are consistent with a low SNAP participation rate, our regression estimator will predict a low participation rate for that state. If the direct estimate for that state is high, the regression estimate will be lower than the direct estimate. On the other hand, if the sample data for a state show a lower participation rate than expected in light of the SNAP prevalence rate and the other predictors, the regression estimate for that state will be higher than the direct estimate.

A limitation of the regression estimator is "bias." Some states actually have higher or lower participation rates than predicted with the regression estimator. Such errors in regression estimates reflect bias. Although the regression estimator borrows strength, using data from all the states and multiple years as well as administrative and ACS data, it makes no further use of the sample data after estimating the regression line. It treats the entire difference between the sample and regression estimates as sampling error (that is, error in the direct estimate). No allowance is made for prediction error (that is, error in the regression estimate). Although not all, if any, true state participation rates lie on the regression line, the assumption underlying the regression estimator is that they do.

Shrinkage estimator. The shrinkage estimator strikes a compromise between the limitations of the direct estimator (imprecision) and the regression estimator (bias) by combining the two estimates. As illustrated in Exhibit I.2, the shrinkage estimator takes a weighted average of the direct and regression estimates, weighting them according to their relative accuracy. When the direct estimate is more precise than the regression estimate, the estimator gives more weight to the direct estimate. On the other hand, when the regression estimate is more precise than the direct estimate, the estimator gives more weight to the regression estimate. The larger samples drawn in large states support more-precise direct estimates, so shrinkage estimates tend to be closer to the direct estimates for large states. The weight given to the regression estimate depends on how well the regression line "fits." If we find good predictors reflecting why some states have higher participation rates than other states, we say that the regression line "fits well." The shrinkage estimate will be closer to the regression estimate when the regression line fits well than when the line fits poorly (See Appendix A for a description of the methods used to produce the estimates in this report.)

Exhibit I.2. Shrinkage estimation



The direct and regression estimates are optimally weighted to improve accuracy by minimizing a measure of error that reflects both imprecision and bias. By accepting a little bias, the shrinkage estimator may be substantially more precise than the direct sample estimator. By sacrificing a little precision, the shrinkage estimator may be substantially less biased than the regression estimator. The shrinkage estimator optimizes the trade-off between imprecision and bias.

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II. A STEP-BY-STEP GUIDE TO DERIVING STATE ESTIMATES

This chapter describes our procedure for estimating state SNAP participation rates for all eligible people and working poor people and the numbers of people eligible for SNAP benefits for FY 2016 to FY 2018. This procedure, summarized by the flowchart in Exhibit II.1, has the following four steps:

1. From CPS ASEC data, SNAP administrative data, and population estimates, derive direct estimates of state SNAP participation rates.

2. Using a regression model and the direct estimates derived in Step 1, predict state SNAP participation rates based on SNAP administrative, individual income tax, and ACS data and population estimates.

3. Using a shrinkage estimator, average the direct estimates from Step 1 and the regression predictions from Step 2 to obtain preliminary shrinkage estimates of state SNAP participation rates.

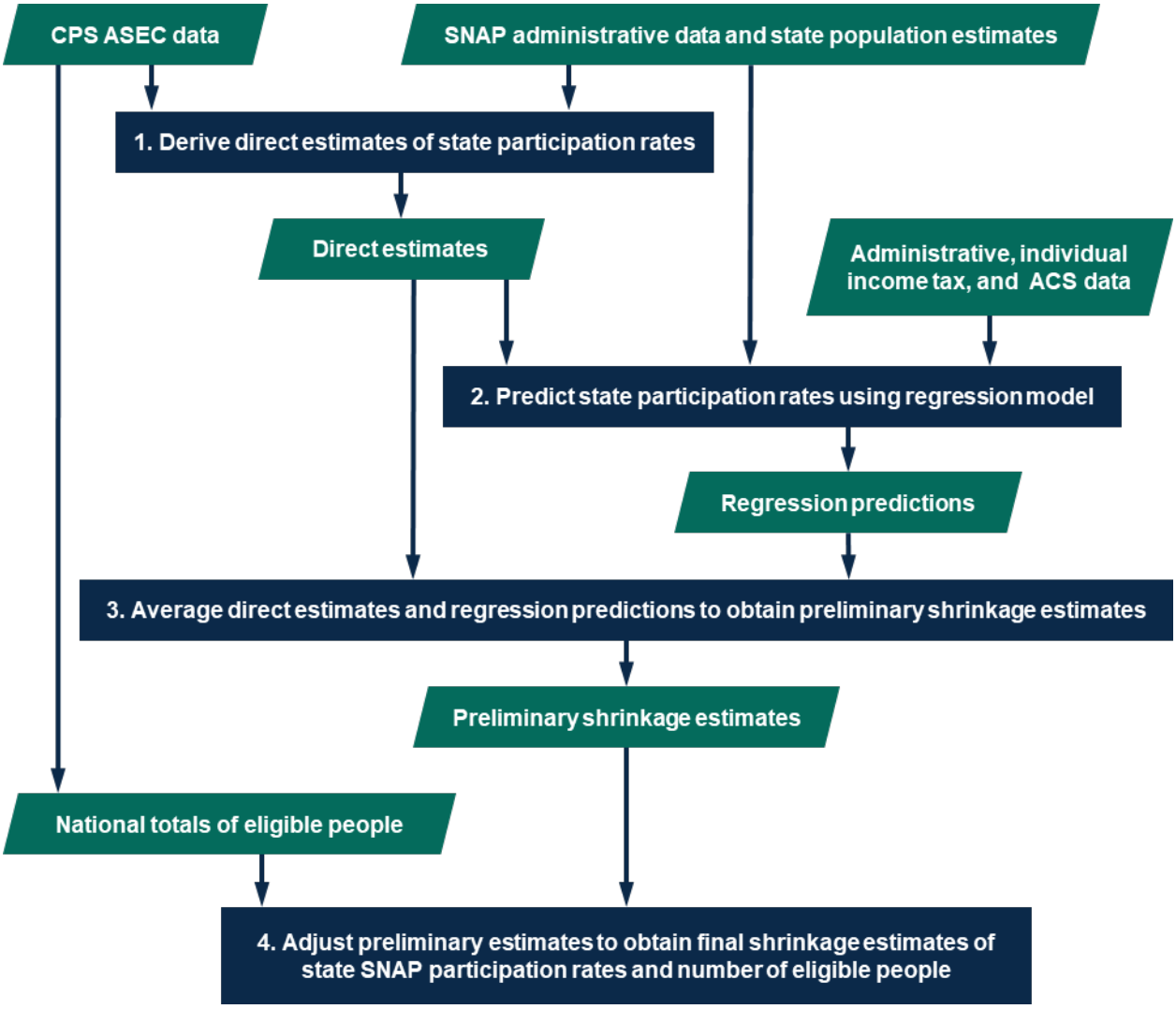
4. Adjust the preliminary shrinkage estimates from Step 3 using national estimates of eligible people derived from the CPS ASEC to obtain final shrinkage estimates of state SNAP participation rates.

Each step is described in the remainder of this chapter. Additional technical details are provided in Appendix A.

A. From CPS ASEC data and SNAP administrative data, derive direct estimates of state SNAP participation rates

A SNAP participation rate is obtained by dividing an estimate of the number of people participating in SNAP by an estimate of the number of people eligible for SNAP, with the resulting ratio expressed as a percentage. We used SNAP QC data to estimate numbers of participants in an average month in the fiscal year and CPS ASEC data to estimate numbers of eligible people in an average month. Because the CPS ASEC collects income data for the prior calendar year, we obtained estimates of eligible people in FY 2018 (October 2017 through September 2018) from the 2018 and 2019 CPS ASEC. To derive a participation rate for working poor people, we divided the number of working poor participants by the number of eligible working poor people. Appendix A presents direct estimates and their standard errors for each group (all eligible people and working poor people) in each state for each of the three fiscal years.

Exhibit II.1. The estimation procedure



CPS ASEC = Current Population Survey Annual Social and Economic Supplement; ACS = American Community Survey; SNAP = Supplemental Nutrition Assistance Program.

B. Using a regression model, predict state SNAP participation rates based on administrative, ACS, and other data

To derive regression estimates for the three fiscal years and for all eligible people and working poor people, we included all of the states, not just nine as in our illustrative example in Chapter 1, and we used seven predictors, not just one. The seven predictors used for the estimates in this report measure the following:

1. Percentage of the population receiving SNAP benefits according to administrative data and population estimates

2. Percentage of children under age 18 with household income under 50 percent of the federal poverty level according to American Community Survey (ACS) one-year estimates

3. Percentage of people age 25 and older who have completed a bachelor's degree according to ACS one-year estimates

4. Percentage of households with earnings according to ACS one-year estimates

5. Percentage of individuals age 65 and older with household income under 125 percent of the federal poverty level according to ACS one-year estimates

6. Percentage of the civilian employed population over age 16 who are private wage and salary workers according to ACS one-year estimates

7. Percentage of all individuals not claimed on tax returns or claimed on tax returns with adjusted gross income under the federal poverty level according to individual income tax data and population estimates

These seven predictors were selected as the best from a longer list described in Table A.13, which provides complete definitions and sources for the predictors. The first four predictors were included in last year's model. The three predictors used in the previous model but not in the current one are (1) median household income according to ACS one-year estimates; (2) the percentage of all individuals not claimed on tax returns according to individual income tax data and population estimates; and (3) the percentage of individuals under age 65 not claimed on tax returns according to individual income tax data and population estimates.

The regression equations do not express causal relationships. Rather, they imply only statistical associations. For this reason, predictors are often called "symptomatic indicators." They are symptomatic of differences among states in conditions associated with having higher or lower participation rates.

Appendix A presents the regression estimates and their standard errors. The standard errors tend to be fairly equal across the states and much smaller than the largest standard errors for direct estimates, reflecting substantial gains in precision from regression for the states with the most error-prone direct estimates.

C. Using shrinkage methods, average the direct estimates and regression predictions to obtain preliminary shrinkage estimates of state SNAP participation rates

To derive preliminary estimates of state SNAP participation rates, we averaged the direct estimates calculated in Step 1 and the regression predictions from Step 2 using an empirical Bayes shrinkage estimator. (See Appendix A for a description of the empirical Bayes methods we used.) We call the estimates from this step "preliminary" because we make some adjustments to them in the next step. Appendix A presents the preliminary shrinkage estimates of state SNAP participation rates for all eligible people and working poor people for all three fiscal years.

D. Adjust the preliminary shrinkage estimates to obtain final shrinkage estimates of state SNAP participation rates and numbers of eligible people

We adjusted the preliminary shrinkage estimates of participation rates in two ways. First, we adjusted the rates so that the counts of eligible people implied by the rates sum to the national count of eligible people estimated directly from the CPS ASEC. Second, we adjusted the rates so that no state's estimated rate was greater than 100 percent. These adjustments were carried out separately for each year and for the two groups (all eligible people and working poor people). The following description of the adjustments will focus on the FY 2018 estimates for all eligible people. In Appendix A, we describe the results of the adjustments for other years and for working poor people and discuss our adjustment method in more detail.

To implement the first adjustment, we calculated preliminary estimates of the numbers of eligible people from the preliminary estimates of participation rates derived in Step 3 and the administrative estimates of the numbers of SNAP participants obtained in Step 1. For FY 2018, the state estimates of eligible people summed to 44,578,496, whereas the national total estimated directly from the CPS ASEC was 43,862,365. To obtain estimated numbers of eligible people for states that sum (aside from rounding error) to the direct estimate of the national total, we multiplied each of the state preliminary estimates of eligible people by $43{,}862{,}365 / 44{,}578{,}496$ (≈ 0.9839). Such benchmarking of estimates for smaller areas to a relatively precise estimated total for a larger area is common practice. (See, for example, Doppelt and Haley (2020) for a discussion of the Bureau of Labor Statistics benchmarking of the Current Employment Statistics.)

After carrying out this first adjustment, three states—Delaware, Illinois, and Oregon—had fewer estimated eligible people than estimated eligible participants in FY 2018, incorrectly implying participation rates over 100 percent. To cap participation rates at 100 percent, we performed a second adjustment. Specifically, we increased the number of eligible people in Delaware, Illinois, and Oregon so that the number of eligible people in those states equaled the number of participants. We reduced the number of eligible people in the other 47 states and the District of Columbia by an equivalent number and in proportion to their numbers of eligible people. This adjustment, which moved small numbers of eligible people among states, did not change the national total. Moreover, except for the states with participation rates initially over 100 percent, this adjustment did not change any state's participation rate by more than one-quarter of a percentage point. The rounded participation rates for some states did increase by one percentage point, however.

Applying this adjustment, we obtained our final shrinkage estimates of the numbers of people eligible for SNAP. From those estimates and our administrative estimates of the numbers of SNAP participants, we derived final shrinkage estimates of participation rates. Our final shrinkage estimates are presented in the next chapter.

III. STATE ESTIMATES OF SNAP PARTICIPATION RATES AND NUMBER OF ELIGIBLE PEOPLE

Tables III.1 and III.2 present our final shrinkage estimates of SNAP participation rates and the number of people eligible, respectively, in each state for FY 2016 to FY 2018 for all eligible people and for working poor people. These shrinkage estimates are relatively precise; they have much smaller standard errors and narrower confidence intervals than the CPS ASEC direct estimates. Tables III.3 to III.8 display approximate 90 percent confidence intervals showing the uncertainty remaining after using shrinkage estimation to derive the estimates in Tables III.1 and III.2. One interpretation of a 90 percent confidence interval is that there is a 90 percent chance that the true value—that is, the true participation rate or the true number of eligible people—falls within the estimated bounds. For example, although our best estimate is that New Jersey's participation rate for all eligible people was 81 percent in FY 2018 (see Table III.1), the true rate may have been higher or lower. However, according to Table III.5, the chances are 90 in 100 that the true rate was between 76 and 86 percent, an interval that is 44 percent narrower than the interval (71 and 89 percent, as cited in Chapter I) around the direct estimate. A narrower interval means that we are less uncertain about the true value. On average, shrinkage confidence intervals for FY 2018 participation rates for all eligible people were 44 percent narrower than the corresponding direct confidence interval. Thus, shrinkage estimation substantially improves precision and reduces our uncertainty.

Despite the impressive gains in precision, substantial uncertainty about the true participation rates for some states remains even after the application of shrinkage methods. Nevertheless, as discussed in Cunnyngham (forthcoming), the shrinkage estimates are sufficiently precise to show, for example, whether a state's SNAP participation rate was probably near the top, near the bottom, or in the middle of the distribution of rates in a given year. That is enough information for many important purposes, such as guiding an initiative to improve program performance.

Final shrinkage estimates for FY 2016 and FY 2017 presented in this report differ slightly from the estimates presented in Cunnyngham (2020a) and Cunnyngham (2020b) for three reasons:

1. **The shrinkage estimator uses data from three years to estimate participation rates for each year.** Annually, data for the most recent year are added and data for the oldest year are dropped. As a result, the estimates for 2016 and 2017 presented in this report are based on 2016 to 2018 data, while the corresponding estimates published in Cunnyngham (2020a) and Cunnyngham (2020b) are based on 2015 to 2017 data.

2. **The shrinkage estimator incorporates a regression model that is updated each year.** Each year we choose a regression model that best predicts participation rates for all three years and both groups (all eligible people and eligible working poor people.) Although we place a premium on maintaining consistency in regression predictors from year to year, differences between 2015 data (used in the previous estimates) and 2018 data (used in the current estimates) resulted in the use of a different regression model. Different regression models lead to slight differences in predicted participation rates, which in turn lead to slight differences in estimated participation rates.

3. **Minor changes to the CPS ASEC data.** The Census Bureau introduced revised questions about income and health insurance to the 2014 CPS ASEC file and, beginning with the 2019 CPS ASEC file, completed a redesigned processing system to take advantage of these new data. The Census Bureau also released updated 2017 and 2018 files that were developed with the redesigned processing system. The FY 2016 through FY 2018 participation rates presented in this report were estimated using the redesigned version of the CPS ASEC.

Because of these updates, the estimates presented in this report should not be compared to those published in earlier reports.

Table III.1. Final shrinkage estimates of SNAP participation rates

	All eligible people			Working poor people		
	FY 2016	FY 2017	FY 2018	FY 2016	FY 2017	FY 2018
Alabama	82	80	79	78	80	77
Alaska	70	77	89	64	68	80
Arizona	73	77	77	64	73	69
Arkansas	72	68	66	68	66	61
California	72	71	70	64	57	59
Colorado	78	75	79	68	62	65
Connecticut	92	90	93	78	83	79
Delaware	100	98	100	88	94	98
District of Columbia	92	90	82	60	43	38
Florida	90	86	86	76	80	75
Georgia	84	84	83	72	72	70
Hawaii	80	79	88	71	71	76
Idaho	77	75	74	72	75	70
Illinois	100	100	100	86	89	92
Indiana	76	73	74	78	75	77
Iowa	88	90	88	84	90	85
Kansas	71	66	68	66	61	62
Kentucky	74	75	75	69	70	72
Louisiana	82	86	83	74	74	73
Maine	85	84	81	81	84	76
Maryland	89	87	91	73	71	72
Massachusetts	92	88	94	67	63	65
Michigan	91	89	89	86	87	86
Minnesota	77	75	76	78	75	74
Mississippi	76	74	70	70	65	65
Missouri	87	85	87	76	77	76
Montana	76	81	78	69	74	69
Nebraska	78	78	79	76	72	74
Nevada	89	91	92	83	87	87
New Hampshire	82	74	80	71	67	70
New Jersey	82	79	81	70	69	70
New Mexico	93	97	98	83	86	88
New York	89	88	89	77	75	75
North Carolina	84	74	69	78	67	65
North Dakota	66	63	63	67	51	60
Ohio	84	83	84	84	86	84
Oklahoma	80	83	85	71	76	78
Oregon	100	100	100	91	96	88
Pennsylvania	95	94	99	89	93	95
Rhode Island	100	100	95	89	89	81
South Carolina	80	79	77	73	75	69
South Dakota	72	76	78	73	71	76
Tennessee	91	91	90	78	80	78
Texas	72	75	75	72	66	74
Utah	74	72	77	69	62	69
Vermont	90	94	92	80	83	76
Virginia	73	73	72	68	65	62
Washington	98	93	98	87	82	85
West Virginia	87	85	88	83	90	87
Wisconsin	92	90	92	85	84	85
Wyoming	53	49	54	54	45	55
United States	83	82	82	75	73	74

Table III.2. Final shrinkage estimates of number of people eligible for SNAP

	All eligible people			Working poor people		
	FY 2016	FY 2017	FY 2018	FY 2016	FY 2017	FY 2018
Alabama	995	955	918	391	429	413
Alaska	117	112	102	54	59	49
Arizona	1,137	1,030	949	604	535	492
Arkansas	579	552	549	272	242	230
California	5,433	5,122	4,935	2,984	2,882	2,552
Colorado	576	566	530	314	286	275
Connecticut	403	388	355	178	163	141
Delaware	121	119	110	58	56	42
District of Columbia	135	126	123	48	47	43
Florida	3,460	3,319	3,184	1,539	1,479	1,449
Georgia	1,930	1,819	1,721	978	884	842
Hawaii	199	189	167	109	103	78
Idaho	223	211	198	129	115	111
Illinois	1,745	1,666	1,612	858	794	750
Indiana	943	891	784	432	405	364
Iowa	354	342	326	189	178	169
Kansas	350	348	309	181	185	166
Kentucky	851	815	763	306	307	286
Louisiana	1,075	1,077	1,035	464	483	452
Maine	187	173	173	79	76	70
Maryland	731	689	617	362	304	292
Massachusetts	718	758	702	278	289	263
Michigan	1,402	1,343	1,240	675	614	548
Minnesota	514	495	483	262	248	244
Mississippi	740	704	687	335	328	286
Missouri	920	848	806	380	408	349
Montana	139	132	125	68	59	66
Nebraska	209	208	198	113	120	108
Nevada	417	420	410	219	192	187
New Hampshire	102	107	93	45	48	32
New Jersey	952	924	824	412	455	413
New Mexico	461	436	420	242	221	231
New York	3,092	2,922	2,791	1,335	1,423	1,193
North Carolina	1,646	1,626	1,742	849	739	844
North Dakota	66	68	68	30	29	28
Ohio	1,744	1,659	1,525	752	729	687
Oklahoma	736	687	638	342	315	312
Oregon	607	563	519	259	234	214
Pennsylvania	1,718	1,699	1,578	770	713	719
Rhode Island	147	137	142	63	47	45
South Carolina	884	867	796	401	404	327
South Dakota	131	121	110	62	58	48
Tennessee	1,205	1,128	1,061	525	474	447
Texas	4,628	4,512	4,459	2,539	2,463	2,454
Utah	292	279	239	166	170	140
Vermont	75	70	66	34	29	31
Virginia	1,082	1,017	986	522	474	474
Washington	842	833	718	419	358	262
West Virginia	373	365	329	131	121	115
Wisconsin	654	648	592	347	352	300
Wyoming	64	66	53	32	29	26
United States	48,101	46,152	43,862	23,133	22,156	20,659

Table III.3. Approximate 90 percent confidence intervals for final shrinkage estimates for FY 2016, all eligible people

