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REPORT

FINAL REPORT

Empirical Bayes Shrinkage Estimates of State Supplemental Nutrition Assistance Program Participation Rates in Fiscal Year 2014 to Fiscal Year 2016 for All Eligible People and Working Poor People

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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 2018, the program served 40 million people in an average month at a total annual cost of $61 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 2014 to 2016. 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 2016 participation rates for all eligible people were 58 percent as wide as the corresponding direct confidence intervals. This report describes our shrinkage estimator in detail.

Final shrinkage estimates for FY 2014 and FY 2015 presented in this report differ slightly from the estimates presented in Cunnyngham (2018a) and Cunnyngham (2018b) because of annual data updates. As a result, the estimates presented in this report should not be compared to those published in earlier reports.

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) 2018, the program served 40 million people in an average month at a total annual cost of $61 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 2014 to FY 2016. The estimates presented here are also reported and compared with one another in Cunnyngham (2019). 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 (2019).

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

> **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.

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.

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 Hawaii's FY 2016 SNAP participation rate, we used only FY 2016 CPS ASEC data on households from Hawaii. Because of the potential errors introduced by the CPS ASEC surveying a small number of families in Hawaii, we can be confident—by a commonly used standard—only that Hawaii's SNAP participation rate in FY 2016 was between about 72 and 88 percent. This range is wide, although typical, reflecting our substantial uncertainty about what Hawaii'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 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 measured by the percentage of all people (eligible and ineligible combined)

who received SNAP benefits, in contrast to the SNAP participation rate, which is measured by

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.

Figure I.1. An illustrative regression estimator
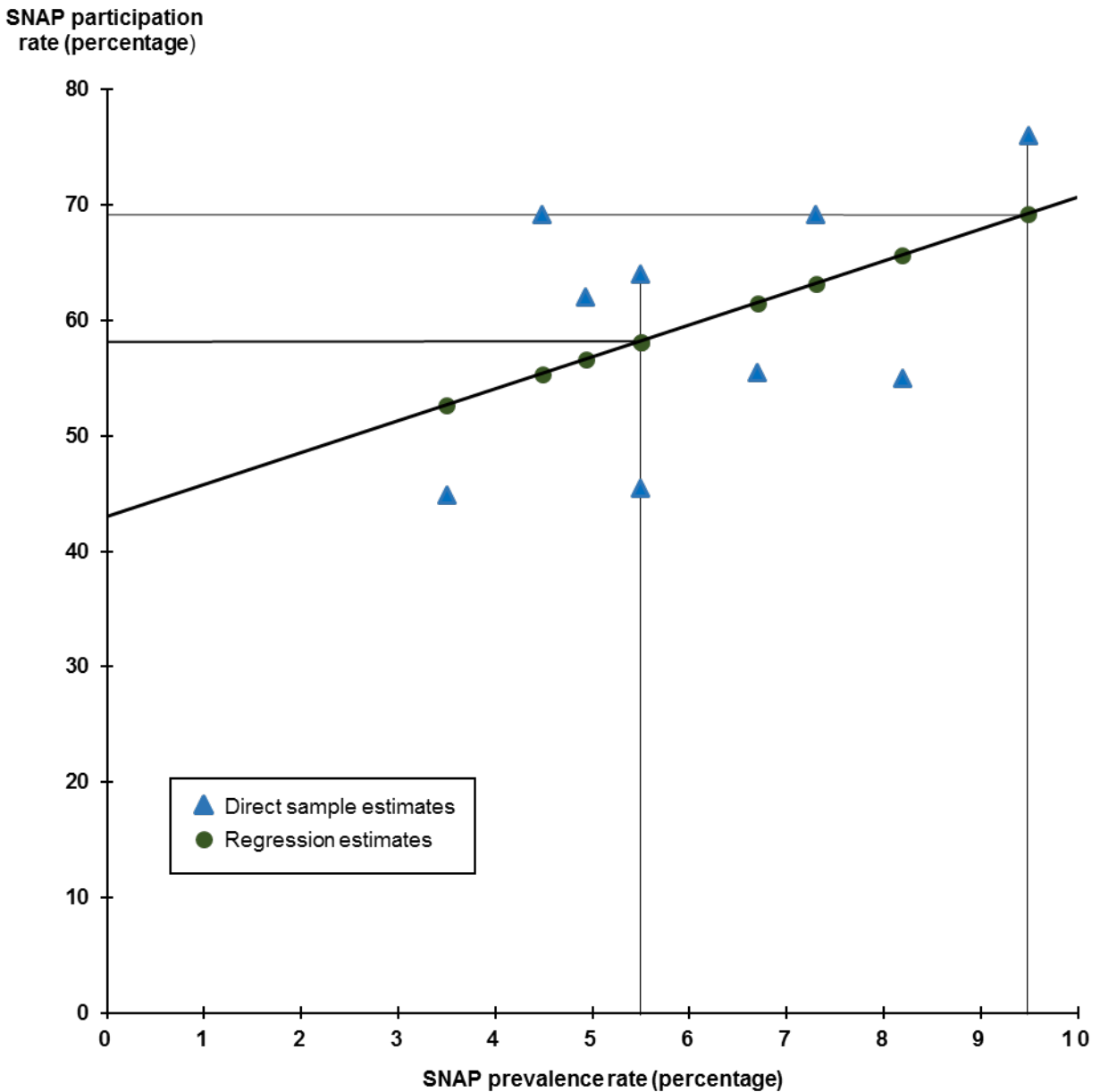
Comparison of direct and regression estimators. Comparing how the direct and regression estimators use data reveals how the regression estimator borrows strength to improve precision. Using Hawaii as an example again, we used only one year of CPS ASEC sample data from the state to estimate Hawaii's participation 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 Hawaii) to predict Hawaii'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.

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 really 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
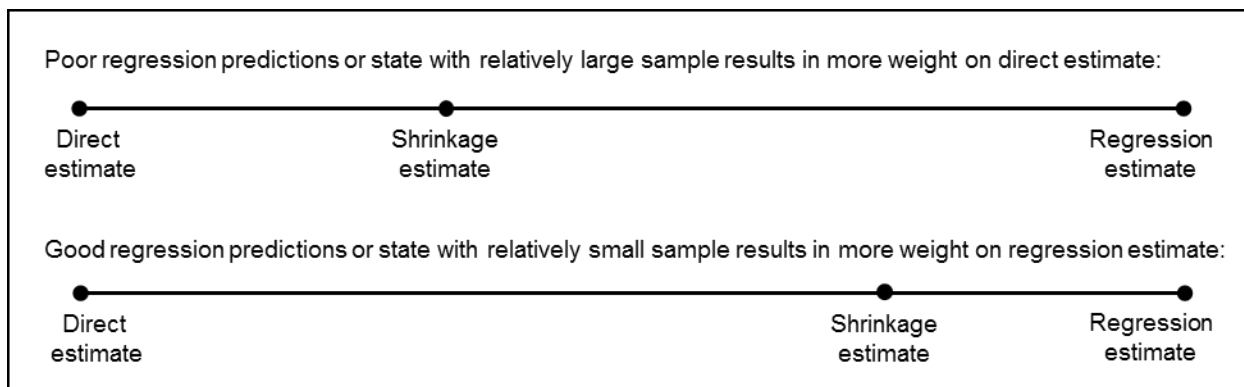
The direct and regression estimates are optimally weighted to improve accuracy by

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.

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 2014 to FY 2016. 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 2016 (October 2015 through September 2016) from the 2016 and 2017 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
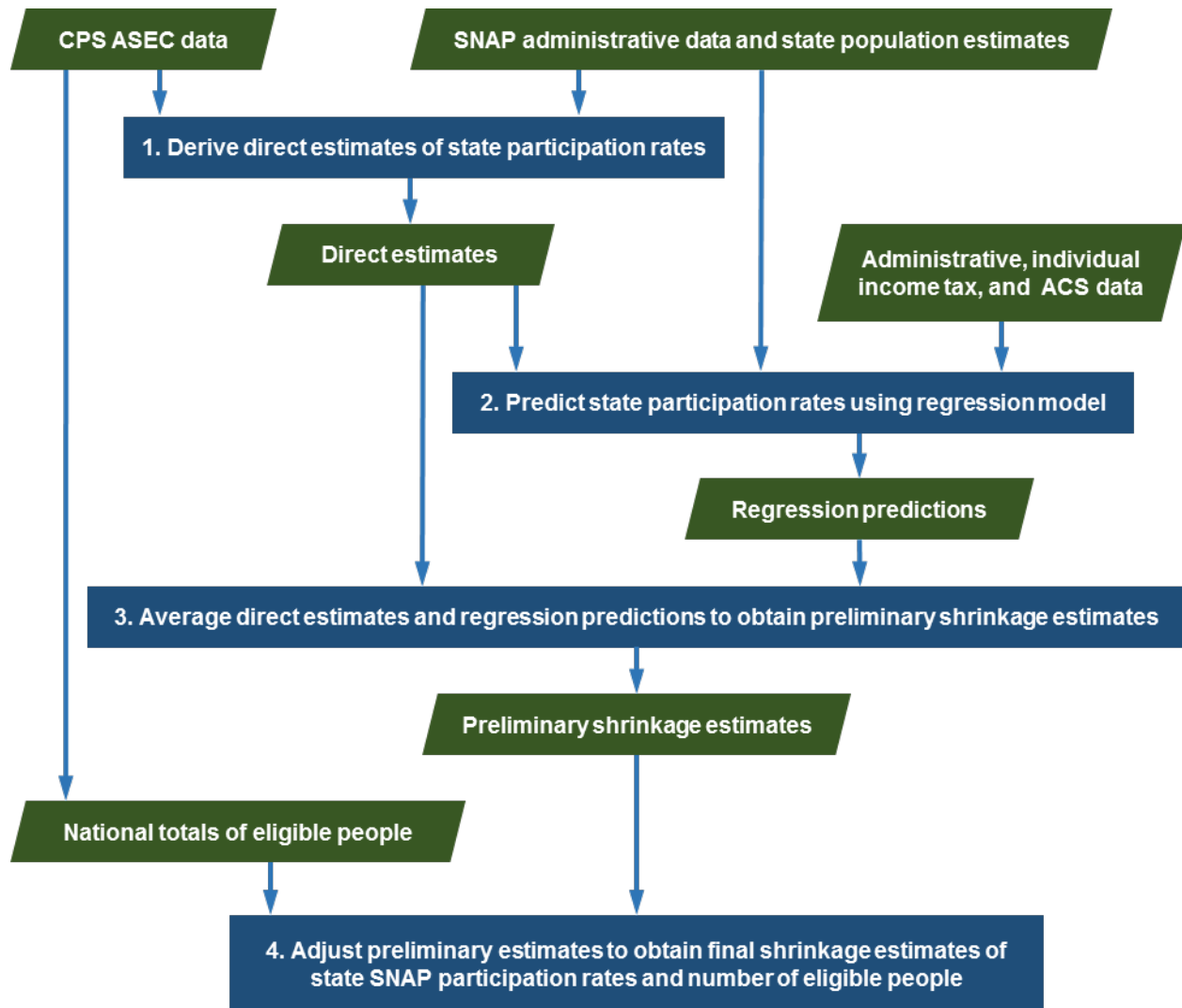
CPS ASEC = Current Population Survey Annual Social and Economic Supplement; ACS = American Community
Survey; SNAP = Supplemental Nutrition Assistance Program.

