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Final Report

Empirical Bayes Shrinkage Estimates of State Supplemental Nutrition Assistance Program Participation Rates in Fiscal Year 2015 to Fiscal Year 2017 for All Eligible People and Working Poor People

August 2020

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ACKNOWLEDGMENTS

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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 2019, the program served nearly 38 million people in an average month at a total annual cost of nearly $54 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 2015 to 2017. Need for the program is measured by estimated numbers of people eligible for SNAP. The program's performance 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, 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 2017 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 FY 2015 and FY 2016 presented in this report differ slightly from the estimates presented in Cunnyngham (2019a) and Cunnyngham (2019b) 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) 2019, the program served 38 million people in an average month at a total annual cost of $54 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 2015 to FY 2017. The estimates presented here are also reported and compared with one another in Cunnyngham (August 2020). Need for the program is measured by estimated numbers of people eligible for SNAP. The program's performance 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 (August 2020).

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 Nevada's FY 2017 SNAP participation rate, we used only FY 2017 CPS ASEC data on households from Nevada. Because of the potential errors introduced by the CPS ASEC surveying a small number of families in Nevada, we can be confident—by a commonly used standard—only that Nevada's SNAP participation rate in FY 2017 was between about 78 and 96 percent. This range is wide, although typical, reflecting our substantial uncertainty about what Nevada'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. Figure I.1 illustrates how a regression estimator works. The simple example in the figure 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 figure 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 Figure 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 Nevada as an example again, we used only one year of CPS ASEC sample data from the state to estimate Nevada'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 Nevada) to predict Nevada'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.

Figure I.1. An illustrative regression estimator
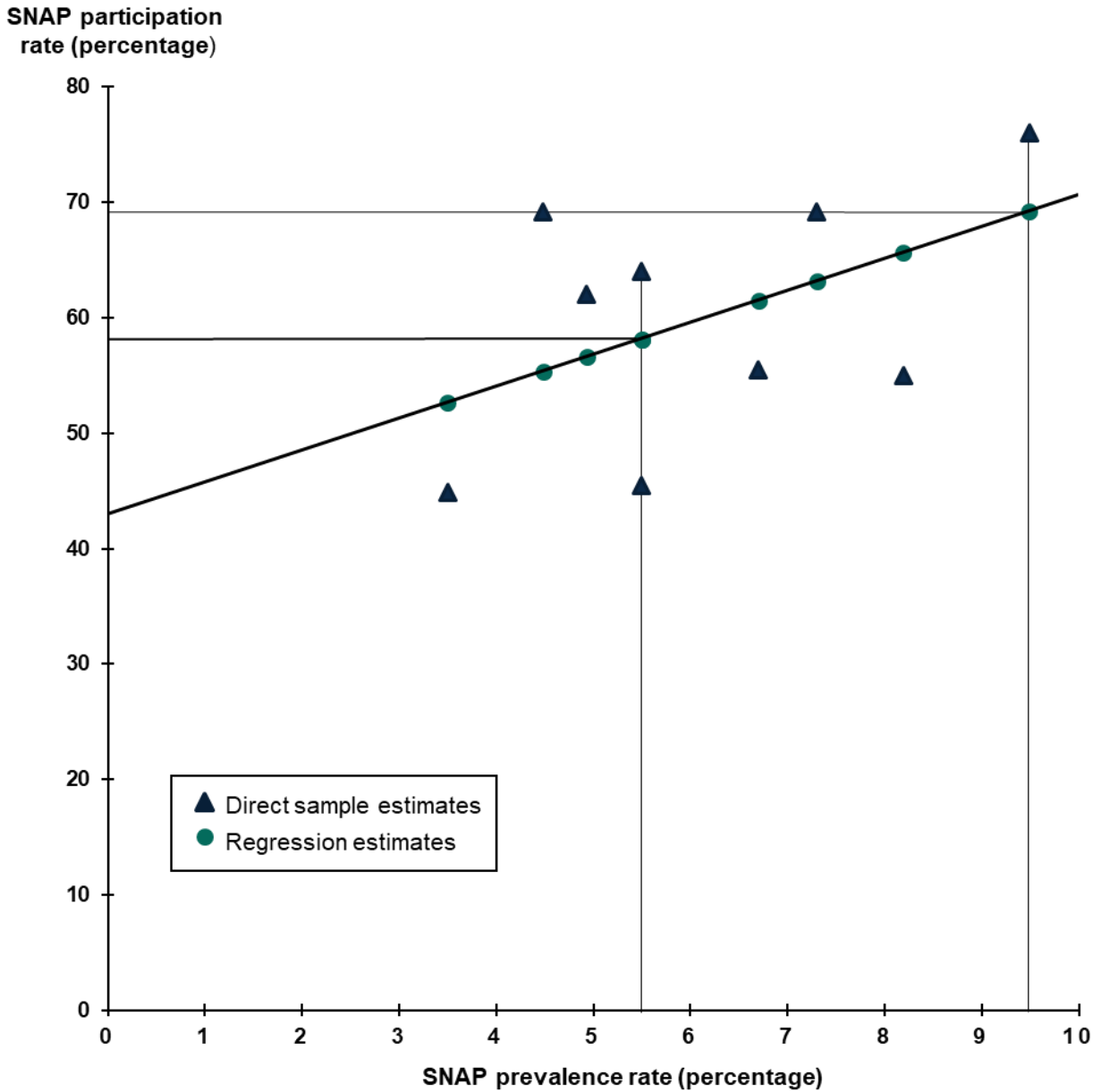
The regression estimator can improve precision by using additional data to identify states with direct estimates that seem too high or too low because of sampling error (error from drawing a sample of the population that has a higher or lower participation rate than the entire state population has). 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 Figure 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.

Figure I.2. Shrinkage estimation
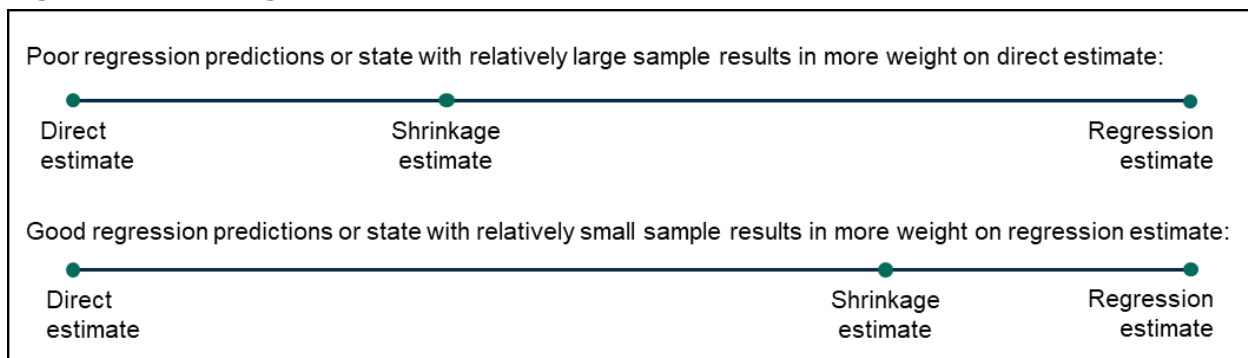
The direct and regression estimates are optimally weighted to improve accuracy by minimizing a measure of error that reflects both imprecision and bias. By accepting a little bias, the shrinkage estimator may be substantially more precise than the direct sample estimator. By sacrificing a little precision, 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 2015 to FY 2017. This procedure, summarized by the flowchart in Figure 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 2017 (October 2016 through September 2017) from the 2017 and 2018 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.

Figure II.1. The estimation procedure
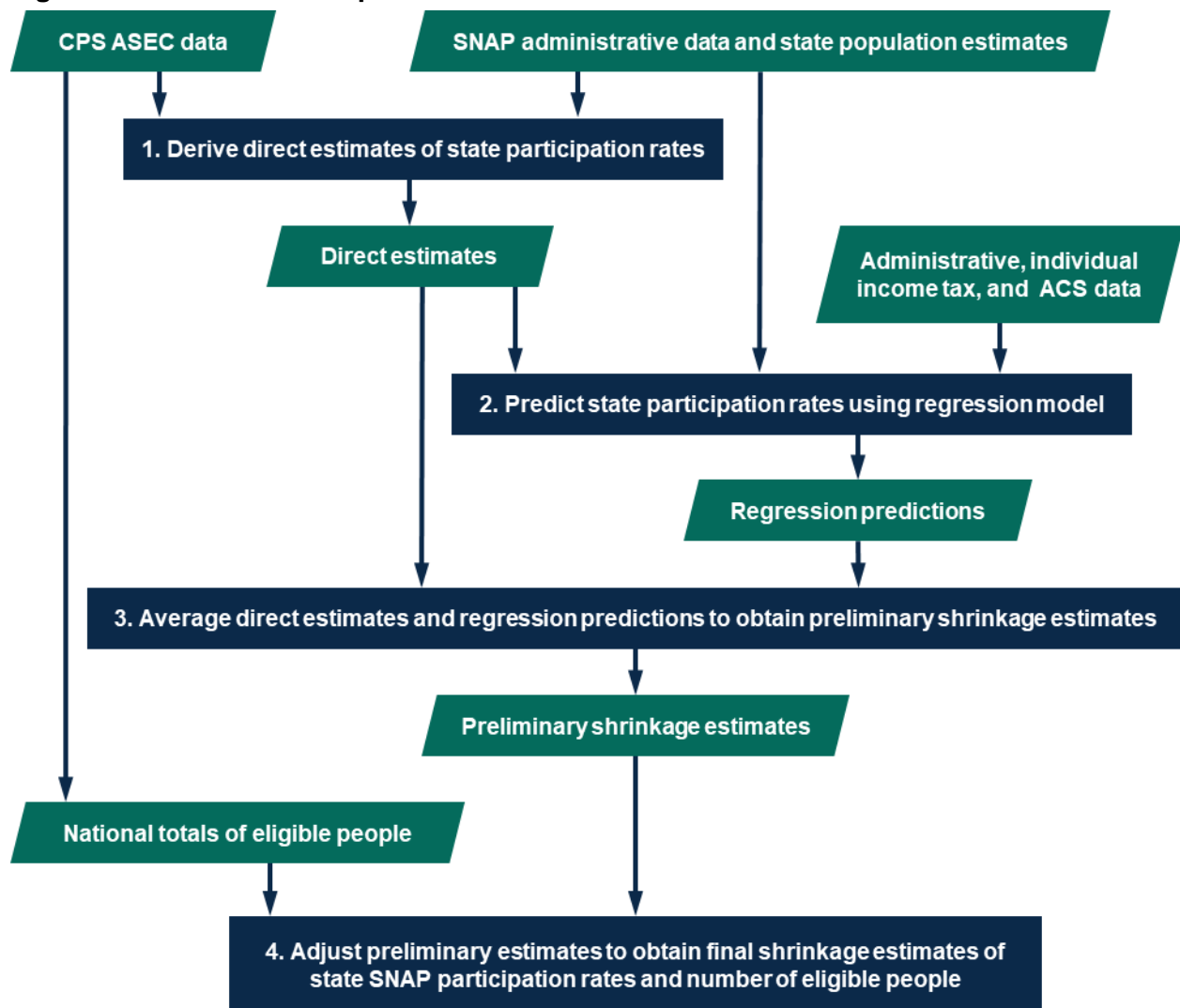
CPS ASEC = Current Population Survey Annual Social and Economic Supplement; ACS = American Community Survey; SNAP = Supplemental Nutrition Assistance Program.

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 people not claimed on tax returns according to individual income tax data and population estimates

3. Percentage of people under age 65 not claimed on tax returns according to individual income tax data and population estimates

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

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

6. Median household income according to ACS one-year estimates

7. Percentage of children under age 18 with household income under 50 percent of the federal poverty level according to ACS one-year 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. All but the sixth predictor were included in last year's model. The predictor used in the previous model but not the current one was the percentage of individuals age 65 and older that either was not claimed on tax returns or was claimed on tax returns with adjusted gross income under the federal poverty level 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 2017 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 2017, the state estimates of eligible people summed to 46,113,740, whereas the national total estimated directly from the CPS ASEC was 45,164,254. 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 $45{,}164{,}254 \, / \, 46{,}113{,}740$ (≈ 0.9794). Such benchmarking of estimates for smaller areas to a relatively precise estimated total for a larger area is common practice.

After carrying out this first adjustment, six states—Delaware, Illinois, New Mexico, Oregon, Rhode Island, and Vermont—had fewer estimated eligible people than estimated eligible participants in FY 2017, 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, New Mexico, Oregon, Rhode Island, and Vermont 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 44 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-third 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 2015 to FY 2017 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 Nevada's participation rate for all eligible people was 86 percent in FY 2017 (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 81 and 90 percent, an interval that is 49 percent narrower than the interval (78 and 96 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 2017 participation rates for all eligible people were 45 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 2015 and FY 2016 presented in this report differ slightly from the estimates presented in Cunnyngham (2019a) and Cunnyngham (2019b) for two 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 2015 and 2016 presented in this report are based on 2015 to 2017 data, while the corresponding estimates published in Cunnyngham (2019a) and Cunnyngham (2019b) are based on 2014 to 2016 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 2014 data (used in the previous estimates) and 2017 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.

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 2015	**FY 2016**	**FY 2017**	**FY 2015**	**FY 2016**	**FY 2017**
Alabama	84	86	84	78	81	83
Alaska	83	73	76	67	58	59
Arizona	72	74	76	61	65	66
Arkansas	73	73	69	65	68	67
California	69	71	71	58	59	57
Colorado	72	80	80	60	74	62
Connecticut	91	91	92	70	71	76
Delaware	100	100	100	86	88	96
District of Columbia	99	97	96	62	66	44
Florida	90	93	90	76	77	83
Georgia	84	86	86	72	76	71
Hawaii	88	85	84	74	70	75
Idaho	84	83	79	78	81	79
Illinois	100	100	100	83	84	85
Indiana	85	78	74	75	76	69
Iowa	87	89	92	78	83	87
Kansas	74	77	71	67	80	65
Kentucky	82	75	75	73	68	72
Louisiana	77	84	85	68	77	73
Maine	89	92	97	79	84	94
Maryland	94	92	89	73	70	69
Massachusetts	85	91	92	59	64	64
Michigan	100	98	94	89	92	89
Minnesota	82	83	81	77	81	78
Mississippi	84	83	77	72	71	70
Missouri	88	87	85	75	79	76
Montana	82	88	90	71	85	79
Nebraska	71	81	78	66	79	71
Nevada	81	85	86	74	77	81
New Hampshire	80	81	76	68	73	68
New Jersey	79	82	81	65	65	70
New Mexico	100	100	100	92	98	100
New York	87	92	93	76	79	83
North Carolina	82	87	77	74	83	68
North Dakota	60	63	63	53	61	54
Ohio	86	85	81	79	82	80
Oklahoma	79	82	84	67	73	72
Oregon	100	100	100	91	94	95
Pennsylvania	93	98	99	83	90	96
Rhode Island	100	100	100	83	88	97
South Carolina	81	80	80	74	75	74
South Dakota	83	82	82	77	81	78
Tennessee	95	92	92	81	80	81
Texas	70	74	75	66	71	63
Utah	69	71	70	62	66	58
Vermont	100	100	100	88	92	97
Virginia	73	76	76	65	71	66
Washington	100	100	96	87	88	82
West Virginia	96	97	92	87	88	98
Wisconsin	99	94	95	89	90	91
Wyoming	58	57	52	53	57	47
United States	83	85	84	72	75	73