	Participation rate (percentage)		Number of eligible people (thousands)	
	Lower bound	Upper bound	Lower bound	Upper bound
Alabama	78	87	941	1,049
Alaska	62	78	104	130
Arizona	69	77	1,070	1,204
Arkansas	68	75	550	608
California	70	75	5,241	5,625
Colorado	72	83	535	617
Connecticut	86	98	379	428
Delaware	94	100	114	127
District of Columbia	86	98	126	143
Florida	87	94	3,314	3,607
Georgia	80	88	1,837	2,023
Hawaii	75	85	186	211
Idaho	72	81	211	236
Illinois	95	100	1,661	1,829
Indiana	71	81	884	1,002
Iowa	83	94	332	376
Kansas	67	76	327	373
Kentucky	70	78	802	900
Louisiana	79	86	1,030	1,119
Maine	80	91	174	199
Maryland	83	95	682	780
Massachusetts	87	98	674	761
Michigan	87	96	1,330	1,473
Minnesota	71	82	475	553
Mississippi	72	80	704	776
Missouri	82	92	862	977
Montana	70	81	129	149
Nebraska	74	83	196	222
Nevada	84	94	394	440
New Hampshire	76	87	95	109
New Jersey	78	87	897	1,008
New Mexico	86	99	429	492
New York	85	92	2,964	3,221
North Carolina	81	88	1,579	1,713
North Dakota	61	71	61	71
Ohio	79	88	1,657	1,832
Oklahoma	75	85	688	784
Oregon	94	100	576	638
Pennsylvania	91	100	1,635	1,800
Rhode Island	94	100	138	155
South Carolina	75	84	835	933
South Dakota	65	79	118	144
Tennessee	87	96	1,143	1,267
Texas	70	75	4,458	4,798
Utah	68	79	270	313
Vermont	84	96	70	80
Virginia	69	78	1,017	1,147
Washington	93	100	800	885
West Virginia	81	93	347	399
Wisconsin	87	97	618	689
Wyoming	48	58	58	70
United States	82	84	47,493	48,710

Table III.4. Approximate 90 percent confidence intervals for final shrinkage estimates for FY 2017, all eligible people

	Participation rate (percentage)		Number of eligible people (thousands)	
	Lower bound	Upper bound	Lower bound	Upper bound
Alabama	76	85	905	1,005
Alaska	69	84	101	123
Arizona	72	81	966	1,094
Arkansas	64	72	519	586
California	68	74	4,922	5,322
Colorado	70	81	527	606
Connecticut	85	96	364	411
Delaware	93	100	113	126
District of Columbia	83	96	116	135
Florida	82	90	3,166	3,472
Georgia	79	88	1,724	1,914
Hawaii	74	84	177	201
Idaho	71	80	198	223
Illinois	95	100	1,587	1,745
Indiana	68	78	833	949
Iowa	84	96	320	364
Kansas	62	71	325	372
Kentucky	71	80	766	865
Louisiana	82	89	1,032	1,121
Maine	78	90	161	185
Maryland	81	93	640	738
Massachusetts	82	94	706	811
Michigan	84	93	1,274	1,412
Minnesota	69	80	457	533
Mississippi	71	76	678	730
Missouri	79	90	792	903
Montana	75	86	123	141
Nebraska	73	83	194	222
Nevada	86	96	396	444
New Hampshire	69	79	100	115
New Jersey	73	84	864	984
New Mexico	91	100	408	464
New York	84	92	2,790	3,053
North Carolina	70	78	1,540	1,711
North Dakota	57	69	61	74
Ohio	79	87	1,575	1,743
Oklahoma	78	89	643	732
Oregon	94	100	533	593
Pennsylvania	90	99	1,618	1,781
Rhode Island	93	100	128	146
South Carolina	75	83	821	912
South Dakota	70	82	111	130
Tennessee	87	96	1,070	1,186
Texas	72	78	4,318	4,706
Utah	67	77	258	300
Vermont	89	100	66	74
Virginia	68	78	951	1,084
Washington	88	98	789	877
West Virginia	79	90	341	388
Wisconsin	85	96	611	686
Wyoming	44	53	60	72
United States	81	83	45,513	46,790

Table III.5. Approximate 90 percent confidence intervals for final shrinkage estimates for FY 2018, all eligible people

	Participation rate (percentage)		Number of eligible people (thousands)	
	Lower bound	Upper bound	Lower bound	Upper bound
Alabama	75	83	869	968
Alaska	82	96	94	110
Arizona	72	82	889	1,009
Arkansas	62	70	515	584
California	67	72	4,748	5,122
Colorado	74	84	494	566
Connecticut	87	98	334	376
Delaware	94	100	104	117
District of Columbia	75	89	113	133
Florida	82	90	3,025	3,343
Georgia	79	88	1,626	1,817
Hawaii	82	93	157	178
Idaho	69	78	185	210
Illinois	95	100	1,535	1,689
Indiana	69	80	731	838
Iowa	83	94	305	347
Kansas	64	73	288	330
Kentucky	70	79	716	810
Louisiana	79	86	990	1,080
Maine	75	87	160	187
Maryland	85	97	576	658
Massachusetts	88	100	657	747
Michigan	85	94	1,175	1,305
Minnesota	70	81	447	518
Mississippi	67	74	654	721
Missouri	81	92	754	859
Montana	73	84	117	134
Nebraska	74	84	185	210
Nevada	87	97	388	431
New Hampshire	74	86	86	100
New Jersey	76	86	773	875
New Mexico	92	100	391	449
New York	85	93	2,669	2,913
North Carolina	65	73	1,638	1,845
North Dakota	57	69	61	74
Ohio	80	89	1,443	1,606
Oklahoma	80	91	598	677
Oregon	94	100	492	546
Pennsylvania	94	100	1,501	1,656
Rhode Island	88	100	132	152
South Carolina	73	81	752	840
South Dakota	72	84	101	119
Tennessee	85	94	1,004	1,119
Texas	72	78	4,268	4,649
Utah	71	82	222	257
Vermont	86	98	62	70
Virginia	68	77	921	1,050
Washington	93	100	680	756
West Virginia	83	93	310	348
Wisconsin	87	97	559	626
Wyoming	49	60	47	58
United States	81	83	43,218	44,506

Table III.6. Approximate 90 percent confidence intervals for final shrinkage estimates for FY 2016, working poor people

	Participation rate (percentage)		Number of eligible people (thousands)	
	Lower bound	Upper bound	Lower bound	Upper bound
Alabama	71	85	357	424
Alaska	54	73	46	62
Arizona	58	71	542	666
Arkansas	60	75	242	302
California	59	68	2,776	3,193
Colorado	60	75	280	348
Connecticut	71	86	161	196
Delaware	80	96	52	63
District of Columbia	49	71	39	57
Florida	70	82	1,416	1,662
Georgia	66	78	892	1,063
Hawaii	64	78	98	120
Idaho	66	79	117	141
Illinois	79	93	789	926
Indiana	70	86	389	475
Iowa	77	91	173	205
Kansas	59	72	163	200
Kentucky	62	77	274	338
Louisiana	67	80	422	505
Maine	72	89	70	87
Maryland	64	81	321	404
Massachusetts	59	75	245	310
Michigan	78	93	618	733
Minnesota	70	87	233	290
Mississippi	64	75	307	364
Missouri	69	83	344	416
Montana	60	77	60	76
Nebraska	69	83	102	124
Nevada	76	91	199	239
New Hampshire	63	79	39	50
New Jersey	63	77	372	452
New Mexico	75	91	218	265
New York	71	84	1,223	1,447
North Carolina	72	84	786	912
North Dakota	59	75	26	34
Ohio	77	91	689	816
Oklahoma	64	77	309	374
Oregon	82	99	235	283
Pennsylvania	82	97	707	832
Rhode Island	81	97	57	69
South Carolina	66	80	364	437
South Dakota	63	83	53	70
Tennessee	72	84	483	567
Texas	67	77	2,351	2,726
Utah	62	76	149	183
Vermont	71	89	30	38
Virginia	61	75	467	577
Washington	79	95	380	457
West Virginia	74	91	117	144
Wisconsin	77	92	316	378
Wyoming	46	62	27	36
United States	73	77	22,562	23,703

Table III.7. Approximate 90 percent confidence intervals for final shrinkage estimates for FY 2017, working poor people

	Participation rate (percentage)		Number of eligible people (thousands)	
	Lower bound	Upper bound	Lower bound	Upper bound
Alabama	74	86	396	462
Alaska	56	79	49	68
Arizona	66	80	483	587
Arkansas	59	73	216	268
California	53	62	2,647	3,117
Colorado	55	69	255	317
Connecticut	75	91	147	179
Delaware	86	100	51	61
District of Columbia	32	53	36	59
Florida	74	86	1,366	1,592
Georgia	65	78	802	965
Hawaii	64	79	92	114
Idaho	68	82	105	125
Illinois	82	96	731	858
Indiana	67	83	362	448
Iowa	82	98	163	194
Kansas	54	67	166	204
Kentucky	63	77	275	339
Louisiana	67	81	439	528
Maine	75	93	68	85
Maryland	62	80	267	341
Massachusetts	54	71	249	330
Michigan	80	94	563	664
Minnesota	66	83	221	276
Mississippi	58	72	294	362
Missouri	70	84	370	446
Montana	66	82	53	66
Nebraska	65	79	108	132
Nevada	79	95	174	209
New Hampshire	59	76	42	54
New Jersey	61	76	404	506
New Mexico	78	95	201	242
New York	68	82	1,292	1,554
North Carolina	61	73	673	804
North Dakota	43	60	24	34
Ohio	78	94	663	795
Oklahoma	69	83	285	345
Oregon	87	100	213	256
Pennsylvania	85	100	653	772
Rhode Island	79	99	42	52
South Carolina	68	82	367	442
South Dakota	63	79	51	64
Tennessee	74	87	435	512
Texas	61	71	2,261	2,665
Utah	55	69	151	190
Vermont	74	92	26	32
Virginia	58	73	420	528
Washington	75	90	324	392
West Virginia	82	98	109	132
Wisconsin	76	91	321	383
Wyoming	38	52	25	34
United States	71	75	21,578	22,734

Table III.8. Approximate 90 percent confidence intervals for final shrinkage estimates for FY 2018, working poor people

	Participation rate (percentage)		Number of eligible people (thousands)	
	Lower bound	Upper bound	Lower bound	Upper bound
Alabama	71	84	376	450
Alaska	68	91	42	56
Arizona	62	76	442	543
Arkansas	55	68	205	255
California	54	64	2,340	2,764
Colorado	58	72	245	304
Connecticut	71	87	127	154
Delaware	88	100	38	47
District of Columbia	29	48	33	53
Florida	68	82	1,318	1,580
Georgia	64	77	763	921
Hawaii	68	85	69	86
Idaho	63	77	100	122
Illinois	84	99	686	815
Indiana	69	85	326	402
Iowa	77	92	154	183
Kansas	56	69	150	183
Kentucky	64	79	256	317
Louisiana	66	79	414	491
Maine	67	86	61	78
Maryland	63	81	256	329
Massachusetts	56	74	227	299
Michigan	78	93	498	599
Minnesota	66	82	218	271
Mississippi	58	71	257	316
Missouri	69	83	315	382
Montana	61	77	58	74
Nebraska	67	81	98	118
Nevada	79	94	171	202
New Hampshire	61	79	28	37
New Jersey	62	77	366	459
New Mexico	78	97	205	256
New York	68	82	1,082	1,305
North Carolina	59	71	766	922
North Dakota	51	69	24	32
Ohio	77	92	626	749
Oklahoma	70	86	281	343
Oregon	80	96	194	234
Pennsylvania	87	100	656	781
Rhode Island	71	91	40	51
South Carolina	63	75	297	356
South Dakota	66	85	42	54
Tennessee	71	85	408	486
Texas	68	80	2,252	2,656
Utah	61	76	125	155
Vermont	67	85	27	34
Virginia	55	69	419	529
Washington	77	93	237	287
West Virginia	77	96	103	127
Wisconsin	78	93	273	326
Wyoming	47	63	22	29
United States	72	76	20,086	21,233

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Appendix A

The Estimation Procedure: Additional Technical Details

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This appendix provides additional information and technical details about our four-step procedure to estimate state SNAP participation rates for all eligible people and working poor people. Each step is discussed in turn.

1. From CPS ASEC data and SNAP administrative data, derive direct estimates of state SNAP participation rates for each of the three fiscal years 2016 to 2018

We derived direct estimates of participation rates for all eligible people for a given fiscal year according to the following formula:

$$(1) \quad Y_{1,i} = 100 \frac{P_i(\varepsilon_{1,i}/100)}{(E_{1,i}/100)T_i},$$

where $Y_{1,i}$ is the estimated participation rate for all eligible people for state i ($i = 1, \ldots, 51$); P_i is the number of people participating in SNAP according to adjusted SNAP Program Operations data; $\varepsilon_{1,i}$ is the percentage of participating people who are correctly receiving benefits and eligible under federal SNAP rules according to SNAP Quality Control (SNAP QC) data; $E_{1,i}$ is the estimated number of people who are eligible for SNAP according to a microsimulation model based on CPS ASEC data, expressed as a percentage of the CPS ASEC population; and T_i is the estimated resident population according to decennial census and administrative records (mainly vital statistics) data.

We estimated P_i by adjusting SNAP program operations data to exclude people who received SNAP benefits only because of a natural disaster. Participant figures, including counts of participants eligible only through disaster assistance, were provided by USDA's Food and Nutrition Service. SNAP Program Operations data include the full population of SNAP cases, so participant counts are not subject to sampling error.

We estimated $\varepsilon_{1,i}$ (the correctly eligible rate) from the SNAP QC sample data as follows:

$$(2) \quad \varepsilon_{1,i} = 100 \frac{\sum_h m_{i,h}\varepsilon_{1,i,h}}{\sum_h m_{i,h}},$$

where h indexes households in a state's SNAP QC sample; $m_{i,h}$ equals the number of people in household h times the weight for household h; and $\varepsilon_{1,i,h}$ is an indicator that household h is eligible to receive SNAP benefits. We excluded from our estimates of participants two groups that are not included in our estimates of eligible people: (1) ineligible participants who received SNAP benefits in error and (2) participants who were eligible through state expanded categorical eligibility policies but would not meet federal SNAP income and resource criteria.

We estimated the percentage of people who were eligible for SNAP using the following formula:

$$(3) \quad E_{1,i} = 100 \frac{Z_{1,i}}{N_i},$$

where $Z_{1,i}$ is the CPS ASEC estimate of the number of eligible people and N_i is the CPS ASEC estimate of the population. Estimated percentages are more precise than estimated counts because the sampling errors in the numerators and denominators of percentages tend to be positively correlated and, therefore, partially cancel each other out.

We derived SNAP eligibility estimates ($Z_{1,i}$) by applying SNAP rules to CPS ASEC households. However, some key information needed to determine whether a household is eligible for SNAP is not collected in the CPS ASEC. For example, there are no data on resources or expenses deductible from gross income. Also, it is not possible to ascertain directly which members of a dwelling unit purchase and prepare food together or which members may be categorically ineligible for SNAP. Yet another limitation is that only annual, rather than monthly, income amounts are recorded.

We have developed methods, described in Lauffer and Vigil (May), to address these data limitations. These methods include procedures for identifying the members of the SNAP household within the (potentially) larger CPS ASEC household, taking account of the restrictions on participation by noncitizens, distributing annual amounts across months, and imputing net income. Lauffer and Vigil (2021) also describes how we applied SNAP gross and net income tests and calculated the benefits for which an eligible household would qualify.

Because our focus in this document is on participation among people who were eligible for SNAP, these estimates of SNAP eligibility counts and participation rates do not include people who were not legally entitled to receive SNAP benefits, such as Supplemental Security Income recipients in California who receive cash in lieu of SNAP benefits. It might be useful in other contexts, however, to consider participation rates among those eligible for SNAP or a cash substitute.

To derive fiscal year estimates of eligibility, we combined two years of the CPS ASEC. For example, to estimate $Z_{1,i}$ for FY 2018, we used data from the 2018 CPS ASEC (simulating October through December 2017) and the 2019 CPS ASEC (simulating January through September 2018). To estimate N_i, we used a weighted average of population estimates from the two CPS ASEC files.

The Census Bureau derives population estimates (T_i) by subtracting from decennial census counts people "exiting" the population (due to death or net out-migration) and adding people "entering" the population (due to birth or net in-migration).

SNAP participation rates for working poor people. We derived sample estimates of participation rates for working poor people for a given year according to the following formulas:

$$(4) \quad Y_{2,i} = 100 \frac{P_i(\varepsilon_{2,i}/100)}{(E_{2,i}/100)T_i},$$

$$(5) \quad \varepsilon_{2,i} = 100 \frac{\sum_h m_{i,h}\varepsilon_{2,i,h}}{\sum_h m_{i,h}},$$

and

$$(6) \quad E_{2,i} = 100 \frac{Z_{2,i}}{N_i},$$

where $Y_{2,i}$ is the estimated participation rate for working poor people for state *i*; $\varepsilon_{2,i}$ is the percentage of SNAP participants who are working poor, correctly receiving SNAP benefits, and eligible under federal SNAP rules according to SNAP QC data; $E_{2,i}$ is the percentage of people who are working poor and eligible for SNAP according to the CPS ASEC; $Z_{2,i}$ is the CPS ASEC estimate of the number of eligible working poor people, and P_i, T_i, h, $m_{i,h}$ and N_i are as defined above.

We defined as working poor any person who was eligible for SNAP and lived in a household in which a member earned money from a job. Working poor people were identified slightly differently in the SNAP QC data than in the CPS ASEC. Specifically, a participant household was identified as working poor if the household had earnings according to the edited SNAP QC data file or, prior to editing, had multiple indicators of earnings that suggested a household was likely to have a member who worked. Exhibit A.1 describes the algorithm that identified working poor participants, and Cronquist et al. (2019) describe the procedure for editing the SNAP QC data. An eligible household was identified as working poor only on the basis of earnings.

Exhibit A.1. Algorithm to identify working poor participants

Working poor participants are defined as those in households with one of the following criteria:

1) Earnings in the edited SNAP QC data
2) Multiple indicators of earnings in the unedited SNAP QC data
   a) At least one person with earned income AND
      i) An earned income deduction or a workforce participation variable indicating employment OR
      ii) Earned and unearned income that sum to total income, or earned income with the earned income deduction already subtracted and unearned income that sum to the total income (some states subtract the earned income deduction from income deemed by an ineligible member before recording it on the file)
   b) An earned income deduction AND
      i) At least one person with a workforce participation variable indicating employment OR
      ii) Earnings implied by the earned income deduction and unearned income that sum to total income OR

iii) Gross income that is more than the earned income implied by the earned income deduction and both unearned and earned income equal zero (to account for household records that have no recorded individual income amounts but do have what appear to be consistent household-level indicators)

Sampling variances. In addition to our point estimates of participation rates, we need estimates of their sampling variability. We estimated the variances of $Y_{1,i}$ and $Y_{2,i}$ as follows:

$$(7)\quad \begin{aligned}\text{var}(Y_{1,i}) &= \text{variance due to } E_{1,i} \text{ when } \varepsilon_{1,i} \text{ is fixed} + \text{variance due to } \varepsilon_{1,i} \text{ when } E_{1,i} \text{ is fixed} \\ &= \text{var}_{E_1|\varepsilon_1}(Y_{1,i}) + \text{var}_{\varepsilon_1|E_1}(Y_{1,i})\end{aligned}$$

and

$$(8)\quad \begin{aligned}\text{var}(Y_{2,i}) &= \text{variance due to } E_{2,i} \text{ when } \varepsilon_{2,i} \text{ is fixed} + \text{variance due to } \varepsilon_{2,i} \text{ when } E_{2,i} \text{ is fixed} \\ &= \text{var}_{E_2|\varepsilon_2}(Y_{2,i}) + \text{var}_{\varepsilon_2|E_2}(Y_{2,i}).\end{aligned}$$

When a variable is held fixed, we fix it at its point estimate. Note that covariance terms are not needed because the estimates of $E_{1,i}$ and $\varepsilon_{1,i}$, and the estimates of $E_{2,i}$ and $\varepsilon_{2,i}$, are based on independent samples.

For a given year, we estimated $\text{var}_{E_1|\varepsilon_1}(Y_{1,i})$ and $\text{var}_{E_2|\varepsilon_2}(Y_{2,i})$ using a replication method called the Successive Difference Replication Method (SDRM) with 160 replicate weights developed by the U.S. Census Bureau for the CPS ASEC (U.S. Census Bureau 2006), resulting in the following formulas:

$$(9)\quad \text{var}_{E_1|\varepsilon_1}(Y_{1,i}) = \frac{4}{160}\sum_{r=1}^{160}(Y_{1,i(r)} - Y_{1,i})^2$$

and

$$(10)\quad \text{var}_{E_2|\varepsilon_2}(Y_{2,i}) = \frac{4}{160}\sum_{r=1}^{160}(Y_{2,i(r)} - Y_{2,i})^2,$$

where is the *r*th ($r = 1,\ldots,160$) replicate estimate with the same form as $Y_{1,i}$ and $Y_{2,i}$, respectively, and calculated using the *r*th set of replicate weights. The replicate estimates $Y_{1,i(r)}$ are obtained by replicating $E_{1,i}$:

$$(11)\quad E_{1,i(r)} = 100\frac{Z_{1,i(r)}}{N_{i(r)}}$$

and

$$(12)\quad Y_{1,i(r)} = 100\frac{P_i(\varepsilon_{1,i}/100)}{(E_{1,i(r)}/100)T_i}.$$

Similarly, the replicate estimates $Y_{2,i(r)}$ are obtained by replicating $E_{2,i}$:

$$(13) \quad E_{2,i(r)} = 100\frac{Z_{2,i(r)}}{N_{i(r)}}$$

and

$$(14) \quad Y_{2,i(r)} = 100\frac{P_i(\varepsilon_{2,i}/100)}{(E_{2,i(r)}/100)T_i}.$$

Correctly eligible rates for all eligible participants and eligible working poor participants are also subject to sampling error, although this sampling error is small relative to other sources of error in the estimated participation rates. Based on Equation (1) and Equation (4), respectively, we can estimate $\mathrm{var}_{\varepsilon_1|E_1}(Y_{1,i})$ and $\mathrm{var}_{\varepsilon_2|E_2}(Y_{2,i})$ according to these formulas:

$$(15) \quad \mathrm{var}_{\varepsilon_1|E_1}(Y_{1,i}) = \left(100\frac{P_i}{T_iE_{1,i}}\right)^2 \mathrm{var}(\varepsilon_{1,i})$$

and

$$(16) \quad \mathrm{var}_{\varepsilon_2|E_2}(Y_{2,i}) = \left(100\frac{P_i}{T_iE_{2,i}}\right)^2 \mathrm{var}(\varepsilon_{2,i}),$$

because $P_{1,i}$ and T_i are constants (or, at least, subject to negligible sampling variability) and $E_{1,i}$ and $E_{2,i}$ are held fixed at their point estimates.