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 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
5. Percentage of people age 25 and older who have completed a bachelor's degree according to ACS one-year estimates
6. Percentage of households with earnings 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. Four predictors listed

above—the first, second, fourth, and seventh—were included in last year's model. The predictors

used in the previous model but not the current one were median household income and the

percentages of (1) renter-occupied housing units that spent 50 percent or more of household

income on rent and utilities and (2) civilian employed individuals age 16 and older who were in

service occupations according to ACS one-year 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 2016 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 2016,

the state estimates of eligible people summed to 48,131,899, whereas the national total estimated

directly from the CPS ASEC was 47,070,082. 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 $47,070,082 / 48,131,899$ (≈ 0.9779). 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—Illinois, New Mexico, Oregon, Rhode Island, Vermont, and Washington—had fewer estimated eligible people than estimated eligible participants in FY 2016, 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 Illinois, New Mexico, Oregon, Rhode Island, Vermont, and Washington 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 half 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 2014 to FY 2016 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 Hawaii's participation rate for all eligible people was 84 percent in FY 2016 (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 79 and 88 percent, an interval that is 58 percent as wide as the interval (72 and 88 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 2016 participation rates for all eligible people were 58 percent as wide as 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 (2019), 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 2014 and FY 2015 presented in this report differ slightly

from the estimates presented in Cunnyngham (2018a) and Cunnyngham (2018b) for three

reasons:

1. **The shrinkage estimator uses data from three years to estimate participation rates for each year.** Annually, data for the most recent year are added and data for the oldest year are dropped. As a result, the estimates for 2014 and 2015 presented in this report are based on 2014 to 2016 data, and the corresponding estimates published in Cunnyngham (2018a) and Cunnyngham (2018b) are based on 2013 to 2015 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 2013 data (used in the previous estimates) and 2016 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 2014	FY 2015	FY 2016	FY 2014	FY 2015	FY 2016
Alabama	82	85	87	69	76	79
Alaska	80	82	71	65	67	59
Arizona	70	72	74	58	61	66
Arkansas	72	73	72	62	65	68
California	65	68	72	50	57	61
Colorado	78	75	78	68	63	69
Connecticut	91	91	91	73	69	73
Delaware	98	100	99	84	86	86
District of Columbia	98	100	97	55	63	64
Florida	91	91	92	75	77	75
Georgia	86	85	86	70	73	74
Hawaii	87	83	84	73	72	72
Idaho	86	83	84	83	78	82
Illinois	100	100	100	82	82	82
Indiana	86	84	80	81	74	79
Iowa	93	90	88	85	80	79
Kansas	79	76	77	76	67	74
Kentucky	85	81	76	74	73	71
Louisiana	74	78	84	62	70	76
Maine	97	90	90	84	78	80
Maryland	94	91	91	76	73	73
Massachusetts	90	84	91	68	61	67
Michigan	100	100	100	96	88	96
Minnesota	88	84	84	83	75	79
Mississippi	83	85	83	69	75	74
Missouri	87	88	89	73	73	77
Montana	84	83	87	79	72	82
Nebraska	78	76	80	75	69	76
Nevada	68	79	83	61	73	77
New Hampshire	83	78	80	76	67	70
New Jersey	77	77	81	68	64	69
New Mexico	93	100	100	84	95	100
New York	89	87	93	77	76	81
North Carolina	79	83	86	67	74	78
North Dakota	66	64	62	65	57	59
Ohio	87	88	85	80	79	80
Oklahoma	77	79	82	58	65	69
Oregon	100	100	100	93	92	92
Pennsylvania	89	91	99	82	81	91
Rhode Island	96	98	100	82	83	90
South Carolina	78	82	80	68	75	73
South Dakota	90	90	83	87	81	82
Tennessee	99	95	93	81	81	79
Texas	73	70	73	65	67	70
Utah	71	69	70	65	63	65
Vermont	100	100	100	97	86	97
Virginia	79	74	75	72	66	70
Washington	100	100	100	89	86	88
West Virginia	86	91	95	81	85	91
Wisconsin	100	97	94	97	90	91
Wyoming	60	58	56	60	55	57
United States	83	83	85	70	72	75

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

	All eligible people			Working poor people		
	FY 2014	FY 2015	FY 2016	FY 2014	FY 2015	FY 2016
Alabama	1,055	1,014	941	449	455	387
Alaska	109	98	115	56	46	58
Arizona	1,281	1,217	1,130	752	661	593
Arkansas	661	627	575	317	278	270
California	6,096	5,844	5,442	3,483	3,436	3,140
Colorado	603	616	574	319	350	309
Connecticut	402	420	406	176	187	192
Delaware	125	125	122	62	59	59
District of Columbia	129	130	129	45	48	45
Florida	3,587	3,614	3,410	1,551	1,620	1,557
Georgia	1,964	2,016	1,880	987	1,014	956
Hawaii	197	202	190	109	118	107
Idaho	223	219	202	125	135	113
Illinois	1,809	1,854	1,745	853	933	901
Indiana	1,021	969	902	503	509	428
Iowa	375	372	357	202	209	200
Kansas	370	358	325	192	197	161
Kentucky	907	903	825	365	361	301
Louisiana	1,141	1,096	1,061	528	501	451
Maine	205	192	176	90	82	79
Maryland	720	744	717	323	352	361
Massachusetts	836	821	730	301	322	278
Michigan	1,503	1,402	1,285	678	602	604
Minnesota	497	484	469	267	266	258
Mississippi	758	719	680	322	294	316
Missouri	978	950	896	432	438	375
Montana	133	129	120	59	58	56
Nebraska	210	218	205	108	114	113
Nevada	480	452	446	236	239	237
New Hampshire	116	116	104	52	54	45
New Jersey	1,036	1,062	967	490	465	422
New Mexico	430	413	427	214	212	201
New York	3,164	3,196	2,956	1,489	1,513	1,278
North Carolina	1,806	1,717	1,609	758	869	845
North Dakota	64	65	70	31	30	34
Ohio	1,841	1,735	1,715	803	817	784
Oklahoma	745	720	720	371	372	350
Oregon	663	650	607	295	304	256
Pennsylvania	1,782	1,799	1,653	704	776	755
Rhode Island	160	155	147	68	62	62
South Carolina	1,016	931	883	467	441	398
South Dakota	109	108	114	54	57	55
Tennessee	1,311	1,281	1,186	582	579	517
Texas	4,841	4,745	4,560	2,755	2,538	2,615
Utah	320	321	306	183	198	175
Vermont	77	70	68	31	30	28
Virginia	1,159	1,141	1,053	573	545	506
Washington	872	885	827	364	424	415
West Virginia	389	373	342	135	145	119
Wisconsin	694	695	640	343	364	321
Wyoming	58	55	60	30	30	30
United States	51,026	50,036	47,070	24,682	24,709	23,117

Table III.3. Approximate 90 percent confidence intervals for final shrinkage estimates for FY 2014, all eligible people