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

	All eligible people			Working poor people		
	FY 2015	FY 2016	FY 2017	FY 2015	FY 2016	FY 2017
Alabama	1,024	954	920	442	377	416
Alaska	97	112	114	46	60	68
Arizona	1,207	1,120	1,039	666	603	588
Arkansas	627	572	541	280	270	239
California	5,775	5,494	5,092	3,376	3,231	2,901
Colorado	644	564	536	365	289	284
Connecticut	418	407	379	186	195	177
Delaware	125	121	117	60	58	55
District of Columbia	132	128	117	49	44	46
Florida	3,656	3,375	3,179	1,640	1,527	1,421
Georgia	2,039	1,879	1,769	1,029	925	893
Hawaii	189	187	179	114	110	97
Idaho	215	205	201	133	115	109
Illinois	1,854	1,745	1,668	924	882	831
Indiana	952	919	883	506	448	440
Iowa	383	353	336	214	192	185
Kansas	370	323	324	198	150	174
Kentucky	893	834	814	361	312	300
Louisiana	1,108	1,051	1,092	516	446	490
Maine	193	174	151	82	75	68
Maryland	724	711	676	351	376	315
Massachusetts	813	726	732	330	291	285
Michigan	1,402	1,303	1,271	596	628	602
Minnesota	495	475	456	259	253	237
Mississippi	727	681	673	305	327	305
Missouri	959	920	846	426	367	412
Montana	130	119	119	59	54	55
Nebraska	232	204	208	120	109	123
Nevada	440	437	443	235	235	205
New Hampshire	114	102	105	53	43	48
New Jersey	1,023	957	889	459	447	446
New Mexico	413	427	422	219	204	191
New York	3,187	2,977	2,780	1,528	1,313	1,300
North Carolina	1,751	1,593	1,569	872	802	721
North Dakota	69	69	67	32	33	27
Ohio	1,776	1,718	1,690	812	770	786
Oklahoma	716	719	679	361	333	330
Oregon	650	607	564	306	250	237
Pennsylvania	1,772	1,664	1,624	760	762	699
Rhode Island	153	147	138	62	63	43
South Carolina	940	875	859	442	389	407
South Dakota	117	115	113	60	56	52
Tennessee	1,282	1,192	1,124	576	511	466
Texas	4,736	4,534	4,526	2,557	2,593	2,572
Utah	323	303	288	201	172	183
Vermont	70	68	66	30	30	25
Virginia	1,149	1,048	970	551	503	468
Washington	885	827	802	419	414	361
West Virginia	353	338	335	143	123	111
Wisconsin	682	638	618	367	327	324
Wyoming	55	59	63	31	30	28
United States	50,036	47,070	45,164	24,709	23,117	22,147

Table III.3. Approximate 90 percent confidence intervals for final shrinkage estimates for FY 2015, all eligible people

	Participation rate (percentage)		Number of eligible people (thousands)	
	Lower bound	Upper bound	Lower bound	Upper bound
Alabama	80	88	973	1,074
Alaska	77	89	91	104
Arizona	69	76	1,143	1,270
Arkansas	69	76	594	659
California	66	72	5,536	6,014
Colorado	67	77	599	690
Connecticut	86	96	394	442
Delaware	95	100	119	132
District of Columbia	92	100	123	140
Florida	86	94	3,495	3,816
Georgia	80	87	1,945	2,133
Hawaii	82	94	177	202
Idaho	80	89	204	226
Illinois	95	100	1,771	1,937
Indiana	81	90	900	1,004
Iowa	82	92	362	404
Kansas	69	79	345	394
Kentucky	78	86	849	936
Louisiana	73	81	1,053	1,163
Maine	84	95	181	205
Maryland	88	99	682	765
Massachusetts	80	90	766	859
Michigan	95	100	1,332	1,472
Minnesota	77	87	463	526
Mississippi	80	89	690	764
Missouri	82	93	899	1,018
Montana	77	87	122	138
Nebraska	66	76	215	248
Nevada	77	86	417	464
New Hampshire	75	85	107	122
New Jersey	75	84	960	1,086
New Mexico	94	100	391	435
New York	84	91	3,061	3,314
North Carolina	78	86	1,671	1,831
North Dakota	56	65	64	75
Ohio	82	89	1,693	1,859
Oklahoma	75	84	673	758
Oregon	94	100	621	679
Pennsylvania	88	97	1,693	1,850
Rhode Island	95	100	145	161
South Carolina	78	85	896	985
South Dakota	77	88	109	125
Tennessee	90	100	1,211	1,354
Texas	67	73	4,539	4,932
Utah	65	73	303	343
Vermont	94	100	67	74
Virginia	69	77	1,083	1,215
Washington	95	100	846	924
West Virginia	90	100	331	375
Wisconsin	94	100	650	714
Wyoming	53	64	49	60
United States	82	84	49,379	50,693

Table III.4. 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	81	90	906	1,003
Alaska	67	79	103	122
Arizona	70	78	1,060	1,179
Arkansas	69	76	543	602
California	69	74	5,295	5,693
Colorado	74	85	524	603
Connecticut	86	96	385	430
Delaware	95	100	115	127
District of Columbia	91	100	120	136
Florida	88	97	3,222	3,529
Georgia	82	90	1,791	1,968
Hawaii	80	90	175	199
Idaho	79	87	195	215
Illinois	95	100	1,668	1,822
Indiana	74	83	866	972
Iowa	83	94	333	373
Kansas	72	83	300	346
Kentucky	71	80	786	883
Louisiana	81	88	1,008	1,094
Maine	86	97	164	184
Maryland	86	97	670	752
Massachusetts	86	96	686	766
Michigan	93	100	1,236	1,369
Minnesota	78	88	446	505
Mississippi	78	87	643	718
Missouri	82	92	863	976
Montana	83	93	112	126
Nebraska	76	85	191	216
Nevada	80	90	412	461
New Hampshire	76	87	96	109
New Jersey	77	87	900	1,014
New Mexico	94	100	404	449
New York	88	96	2,854	3,100
North Carolina	83	91	1,524	1,662
North Dakota	59	68	64	74
Ohio	81	89	1,638	1,798
Oklahoma	77	87	677	761
Oregon	94	100	579	634
Pennsylvania	94	100	1,589	1,740
Rhode Island	95	100	140	154
South Carolina	76	84	831	919
South Dakota	76	88	106	124
Tennessee	87	98	1,120	1,264
Texas	71	76	4,366	4,702
Utah	66	75	284	322
Vermont	94	100	64	71
Virginia	72	80	991	1,105
Washington	95	100	790	864
West Virginia	91	100	317	358
Wisconsin	90	99	607	669
Wyoming	52	62	54	64
United States	84	86	46,471	47,669

Table III.5. 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	80	88	875	965
Alaska	69	83	104	124
Arizona	71	81	975	1,102
Arkansas	65	74	506	576
California	68	74	4,885	5,298
Colorado	75	85	503	568
Connecticut	87	97	359	399
Delaware	95	100	111	123
District of Columbia	89	100	108	126
Florida	85	94	3,020	3,338
Georgia	82	90	1,686	1,852
Hawaii	79	90	167	190
Idaho	74	83	190	212
Illinois	95	100	1,594	1,742
Indiana	69	78	828	938
Iowa	87	97	316	356
Kansas	66	76	302	346
Kentucky	71	80	765	864
Louisiana	81	88	1,042	1,141
Maine	91	100	141	160
Maryland	83	94	634	717
Massachusetts	86	97	689	774
Michigan	89	98	1,206	1,337
Minnesota	76	86	428	484
Mississippi	74	80	649	697
Missouri	80	91	792	901
Montana	85	95	112	126
Nebraska	73	83	195	222
Nevada	81	91	419	468
New Hampshire	71	81	98	112
New Jersey	76	87	828	949
New Mexico	93	100	400	445
New York	89	97	2,656	2,905
North Carolina	73	81	1,494	1,645
North Dakota	59	68	62	72
Ohio	77	85	1,608	1,772
Oklahoma	80	89	639	719
Oregon	94	100	535	593
Pennsylvania	95	100	1,552	1,696
Rhode Island	94	100	131	145
South Carolina	76	84	816	901
South Dakota	76	87	105	121
Tennessee	86	97	1,062	1,187
Texas	72	78	4,336	4,717
Utah	65	74	269	307
Vermont	93	100	62	70
Virginia	72	81	914	1,025
Washington	91	100	761	844
West Virginia	87	98	315	355
Wisconsin	90	100	586	650
Wyoming	47	56	57	68
United States	83	85	44,537	45,791

Table III.6. Approximate 90 percent confidence intervals for final shrinkage estimates for FY 2015, working poor people

	Participation rate (percentage)		Number of eligible people (thousands)	
	Lower bound	Upper bound	Lower bound	Upper bound
Alabama	71	84	405	479
Alaska	58	76	40	52
Arizona	55	66	606	726
Arkansas	59	71	254	306
California	54	62	3,132	3,621
Colorado	53	67	322	408
Connecticut	63	77	167	205
Delaware	78	94	54	65
District of Columbia	52	73	41	57
Florida	69	83	1,493	1,788
Georgia	66	78	946	1,111
Hawaii	67	82	103	126
Idaho	72	85	122	145
Illinois	76	89	853	995
Indiana	69	81	464	548
Iowa	71	85	195	233
Kansas	60	74	178	218
Kentucky	67	80	330	392
Louisiana	62	74	469	563
Maine	71	87	74	90
Maryland	66	81	314	387
Massachusetts	52	67	290	370
Michigan	81	97	542	649
Minnesota	69	85	233	286
Mississippi	65	79	274	336
Missouri	68	81	389	464
Montana	64	78	54	65
Nebraska	59	73	107	132
Nevada	68	81	215	255
New Hampshire	60	76	47	59
New Jersey	58	72	409	510
New Mexico	85	99	202	235
New York	70	81	1,410	1,646
North Carolina	68	80	802	941
North Dakota	46	60	28	37
Ohio	73	85	750	874
Oklahoma	61	73	329	393
Oregon	84	99	280	331
Pennsylvania	76	89	699	822
Rhode Island	75	91	57	68
South Carolina	68	81	405	478
South Dakota	69	85	54	66
Tennessee	75	88	528	623
Texas	61	71	2,368	2,746
Utah	56	68	181	221
Vermont	79	97	27	33
Virginia	59	72	495	607
Washington	80	94	385	453
West Virginia	79	94	131	155
Wisconsin	82	96	338	396
Wyoming	46	61	27	36
United States	70	74	24,108	25,309

Table III.7. 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	74	87	346	409
Alaska	50	65	52	68
Arizona	59	71	547	659
Arkansas	61	75	242	297
California	55	63	3,007	3,455
Colorado	66	82	258	320
Connecticut	64	79	175	215
Delaware	80	97	52	63
District of Columbia	54	78	36	51
Florida	70	83	1,394	1,661
Georgia	70	82	851	999
Hawaii	63	77	99	121
Idaho	75	88	105	124
Illinois	78	90	815	948
Indiana	69	82	407	488
Iowa	76	90	175	208
Kansas	72	88	135	165
Kentucky	61	75	280	344
Louisiana	71	83	410	482
Maine	76	92	68	82
Maryland	62	78	335	418
Massachusetts	57	71	259	324
Michigan	84	100	572	683
Minnesota	73	89	227	279
Mississippi	65	78	296	358
Missouri	72	85	337	398
Montana	77	93	50	59
Nebraska	71	86	99	119
Nevada	70	84	213	257
New Hampshire	65	81	38	48
New Jersey	58	72	398	495
New Mexico	91	100	188	219
New York	72	85	1,209	1,416
North Carolina	76	89	741	863
North Dakota	53	68	29	37
Ohio	75	88	711	830
Oklahoma	66	79	304	362
Oregon	86	100	228	273
Pennsylvania	83	98	702	823
Rhode Island	80	96	58	69
South Carolina	69	81	358	421
South Dakota	72	90	49	62
Tennessee	73	87	467	555
Texas	66	76	2,402	2,783
Utah	60	72	157	188
Vermont	83	100	26	33
Virginia	64	78	454	553
Washington	80	95	380	449
West Virginia	80	96	112	135
Wisconsin	83	97	301	353
Wyoming	50	65	26	34
United States	73	77	22,553	23,682

Table III.8. 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	76	89	384	448
Alaska	49	68	57	79
Arizona	59	73	527	648
Arkansas	60	74	214	264
California	53	61	2,679	3,122
Colorado	55	69	253	316
Connecticut	69	84	160	194
Delaware	88	100	50	60
District of Columbia	33	55	34	58
Florida	76	91	1,297	1,544
Georgia	65	77	819	967
Hawaii	67	83	87	107
Idaho	72	85	100	118
Illinois	78	92	766	897
Indiana	62	76	395	485
Iowa	79	95	168	203
Kansas	58	71	156	192
Kentucky	65	78	272	328
Louisiana	67	79	448	531
Maine	85	100	61	74
Maryland	61	76	279	350
Massachusetts	56	71	252	318
Michigan	81	96	549	655
Minnesota	71	86	213	260
Mississippi	63	76	277	334
Missouri	70	83	376	447
Montana	72	86	50	60
Nebraska	64	77	111	135
Nevada	74	88	187	223
New Hampshire	60	76	42	53
New Jersey	61	78	392	499
New Mexico	92	100	176	207
New York	76	90	1,190	1,410
North Carolina	63	74	661	782
North Dakota	47	61	24	31
Ohio	73	86	721	851
Oklahoma	66	79	300	360
Oregon	86	100	214	260
Pennsylvania	88	100	645	753
Rhode Island	88	100	39	47
South Carolina	68	81	373	441
South Dakota	71	86	47	57
Tennessee	75	88	428	505
Texas	58	68	2,371	2,772
Utah	51	64	164	203
Vermont	87	100	22	27
Virginia	59	73	419	517
Washington	75	89	329	392
West Virginia	89	100	101	121
Wisconsin	84	98	298	349
Wyoming	39	54	24	33
United States	71	75	21,577	22,716

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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 2015 to 2017**

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 Vigil (2019) and earlier reports in that series, 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. Vigil (2019) 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 are eligible for SNAP, these estimates of SNAP eligibility counts and participation rates do not include people who are 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 2017, we used data from the 2017 CPS ASEC (simulating October through December 2016) and the 2018 CPS ASEC (simulating January through September 2017). 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:

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

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

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. Figure A.1 describes the algorithm that identified working poor participants, and Vigil et al. (2017) describe the procedure for editing the SNAP QC data. An eligible household was identified as working poor only on the basis of earnings.

Figure 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) $\operatorname{var}(Y_{1,i}) =$ variance due to $E_{1,i}$ when $\varepsilon_{1,i}$ is fixed + variance due to $\varepsilon_{1,i}$ when $E_{1,i}$ is fixed

$$= \operatorname{var}_{E_1|\varepsilon_1}(Y_{1,i}) + \operatorname{var}_{\varepsilon_1|E_1}(Y_{1,i})$$

and

(8) $\operatorname{var}(Y_{2,i}) =$ variance due to $E_{2,i}$ when $\varepsilon_{2,i}$ is fixed + variance due to $\varepsilon_{2,i}$ when $E_{2,i}$ is fixed

$$= \operatorname{var}_{E_2|\varepsilon_2}(Y_{2,i}) + \operatorname{var}_{\varepsilon_2|E_2}(Y_{2,i}).$$

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 $\operatorname{var}_{E_1|\varepsilon_1}(Y_{1,i})$ and $\operatorname{var}_{E_2|\varepsilon_2}(Y_{2,i})$ 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, resulting in the following formulas:

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

and

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

where is the rth ($r = 1,\ldots,160$) replicate estimate with the same form as $Y_{1,i}$ and $Y_{2,i}$, respectively, and calculated using the rth 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:

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

and

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

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:

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

and

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

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

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

where

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

and

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

where

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

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:

$$(23) \quad \mathrm{cov}(Y_{1,i},Y_{2,i}) = \text{covariance due to } E_{1,i} \text{ and } E_{2,i} \text{ when } \varepsilon_{1,i} \text{ and } \varepsilon_{2,i} \text{ are fixed}$$
$$+ \text{ covariance due to } \varepsilon_{1,i} \text{ and } \varepsilon_{2,i} \text{ when } E_{1,i} \text{ and } E_{2,i} \text{ are fixed}$$
$$= \mathrm{cov}_{E_1 E_2 | \varepsilon_1 \varepsilon_2}(Y_{1,i},Y_{2,i}) + \mathrm{cov}_{\varepsilon_1 \varepsilon_2 | E_1 E_2}(Y_{1,i},Y_{2,i}).$$

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:

$$(24) \quad \mathrm{cov}_{E_1 E_2 | \varepsilon_1 \varepsilon_2}(Y_{1,i},Y_{2,i}) = \frac{4}{160}\sum_{r=1}^{160}(Y_{1,i(r)}-Y_{1,i})(Y_{2,i(r)}-Y_{2,i}).$$

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

$$(25) \quad \mathrm{cov}_{\varepsilon_1 \varepsilon_2 | E_1 E_2}(Y_{1,i},Y_{2,i}) = \left(100\frac{P_i}{T_i E_{1,i}}\right)\left(100\frac{P_i}{T_i E_{2,i}}\right)\mathrm{cov}(\varepsilon_{1,i},\varepsilon_{2,i})$$

where

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

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:

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

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

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

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:

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

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 $Y_{2,i,t-g}$:

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

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 Figure 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 2015, 2016, and 2017, and three predicting SNAP participation rates for working poor people in fiscal years 2015, 2016, and 2017. 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 people not claimed on tax returns according to individual income tax data and population estimates

3. Percentage of people under age 65 not claimed on tax returns according to individual income tax data and population estimates

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

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

6. Median household income according to ACS one-year estimates

7. Percentage of children under age 18 with household income under 50 percent of the federal poverty level according to ACS one-year estimates

For all the predictors, we used 2015 values in both equations for predicting FY 2015 rates, 2016 values in both equations for predicting FY 2016 rates, and 2017 values in both equations for predicting FY 2017 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 one used to produce the estimates in Cunnyngham (2019a): the percentage of people age 65 and older 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. 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, all but the sixth predictor listed above were used to produce the estimates in Cunnyngham (2019a).