To calculate $\mathrm{var}(\varepsilon_{1,i})$ and $\mathrm{var}(\varepsilon_{2,i})$, we constructed 500 bootstrap replicate weights for the SNAP QC sample. The estimates $\varepsilon_{1,i}$ and $\varepsilon_{2,i}$ are then replicated 500 times, each using a set of bootstrap replicate weights:

$$(17) \quad \varepsilon_{1,i(r)} = 100\frac{\sum_h m_{i,h(r)}\varepsilon_{1,i,h}}{\sum_h m_{i,h(r)}}, (r = 1, 2, ..., 500)$$

and

$$(18) \quad \varepsilon_{2,i(r)} = 100\frac{\sum_h m_{i,h(r)}\varepsilon_{2i,h}}{\sum_h m_{i,h(r)}}, (r = 1, 2, ..., 500),$$

where $m_{i,h(r)}$ is the number of people in household *h* times the *r*th replicate weight for household *h*. Then:

$$(19) \quad \text{var}(\varepsilon_{1,i}) = \frac{1}{499}\sum_{r=1}^{500}\left(\varepsilon_{1,i(r)} - \overline{\varepsilon}^{*}_{1,i}\right)^2,$$

where

$$(20) \quad \overline{\varepsilon}^{*}_{1,i} = \frac{1}{500}\sum_{r=1}^{500}\varepsilon_{1,i(r)}$$

and

$$(21) \quad \text{var}(\varepsilon_{2,i}) = \frac{1}{499}\sum_{r=1}^{500}\left(\varepsilon_{2,i(r)} - \overline{\varepsilon}^{*}_{2,i}\right)^2,$$

where

$$(22) \quad \overline{\varepsilon}^{*}_{2,i} = \frac{1}{500}\sum_{r=1}^{500}\varepsilon_{2,i(r)}.$$

Summing the estimates from Equations (9) and (15)—as indicated by Equation (7)—and taking the square root of the sum provides an estimated standard error of the participation rate for all eligible people. Similarly, summing the estimates from Equations (10) and (16)—as indicated by Equation (8)—and taking the square root of the sum provides an estimated standard error of the participation rate for working poor people.

Covariances. We estimated the covariance between the estimates of participation rates for all eligible people and working poor people, for a given year, according to:

$$\begin{aligned}(23) \quad \text{cov}(Y_{1,i}, Y_{2,i}) &= \text{covariance due to } E_{1,i} \text{ and } E_{2,i} \text{ when } \varepsilon_{1,i} \text{ and } \varepsilon_{2,i} \text{ are fixed} \\ &\quad + \text{covariance due to } \varepsilon_{1,i} \text{ and } \varepsilon_{2,i} \text{ when } E_{1,i} \text{ and } E_{2,i} \text{ are fixed} \\ &= \text{cov}_{E_1E_2|\varepsilon_1\varepsilon_2}(Y_{1,i}, Y_{2,i}) + \text{cov}_{\varepsilon_1\varepsilon_2|E_1E_2}(Y_{1,i}, Y_{2,i}).\end{aligned}$$

Note that we do not need to include additional terms because the CPS ASEC and SNAP QC samples are independent. To derive an estimate of the first term in this expression, we obtained an SDRM estimate of the covariance due to $E_{1,i}$ and $E_{2,i}$ according to:

$$(24) \quad \text{cov}_{E_1E_2|\varepsilon_1\varepsilon_2}(Y_{1,i}, Y_{2,i}) = \frac{4}{160}\sum_{r=1}^{160}(Y_{1,i(r)} - Y_{1,i})(Y_{2,i(r)} - Y_{2,i}).$$

For the second term, we estimated the covariance due to $\varepsilon_{1,i}$ and $\varepsilon_{2,i}$ according to:

$$(25) \quad \text{cov}_{\varepsilon_1\varepsilon_2|E_1E_2}(Y_{1,i}, Y_{2,i}) = \left(100\frac{P_i}{T_iE_{1,i}}\right)\left(100\frac{P_i}{T_iE_{2,i}}\right)\text{cov}(\varepsilon_{1,i}, \varepsilon_{2,i})$$

where

$$(26)\quad \operatorname{cov}(\varepsilon_{1,i},\varepsilon_{2,i}) = \frac{1}{(\sum_h m_{i,h})^2}\left(\frac{n_i}{n_i - 1}\right)\sum_h {m_{i,h}}^2\left(\varepsilon_{1,i,h} - \varepsilon_{1,i}\right)\left(\varepsilon_{2,i,h} - \varepsilon_{2,i}\right).$$

CPS ASEC samples from different years are not independent, so participation rates for different years are correlated. (SNAP QC samples from different years are independent, so sampling variability in estimates from the CPS ASEC is the only source of intertemporal covariation between participation rates.) We derived a preliminary SDRM estimate of the correlation between $Y_{1,i,t}$ and $Y_{2,i,t-g}$, the sample estimate for all eligible people for one year (year *t*) and the sample estimate for working poor people for *g* years earlier, as follows:

$$(27)\quad \operatorname{cov}(Y_{1,i,t}, Y_{2,i,t-g}) = \frac{4}{160}\sum_{r=1}^{160}(Y_{1,i(r),t} - Y_{1,i,t})(Y_{2,i(r),t\text{-}g} - Y_{2,i,t-g}).$$

The correlation between $Y_{1,i,t}$ and $Y_{2,i,t-g}$ is

$$(28)\quad \operatorname{corr}(Y_{1,i,t}, Y_{2,i,t\text{-}g}) = \frac{\operatorname{cov}(Y_{1,i,t}, Y_{2,i,t\text{-}g})}{\sqrt{\operatorname{var}(Y_{1,i,t})\,\operatorname{var}(Y_{2,i,t\text{-}g})}}.$$

To improve the precision of estimated correlations (and covariances), we used a simple smoothing technique in which we "replaced" the state-specific correlation from Equation (28) by the average correlation between $Y_{1,i,t}$ and $Y_{2,i,t-g}$ across states:

$$(29)\quad \overline{\operatorname{corr}}(Y_{1,t}, Y_{2,t-g}) = \frac{\sum_{i=1}^{51}(n_{i,t} + n_{i,t-g})\operatorname{corr}(Y_{1,i,t}, Y_{2,i,t-g})}{\sum_{i=1}^{51}(n_{i,t} + n_{i,t-g})},$$

where $n_{i,t}$ and $n_{i,t-g}$ are the (unweighted) number of households in the CPS ASEC samples for one year and *g* years earlier, respectively. Using this average correlation, we obtained as our final estimate of the covariance between $Y_{1,i,t}$ and $Y_{2,i,t-g}$:

$$(30)\quad \operatorname{cov}(Y_{1,i,t}, Y_{2,i,t-g}) = \overline{\operatorname{corr}}(Y_{1,t}, Y_{2,t-g})\sqrt{\operatorname{var}(Y_{1,i,t})\,\operatorname{var}(Y_{2,i,t-g})}.$$

Other intertemporal covariances—such as the covariance between the participation rates for working poor people in two different years—are similarly estimated. All interstate covariances equal zero because state samples are independent in both the CPS ASEC and the SNAP QC. As described under Step 3, the variances and covariances obtained in this step are the elements of a variance-covariance matrix used in deriving shrinkage estimates of participation rates.

Table A.1 presents estimates of the number of people participating in SNAP (values of P_i); Table A.2 presents the percentages of all and working poor participants who are income eligible

and correctly receiving SNAP benefits (values of $\varepsilon_{1,i}$ and $\varepsilon_{2,i}$); and Tables A.3 and A.4 show payment error-adjusted numbers of, respectively, all people and working poor people receiving SNAP benefits under normal program eligibility rules (values of $P_i(\varepsilon_{1,i}/100)$ and $P_i(\varepsilon_{2,i}/100)$). Tables A.5, A.6, A.7, and A.8 present CPS ASEC estimates of SNAP eligibility percentages for all eligible people and working poor people (values of $E_{1,i}$ and $E_{2,i}$), the number of eligible people (values of $Z_{1,i}$), the number of eligible working poor people (values of $Z_{2,i}$), and the population (values of N_i), respectively, and Table A.9 presents the population totals (values of T_i). Table A.10 shows the percentage of working poor participants in Table A.4 that are in households without reported earned income but are identified as working poor through the other indicators described in Exhibit A.1. Table A.11 displays direct estimates of participation rates for all eligible people and working poor people (values of $Y_{1,i}$ and $Y_{2,i}$), and Table A.12 presents standard errors for the direct estimates.

2. Using a regression model, predict state SNAP participation rates based on administrative, ACS, and other data

Our regression model consisted of six equations, with three predicting SNAP participation rates for all eligible people in fiscal years 2016, 2017, and 2018, and three predicting SNAP participation rates for working poor people in fiscal years 2016, 2017, and 2018. The six equations were estimated jointly, and the values of the regression coefficients could vary from equation to equation. The predictors used were (in addition to an intercept):

1. Percentage of the population receiving SNAP benefits according to administrative data and population estimates

2. Percentage of children under age 18 with household income under 50 percent of the federal poverty level according to American Community Survey (ACS) one-year estimates

3. Percentage of people age 25 and older who have completed a bachelor's degree according to ACS one-year estimates

4. Percentage of households with earnings according to ACS one-year estimates

5. Percentage of individuals age 65 and older with household income under 125 percent of the federal poverty level according to ACS one-year estimates

6. Percentage of the civilian employed population over age 16 who are private wage and salary workers according to ACS one-year estimates

7. Percentage of all individuals not claimed on tax returns or claimed on tax returns with adjusted gross income under the federal poverty level according to individual income tax data and population estimates

For all the predictors, we used 2016 values in both equations for predicting FY 2016 rates, 2017 values in both equations for predicting FY 2017 rates, and 2018 values in both equations for

predicting FY 2018 rates. Because prediction errors were allowed to be correlated and intergroup and intertemporal correlations among direct estimates were taken into account as specified in the next step, the shrinkage estimates for a group (all eligible people or working poor people) in any one year were determined by the predictions and sample estimates for all three years and both groups.

In addition to the predictors that we selected for our model, we considered many other potential predictors, including three that were used to produce the estimates in Cunnyngham (2020a): (1) median household income according to ACS one-year estimates; (2) the percentage of all individuals not claimed on tax returns according to individual income tax data and population estimates; and (3) the percentage of individuals under age 65 not claimed on tax returns according to individual income tax data and population estimates. All of the predictors considered had three characteristics: (1) it is plausible that they are good indicators of differences among states in SNAP participation rates; (2) they could be defined and measured uniformly across states; and (3) they could be obtained from nonsample or highly precise sample data—such as the ACS or administrative records data—and, thus, measured with little or no sampling error. In addition, first four predictors listed above were used to produce the estimates in Cunnyngham (2020a).

The regression equations do not express causal relationships. Rather, they imply only statistical associations. For this reason, predictors are often called "symptomatic indicators." They are symptomatic of differences among states in conditions associated with having higher or lower participation rates.

As shown in the next step, where we describe the regression estimation procedure in more detail, we do not have to calculate regression estimates as a separate step, although we do have to select a best regression model before we can calculate shrinkage estimates. We selected our best model on the basis of its strong relative performance in predicting participation rates. We judged performance by examining functions of the regression residuals, such as mean squared error. In addition to assessing the predictive fit of alternative specifications, we checked for potential biases as part of our extensive model evaluation. To check for biases, we looked for a persistent tendency to under- or overpredict the number of eligible people for certain types of states categorized by, for example, population size, region, and percentage of the population that is black or Hispanic. We found no evidence of correctable bias.

Predictors considered are listed in Table A.13 and definitions, and data sources for the predictors in our chosen regression model are given in Table A.14. The values for the predictors listed above are displayed in Tables A.15, A.16, and A.17.

3. Using shrinkage methods, average the direct estimates and regression predictions to obtain preliminary shrinkage estimates of state SNAP participation rates

To average the direct estimates and the regression predictions, we used an empirical Bayes shrinkage estimator. A state's shrinkage estimate for either all eligible people or working poor people in a given year does not have to be between the direct and regression estimates for the

group and year in question. It may be above both of those estimates if, for example, they seem too low based on data from other years. However, in most cases, the shrinkage estimates presented in this report are between the direct and regression estimates. In the remaining cases, the shrinkage estimate is usually close to either the direct or regression estimate, and it is often close to both because the sample and regression estimates are close to each other.

The shrinkage estimator does not have a closed-form expression from which we can calculate shrinkage estimates. Instead, we must numerically integrate over six scalar parameters for which we do not have an exact value—σ_1, σ_2, ρ, η_1, η_2, and $\eta_{1,2}$. The parameters η_1 and η_2 capture intertemporal (between-year) correlations among regression prediction errors for all eligible people and for working poor people, respectively; σ_1 and σ_2 capture additional within-year variance across states. Correlations between all eligible people and working poor people are parameterized by ρ and $\eta_{1,2}$, with ρ capturing the between-year portion and $\eta_{1,2}$ capturing the additional within-year portion. To perform the numerical integration, we specified a grid that resulted in 6,714,048equally spaced points, starting with $\sigma_1 = 0.001$, $\sigma_2 = 0.001$, $\rho = -0.996$, $\eta_1 = 0.000$, $\eta_2 = 0.000$, and $\eta_{1,2} = -0.991$ and incrementing σ_1, σ_2, ρ, η_1, η_2, and $\eta_{1,2}$ by 0.350, 0.700, 0.133, 0.600, 0.700, and 0.199, respectively, up to $\sigma_1 = 3.851$, $\sigma_2 = 7.001$, $\rho = 0.999$, $\eta_1 = 9.600$, $\eta_2 = 11.200$, and $\eta_{1,2} = 0.999$. For combination k of σ_1, σ_2, ρ, η_1, η_2, and $\eta_{1,2}$ (k = 1,…, 6,714,048), we calculated a vector of shrinkage estimates:

$$(31) \quad \theta_k = (\Sigma_k^{-1} + V^{-1})^{-1}(\Sigma_k^{-1} X\hat{B}_k + V^{-1}Y),$$

a variance-covariance matrix:

$$(32) \quad U_k = (\Sigma_k^{-1} + V^{-1})^{-1} + (\Sigma_k^{-1} + V^{-1})^{-1}\Sigma_k^{-1} X(X'(\Sigma_k + V)^{-1} X)^{-1} X'\Sigma_k^{-1}(\Sigma_k^{-1} + V^{-1})^{-1},$$

and a probability:

$$(33) \quad p_k^* = |\Sigma_k + V|^{-1/2} |X'(\Sigma_k + V)^{-1} X|^{-1/2} \exp\left(-1/2 (Y - X\hat{B}_k)'(\Sigma_k + V)^{-1} (Y - X\hat{B}_k)\right).$$

In these expressions, *Y* is a column vector of direct estimates (from Step 1) with 306 elements—six sample estimates for each of the 50 states and the District of Columbia. The first six elements of *Y* pertain to the first state, the next six to the second state, and so forth. For a given state, the first two elements are the FY 2016 sample estimates for all eligible people and working poor people, respectively; the second two elements are the FY 2017 estimates; and the final two elements are the FY 2018 estimates. The vector of shrinkage estimates, θ_k, has the same structure as the vector of sample estimates, *Y*. *V* is the (306×306) variance-covariance matrix for the sample estimates. Because state samples are independent in the CPS ASEC, *V* is block-diagonal with 51 (6×6) blocks. We described under Step 1 how we derived estimates for the variance and covariance elements of *V* (Equations (21) and (30), respectively). *X* is a (306×48) matrix containing values for each of the seven predictors (plus an intercept) for every state, every fiscal year (2016, 2017, and 2018), and both groups (all eligible people and working poor people). The first six rows of *X* pertain to the first state, the next six rows pertain to the second state, and so forth. The six rows for state *i* are given by

$$(34)\quad X_i = \begin{pmatrix} x'_{i,1,1} & \underline{0} & \underline{0} & \underline{0} & \underline{0} & \underline{0} \\ \underline{0} & x'_{i,1,2} & \underline{0} & \underline{0} & \underline{0} & \underline{0} \\ \underline{0} & \underline{0} & x'_{i,2,1} & \underline{0} & \underline{0} & \underline{0} \\ \underline{0} & \underline{0} & \underline{0} & x'_{i,2,2} & \underline{0} & \underline{0} \\ \underline{0} & \underline{0} & \underline{0} & \underline{0} & x'_{i,3,1} & \underline{0} \\ \underline{0} & \underline{0} & \underline{0} & \underline{0} & \underline{0} & x'_{i,3,2} \end{pmatrix},$$

where $x'_{i,t,1}$ is a row vector for fiscal year t ($t=1$ for 2016, $t=2$ for 2017, and $t=3$ for 2018) with eight elements (an intercept plus the seven predictors listed under Step 2) to predict participation rates for all eligible people, $x'_{i,t,2}$ is a row vector for year t with eight elements (an intercept plus the seven predictors) to predict participation rates for working poor people, and $\underline{0}$ is a row vector with eight zeros. In a given year, the values of the predictors are the same for the equations for all eligible people and for working poor people. Thus, $x'_{i,t,1} = x'_{i,t,2}$. $\hat{B}_k$ is a (48×1) vector of regression coefficients, and is

$$(35)\quad \hat{B}_k = (X'(\Sigma_k + V)^{-1}X)^{-1}X'(\Sigma_k + V)^{-1}Y\,.$$

Finally, Σ_k is a block-diagonal matrix with 51 (6×6) blocks, and every block equals

$$(36)\quad \Sigma_k^* = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix} \otimes \begin{pmatrix} \sigma_{1,k}^2 & \sigma_{1,k}\sigma_{2,k}\rho_k \\ \sigma_{1,k}\sigma_{2,k}\rho_k & \sigma_{2,k}^2 \end{pmatrix} + \begin{pmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{pmatrix} \otimes \begin{pmatrix} \eta_{1,k}^2 & \eta_{1,k}\eta_{2,k}\eta_{1,2,k} \\ \eta_{1,k}\eta_{2,k}\eta_{1,2,k} & \eta_{2,k}^2 \end{pmatrix}.$$

After calculating θ_k, U_k, and p_k^* 6,714,048times (once for each combination of σ_1, σ_2, ρ, η_1, η_2, and $\eta_{1,2}$), we calculated the probability of ($\sigma_{1,k}, \sigma_{2,k}, \rho_k, \eta_{1,k}, \eta_{2,k}, \eta_{1,2,k}$):

$$(37)\quad p_k = \frac{p_k^*}{\sum_{k=1}^{6,714,048} p_k^*},$$

which is also an estimate of the probability that the shrinkage estimates θ_k are the true values. As Equation (37) suggests, the p_k are obtained by normalizing the p_k^* to sum to one.

To complete the numerical integration over σ_1, σ_2, ρ, η_1, η_2, and $\eta_{1,2}$ and obtain a single set of shrinkage estimates, we calculated a weighted sum of the 6,714,048sets of shrinkage estimates, weighting each set θ_k by its associated probability p_k. Thus, our shrinkage estimates are:

$$(38)\quad \theta = \sum_{k=1}^{6,714,048} p_k\theta_k\,.$$

We call these estimates "preliminary" because we make some fairly small adjustments to them in the next step to derive our "final" estimates. The variance-covariance matrix for our preliminary shrinkage estimates is

$$(39) \quad U = \sum_{k=1}^{6,714,048} p_k U_k + \sum_{k=1}^{6,714,048} p_k (\theta_k - \theta)(\theta_k - \theta)' .$$

The first term on the right side of this expression reflects the error from sampling variability and the lack of fit of the regression model. The second term captures how the shrinkage estimates vary as σ_1, σ_2, ρ, η_1, η_2, and $\eta_{1,2}$ vary. Thus, the second term accounts for the variability from not knowing and, thus, having to estimate σ_1, σ_2, ρ, η_1, η_2, and $\eta_{1,2}$. As described later, standard errors of the final shrinkage estimates for states are calculated as functions of the square roots of the diagonal elements of *U*.

Regression estimates can be similarly obtained. They are

$$(40) \quad R = \sum_{k=1}^{6,714,048} p_k R_k ,$$

where $R_k = X\hat{B}_k$ is the vector of regression estimates obtained when $\sigma_1 = \sigma_{1,k}$; $\sigma_2 = \sigma_{2,k}$; $\rho = \rho_k$; $\eta_1 = \eta_{1,k}$; $\eta_2 = \eta_{2,k}$; and $\eta_{1,2} = \eta_{1,2,k}$. The variance-covariance matrix is

$$(41) \quad G = \sum_{k=1}^{6,714,048} p_k G_k + \sum_{k=1}^{6,714,048} p_k (R_k - R)(R_k - R)' ,$$

where $G_k = X(X'(\Sigma_k + V)^{-1} X)^{-1} X' + \Sigma_k$. We can estimate the regression coefficient vector by

$$(42) \quad \hat{B} = \sum_{k=1}^{6,714,048} p_k \hat{B}_k .$$

Regression estimates of participation rates for all eligible people and working poor people are in Table A.18, and the standard errors for the regression estimates are in Table A.19. Preliminary shrinkage estimates of SNAP participation rates are displayed in Table A.20.

4. Adjust the preliminary shrinkage estimates to obtain final shrinkage estimates of state SNAP participation rates and numbers of eligible people

We adjusted the preliminary shrinkage estimates of participation rates in two ways. First, we adjusted the rates so that the number of eligible people implied by the rates sum to the national number of eligible people estimated directly from the CPS ASEC. Second, we adjusted the rates so that no state's estimated rate was greater than 100 percent. These adjustments were carried out separately for each year and for the two groups of eligible people (all eligible people and working poor people).