	Participation rate (percentage)		Number of eligible people (thousands)	
	Lower bound	Upper bound	Lower bound	Upper bound
Alabama	78	86	1,002	1,109
Alaska	74	86	100	117
Arizona	66	73	1,211	1,351
Arkansas	68	76	623	699
California	62	67	5,859	6,334
Colorado	73	82	565	640
Connecticut	85	96	379	426
Delaware	93	100	119	132
District of Columbia	91	100	120	138
Florida	87	94	3,441	3,732
Georgia	82	90	1,869	2,059
Hawaii	82	92	186	209
Idaho	81	92	210	237
Illinois	96	100	1,729	1,888
Indiana	81	91	959	1,083
Iowa	88	99	354	397
Kansas	75	84	349	391
Kentucky	81	89	863	951
Louisiana	70	78	1,083	1,199
Maine	92	100	194	215
Maryland	89	99	681	758
Massachusetts	85	95	789	883
Michigan	95	100	1,425	1,581
Minnesota	84	93	470	524
Mississippi	79	87	723	793
Missouri	81	93	914	1,042
Montana	79	89	125	141
Nebraska	73	82	197	222
Nevada	64	72	452	508
New Hampshire	78	88	109	123
New Jersey	72	81	974	1,097
New Mexico	88	99	405	454
New York	86	93	3,037	3,291
North Carolina	75	82	1,724	1,888
North Dakota	60	72	58	69
Ohio	83	91	1,753	1,929
Oklahoma	72	81	701	790
Oregon	94	100	632	693
Pennsylvania	85	93	1,701	1,862
Rhode Island	91	100	151	168
South Carolina	74	82	959	1,073
South Dakota	84	96	102	116
Tennessee	94	100	1,245	1,377
Texas	70	76	4,652	5,029
Utah	66	76	298	342
Vermont	94	100	73	81
Virginia	74	83	1,090	1,228
Washington	95	100	833	910
West Virginia	81	92	364	414
Wisconsin	95	100	660	729
Wyoming	55	65	54	63
United States	82	84	50,369	51,683

Table III.4. 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	81	89	962	1,066
Alaska	77	88	91	105
Arizona	68	75	1,153	1,281
Arkansas	69	76	595	659
California	65	71	5,589	6,099
Colorado	70	80	575	658
Connecticut	86	96	395	445
Delaware	94	100	118	132
District of Columbia	94	100	122	138
Florida	87	95	3,454	3,774
Georgia	81	89	1,919	2,112
Hawaii	78	87	190	213
Idaho	78	87	207	231
Illinois	95	100	1,771	1,937
Indiana	79	89	912	1,026
Iowa	85	95	350	394
Kansas	72	81	336	380
Kentucky	77	86	858	948
Louisiana	74	82	1,041	1,150
Maine	84	95	180	203
Maryland	86	96	702	786
Massachusetts	80	89	773	869
Michigan	95	100	1,329	1,475
Minnesota	79	89	455	512
Mississippi	81	90	682	756
Missouri	83	94	887	1,012
Montana	78	87	122	137
Nebraska	71	81	204	232
Nevada	75	84	427	476
New Hampshire	73	84	109	124
New Jersey	72	81	995	1,129
New Mexico	94	100	392	434
New York	84	91	3,065	3,328
North Carolina	80	87	1,644	1,789
North Dakota	59	70	60	70
Ohio	83	92	1,652	1,817
Oklahoma	74	83	677	764
Oregon	94	100	620	680
Pennsylvania	87	95	1,716	1,881
Rhode Island	93	100	147	164
South Carolina	78	86	885	976
South Dakota	83	96	100	116
Tennessee	90	100	1,214	1,348
Texas	67	73	4,543	4,947
Utah	65	74	300	342
Vermont	94	100	66	75
Virginia	69	78	1,072	1,210
Washington	95	100	845	925
West Virginia	85	96	350	397
Wisconsin	92	100	660	730
Wyoming	53	63	50	60
United States	82	84	49,371	50,701

Table III.5. 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	83	91	894	988
Alaska	65	78	105	125
Arizona	70	77	1,070	1,190
Arkansas	69	76	546	605
California	69	75	5,245	5,639
Colorado	73	83	535	613
Connecticut	86	97	383	430
Delaware	93	100	115	130
District of Columbia	91	100	121	137
Florida	88	96	3,255	3,565
Georgia	82	90	1,794	1,966
Hawaii	79	88	179	201
Idaho	80	89	192	212
Illinois	96	100	1,672	1,819
Indiana	75	84	847	956
Iowa	82	93	335	380
Kansas	72	82	304	346
Kentucky	72	80	778	873
Louisiana	80	87	1,018	1,104
Maine	85	95	167	186
Maryland	86	96	676	757
Massachusetts	86	96	689	770
Michigan	95	100	1,221	1,350
Minnesota	79	89	442	496
Mississippi	78	87	641	719
Missouri	84	95	840	952
Montana	82	92	113	128
Nebraska	75	85	194	217
Nevada	79	88	421	471
New Hampshire	75	85	97	110
New Jersey	76	86	911	1,024
New Mexico	94	100	405	448
New York	89	96	2,836	3,075
North Carolina	83	90	1,542	1,676
North Dakota	57	67	64	76
Ohio	81	89	1,630	1,800
Oklahoma	77	86	678	763
Oregon	94	100	578	635
Pennsylvania	95	100	1,580	1,727
Rhode Island	95	100	139	154
South Carolina	75	84	835	931
South Dakota	75	91	103	125
Tennessee	88	98	1,125	1,248
Texas	71	76	4,389	4,730
Utah	66	75	285	326
Vermont	94	100	64	71
Virginia	71	80	994	1,112
Washington	95	100	790	864
West Virginia	90	100	321	363
Wisconsin	89	99	608	672
Wyoming	51	61	55	65
United States	84	86	46,472	47,668

Table III.6. Approximate 90 percent confidence intervals for final shrinkage estimates for FY 2014, working poor people

	Participation rate (percentage)		Number of eligible people (thousands)	
	Lower bound	Upper bound	Lower bound	Upper bound
Alabama	63	76	408	490
Alaska	55	75	47	65
Arizona	53	64	682	823
Arkansas	55	68	284	350
California	47	54	3,214	3,752
Colorado	61	75	287	350
Connecticut	66	80	159	194
Delaware	76	92	56	68
District of Columbia	45	65	37	53
Florida	68	81	1,417	1,686
Georgia	64	76	899	1,075
Hawaii	66	79	99	119
Idaho	76	91	114	136
Illinois	76	88	787	918
Indiana	74	89	456	549
Iowa	77	92	183	221
Kansas	69	83	174	210
Kentucky	67	80	334	396
Louisiana	56	67	481	575
Maine	77	92	82	98
Maryland	68	83	290	355
Massachusetts	61	76	268	334
Michigan	88	100	618	738
Minnesota	77	90	245	289
Mississippi	62	75	292	352
Missouri	66	80	391	473
Montana	73	86	54	64
Nebraska	69	82	98	118
Nevada	55	67	214	258
New Hampshire	68	83	47	57
New Jersey	61	75	439	540
New Mexico	77	91	197	232
New York	71	84	1,369	1,609
North Carolina	61	72	696	819
North Dakota	55	74	27	36
Ohio	74	87	738	867
Oklahoma	53	64	337	406
Oregon	85	100	269	320
Pennsylvania	76	89	648	759
Rhode Island	74	90	61	74
South Carolina	61	74	423	512
South Dakota	79	96	49	59
Tennessee	74	87	534	631
Texas	61	70	2,555	2,955
Utah	58	72	165	202
Vermont	88	100	28	34
Virginia	64	79	510	637
Washington	82	96	335	393
West Virginia	73	90	121	148
Wisconsin	89	100	317	370
Wyoming	53	67	26	33
United States	69	72	24,071	25,293

Table III.7. 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	69	82	415	494
Alaska	58	76	39	52
Arizona	56	67	603	720
Arkansas	59	72	252	305
California	52	61	3,171	3,701
Colorado	56	70	310	390
Connecticut	62	76	168	205
Delaware	78	94	54	65
District of Columbia	53	73	41	56
Florida	70	84	1,474	1,765
Georgia	67	79	932	1,097
Hawaii	65	78	108	129
Idaho	71	85	123	147
Illinois	75	88	859	1,006
Indiana	68	81	464	553
Iowa	72	88	189	229
Kansas	61	74	177	217
Kentucky	67	80	329	392
Louisiana	64	76	456	545
Maine	71	86	74	91
Maryland	66	80	317	387
Massachusetts	54	68	283	361
Michigan	80	95	548	656
Minnesota	68	82	240	292
Mississippi	67	82	265	322
Missouri	66	79	397	479
Montana	66	79	53	64
Nebraska	63	76	103	126
Nevada	67	79	219	259
New Hampshire	60	75	48	60
New Jersey	57	71	414	515
New Mexico	88	100	197	228
New York	70	82	1,393	1,634
North Carolina	69	80	805	933
North Dakota	49	65	26	34
Ohio	73	85	754	880
Oklahoma	59	71	338	406
Oregon	84	100	279	329
Pennsylvania	74	87	714	837
Rhode Island	75	91	56	68
South Carolina	68	81	404	478
South Dakota	72	90	50	63
Tennessee	74	87	532	625
Texas	62	72	2,343	2,734
Utah	57	69	178	218
Vermont	77	96	27	33
Virginia	59	73	484	606
Washington	79	93	389	459
West Virginia	78	92	133	157
Wisconsin	83	97	335	393
Wyoming	48	63	26	34
United States	70	74	24,098	25,319