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—σ_1, σ_2,

ρ, η_1, η_2, and $\eta_{1,2}$—that measure the lack of fit of the regression model and the correlations among regression prediction errors. To perform the numerical integration, we specified a grid of 8,053,188 equally spaced points, starting with $\sigma_1 = 0.001$, $\sigma_2 = 0.001$, $\rho = -0.993$, $\eta_1 = 0.000$, $\eta_2 = 0.000$, and $\eta_{1,2} = -0.996$ and incrementing σ_1, σ_2, ρ, η_1, η_2, and $\eta_{1,2}$ by 0.400, 0.670, 0.166, 0.500, 0.550, and 0.166, respectively, up to $\sigma_1 = 4.801$, $\sigma_2 = 6.701$, $\rho = 0.999$, $\eta_1 = 7.500$, $\eta_2 = 9.500$, and $\eta_{1,2} = 0.996$. For combination k of σ_1, σ_2, ρ, η_1, η_2, and $\eta_{1,2}$ (k = 1,…, 7733440), 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 2015 sample estimates for all eligible people and working poor people, respectively; the second two elements are the FY 2016 estimates; and the final two elements are the FY 2017 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 elements of V. X is a (306×48) matrix containing values for each of the seven predictors (plus an intercept) for every state, every fiscal year (2015, 2016, and 2017), 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 2015, $t = 2$ for 2016, and $t = 3$ for 2017) 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 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^* 7,733,440 times (once for each combination of σ_1, σ_2, ρ, η_1, η_2, and $\eta_{1,2}$), we calculated the probability of ($\sigma_{1,k}$, $\sigma_{2,k}$, ρ_k, $\eta_{1,k}$, $\eta_{2,k}$, $\eta_{1,2,k}$):

$$(37) \quad p_k = \frac{p_k^*}{\sum\limits_{k=1}^{7,733,440} p_k^*},$$

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 7,733,440 sets of shrinkage estimates, weighting each set θ_k by its associated probability p_k. Thus, our shrinkage estimates are:

$$(38) \quad \theta = \sum\limits_{k=1}^{7,733,440} p_k \theta_k .$$

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

$$(39) \quad U = \sum\limits_{k=1}^{7,733,440} p_k U_k + \sum\limits_{k=1}^{7,733,440} p_k (\theta_k - \theta)(\theta_k - \theta)' .$$

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

$$(40) \quad R = \sum_{k=1}^{7,733,440} p_k R_k \, ,$$

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

$$(41) \quad G = \sum_{k=1}^{7,733,440} p_k G_k \; + \; \sum_{k=1}^{7,733,440} p_k (R_k - R)(R_k - R)' \, ,$$

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

$$(42) \quad \hat{B} = \sum_{k=1}^{7,733,440} p_k \hat{B}_k \, .$$

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 2017 estimates for all eligible people as an example, the state eligible people counts from Equation (43) summed to 46,113,740, and the national total estimated directly from the CPS ASEC was 45,164,254. 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 $45,164,254\,/\,46,113,740\;(\approx 0.9794)$. Figure A.2 shows the direct estimates of national totals and adjustment factors for all three years and both groups.

Figure 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 2015	50,036,073	0.9814	24,708,657	0.9829
FY 2016	47,070,082	0.9753	23,117,299	0.9643
FY 2017	45,164,254	0.9794	22,146,509	0.9746

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 22 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. Figure 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 2015 or FY 2016.) 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.

Figure A.3. Estimated participation rates over 100 percent

	All eligible people			Eligible working poor people
	FY 2015	**FY 2016**	**FY 2017**	**FY 2017**
Delaware	102.8	101.1	104.2	
Illinois	102.3	101.1	101.2	
Michigan	103.1			
New Mexico	103.8	109.3	110.7	102.2
Oregon	114.9	113.0	111.9	
Rhode Island	100.2	104.6	107.6	
Vermont	104.1	102.1	107.8	
Washington	105.1	103.1		

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 (≈ 0.9794 for all eligible people for FY 2017), and $U(6i - 1, 6i - 1)$ is the $(6i - 1, 6i - 1)$ diagonal element of U for all eligible people for FY 2017, which was derived according to Equation (39). To derive standard error estimates for all eligible people for 2015 and 2016, 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 2015, 2016, and 2017, 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 2015	FY 2016	FY 2017
Alabama	889,380	850,804	804,336
Alaska	81,121	82,326	89,113
Arizona	999,401	960,105	918,728
Arkansas	468,904	426,069	388,362
California	4,417,549	4,340,042	4,112,066
Colorado	495,134	475,690	459,247
Connecticut	442,161	431,597	410,344
Delaware	149,981	147,559	146,805
District of Columbia	141,845	134,625	123,289
Florida	3,656,169	3,454,530	3,184,409
Georgia	1,800,531	1,733,473	1,625,415
Hawaii	188,895	176,729	169,045
Idaho	196,872	185,303	171,251
Illinois	2,042,306	1,914,393	1,878,519
Indiana	831,740	741,610	671,986
Iowa	391,224	380,705	365,893
Kansas	273,974	253,833	233,778
Kentucky	768,882	666,264	654,873
Louisiana	859,738	892,224	928,616
Maine	202,579	189,245	179,734
Maryland	781,035	744,343	684,282
Massachusetts	785,778	779,192	765,714
Michigan	1,571,344	1,473,614	1,375,434
Minnesota	496,023	478,783	453,564
Mississippi	636,322	582,658	537,370
Missouri	844,597	810,690	758,855
Montana	119,082	116,626	120,889
Nebraska	174,092	175,851	175,849
Nevada	420,413	439,782	440,614
New Hampshire	106,296	98,464	92,457
New Jersey	905,728	879,987	817,979
New Mexico	453,146	471,247	460,534
New York	3,039,108	2,968,227	2,910,894
North Carolina	1,646,202	1,568,387	1,345,612
North Dakota	53,148	54,252	53,748
Ohio	1,676,263	1,608,633	1,501,795
Oklahoma	598,257	612,869	603,896
Oregon	779,749	734,864	680,671
Pennsylvania	1,826,667	1,863,836	1,842,945
Rhode Island	175,025	171,055	159,187
South Carolina	804,572	767,463	719,977
South Dakota	98,553	95,983	93,259
Tennessee	1,229,391	1,113,231	1,047,049
Texas	3,724,688	3,768,416	3,868,117
Utah	225,603	219,820	206,299
Vermont	84,994	79,715	76,558
Virginia	860,375	826,354	775,548
Washington	1,070,933	1,011,412	929,486
West Virginia	367,908	357,134	340,300
Wisconsin	805,540	728,077	691,635
Wyoming	32,605	33,853	32,839
United States	45,691,823	44,071,944	42,079,165

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 2015	FY 2016	FY 2017	FY 2015	FY 2016	FY 2017
Alabama	96.75	96.08	95.63	38.76	35.79	42.79
Alaska	99.71	99.92	96.77	37.94	41.71	44.62
Arizona	87.36	86.51	85.93	40.51	40.57	42.35
Arkansas	97.20	97.69	96.52	38.89	43.16	41.05
California	90.31	90.21	88.28	44.19	43.87	40.23
Colorado	93.62	94.33	92.97	44.32	44.81	38.49
Connecticut	86.25	85.99	84.92	29.29	32.34	32.94
Delaware	83.51	81.91	79.63	33.99	34.54	35.99
District of Columbia	91.68	92.39	91.32	21.43	21.43	16.34
Florida	89.84	90.50	89.80	34.11	33.88	37.20
Georgia	94.61	93.69	93.86	41.10	40.62	38.92
Hawaii	88.22	89.84	89.04	44.82	43.49	43.22
Idaho	92.03	92.27	92.32	53.11	50.18	50.18
Illinois	90.77	91.16	88.78	37.37	38.63	37.68
Indiana	97.60	96.91	96.81	45.51	45.57	44.97
Iowa	85.28	82.14	84.35	42.71	41.54	43.88
Kansas	99.70	98.52	98.75	48.50	47.10	48.08
Kentucky	95.71	94.35	93.54	34.45	31.88	32.86
Louisiana	99.37	99.35	99.34	40.87	38.38	38.56
Maine	84.80	84.26	80.81	31.88	33.52	35.38
Maryland	86.81	87.50	87.46	32.94	35.40	31.55
Massachusetts	88.22	84.86	87.69	24.94	23.97	23.73
Michigan	89.21	86.89	86.45	33.56	39.24	38.80
Minnesota	81.79	82.34	81.77	40.13	42.78	40.93
Mississippi	96.41	96.49	96.39	34.43	40.02	39.65
Missouri	99.49	98.65	94.85	37.69	35.68	41.48
Montana	89.71	90.01	88.12	35.46	39.70	36.14
Nebraska	94.69	93.34	92.57	45.65	48.65	49.33
Nevada	85.38	84.45	86.63	41.52	41.33	37.82
New Hampshire	85.91	84.36	85.85	34.01	31.98	34.84
New Jersey	89.71	89.28	88.47	33.07	32.85	38.01
New Mexico	91.11	90.54	91.67	44.47	42.56	41.53
New York	91.58	92.36	89.15	37.97	34.78	37.04
North Carolina	87.07	88.50	89.72	39.19	42.30	36.61
North Dakota	78.70	80.06	79.06	32.44	36.96	27.38
Ohio	90.61	90.53	91.38	38.39	39.16	41.79
Oklahoma	94.83	95.96	95.01	40.30	39.41	39.49
Oregon	83.33	82.56	82.84	35.82	32.05	33.01
Pennsylvania	89.78	87.72	87.24	34.35	36.94	36.25
Rhode Island	87.35	85.71	86.50	29.56	32.54	26.44
South Carolina	95.16	91.59	95.18	40.86	38.09	42.07
South Dakota	98.32	98.32	98.81	46.94	46.97	43.83
Tennessee	98.84	98.84	98.26	38.03	36.74	36.30
Texas	89.05	88.69	87.71	45.48	48.65	41.99
Utah	98.66	97.65	97.47	55.37	51.97	51.15
Vermont	82.77	84.69	86.00	30.58	34.16	31.51
Virginia	97.65	96.18	95.53	41.79	43.02	39.94
Washington	82.62	81.76	83.02	33.93	35.94	31.75
West Virginia	92.16	91.25	90.80	33.69	30.33	31.93
Wisconsin	83.60	82.70	84.81	40.57	40.34	42.63
Wyoming	97.38	98.94	98.16	50.90	50.80	40.14

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 2015	FY 2016	FY 2017
Alabama	860,502	817,461	769,178
Alaska	80,883	82,258	86,233
Arizona	873,127	830,577	789,472
Arkansas	455,775	416,235	374,863
California	3,989,268	3,915,152	3,630,296
Colorado	463,544	448,737	426,971
Connecticut	381,377	371,122	348,448
Delaware	125,242	120,861	116,893
District of Columbia	130,036	124,377	112,589
Florida	3,284,775	3,126,488	2,859,599
Georgia	1,703,500	1,624,091	1,525,631
Hawaii	166,645	158,777	150,518
Idaho	181,181	170,979	158,107
Illinois	1,853,883	1,745,218	1,667,749
Indiana	811,762	718,665	650,563
Iowa	333,628	312,696	308,634
Kansas	273,155	250,074	230,846
Kentucky	735,928	628,587	612,549
Louisiana	854,339	886,433	922,459
Maine	171,787	159,458	145,252
Maryland	677,993	651,322	598,507
Massachusetts	693,253	661,199	671,439
Michigan	1,401,859	1,280,408	1,189,104
Minnesota	405,707	394,225	370,870
Mississippi	613,478	562,218	517,976
Missouri	840,315	799,762	719,774
Montana	106,828	104,980	106,529
Nebraska	164,849	164,138	162,792
Nevada	358,940	371,383	381,686
New Hampshire	91,323	83,067	79,377
New Jersey	812,547	785,661	723,633
New Mexico	412,857	426,667	422,153
New York	2,783,306	2,741,395	2,595,062
North Carolina	1,433,299	1,388,038	1,207,243
North Dakota	41,826	43,434	42,492
Ohio	1,518,929	1,456,247	1,372,355
Oklahoma	567,309	588,097	573,750
Oregon	649,726	606,726	563,841
Pennsylvania	1,640,000	1,634,976	1,607,859
Rhode Island	152,879	146,616	137,703
South Carolina	765,639	702,950	685,260
South Dakota	96,894	94,371	92,152
Tennessee	1,215,142	1,100,351	1,028,820
Texas	3,316,686	3,342,397	3,392,571
Utah	222,580	214,654	201,076
Vermont	70,347	67,515	65,838
Virginia	840,139	794,779	740,865
Washington	884,783	826,941	771,678
West Virginia	339,046	325,895	308,999
Wisconsin	673,464	602,149	586,610
Wyoming	31,750	33,494	32,236
United States	41,554,029	39,904,300	37,837,101

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 2015	FY 2016	FY 2017
Alabama	344,733	304,511	344,183
Alaska	30,780	34,337	39,762
Arizona	404,817	389,543	389,109
Arkansas	182,343	183,900	159,407
California	1,952,292	1,904,063	1,654,120
Colorado	219,438	213,142	176,741
Connecticut	129,522	139,570	135,159
Delaware	50,985	50,968	52,832
District of Columbia	30,397	28,854	20,149
Florida	1,247,156	1,170,360	1,184,632
Georgia	740,054	704,137	632,612
Hawaii	84,667	76,863	73,054
Idaho	104,567	92,981	85,934
Illinois	763,128	739,453	707,732
Indiana	378,566	337,989	302,165
Iowa	167,080	158,156	160,558
Kansas	132,888	119,555	112,403
Kentucky	264,872	212,398	215,198
Louisiana	351,409	342,462	358,056
Maine	64,576	63,425	63,599
Maryland	257,265	263,497	215,905
Massachusetts	195,934	186,788	181,696
Michigan	527,390	578,217	533,641
Minnesota	199,054	204,804	185,626
Mississippi	219,111	233,180	213,078
Missouri	318,286	289,246	314,781
Montana	42,226	46,299	43,683
Nebraska	79,482	85,546	86,743
Nevada	174,555	181,779	166,627
New Hampshire	36,157	31,488	32,209
New Jersey	299,497	289,058	310,930
New Mexico	201,496	200,563	191,237
New York	1,154,010	1,032,231	1,078,195
North Carolina	645,064	663,396	492,615
North Dakota	17,241	20,054	14,715
Ohio	643,434	629,892	627,615
Oklahoma	241,104	241,562	238,466
Oregon	279,275	235,495	224,662
Pennsylvania	627,515	688,538	668,012
Rhode Island	51,737	55,663	42,091
South Carolina	328,716	292,311	302,880
South Dakota	46,261	45,083	40,872
Tennessee	467,488	409,034	380,026
Texas	1,694,100	1,833,184	1,624,261
Utah	124,912	114,243	105,516
Vermont	25,993	27,227	24,120
Virginia	359,559	355,481	309,762
Washington	363,368	363,461	295,112
West Virginia	123,959	108,312	108,651
Wisconsin	326,832	293,684	294,858
Wyoming	16,597	17,198	13,183
United States	17,731,888	17,283,187	16,229,172

Source: SNAP QC database.