To implement the first adjustment, we calculated preliminary estimates of counts for all eligible people according to

$$(43) \quad \psi_{1,i} = \frac{P_i(\varepsilon_{1,i}/100)}{(\theta_{1,i}/100)},$$

where $\psi_{1,i}$ is the preliminary count of all eligible people for state i, P_i and $\varepsilon_{1,i}$ are the participant count and correctly-eligible rate figures used in Equation (1), and $\theta_{1,i}$ is the preliminary participation rate derived in Equation (38). Using the FY 2018 estimates for all eligible people as an example, the state eligible people counts from Equation (43) summed to 44,578,496, and the national total estimated directly from the CPS ASEC was 43,862,365. To obtain estimated eligible people counts for states that sum (aside from rounding error) to the direct estimate of the national total, we multiplied each of the eligible people counts from Equation (43) by $43{,}862{,}365/44{,}578{,}496$ (≈ 0.9839). Exhibit A.2 shows the direct estimates of national totals and adjustment factors for all three years and both groups.

Exhibit A.2. Direct estimates of national totals and adjustment factors

	All eligible people		Eligible working poor people	
	Direct estimate	Adjustment factor	Direct estimate	Adjustment factor
FY 2016	48,101,111	0.9816	23,132,627	0.9783
FY 2017	46,151,753	0.9825	22,156,167	0.9746
FY 2018	43,862,365	0.9839	20,659,345	0.9702

From the final shrinkage estimates of the numbers of eligible people, we calculated final shrinkage estimates of participation rates according to

$$(44) \quad \theta_{F,1,i} = 100\frac{P_i(\varepsilon_{1,i}/100)}{\psi_{F,1,i}},$$

where $\theta_{F,1,i}$ is the final shrinkage estimate of the participation rate for all eligible people in state i and $\psi_{F,1,i}$ is the final shrinkage estimate of the number of all eligible people. P_i and $\varepsilon_{1,i}$ are the participant count and correctly eligible rate figures used in Equations (1) and (38). We derived final shrinkage participation rates for eligible working poor people in the same way.

After calculating the final shrinkage participation rates, there were 8 instances where a state had an implied participation rate over 100 percent because the estimated number of eligible people was less than the number of participants. Exhibit A.3 shows the estimated participation rates over 100 percent by state, year, and group. (There were no estimated participation rates for working poor people over 100 percent in FY 2016 to FY 2018.) To cap participation rates at 100 percent, we increased the number of eligible people in states with estimated participation rates of over 100 percent so that the number of eligible people in that state equaled the number of participants each year. We reduced the number of eligible people in the other states and the District of

Columbia by an equivalent number and in proportion to their numbers of eligible people. These adjustments, which were carried out separately for the three years and two groups, moved small numbers of eligible people among states but did not change the national totals. Except for the states with participation rates initially over 100 percent, the adjustments did not change any state's participation rate by more than eight-tenths of a percentage point.

Exhibit A.3. Estimated participation rates over 100 percent

	All eligible people		
	FY 2016	FY 2017	FY 2018
Delaware	100.5		106.7
Illinois	100.3		104.4
Oregon	109.0	105.6	104.4
Rhode Island	103.8	100.2	

In Tables III.3 to III.8 of Chapter III, we reported approximate 90 percent confidence intervals for our final shrinkage estimates for all eligible people and eligible working poor people. The upper and lower bounds of the confidence intervals were calculated according to

$$(45) \quad \text{Upper Bound}_i = F_i + 1.645\, e_i$$

and:

$$(46) \quad \text{Lower Bound}_i = F_i - 1.645\, e_i,$$

where F_i is the final shrinkage estimate for state i and e_i is the standard error of that estimate. For participation rates and eligible people counts, the standard errors are, respectively

$$(47) \quad e_i = \frac{1}{r}\sqrt{U(6i-1,6i-1)}$$

and

$$(48) \quad e_i = \frac{\psi_{F,1,i}}{\theta_{F,1,i}}\; r\sqrt{U(6i-1,6i-1)},$$

where r is the ratio used to adjust preliminary estimates of state eligible people counts to the direct estimate of the national total (≈ 0.9838 for all eligible people for FY 2018), and $U(6i-1,6i-1)$ is the $(6i-1,6i-1)$ diagonal element of U for all eligible people for FY 2018, which was derived according to Equation (39). To derive standard error estimates for all eligible people for 2016 and 2017, we used the $(6i-5,6i-5)$ and $(6i-3,6i-3)$ diagonal elements of U, respectively. To derive estimates for working poor people for FY 2016, FY 2017, and FY 2018, we used the $(6i-4,6i-4)$, $(6i-2,6i-2)$, and $(6i,6i)$ diagonal elements of U, respectively. Our estimate of e_i does not take account of the correlation between r and our preliminary

shrinkage estimates for states, which were summed to obtain the denominator of *r*. Instead, *r* is treated as a constant.

Table A.21 presents final shrinkage estimates of participation rates for all eligible people and working poor people (values of $\theta_{F,1,i}$ and $\theta_{F,2,i}$), and Table A.22 presents standard errors for the rates. Tables A.23 and A.24 display final shrinkage estimates of the numbers of all eligible people and eligible working poor people (values of $\psi_{F,1,i}$ and $\psi_{F,2,i}$), respectively, and Tables A.25 and A.26 present the standard errors for those estimated counts. (The rates in Table A.21 and counts in Tables A.23 and A.24 are the same as those in Table III.1 and Table III.2 except for the number of digits displayed.)

Table A.1. Number of people receiving SNAP benefits, monthly average

	FY 2016	FY 2017	FY 2018
Alabama	850,804	804,336	766,681
Alaska	82,326	89,113	91,995
Arizona	960,105	918,728	845,733
Arkansas	426,069	388,362	372,451
California	4,340,042	4,112,066	3,948,658
Colorado	475,690	459,247	449,824
Connecticut	431,597	410,344	387,329
Delaware	147,559	146,805	140,298
District of Columbia	134,625	123,289	112,282
Florida	3,454,530	3,184,409	3,080,213
Georgia	1,733,473	1,625,415	1,556,452
Hawaii	176,729	169,045	163,604
Idaho	185,303	171,251	157,858
Illinois	1,914,393	1,878,519	1,826,011
Indiana	741,610	671,986	617,032
Iowa	380,705	365,893	345,406
Kansas	253,833	233,778	217,420
Kentucky	666,264	654,873	615,305
Louisiana	892,224	928,616	867,342
Maine	189,245	179,734	167,858
Maryland	744,343	684,282	646,483
Massachusetts	779,192	765,714	770,566
Michigan	1,473,614	1,375,434	1,281,862
Minnesota	478,783	453,564	428,986
Mississippi	582,658	537,370	505,308
Missouri	810,690	758,855	736,590
Montana	116,626	120,889	115,223
Nebraska	175,851	175,849	169,811
Nevada	439,782	440,614	439,941
New Hampshire	98,464	92,457	86,502
New Jersey	879,987	817,979	760,303
New Mexico	471,247	460,534	456,251
New York	2,968,227	2,910,894	2,796,620
North Carolina	1,568,387	1,345,612	1,086,802
North Dakota	54,252	53,748	52,621
Ohio	1,608,633	1,501,795	1,421,366
Oklahoma	612,869	603,896	585,064
Oregon	734,864	680,671	633,970
Pennsylvania	1,863,836	1,842,945	1,818,589
Rhode Island	171,055	159,187	157,050
South Carolina	767,463	719,977	658,119
South Dakota	95,983	93,259	87,410
Tennessee	1,113,231	1,047,049	970,875
Texas	3,768,416	3,868,117	3,808,084
Utah	219,820	206,299	189,093
Vermont	79,715	76,558	73,058
Virginia	826,354	775,548	736,221
Washington	1,011,412	929,486	877,244
West Virginia	357,134	340,300	321,009
Wisconsin	728,077	691,635	652,885
Wyoming	33,853	32,839	29,330
United States	44,071,944	42,079,165	40,082,988

Source: USDA, Food and Nutrition Service.

Table A.2. Estimated percentage of participants who are correctly receiving benefits and eligible under federal SNAP rules

	All participants			Working poor participants		
	FY 2016	FY 2017	FY 2018	FY 2016	FY 2017	FY 2018
Alabama	96.05	95.56	94.58	35.78	42.76	41.75
Alaska	99.92	96.77	97.90	41.71	44.62	42.25
Arizona	86.54	85.94	86.23	40.58	42.37	40.04
Arkansas	97.69	96.52	97.49	43.16	41.05	37.92
California	90.28	88.25	87.01	43.90	40.23	37.96
Colorado	94.40	92.94	92.85	44.84	38.48	39.55
Connecticut	85.96	85.18	85.06	32.32	33.03	28.60
Delaware	81.88	79.70	78.68	34.53	36.04	29.69
District of Columbia	92.40	91.33	89.99	21.43	16.34	14.69
Florida	90.52	89.83	88.70	33.88	37.22	35.18
Georgia	93.65	93.79	92.19	40.60	38.90	38.11
Hawaii	89.90	89.00	89.73	43.52	43.21	36.26
Idaho	92.28	92.56	92.09	50.18	50.34	49.50
Illinois	91.17	88.69	88.27	38.62	37.65	37.62
Indiana	96.91	96.81	94.65	45.57	44.97	45.60
Iowa	82.17	84.08	83.46	41.55	43.76	41.30
Kansas	98.52	98.75	97.24	47.10	48.08	47.60
Kentucky	94.35	93.54	92.59	31.88	32.87	33.30
Louisiana	99.35	99.34	98.99	38.38	38.56	37.93
Maine	84.22	81.29	83.86	33.48	35.63	31.67
Maryland	87.52	87.48	86.90	35.40	31.56	32.63
Massachusetts	84.87	87.38	85.92	23.97	23.64	22.16
Michigan	86.91	86.59	86.33	39.24	38.87	36.63
Minnesota	82.36	81.59	85.03	42.79	40.80	42.18
Mississippi	96.50	96.39	95.81	40.02	39.66	36.57
Missouri	98.65	94.85	94.91	35.68	41.48	36.05
Montana	90.08	88.08	85.40	39.73	36.13	39.68
Nebraska	93.37	92.33	92.04	48.66	49.21	47.10
Nevada	84.52	86.46	85.87	41.37	37.76	36.82
New Hampshire	84.32	86.14	85.91	31.95	35.04	26.34
New Jersey	89.25	88.76	88.18	32.82	38.16	37.77
New Mexico	90.56	91.67	90.43	42.56	41.54	44.37
New York	92.37	88.60	88.93	34.77	36.81	31.90
North Carolina	88.51	89.73	110.51	42.30	36.62	50.29
North Dakota	80.03	79.08	80.98	36.94	27.42	31.98
Ohio	90.55	91.38	90.43	39.16	41.80	40.79
Oklahoma	95.97	95.02	93.09	39.42	39.50	41.77
Oregon	82.59	82.74	81.87	32.05	32.98	29.85
Pennsylvania	87.74	86.71	86.02	36.95	36.01	37.57
Rhode Island	85.72	85.86	85.81	32.54	26.24	23.34
South Carolina	91.62	95.12	93.36	38.09	42.05	34.15
South Dakota	98.32	98.81	97.72	46.97	43.83	41.48
Tennessee	98.84	98.26	97.98	36.74	36.30	35.84
Texas	88.64	87.74	87.74	48.61	42.02	47.55
Utah	97.65	97.47	97.18	51.97	51.15	50.96
Vermont	84.67	86.20	83.45	34.13	31.59	31.78
Virginia	96.18	95.53	96.70	43.02	39.94	39.69
Washington	81.82	83.01	80.41	35.95	31.75	25.37
West Virginia	91.22	90.73	89.89	30.31	31.91	31.03
Wisconsin	82.72	84.83	83.19	40.34	42.65	39.07
Wyoming	98.94	98.16	98.01	50.80	40.14	47.99

Source: SNAP QC database.

Table A.3. Estimated number of participants who are correctly receiving benefits and income eligible under federal SNAP rules, monthly average

	FY 2016	FY 2017	FY 2018
Alabama	817,180	768,583	725,158
Alaska	82,258	86,233	90,067
Arizona	830,827	789,573	729,267
Arkansas	416,235	374,863	363,095
California	3,918,060	3,628,816	3,435,609
Colorado	449,047	426,820	417,657
Connecticut	371,014	349,519	329,466
Delaware	120,827	117,005	110,384
District of Columbia	124,389	112,604	101,041
Florida	3,126,902	2,860,523	2,732,180
Georgia	1,623,467	1,524,460	1,434,831
Hawaii	158,885	150,455	146,800
Idaho	171,003	158,517	145,375
Illinois	1,745,410	1,666,077	1,611,765
Indiana	718,665	650,563	584,033
Iowa	312,810	307,654	288,276
Kansas	250,074	230,846	211,428
Kentucky	628,647	612,568	569,699
Louisiana	886,433	922,459	858,556
Maine	159,380	146,097	140,761
Maryland	651,464	598,596	561,800
Massachusetts	661,300	669,104	662,039
Michigan	1,280,688	1,190,961	1,106,619
Minnesota	394,321	370,058	364,784
Mississippi	562,277	517,992	484,151
Missouri	799,762	719,774	699,090
Montana	105,060	106,477	98,405
Nebraska	164,194	162,368	156,297
Nevada	371,721	380,955	377,760
New Hampshire	83,025	79,638	74,314
New Jersey	785,353	726,030	670,443
New Mexico	426,738	422,172	412,574
New York	2,741,751	2,578,994	2,486,894
North Carolina	1,388,242	1,207,431	1,200,981
North Dakota	43,420	42,504	42,615
Ohio	1,456,553	1,372,265	1,285,398
Oklahoma	588,158	573,798	544,619
Oregon	606,917	563,160	519,012
Pennsylvania	1,635,330	1,598,036	1,564,423
Rhode Island	146,635	136,680	134,758
South Carolina	703,111	684,813	614,426
South Dakota	94,371	92,152	85,417
Tennessee	1,100,351	1,028,820	951,215
Texas	3,340,173	3,393,770	3,341,137
Utah	214,654	201,076	183,764
Vermont	67,496	65,992	60,965
Virginia	794,779	740,865	711,940
Washington	827,568	771,538	705,374
West Virginia	325,763	308,747	288,558
Wisconsin	602,294	586,707	543,115
Wyoming	33,494	32,236	28,747
United States	39,908,477	37,807,944	35,987,083

Source: SNAP QC database.

Table A.4. Estimated number of working poor participants who are correctly receiving benefits and eligible under federal SNAP rules, monthly average

	FY 2016	FY 2017	FY 2018
Alabama	304,375	343,966	320,112
Alaska	34,337	39,762	38,870
Arizona	389,611	389,274	338,631
Arkansas	183,900	159,407	141,241
California	1,905,235	1,654,120	1,499,029
Colorado	213,295	176,737	177,914
Connecticut	139,496	135,541	110,788
Delaware	50,948	52,914	41,661
District of Columbia	28,853	20,152	16,491
Florida	1,170,326	1,185,364	1,083,619
Georgia	703,773	632,270	593,211
Hawaii	76,911	73,043	59,316
Idaho	92,979	86,204	78,137
Illinois	739,415	707,338	686,945
Indiana	337,989	302,165	281,342
Iowa	158,187	160,118	142,653
Kansas	119,555	112,403	103,501
Kentucky	212,398	215,250	204,878
Louisiana	342,462	358,056	329,000
Maine	63,359	64,032	53,156
Maryland	263,520	215,973	210,928
Massachusetts	186,772	181,007	170,781
Michigan	578,202	534,576	469,508
Minnesota	204,862	185,063	180,942
Mississippi	233,191	213,110	184,796
Missouri	289,246	314,781	265,511
Montana	46,332	43,675	45,722
Nebraska	85,569	86,534	79,986
Nevada	181,920	166,376	161,969
New Hampshire	31,456	32,393	22,785
New Jersey	288,847	312,141	287,144
New Mexico	200,572	191,324	202,443
New York	1,032,171	1,071,471	892,262
North Carolina	663,459	492,790	546,498
North Dakota	20,039	14,738	16,826
Ohio	629,973	627,675	579,804
Oklahoma	241,568	238,551	244,358
Oregon	235,509	224,492	189,259
Pennsylvania	688,631	663,589	683,280
Rhode Island	55,658	41,777	36,654
South Carolina	292,342	302,758	224,781
South Dakota	45,083	40,872	36,259
Tennessee	409,034	380,026	347,952
Texas	1,831,789	1,625,460	1,810,782
Utah	114,243	105,516	96,352
Vermont	27,207	24,183	23,216
Virginia	355,481	309,762	292,199
Washington	363,623	295,140	222,566
West Virginia	108,251	108,583	99,609
Wisconsin	293,699	294,989	255,089
Wyoming	17,198	13,183	14,074
United States	17,282,853	16,220,624	15,194,827

Source: SNAP QC database.

Table A.5. Estimated percentage of people eligible for SNAP

	All eligible people			Working poor people		
	FY 2016	FY 2017	FY 2018	FY 2016	FY 2017	FY 2018
Alabama	20.17	19.54	19.52	7.89	8.69	8.09
Alaska	15.25	15.60	14.26	7.66	7.07	6.62
Arizona	16.58	15.10	14.47	9.11	7.90	7.37
Arkansas	19.09	18.38	18.09	8.23	7.69	8.05
California	14.11	13.21	12.74	7.88	7.34	6.73
Colorado	10.22	10.38	9.87	4.98	5.49	5.09
Connecticut	10.51	11.51	10.94	4.76	4.50	4.40
Delaware	13.43	11.98	10.17	6.46	5.48	4.13
District of Columbia	19.98	17.74	17.75	7.05	6.16	6.51
Florida	17.19	16.01	15.66	8.10	7.31	6.87
Georgia	20.04	17.43	16.70	10.20	8.64	8.50
Hawaii	14.50	14.10	12.91	7.99	7.67	6.55
Idaho	13.16	11.75	11.49	7.92	6.29	6.35
Illinois	13.15	13.13	11.64	6.90	6.22	5.23
Indiana	14.29	13.37	11.82	6.01	5.98	5.53
Iowa	11.34	9.08	7.98	6.18	4.51	4.48
Kansas	11.25	12.85	10.34	6.02	6.84	5.44
Kentucky	20.81	17.63	16.55	8.66	7.26	5.85
Louisiana	23.94	23.91	22.81	10.56	10.91	10.83
Maine	16.06	14.65	13.12	6.65	6.00	4.98
Maryland	10.86	10.29	9.54	5.36	4.74	3.93
Massachusetts	11.35	11.70	10.45	5.06	5.21	4.84
Michigan	13.73	13.58	12.55	6.07	6.53	5.48
Minnesota	9.47	9.74	10.32	4.32	4.60	5.21
Mississippi	25.65	23.86	23.94	12.09	10.88	10.34
Missouri	13.46	13.01	13.08	5.73	6.21	5.94
Montana	12.83	10.93	10.67	6.00	5.09	5.02
Nebraska	10.45	10.99	10.84	5.34	6.19	5.93
Nevada	13.75	14.19	14.38	7.33	6.43	7.18
New Hampshire	8.62	8.17	6.48	3.97	3.38	2.90
New Jersey	11.83	10.57	9.45	5.84	4.77	4.12
New Mexico	22.52	22.31	20.72	11.20	11.78	10.89
New York	15.31	15.02	14.76	6.57	6.43	6.38
North Carolina	16.67	17.14	16.21	8.11	8.22	7.59
North Dakota	8.77	9.58	8.74	3.88	4.50	3.56
Ohio	15.13	14.36	13.44	6.18	5.95	6.05
Oklahoma	18.10	16.53	15.30	8.71	8.13	7.05
Oregon	12.83	12.77	11.57	6.15	5.66	5.20
Pennsylvania	13.47	13.57	12.42	5.78	5.67	5.09
Rhode Island	12.94	12.46	12.09	5.21	4.79	4.22
South Carolina	18.05	17.24	15.16	7.69	7.15	6.90
South Dakota	14.93	13.69	12.10	7.27	5.95	5.30
Tennessee	18.94	16.58	14.38	8.71	7.19	6.51
Texas	16.92	16.36	15.93	9.05	9.13	8.45
Utah	9.96	8.86	8.00	5.76	5.74	4.95
Vermont	11.29	10.46	9.82	4.96	4.53	4.01
Virginia	13.04	11.88	11.38	5.50	5.48	5.39
Washington	11.99	11.23	9.01	5.43	5.25	3.74
West Virginia	21.77	21.21	19.01	7.35	6.86	6.56
Wisconsin	11.87	9.98	10.30	6.29	5.87	5.59
Wyoming	11.88	11.98	10.19	5.71	5.70	5.21

Source: CPS ASEC.