Table III.8. 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	72	85	356	419
Alaska	52	67	50	65
Arizona	60	72	540	646
Arkansas	61	75	242	298
California	56	65	2,923	3,357
Colorado	61	76	276	343
Connecticut	65	80	173	211
Delaware	78	95	53	65
District of Columbia	52	75	37	54
Florida	68	82	1,416	1,699
Georgia	68	79	880	1,032
Hawaii	66	78	97	116
Idaho	75	89	104	123
Illinois	76	88	831	970
Indiana	72	86	389	467
Iowa	72	86	181	218
Kansas	67	82	145	178
Kentucky	64	78	271	330
Louisiana	70	82	414	488
Maine	73	87	72	87
Maryland	65	80	324	398
Massachusetts	60	74	248	308
Michigan	88	100	553	655
Minnesota	72	87	233	282
Mississippi	67	80	288	345
Missouri	70	84	343	407
Montana	75	90	51	61
Nebraska	69	83	103	124
Nevada	70	84	215	258
New Hampshire	63	78	40	50
New Jersey	62	75	380	463
New Mexico	92	100	186	215
New York	74	87	1,176	1,379
North Carolina	73	84	781	910
North Dakota	51	67	29	39
Ohio	74	87	720	848
Oklahoma	62	75	318	383
Oregon	84	100	233	279
Pennsylvania	84	98	697	812
Rhode Island	82	99	56	67
South Carolina	67	80	364	432
South Dakota	72	92	48	62
Tennessee	73	86	474	559
Texas	65	76	2,412	2,818
Utah	59	71	159	191
Vermont	87	100	25	31
Virginia	63	78	451	560
Washington	80	95	380	450
West Virginia	84	99	109	129
Wisconsin	84	99	296	346
Wyoming	50	65	26	34
United States	73	77	22,546	23,688

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APPENDIX A

THE ESTIMATION PROCEDURE: ADDITIONAL TECHNICAL DETAILS

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 2014 to 2016**

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 Cunnyngham (2018c) 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. Cunnyngham (2018c) 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 2016, we used data from the 2016 CPS ASEC (simulating October through December 2015) and the 2017 CPS ASEC (simulating January through September 2016). To estimate N_i, we used a weighted average of population estimates from the two CPS ASEC files.

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

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

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

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

and

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

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

We defined as working poor any person who was eligible for SNAP and lived in a household in which a member earned money from a job. Working poor people were identified slightly differently in the SNAP QC data than in the CPS ASEC. Specifically, a participant household was identified as working poor if the household had earnings according to the edited SNAP QC data file or, prior to editing, had multiple indicators of earnings that suggested a household was likely to have a member who worked. 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:

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

and

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

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 $\mathrm{var}_{E_1|\varepsilon_1}(Y_{1,i})$ and $\mathrm{var}_{E_2|\varepsilon_2}(Y_{2,i})$ 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:

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

and

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

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

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

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 $\text{var}(\varepsilon_{1,i})$ and $\text{var}(\varepsilon_{2,i})$, 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:

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

where

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

and

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

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:

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

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:

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

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

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

where

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

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 2014, 2015, and 2016, and three predicting SNAP

participation rates for working poor people in fiscal years 2014, 2015, and 2016. 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 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

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

6. Percentage of households with earnings 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 2014 values in both equations for predicting FY 2014 rates, 2015 values in both equations for predicting FY 2015 rates, and 2016 values in both equations for predicting FY 2016 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 (2018a), the percentage of occupied housing units that are owner occupied according to ACS one-year 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, four predictors listed above—the first, second, fourth, and seventh—were used to produce the estimates in Cunnyngham (2018a).

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. 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, 0.400, 0.550, and 0.166, respectively, up to $\sigma_1 = 4.401$,

$\sigma_2 = 6.701$, $\rho = 0.999$, $\eta_1 = 7.200$, $\eta_2 = 9.900$, and $\eta_{1,2} = 0.996$. For combination k of σ_1, σ_2,

ρ, η_1, η_2, and $\eta_{1,2}$ ($k = 1,\ldots,$ 8053188), 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 2014 sample estimates for all eligible people and working poor

people, respectively; the second two elements are the FY 2015 estimates; and the final two

elements are the FY 2016 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 (2014, 2015, and 2016), 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 2014, $t = 2$ for 2015, and $t = 3$ for 2016)

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^* 8,053,188 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, $\eta_{1,k}$, $\eta_{2,k}$, $\eta_{1,2,k}$):

$$(37) \quad p_k = \frac{p_k^*}{\sum_{k=1}^{8,053,188} p_k^*},$$

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 8,053,188 sets of shrinkage estimates, weighting each set θ_k by its associated probability p_k. Thus, our shrinkage estimates are:

$$(38) \quad \theta = \sum_{k=1}^{8,053,188} p_k \theta_k.$$

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

$$(39) \quad U = \sum_{k=1}^{8,053,188} p_k U_k + \sum_{k=1}^{8,053,188} p_k (\theta_k - \theta)(\theta_k - \theta)'.$$

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

$$(40) \quad R = \sum_{k=1}^{8,053,188} p_k R_k,$$

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

$$(41) \quad G = \sum_{k=1}^{8,053,188} p_k G_k + \sum_{k=1}^{8,053,188} p_k (R_k - R)(R_k - R)',$$

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

$$(42) \quad \hat{B} = \sum_{k=1}^{8,053,188} p_k \hat{B}_k.$$

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 2016 estimates for all eligible people as an example, the state eligible people counts from Equation (43) summed to 48,131,899, and the national total estimated directly from the CPS ASEC was 47,070,082. 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 $47,070,082 / 48,131,899 \, (\approx 0.9779)$. 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 2014	51,025,996	0.9792	24,681,803	0.9790
FY 2015	50,036,073	0.9782	24,708,657	0.9759
FY 2016	47,070,082	0.9779	23,117,299	0.9656

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 19 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 2014 or FY 2015.) 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 2014	FY 2015	FY 2016	FY 2016
Delaware		101.9		
Illinois	100.4	102.6	101.2	
Michigan	102.2	101.6		
New Mexico		103.8	109.3	101.4
Oregon	114.8	115.0	112.1	
Rhode Island			104.6	
Vermont	107.4	102.5	105.1	
Washington	105.6	104.8	103.0	

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 (≈ 0.9779 for all eligible people for FY 2016), and $U(6i - 1, 6i - 1)$ is the $(6i-1, 6i-1)$ diagonal element of U for all eligible people for FY 2016, which was derived according to Equation (39). To derive standard error estimates for all eligible people for 2014 and 2015, 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 2014, 2015, and 2016, 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 2014	FY 2015	FY 2016
Alabama	902,073	889,380	850,804
Alaska	87,486	81,121	82,326
Arizona	1,044,310	999,401	960,105
Arkansas	491,918	468,904	426,069
California	4,349,634	4,417,549	4,340,042
Colorado	505,169	495,134	475,690
Connecticut	438,559	442,161	431,597
Delaware	150,232	149,981	147,559
District of Columbia	142,707	141,845	134,625
Florida	3,526,311	3,656,169	3,454,530
Georgia	1,815,871	1,800,531	1,733,473
Hawaii	194,264	188,895	176,729
Idaho	211,781	196,872	185,303
Illinois	2,015,283	2,042,306	1,914,393
Indiana	892,699	831,740	741,610
Iowa	408,070	391,224	380,705
Kansas	293,456	273,974	253,833
Kentucky	828,076	768,882	666,264
Louisiana	877,340	859,738	892,224
Maine	230,536	202,579	189,245
Maryland	787,597	781,035	744,343
Massachusetts	863,412	785,778	779,192
Michigan	1,679,421	1,571,344	1,473,614
Minnesota	533,743	496,023	478,783
Mississippi	656,770	636,322	582,658
Missouri	858,416	844,597	810,690
Montana	124,906	119,082	116,626
Nebraska	173,530	174,092	175,851
Nevada	383,622	420,413	439,782
New Hampshire	111,701	106,296	98,464
New Jersey	883,434	905,728	879,987
New Mexico	431,494	453,146	471,247
New York	3,122,879	3,039,108	2,968,227
North Carolina	1,575,676	1,646,202	1,568,387
North Dakota	53,753	53,148	54,252
Ohio	1,752,135	1,676,263	1,608,633
Oklahoma	608,492	598,257	612,869
Oregon	802,190	779,749	734,864
Pennsylvania	1,796,154	1,826,667	1,863,836
Rhode Island	178,518	175,025	171,055
South Carolina	834,511	804,572	767,463
South Dakota	100,938	98,553	95,983
Tennessee	1,312,505	1,229,391	1,113,231
Texas	3,852,675	3,724,688	3,768,416
Utah	229,911	225,603	219,820
Vermont	93,000	84,994	79,715
Virginia	918,902	860,375	826,354
Washington	1,095,551	1,070,933	1,011,412
West Virginia	362,501	367,908	357,134
Wisconsin	841,533	805,540	728,077
Wyoming	35,871	32,605	33,853
United States	46,461,517	45,691,823	44,071,944