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

	All eligible people			Working poor people		
	FY 2015	FY 2016	FY 2017	FY 2015	FY 2016	FY 2017
Alabama	21.09	20.59	18.98	8.58	8.14	8.05
Alaska	13.75	15.87	16.19	6.92	8.92	8.79
Arizona	18.65	16.47	15.18	10.42	9.14	8.35
Arkansas	21.05	18.82	18.08	9.77	8.21	7.82
California	14.72	14.27	13.39	8.55	8.24	7.80
Colorado	11.75	9.21	9.82	6.71	4.60	5.33
Connecticut	10.77	10.93	11.45	5.64	5.18	4.78
Delaware	12.01	12.72	11.62	5.66	5.62	5.63
District of Columbia	20.49	19.64	16.61	7.66	6.79	6.02
Florida	19.19	16.50	15.40	8.97	7.64	7.20
Georgia	21.44	19.36	17.15	10.82	10.14	8.50
Hawaii	14.99	13.84	13.29	8.48	8.01	7.28
Idaho	13.92	12.97	11.44	8.44	7.84	6.31
Illinois	13.51	13.44	12.88	7.38	7.47	6.15
Indiana	15.65	13.91	12.50	8.62	6.71	5.91
Iowa	11.58	10.87	9.38	6.34	6.27	4.94
Kansas	12.69	11.14	12.56	6.91	5.47	6.48
Kentucky	21.83	19.68	16.98	8.44	8.03	6.76
Louisiana	23.51	23.56	24.52	10.42	10.36	11.14
Maine	14.11	15.46	12.83	6.17	7.12	5.10
Maryland	11.84	11.35	9.85	5.56	5.61	4.74
Massachusetts	12.95	10.93	10.90	5.17	5.16	5.12
Michigan	14.03	13.04	12.82	6.59	5.85	5.57
Minnesota	8.44	8.77	9.62	3.73	4.16	4.69
Mississippi	25.68	24.54	23.55	11.63	12.10	10.98
Missouri	13.00	13.66	13.29	6.09	6.24	6.04
Montana	13.03	12.24	10.33	5.84	5.93	5.14
Nebraska	11.56	10.43	11.42	6.01	5.61	6.76
Nevada	15.26	13.50	14.83	7.88	7.18	6.92
New Hampshire	8.40	8.01	6.83	3.76	3.49	2.56
New Jersey	12.29	11.55	10.37	5.48	5.71	4.78
New Mexico	20.42	21.47	22.01	9.80	10.55	11.62
New York	16.33	14.95	14.59	7.28	6.78	6.60
North Carolina	17.47	16.01	16.11	8.48	7.31	7.56
North Dakota	9.71	9.09	9.65	4.93	4.01	4.42
Ohio	15.23	14.96	14.12	7.01	6.32	5.85
Oklahoma	18.77	17.59	16.09	9.77	8.60	8.06
Oregon	13.39	12.57	12.64	7.63	6.51	6.45
Pennsylvania	13.63	12.29	12.77	5.57	5.12	5.29
Rhode Island	13.06	12.82	12.25	5.31	5.10	4.77
South Carolina	19.63	18.27	16.71	8.24	8.22	7.97
South Dakota	14.63	14.37	11.98	7.12	6.90	5.50
Tennessee	18.45	17.77	15.64	8.57	7.99	6.63
Texas	17.89	16.63	16.49	9.73	9.13	9.40
Utah	11.70	10.44	9.03	6.90	6.30	6.09
Vermont	11.90	9.84	10.34	5.56	4.10	4.51
Virginia	13.56	13.00	11.57	6.03	5.43	5.40
Washington	11.48	11.03	10.13	5.96	5.21	4.73
West Virginia	21.75	20.84	19.82	7.87	7.04	6.67
Wisconsin	12.51	12.13	10.17	6.21	6.08	5.54
Wyoming	10.10	11.77	12.24	5.64	6.06	6.34

Source: CPS ASEC.

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

	FY 2015	FY 2016	FY 2017
Alabama	1,015,802	995,150	915,588
Alaska	96,681	112,604	116,051
Arizona	1,253,003	1,128,464	1,058,574
Arkansas	618,750	554,540	530,715
California	5,743,044	5,591,020	5,260,140
Colorado	635,660	505,493	543,112
Connecticut	384,902	390,428	407,798
Delaware	114,293	120,941	112,077
District of Columbia	137,669	134,231	114,672
Florida	3,836,664	3,370,369	3,208,253
Georgia	2,158,953	1,982,182	1,761,462
Hawaii	206,930	192,452	186,507
Idaho	229,291	217,158	196,759
Illinois	1,719,482	1,697,783	1,625,432
Indiana	1,017,785	904,655	817,063
Iowa	358,381	337,466	287,821
Kansas	362,088	318,726	360,789
Kentucky	953,149	863,441	747,634
Louisiana	1,079,527	1,080,424	1,116,590
Maine	187,905	205,150	169,389
Maryland	699,789	672,167	587,907
Massachusetts	874,730	741,017	741,923
Michigan	1,384,944	1,288,906	1,269,558
Minnesota	459,916	477,254	536,185
Mississippi	758,290	723,504	694,676
Missouri	775,253	807,082	792,813
Montana	132,356	126,209	107,366
Nebraska	215,557	195,252	214,391
Nevada	435,997	394,826	441,450
New Hampshire	109,209	105,014	90,901
New Jersey	1,098,433	1,025,372	931,374
New Mexico	416,580	438,886	450,018
New York	3,215,559	2,919,578	2,871,964
North Carolina	1,727,107	1,604,948	1,651,496
North Dakota	73,437	68,456	71,849
Ohio	1,747,626	1,714,949	1,625,614
Oklahoma	725,147	689,049	619,447
Oregon	537,500	516,013	529,919
Pennsylvania	1,718,186	1,544,600	1,607,336
Rhode Island	136,592	134,873	128,439
South Carolina	939,812	891,624	828,096
South Dakota	124,028	122,657	103,863
Tennessee	1,215,425	1,183,675	1,047,499
Texas	4,875,277	4,591,367	4,617,743
Utah	349,465	319,496	281,533
Vermont	72,765	60,965	63,649
Virginia	1,115,670	1,064,146	953,467
Washington	822,730	802,124	749,903
West Virginia	392,399	377,227	357,258
Wisconsin	718,343	698,806	591,117
Wyoming	57,990	67,362	69,073
United States	50,036,072	47,070,080	45,164,252

Source: CPS ASEC.

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

	FY 2015	FY 2016	FY 2017
Alabama	413,321	393,364	388,011
Alaska	48,626	63,288	63,023
Arizona	699,987	626,658	582,161
Arkansas	287,060	241,820	229,489
California	3,334,330	3,225,721	3,065,045
Colorado	362,976	252,280	294,952
Connecticut	201,532	184,786	170,050
Delaware	53,838	53,433	54,286
District of Columbia	51,438	46,431	41,568
Florida	1,793,111	1,559,844	1,499,558
Georgia	1,089,427	1,038,376	872,919
Hawaii	117,121	111,384	102,187
Idaho	138,995	131,281	108,423
Illinois	939,211	943,911	776,325
Indiana	560,386	436,356	386,399
Iowa	196,348	194,758	151,552
Kansas	197,230	156,402	186,137
Kentucky	368,412	352,346	297,879
Louisiana	478,651	475,170	507,276
Maine	82,122	94,397	67,354
Maryland	328,688	332,626	282,924
Massachusetts	349,049	349,921	348,335
Michigan	650,998	577,940	552,131
Minnesota	203,289	226,570	261,741
Mississippi	343,414	356,688	323,824
Missouri	363,288	368,538	360,403
Montana	59,308	61,152	53,441
Nebraska	112,086	104,927	126,987
Nevada	224,955	210,036	205,877
New Hampshire	48,836	45,722	34,059
New Jersey	490,003	506,482	429,625
New Mexico	199,973	215,727	237,605
New York	1,434,335	1,323,521	1,298,851
North Carolina	837,981	733,144	774,668
North Dakota	37,238	30,191	32,894
Ohio	804,691	724,565	673,649
Oklahoma	377,548	336,908	310,279
Oregon	306,464	267,128	270,473
Pennsylvania	702,418	642,938	665,523
Rhode Island	55,527	53,617	49,985
South Carolina	394,622	401,262	394,778
South Dakota	60,382	58,943	47,669
Tennessee	564,595	532,049	443,844
Texas	2,651,353	2,521,046	2,631,474
Utah	206,030	192,882	189,961
Vermont	34,019	25,373	27,781
Virginia	495,922	444,811	444,961
Washington	426,943	378,614	350,279
West Virginia	141,939	127,388	120,137
Wisconsin	356,247	349,903	322,001
Wyoming	32,391	34,681	35,751
United States	24,708,657	23,117,298	22,146,508

Source: CPS ASEC.

Table A.8. CPS ASEC population estimate

	FY 2015	FY 2016	FY 2017
Alabama	4,817,427	4,834,041	4,822,952
Alaska	702,912	709,466	716,689
Arizona	6,718,940	6,852,562	6,974,456
Arkansas	2,938,774	2,947,205	2,936,118
California	39,010,767	39,169,692	39,283,314
Colorado	5,410,329	5,487,221	5,531,141
Connecticut	3,573,237	3,570,674	3,561,139
Delaware	951,675	950,949	964,583
District of Columbia	671,832	683,560	690,577
Florida	19,996,744	20,430,291	20,839,266
Georgia	10,069,934	10,236,799	10,270,297
Hawaii	1,380,835	1,390,805	1,402,902
Idaho	1,647,156	1,674,147	1,719,509
Illinois	12,725,860	12,631,038	12,619,850
Indiana	6,503,426	6,505,417	6,538,445
Iowa	3,095,675	3,104,782	3,067,581
Kansas	2,852,522	2,861,845	2,873,129
Kentucky	4,366,487	4,386,978	4,403,444
Louisiana	4,592,316	4,584,936	4,553,882
Maine	1,331,327	1,326,701	1,319,823
Maryland	5,910,076	5,924,718	5,969,097
Massachusetts	6,753,784	6,781,082	6,804,322
Michigan	9,873,147	9,885,425	9,906,363
Minnesota	5,451,875	5,443,183	5,575,391
Mississippi	2,952,783	2,948,243	2,950,165
Missouri	5,962,367	5,907,222	5,966,041
Montana	1,015,809	1,031,169	1,039,122
Nebraska	1,865,136	1,872,007	1,877,305
Nevada	2,856,405	2,924,226	2,977,053
New Hampshire	1,299,542	1,311,760	1,331,348
New Jersey	8,941,033	8,874,034	8,980,374
New Mexico	2,039,570	2,043,988	2,044,771
New York	19,691,085	19,535,503	19,687,869
North Carolina	9,885,497	10,026,749	10,248,889
North Dakota	755,923	752,954	744,368
Ohio	11,472,076	11,464,288	11,516,079
Oklahoma	3,862,624	3,916,519	3,850,940
Oregon	4,015,201	4,105,849	4,191,416
Pennsylvania	12,603,728	12,567,392	12,588,703
Rhode Island	1,045,660	1,051,896	1,048,612
South Carolina	4,787,104	4,879,972	4,955,389
South Dakota	848,009	853,636	867,301
Tennessee	6,587,859	6,659,665	6,698,907
Texas	27,247,660	27,616,507	27,994,995
Utah	2,985,747	3,060,888	3,118,052
Vermont	611,545	619,319	615,768
Virginia	8,227,631	8,185,590	8,239,911
Washington	7,167,254	7,271,684	7,402,881
West Virginia	1,804,535	1,809,975	1,802,159
Wisconsin	5,740,395	5,759,095	5,813,136
Wyoming	574,108	572,462	564,229
United States	318,193,342	319,996,108	322,460,050

Source: CPS ASEC.

Table A.9. Population on July 1

	FY 2015	FY 2016	FY 2017
Alabama	4,853,875	4,860,545	4,860,545
Alaska	737,709	741,522	741,522
Arizona	6,817,565	6,908,642	6,908,642
Arkansas	2,977,853	2,988,231	2,988,231
California	38,993,940	39,296,476	39,296,476
Colorado	5,448,819	5,530,105	5,530,105
Connecticut	3,584,730	3,587,685	3,587,685
Delaware	944,076	952,698	952,698
District of Columbia	670,377	684,336	684,336
Florida	20,244,914	20,656,589	20,656,589
Georgia	10,199,398	10,313,620	10,313,620
Hawaii	1,425,157	1,428,683	1,428,683
Idaho	1,652,828	1,680,026	1,680,026
Illinois	12,839,047	12,835,726	12,835,726
Indiana	6,612,768	6,634,007	6,634,007
Iowa	3,121,997	3,130,869	3,130,869
Kansas	2,906,721	2,907,731	2,907,731
Kentucky	4,424,611	4,436,113	4,436,113
Louisiana	4,668,960	4,686,157	4,686,157
Maine	1,329,453	1,330,232	1,330,232
Maryland	5,994,983	6,024,752	6,024,752
Massachusetts	6,784,240	6,823,721	6,823,721
Michigan	9,917,715	9,933,445	9,933,445
Minnesota	5,482,435	5,525,050	5,525,050
Mississippi	2,989,390	2,985,415	2,985,415
Missouri	6,076,204	6,091,176	6,091,176
Montana	1,032,073	1,038,656	1,038,656
Nebraska	1,893,765	1,907,603	1,907,603
Nevada	2,883,758	2,939,254	2,939,254
New Hampshire	1,330,111	1,335,015	1,335,015
New Jersey	8,935,421	8,978,416	8,978,416
New Mexico	2,080,328	2,085,432	2,085,432
New York	19,747,183	19,836,286	19,836,286
North Carolina	10,035,186	10,156,689	10,156,689
North Dakota	756,835	755,548	755,548
Ohio	11,605,090	11,622,554	11,622,554
Oklahoma	3,907,414	3,921,207	3,921,207
Oregon	4,024,634	4,085,989	4,085,989
Pennsylvania	12,791,904	12,787,085	12,787,085
Rhode Island	1,055,607	1,057,566	1,057,566
South Carolina	4,894,834	4,959,822	4,959,822
South Dakota	857,919	861,542	861,542
Tennessee	6,595,056	6,649,404	6,649,404
Texas	27,429,639	27,904,862	27,904,862
Utah	2,990,632	3,044,321	3,044,321
Vermont	626,088	623,354	623,354
Virginia	8,367,587	8,414,380	8,414,380
Washington	7,160,290	7,280,934	7,280,934
West Virginia	1,841,053	1,828,637	1,828,637
Wisconsin	5,767,891	5,772,917	5,772,917
Wyoming	586,555	584,910	584,910
United States	320,896,618	323,405,935	323,405,935

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 2015	FY 2016	FY 2017
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	0.2	0.5	0.7
Colorado	0.0	0.0	0.0
Connecticut	0.0	0.0	0.0
Delaware	0.0	0.0	0.0
District of Columbia	1.9	0.6	0.0
Florida	0.3	0.2	0.0
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	0.0	0.4
Kansas	0.0	0.0	0.0
Kentucky	0.0	0.0	0.0
Louisiana	0.0	0.0	0.0
Maine	0.0	0.0	0.0
Maryland	0.0	0.0	0.0
Massachusetts	0.4	0.0	0.0
Michigan	0.0	0.0	0.0
Minnesota	4.7	2.8	0.4
Mississippi	0.0	0.0	0.0
Missouri	0.1	0.0	0.0
Montana	0.5	0.0	0.0
Nebraska	0.1	0.0	0.0
Nevada	0.0	0.0	0.0
New Hampshire	0.0	0.0	0.0
New Jersey	0.7	0.8	0.0
New Mexico	0.0	0.0	0.0
New York	0.1	0.0	0.0
North Carolina	0.1	0.0	0.0
North Dakota	0.0	0.0	0.0
Ohio	0.0	0.0	0.0
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	0.0	0.4	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	0.2	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 2015	FY 2016	FY 2017	FY 2015	FY 2016	FY 2017
Alabama	84.08	81.70	83.36	82.78	76.99	88.02
Alaska	79.71	69.89	71.82	60.31	51.91	60.98
Arizona	68.67	73.01	75.29	57.00	61.66	67.48
Arkansas	72.69	74.03	69.40	62.69	75.00	68.25
California	69.49	69.80	68.99	58.58	58.84	53.95
Colorado	72.41	88.08	78.63	60.03	83.83	59.93
Connecticut	98.77	94.61	84.81	64.06	75.17	78.89
Delaware	110.46	99.75	105.60	95.46	95.21	98.54
District of Columbia	94.66	92.55	99.08	59.22	62.07	48.91
Florida	84.57	91.75	89.92	68.70	74.21	79.70
Georgia	77.90	81.32	86.25	67.07	67.31	72.17
Hawaii	78.03	80.31	79.25	70.04	67.18	70.20
Idaho	78.75	78.46	82.24	74.97	70.58	81.12
Illinois	106.87	101.16	100.88	80.54	77.09	89.63
Indiana	78.44	77.90	78.48	66.44	75.96	77.07
Iowa	92.31	91.89	105.06	84.38	80.53	103.80
Kansas	74.03	77.22	63.22	66.12	75.24	59.67
Kentucky	76.20	71.99	81.33	70.95	59.61	71.71
Louisiana	77.84	80.27	80.28	72.21	70.51	68.59
Maine	91.55	77.52	85.08	78.74	67.01	93.68
Maryland	95.51	95.29	100.86	77.16	77.90	75.61
Massachusetts	78.90	88.67	90.24	55.88	53.05	52.01
Michigan	100.77	98.86	93.41	80.65	99.56	96.39
Minnesota	87.72	81.38	69.80	97.37	89.05	71.57
Mississippi	79.91	76.74	73.68	63.02	64.56	65.02
Missouri	106.36	96.10	88.92	85.97	76.12	85.55
Montana	79.44	82.58	99.26	70.08	75.17	81.78
Nebraska	75.32	82.50	74.73	69.84	80.01	67.22
Nevada	81.55	93.58	87.57	76.86	86.11	81.98
New Hampshire	81.70	77.72	87.08	72.33	67.67	94.31
New Jersey	74.02	75.73	77.71	61.16	56.41	72.39
New Mexico	97.17	95.28	91.98	98.79	91.12	78.92
New York	86.31	92.47	89.68	80.23	76.81	82.39
North Carolina	81.75	85.38	73.76	75.83	89.33	64.17
North Dakota	56.89	63.23	58.27	46.24	66.20	44.07
Ohio	85.92	83.76	83.65	79.04	85.75	92.31
Oklahoma	77.34	85.25	90.96	63.13	71.61	75.48
Oregon	120.60	118.15	109.15	90.91	88.59	85.21
Pennsylvania	94.05	104.03	98.48	88.02	105.25	98.82
Rhode Island	110.87	108.12	106.31	92.30	103.26	83.49
South Carolina	79.67	77.57	82.68	81.46	71.68	76.65
South Dakota	77.22	76.23	89.32	75.73	75.79	86.31
Tennessee	99.87	93.10	98.95	82.71	77.00	86.26
Texas	67.58	72.05	73.71	63.47	71.96	61.92
Utah	63.59	67.55	73.15	60.53	59.55	56.89
Vermont	94.43	110.03	102.18	74.63	106.62	85.77
Virginia	74.04	72.66	76.09	71.29	77.74	68.17
Washington	107.65	102.96	104.63	85.19	95.88	85.66
West Virginia	84.69	85.51	85.24	85.60	84.16	89.13
Wisconsin	93.31	85.96	99.93	91.31	83.73	92.21
Wyoming	53.59	48.66	45.02	50.15	48.53	35.57