Table A.6. Directly estimated number of people eligible for SNAP

	FY 2016	FY 2017	FY 2018
Alabama	976,229	941,919	949,204
Alaska	108,053	111,932	102,889
Arizona	1,135,794	1,052,025	1,040,232
Arkansas	563,131	539,225	528,307
California	5,528,795	5,191,389	4,997,272
Colorado	560,001	574,019	561,565
Connecticut	375,574	409,885	377,792
Delaware	127,645	115,432	99,178
District of Columbia	136,561	122,450	122,907
Florida	3,511,905	3,337,231	3,306,026
Georgia	2,052,478	1,790,847	1,735,768
Hawaii	201,550	197,871	180,438
Idaho	220,305	201,964	201,948
Illinois	1,659,829	1,656,275	1,466,107
Indiana	929,693	874,041	777,888
Iowa	351,670	278,535	247,438
Kansas	322,305	369,163	294,733
Kentucky	911,951	775,394	734,709
Louisiana	1,096,660	1,087,835	1,031,448
Maine	212,937	193,172	173,591
Maryland	644,233	615,162	575,676
Massachusetts	768,936	795,257	718,461
Michigan	1,356,029	1,345,760	1,246,940
Minnesota	514,792	542,889	590,047
Mississippi	756,162	704,242	698,279
Missouri	796,668	777,279	787,786
Montana	132,315	113,682	111,169
Nebraska	195,696	206,479	205,078
Nevada	401,877	421,969	432,825
New Hampshire	113,172	108,704	87,286
New Jersey	1,050,386	949,499	836,133
New Mexico	460,056	455,298	425,748
New York	2,989,851	2,957,614	2,874,174
North Carolina	1,669,532	1,756,837	1,679,494
North Dakota	66,045	71,212	65,019
Ohio	1,734,779	1,653,328	1,542,342
Oklahoma	710,359	636,815	590,841
Oregon	527,903	536,120	485,315
Pennsylvania	1,693,119	1,708,482	1,559,471
Rhode Island	135,994	130,686	125,710
South Carolina	880,145	853,252	761,734
South Dakota	127,291	118,609	103,735
Tennessee	1,259,679	1,110,135	963,229
Texas	4,674,279	4,582,636	4,528,506
Utah	304,764	276,314	253,252
Vermont	69,990	64,466	60,551
Virginia	1,065,760	977,528	951,631
Washington	872,410	830,905	678,728
West Virginia	394,262	382,205	337,513
Wisconsin	683,513	580,252	598,726
Wyoming	68,048	67,532	57,526
United States	48,101,111	46,151,753	43,862,365

Source: CPS ASEC.

Table A.7. Directly estimated number of working poor people eligible for SNAP

	FY 2016	FY 2017	FY 2018
Alabama	381,560	419,123	393,643
Alaska	54,267	50,699	47,736
Arizona	624,077	550,559	530,028
Arkansas	242,851	225,522	235,108
California	3,086,880	2,883,349	2,640,608
Colorado	272,932	303,297	289,505
Connecticut	169,979	160,296	151,714
Delaware	61,342	52,805	40,241
District of Columbia	48,208	42,546	45,096
Florida	1,655,888	1,523,646	1,450,672
Georgia	1,044,264	886,992	883,824
Hawaii	111,040	107,537	91,551
Idaho	132,601	108,038	111,644
Illinois	870,546	784,987	659,207
Indiana	390,994	391,302	363,820
Iowa	191,513	138,421	138,854
Kansas	172,569	196,580	155,142
Kentucky	379,596	319,268	259,732
Louisiana	483,980	496,497	489,808
Maine	88,107	79,136	65,825
Maryland	317,981	283,094	236,973
Massachusetts	342,587	353,791	332,508
Michigan	599,578	647,427	544,205
Minnesota	234,737	256,364	297,573
Mississippi	356,344	321,098	301,588
Missouri	339,018	371,281	357,997
Montana	61,920	52,956	52,264
Nebraska	99,969	116,342	112,070
Nevada	214,221	191,373	215,967
New Hampshire	52,081	44,994	38,991
New Jersey	518,219	428,228	364,320
New Mexico	228,767	240,463	223,817
New York	1,282,221	1,265,355	1,242,573
North Carolina	812,252	842,202	786,063
North Dakota	29,232	33,411	26,472
Ohio	708,595	685,432	694,643
Oklahoma	341,659	313,167	272,409
Oregon	253,137	237,655	218,211
Pennsylvania	726,364	713,929	639,135
Rhode Island	54,724	50,214	43,861
South Carolina	374,938	353,790	346,606
South Dakota	61,977	51,588	45,450
Tennessee	579,131	481,809	436,193
Texas	2,500,045	2,555,688	2,401,015
Utah	176,191	179,142	156,645
Vermont	30,765	27,904	24,712
Virginia	449,769	451,116	451,109
Washington	394,975	388,778	281,616
West Virginia	133,131	123,596	116,512
Wisconsin	362,210	341,226	324,666
Wyoming	32,693	32,156	29,425
United States	23,132,627	22,156,167	20,659,345

Source: CPS ASEC.

Table A.8. CPS ASEC population estimate

	FY 2016	FY 2017	FY 2018
Alabama	4,838,963	4,820,815	4,863,571
Alaska	708,324	717,431	721,566
Arizona	6,849,635	6,966,095	7,187,373
Arkansas	2,949,712	2,934,369	2,920,062
California	39,179,029	39,292,653	39,240,144
Colorado	5,481,427	5,529,211	5,688,751
Connecticut	3,574,095	3,560,181	3,451,880
Delaware	950,132	963,946	975,502
District of Columbia	683,571	690,406	692,544
Florida	20,432,540	20,851,024	21,107,389
Georgia	10,242,197	10,271,931	10,395,999
Hawaii	1,389,754	1,402,848	1,397,484
Idaho	1,674,301	1,718,632	1,757,875
Illinois	12,619,308	12,610,953	12,600,165
Indiana	6,506,985	6,538,271	6,580,035
Iowa	3,100,556	3,066,069	3,100,009
Kansas	2,865,498	2,872,684	2,851,686
Kentucky	4,383,086	4,397,309	4,439,959
Louisiana	4,581,787	4,550,227	4,522,566
Maine	1,325,622	1,318,447	1,322,891
Maryland	5,932,682	5,977,534	6,031,940
Massachusetts	6,777,027	6,794,543	6,872,921
Michigan	9,878,438	9,908,214	9,936,957
Minnesota	5,434,751	5,572,938	5,716,201
Mississippi	2,948,292	2,951,480	2,916,597
Missouri	5,916,716	5,975,751	6,024,479
Montana	1,031,518	1,040,196	1,041,842
Nebraska	1,871,914	1,878,638	1,891,310
Nevada	2,923,131	2,974,613	3,009,090
New Hampshire	1,312,592	1,330,906	1,346,133
New Jersey	8,876,480	8,984,709	8,849,297
New Mexico	2,042,565	2,040,738	2,054,871
New York	19,527,770	19,686,401	19,475,315
North Carolina	10,014,097	10,248,861	10,360,068
North Dakota	752,976	743,160	744,104
Ohio	11,467,564	11,511,577	11,479,167
Oklahoma	3,923,797	3,852,593	3,862,179
Oregon	4,115,349	4,196,850	4,194,068
Pennsylvania	12,569,416	12,588,405	12,556,499
Rhode Island	1,050,971	1,049,130	1,039,996
South Carolina	4,877,187	4,949,317	5,024,763
South Dakota	852,580	866,370	857,574
Tennessee	6,652,535	6,697,490	6,697,665
Texas	27,619,793	28,004,737	28,425,458
Utah	3,060,452	3,119,746	3,166,083
Vermont	619,969	616,141	616,871
Virginia	8,174,308	8,231,330	8,363,593
Washington	7,279,004	7,401,572	7,530,083
West Virginia	1,811,254	1,801,743	1,775,598
Wisconsin	5,760,449	5,814,257	5,810,465
Wyoming	572,775	563,881	564,261
United States	319,984,869	322,447,323	324,052,896

Source: CPS ASEC.

Table A.9. Population on July 1

	FY 2016	FY 2017	FY 2018
Alabama	4,863,525	4,875,120	4,887,681
Alaska	741,456	739,786	735,139
Arizona	6,941,072	7,048,876	7,158,024
Arkansas	2,989,918	3,002,997	3,009,733
California	39,167,117	39,399,349	39,461,588
Colorado	5,539,215	5,615,902	5,691,287
Connecticut	3,578,141	3,573,880	3,571,520
Delaware	948,921	957,078	965,479
District of Columbia	685,815	695,691	701,547
Florida	20,613,477	20,976,812	21,244,317
Georgia	10,301,890	10,413,055	10,511,131
Hawaii	1,427,559	1,424,203	1,420,593
Idaho	1,682,380	1,718,904	1,750,536
Illinois	12,820,527	12,786,196	12,723,071
Indiana	6,634,304	6,660,082	6,695,497
Iowa	3,131,371	3,143,637	3,148,618
Kansas	2,910,844	2,910,689	2,911,359
Kentucky	4,438,182	4,453,874	4,461,153
Louisiana	4,678,135	4,670,818	4,659,690
Maine	1,331,317	1,335,063	1,339,057
Maryland	6,003,323	6,024,891	6,035,802
Massachusetts	6,823,608	6,863,246	6,882,635
Michigan	9,950,571	9,976,447	9,984,072
Minnesota	5,522,744	5,568,155	5,606,249
Mississippi	2,987,938	2,989,663	2,981,020
Missouri	6,087,135	6,108,612	6,121,623
Montana	1,040,859	1,053,090	1,060,665
Nebraska	1,905,616	1,917,575	1,925,614
Nevada	2,917,563	2,972,405	3,027,341
New Hampshire	1,342,307	1,349,767	1,353,465
New Jersey	8,870,827	8,888,543	8,886,025
New Mexico	2,091,630	2,093,395	2,092,741
New York	19,633,428	19,590,719	19,530,351
North Carolina	10,154,788	10,270,800	10,381,615
North Dakota	754,434	755,176	758,080
Ohio	11,634,370	11,664,129	11,676,341
Oklahoma	3,926,331	3,932,640	3,940,235
Oregon	4,089,976	4,146,592	4,181,886
Pennsylvania	12,782,275	12,790,447	12,800,922
Rhode Island	1,056,770	1,056,486	1,058,287
South Carolina	4,957,968	5,021,219	5,084,156
South Dakota	862,996	873,286	878,698
Tennessee	6,646,010	6,708,794	6,771,631
Texas	27,914,410	28,322,717	28,628,666
Utah	3,041,868	3,103,118	3,153,550
Vermont	623,657	624,525	624,358
Virginia	8,410,106	8,465,207	8,501,286
Washington	7,294,771	7,425,432	7,523,869
West Virginia	1,831,023	1,817,048	1,804,291
Wisconsin	5,772,628	5,792,051	5,807,406
Wyoming	584,215	578,934	577,601
United States	322,941,311	325,147,121	326,687,501

Source: U.S. Census Bureau, Population Division.

Table A.10. Percentage of working poor participants without reported earned income but with other indicators of earnings

	FY 2016	FY 2017	FY 2018
Alabama	0.0	0.0	0.0
Alaska	0.0	0.0	0.0
Arizona	0.0	0.0	0.0
Arkansas	0.0	0.0	0.0
California	0.5	0.7	0.0
Colorado	0.0	0.0	0.0
Connecticut	0.0	0.0	0.0
Delaware	0.0	0.0	0.0
District of Columbia	0.6	0.0	0.0
Florida	0.2	0.0	0.6
Georgia	0.0	0.0	0.0
Hawaii	0.0	0.0	0.0
Idaho	0.0	0.0	0.0
Illinois	0.0	0.0	0.0
Indiana	0.0	0.0	0.0
Iowa	0.0	0.4	0.3
Kansas	0.0	0.0	0.0
Kentucky	0.0	0.0	0.2
Louisiana	0.0	0.0	0.0
Maine	0.0	0.0	0.0
Maryland	0.0	0.0	0.0
Massachusetts	0.0	0.0	0.0
Michigan	0.0	0.0	0.0
Minnesota	2.8	0.4	0.7
Mississippi	0.0	0.0	0.0
Missouri	0.0	0.0	0.0
Montana	0.0	0.0	0.0
Nebraska	0.0	0.0	0.0
Nevada	0.0	0.0	0.0
New Hampshire	0.0	0.0	0.0
New Jersey	0.8	0.0	0.0
New Mexico	0.0	0.0	0.0
New York	0.0	0.0	0.0
North Carolina	0.0	0.0	0.0
North Dakota	0.0	0.0	0.0
Ohio	0.0	0.0	0.5
Oklahoma	0.0	0.0	0.0
Oregon	0.0	0.0	0.0
Pennsylvania	0.0	0.0	0.0
Rhode Island	0.0	0.0	0.0
South Carolina	0.0	0.0	0.0
South Dakota	0.0	0.0	0.0
Tennessee	0.0	0.0	0.0
Texas	0.4	0.0	0.0
Utah	0.0	0.0	0.0
Vermont	0.0	0.0	0.0
Virginia	0.0	0.0	0.0
Washington	0.0	0.0	0.0
West Virginia	0.0	0.0	0.0
Wisconsin	0.0	0.0	0.0
Wyoming	0.0	0.0	0.0

Source: SNAP QC database.

Table A.11. Direct estimates of SNAP participation rates

	All eligible people			Working poor people		
	FY 2016	FY 207	FY 2018	FY 2016	FY 2017	FY 2018
Alabama	83.29	80.69	76.02	79.37	81.16	80.92
Alaska	72.73	74.71	85.92	60.45	76.06	79.92
Arizona	72.19	74.17	70.39	61.61	69.87	64.15
Arkansas	72.92	67.93	66.68	74.71	69.07	58.29
California	70.89	69.71	68.36	61.74	57.21	56.45
Colorado	79.35	73.21	74.34	77.33	57.37	61.43
Connecticut	98.67	84.95	84.29	81.98	84.23	70.58
Delaware	94.78	102.09	112.45	83.16	100.92	104.60
District of Columbia	90.79	91.26	81.15	59.66	47.00	36.10
Florida	88.26	85.20	82.11	70.06	77.33	74.22
Georgia	78.64	83.97	81.76	67.00	70.32	66.38
Hawaii	76.74	74.90	80.03	67.43	66.91	63.74
Idaho	77.25	78.48	72.29	69.78	79.78	70.28
Illinois	103.51	99.21	108.87	83.60	88.87	103.20
Indiana	75.82	73.07	73.79	84.78	75.81	76.00
Iowa	88.08	107.73	114.71	81.79	112.82	101.15
Kansas	76.38	61.72	70.27	68.20	56.43	65.35
Kentucky	68.08	78.00	77.17	55.26	66.56	78.51
Louisiana	79.17	82.61	80.79	69.30	70.25	65.19
Maine	74.53	74.69	80.11	71.60	79.91	79.78
Maryland	99.93	96.54	97.53	81.90	75.69	88.95
Massachusetts	85.42	83.29	92.02	54.15	50.65	51.29
Michigan	93.76	87.89	88.33	95.74	82.01	85.87
Minnesota	75.38	68.22	63.04	85.88	72.25	62.00
Mississippi	73.37	72.61	67.84	64.57	65.52	59.95
Missouri	97.58	90.59	87.33	82.93	82.94	72.99
Montana	78.69	92.52	86.95	74.15	81.47	85.93
Nebraska	82.42	77.04	74.86	84.08	72.87	70.10
Nevada	92.67	90.35	86.75	85.08	87.00	74.55
New Hampshire	71.74	72.24	84.68	59.06	70.99	58.12
New Jersey	74.82	77.29	79.85	55.77	73.68	78.49
New Mexico	90.58	90.39	95.15	85.62	77.56	88.81
New York	91.21	87.63	86.28	80.06	85.09	71.61
North Carolina	82.00	68.58	71.36	80.55	58.39	69.38
North Dakota	65.62	58.74	64.33	68.42	43.41	62.39
Ohio	82.76	81.92	81.93	87.63	90.38	82.06
Oklahoma	82.74	88.27	90.35	70.66	74.62	87.93
Oregon	115.68	106.32	107.26	93.61	95.61	86.99
Pennsylvania	94.98	92.06	98.40	93.23	91.48	104.87
Rhode Island	107.23	103.86	105.35	101.15	82.62	82.13
South Carolina	78.59	79.11	79.72	76.70	84.35	64.09
South Dakota	73.24	77.08	80.36	71.87	78.60	77.86
Tennessee	87.44	92.52	97.67	70.70	78.74	78.90
Texas	70.71	73.23	73.26	72.50	62.89	74.88
Utah	70.86	73.16	72.85	65.24	59.22	61.76
Vermont	95.87	100.99	99.48	87.91	85.50	92.82
Virginia	72.48	73.70	73.60	76.82	66.77	63.73
Washington	94.66	92.56	104.01	91.86	75.67	79.10
West Virginia	81.73	80.10	84.14	80.43	87.11	84.13
Wisconsin	87.93	101.50	90.76	80.92	86.78	78.61
Wyoming	48.26	46.49	48.82	51.57	39.93	46.73

Table A.12. Standard errors of direct estimates of SNAP participation rates

	All eligible people			Working poor people		
	FY 2016	FY 2017	FY 2018	FY 2016	FY 2017	FY 2018
Alabama	4.971	3.952	4.101	7.404	5.466	7.537
Alaska	6.952	8.718	6.071	6.630	12.933	10.637
Arizona	3.454	5.761	5.172	5.364	7.779	7.033
Arkansas	2.793	3.417	3.456	8.047	6.138	5.314
California	1.875	2.032	1.936	3.460	3.510	3.958
Colorado	8.120	6.151	6.223	9.127	6.852	7.772
Connecticut	8.634	7.443	7.329	11.258	12.157	11.408
Delaware	6.848	7.513	8.277	10.337	13.523	15.800
District of Columbia	3.853	4.436	4.403	7.511	6.866	5.914
Florida	2.935	3.290	3.802	4.988	5.247	5.851
Georgia	3.325	3.587	4.248	5.395	5.459	5.544
Hawaii	4.770	4.842	5.471	6.815	7.675	8.006
Idaho	3.694	5.338	5.172	6.832	7.052	7.576
Illinois	4.542	4.313	6.492	6.635	7.294	10.126
Indiana	4.725	4.768	5.377	8.968	9.120	8.692
Iowa	6.055	8.905	11.837	8.154	10.961	11.027
Kansas	5.836	4.134	5.390	7.862	5.881	6.260
Kentucky	3.714	6.244	5.744	7.274	8.857	9.528
Louisiana	2.600	2.455	2.718	5.932	5.103	4.778
Maine	6.348	5.513	9.376	11.199	11.470	18.564
Maryland	7.901	8.235	7.423	11.689	10.566	13.272
Massachusetts	4.744	5.610	6.225	6.167	7.261	7.461
Michigan	5.067	4.762	4.309	8.317	7.509	8.315
Minnesota	5.854	5.995	4.664	10.947	10.129	7.714
Mississippi	3.071	1.924	2.464	4.643	5.747	5.184
Missouri	5.159	6.017	7.035	8.522	8.639	9.248
Montana	5.252	6.679	8.315	8.067	11.264	12.820
Nebraska	5.932	7.943	6.894	11.306	9.619	7.821
Nevada	6.014	6.313	5.048	9.498	10.007	7.981
New Hampshire	6.369	6.031	7.587	9.250	10.470	11.228
New Jersey	4.168	5.237	5.389	5.651	8.493	9.466
New Mexico	6.032	5.667	7.576	6.972	6.344	9.400
New York	3.039	3.521	3.346	6.248	6.859	6.806
North Carolina	2.899	3.325	3.725	5.934	4.428	4.998
North Dakota	4.886	5.690	5.717	8.976	7.298	8.189
Ohio	3.587	3.603	5.049	6.588	8.035	8.327
Oklahoma	6.191	6.469	6.209	7.584	7.746	11.351
Oregon	7.290	8.720	6.667	9.809	14.934	10.343
Pennsylvania	4.731	4.115	5.306	8.137	8.619	10.687
Rhode Island	9.258	9.729	9.232	13.780	14.775	16.164
South Carolina	4.965	4.164	4.509	7.185	8.989	6.109
South Dakota	9.660	11.478	8.092	10.184	13.172	13.841
Tennessee	4.510	4.361	4.770	5.902	6.751	7.196
Texas	1.734	2.261	2.197	3.782	3.750	4.359
Utah	6.247	6.587	7.918	7.577	7.401	8.418
Vermont	6.650	7.180	7.305	12.653	11.748	13.325
Virginia	3.911	4.563	5.155	6.848	7.239	7.231
Washington	4.970	5.377	7.584	9.479	9.707	11.625
West Virginia	8.376	5.427	4.151	8.776	8.258	10.114
Wisconsin	5.727	6.191	6.049	9.134	8.145	9.059
Wyoming	4.047	3.134	4.683	6.683	4.967	6.375

Table A.13. Potential predictors

Predictor	Data source(s)
Number of people who received SNAP benefits	Administrative data
Estimated population on July 1; Change in July 1 estimated population	Census Bureau
Percentages of population that (1) received SNAP benefits, (2) correctly received regular SNAP benefits, and (3) correctly received regular SNAP benefits under federal eligibility rules	Administrative data; population estimates
Percentage of children ages 5 to 17 approved to receive free lunches under the National School Lunch Program	
Percentage of elderly people that received Supplemental Security Income	
Percentage of population that received unemployment	
Per capita personal income	Commerce Bureau; population estimates
Mean adjusted gross income; Median adjusted gross income	Individual income tax data
Percentages of exemptions for (1) people, (2) elderly people, and (3) children claimed on tax returns with adjusted gross income below the federal poverty level (FPL)	
Percentages of (1) people, (2) elderly people, and (3) nonelderly people not claimed on tax returns	Individual income tax data; population estimates
Percentages of (1) people; (2) elderly people; and (3) non-elderly people, not claimed on tax returns or claimed on returns with adjusted gross income below the FPL	
Percentages of population that were (1) foreign-born and entered the U.S. in 2000 or later and (2) noncitizens	American Community Survey one-year estimates
Percentage of foreign-born people who entered the U.S. in 2000 or later	
Percentages of households that (1) were married-couple families, (2) were nonfamily households, and (3) had one or more children under age 18	
Percentages of households and families that had a female householder, no husband present, and related children under age 18	
Percentages of adults age 25 and older who had (1) completed high school or equivalent and (2) completed a bachelor's degree	
Employment/population ratio and labor force participation rate for the civilian population age 16 and older	
Employment rate for the civilian population ages 16 to 64 in the labor force	
Disability rate the civilian population ages 16 to 64 not in the labor force	
Percentages of civilian employed population age 16 and older who were (1) in service occupations and (2) private wage and salary workers	
Percentage of households that had earnings	
Percentage of occupied housing units that were owner occupied	
Percentages of renter-occupied housing units that spent (1) 30 percent or more and (2) 50 percent or more of household income on rent and utilities	
Lower rent quartile among renter-occupied housing units paying cash rent	
Median monthly housing costs among occupied housing units with cost	
Median household income; median family income	
Percentages of population with household income under (1) 100 percent and (2) 200 percent of the FPL	
Percentages of children with household income under (1) 50 percent and (2) 100 percent of the FPL	
Percentages of adults ages 18 to 64 with household income under (1) 100 percent and (2) 125 percent of the FPL	
Percentage of adults age 65 and older with household income under (1) 125 percent and (2) 200 percent of the FPL	
Percentage of families with income under 130 percent of the FPL	

Table A.14. Predictors in current model

Predictor	Rate numerator	Rate denominator
SNAP prevalence rate	People receiving SNAP benefits according to SNAP Program Operations data	Resident population[a]
Rate of children with income under 50 percent of poverty	Children under age 18 with income under 50 percent of the poverty level according to ACS one-year estimates[c]	Total children under age 18 according to ACS one-year estimates[c]
Bachelor's degree rate	People age 25 and older who have completed a bachelor's degree according to ACS one-year estimates[c]	People age 25 and older according to ACS one-year estimates[c]
Household earnings rate	Households with earnings according to ACS one-year estimates[c]	Total households according to ACS one-year estimates[c]
Rate of elderly people with income under 125 percent of poverty	Adults age 65 and older with income under 125 percent of the poverty level according to ACS one-year estimates[c]	Total adults age 65 and older according to ACS one-year estimates[c]
Private sector employment rate	Civilians age16 and older employed in the private sector according to ACS one-year estimates[c]	Total employed civilians age 16 and older according to ACS one-year estimates[c]
Combined poverty and tax return non-filer rate	People not claimed on tax returns or claimed on tax returns with adjusted gross income under the federal poverty level[b]	Resident population[a]

Note: All rates expressed as percentages.