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 2014	FY 2015	FY 2016	FY 2014	FY 2015	FY 2016
Alabama	96.08	96.75	96.08	34.54	38.76	35.79
Alaska	99.56	99.71	99.92	41.44	37.94	41.71
Arizona	85.23	87.36	86.51	41.92	40.51	40.57
Arkansas	96.86	97.20	97.69	39.69	38.89	43.16
California	91.06	90.31	90.21	40.36	44.19	43.87
Colorado	92.64	93.62	94.33	42.88	44.32	44.81
Connecticut	83.06	86.25	85.99	29.36	29.29	32.34
Delaware	81.65	83.51	81.91	34.55	33.99	34.54
District of Columbia	89.01	91.68	92.39	17.52	21.43	21.43
Florida	92.38	89.84	90.50	32.85	34.11	33.88
Georgia	93.23	94.61	93.69	38.19	41.10	40.62
Hawaii	87.77	88.22	89.84	40.88	44.82	43.49
Idaho	91.11	92.03	92.27	49.01	53.11	50.18
Illinois	89.75	90.77	91.16	34.68	37.37	38.63
Indiana	98.22	97.60	96.91	45.87	45.51	45.57
Iowa	85.75	85.28	82.14	41.86	42.71	41.54
Kansas	99.78	99.70	98.52	49.73	48.50	47.10
Kentucky	92.88	95.71	94.35	32.41	34.45	31.88
Louisiana	96.13	99.37	99.35	37.15	40.87	38.38
Maine	85.91	84.80	84.26	32.93	31.88	33.52
Maryland	86.16	86.81	87.50	30.98	32.94	35.40
Massachusetts	87.55	88.22	84.86	23.74	24.94	23.97
Michigan	89.51	89.21	86.89	38.79	33.56	39.24
Minnesota	82.40	81.79	82.34	41.78	40.13	42.78
Mississippi	95.96	96.41	96.49	33.80	34.43	40.02
Missouri	99.06	99.49	98.65	36.76	37.69	35.68
Montana	89.46	89.71	90.01	37.77	35.46	39.70
Nebraska	93.97	94.69	93.34	46.92	45.65	48.65
Nevada	85.47	85.38	84.45	37.53	41.52	41.33
New Hampshire	85.72	85.91	84.36	35.55	34.01	31.98
New Jersey	89.73	89.71	89.28	37.64	33.07	32.85
New Mexico	92.79	91.11	90.54	41.76	44.47	42.56
New York	90.26	91.58	92.36	36.88	37.97	34.78
North Carolina	90.11	87.07	88.50	32.07	39.19	42.30
North Dakota	78.49	78.70	80.06	37.73	32.44	36.96
Ohio	91.27	90.61	90.53	36.70	38.39	39.16
Oklahoma	93.73	94.83	95.96	35.47	40.30	39.41
Oregon	82.62	83.33	82.56	34.10	35.82	32.05
Pennsylvania	87.99	89.78	87.72	32.26	34.35	36.94
Rhode Island	86.23	87.35	85.71	31.15	29.56	32.54
South Carolina	95.10	95.16	91.59	37.93	40.86	38.09
South Dakota	97.65	98.32	98.32	46.83	46.94	46.97
Tennessee	99.31	98.84	98.84	35.76	38.03	36.74
Texas	91.89	89.05	88.69	46.71	45.48	48.65
Utah	98.46	98.66	97.65	51.86	55.37	51.97
Vermont	82.51	82.77	84.69	32.19	30.58	34.16
Virginia	99.30	97.65	96.18	44.61	41.79	43.02
Washington	79.56	82.62	81.76	29.61	33.93	35.94
West Virginia	92.40	92.16	91.25	30.22	33.69	30.33
Wisconsin	82.55	83.60	82.70	39.40	40.57	40.34
Wyoming	97.20	97.38	98.94	49.63	50.90	50.80

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 2014	FY 2015	FY 2016
Alabama	866,730	860,502	817,461
Alaska	87,100	80,883	82,258
Arizona	890,086	873,127	830,577
Arkansas	476,472	455,775	416,235
California	3,960,733	3,989,268	3,915,152
Colorado	467,973	463,544	448,737
Connecticut	364,245	381,377	371,122
Delaware	122,670	125,242	120,861
District of Columbia	127,029	130,036	124,377
Florida	3,257,677	3,284,775	3,126,488
Georgia	1,692,864	1,703,500	1,624,091
Hawaii	170,504	166,645	158,777
Idaho	192,960	181,181	170,979
Illinois	1,808,696	1,853,883	1,745,218
Indiana	876,836	811,762	718,665
Iowa	349,904	333,628	312,696
Kansas	292,802	273,155	250,074
Kentucky	769,092	735,928	628,587
Louisiana	843,404	854,339	886,433
Maine	198,060	171,787	159,458
Maryland	678,562	677,993	651,322
Massachusetts	755,909	693,253	661,199
Michigan	1,503,283	1,401,859	1,280,408
Minnesota	439,815	405,707	394,225
Mississippi	630,263	613,478	562,218
Missouri	850,338	840,315	799,762
Montana	111,735	106,828	104,980
Nebraska	163,071	164,849	164,138
Nevada	327,889	358,940	371,383
New Hampshire	95,750	91,323	83,067
New Jersey	792,661	812,547	785,661
New Mexico	400,366	412,857	426,667
New York	2,818,586	2,783,306	2,741,395
North Carolina	1,419,779	1,433,299	1,388,038
North Dakota	42,188	41,826	43,434
Ohio	1,599,244	1,518,929	1,456,247
Oklahoma	570,333	567,309	588,097
Oregon	662,769	649,726	606,726
Pennsylvania	1,580,454	1,640,000	1,634,976
Rhode Island	153,943	152,879	146,616
South Carolina	793,595	765,639	702,950
South Dakota	98,567	96,894	94,371
Tennessee	1,303,409	1,215,142	1,100,351
Texas	3,540,107	3,316,686	3,342,397
Utah	226,375	222,580	214,654
Vermont	76,735	70,347	67,515
Virginia	912,470	840,139	794,779
Washington	871,598	884,783	826,941
West Virginia	334,955	339,046	325,895
Wisconsin	694,711	673,464	602,149
Wyoming	34,867	31,750	33,494
United States	42,300,166	41,554,029	39,904,300

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 2014	FY 2015	FY 2016
Alabama	311,576	344,733	304,511
Alaska	36,257	30,780	34,337
Arizona	437,775	404,817	389,543
Arkansas	195,262	182,343	183,900
California	1,755,338	1,952,292	1,904,063
Colorado	216,637	219,438	213,142
Connecticut	128,757	129,522	139,570
Delaware	51,901	50,985	50,968
District of Columbia	25,007	30,397	28,854
Florida	1,158,287	1,247,156	1,170,360
Georgia	693,409	740,054	704,137
Hawaii	79,423	84,667	76,863
Idaho	103,785	104,567	92,981
Illinois	699,001	763,128	739,453
Indiana	409,499	378,566	337,989
Iowa	170,806	167,080	158,156
Kansas	145,947	132,888	119,555
Kentucky	268,379	264,872	212,398
Louisiana	325,967	351,409	342,462
Maine	75,911	64,576	63,425
Maryland	243,998	257,265	263,497
Massachusetts	205,017	195,934	186,788
Michigan	651,515	527,390	578,217
Minnesota	223,019	199,054	204,804
Mississippi	222,001	219,111	233,180
Missouri	315,545	318,286	289,246
Montana	47,174	42,226	46,299
Nebraska	81,420	79,482	85,546
Nevada	143,966	174,555	181,779
New Hampshire	39,715	36,157	31,488
New Jersey	332,516	299,497	289,058
New Mexico	180,192	201,496	200,563
New York	1,151,687	1,154,010	1,032,231
North Carolina	505,335	645,064	663,396
North Dakota	20,281	17,241	20,054
Ohio	643,069	643,434	629,892
Oklahoma	215,826	241,104	241,562
Oregon	273,579	279,275	235,495
Pennsylvania	579,475	627,515	688,538
Rhode Island	55,605	51,737	55,663
South Carolina	316,530	328,716	292,311
South Dakota	47,269	46,261	45,083
Tennessee	469,326	467,488	409,034
Texas	1,799,739	1,694,100	1,833,184
Utah	119,234	124,912	114,243
Vermont	29,934	25,993	27,227
Virginia	409,959	359,559	355,481
Washington	324,360	363,368	363,461
West Virginia	109,551	123,959	108,312
Wisconsin	331,547	326,832	293,684
Wyoming	17,803	16,597	17,198
United States	17,395,109	17,731,888	17,283,187

Source: SNAP QC database.