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

	All eligible people			Working poor people		
	FY 2015	FY 2016	FY 2017	FY 2015	FY 2016	FY 2017
Alabama	4.624	4.889	4.096	7.975	7.096	6.059
Alaska	4.426	5.473	7.352	7.964	5.675	8.781
Arizona	3.144	3.431	4.924	4.637	5.207	7.001
Arkansas	2.984	3.025	3.974	5.375	7.816	6.445
California	1.966	1.717	1.962	3.125	3.077	3.156
Colorado	7.233	7.624	5.738	9.418	8.763	7.158
Connecticut	9.299	8.227	7.238	8.608	11.048	10.735
Delaware	7.964	7.549	8.379	12.183	12.200	12.476
District of Columbia	4.169	3.868	5.133	6.934	8.052	7.460
Florida	2.742	3.147	3.559	5.168	5.485	5.943
Georgia	3.552	3.817	3.653	5.630	5.536	5.422
Hawaii	5.516	4.890	5.118	6.640	6.473	7.948
Idaho	4.678	3.970	5.611	7.704	7.135	7.933
Illinois	4.605	4.243	4.375	6.289	6.151	7.313
Indiana	4.356	4.761	4.749	5.269	7.206	8.304
Iowa	6.113	8.603	9.293	9.585	8.725	14.498
Kansas	5.140	5.408	4.379	7.522	8.875	5.927
Kentucky	4.285	4.345	7.354	7.887	7.352	8.166
Louisiana	3.378	2.672	3.005	6.116	6.207	5.026
Maine	7.036	5.671	7.412	12.660	8.802	12.649
Maryland	7.126	6.751	8.676	9.782	10.148	10.743
Massachusetts	4.610	5.078	6.165	6.508	6.114	6.886
Michigan	5.381	4.585	4.719	8.124	8.324	9.000
Minnesota	7.271	6.697	6.314	11.409	12.856	10.032
Mississippi	3.329	4.899	2.083	5.781	5.839	6.264
Missouri	6.832	5.737	7.005	8.034	7.092	8.897
Montana	6.345	6.363	6.699	6.839	9.784	9.532
Nebraska	5.270	5.863	6.419	7.325	9.773	7.411
Nevada	5.236	6.528	5.589	7.089	10.502	9.014
New Hampshire	6.729	7.079	7.543	9.715	10.947	14.340
New Jersey	4.485	4.490	5.594	7.139	6.101	8.777
New Mexico	6.003	6.661	6.958	6.936	6.473	7.728
New York	3.033	3.200	3.574	5.907	5.848	6.808
North Carolina	3.589	3.606	3.452	6.458	7.183	5.426
North Dakota	5.374	5.073	6.080	7.586	10.288	8.383
Ohio	4.237	3.714	4.094	6.123	6.459	8.513
Oklahoma	4.713	5.558	5.767	5.348	6.924	6.852
Oregon	7.353	6.137	8.332	7.584	8.474	11.408
Pennsylvania	4.705	5.367	4.817	8.100	9.339	9.455
Rhode Island	9.157	9.499	10.066	13.077	15.299	14.363
South Carolina	3.899	4.577	4.417	6.999	6.131	7.964
South Dakota	7.741	8.544	13.971	9.326	8.904	10.709
Tennessee	5.193	5.196	5.045	6.641	6.824	7.730
Texas	1.950	1.767	2.218	3.575	3.813	3.608
Utah	4.243	5.114	5.478	6.337	5.591	6.079
Vermont	7.251	7.473	9.068	10.477	14.719	14.701
Virginia	4.321	3.762	4.820	7.009	7.478	7.906
Washington	5.841	5.132	8.029	8.791	8.910	10.523
West Virginia	9.462	8.139	5.425	6.988	8.366	10.211
Wisconsin	5.489	5.272	6.205	8.796	8.240	9.446
Wyoming	5.056	4.004	3.825	7.118	6.330	5.421

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	
Four measures of state eligibility policy expansiveness; four measures of state eligibility policy expansiveness in the previous year	State SNAP eligibility policies
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 for the civilian population ages 16 to 64	
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]
Tax non-filer rate	People not claimed on tax returns[b]	Resident population[a]
Non-elderly tax non-filer rate	People under age 65 not claimed on tax returns[b]	Resident population under age 65[a]
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]
Median household income	Median household income according to ACS one-year estimates[c]	10,000
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]

Note: All rates expressed as percentages.

[a]Estimates of the resident population are from the annual July 1 population estimates released in June 2017, 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 http://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml.

ACS = American Community Survey.

Table A.15. Values for FY 2015 predictors

	SNAP prevalence rate	Tax non-filer rate	Non-elderly tax non-filer rate	Bachelor's degree rate	Household earnings rate	Median household income (10,000)	Child under 50 percent of poverty rate
Alabama	18.323	21.303	17.524	24.2	71.9	4.48	12.7
Alaska	10.996	14.080	13.219	29.7	86.1	7.34	5.6
Arizona	14.659	21.063	18.001	27.7	74.3	5.15	11.2
Arkansas	15.746	21.283	17.472	21.8	72.7	4.20	11.3
California	11.329	16.938	14.049	32.3	80.5	6.45	8.9
Colorado	9.087	13.690	11.757	39.2	81.9	6.39	6.2
Connecticut	12.335	14.874	12.558	38.3	78.7	7.13	6.9
Delaware	15.886	16.489	14.278	30.9	76.1	6.13	7.7
District of Columbia	21.159	25.794	24.160	56.7	80.6	7.56	13.0
Florida	18.060	18.180	13.327	28.4	72.1	4.94	9.5
Georgia	17.653	18.567	15.643	29.9	78.7	5.12	11.2
Hawaii	13.254	15.008	12.570	31.4	81.1	7.35	6.9
Idaho	11.911	12.806	10.310	26.0	76.5	4.83	6.5
Illinois	15.907	13.870	11.427	32.9	78.5	5.96	8.4
Indiana	12.578	13.757	12.185	24.9	77.4	5.05	9.3
Iowa	12.531	13.225	10.750	26.8	79.1	5.47	6.6
Kansas	9.426	13.340	11.882	31.7	79.3	5.39	7.2
Kentucky	17.377	19.707	16.033	23.3	72.7	4.52	11.9
Louisiana	18.414	22.255	19.113	23.2	75.5	4.57	13.9
Maine	15.238	16.534	12.797	30.1	73.8	5.15	7.8
Maryland	13.028	14.578	12.139	38.8	81.3	7.58	6.2
Massachusetts	11.582	15.254	13.017	41.5	78.9	7.06	7.1
Michigan	15.844	15.511	14.113	27.8	74.0	5.11	10.1
Minnesota	9.047	10.538	8.685	34.7	80.5	6.35	5.4
Mississippi	21.286	22.117	18.063	20.8	71.5	4.06	16.5
Missouri	13.900	16.744	14.444	27.8	76.1	5.02	8.8
Montana	11.538	14.640	12.468	30.6	75.9	4.95	7.6
Nebraska	9.193	10.934	8.545	30.2	81.4	5.50	7.4
Nevada	14.579	17.427	14.674	23.6	77.3	5.24	9.0
New Hampshire	7.992	11.008	8.474	35.7	79.7	7.03	5.3
New Jersey	10.136	12.764	9.871	37.6	79.5	7.22	7.1
New Mexico	21.782	19.822	17.208	26.5	73.6	4.54	13.0
New York	15.390	16.646	13.506	35.0	77.4	6.09	10.0
North Carolina	16.404	18.608	15.456	29.4	76.1	4.78	10.5
North Dakota	7.022	12.675	10.664	29.1	82.2	6.06	6.6
Ohio	14.444	15.614	12.789	26.8	75.7	5.11	10.3
Oklahoma	15.311	19.943	17.219	24.6	76.2	4.86	9.6
Oregon	19.374	17.160	14.849	32.2	75.1	5.41	8.0
Pennsylvania	14.280	15.264	12.656	29.7	75.5	5.57	8.6
Rhode Island	16.580	16.628	13.578	32.7	75.8	5.81	7.6
South Carolina	16.437	20.142	16.967	26.8	74.2	4.72	10.7
South Dakota	11.487	11.296	9.739	27.5	80.0	5.30	9.1
Tennessee	18.641	17.477	13.696	25.7	75.4	4.73	11.0
Texas	13.579	15.521	12.742	28.4	82.5	5.57	9.5
Utah	7.544	10.866	9.262	31.8	83.9	6.29	5.1
Vermont	13.575	12.203	10.438	36.9	77.1	5.70	4.6
Virginia	10.282	15.163	12.706	37.0	80.4	6.63	7.1
Washington	14.957	12.970	10.780	34.2	78.5	6.41	7.0
West Virginia	19.984	21.509	17.510	19.6	67.3	4.20	12.8
Wisconsin	13.966	11.904	9.834	28.4	78.1	5.56	6.8
Wyoming	5.559	12.539	10.705	26.2	82.2	6.02	3.8

Table A.16. Values for FY 2016 predictors

	SNAP prevalence rate	Tax non-filer rate	Non-elderly tax non-filer rate	Bachelor's degree rate	Household earnings rate	Median household income (10,000)	Child under 50 percent of poverty rate
Alabama	17.504	22.015	18.325	24.7	71.8	4.63	11.5
Alaska	11.102	15.543	14.583	29.6	86.0	7.64	6.2
Arizona	13.897	21.594	18.730	28.9	74.3	5.36	11.0
Arkansas	14.258	21.830	18.078	22.4	72.7	4.43	10.3
California	11.044	17.468	14.623	32.9	80.5	6.77	8.1
Colorado	8.602	14.329	12.512	39.9	82.1	6.57	5.0
Connecticut	12.030	15.126	12.576	38.6	79.4	7.34	6.0
Delaware	15.489	16.960	14.805	31.0	75.9	6.18	6.6
District of Columbia	19.672	26.408	24.362	56.8	80.4	7.55	15.9
Florida	16.724	19.926	15.302	28.6	72.0	5.09	9.1
Georgia	16.808	19.968	17.121	30.5	79.1	5.36	10.2
Hawaii	12.370	15.414	12.861	31.9	80.4	7.45	5.2
Idaho	11.030	12.850	10.494	27.6	77.1	5.18	7.0
Illinois	14.915	14.503	11.941	34.0	78.5	6.10	7.6
Indiana	11.179	14.229	12.663	25.6	77.9	5.23	8.7
Iowa	12.160	13.573	11.272	28.4	79.1	5.62	6.2
Kansas	8.730	14.017	12.628	32.8	79.4	5.49	5.7
Kentucky	15.019	20.139	16.485	23.4	72.6	4.67	11.8
Louisiana	19.040	23.230	20.119	23.4	74.6	4.51	12.5
Maine	14.226	16.363	12.733	30.1	74.6	5.31	6.6
Maryland	12.355	15.044	12.620	39.3	81.5	7.89	5.9
Massachusetts	11.419	15.347	13.099	42.7	79.1	7.53	6.6
Michigan	14.835	15.707	14.302	28.3	74.2	5.25	9.3
Minnesota	8.666	10.740	8.971	34.8	79.9	6.56	5.6
Mississippi	19.517	22.880	18.927	21.8	72.4	4.18	14.3
Missouri	13.309	17.055	14.769	28.5	76.0	5.17	9.0
Montana	11.229	14.766	12.757	31.0	75.4	5.00	6.7
Nebraska	9.218	11.333	9.064	31.4	81.0	5.69	5.8
Nevada	14.962	17.909	15.099	23.5	77.5	5.52	8.1
New Hampshire	7.376	11.071	8.536	36.6	80.4	7.09	3.0
New Jersey	9.801	13.063	10.047	38.6	79.6	7.61	5.8
New Mexico	22.597	20.871	18.400	27.2	73.0	4.67	13.4
New York	14.964	17.015	13.644	35.7	77.3	6.29	9.6
North Carolina	15.442	19.100	16.028	30.4	76.3	5.06	9.3
North Dakota	7.181	13.157	11.302	29.6	82.3	6.07	6.3
Ohio	13.841	15.980	13.199	27.5	75.9	5.23	9.9
Oklahoma	15.630	21.019	18.416	25.2	76.4	4.92	10.0
Oregon	17.985	17.747	15.666	32.7	75.9	5.75	7.3
Pennsylvania	14.576	15.365	12.779	30.8	75.2	5.69	8.1
Rhode Island	16.174	16.707	13.766	34.1	75.2	6.06	7.6
South Carolina	15.474	20.437	17.320	27.2	74.3	4.95	11.5
South Dakota	11.141	11.208	9.919	28.9	80.0	5.45	9.8
Tennessee	16.742	17.858	14.158	26.1	75.2	4.85	10.4
Texas	13.505	17.109	14.445	28.9	82.5	5.66	9.5
Utah	7.221	11.101	9.540	32.6	83.9	6.60	4.9
Vermont	12.788	12.021	10.380	36.4	76.2	5.77	8.3
Virginia	9.821	15.470	13.009	38.1	80.1	6.81	6.8
Washington	13.891	13.119	11.029	35.1	78.8	6.71	5.9
West Virginia	19.530	22.270	18.343	20.8	67.4	4.34	11.1
Wisconsin	12.612	12.050	10.167	29.5	77.8	5.68	6.5
Wyoming	5.788	14.031	12.300	27.1	80.4	5.99	4.4