[a]Estimates of the resident population are from the annual July 1 population estimates released in June 2020, available at http://www.census.gov/popest/.

[b]Counts of people claimed on tax returns are from individual income tax data provided by the Census Bureau Small Area Estimates Branch.

[c]ACS one-year estimates available at https://data.census.gov/cedsci/.

ACS = American Community Survey.

Table A.15. Values for FY 2016 predictors

	SNAP prevalence rate	Combined poverty and non-filer rate	Bachelor's degree rate	Private sector employment rate	Household earnings rate	Child 50 percent of poverty rate	Elderly 125 percent of poverty rate
Alabama	17.494	38.590	24.7	79.2	71.8	11.50	15.4
Alaska	11.103	26.901	29.6	67.5	86.0	6.20	7.5
Arizona	13.832	36.852	28.9	79.7	74.3	11.00	13.3
Arkansas	14.250	39.020	22.4	79.3	72.7	10.30	16.8
California	11.081	31.083	32.9	78.2	80.5	8.10	15.1
Colorado	8.588	26.137	39.9	80.2	82.1	5.00	11.6
Connecticut	12.062	25.912	38.6	80.6	79.4	6.00	9.8
Delaware	15.550	29.530	31.0	82.4	75.9	6.60	10.3
District of Columbia	19.630	38.480	56.8	71.1	80.4	15.90	18.7
Florida	16.759	37.128	28.6	82.1	72.0	9.10	15.4
Georgia	16.827	37.764	30.5	80.1	79.1	10.20	14.8
Hawaii	12.380	27.875	31.9	73.1	80.4	5.20	12.8
Idaho	11.014	27.376	27.6	77.4	77.1	7.00	14.4
Illinois	14.932	28.226	34.0	83.4	78.5	7.60	13.6
Indiana	11.178	29.151	25.6	84.9	77.9	8.70	11.8
Iowa	12.158	24.885	28.4	80.2	79.1	6.20	11.5
Kansas	8.720	27.452	32.8	78.4	79.4	5.70	12.2
Kentucky	15.012	35.831	23.4	80.8	72.6	11.80	16.5
Louisiana	19.072	40.416	23.4	79.7	74.6	12.50	18.7
Maine	14.215	29.296	30.1	78.2	74.6	6.60	13.9
Maryland	12.399	26.731	39.3	73.4	81.5	5.90	11.2
Massachusetts	11.419	25.423	42.7	82.0	79.1	6.60	12.2
Michigan	14.809	31.550	28.3	84.6	74.2	9.30	12.2
Minnesota	8.669	21.446	34.8	82.8	79.9	5.60	11.5
Mississippi	19.500	41.961	21.8	75.9	72.4	14.30	19.2
Missouri	13.318	31.890	28.5	82.3	76.0	9.00	13.0
Montana	11.205	29.784	31.0	74.6	75.4	6.70	15.2
Nebraska	9.228	23.461	31.4	80.4	81.0	5.80	12.2
Nevada	15.074	31.933	23.5	83.3	77.5	8.10	13.4
New Hampshire	7.335	21.117	36.6	80.2	80.4	3.00	7.6
New Jersey	9.920	24.383	38.6	82.3	79.6	5.80	11.9
New Mexico	22.530	39.028	27.2	70.8	73.0	13.40	17.3
New York	15.118	32.549	35.7	79.0	77.3	9.60	16.0
North Carolina	15.445	34.438	30.4	80.2	76.3	9.30	15.0
North Dakota	7.191	23.010	29.6	77.9	82.3	6.30	13.4
Ohio	13.827	29.864	27.5	83.3	75.9	9.90	12.4
Oklahoma	15.609	36.764	25.2	76.6	76.4	10.00	14.0
Oregon	17.967	30.341	32.7	79.3	75.9	7.30	11.7
Pennsylvania	14.581	28.646	30.8	84.8	75.2	8.10	12.0
Rhode Island	16.187	29.434	34.1	82.4	75.2	7.60	14.0
South Carolina	15.479	36.157	27.2	79.9	74.3	11.50	14.2
South Dakota	11.122	24.151	28.9	76.0	80.0	9.80	15.7
Tennessee	16.750	34.095	26.1	79.8	75.2	10.40	14.0
Texas	13.500	34.179	28.9	80.1	82.5	9.50	15.3
Utah	7.226	22.545	32.6	81.0	83.9	4.90	9.9
Vermont	12.782	25.318	36.4	78.4	76.2	8.30	14.7
Virginia	9.826	27.412	38.1	75.4	80.1	6.80	11.7
Washington	13.865	24.008	35.1	78.3	78.8	5.90	11.1
West Virginia	19.505	38.310	20.8	76.1	67.4	11.10	15.2
Wisconsin	12.613	24.615	29.5	82.6	77.8	6.50	12.0
Wyoming	5.795	26.066	27.1	73.2	80.4	4.40	13.4

Table A.16. Values for FY 2017 predictors

	SNAP prevalence rate	Combined poverty and non-filer rate	Bachelor's degree rate	Private sector employment rate	Household earnings rate	Child 50 percent of poverty rate	Elderly 125 percent of poverty rate
Alabama	16.501	38.631	25.5	80.0	71.7	11.30	16.1
Alaska	12.047	27.286	28.8	68.7	84.7	7.10	11.8
Arizona	13.043	36.111	29.4	80.8	74.8	8.90	13.4
Arkansas	12.940	38.942	23.4	78.8	73.0	9.60	16.1
California	10.448	30.661	33.6	78.4	80.8	7.20	15.2
Colorado	8.183	25.598	41.2	80.4	81.9	5.20	11.7
Connecticut	11.484	25.678	38.7	80.6	78.7	5.90	10.3
Delaware	15.343	29.108	31.5	81.7	74.8	7.40	12.8
District of Columbia	17.742	38.098	57.3	70.3	80.7	14.10	19.5
Florida	15.190	35.891	29.7	82.6	72.2	8.80	15.2
Georgia	15.613	37.517	30.9	80.2	79.0	9.20	15.7
Hawaii	11.868	27.353	32.9	73.2	79.8	6.10	12.5
Idaho	9.970	26.831	26.8	78.2	77.0	6.40	11.9
Illinois	14.700	27.963	34.4	83.7	78.2	7.60	13.0
Indiana	10.093	28.728	26.8	85.0	77.5	8.20	12.2
Iowa	11.647	24.855	28.9	80.4	79.1	4.80	11.2
Kansas	8.037	27.211	33.7	77.6	79.4	6.50	11.6
Kentucky	14.709	35.621	24.0	80.5	72.7	11.10	16.2
Louisiana	19.882	40.621	23.8	78.9	73.9	14.30	18.3
Maine	13.467	28.832	32.1	78.5	74.7	5.70	13.9
Maryland	11.360	26.533	39.7	73.4	81.6	6.40	11.0
Massachusetts	11.162	25.038	43.4	82.4	78.7	7.00	13.5
Michigan	13.791	31.137	29.1	84.7	74.5	8.70	12.6
Minnesota	8.148	21.184	36.1	83.0	80.4	4.70	10.9
Mississippi	17.981	42.254	21.9	76.3	71.9	13.10	20.0
Missouri	12.427	31.651	29.1	82.4	76.4	8.00	13.4
Montana	11.486	29.634	32.3	75.3	77.0	6.80	12.2
Nebraska	9.178	23.288	31.7	80.5	81.9	5.60	11.8
Nevada	14.836	31.455	24.9	83.1	78.3	7.80	13.7
New Hampshire	6.855	20.851	36.9	80.0	80.5	4.80	9.8
New Jersey	9.206	23.894	39.7	82.1	79.7	6.00	11.8
New Mexico	22.016	38.748	27.1	71.0	71.7	12.30	18.0
New York	14.859	31.526	36.0	78.8	77.4	9.00	16.3
North Carolina	13.105	34.421	31.3	80.1	76.5	9.40	14.7
North Dakota	7.120	22.523	30.7	77.2	82.6	5.80	14.5
Ohio	12.880	29.579	28.0	83.2	75.8	9.20	11.8
Oklahoma	15.361	36.533	25.5	76.7	76.4	9.30	14.6
Oregon	16.427	29.934	33.7	79.6	75.8	6.50	13.0
Pennsylvania	14.412	28.223	31.4	84.5	74.5	7.90	12.9
Rhode Island	15.079	28.569	33.5	81.9	76.5	5.30	15.1
South Carolina	14.339	35.976	28.0	79.9	74.4	10.20	14.5
South Dakota	10.684	24.319	28.1	77.8	79.4	7.30	13.6
Tennessee	15.607	33.877	27.3	80.0	75.7	9.20	14.6
Texas	13.671	33.616	29.6	80.2	82.3	9.10	16.1
Utah	6.653	22.339	34.6	81.0	84.4	4.50	10.6
Vermont	12.262	25.086	38.3	77.5	77.4	4.90	12.3
Virginia	9.163	27.262	38.7	75.0	80.0	6.50	11.0
Washington	12.521	23.496	35.5	78.7	79.1	6.60	11.6
West Virginia	18.729	37.837	20.2	76.9	66.4	11.90	16.5
Wisconsin	11.945	24.275	30.4	82.5	77.8	5.90	12.4
Wyoming	5.672	25.338	27.6	72.3	79.2	7.20	11.9

Table A.17. Values for FY 2018 predictors

	SNAP prevalence rate	Combined poverty and non-filer rate	Bachelor's degree rate	Private sector employment rate	Household earnings rate	Child 50 percent of poverty rate	Elderly 125 percent of poverty rate
Alabama	15.686	38.520	25.5	79.3	71.2	11.30	16.4
Alaska	12.514	26.683	30.2	67.9	83.8	6.00	10.2
Arizona	11.815	35.479	29.7	80.4	75.0	8.10	12.8
Arkansas	12.375	38.841	23.3	78.6	73.2	9.70	16.2
California	10.006	30.426	34.2	78.5	80.7	7.50	15.2
Colorado	7.904	25.578	41.7	80.6	82.0	5.20	11.2
Connecticut	10.845	25.719	39.6	81.6	78.9	6.00	10.9
Delaware	14.531	28.975	31.3	80.2	75.8	7.60	9.2
District of Columbia	16.005	38.018	60.4	72.2	79.9	15.50	21.0
Florida	14.499	35.209	30.4	82.7	72.3	8.20	15.5
Georgia	14.808	37.359	31.9	80.6	78.8	8.80	15.1
Hawaii	11.517	27.222	33.5	73.1	80.1	5.90	9.7
Idaho	9.018	26.072	27.7	78.9	76.8	5.60	13.3
Illinois	14.352	27.707	35.1	83.6	78.5	6.90	13.0
Indiana	9.216	28.671	27.1	85.0	77.8	7.90	12.3
Iowa	10.970	24.709	29.0	80.5	78.5	5.40	12.2
Kansas	7.468	27.063	33.8	78.4	79.1	5.90	12.2
Kentucky	13.793	35.663	24.8	80.8	73.0	11.00	16.3
Louisiana	18.614	40.463	24.3	79.2	73.9	11.60	19.4
Maine	12.536	28.211	31.5	79.4	73.8	6.20	14.6
Maryland	10.711	26.545	40.8	74.2	81.4	5.90	10.7
Massachusetts	11.196	24.872	44.5	82.5	78.7	5.50	13.3
Michigan	12.839	30.766	29.6	85.0	74.2	9.30	13.3
Minnesota	7.652	21.145	36.7	83.2	79.8	4.70	11.5
Mississippi	16.951	42.179	23.2	76.1	71.7	14.30	19.2
Missouri	12.033	31.505	29.5	82.6	75.9	7.70	13.7
Montana	10.863	29.453	31.7	75.0	76.5	7.00	13.3
Nebraska	8.819	23.179	32.4	79.5	80.5	4.80	12.4
Nevada	14.532	31.141	24.9	82.7	77.7	7.10	13.9
New Hampshire	6.391	20.685	36.8	81.4	78.6	5.50	9.4
New Jersey	8.556	23.574	40.8	82.2	80.0	5.90	11.6
New Mexico	21.802	38.318	27.7	71.7	71.6	13.20	18.8
New York	14.319	30.526	37.2	78.8	76.9	8.60	16.4
North Carolina	10.469	34.162	31.9	80.5	76.7	8.80	14.1
North Dakota	6.941	22.294	29.7	76.5	81.5	4.70	14.7
Ohio	12.173	29.419	29.0	83.4	75.8	8.80	13.2
Oklahoma	14.848	36.159	25.6	77.1	76.5	10.00	14.2
Oregon	15.160	29.455	34.0	79.4	75.9	6.80	12.7
Pennsylvania	14.207	27.984	31.8	84.6	75.5	7.80	13.0
Rhode Island	14.840	28.182	34.4	82.6	74.2	8.20	17.2
South Carolina	12.945	35.631	28.3	80.0	74.3	9.60	14.7
South Dakota	9.948	24.094	29.2	77.7	80.6	7.80	13.3
Tennessee	14.337	33.739	27.5	80.3	75.5	9.90	14.5
Texas	13.302	33.265	30.3	80.3	82.2	9.10	16.3
Utah	5.996	22.013	34.9	80.6	83.8	3.90	9.0
Vermont	11.701	24.921	38.7	76.7	77.7	5.80	13.3
Virginia	8.660	27.209	39.3	74.9	79.4	6.70	12.5
Washington	11.659	23.334	36.7	78.7	79.0	5.40	10.6
West Virginia	17.791	37.338	21.3	76.8	66.9	10.80	15.9
Wisconsin	11.242	24.158	30.0	83.5	77.5	5.90	12.2
Wyoming	5.078	24.404	26.9	72.1	79.1	5.80	10.5

Table A.18. Regression estimates of SNAP participation rates

	All eligible people			Working poor people		
	FY 2016	FY 2017	FY 2018	FY 2016	FY 2017	FY 2018
Alabama	81.81	80.30	79.08	74.06	75.84	72.30
Alaska	68.84	75.55	87.01	63.72	66.05	77.71
Arizona	72.28	75.85	76.26	64.28	71.55	67.30
Arkansas	68.18	64.69	62.80	64.62	62.62	59.44
California	70.33	69.16	68.01	62.97	55.46	57.32
Colorado	77.06	74.92	78.23	64.44	60.39	61.91
Connecticut	90.86	89.47	92.06	76.42	80.31	76.44
Delaware	98.65	96.18	104.68	86.15	91.30	94.84
District of Columbia	90.13	87.24	80.11	58.00	40.35	37.28
Florida	89.08	84.77	84.72	76.86	79.51	73.43
Georgia	84.52	83.55	83.53	72.21	70.94	70.30
Hawaii	80.19	79.71	88.19	70.85	70.48	76.33
Idaho	73.19	71.90	70.49	70.93	71.93	67.77
Illinois	95.97	96.26	100.25	84.33	86.45	87.39
Indiana	75.13	72.10	73.56	74.52	71.46	73.61
Iowa	85.23	86.62	85.11	81.20	85.08	80.76
Kansas	70.07	65.99	67.12	63.56	58.89	58.74
Kentucky	73.63	74.28	73.90	71.55	70.86	70.83
Louisiana	82.30	85.58	82.79	75.67	75.52	74.97
Maine	88.18	87.29	83.89	78.74	81.26	73.74
Maryland	84.85	82.86	86.86	69.77	68.37	68.17
Massachusetts	90.11	86.11	92.10	74.00	68.23	70.91
Michigan	88.75	86.60	86.95	81.19	84.45	81.38
Minnesota	80.78	79.05	80.41	75.47	71.88	71.68
Mississippi	75.61	72.75	70.30	70.84	64.13	65.07
Missouri	80.19	78.68	80.53	73.89	74.36	73.71
Montana	71.86	76.48	74.63	64.74	70.25	64.84
Nebraska	76.30	76.15	77.23	73.08	69.43	70.83
Nevada	86.51	88.21	90.05	82.58	85.50	86.61
New Hampshire	80.65	73.26	78.57	71.53	66.56	70.88
New Jersey	84.35	79.85	82.77	73.11	67.72	68.52
New Mexico	91.92	96.73	97.69	79.80	85.11	84.05
New York	85.52	85.77	86.73	72.36	69.07	70.10
North Carolina	84.34	75.58	68.91	73.92	66.22	59.75
North Dakota	63.49	61.24	60.74	65.10	51.03	58.24
Ohio	83.17	82.58	84.21	79.09	81.24	79.83
Oklahoma	76.00	79.72	81.46	69.38	74.68	75.51
Oregon	104.32	101.31	100.10	88.76	93.40	85.71
Pennsylvania	94.16	93.41	98.19	85.02	89.08	89.46
Rhode Island	99.90	96.62	91.07	85.98	86.83	78.42
South Carolina	77.67	77.35	75.42	70.84	71.96	68.04
South Dakota	69.89	74.06	75.47	71.72	68.20	73.29
Tennessee	86.03	85.84	83.84	79.16	80.26	77.74
Texas	73.53	76.88	76.39	67.65	62.96	68.36
Utah	71.94	70.26	75.16	68.85	62.03	68.59
Vermont	85.93	90.28	87.95	76.38	79.55	71.52
Virginia	73.13	72.62	71.94	61.90	60.84	56.41
Washington	96.03	90.58	96.00	84.39	81.27	82.98
West Virginia	87.56	85.16	88.28	80.59	87.35	83.69
Wisconsin	89.58	87.23	89.15	84.48	83.36	84.71
Wyoming	53.42	49.26	55.38	54.83	46.56	55.92

Table A.19. Standard errors of regression estimates of SNAP participation rates

	All eligible people			Working poor people		
	FY 2016	FY 2017	FY 2018	FY 2016	FY 2017	FY 2018
Alabama	3.836	3.798	3.834	5.109	5.084	5.191
Alaska	5.834	5.354	5.335	7.483	7.545	7.784
Arizona	4.177	4.033	4.123	5.795	5.479	5.570
Arkansas	4.022	4.107	4.118	5.581	5.744	5.609
California	3.768	3.829	3.828	5.052	5.205	5.148
Colorado	4.046	3.953	4.015	5.404	5.288	5.356
Connecticut	3.941	3.936	3.935	5.282	5.430	5.308
Delaware	4.101	3.893	4.565	5.576	5.282	6.715
District of Columbia	5.597	5.853	5.893	8.521	8.253	7.977
Florida	4.034	3.955	4.077	5.499	5.411	5.654
Georgia	4.035	4.088	4.220	5.526	5.560	5.762
Hawaii	4.175	4.090	4.366	5.664	5.541	6.178
Idaho	3.843	3.799	3.947	5.190	5.033	5.321
Illinois	3.970	3.926	4.051	5.375	5.366	5.522
Indiana	4.069	4.037	4.176	5.628	5.609	5.867
Iowa	3.879	3.980	3.842	5.196	5.399	5.118
Kansas	3.827	3.828	3.854	5.111	5.109	5.087
Kentucky	3.916	3.812	3.842	5.335	5.224	5.259
Louisiana	3.988	4.101	4.071	5.453	5.865	5.575
Maine	3.933	4.075	4.124	5.350	5.879	5.866
Maryland	4.116	4.225	4.196	5.483	5.851	5.794
Massachusetts	4.044	4.237	4.219	5.407	5.794	5.811
Michigan	3.907	3.872	4.062	5.293	5.317	5.732
Minnesota	3.987	3.952	4.006	5.382	5.297	5.409
Mississippi	4.102	4.053	4.159	5.512	5.721	5.799
Missouri	3.693	3.674	3.692	4.909	4.853	4.865
Montana	4.134	3.897	3.864	5.747	5.247	5.211
Nebraska	3.828	3.890	3.864	5.118	5.154	5.157
Nevada	3.946	4.038	4.012	5.392	5.466	5.424
New Hampshire	4.206	3.925	4.254	5.682	5.291	5.931
New Jersey	3.890	3.918	3.925	5.143	5.245	5.260
New Mexico	4.769	4.754	4.883	6.320	6.489	6.910
New York	3.723	3.793	3.847	4.969	5.131	5.191
North Carolina	3.629	3.686	3.908	4.802	4.867	5.185
North Dakota	4.184	4.533	4.687	5.733	6.353	6.626
Ohio	3.939	3.915	3.912	5.445	5.667	5.446
Oklahoma	3.865	3.960	3.908	5.071	5.322	5.326
Oregon	4.273	4.165	4.032	5.853	5.826	5.584
Pennsylvania	3.910	3.958	4.057	5.261	5.425	5.607
Rhode Island	4.022	4.326	4.425	5.450	6.506	6.297
South Carolina	3.821	3.737	3.740	5.167	4.999	4.958
South Dakota	4.906	4.142	4.385	7.002	5.643	6.159
Tennessee	3.731	3.669	3.715	4.918	4.844	5.016
Texas	4.181	4.215	4.252	5.750	5.716	5.951
Utah	4.025	4.028	4.101	5.377	5.347	5.549
Vermont	4.170	4.113	4.064	5.765	5.782	5.612
Virginia	3.941	4.045	3.970	5.284	5.521	5.289
Washington	4.085	3.977	4.002	5.547	5.449	5.473
West Virginia	4.587	4.505	4.488	6.206	6.217	6.468
Wisconsin	3.929	3.944	3.971	5.323	5.333	5.382
Wyoming	4.467	4.527	4.725	6.267	6.312	6.452