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

	All eligible people			Working poor people		
	FY 2014	FY 2015	FY 2016	FY 2014	FY 2015	FY 2016
Alabama	20.44	21.09	20.59	8.81	8.58	8.14
Alaska	14.99	13.75	15.87	6.90	6.92	8.92
Arizona	20.11	18.65	16.47	11.22	10.42	9.14
Arkansas	22.67	21.05	18.82	10.29	9.77	8.21
California	15.78	14.72	14.27	9.20	8.55	8.24
Colorado	11.49	11.75	9.21	5.88	6.71	4.60
Connecticut	10.16	10.77	10.93	4.33	5.64	5.18
Delaware	13.84	12.01	12.72	6.76	5.66	5.62
District of Columbia	20.39	20.49	19.64	7.38	7.66	6.79
Florida	18.78	19.19	16.50	8.37	8.97	7.64
Georgia	18.73	21.44	19.36	9.10	10.82	10.14
Hawaii	15.50	14.99	13.84	8.87	8.48	8.01
Idaho	12.67	13.92	12.97	6.76	8.44	7.84
Illinois	14.57	13.51	13.44	7.20	7.38	7.47
Indiana	15.72	15.65	13.91	7.60	8.62	6.71
Iowa	11.07	11.58	10.87	5.49	6.34	6.27
Kansas	13.59	12.69	11.14	7.03	6.91	5.47
Kentucky	21.58	21.83	19.68	8.72	8.44	8.03
Louisiana	25.13	23.51	23.56	11.31	10.42	10.36
Maine	14.84	14.11	15.46	6.01	6.17	7.12
Maryland	11.84	11.84	11.35	5.03	5.56	5.61
Massachusetts	14.02	12.95	10.93	5.37	5.17	5.16
Michigan	15.02	14.03	13.04	6.78	6.59	5.85
Minnesota	9.12	8.44	8.77	5.19	3.73	4.16
Mississippi	26.90	25.68	24.54	10.99	11.63	12.10
Missouri	14.43	13.00	13.66	6.73	6.09	6.24
Montana	13.81	13.03	12.24	6.04	5.84	5.93
Nebraska	11.55	11.56	10.43	5.67	6.01	5.61
Nevada	18.36	15.26	13.50	9.09	7.88	7.18
New Hampshire	8.84	8.40	8.01	3.98	3.76	3.49
New Jersey	12.63	12.29	11.55	5.57	5.48	5.71
New Mexico	21.52	20.42	21.47	10.25	9.80	10.55
New York	16.09	16.33	14.95	6.77	7.28	6.78
North Carolina	18.63	17.47	16.01	8.39	8.48	7.31
North Dakota	9.14	9.71	9.09	4.63	4.93	4.01
Ohio	16.42	15.23	14.96	7.56	7.01	6.32
Oklahoma	19.30	18.77	17.59	10.59	9.77	8.60
Oregon	14.28	13.39	12.57	7.25	7.63	6.51
Pennsylvania	14.32	13.63	12.29	5.77	5.57	5.12
Rhode Island	12.85	13.06	12.82	4.18	5.31	5.10
South Carolina	21.00	19.63	18.27	9.74	8.24	8.22
South Dakota	12.91	14.63	14.37	5.90	7.12	6.90
Tennessee	20.32	18.45	17.77	9.54	8.57	7.99
Texas	18.63	17.89	16.63	10.54	9.73	9.13
Utah	11.79	11.70	10.44	7.03	6.90	6.30
Vermont	10.47	11.90	9.84	4.14	5.56	4.10
Virginia	11.88	13.56	13.00	4.87	6.03	5.43
Washington	12.16	11.48	11.03	6.22	5.96	5.21
West Virginia	22.58	21.75	20.84	7.58	7.87	7.04
Wisconsin	12.15	12.51	12.13	5.51	6.21	6.08
Wyoming	9.90	10.10	11.77	4.94	5.64	6.06

Source:　CPS ASEC.

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

	FY 2014	FY 2015	FY 2016
Alabama	974,428	1,015,802	995,150
Alaska	104,503	96,681	112,604
Arizona	1,335,894	1,253,003	1,128,464
Arkansas	657,038	618,750	554,540
California	6,085,933	5,743,044	5,591,020
Colorado	615,796	635,660	505,493
Connecticut	363,588	384,902	390,428
Delaware	127,939	114,293	120,941
District of Columbia	133,691	137,669	134,231
Florida	3,690,432	3,836,664	3,370,369
Georgia	1,859,037	2,158,953	1,982,182
Hawaii	211,200	206,930	192,452
Idaho	203,677	229,291	217,158
Illinois	1,863,328	1,719,482	1,697,783
Indiana	1,018,241	1,017,785	904,655
Iowa	340,845	358,381	337,466
Kansas	386,413	362,088	318,726
Kentucky	935,757	953,149	863,441
Louisiana	1,143,460	1,079,527	1,080,424
Maine	193,551	187,905	205,150
Maryland	703,171	699,789	672,167
Massachusetts	932,855	874,730	741,017
Michigan	1,487,151	1,384,944	1,288,906
Minnesota	493,347	459,916	477,254
Mississippi	793,385	758,290	723,504
Missouri	860,279	775,253	807,082
Montana	138,810	132,356	126,209
Nebraska	216,340	215,557	195,252
Nevada	515,887	435,997	394,826
New Hampshire	116,670	109,209	105,014
New Jersey	1,125,179	1,098,433	1,025,372
New Mexico	440,485	416,580	438,886
New York	3,158,088	3,215,559	2,919,578
North Carolina	1,823,413	1,727,107	1,604,948
North Dakota	66,572	73,437	68,456
Ohio	1,888,737	1,747,626	1,714,949
Oklahoma	720,418	725,147	689,049
Oregon	565,750	537,500	516,013
Pennsylvania	1,813,223	1,718,186	1,544,600
Rhode Island	134,613	136,592	134,873
South Carolina	996,758	939,812	891,624
South Dakota	108,922	124,028	122,657
Tennessee	1,315,711	1,215,425	1,183,675
Texas	4,957,965	4,875,277	4,591,367
Utah	344,226	349,465	319,496
Vermont	64,712	72,765	60,965
Virginia	979,924	1,115,670	1,064,146
Washington	854,793	822,730	802,124
West Virginia	411,969	392,399	377,227
Wisconsin	695,007	718,343	698,806
Wyoming	56,886	57,990	67,362
United States	51,025,994	50,036,072	47,070,080

Source: CPS ASEC.

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

	FY 2014	FY 2015	FY 2016
Alabama	420,147	413,321	393,364
Alaska	48,085	48,626	63,288
Arizona	745,199	699,987	626,658
Arkansas	298,083	287,060	241,820
California	3,548,324	3,334,330	3,225,721
Colorado	315,047	362,976	252,280
Connecticut	154,813	201,532	184,786
Delaware	62,475	53,838	53,433
District of Columbia	48,411	51,438	46,431
Florida	1,645,248	1,793,111	1,559,844
Georgia	903,221	1,089,427	1,038,376
Hawaii	120,848	117,121	111,384
Idaho	108,656	138,995	131,281
Illinois	921,020	939,211	943,911
Indiana	491,920	560,386	436,356
Iowa	169,241	196,348	194,758
Kansas	199,910	197,230	156,402
Kentucky	378,356	368,412	352,346
Louisiana	514,813	478,651	475,170
Maine	78,298	82,122	94,397
Maryland	298,826	328,688	332,626
Massachusetts	357,138	349,049	349,921
Michigan	671,815	650,998	577,940
Minnesota	280,734	203,289	226,570
Mississippi	324,271	343,414	356,688
Missouri	401,076	363,288	368,538
Montana	60,660	59,308	61,152
Nebraska	106,311	112,086	104,927
Nevada	255,258	224,955	210,036
New Hampshire	52,474	48,836	45,722
New Jersey	495,801	490,003	506,482
New Mexico	209,817	199,973	215,727
New York	1,328,434	1,434,335	1,323,521
North Carolina	821,359	837,981	733,144
North Dakota	33,704	37,238	30,191
Ohio	869,254	804,691	724,565
Oklahoma	395,286	377,548	336,908
Oregon	287,307	306,464	267,128
Pennsylvania	730,426	702,418	642,938
Rhode Island	43,812	55,527	53,617
South Carolina	462,029	394,622	401,262
South Dakota	49,778	60,382	58,943
Tennessee	617,924	564,595	532,049
Texas	2,804,903	2,651,353	2,521,046
Utah	205,175	206,030	192,882
Vermont	25,593	34,019	25,373
Virginia	401,382	495,922	444,811
Washington	437,007	426,943	378,614
West Virginia	138,385	141,939	127,388
Wisconsin	315,369	356,247	349,903
Wyoming	28,382	32,391	34,681
United States	24,681,802	24,708,657	23,117,298

Source: CPS ASEC.,

Table A.8. CPS ASEC population estimate

	FY 2014	FY 2015	FY 2016
Alabama	4,766,973	4,817,427	4,834,041
Alaska	697,249	702,912	709,466
Arizona	6,643,658	6,718,940	6,852,562
Arkansas	2,898,172	2,938,774	2,947,205
California	38,570,108	39,010,767	39,169,692
Colorado	5,357,535	5,410,329	5,487,221
Connecticut	3,578,118	3,573,237	3,570,674
Delaware	924,411	951,675	950,949
District of Columbia	655,676	671,832	683,560
Florida	19,655,571	19,996,744	20,430,291
Georgia	9,927,098	10,069,934	10,236,799
Hawaii	1,362,970	1,380,835	1,390,805
Idaho	1,607,764	1,647,156	1,674,147
Illinois	12,790,827	12,725,860	12,631,038
Indiana	6,475,980	6,503,426	6,505,417
Iowa	3,079,947	3,095,675	3,104,782
Kansas	2,844,118	2,852,522	2,861,845
Kentucky	4,336,830	4,366,487	4,386,978
Louisiana	4,550,462	4,592,316	4,584,936
Maine	1,303,867	1,331,327	1,326,701
Maryland	5,939,391	5,910,076	5,924,718
Massachusetts	6,655,516	6,753,784	6,781,082
Michigan	9,902,914	9,873,147	9,885,425
Minnesota	5,409,212	5,451,875	5,443,183
Mississippi	2,949,887	2,952,783	2,948,243
Missouri	5,963,321	5,962,367	5,907,222
Montana	1,005,093	1,015,809	1,031,169
Nebraska	1,873,772	1,865,136	1,872,007
Nevada	2,809,353	2,856,405	2,924,226
New Hampshire	1,319,380	1,299,542	1,311,760
New Jersey	8,906,333	8,941,033	8,874,034
New Mexico	2,046,733	2,039,570	2,043,988
New York	19,627,344	19,691,085	19,535,503
North Carolina	9,789,985	9,885,497	10,026,749
North Dakota	728,680	755,923	752,954
Ohio	11,505,058	11,472,076	11,464,288
Oklahoma	3,733,659	3,862,624	3,916,519
Oregon	3,961,837	4,015,201	4,105,849
Pennsylvania	12,663,467	12,603,728	12,567,392
Rhode Island	1,047,213	1,045,660	1,051,896
South Carolina	4,745,424	4,787,104	4,879,972
South Dakota	843,475	848,009	853,636
Tennessee	6,476,527	6,587,859	6,659,665
Texas	26,611,406	27,247,660	27,616,507
Utah	2,920,442	2,985,747	3,060,888
Vermont	618,104	611,545	619,319
Virginia	8,245,129	8,227,631	8,185,590
Washington	7,030,210	7,167,254	7,271,684
West Virginia	1,824,653	1,804,535	1,809,975
Wisconsin	5,720,889	5,740,395	5,759,095
Wyoming	574,509	574,108	572,462
United States	315,476,246	318,193,342	319,996,108

Source: CPS ASEC.