Table A.17. Values for FY 2017 predictors

	SNAP prevalence rate	Tax non-filer rate	Non-elderly tax non-filer rate	Bachelor's degree rate	Household earnings rate	Median household income (10,000)	Child under 50 percent of poverty rate
Alabama	16.499	22.313	18.643	25.5	71.7	4.81	11.3
Alaska	12.046	16.000	15.059	28.8	84.7	7.32	7.1
Arizona	13.034	22.095	19.297	29.4	74.8	5.66	8.9
Arkansas	12.932	22.170	18.399	23.4	73.0	4.59	9.6
California	10.437	17.300	14.433	33.6	80.8	7.18	7.2
Colorado	8.178	14.513	12.729	41.2	81.9	6.91	5.2
Connecticut	11.482	14.772	12.222	38.7	78.7	7.42	5.9
Delaware	15.339	16.430	14.267	31.5	74.8	6.29	7.4
District of Columbia	17.722	26.797	24.804	57.3	80.7	8.24	14.1
Florida	15.181	18.550	13.699	29.7	72.2	5.26	8.8
Georgia	15.609	19.951	17.075	30.9	79.0	5.62	9.2
Hawaii	11.869	14.946	12.430	32.9	79.8	7.78	6.1
Idaho	9.963	13.090	10.819	26.8	77.0	5.22	6.4
Illinois	14.692	14.534	11.959	34.4	78.2	6.30	7.6
Indiana	10.090	14.261	12.721	26.8	77.5	5.42	8.2
Iowa	11.639	13.723	11.475	28.9	79.1	5.86	4.8
Kansas	8.032	14.256	12.942	33.7	79.4	5.64	6.5
Kentucky	14.703	20.341	16.708	24.0	72.7	4.84	11.1
Louisiana	19.881	23.305	20.128	23.8	73.9	4.61	14.3
Maine	13.463	16.100	12.504	32.1	74.7	5.63	5.7
Maryland	11.358	14.761	12.305	39.7	81.6	8.08	6.4
Massachusetts	11.157	15.276	13.098	43.4	78.7	7.74	7.0
Michigan	13.787	15.904	14.520	29.1	74.5	5.49	8.7
Minnesota	8.146	10.809	9.103	36.1	80.4	6.84	4.7
Mississippi	17.974	23.368	19.435	21.9	71.9	4.35	13.1
Missouri	12.423	17.075	14.781	29.1	76.4	5.36	8.0
Montana	11.479	15.466	13.573	32.3	77.0	5.34	6.8
Nebraska	9.170	11.349	9.147	31.7	81.9	6.00	5.6
Nevada	14.823	17.203	14.260	24.9	78.3	5.80	7.8
New Hampshire	6.850	11.628	9.282	36.9	80.5	7.34	4.8
New Jersey	9.203	11.758	8.591	39.7	79.7	8.01	6.0
New Mexico	21.999	21.042	18.739	27.1	71.7	4.67	12.3
New York	14.859	15.674	12.106	36.0	77.4	6.49	9.0
North Carolina	13.101	19.451	16.407	31.3	76.5	5.28	9.4
North Dakota	7.117	12.593	10.679	30.7	82.6	6.18	5.8
Ohio	12.875	16.147	13.421	28.0	75.8	5.40	9.2
Oklahoma	15.356	21.213	18.609	25.5	76.4	5.01	9.3
Oregon	16.415	18.098	16.079	33.7	75.8	6.02	6.5
Pennsylvania	14.409	15.164	12.600	31.4	74.5	5.92	7.9
Rhode Island	15.068	16.141	13.144	33.5	76.5	6.39	5.3
South Carolina	14.339	20.687	17.588	28.0	74.4	5.06	10.2
South Dakota	10.679	11.821	10.713	28.1	79.4	5.65	7.3
Tennessee	15.607	18.071	14.419	27.3	75.7	5.13	9.2
Texas	13.657	16.890	14.280	29.6	82.3	5.92	9.1
Utah	6.648	11.393	9.897	34.6	84.4	6.84	4.5
Vermont	12.259	12.023	10.538	38.3	77.4	5.75	4.9
Virginia	9.162	15.533	13.080	38.7	80.0	7.15	6.5
Washington	12.518	13.531	11.518	35.5	79.1	7.10	6.6
West Virginia	18.728	22.354	18.352	20.2	66.4	4.35	11.9
Wisconsin	11.941	12.149	10.331	30.4	77.8	5.93	5.9
Wyoming	5.672	13.445	11.663	27.6	79.2	6.04	7.2

Table A.18. Regression estimates of SNAP participation rates

	All eligible people			Working poor people		
	FY 2015	FY 2016	FY 2017	FY 2015	FY 2016	FY 2017
Alabama	81.92	83.75	81.46	72.30	74.26	76.04
Alaska	81.40	71.49	74.61	67.32	57.18	58.10
Arizona	71.60	72.01	74.83	61.09	62.99	65.37
Arkansas	69.39	68.93	66.49	64.87	65.78	65.67
California	65.65	68.27	69.37	55.46	55.67	55.54
Colorado	70.13	76.53	77.97	59.15	70.20	60.78
Connecticut	88.86	88.24	90.24	70.07	69.87	75.63
Delaware	99.98	98.45	101.40	82.40	83.63	92.24
District of Columbia	96.81	94.99	93.52	60.89	63.63	41.60
Florida	89.16	89.30	88.01	79.72	77.12	85.37
Georgia	82.75	84.86	84.45	72.31	75.15	69.82
Hawaii	88.15	83.89	84.05	71.68	65.60	72.04
Idaho	82.94	81.61	76.67	78.10	79.65	77.19
Illinois	97.93	96.86	97.29	83.32	83.63	84.86
Indiana	83.79	75.78	71.21	75.76	73.88	67.60
Iowa	83.03	84.80	87.80	76.25	79.69	83.76
Kansas	73.06	75.60	71.65	65.49	76.21	62.86
Kentucky	81.82	73.96	73.58	73.66	67.26	70.97
Louisiana	75.19	83.16	83.32	66.34	74.60	71.62
Maine	87.31	90.99	95.54	77.48	82.55	91.68
Maryland	90.38	88.10	85.04	71.05	66.41	65.69
Massachusetts	84.10	88.49	89.87	65.29	68.97	69.50
Michigan	101.30	95.27	91.40	85.84	86.79	84.55
Minnesota	81.25	81.73	81.67	70.89	73.80	72.85
Mississippi	83.89	81.67	76.99	74.90	72.66	72.15
Missouri	82.13	81.67	80.68	72.76	76.30	74.21
Montana	79.15	85.25	85.66	71.19	83.85	78.21
Nebraska	68.13	77.16	75.74	65.08	75.71	69.16
Nevada	79.32	81.35	83.77	71.58	72.65	77.94
New Hampshire	76.90	78.87	72.68	65.12	69.12	63.56
New Jersey	78.96	81.26	80.68	64.36	63.05	67.87
New Mexico	104.09	108.91	111.26	88.73	93.62	99.47
New York	85.58	88.66	91.69	70.89	72.21	77.87
North Carolina	80.20	85.31	76.09	71.26	77.98	65.79
North Dakota	59.30	61.42	62.64	55.31	60.61	55.80
Ohio	82.82	82.31	78.62	74.04	75.06	73.52
Oklahoma	76.28	77.90	80.70	68.16	72.09	72.32
Oregon	111.27	108.26	108.54	92.94	93.59	95.80
Pennsylvania	89.91	94.35	96.45	77.54	82.89	89.72
Rhode Island	97.08	101.25	104.52	81.83	85.04	95.41
South Carolina	79.74	78.34	77.30	70.24	70.20	69.63
South Dakota	81.17	80.30	79.92	74.44	77.13	74.68
Tennessee	89.32	87.58	85.91	80.92	78.99	80.19
Texas	69.84	72.12	74.57	64.34	65.99	60.59
Utah	68.56	69.57	68.37	62.64	65.85	57.50
Vermont	103.03	98.82	106.14	87.89	89.15	95.86
Virginia	71.79	75.31	75.12	59.29	63.76	59.93
Washington	101.93	100.15	92.61	85.10	84.34	79.46
West Virginia	94.89	94.89	91.22	83.44	83.03	94.02
Wisconsin	96.98	93.08	92.08	86.29	86.14	87.28
Wyoming	58.41	57.98	52.20	56.34	59.41	50.03

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

	All eligible people			Working poor people		
	FY 2015	**FY 2016**	**FY 2017**	**FY 2015**	**FY 2016**	**FY 2017**
Alabama	3.200	3.216	3.208	5.025	5.070	5.109
Alaska	4.438	4.571	4.615	6.930	6.681	6.958
Arizona	3.381	3.400	3.629	5.274	5.434	5.687
Arkansas	3.442	3.443	3.632	5.394	5.532	5.733
California	3.286	3.260	3.399	5.125	5.116	5.282
Colorado	3.520	3.745	3.544	5.423	5.832	5.488
Connecticut	3.412	3.308	3.336	5.273	5.155	5.218
Delaware	3.540	3.606	3.669	5.392	5.587	5.683
District of Columbia	5.204	5.080	5.696	8.250	8.782	8.571
Florida	3.820	3.658	3.865	6.093	5.724	6.097
Georgia	3.338	3.359	3.365	5.242	5.357	5.261
Hawaii	4.020	3.793	3.945	6.095	5.742	6.057
Idaho	3.356	3.238	3.293	5.231	5.101	5.112
Illinois	3.317	3.258	3.316	5.151	5.132	5.210
Indiana	3.539	3.448	3.476	5.453	5.390	5.423
Iowa	3.182	3.162	3.497	4.998	4.995	5.445
Kansas	3.591	3.770	3.648	5.479	5.890	5.606
Kentucky	3.131	3.395	3.233	4.921	5.359	5.184
Louisiana	3.385	3.361	3.584	5.345	5.285	5.719
Maine	3.421	3.485	3.744	5.426	5.480	5.890
Maryland	3.602	3.554	3.516	5.532	5.469	5.451
Massachusetts	3.439	3.444	3.559	5.357	5.447	5.517
Michigan	3.993	3.803	3.721	6.069	5.955	5.795
Minnesota	3.314	3.325	3.295	5.143	5.248	5.144
Mississippi	3.800	3.525	3.339	5.975	5.492	5.382
Missouri	3.143	3.077	3.087	4.886	4.853	4.831
Montana	3.531	3.618	3.434	5.423	5.669	5.318
Nebraska	3.642	3.494	3.504	5.586	5.463	5.411
Nevada	3.208	3.304	3.468	5.012	5.160	5.368
New Hampshire	3.639	3.515	3.415	5.635	5.475	5.315
New Jersey	3.745	3.668	3.992	5.795	5.746	6.242
New Mexico	3.614	3.943	4.127	5.534	6.017	6.307
New York	3.176	3.279	3.582	5.004	5.181	5.691
North Carolina	3.181	3.205	3.211	5.003	5.074	5.031
North Dakota	3.397	3.381	3.424	5.253	5.294	5.255
Ohio	3.132	3.171	3.116	4.898	4.974	4.933
Oklahoma	3.397	3.283	3.464	5.299	5.203	5.395
Oregon	3.872	3.877	4.141	5.897	6.062	6.380
Pennsylvania	3.111	3.154	3.324	4.840	4.956	5.230
Rhode Island	3.350	3.322	3.888	5.214	5.206	6.084
South Carolina	3.143	3.104	3.097	4.931	4.910	4.899
South Dakota	3.780	4.140	3.666	5.796	6.446	5.656
Tennessee	3.367	3.329	3.242	5.304	5.234	5.132
Texas	3.553	3.558	3.587	5.557	5.649	5.609
Utah	3.354	3.356	3.430	5.207	5.222	5.280
Vermont	4.020	3.814	4.265	6.191	6.033	6.593
Virginia	3.212	3.204	3.234	5.013	5.045	5.033
Washington	3.430	3.412	3.347	5.292	5.340	5.222
West Virginia	3.937	3.868	3.947	5.977	6.036	6.271
Wisconsin	3.399	3.325	3.382	5.259	5.233	5.266
Wyoming	3.824	3.736	3.898	5.941	5.883	6.042

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

	All eligible people			Working poor people		
	FY 2015	FY 2016	FY 2017	FY 2015	FY 2016	FY 2017
Alabama	82.05	83.24	81.59	76.63	77.86	80.65
Alaska	81.06	71.17	74.15	65.82	55.54	57.01
Arizona	70.64	72.09	74.18	59.76	62.31	64.53
Arkansas	71.00	70.70	67.64	64.07	65.77	65.02
California	67.44	69.25	69.60	56.83	56.83	55.57
Colorado	70.24	77.38	77.82	59.15	71.11	60.56
Connecticut	89.04	88.53	89.75	68.48	68.93	74.39
Delaware	100.93	98.61	102.07	84.12	85.01	93.76
District of Columbia	96.41	94.18	93.76	61.32	63.78	42.64
Florida	87.72	90.01	87.81	74.74	73.89	81.25
Georgia	81.56	83.98	84.18	70.72	73.41	69.03
Hawaii	85.93	82.57	82.26	72.95	67.32	73.29
Idaho	82.24	81.00	76.84	77.09	78.17	76.63
Illinois	100.42	98.58	99.10	81.18	80.88	82.95
Indiana	83.21	75.98	71.93	73.57	72.81	66.88
Iowa	84.97	86.04	89.67	76.84	79.58	84.36
Kansas	72.14	75.24	69.48	66.00	76.93	62.89
Kentucky	80.49	73.20	73.42	72.11	65.59	69.83
Louisiana	75.29	81.96	82.49	66.92	73.98	71.25
Maine	86.97	88.99	94.21	77.43	81.18	91.35
Maryland	91.46	89.00	86.47	72.11	67.51	66.86
Massachusetts	83.28	88.47	89.59	58.36	61.86	62.17
Michigan	101.20	95.52	91.30	87.03	88.85	86.36
Minnesota	80.06	80.60	79.39	75.44	78.06	76.43
Mississippi	82.39	80.28	75.09	70.59	68.80	68.00
Missouri	85.55	84.49	83.05	73.36	75.96	74.53
Montana	80.21	85.56	87.54	69.93	81.93	77.26
Nebraska	69.39	78.26	76.27	65.19	75.78	68.81
Nevada	79.56	82.60	84.03	72.93	74.52	79.10
New Hampshire	77.89	78.99	73.91	67.04	70.23	65.81
New Jersey	77.53	79.76	79.49	64.10	62.38	67.99
New Mexico	101.83	106.59	108.40	90.58	94.82	99.60
New York	85.25	89.48	91.12	74.23	75.83	80.82
North Carolina	79.91	84.66	75.09	72.73	79.76	66.56
North Dakota	58.76	61.42	61.99	52.30	58.57	52.68
Ohio	83.49	82.37	79.27	77.84	78.86	77.81
Oklahoma	77.38	79.47	82.46	65.57	69.95	70.38
Oregon	112.78	110.21	109.62	89.85	90.66	92.42
Pennsylvania	90.38	95.47	96.67	81.12	87.10	93.10
Rhode Island	98.31	102.00	105.43	81.54	84.76	94.69
South Carolina	79.50	78.03	77.91	73.14	72.41	72.52
South Dakota	80.70	79.71	79.76	75.85	78.22	76.35
Tennessee	92.50	89.70	89.34	79.82	77.21	79.38
Texas	68.37	71.64	73.17	65.11	68.18	61.54
Utah	67.34	68.87	68.17	61.10	63.91	56.04
Vermont	102.15	99.61	105.62	86.25	88.97	94.53
Virginia	71.41	73.70	74.59	64.12	68.11	64.46
Washington	103.18	100.58	93.89	85.25	84.60	79.72
West Virginia	93.81	93.79	90.08	85.17	84.69	95.43
Wisconsin	96.44	91.74	92.61	87.53	86.62	88.76
Wyoming	56.78	55.48	50.34	52.45	54.98	45.32

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

	All eligible people			Working poor people		
	FY 2015	FY 2016	FY 2017	FY 2015	FY 2016	FY 2017
Alabama	84.05	85.66	83.58	77.97	80.74	82.77
Alaska	83.03	73.24	75.96	66.96	57.60	58.50
Arizona	72.36	74.19	75.99	60.80	64.61	66.23
Arkansas	72.73	72.76	69.29	65.19	68.21	66.73
California	69.08	71.26	71.30	57.82	58.93	57.03
Colorado	71.95	79.63	79.72	60.18	73.74	62.15
Connecticut	91.21	91.11	91.94	69.67	71.48	76.35
Delaware	100.00	100.00	100.00	85.59	88.16	96.22
District of Columbia	98.76	96.92	96.04	62.39	66.14	43.76
Florida	89.86	92.62	89.95	76.04	76.63	83.39
Georgia	83.54	86.42	86.23	71.95	76.13	70.85
Hawaii	88.03	84.97	84.27	74.22	69.81	75.21
Idaho	84.24	83.36	78.72	78.43	81.06	78.64
Illinois	100.00	100.00	100.00	82.59	83.88	85.13
Indiana	85.24	78.19	73.68	74.85	75.50	68.63
Iowa	87.04	88.54	91.86	78.18	82.53	86.58
Kansas	73.90	77.43	71.18	67.15	79.78	64.54
Kentucky	82.45	75.33	75.21	73.36	68.02	71.66
Louisiana	77.13	84.34	84.50	68.08	76.72	73.12
Maine	89.09	91.58	96.51	78.78	84.19	93.75
Maryland	93.68	91.59	88.58	73.36	70.01	68.61
Massachusetts	85.31	91.05	91.77	59.37	64.15	63.80
Michigan	100.00	98.29	93.53	88.55	92.14	88.63
Minnesota	82.01	82.94	81.33	76.76	80.95	78.43
Mississippi	84.40	82.61	76.92	71.81	71.35	69.78
Missouri	87.63	86.94	85.08	74.64	78.78	76.48
Montana	82.16	88.05	89.68	71.15	84.96	79.28
Nebraska	71.08	80.53	78.13	66.33	78.59	70.62
Nevada	81.49	85.00	86.08	74.20	77.28	81.18
New Hampshire	79.79	81.29	75.71	68.21	72.83	67.54
New Jersey	79.42	82.08	81.43	65.21	64.69	69.78
New Mexico	100.00	100.00	100.00	92.16	98.33	100.00
New York	87.33	92.08	93.34	75.53	78.64	82.94
North Carolina	81.86	87.13	76.92	74.00	82.72	68.31
North Dakota	60.19	63.20	63.50	53.21	60.73	54.07
Ohio	85.52	84.76	81.20	79.20	81.79	79.86
Oklahoma	79.26	81.78	84.47	66.71	72.54	72.23
Oregon	100.00	100.00	100.00	91.41	94.02	94.85
Pennsylvania	92.58	98.24	99.02	82.53	90.33	95.54
Rhode Island	100.00	100.00	100.00	82.96	87.90	97.17
South Carolina	81.43	80.30	79.81	74.41	75.09	74.42
South Dakota	82.67	82.02	81.71	77.17	81.12	78.35
Tennessee	94.75	92.31	91.52	81.21	80.07	81.47
Texas	70.04	73.72	74.95	66.25	70.71	63.16
Utah	68.98	70.88	69.84	62.17	66.28	57.52
Vermont	100.00	100.00	100.00	87.75	92.26	97.01
Virginia	73.15	75.84	76.41	65.24	70.64	66.15
Washington	100.00	100.00	96.18	86.74	87.73	81.81
West Virginia	96.10	96.52	92.28	86.66	87.82	97.93
Wisconsin	98.79	94.41	94.87	89.05	89.83	91.09
Wyoming	58.17	57.10	51.57	53.37	57.01	46.51