Table A.20. Preliminary shrinkage estimates of SNAP participation rates

	All eligible people			Working poor people		
	FY 2016	FY 2017	FY 2018	FY 2016	FY 2017	FY 2018
Alabama	80.48	79.02	77.51	76.19	78.13	75.16
Alaska	68.82	75.54	87.00	62.13	66.14	77.22
Arizona	71.66	75.25	75.44	63.08	70.90	66.74
Arkansas	70.46	66.65	64.90	66.18	64.18	59.53
California	70.69	69.56	68.34	62.45	55.94	56.99
Colorado	76.43	74.00	77.37	66.42	60.21	62.88
Connecticut	90.19	88.54	91.12	76.58	80.88	76.47
Delaware	98.67	96.50	104.95	86.33	91.92	95.28
District of Columbia	90.46	87.93	80.43	58.40	41.54	37.26
Florida	88.58	84.61	84.24	74.39	78.11	72.54
Georgia	82.46	82.29	81.83	70.42	69.73	68.36
Hawaii	78.44	78.00	86.22	69.24	69.28	73.95
Idaho	75.03	73.89	72.17	70.63	73.14	68.24
Illinois	98.41	98.22	102.68	84.35	86.77	88.83
Indiana	74.69	71.67	73.09	76.57	72.74	74.96
Iowa	86.59	88.42	86.77	81.91	87.44	82.13
Kansas	70.06	65.12	67.11	64.46	59.19	60.46
Kentucky	72.42	73.77	73.27	67.89	68.35	69.40
Louisiana	80.85	84.13	81.40	72.26	72.19	70.54
Maine	83.75	82.71	79.72	78.85	81.75	74.10
Maryland	87.42	85.27	89.36	71.14	69.21	70.02
Massachusetts	90.35	86.61	92.58	65.77	60.98	62.94
Michigan	89.57	87.07	87.59	83.74	84.88	83.06
Minnesota	75.18	73.42	74.21	76.61	72.70	71.80
Mississippi	74.51	72.25	69.14	68.01	63.36	62.59
Missouri	85.26	83.36	85.10	74.52	75.25	73.89
Montana	74.20	79.07	77.01	67.07	71.69	67.30
Nebraska	76.91	76.54	77.58	74.27	70.37	71.60
Nevada	87.40	89.00	90.53	81.25	84.53	84.22
New Hampshire	80.01	72.92	78.27	69.14	65.78	68.06
New Jersey	80.83	77.16	79.87	68.54	66.82	67.50
New Mexico	90.80	95.13	96.49	81.21	84.26	85.13
New York	86.91	86.67	87.47	75.65	73.39	72.56
North Carolina	82.66	72.92	67.69	76.42	65.03	62.81
North Dakota	64.32	61.65	61.63	65.34	49.90	58.56
Ohio	81.85	81.22	82.76	81.91	83.91	81.84
Oklahoma	78.30	81.95	83.84	69.20	73.80	75.96
Oregon	107.01	103.72	102.72	88.90	93.39	85.70
Pennsylvania	93.34	92.34	97.30	87.54	90.75	92.26
Rhode Island	101.85	98.42	93.08	87.02	86.69	78.82
South Carolina	78.00	77.59	75.79	71.39	73.01	66.73
South Dakota	70.70	74.92	76.36	71.71	69.17	73.53
Tennessee	89.51	89.57	87.97	76.20	78.16	75.52
Texas	70.75	73.85	73.56	70.59	64.31	71.59
Utah	72.15	70.67	75.35	67.32	60.33	66.79
Vermont	88.41	92.65	90.44	77.96	80.58	73.49
Virginia	72.02	71.51	70.89	66.56	63.68	59.80
Washington	96.31	90.95	96.50	84.96	80.34	82.37
West Virginia	85.53	83.12	86.17	81.01	87.80	84.08
Wisconsin	90.34	88.83	90.00	82.82	81.69	82.60
Wyoming	51.58	47.72	53.47	52.98	43.86	53.17

Table A.21. Final shrinkage estimates of SNAP participation rates

	All eligible people			Working poor people		
	FY 2016	FY 2017	FY 2018	FY 2016	FY 2017	FY 2018
Alabama	82.10	80.49	78.96	77.88	80.17	77.47
Alaska	70.21	76.94	88.62	63.51	67.86	79.59
Arizona	73.10	76.64	76.85	64.48	72.75	68.79
Arkansas	71.88	67.88	66.11	67.65	65.85	61.36
California	72.12	70.85	69.62	63.84	57.40	58.74
Colorado	77.96	75.37	78.82	67.90	61.78	64.81
Connecticut	92.01	90.18	92.82	78.28	82.99	78.83
Delaware	100.00	98.29	100.00	88.24	94.31	98.21
District of Columbia	92.28	89.56	81.93	59.70	42.62	38.40
Florida	90.36	86.18	85.81	76.04	80.15	74.77
Georgia	84.12	83.81	83.35	71.98	71.54	70.46
Hawaii	80.02	79.44	87.83	70.77	71.09	76.22
Idaho	76.54	75.26	73.52	72.19	75.04	70.33
Illinois	100.00	100.00	100.00	86.22	89.04	91.56
Indiana	76.19	73.00	74.46	78.27	74.63	77.27
Iowa	88.34	90.06	88.39	83.73	89.72	84.65
Kansas	71.47	66.32	68.36	65.89	60.73	62.32
Kentucky	73.88	75.14	74.64	69.40	70.14	71.54
Louisiana	82.48	85.69	82.92	73.86	74.07	72.71
Maine	85.44	84.24	81.21	80.60	83.88	76.38
Maryland	89.18	86.84	91.03	72.72	71.01	72.17
Massachusetts	92.17	88.22	94.30	67.23	62.57	64.88
Michigan	91.38	88.68	89.23	85.60	87.09	85.62
Minnesota	76.70	74.78	75.59	78.31	74.60	74.01
Mississippi	76.01	73.58	70.43	69.52	65.02	64.51
Missouri	86.98	84.90	86.69	76.17	77.21	76.16
Montana	75.70	80.53	78.44	68.55	73.56	69.37
Nebraska	78.46	77.96	79.03	75.91	72.20	73.81
Nevada	89.16	90.65	92.22	83.05	86.74	86.81
New Hampshire	81.62	74.27	79.73	70.67	67.50	70.15
New Jersey	82.46	78.58	81.36	70.05	68.56	69.58
New Mexico	92.63	96.89	98.29	83.01	86.46	87.75
New York	88.66	88.28	89.11	77.33	75.31	74.79
North Carolina	84.32	74.27	68.96	78.11	66.72	64.74
North Dakota	65.61	62.79	62.78	66.79	51.20	60.36
Ohio	83.50	82.72	84.30	83.73	86.10	84.36
Oklahoma	79.87	83.47	85.40	70.73	75.73	78.29
Oregon	100.00	100.00	100.00	90.87	95.83	88.34
Pennsylvania	95.21	94.05	99.12	89.48	93.12	95.09
Rhode Island	100.00	100.00	94.82	88.95	88.95	81.24
South Carolina	79.57	79.02	77.21	72.98	74.92	68.78
South Dakota	72.13	76.30	77.79	73.30	70.97	75.79
Tennessee	91.32	91.22	89.61	77.89	80.20	77.84
Texas	72.18	75.22	74.93	72.16	65.99	73.79
Utah	73.60	71.97	76.75	68.81	61.90	68.84
Vermont	90.19	94.37	92.12	79.69	82.68	75.74
Virginia	73.46	72.83	72.21	68.04	65.34	61.63
Washington	98.25	92.64	98.30	86.84	82.44	84.90
West Virginia	87.25	84.66	87.78	82.80	90.09	86.66
Wisconsin	92.16	90.48	91.68	84.65	83.82	85.14
Wyoming	52.62	48.60	54.47	54.15	45.00	54.81

Table A.22. Standard errors of final shrinkage estimates of SNAP participation rates

	All eligible people			Working poor people		
	FY 2016	FY 2017	FY 2018	FY 2016	FY 2017	FY 2018
Alabama	2.698	2.562	2.588	4.056	3.725	4.224
Alaska	4.838	4.543	4.204	5.544	6.940	6.860
Arizona	2.613	2.890	2.934	4.008	4.318	4.288
Arkansas	2.168	2.510	2.507	4.500	4.319	4.011
California	1.547	1.677	1.596	2.713	2.840	2.966
Colorado	3.333	3.167	3.211	4.508	4.113	4.274
Connecticut	3.365	3.330	3.294	4.690	4.950	4.756
Delaware	3.383	3.240	3.905	4.907	4.856	6.341
District of Columbia	3.581	4.047	4.045	6.651	6.269	5.658
Florida	2.316	2.411	2.597	3.697	3.727	4.111
Georgia	2.465	2.653	2.800	3.839	4.009	4.031
Hawaii	3.098	3.052	3.382	4.408	4.591	5.110
Idaho	2.511	2.745	2.833	4.046	3.988	4.238
Illinois	2.944	2.869	3.155	4.204	4.302	4.794
Indiana	2.882	2.876	3.066	4.764	4.798	4.934
Iowa	3.275	3.522	3.391	4.376	4.862	4.531
Kansas	2.824	2.712	2.806	4.014	3.794	3.774
Kentucky	2.582	2.759	2.772	4.381	4.395	4.668
Louisiana	2.072	2.156	2.178	4.016	4.142	3.786
Maine	3.540	3.531	3.796	5.105	5.655	5.926
Maryland	3.628	3.760	3.660	5.018	5.265	5.448
Massachusetts	3.395	3.710	3.690	4.800	5.334	5.362
Michigan	2.818	2.760	2.840	4.442	4.352	4.763
Minnesota	3.499	3.476	3.343	5.143	5.035	4.866
Mississippi	2.247	1.676	2.057	3.586	4.107	3.986
Missouri	3.307	3.375	3.408	4.417	4.397	4.443
Montana	3.328	3.305	3.289	4.940	4.843	4.869
Nebraska	2.977	3.150	3.075	4.448	4.364	4.182
Nevada	2.997	3.125	2.966	4.563	4.789	4.482
New Hampshire	3.425	3.171	3.564	4.894	4.869	5.428
New Jersey	2.921	3.095	3.040	4.122	4.669	4.738
New Mexico	3.838	3.784	4.078	4.865	4.910	5.857
New York	2.234	2.406	2.358	3.951	4.224	4.249
North Carolina	2.075	2.365	2.478	3.520	3.576	3.641
North Dakota	3.053	3.567	3.614	4.760	5.107	5.428
Ohio	2.548	2.534	2.726	4.279	4.737	4.572
Oklahoma	3.154	3.275	3.182	4.110	4.353	4.754
Oregon	3.652	3.633	3.406	5.089	5.383	4.962
Pennsylvania	2.778	2.736	2.948	4.442	4.703	5.012
Rhode Island	3.636	3.994	4.029	5.123	6.207	6.046
South Carolina	2.674	2.537	2.573	4.019	4.235	3.794
South Dakota	4.358	3.690	3.802	5.993	5.140	5.689
Tennessee	2.865	2.850	2.935	3.782	3.949	4.164
Texas	1.609	1.961	1.938	3.239	3.291	3.687
Utah	3.260	3.294	3.402	4.265	4.245	4.530
Vermont	3.504	3.551	3.480	5.371	5.374	5.335
Virginia	2.683	2.892	2.856	4.354	4.521	4.326
Washington	3.024	2.992	3.150	4.825	4.706	4.874
West Virginia	3.701	3.344	3.083	5.111	5.101	5.598
Wisconsin	3.053	3.191	3.114	4.537	4.489	4.577
Wyoming	3.012	2.732	3.326	4.808	4.260	4.876

Table A.23. Final shrinkage estimates of number of people eligible for SNAP

	FY 2016	FY 2017	FY 2018
Alabama	995,349	954,929	918,430
Alaska	117,164	112,083	101,634
Arizona	1,136,542	1,030,206	948,956
Arkansas	579,107	552,224	549,191
California	5,432,955	5,121,853	4,934,763
Colorado	575,960	566,320	529,913
Connecticut	403,232	387,598	354,959
Delaware	120,827	119,041	110,384
District of Columbia	134,790	125,728	123,332
Florida	3,460,354	3,319,413	3,183,850
Georgia	1,929,885	1,818,875	1,721,392
Hawaii	198,560	189,389	167,138
Idaho	223,428	210,634	197,737
Illinois	1,745,410	1,666,077	1,611,765
Indiana	943,268	891,230	784,377
Iowa	354,115	341,619	326,132
Kansas	349,900	348,078	309,274
Kentucky	850,881	815,280	763,297
Louisiana	1,074,745	1,076,564	1,035,435
Maine	186,543	173,424	173,328
Maryland	730,533	689,273	617,165
Massachusetts	717,500	758,482	702,022
Michigan	1,401,543	1,342,936	1,240,221
Minnesota	514,128	494,884	482,581
Mississippi	739,778	703,969	687,452
Missouri	919,517	847,776	806,413
Montana	138,791	132,218	125,448
Nebraska	209,269	208,270	197,770
Nevada	416,898	420,263	409,624
New Hampshire	101,725	107,226	93,207
New Jersey	952,395	923,881	824,020
New Mexico	460,714	435,701	419,767
New York	3,092,420	2,921,539	2,790,955
North Carolina	1,646,311	1,625,671	1,741,678
North Dakota	66,176	67,695	67,884
Ohio	1,744,374	1,658,921	1,524,784
Oklahoma	736,362	687,428	637,716
Oregon	606,917	563,160	519,012
Pennsylvania	1,717,523	1,699,184	1,578,320
Rhode Island	146,635	136,680	142,122
South Carolina	883,653	866,579	795,819
South Dakota	130,843	120,771	109,808
Tennessee	1,205,000	1,127,795	1,061,448
Texas	4,627,879	4,512,038	4,458,882
Utah	291,657	279,374	239,423
Vermont	74,840	69,932	66,177
Virginia	1,081,848	1,017,187	985,874
Washington	842,302	832,864	717,587
West Virginia	373,356	364,697	328,732
Wisconsin	653,550	648,469	592,386
Wyoming	63,658	66,325	52,781

Table A.24. Final shrinkage estimates of number of working poor people eligible for SNAP

	FY 2016	FY 2017	FY 2018
Alabama	390,832	429,063	413,194
Alaska	54,067	58,591	48,836
Arizona	604,219	535,100	492,239
Arkansas	271,856	242,079	230,190
California	2,984,447	2,881,978	2,551,930
Colorado	314,150	286,074	274,517
Connecticut	178,209	163,331	140,548
Delaware	57,735	56,104	42,422
District of Columbia	48,331	47,283	42,940
Florida	1,539,179	1,479,010	1,449,258
Georgia	977,709	883,739	841,872
Hawaii	108,672	102,747	77,818
Idaho	128,792	114,873	111,094
Illinois	857,620	794,433	750,232
Indiana	431,824	404,866	364,113
Iowa	188,936	178,473	168,512
Kansas	181,441	185,079	166,073
Kentucky	306,051	306,905	286,389
Louisiana	463,667	483,416	452,458
Maine	78,609	76,336	69,591
Maryland	362,391	304,135	292,261
Massachusetts	277,809	289,309	263,226
Michigan	675,477	613,789	548,372
Minnesota	261,594	248,077	244,476
Mississippi	335,426	327,776	286,445
Missouri	379,728	407,702	348,621
Montana	67,584	59,370	65,912
Nebraska	112,720	119,848	108,372
Nevada	219,051	191,817	186,585
New Hampshire	44,509	47,991	32,481
New Jersey	412,315	455,249	412,700
New Mexico	241,623	221,287	230,712
New York	1,334,827	1,422,808	1,193,016
North Carolina	849,354	738,571	844,121
North Dakota	30,001	28,782	27,875
Ohio	752,397	728,987	687,285
Oklahoma	341,523	315,019	312,108
Oregon	259,177	234,270	214,248
Pennsylvania	769,564	712,604	718,525
Rhode Island	62,572	46,966	45,117
South Carolina	400,603	404,128	326,808
South Dakota	61,508	57,591	47,841
Tennessee	525,175	473,864	446,993
Texas	2,538,585	2,463,207	2,453,957
Utah	166,020	170,463	139,967
Vermont	34,140	29,250	30,650
Virginia	522,464	474,042	474,085
Washington	418,704	358,022	262,141
West Virginia	130,733	120,524	114,941
Wisconsin	346,948	351,943	299,600
Wyoming	31,758	29,297	25,679

Table A.25. Standard errors of final shrinkage estimates of number of people eligible for SNAP

	FY 2016	FY 2017	FY 2018
Alabama	32,800	30,437	30,244
Alaska	8,095	6,627	4,844
Arizona	40,736	38,892	36,401
Arkansas	17,510	20,448	20,918
California	116,889	121,371	113,642
Colorado	24,685	23,829	21,687
Connecticut	14,786	14,331	12,654
Delaware	4,044	3,929	3,788
District of Columbia	5,244	5,689	6,118
Florida	88,929	92,987	96,801
Georgia	56,699	57,654	58,084
Hawaii	7,707	7,285	6,466
Idaho	7,349	7,693	7,655
Illinois	51,112	47,824	46,699
Indiana	35,773	35,161	32,452
Iowa	13,165	13,376	12,569
Kansas	13,863	14,254	12,754
Kentucky	29,813	29,973	28,474
Louisiana	27,065	27,123	27,317
Maine	7,750	7,278	8,138
Maryland	29,796	29,883	24,930
Massachusetts	26,498	31,940	27,596
Michigan	43,331	41,854	39,650
Minnesota	23,515	23,037	21,439
Mississippi	21,929	16,059	20,172
Missouri	35,059	33,749	31,849
Montana	6,118	5,434	5,285
Nebraska	7,962	8,425	7,731
Nevada	14,051	14,506	13,234
New Hampshire	4,280	4,584	4,186
New Jersey	33,825	36,436	30,935
New Mexico	19,143	17,039	17,495
New York	78,111	79,729	74,212
North Carolina	40,628	51,824	62,884
North Dakota	3,087	3,851	3,926
Ohio	53,367	50,895	49,524
Oklahoma	29,154	27,009	23,874
Oregon	18,650	18,358	16,219
Pennsylvania	50,252	49,499	47,160
Rhode Island	4,953	5,441	6,067
South Carolina	29,772	27,859	26,642
South Dakota	7,928	5,849	5,392
Tennessee	37,907	35,276	34,928
Texas	103,443	117,765	115,840
Utah	12,953	12,805	10,662
Vermont	2,916	2,635	2,511
Virginia	39,621	40,441	39,165
Washington	25,991	26,935	23,101
West Virginia	15,877	14,425	11,599
Wisconsin	21,708	22,899	20,210
Wyoming	3,654	3,733	3,238

Table A.26. Standard errors of final shrinkage estimates of number of working poor people eligible for SNAP

	FY 2016	FY 2017	FY 2018
Alabama	20,352	19,936	22,526
Alaska	4,720	5,992	4,209
Arizona	37,554	31,758	30,684
Arkansas	18,083	15,876	15,048
California	126,827	142,615	128,864
Colorado	20,856	19,043	18,104
Connecticut	10,677	9,742	8,480
Delaware	3,210	2,889	2,739
District of Columbia	5,385	6,955	6,327
Florida	74,829	68,772	79,687
Georgia	52,148	49,516	48,161
Hawaii	6,769	6,636	5,217
Idaho	7,218	6,104	6,695
Illinois	41,822	38,383	39,277
Indiana	26,285	26,025	23,249
Iowa	9,875	9,673	9,019
Kansas	11,052	11,561	10,057
Kentucky	19,318	19,232	18,687
Louisiana	25,210	27,032	23,556
Maine	4,979	5,146	5,399
Maryland	25,006	22,550	22,062
Massachusetts	19,835	24,664	21,756
Michigan	35,050	30,672	30,503
Minnesota	17,181	16,744	16,074
Mississippi	17,300	20,703	17,697
Missouri	22,020	23,220	20,339
Montana	4,870	3,908	4,626
Nebraska	6,605	7,243	6,140
Nevada	12,036	10,590	9,633
New Hampshire	3,082	3,462	2,513
New Jersey	24,262	31,001	28,104
New Mexico	14,161	12,567	15,401
New York	68,208	79,812	67,777
North Carolina	38,269	39,586	47,471
North Dakota	2,138	2,871	2,506
Ohio	38,453	40,105	37,247
Oklahoma	19,844	18,106	18,950
Oregon	14,514	13,159	12,035
Pennsylvania	38,205	35,991	37,871
Rhode Island	3,604	3,277	3,357
South Carolina	22,060	22,847	18,026
South Dakota	5,029	4,171	3,591
Tennessee	25,500	23,335	23,910
Texas	113,953	122,838	122,602
Utah	10,289	11,691	9,210
Vermont	2,301	1,901	2,159
Virginia	33,432	32,795	33,275
Washington	23,262	20,439	15,050
West Virginia	8,069	6,824	7,425
Wisconsin	18,595	18,851	16,104
Wyoming	2,820	2,773	2,284

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APPENDIX B

DATA FOR FIGURES
(CUNNYNGHAM FORTHCOMING)

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Table B.1a. How many people were eligible in 2018? What percentage participated? (States)

Eligible people (thousands)	State	Lower bound of confidence interval	FY 2018 participation rate	Upper bound of confidence interval
110	Delaware *	94	100	100
519	Oregon *	94	100	100
1,612	Illinois *	95	100	100
1,578	Pennsylvania *	94	99	100
718	Washington *	93	98	100
420	New Mexico *	92	98	100
142	Rhode Island *	88	95	100
702	Massachusetts *	88	94	100
355	Connecticut *	87	93	98
410	Nevada *	87	92	97
66	Vermont *	86	92	98
592	Wisconsin *	87	92	97
617	Maryland *	85	91	97
1,061	Tennessee *	85	90	94
1,240	Michigan *	85	89	94
2,791	New York *	85	89	93
102	Alaska *	82	89	96
326	Iowa *	83	88	94
167	Hawaii *	82	88	93
329	West Virginia *	83	88	93
806	Missouri *	81	87	92
3,184	Florida *	82	86	90
638	Oklahoma	80	85	91
1,525	Ohio	80	84	89
1,721	Georgia	79	83	88
1,035	Louisiana	79	83	86
123	District of Columbia	75	82	89
824	New Jersey	76	81	86
173	Maine	75	81	87
93	New Hampshire	74	80	86
198	Nebraska	74	79	84
918	Alabama *	75	79	83
530	Colorado	74	79	84
125	Montana	73	78	84
110	South Dakota	72	78	84
796	South Carolina *	73	77	81
949	Arizona *	72	77	82
239	Utah *	71	77	82
483	Minnesota *	70	76	81
4,459	Texas *	72	75	78
763	Kentucky *	70	75	79
784	Indiana *	69	74	80
198	Idaho *	69	74	78
986	Virginia *	68	72	77
687	Mississippi *	67	70	74
4,935	California *	67	70	72
1,742	North Carolina *	65	69	73
309	Kansas *	64	68	73
549	Arkansas *	62	66	70
68	North Dakota *	57	63	69
53	Wyoming *	49	54	60

*State's participation rate is significantly different from the national participation rate of 82 percent.