Table A.9. Population on July 1

	FY 2014	FY 2015	FY 2016
Alabama	4,846,411	4,853,875	4,860,545
Alaska	737,046	737,709	741,522
Arizona	6,728,783	6,817,565	6,908,642
Arkansas	2,966,835	2,977,853	2,988,231
California	38,792,291	38,993,940	39,296,476
Colorado	5,355,588	5,448,819	5,530,105
Connecticut	3,594,762	3,584,730	3,587,685
Delaware	935,968	944,076	952,698
District of Columbia	659,836	670,377	684,336
Florida	19,905,569	20,244,914	20,656,589
Georgia	10,097,132	10,199,398	10,313,620
Hawaii	1,420,257	1,425,157	1,428,683
Idaho	1,634,806	1,652,828	1,680,026
Illinois	12,882,189	12,839,047	12,835,726
Indiana	6,597,880	6,612,768	6,634,007
Iowa	3,109,481	3,121,997	3,130,869
Kansas	2,902,507	2,906,721	2,907,731
Kentucky	4,412,617	4,424,611	4,436,113
Louisiana	4,648,990	4,668,960	4,686,157
Maine	1,330,256	1,329,453	1,330,232
Maryland	5,975,346	5,994,983	6,024,752
Massachusetts	6,755,124	6,784,240	6,823,721
Michigan	9,916,306	9,917,715	9,933,445
Minnesota	5,457,125	5,482,435	5,525,050
Mississippi	2,993,443	2,989,390	2,985,415
Missouri	6,063,827	6,076,204	6,091,176
Montana	1,023,252	1,032,073	1,038,656
Nebraska	1,882,980	1,893,765	1,907,603
Nevada	2,838,281	2,883,758	2,939,254
New Hampshire	1,327,996	1,330,111	1,335,015
New Jersey	8,938,844	8,935,421	8,978,416
New Mexico	2,085,567	2,080,328	2,085,432
New York	19,748,858	19,747,183	19,836,286
North Carolina	9,940,387	10,035,186	10,156,689
North Dakota	740,040	756,835	755,548
Ohio	11,596,998	11,605,090	11,622,554
Oklahoma	3,879,610	3,907,414	3,921,207
Oregon	3,971,202	4,024,634	4,085,989
Pennsylvania	12,793,767	12,791,904	12,787,085
Rhode Island	1,054,907	1,055,607	1,057,566
South Carolina	4,829,160	4,894,834	4,959,822
South Dakota	853,304	857,919	861,542
Tennessee	6,547,779	6,595,056	6,649,404
Texas	26,979,078	27,429,639	27,904,862
Utah	2,944,498	2,990,632	3,044,321
Vermont	626,767	626,088	623,354
Virginia	8,328,098	8,367,587	8,414,380
Washington	7,063,166	7,160,290	7,280,934
West Virginia	1,848,751	1,841,053	1,828,637
Wisconsin	5,759,432	5,767,891	5,772,917
Wyoming	584,304	586,555	584,910
United States	318,907,401	320,896,618	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 2014	FY 2015	FY 2016
Alabama	0.0	0.0	0.0
Alaska	0.0	0.0	0.0
Arizona	0.0	0.0	0.0
Arkansas	0.6	0.0	0.0
California	0.3	0.2	0.5
Colorado	0.0	0.0	0.0
Connecticut	1.2	0.0	0.0
Delaware	0.0	0.0	0.0
District of Columbia	0.0	1.9	0.6
Florida	0.0	0.3	0.2
Georgia	0.0	0.0	0.0
Hawaii	1.2	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	0.1	0.0	0.0
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	0.2	0.4	0.0
Michigan	0.0	0.0	0.0
Minnesota	4.4	4.7	2.8
Mississippi	0.4	0.0	0.0
Missouri	0.3	0.1	0.0
Montana	0.0	0.5	0.0
Nebraska	0.0	0.1	0.0
Nevada	0.0	0.0	0.0
New Hampshire	0.0	0.0	0.0
New Jersey	0.0	0.7	0.8
New Mexico	0.0	0.0	0.0
New York	0.0	0.1	0.0
North Carolina	0.0	0.1	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	0.8	0.0	0.0
Rhode Island	1.4	0.0	0.0
South Carolina	0.0	0.0	0.0
South Dakota	0.9	0.0	0.0
Tennessee	0.0	0.0	0.0
Texas	0.4	0.0	0.4
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	0.5	0.0	0.0
Wisconsin	0.3	0.2	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 2014	FY 2015	FY 2016	FY 2014	FY 2015	FY 2016
Alabama	87.49	84.08	81.70	72.94	82.78	76.99
Alaska	78.85	79.71	69.89	71.33	60.31	51.91
Arizona	65.79	68.67	73.01	58.00	57.00	61.66
Arkansas	70.84	72.69	74.03	63.99	62.69	75.00
California	64.71	69.49	69.80	49.19	58.58	58.84
Colorado	76.02	72.41	88.08	68.79	60.03	83.83
Connecticut	99.72	98.77	94.61	82.79	64.06	75.17
Delaware	94.70	110.46	99.75	82.05	95.46	95.21
District of Columbia	94.42	94.66	92.55	51.33	59.22	62.07
Florida	87.16	84.57	91.75	69.52	68.70	74.21
Georgia	89.53	77.90	81.32	75.48	67.07	67.31
Hawaii	77.48	78.03	80.31	63.07	70.04	67.18
Idaho	93.17	78.75	78.46	93.94	74.97	70.58
Illinois	96.38	106.87	101.16	75.36	80.54	77.09
Indiana	84.52	78.44	77.90	81.71	66.44	75.96
Iowa	101.68	92.31	91.89	99.97	84.38	80.53
Kansas	74.25	74.03	77.22	71.54	66.12	75.24
Kentucky	80.78	76.20	71.99	69.72	70.95	59.61
Louisiana	72.20	77.84	80.27	61.98	72.21	70.51
Maine	100.30	91.55	77.52	95.03	78.74	67.01
Maryland	95.92	95.51	95.29	81.16	77.16	77.90
Massachusetts	79.84	78.90	88.67	56.56	55.88	53.05
Michigan	100.95	100.77	98.86	96.85	80.65	99.56
Minnesota	88.37	87.72	81.38	78.74	97.37	89.05
Mississippi	78.28	79.91	76.74	67.47	63.02	64.56
Missouri	97.21	106.36	96.10	77.37	85.97	76.12
Montana	79.07	79.44	82.58	76.39	70.08	75.17
Nebraska	75.01	75.32	82.50	76.21	69.84	80.01
Nevada	62.91	81.55	93.58	55.83	76.86	86.11
New Hampshire	81.54	81.70	77.72	75.19	72.33	67.67
New Jersey	70.19	74.02	75.73	66.82	61.16	56.41
New Mexico	89.20	97.17	95.28	84.28	98.79	91.12
New York	88.70	86.31	92.47	86.16	80.23	76.81
North Carolina	76.69	81.75	85.38	60.59	75.83	89.33
North Dakota	62.40	56.89	63.23	59.25	46.24	66.20
Ohio	84.00	85.92	83.76	73.39	79.04	85.75
Oklahoma	76.19	77.34	85.25	52.55	63.13	71.61
Oregon	116.87	120.60	118.15	95.00	90.91	88.59
Pennsylvania	86.28	94.05	104.03	78.53	88.02	105.25
Rhode Island	113.53	110.87	108.12	125.99	92.30	103.26
South Carolina	78.24	79.67	77.57	67.32	81.46	71.68
South Dakota	89.45	77.22	76.23	93.87	75.73	75.79
Tennessee	97.99	99.87	93.10	75.13	82.71	77.00
Texas	70.43	67.58	72.05	63.29	63.47	71.96
Utah	65.23	63.59	67.55	57.64	60.53	59.55
Vermont	116.94	94.43	110.03	115.35	74.63	106.62
Virginia	92.19	74.04	72.66	101.12	71.29	77.74
Washington	101.49	107.65	102.96	73.88	85.19	95.88
West Virginia	80.25	84.69	85.51	78.13	85.60	84.16
Wisconsin	99.29	93.31	85.96	104.43	91.31	83.73
Wyoming	60.26	53.59	48.66	61.68	50.15	48.53