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

	All eligible people			Working poor people		
	FY 2015	FY 2016	FY 2017	FY 2015	FY 2016	FY 2017
Alabama	2.504	2.641	2.470	3.969	4.095	3.897
Alaska	3.372	3.760	4.043	5.389	4.709	5.602
Arizona	2.283	2.384	2.802	3.332	3.651	4.125
Arkansas	2.250	2.266	2.702	3.695	4.229	4.194
California	1.718	1.555	1.747	2.544	2.482	2.651
Colorado	3.049	3.397	2.955	4.319	4.845	4.188
Connecticut	3.136	3.022	2.995	4.262	4.402	4.435
Delaware	3.215	3.268	3.327	4.813	5.105	5.087
District of Columbia	3.847	3.648	4.568	6.207	7.081	6.675
Florida	2.377	2.538	2.713	4.159	4.072	4.396
Georgia	2.316	2.454	2.438	3.517	3.722	3.581
Hawaii	3.453	3.240	3.329	4.535	4.375	4.808
Idaho	2.602	2.417	2.682	4.028	3.964	3.970
Illinois	2.846	2.742	2.763	3.834	3.847	4.061
Indiana	2.798	2.729	2.750	3.784	4.127	4.280
Iowa	2.894	3.070	3.248	4.251	4.273	4.842
Kansas	2.909	3.294	2.904	4.163	4.899	4.070
Kentucky	2.423	2.618	2.756	3.827	4.223	4.053
Louisiana	2.298	2.070	2.306	3.786	3.767	3.796
Maine	3.322	3.142	3.515	4.943	4.840	5.356
Maryland	3.244	3.211	3.269	4.656	4.721	4.682
Massachusetts	2.940	3.044	3.229	4.345	4.359	4.508
Michigan	3.235	3.014	2.899	4.836	4.928	4.737
Minnesota	3.136	3.128	3.060	4.769	4.979	4.770
Mississippi	2.582	2.726	1.655	4.406	4.115	3.932
Missouri	3.269	3.227	3.310	3.993	3.993	4.046
Montana	3.079	3.208	3.070	4.095	4.719	4.374
Nebraska	3.037	2.962	3.001	4.246	4.426	4.096
Nevada	2.628	2.883	2.836	3.863	4.348	4.334
New Hampshire	3.190	3.182	3.082	4.814	4.950	4.856
New Jersey	2.934	2.957	3.360	4.372	4.270	5.082
New Mexico	3.461	3.797	3.990	4.273	4.549	5.119
New York	2.084	2.290	2.522	3.545	3.757	4.272
North Carolina	2.250	2.283	2.227	3.590	3.797	3.488
North Dakota	2.813	2.750	2.870	4.166	4.451	4.226
Ohio	2.400	2.390	2.382	3.672	3.837	4.013
Oklahoma	2.819	2.889	3.007	3.592	3.880	4.023
Oregon	3.568	3.541	3.875	4.671	5.089	5.631
Pennsylvania	2.483	2.696	2.653	4.056	4.377	4.479
Rhode Island	3.165	3.149	3.660	4.719	4.862	5.617
South Carolina	2.308	2.436	2.373	3.758	3.716	3.820
South Dakota	3.413	3.816	3.466	4.721	5.402	4.729
Tennessee	3.182	3.347	3.067	4.059	4.207	4.092
Texas	1.747	1.650	1.904	2.977	3.162	2.989
Utah	2.559	2.709	2.825	3.686	3.643	3.672
Vermont	3.595	3.605	3.958	5.402	5.817	6.076
Virginia	2.530	2.481	2.627	4.042	4.244	4.196
Washington	2.943	2.865	3.002	4.318	4.473	4.381
West Virginia	3.626	3.577	3.272	4.472	4.850	5.195
Wisconsin	2.807	2.793	2.977	4.260	4.306	4.404
Wyoming	3.283	2.993	2.948	4.664	4.559	4.344

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

.	FY 2015	FY 2016	FY 2017
Alabama	1,023,779	954,300	920,269
Alaska	97,409	112,308	113,529
Arizona	1,206,617	1,119,554	1,038,872
Arkansas	626,643	572,071	541,020
California	5,774,989	5,493,918	5,091,920
Colorado	644,287	563,537	535,603
Connecticut	418,153	407,349	378,981
Delaware	125,242	120,861	116,893
District of Columbia	131,666	128,330	117,227
Florida	3,655,536	3,375,438	3,178,973
Georgia	2,039,037	1,879,232	1,769,221
Hawaii	189,313	186,854	178,617
Idaho	215,079	205,111	200,857
Illinois	1,853,883	1,745,218	1,667,749
Indiana	952,361	919,154	882,955
Iowa	383,291	353,156	335,981
Kansas	369,633	322,970	324,335
Kentucky	892,571	834,472	814,471
Louisiana	1,107,709	1,050,977	1,091,610
Maine	192,818	174,115	150,512
Maryland	723,706	711,122	675,683
Massachusetts	812,605	726,230	731,620
Michigan	1,401,859	1,302,653	1,271,397
Minnesota	494,732	475,309	456,013
Mississippi	726,861	680,529	673,354
Missouri	958,937	919,881	846,022
Montana	130,020	119,224	118,792
Nebraska	231,913	203,815	208,351
Nevada	440,451	436,913	443,409
New Hampshire	114,457	102,184	104,844
New Jersey	1,023,097	957,167	888,663
New Mexico	412,857	426,667	422,153
New York	3,187,280	2,977,099	2,780,284
North Carolina	1,750,917	1,593,147	1,569,448
North Dakota	69,492	68,723	66,918
Ohio	1,776,118	1,718,071	1,690,066
Oklahoma	715,714	719,142	679,213
Oregon	649,726	606,726	563,841
Pennsylvania	1,771,520	1,664,203	1,623,702
Rhode Island	152,879	146,616	137,703
South Carolina	940,221	875,423	858,641
South Dakota	117,212	115,055	112,781
Tennessee	1,282,435	1,192,064	1,124,155
Texas	4,735,547	4,533,803	4,526,204
Utah	322,687	302,858	287,924
Vermont	70,347	67,515	65,838
Virginia	1,148,579	1,047,934	969,624
Washington	884,783	826,941	802,333
West Virginia	352,820	337,647	334,865
Wisconsin	681,703	637,834	618,314
Wyoming	54,585	58,660	62,507

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

	FY 2015	FY 2016	FY 2017
Alabama	442,151	377,152	415,846
Alaska	45,966	59,617	67,964
Arizona	665,840	602,871	587,554
Arkansas	279,722	269,615	238,878
California	3,376,382	3,230,884	2,900,522
Colorado	364,647	289,031	284,381
Connecticut	185,915	195,254	177,032
Delaware	59,569	57,814	54,909
District of Columbia	48,724	43,627	46,045
Florida	1,640,157	1,527,251	1,420,671
Georgia	1,028,513	924,922	892,937
Hawaii	114,078	110,098	97,130
Idaho	133,320	114,702	109,275
Illinois	924,009	881,586	831,403
Indiana	505,771	447,649	440,265
Iowa	213,718	191,632	185,454
Kansas	197,903	149,851	174,148
Kentucky	361,038	312,271	300,303
Louisiana	516,161	446,399	489,668
Maine	81,969	75,339	67,840
Maryland	350,674	376,361	314,671
Massachusetts	330,011	291,153	284,779
Michigan	595,617	627,552	602,129
Minnesota	259,332	253,011	236,670
Mississippi	305,106	326,823	305,347
Missouri	426,454	367,166	411,567
Montana	59,349	54,493	55,097
Nebraska	119,834	108,858	122,829
Nevada	235,250	235,211	205,257
New Hampshire	53,008	43,232	47,688
New Jersey	459,261	446,817	445,606
New Mexico	218,636	203,968	191,237
New York	1,527,950	1,312,624	1,299,945
North Carolina	871,740	801,984	721,191
North Dakota	32,399	33,020	27,216
Ohio	812,443	770,172	785,938
Oklahoma	361,409	333,001	330,162
Oregon	305,516	250,479	236,861
Pennsylvania	760,366	762,264	699,195
Rhode Island	62,365	63,326	43,316
South Carolina	441,749	389,294	406,980
South Dakota	59,949	55,579	52,165
Tennessee	575,619	510,836	466,478
Texas	2,557,259	2,592,681	2,571,649
Utah	200,934	172,359	183,456
Vermont	29,621	29,511	24,865
Virginia	551,160	503,259	468,283
Washington	418,931	414,288	360,713
West Virginia	143,048	123,327	110,943
Wisconsin	367,011	326,920	323,705
Wyoming	31,100	30,164	28,344

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

	FY 2015	FY 2016	FY 2017
Alabama	30,825	29,637	27,377
Alaska	3,998	5,808	6,082
Arizona	38,463	36,239	38,552
Arkansas	19,593	17,948	21,234
California	145,120	120,749	125,572
Colorado	27,595	24,219	19,982
Connecticut	14,530	13,610	12,428
Delaware	3,807	3,864	3,581
District of Columbia	5,182	4,866	5,613
Florida	97,735	93,168	96,528
Georgia	57,127	53,754	50,353
Hawaii	7,505	7,178	7,102
Idaho	6,714	5,990	6,888
Illinois	50,397	46,845	45,013
Indiana	31,594	32,316	33,176
Iowa	12,879	12,333	11,957
Kansas	14,702	13,841	13,320
Kentucky	26,506	29,214	30,045
Louisiana	33,344	25,978	29,986
Maine	7,266	6,017	5,519
Maryland	25,325	25,114	25,099
Massachusetts	28,301	24,457	25,915
Michigan	42,650	40,232	39,670
Minnesota	19,119	18,058	17,270
Mississippi	22,474	22,622	14,582
Missouri	36,154	34,392	33,136
Montana	4,924	4,376	4,094
Nebraska	10,014	7,551	8,056
Nevada	14,356	14,929	14,704
New Hampshire	4,624	4,029	4,296
New Jersey	38,196	34,740	36,912
New Mexico	13,272	13,564	13,748
New York	76,861	74,589	75,611
North Carolina	48,631	42,044	45,748
North Dakota	3,282	3,012	3,045
Ohio	50,368	48,802	49,912
Oklahoma	25,723	25,589	24,337
Oregon	17,551	16,827	17,444
Pennsylvania	48,007	46,003	43,781
Rhode Island	4,822	4,221	4,349
South Carolina	26,931	26,751	25,704
South Dakota	4,890	5,392	4,816
Tennessee	43,522	43,544	37,925
Texas	119,390	102,224	115,724
Utah	12,097	11,661	11,722
Vermont	2,334	2,334	2,241
Virginia	40,138	34,529	33,552
Washington	23,556	22,275	25,207
West Virginia	13,451	12,606	11,953
Wisconsin	19,571	19,010	19,533
Wyoming	3,114	3,098	3,597

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

	FY 2015	FY 2016	FY 2017
Alabama	22,510	19,129	19,588
Alaska	3,699	4,874	6,510
Arizona	36,495	34,068	36,609
Arkansas	15,857	16,718	15,018
California	148,543	136,089	134,887
Colorado	26,171	18,991	19,169
Connecticut	11,374	12,023	10,287
Delaware	3,350	3,347	2,904
District of Columbia	4,847	4,671	7,026
Florida	89,703	81,163	74,917
Georgia	50,276	45,221	45,148
Hawaii	6,970	6,900	6,212
Idaho	6,847	5,609	5,519
Illinois	42,889	40,429	39,674
Indiana	25,571	24,468	27,468
Iowa	11,622	9,922	10,376
Kansas	12,269	9,202	10,986
Kentucky	18,835	19,387	16,989
Louisiana	28,702	21,918	25,428
Maine	5,143	4,331	3,877
Maryland	22,255	25,379	21,482
Massachusetts	24,152	19,780	20,128
Michigan	32,530	33,561	32,197
Minnesota	16,114	15,561	14,398
Mississippi	18,720	18,849	17,211
Missouri	22,813	18,609	21,781
Montana	3,416	3,027	3,041
Nebraska	7,671	6,131	7,127
Nevada	12,249	13,232	10,962
New Hampshire	3,741	2,938	3,430
New Jersey	30,790	29,488	32,466
New Mexico	10,138	9,435	9,374
New York	71,721	62,709	66,973
North Carolina	42,297	36,810	36,839
North Dakota	2,536	2,420	2,128
Ohio	37,664	36,128	39,514
Oklahoma	19,457	17,811	18,399
Oregon	15,610	13,559	14,068
Pennsylvania	37,371	36,933	32,788
Rhode Island	3,547	3,503	2,505
South Carolina	22,311	19,268	20,899
South Dakota	3,667	3,702	3,150
Tennessee	28,767	26,839	23,440
Texas	114,902	115,932	121,761
Utah	11,913	9,474	11,718
Vermont	1,824	1,861	1,558
Virginia	34,145	30,236	29,714
Washington	20,854	21,124	19,323
West Virginia	7,383	6,810	5,887
Wisconsin	17,557	15,669	15,656
Wyoming	2,718	2,412	2,648

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APPENDIX B

DATA FOR FIGURES IN CUNNYNGHAM (AUGUST 2020)

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Table B.1a. How many people were eligible in 2017? What percentage participated? (States)

Eligible people (thousands)	State	Lower bound of confidence interval	FY 2017 participation rate	Upper bound of confidence interval
564	Oregon *	94	100	100
422	New Mexico *	93	100	100
66	Vermont *	93	100	100
138	Rhode Island *	94	100	100
117	Delaware *	95	100	100
1,668	Illinois *	95	100	100
1,624	Pennsylvania *	95	99	100
151	Maine *	91	97	100
802	Washington *	91	96	100
117	District of Columbia *	89	96	100
618	Wisconsin *	90	95	100
1,271	Michigan *	89	94	98
2,780	New York *	89	93	97
335	West Virginia *	87	92	98
379	Connecticut *	87	92	97
336	Iowa *	87	92	97
732	Massachusetts *	86	92	97
1,124	Tennessee *	86	92	97
3,179	Florida *	85	90	94
119	Montana *	85	90	95
676	Maryland *	83	89	94
1,769	Georgia	82	86	90
443	Nevada	81	86	91
846	Missouri	80	85	91
1,092	Louisiana	81	85	88
679	Oklahoma	80	84	89
179	Hawaii	79	84	90
920	Alabama	80	84	88
113	South Dakota	76	82	87
889	New Jersey	76	81	87
456	Minnesota	76	81	86
1,690	Ohio	77	81	85
859	South Carolina *	76	80	84
536	Colorado *	75	80	85
201	Idaho *	74	79	83
208	Nebraska *	73	78	83
673	Mississippi *	74	77	80
1,569	North Carolina *	73	77	81
970	Virginia *	72	76	81
1,039	Arizona *	71	76	81
114	Alaska *	69	76	83
105	New Hampshire *	71	76	81
814	Kentucky *	71	75	80
4,526	Texas *	72	75	78
883	Indiana *	69	74	78
5,092	California *	68	71	74
324	Kansas *	66	71	76
288	Utah *	65	70	74
541	Arkansas *	65	69	74
67	North Dakota *	59	63	68
63	Wyoming *	47	52	56

*State's participation rate is significantly different from the national participation rate of 84 percent.