Table B.1b. How many people were eligible in 2018? What percentage participated? (Regions and national)

Eligible people (thousands)	Region	Lower bound of confidence interval	FY 2018 participation rate	Upper bound of confidence interval
4,323	Northeast Region	87	90	93
6,562	Midwest Region	85	88	91
4,568	Mid-Atlantic Region	85	88	90
10,873	Southeast Region	78	80	82
2,199	Mountain Plains Region	76	79	82
8,289	Southwest Region	76	78	80
7,047	Western Region	75	77	79
43,862	United States	81	82	83

Note: The regional estimates reflect FNS regional boundaries in FY 2020.

Table B.2a. How many working poor people were eligible in 2018? What percentage participated? (States)

Eligible people (thousands)	State	Lower bound of confidence interval	FY 2018 participation rate	Upper bound of confidence interval
42	Delaware *	88	98	100
719	Pennsylvania *	87	95	100
750	Illinois *	84	92	99
214	Oregon *	80	88	96
231	New Mexico *	78	88	97
187	Nevada *	79	87	94
115	West Virginia *	77	87	96
548	Michigan *	78	86	93
300	Wisconsin *	78	85	93
262	Washington *	77	85	93
169	Iowa *	77	85	92
687	Ohio *	77	84	92
45	Rhode Island *	71	81	91
49	Alaska	68	80	91
141	Connecticut	71	79	87
312	Oklahoma	70	78	86
447	Tennessee	71	78	85
413	Alabama	71	77	84
364	Indiana	69	77	85
70	Maine	67	76	86
78	Hawaii	68	76	85
349	Missouri	69	76	83
48	South Dakota	66	76	85
31	Vermont	67	76	85
1,193	New York	68	75	82
1,449	Florida	68	75	82
244	Minnesota	66	74	82
108	Nebraska	67	74	81
2,454	Texas	68	74	80
452	Louisiana	66	73	79
292	Maryland	63	72	81
286	Kentucky	64	72	79
842	Georgia	64	70	77
111	Idaho	63	70	77
32	New Hampshire	61	70	79
413	New Jersey	62	70	77
66	Montana	61	69	77
140	Utah	61	69	76
492	Arizona	62	69	76
327	South Carolina	63	69	75
263	Massachusetts *	56	65	74
275	Colorado *	58	65	72
844	North Carolina *	59	65	71
286	Mississippi *	58	65	71
166	Kansas *	56	62	69
474	Virginia *	55	62	69
230	Arkansas *	55	61	68
28	North Dakota *	51	60	69
2,552	California *	54	59	64
26	Wyoming *	47	55	63
43	District of Columbia *	29	38	48

*State's participation rate is significantly different from the national participation rate of 74 percent.

Table B.2b. How many working poor people were eligible in 2018? What percentage participated? (Regions and national)

Eligible people (thousands)	Region	Lower bound of confidence interval	FY 2018 participation rate	Upper bound of confidence interval
3,063	Midwest Region	80	85	89
2,098	Mid-Atlantic Region	73	78	82
1,775	Northeast Region	69	74	79
4,312	Southwest Region	70	73	77
4,895	Southeast Region	68	72	75
1,065	Mountain Plains Region	66	69	73
3,453	Western Region	61	65	69
20,659	United States	72	74	76

Note: The regional estimates reflect FNS regional boundaries in FY 2020.

Table B.3. Estimates of participation rates (percentage)

	All eligible people			Working poor people		
	FY 2016	FY 2017	FY 2018	FY 2016	FY 2017	FY 2018
Alabama	82	80	79	78	80	77
Alaska	70	77	89	64	68	80
Arizona	73	77	77	64	73	69
Arkansas	72	68	66	68	66	61
California	72	71	70	64	57	59
Colorado	78	75	79	68	62	65
Connecticut	92	90	93	78	83	79
Delaware	100	98	100	88	94	98
District of Columbia	92	90	82	60	43	38
Florida	90	86	86	76	80	75
Georgia	84	84	83	72	72	70
Hawaii	80	79	88	71	71	76
Idaho	77	75	74	72	75	70
Illinois	100	100	100	86	89	92
Indiana	76	73	74	78	75	77
Iowa	88	90	88	84	90	85
Kansas	71	66	68	66	61	62
Kentucky	74	75	75	69	70	72
Louisiana	82	86	83	74	74	73
Maine	85	84	81	81	84	76
Maryland	89	87	91	73	71	72
Massachusetts	92	88	94	67	63	65
Michigan	91	89	89	86	87	86
Minnesota	77	75	76	78	75	74
Mississippi	76	74	70	70	65	65
Missouri	87	85	87	76	77	76
Montana	76	81	78	69	74	69
Nebraska	78	78	79	76	72	74
Nevada	89	91	92	83	87	87
New Hampshire	82	74	80	71	67	70
New Jersey	82	79	81	70	69	70
New Mexico	93	97	98	83	86	88
New York	89	88	89	77	75	75
North Carolina	84	74	69	78	67	65
North Dakota	66	63	63	67	51	60
Ohio	84	83	84	84	86	84
Oklahoma	80	83	85	71	76	78
Oregon	100	100	100	91	96	88
Pennsylvania	95	94	99	89	93	95
Rhode Island	100	100	95	89	89	81
South Carolina	80	79	77	73	75	69
South Dakota	72	76	78	73	71	76
Tennessee	91	91	90	78	80	78
Texas	72	75	75	72	66	74
Utah	74	72	77	69	62	69
Vermont	90	94	92	80	83	76
Virginia	73	73	72	68	65	62
Washington	98	93	98	87	82	85
West Virginia	87	85	88	83	90	87
Wisconsin	92	90	92	85	84	85
Wyoming	53	49	54	54	45	55
Mid-Atlantic Region	87	85	88	77	78	78
Midwest Region	89	87	88	84	85	85
Mountain Plains Region	79	77	79	71	68	69
Northeast Region	90	88	90	76	75	74
Southeast Region	85	82	80	75	75	72
Southwest Region	75	78	78	71	69	73
Western Region	78	77	77	69	64	65
United States	83	82	82	75	73	74

Table B.4. How did your state rank in 2018?

FY 2018 participation rate	State	Upper bound of confidence interval	FY 2018 rank	Lower bound of confidence interval
100	Delaware	1	1	4
100	Oregon	1	2	5
100	Illinois	1	3	4
99	Pennsylvania	3	4	8
98	Washington	3	5	9
98	New Mexico	2	6	12
95	Rhode Island	4	7	17
94	Massachusetts	4	8	18
93	Connecticut	6	9	19
92	Nevada	6	10	19
92	Vermont	6	11	20
92	Wisconsin	7	12	20
91	Maryland	7	13	22
90	Tennessee	9	14	23
89	Michigan	9	15	23
89	New York	10	16	23
89	Alaska	8	17	28
88	Iowa	9	18	26
88	Hawaii	10	19	27
88	West Virginia	10	20	26
87	Missouri	12	21	29
86	Florida	14	22	28
85	Oklahoma	14	23	31
84	Ohio	17	24	31
83	Georgia	18	25	33
83	Louisiana	20	26	33
82	District of Columbia	17	27	39
81	New Jersey	21	28	37
81	Maine	19	29	39
80	New Hampshire	22	30	40
79	Nebraska	24	31	41
79	Alabama	26	32	40
79	Colorado	25	33	41
78	Montana	25	34	42
78	South Dakota	24	35	44
77	South Carolina	29	36	42
77	Arizona	28	37	43
77	Utah	27	38	44
76	Minnesota	30	39	45
75	Texas	33	40	44
75	Kentucky	32	41	45
74	Indiana	32	42	46
74	Idaho	34	43	47
72	Virginia	36	44	48
70	Mississippi	41	45	48
70	California	43	46	48
69	North Carolina	42	47	49
68	Kansas	43	48	49
66	Arkansas	46	49	50
63	North Dakota	47	50	50
54	Wyoming	51	51	51

Table B.5a. How did your state compare with other states in 2018 for all eligibles? (Delaware–Iowa)

	DE	OR	IL	PA	WA	NM	RI	MA	CT	NV	VT	WI	MD	TN	MI	NY	AK
DE		-	-	L	L	L	L	L	L	L	L	L	L	L	L	L	L
OR	-		-	L	L	L	L	L	L	L	L	L	L	L	L	L	L
IL	-	-		L	L	-	L	L	L	L	L	L	L	L	L	L	L
PA	H	H	H		-	-	-	-	L	L	L	L	L	L	L	L	L
WA	H	H	H	-		-	-	-	L	L	L	L	L	L	L	L	L
NM	H	H	-	-	-		-	-	-	-	-	L	L	L	L	L	L
RI	H	H	H	-	-	-		-	-	-	-	-	-	-	-	L	-
MA	H	H	H	-	-	-	-		-	-	-	-	-	-	-	-	-
CT	H	H	H	H	H	-	-	-		-	-	-	-	-	-	-	-
NV	H	H	H	H	H	-	-	-	-		-	-	-	-	-	-	-
VT	H	H	H	H	H	-	-	-	-	-		-	-	-	-	-	-
WI	H	H	H	H	H	H	-	-	-	-	-		-	-	-	-	-
MD	H	H	H	H	H	H	-	-	-	-	-	-		-	-	-	-
TN	H	H	H	H	H	H	-	-	-	-	-	-	-		-	-	-
MI	H	H	H	H	H	H	-	-	-	-	-	-	-	-		-	-
NY	H	H	H	H	H	H	H	-	-	-	-	-	-	-	-		-
AK	H	H	H	H	H	H	-	-	-	-	-	-	-	-	-	-	
IA	H	H	H	H	H	H	H	-	-	-	-	-	-	-	-	-	-
HI	H	H	H	H	H	H	-	H	-	-	-	-	-	-	-	-	-
WV	H	H	H	H	H	H	H	H	-	-	-	-	-	-	-	-	-
MO	H	H	H	H	H	H	H	H	H	H	-	-	-	-	-	-	-
FL	H	H	H	H	H	H	H	H	H	H	H	H	-	-	-	-	-
OK	H	H	H	H	H	H	H	H	H	H	H	H	H	-	-	-	-
OH	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	-
GA	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	-
LA	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	-
DC	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	-
NJ	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
ME	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	-
NH	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
NE	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
AL	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
CO	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
MT	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
SD	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
SC	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
AZ	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
UT	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
MN	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
TX	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
KY	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
IN	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
ID	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
VA	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
MS	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
CA	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
NC	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
KS	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
AR	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
ND	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
WY	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H

Note: An “H” indicates that there is at least a 90 percent chance the state identified at the top of the column has a higher true participation rate than the state identified at the left of the row. An “L” indicates that there is at least a 90 percent chance that the row state has a higher true participation rate than the column state.

Table B.5b. How did your state compare with other states in 2018 for all eligibles? (Alaska–Montana)

. .	IA	HI	WV	MO	FL	OK	OH	GA	LA	DC	NJ	ME	NH	NE	AL	CO	MT
DE	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
OR	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
IL	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
PA	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
WA	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
NM	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
RI	L	-	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
MA	-	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
CT	-	-	-	L	L	L	L	L	L	L	L	L	L	L	L	L	L
NV	-	-	-	L	L	L	L	L	L	L	L	L	L	L	L	L	L
VT	-	-	-	-	L	L	L	L	L	L	L	L	L	L	L	L	L
WI	-	-	-	-	L	L	L	L	L	L	L	L	L	L	L	L	L
MD	-	-	-	-	-	L	L	L	L	L	L	L	L	L	L	L	L
TN	-	-	-	-	-	-	L	L	L	L	L	L	L	L	L	L	L
MI	-	-	-	-	-	-	L	L	L	L	L	L	L	L	L	L	L
NY	-	-	-	-	-	-	L	L	L	L	L	L	L	L	L	L	L
AK	-	-	-	-	-	-	-	-	-	-	L	-	L	L	L	L	L
IA		-	-	-	-	-	-	-	L	-	L	L	L	L	L	L	L
HI	-		-	-	-	-	-	-	-	-	L	L	L	L	L	L	L
WV	-	-		-	-	-	-	-	L	-	L	L	L	L	L	L	L
MO	-	-	-		-	-	-	-	-	-	-	-	L	L	L	L	L
FL	-	-	-	-		-	-	-	-	-	-	-	L	L	L	L	L
OK	-	-	-	-	-		-	-	-	-	-	-	-	L	L	L	L
OH	-	-	-	-	-	-		-	-	-	-	-	-	L	L	L	L
GA	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
LA	H	-	H	-	-	-	-	-		-	-	-	-	-	-	-	-
DC	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-
NJ	H	H	H	-	-	-	-	-	-	-		-	-	-	-	-	-
ME	H	H	H	-	-	-	-	-	-	-	-		-	-	-	-	-
NH	H	H	H	H	H	-	-	-	-	-	-	-		-	-	-	-
NE	H	H	H	H	H	H	H	-	-	-	-	-	-		-	-	-
AL	H	H	H	H	H	H	H	-	-	-	-	-	-	-		-	-
CO	H	H	H	H	H	H	H	-	-	-	-	-	-	-	-		-
MT	H	H	H	H	H	H	H	-	-	-	-	-	-	-	-	-	
SD	H	H	H	H	H	H	H	-	-	-	-	-	-	-	-	-	-
SC	H	H	H	H	H	H	H	H	H	-	-	-	-	-	-	-	-
AZ	H	H	H	H	H	H	H	H	H	-	-	-	-	-	-	-	-
UT	H	H	H	H	H	H	H	H	H	-	-	-	-	-	-	-	-
MN	H	H	H	H	H	H	H	H	H	-	H	H	-	-	-	-	-
TX	H	H	H	H	H	H	H	H	H	H	H	H	-	-	-	-	-
KY	H	H	H	H	H	H	H	H	H	H	H	H	-	-	-	-	-
IN	H	H	H	H	H	H	H	H	H	H	H	H	-	-	-	-	-
ID	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	-	H
VA	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
MS	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
CA	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
NC	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
KS	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
AR	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
ND	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
WY	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H

Note: An “H” indicates that there is at least a 90 percent chance the state identified at the top of the column has a higher true participation rate than the state identified at the left of the row. An “L” indicates that there is at least a 90 percent chance that the row state has a higher true participation rate than the column state.

Table B.5c. How did your state compare with other states in 2018 for all eligibles? (South Dakota–Wyoming)

..	SD	SC	AZ	UT	MN	TX	KY	IN	ID	VA	MS	CA	NC	KS	AR	ND	WY
DE	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
OR	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
IL	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
PA	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
WA	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
NM	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
RI	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
MA	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
CT	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
NV	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
VT	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
WI	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
MD	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
TN	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
MI	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
NY	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
AK	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
IA	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
HI	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
WV	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
MO	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
FL	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
OK	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
OH	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
GA	-	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
LA	-	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
DC	-	-	-	-	-	L	L	L	L	L	L	L	L	L	L	L	L
NJ	-	-	-	-	L	L	L	L	L	L	L	L	L	L	L	L	L
ME	-	-	-	-	L	L	L	L	L	L	L	L	L	L	L	L	L
NH	-	-	-	-	-	-	-	-	L	L	L	L	L	L	L	L	L
NE	-	-	-	-	-	-	-	-	L	L	L	L	L	L	L	L	L
AL	-	-	-	-	-	-	-	-	L	L	L	L	L	L	L	L	L
CO	-	-	-	-	-	-	-	-	-	L	L	L	L	L	L	L	L
MT	-	-	-	-	-	-	-	-	L	L	L	L	L	L	L	L	L
SD		-	-	-	-	-	-	-	-	-	L	L	L	L	L	L	L
SC	-		-	-	-	-	-	-	-	L	L	L	L	L	L	L	L
AZ	-	-		-	-	-	-	-	-	-	L	L	L	L	L	L	L
UT	-	-	-		-	-	-	-	-	-	L	L	L	L	L	L	L
MN	-	-	-	-		-	-	-	-	-	L	L	L	L	L	L	L
TX	-	-	-	-	-		-	-	-	-	L	L	L	L	L	L	L
KY	-	-	-	-	-	-		-	-	-	L	L	L	L	L	L	L
IN	-	-	-	-	-	-	-		-	-	-	L	L	L	L	L	L
ID	-	-	-	-	-	-	-	-		-	-	-	-	L	L	L	L
VA	-	H	-	-	-	-	-	-	-		-	-	-	-	L	L	L
MS	H	H	H	H	H	H	H	-	-	-		-	-	-	L	L	L
CA	H	H	H	H	H	H	H	H	-	-	-		-	-	-	L	L
NC	H	H	H	H	H	H	H	H	-	-	-	-		-	-	L	L
KS	H	H	H	H	H	H	H	H	H	-	-	-	-		-	L	L
AR	H	H	H	H	H	H	H	H	H	H	H	-	-	-		-	L
ND	H	H	H	H	H	H	H	H	H	H	H	H	H	H	-		L
WY	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	

Note: An “H” indicates that there is at least a 90 percent chance the state identified at the top of the column has a higher true participation rate than the state identified at the left of the row. An “L” indicates that there is at least a 90 percent chance that the row state has a higher true participation rate than the column state.

Table B.6. Estimates of participation rates varied widely

FY 2018 participation rate for all eligible people		
Above 90 percent (top quarter)	Between 76 and 90 percent	Below 76 percent (bottom quarter)
Connecticut	Alabama	Arkansas
Delaware	Alaska	California
Illinois	Arizona	Idaho
Maryland	Colorado	Indiana
Massachusetts	District of Columbia	Kansas
Nevada	Florida	Kentucky
New Mexico	Georgia	Mississippi
Oregon	Hawaii	North Carolina
Pennsylvania	Iowa	North Dakota
Rhode Island	Louisiana	Texas
Vermont	Maine	Virginia
Washington	Michigan	Wyoming
Wisconsin	Minnesota	
	Missouri	
	Montana	
	Nebraska	
	New Hampshire	
	New Jersey	
	New York	
	Ohio	
	Oklahoma	
	South Carolina	
	South Dakota	
	Tennessee	
	Utah	
	West Virginia	

Table B.7. Supporting detail for Cunnyngham (May 2021)

Description	States		
In 22 states, the participation rate for all eligible people was significantly higher than the national rate	Alaska Connecticut Delaware Florida Hawaii Illinois Iowa Maryland	Massachusetts Michigan Missouri Nevada New Mexico New York Oregon Pennsylvania	Rhode Island Tennessee Vermont Washington West Virginia Wisconsin
In 17 states, the participation rate for all eligible people was significantly lower than the national rate	Alabama Arizona Arkansas California Idaho Indiana	Kansas Kentucky Minnesota Mississippi North Carolina North Dakota	South Carolina Texas Utah Virginia Wyoming
In 13 states, the participation rate for eligible working poor people was significantly higher than the national rate	Delaware Illinois Iowa Michigan Nevada	New Mexico Ohio Oregon Pennsylvania Rhode Island	Washington West Virginia Wisconsin
In 10 states and the District of Columbia, the participation rate for eligible working poor people was significantly lower than the national rate	Arkansas California Colorado District of Columbia	Kansas Massachusetts Mississippi North Carolina	North Dakota Virginia Wyoming
In 27 states and the District of Columbia, the participation rate for working poor people was significantly lower than the rate for all eligible people	Arizona California Colorado Connecticut District of Columbia Florida Georgia Hawaii Illinois Kansas	Louisiana Maryland Massachusetts Mississippi Missouri Montana New Hampshire New Jersey New Mexico New York	Oregon Rhode Island South Carolina Tennessee Utah Vermont Virginia Washington
In 6 states and the District of Columbia, the difference between the rates for working poor people and all eligible people was significantly greater than 8 percentage points	Colorado District of Columbia Maryland	Massachusetts New York Oregon	Vermont

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