Table B.1b. How many people were eligible in 2017? What percentage participated? (Regions and national)

Eligible people (thousands)	Region	Lower bound of confidence interval	FY 2017 participation rate	Upper bound of confidence interval
4,350	Northeast Region	90	93	96
4,727	Mid-Atlantic Region	86	89	92
6,586	Midwest Region	86	89	91
10,909	Southeast Region	82	84	86
2,899	Mountain Plains Region	77	80	83
7,260	Southwest Region	76	78	81
8,433	Western Region	75	77	80
45,164	United States	83	84	85

Table B.2a. How many working poor people were eligible in 2017? What percentage participated? (States)

Eligible people (thousands)	State	Lower bound of confidence interval	FY 2017 participation rate	Upper bound of confidence interval
191	New Mexico *	92	100	100
111	West Virginia *	89	98	100
43	Rhode Island *	88	97	100
25	Vermont *	87	97	100
55	Delaware *	88	96	100
699	Pennsylvania *	88	96	100
237	Oregon *	86	95	100
68	Maine *	85	94	100
324	Wisconsin *	84	91	98
602	Michigan *	81	89	96
185	Iowa *	79	87	95
831	Illinois *	78	85	92
1,421	Florida *	76	83	91
1,300	New York *	76	83	90
416	Alabama *	76	83	89
361	Washington *	75	82	89
466	Tennessee *	75	81	88
205	Nevada *	74	81	88
786	Ohio *	73	80	86
55	Montana *	72	79	86
109	Idaho *	72	79	85
237	Minnesota	71	78	86
52	South Dakota	71	78	86
412	Missouri	70	76	83
177	Connecticut	69	76	84
97	Hawaii	67	75	83
407	South Carolina	68	74	81
490	Louisiana	67	73	79
330	Oklahoma	66	72	79
300	Kentucky	65	72	78
893	Georgia	65	71	77
123	Nebraska	64	71	77
305	Mississippi	63	70	76
446	New Jersey	61	70	78
440	Indiana	62	69	76
315	Maryland	61	69	76
721	North Carolina *	63	68	74
48	New Hampshire	60	68	76
239	Arkansas *	60	67	74
588	Arizona *	59	66	73
468	Virginia *	59	66	73
174	Kansas *	58	65	71
285	Massachusetts *	56	64	71
2,572	Texas *	58	63	68
284	Colorado *	55	62	69
68	Alaska *	49	59	68
183	Utah *	51	58	64
2,901	California *	53	57	61
27	North Dakota *	47	54	61
28	Wyoming *	39	47	54
46	District of Columbia *	33	44	55

*State's participation rate is significantly different from the national participation rate of 73 percent.

Table B.2b. How many working poor people were eligible in 2017? What percentage participated? (Regions and national)

Eligible people (thousands)	Region	Lower bound of confidence interval	FY 2017 participation rate	Upper bound of confidence interval
3,220	Midwest Region	78	82	86
1,945	Northeast Region	75	80	85
2,140	Mid-Atlantic Region	74	79	83
4,930	Southeast Region	73	76	80
1,525	Mountain Plains Region	67	70	74
3,822	Southwest Region	63	67	71
4,565	Western Region	61	64	68
22,147	United States	71	73	75

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

	All eligible people			Working poor people		
	FY 2015	FY 2016	FY 2017	FY 2015	FY 2016	FY 2017
Alabama	84	86	84	78	81	83
Alaska	83	73	76	67	58	59
Arizona	72	74	76	61	65	66
Arkansas	73	73	69	65	68	67
California	69	71	71	58	59	57
Colorado	72	80	80	60	74	62
Connecticut	91	91	92	70	71	76
Delaware	100	100	100	86	88	96
District of Columbia	99	97	96	62	66	44
Florida	90	93	90	76	77	83
Georgia	84	86	86	72	76	71
Hawaii	88	85	84	74	70	75
Idaho	84	83	79	78	81	79
Illinois	100	100	100	83	84	85
Indiana	85	78	74	75	76	69
Iowa	87	89	92	78	83	87
Kansas	74	77	71	67	80	65
Kentucky	82	75	75	73	68	72
Louisiana	77	84	85	68	77	73
Maine	89	92	97	79	84	94
Maryland	94	92	89	73	70	69
Massachusetts	85	91	92	59	64	64
Michigan	100	98	94	89	92	89
Minnesota	82	83	81	77	81	78
Mississippi	84	83	77	72	71	70
Missouri	88	87	85	75	79	76
Montana	82	88	90	71	85	79
Nebraska	71	81	78	66	79	71
Nevada	81	85	86	74	77	81
New Hampshire	80	81	76	68	73	68
New Jersey	79	82	81	65	65	70
New Mexico	100	100	100	92	98	100
New York	87	92	93	76	79	83
North Carolina	82	87	77	74	83	68
North Dakota	60	63	63	53	61	54
Ohio	86	85	81	79	82	80
Oklahoma	79	82	84	67	73	72
Oregon	100	100	100	91	94	95
Pennsylvania	93	98	99	83	90	96
Rhode Island	100	100	100	83	88	97
South Carolina	81	80	80	74	75	74
South Dakota	83	82	82	77	81	78
Tennessee	95	92	92	81	80	81
Texas	70	74	75	66	71	63
Utah	69	71	70	62	66	58
Vermont	100	100	100	88	92	97
Virginia	73	76	76	65	71	66
Washington	100	100	96	87	88	82
West Virginia	96	97	92	87	88	98
Wisconsin	99	94	95	89	90	91
Wyoming	58	57	52	53	57	47
Mid-Atlantic Region	87	89	89	74	77	79
Midwest Region	93	91	89	82	84	82
Mountain Plains Region	78	81	80	68	76	70
Northeast Region	88	92	93	73	76	80
Southeast Region	86	87	84	75	77	76
Southwest Region	74	78	78	68	73	67
Western Region	76	77	77	64	65	64
United States	83	85	84	72	75	73

Table B.4. How did your state rank in 2017?

FY 2017 participation rate	State	Upper bound of confidence interval	FY 2016 rank	Lower bound of confidence interval
100	Oregon	1	1	4
100	New Mexico	1	2	4
100	Vermont	1	3	6
100	Rhode Island	1	4	5
100	Delaware	3	5	7
100	Illinois	4	6	9
99	Pennsylvania	6	7	11
97	Maine	6	8	17
96	Washington	7	9	16
96	District of Columbia	5	10	20
95	Wisconsin	7	11	18
94	Michigan	8	12	20
93	New York	9	13	19
92	West Virginia	9	14	22
92	Connecticut	10	15	22
92	Iowa	9	16	22
92	Massachusetts	9	17	23
92	Tennessee	10	18	23
90	Florida	12	19	25
90	Montana	12	20	26
89	Maryland	13	21	27
86	Georgia	18	22	29
86	Nevada	17	23	31
85	Missouri	18	24	33
85	Louisiana	20	25	32
84	Oklahoma	19	26	34
84	Hawaii	19	27	35
84	Alabama	21	28	34
82	South Dakota	22	29	40
81	New Jersey	22	30	40
81	Minnesota	23	31	39
81	Ohio	25	32	38
80	South Carolina	27	33	40
80	Colorado	26	34	42
79	Idaho	28	35	42
78	Nebraska	28	36	44
77	Mississippi	33	37	43
77	North Carolina	32	38	44
76	Virginia	32	39	45
76	Arizona	32	40	46
76	Alaska	29	41	48
76	New Hampshire	32	42	47
75	Kentucky	33	43	47
75	Texas	36	44	46
74	Indiana	37	45	48
71	California	43	46	49
71	Kansas	41	47	49
70	Utah	43	48	49
69	Arkansas	44	49	50
63	North Dakota	49	50	50
52	Wyoming	51	51	51

Table B.5a. How did your state compare with other states in 2017 for all eligibles? (Oregon–Massachusetts)

	OR	NM	VT	RI	DE	IL	PA	ME	WA	DC	WI	MI	NY	WV	CT	IA	MA
OR		-	-	-	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
VT	-	-		-	-	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
DE	H	H	-	-		-	L	L	L	L	L	L	L	L	L	L	L
IL	H	H	H	H	-		-	-	L	-	L	L	L	L	L	L	L
PA	H	H	H	H	H	-		-	-	-	-	L	L	L	L	L	L
ME	H	H	H	H	H	-	-		-	-	-	-	-	-	-	-	-
WA	H	H	H	H	H	H	-	-		-	-	-	-	-	-	-	-
DC	H	H	H	H	H	-	-	-	-		-	-	-	-	-	-	-
WI	H	H	H	H	H	H	-	-	-	-		-	-	-	-	-	-
MI	H	H	H	H	H	H	H	-	-	-	-		-	-	-	-	-
NY	H	H	H	H	H	H	H	-	-	-	-	-		-	-	-	-
WV	H	H	H	H	H	H	H	-	-	-	-	-	-		-	-	-
CT	H	H	H	H	H	H	H	-	-	-	-	-	-	-		-	-
IA	H	H	H	H	H	H	H	-	-	-	-	-	-	-	-		-
MA	H	H	H	H	H	H	H	-	-	-	-	-	-	-	-	-	
TN	H	H	H	H	H	H	H	-	-	-	-	-	-	-	-	-	-
FL	H	H	H	H	H	H	H	H	H	-	-	-	-	-	-	-	-
MT	H	H	H	H	H	H	H	H	H	-	H	-	-	-	-	-	-
MD	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	H
NV	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	-
MO	H	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	H
OK	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
HI	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
SD	H	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
MN	H	H	H	H	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	H
SC	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
ID	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
MS	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
VA	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
AK	H	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
KY	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
IN	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
KS	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
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 2017 for all eligibles? (Tennessee–Colorado)

. .	TN	FL	MT	MD	GA	NV	MO	LA	OK	HI	AL	SD	NJ	MN	OH	SC	CO
OR	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
VT	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
DE	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
ME	-	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
DC	-	-	-	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
MI	-	-	-	-	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
WV	-	-	-	-	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
IA	-	-	-	-	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
TN		-	-	-	L	L	L	L	L	L	L	L	L	L	L	L	L
FL	-		-	-	-	-	-	L	L	L	L	L	L	L	L	L	L
MT	-	-		-	-	-	-	L	L	-	L	L	L	L	L	L	L
MD	-	-	-		-	-	-	-	-	-	-	L	L	L	L	L	L
GA	H	-	-	-		-	-	-	-	-	-	-	-	-	L	L	L
NV	H	-	-	-	-		-	-	-	-	-	-	-	-	L	L	L
MO	H	-	-	-	-	-		-	-	-	-	-	-	-	-	L	-
LA	H	H	H	-	-	-	-		-	-	-	-	-	-	-	L	-
OK	H	H	H	-	-	-	-	-		-	-	-	-	-	-	L	-
HI	H	H	-	-	-	-	-	-	-		-	-	-	-	-	-	-
AL	H	H	H	-	-	-	-	-	-	-		-	-	-	-	-	-
SD	H	H	H	H	-	-	-	-	-	-	-		-	-	-	-	-
NJ	H	H	H	H	-	-	-	-	-	-	-	-		-	-	-	-
MN	H	H	H	H	-	-	-	-	-	-	-	-	-		-	-	-
OH	H	H	H	H	H	H	-	-	-	-	-	-	-	-		-	-
SC	H	H	H	H	H	H	H	H	H	-	-	-	-	-	-		-
CO	H	H	H	H	H	H	-	-	-	-	-	-	-	-	-	-	
ID	H	H	H	H	H	H	H	H	H	-	H	-	-	-	-	-	-
NE	H	H	H	H	H	H	H	H	H	-	H	-	-	-	-	-	-
MS	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	-	-
VA	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	-	-
AK	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	-	-
KY	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
IN	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
KS	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
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 2017 for all eligibles? (Idaho–Wyoming)

..	ID	NE	MS	NC	VA	AZ	AK	NH	KY	TX	IN	CA	KS	UT	AR	ND	WY
OR	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
VT	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
DE	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
ME	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
DC	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
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
WV	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
IA	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
TN	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
MT	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
GA	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
MO	L	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	L
OK	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
AL	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
SD	-	-	-	-	-	-	-	L	L	L	L	L	L	L	L	L	L
NJ	-	-	-	-	L	-	-	L	L	L	L	L	L	L	L	L	L
MN	-	-	-	-	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
SC	-	-	-	-	-	-	-	-	L	L	L	L	L	L	L	L	L
CO	-	-	-	-	-	-	-	-	-	L	L	L	L	L	L	L	L
ID		-	-	-	-	-	-	-	-	-	L	L	L	L	L	L	L
NE	-		-	-	-	-	-	-	-	-	-	L	L	L	L	L	L
MS	-	-		-	-	-	-	-	-	-	-	L	L	L	L	L	L
NC	-	-	-		-	-	-	-	-	-	-	L	L	L	L	L	L
VA	-	-	-	-		-	-	-	-	-	-	L	L	L	L	L	L
AZ	-	-	-	-	-		-	-	-	-	-	L	-	L	L	L	L
AK	-	-	-	-	-	-		-	-	-	-	-	-	L	L	L	L
NH	-	-	-	-	-	-	-		-	-	-	L	-	L	L	L	L
KY	-	-	-	-	-	-	-	-		-	-	-	-	L	L	L	L
TX	-	-	-	-	-	-	-	-	-		-	L	-	L	L	L	L
IN	H	-	-	-	-	-	-	-	-	-		-	-	-	-	L	L
CA	H	H	H	H	H	H	-	H	-	H	-		-	-	-	L	L
KS	H	H	H	H	H	-	-	-	-	-	-	-		-	-	L	L
UT	H	H	H	H	H	H	H	H	H	H	-	-	-		-	L	L
AR	H	H	H	H	H	H	H	H	H	H	-	-	-	-		L	L
ND	H	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 2017 participation rate for all eligible people		
Above 92 percent (top quarter)	**Between 77 and 92 percent**	**Below 77 percent (bottom quarter)**
Oregon	West Virginia	Virginia
New Mexico	Connecticut	Arizona
Vermont	Iowa	Alaska
Rhode Island	Massachusetts	New Hampshire
Delaware	Tennessee	Kentucky
Illinois	Florida	Texas
Pennsylvania	Montana	Indiana
Maine	Maryland	California
Washington	Georgia	Kansas
District of Columbia	Nevada	Utah
Wisconsin	Missouri	Arkansas
Michigan	Louisiana	North Dakota
New York	Oklahoma	Wyoming
	Hawaii	
	Alabama	
	South Dakota	
	New Jersey	
	Minnesota	
	Ohio	
	South Carolina	
	Colorado	
	Idaho	
	Nebraska	
	Mississippi	
	North Carolina	

Table B.7. Supporting detail for Cunnyngham (August 2020)

Description	States		
In 20 states and the District of Columbia, the participation rate for all eligible people was significantly higher than the national rate	Connecticut Delaware District of Columbia Florida Illinois Iowa Maine	Maryland Massachusetts Michigan Montana New Mexico New York Oregon	Pennsylvania Rhode Island Tennessee Vermont Washington West Virginia Wisconsin
In 19 states, the participation rate for all eligible people was significantly lower than the national rate	Alaska Arizona Arkansas California Colorado Idaho Indiana	Kansas Kentucky Mississippi Nebraska New Hampshire North Carolina	North Dakota South Carolina Texas Utah Virginia Wyoming
In 21 states, the participation rate for eligible working poor people was significantly higher than the national rate	Alabama Delaware Florida Idaho Illinois Iowa Maine	Michigan Montana Nevada New Mexico New York Ohio Oregon	Pennsylvania Rhode Island Tennessee Vermont Washington West Virginia Wisconsin
In 13 states and the District of Columbia, the participation rate for eligible working poor people was significantly lower than the national rate	Alaska Arizona Arkansas California Colorado	District of Columbia Kansas Massachusetts North Carolina North Dakota	Texas Utah Virginia Wyoming
In 32 states and the District of Columbia, the participation rate for working poor people was significantly lower than the rate for all eligible people	Alaska Arizona California Colorado Connecticut Delaware District of Columbia Florida Georgia Hawaii Illinois	Kansas Louisiana Maryland Massachusetts Mississippi Missouri Montana Nebraska New Hampshire New Jersey New York	North Carolina North Dakota Oklahoma Oregon Rhode Island Tennessee Texas Utah Vermont Virginia Washington
In 8 states and the District of Columbia, the difference between the rates for working poor people and all eligible people was significantly greater than 10 percentage points	Alaska California Colorado	District of Columbia Georgia Illinois	Maryland Massachusetts Oregon