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

	All eligible people			Working poor people		
	FY 2014	**FY 2015**	**FY 2016**	**FY 2014**	**FY 2015**	**FY 2016**
Alabama	3.949	4.624	4.889	6.782	7.975	7.096
Alaska	5.065	4.426	5.473	9.181	7.964	5.675
Arizona	3.266	3.144	3.431	4.643	4.637	5.207
Arkansas	3.780	2.984	3.025	5.853	5.375	7.816
California	1.666	1.966	1.717	2.722	3.125	3.077
Colorado	6.169	7.233	7.624	8.257	9.418	8.763
Connecticut	8.756	9.299	8.227	10.482	8.608	11.048
Delaware	5.578	7.964	7.549	8.588	12.183	12.200
District of Columbia	4.840	4.169	3.868	6.740	6.934	8.052
Florida	2.601	2.742	3.147	4.968	5.168	5.485
Georgia	4.082	3.552	3.817	6.470	5.630	5.536
Hawaii	5.240	5.516	4.890	6.377	6.640	6.473
Idaho	6.988	4.678	3.970	9.407	7.704	7.135
Illinois	4.167	4.605	4.243	5.978	6.289	6.151
Indiana	5.891	4.356	4.761	8.081	5.269	7.206
Iowa	7.252	6.113	8.603	11.345	9.585	8.725
Kansas	4.628	5.140	5.408	8.076	7.522	8.875
Kentucky	4.485	4.285	4.345	7.009	7.887	7.352
Louisiana	3.330	3.378	2.672	4.688	6.116	6.207
Maine	6.815	7.036	5.671	11.847	12.660	8.802
Maryland	5.684	7.126	6.751	9.709	9.782	10.148
Massachusetts	5.341	4.610	5.078	7.620	6.508	6.114
Michigan	5.052	5.381	4.585	8.545	8.124	8.324
Minnesota	6.160	7.271	6.697	7.984	11.409	12.856
Mississippi	2.975	3.329	4.899	5.666	5.781	5.839
Missouri	6.008	6.832	5.737	8.198	8.034	7.092
Montana	6.917	6.345	6.363	8.696	6.839	9.784
Nebraska	5.946	5.270	5.863	9.102	7.325	9.773
Nevada	3.715	5.236	6.528	5.331	7.089	10.502
New Hampshire	6.834	6.729	7.079	10.332	9.715	10.947
New Jersey	3.931	4.485	4.490	6.870	7.139	6.101
New Mexico	6.398	6.003	6.661	7.181	6.936	6.473
New York	3.070	3.033	3.200	6.226	5.907	5.848
North Carolina	3.515	3.589	3.606	5.188	6.458	7.183
North Dakota	5.666	5.374	5.073	9.501	7.586	10.288
Ohio	3.782	4.237	3.714	6.376	6.123	6.459
Oklahoma	4.458	4.713	5.558	4.511	5.348	6.924
Oregon	8.361	7.353	6.137	9.866	7.584	8.474
Pennsylvania	3.838	4.705	5.367	7.259	8.100	9.339
Rhode Island	8.938	9.157	9.499	18.455	13.077	15.299
South Carolina	4.063	3.899	4.577	5.961	6.999	6.131
South Dakota	10.354	7.741	8.544	13.741	9.326	8.904
Tennessee	5.082	5.193	5.196	6.869	6.641	6.824
Texas	1.859	1.950	1.767	3.242	3.575	3.813
Utah	6.187	4.243	5.114	7.551	6.337	5.591
Vermont	9.076	7.251	7.473	16.460	10.477	14.719
Virginia	5.550	4.321	3.762	10.959	7.009	7.478
Washington	6.212	5.841	5.132	8.160	8.791	8.910
West Virginia	5.028	9.462	8.139	8.626	6.988	8.366
Wisconsin	6.189	5.489	5.272	11.378	8.796	8.240
Wyoming	4.570	5.056	4.004	7.301	7.118	6.330

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, (3) correctly received regular SNAP benefits under federal eligibility rules 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	Administrative data; population estimates
Per capita personal income	Commerce Bureau; population estimates
Mean adjusted gross income; Median adjusted gross income 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)	Individual income tax data
Percentages of (1) people, (2) elderly people, and (3) nonelderly people not claimed on tax returns 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	Individual income tax data; population estimates
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 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	American Community Survey one-year estimates

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 nonfiler rate	People not claimed on tax returns[b]	Resident population[a]
Non-elderly tax nonfiler rate	People under age 65 not claimed on tax returns[b]	Resident population under age 65[a]
Elderly combined poverty and tax nonfiler rate	People age 65 and older not claimed on tax returns or claimed on tax returns with adjusted gross income under the federal poverty level[b]	Resident population age 65 and older[a]
Bachelor's degree rate	People age 25 and older who have completed a bachelor's degree according to ACS one-year estimates[c]	Total people age 25 and older according to ACS one-year estimates[c]
Household earnings rate	Households with earnings according to ACS one-year estimates[c]	Total households according to ACS one-year estimates[c]
Rate of children with income under 50 percent of poverty	Children under age 18 with household 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 2014 predictors

	SNAP prevalence rate	Tax nonfiler rate	Non-elderly tax nonfiler rate	Elderly combined poverty and nonfiler rate	Bachelor's degree rate	Household earnings rate	Child under 50 percent of poverty rate
Alabama	18.613	21.007	17.333	51.126	23.5	72.4	13.1
Alaska	11.870	14.225	13.387	31.576	28.0	86.6	5.7
Arizona	15.520	21.028	18.157	47.724	27.6	74.3	12.1
Arkansas	16.581	20.999	17.283	51.681	21.4	73.5	11.1
California	11.213	17.285	14.569	46.018	31.7	80.4	9.3
Colorado	9.433	13.623	11.749	36.657	38.3	82.1	6.7
Connecticut	12.200	15.107	12.954	36.689	38.0	79.0	6.9
Delaware	16.051	16.503	14.411	35.927	30.6	77.4	7.8
District of Columbia	21.628	26.041	24.548	44.391	55.0	79.6	12.4
Florida	17.715	18.299	13.678	49.064	27.3	72.2	10.3
Georgia	17.984	18.257	15.443	48.613	29.1	78.6	11.9
Hawaii	13.678	14.989	12.645	39.975	31.0	80.8	6.0
Idaho	12.954	13.537	11.195	42.226	25.0	77.2	7.1
Illinois	15.644	13.977	11.636	39.943	32.8	78.7	9.0
Indiana	13.530	13.753	12.284	41.122	24.7	78.0	9.2
Iowa	13.123	13.121	10.678	36.123	27.7	79.3	6.6
Kansas	10.110	13.034	11.662	36.910	31.5	79.2	7.6
Kentucky	18.766	19.655	16.057	50.874	22.2	72.4	11.9
Louisiana	18.872	21.334	18.212	50.607	22.9	75.7	14.2
Maine	17.330	16.882	13.270	44.487	29.4	74.2	9.1
Maryland	13.181	14.614	12.314	37.074	38.2	81.7	5.8
Massachusetts	12.782	15.541	13.420	38.659	41.2	78.7	7.3
Michigan	16.936	15.510	14.220	39.556	27.4	73.8	10.6
Minnesota	9.781	10.809	9.057	33.991	34.3	80.2	6.2
Mississippi	21.940	21.960	18.025	54.843	21.1	71.8	15.4
Missouri	14.156	16.709	14.489	43.532	27.5	75.5	9.7
Montana	12.207	14.533	12.469	39.704	29.3	75.7	8.4
Nebraska	9.216	11.130	8.840	36.802	29.5	81.3	6.7
Nevada	13.516	17.502	15.028	44.116	23.1	78.2	10.2
New Hampshire	8.411	11.143	8.716	35.048	35.0	80.5	4.8
New Jersey	9.883	13.100	10.370	39.382	37.4	80.1	7.0
New Mexico	20.690	19.764	17.270	47.132	26.4	73.7	13.9
New York	15.813	16.958	13.962	45.684	34.5	77.3	10.2
North Carolina	15.851	18.610	15.565	47.456	28.7	76.5	10.5
North Dakota	7.264	10.685	8.335	34.028	27.4	82.6	7.9
Ohio	15.109	15.608	12.878	41.233	26.6	75.5	11.1
Oklahoma	15.684	19.443	16.760	46.430	24.2	76.8	10.2
Oregon	20.200	17.586	15.452	40.712	30.8	75.4	8.9
Pennsylvania	14.039	15.204	12.679	42.435	29.0	75.4	9.1
Rhode Island	16.923	16.868	13.907	43.878	30.4	76.6	9.1
South Carolina	17.281	20.082	16.989	46.582	26.3	74.2	13.5
South Dakota	11.829	11.478	10.012	31.452	27.8	80.8	7.0
Tennessee	20.045	17.501	13.843	49.293	25.3	75.3	11.8
Texas	14.280	15.327	12.622	47.094	27.8	82.3	10.3
Utah	7.808	11.421	9.941	35.285	31.1	84.2	5.2
Vermont	14.838	12.313	10.618	38.280	34.9	78.2	7.6
Virginia	11.034	15.174	12.841	38.452	36.7	80.4	7.2
Washington	15.511	13.489	11.509	35.751	33.1	78.6	7.7
West Virginia	19.608	21.218	17.277	52.663	19.2	67.4	11.5
Wisconsin	14.611	12.012	9.970	37.500	28.4	78.3	7.5
Wyoming	6.139	11.970	10.172	34.998	26.6	82.3	5.8

Table A.16. Values for FY 2015 predictors

	SNAP prevalence rate	Tax nonfiler rate	Non-elderly tax nonfiler rate	Elderly combined poverty and nonfiler rate	Bachelor's degree rate	Household earnings rate	Child under 50 percent of poverty rate
Alabama	18.323	21.303	17.524	51.197	24.2	71.9	12.7
Alaska	10.996	14.080	13.219	30.926	29.7	86.1	5.6
Arizona	14.659	21.063	18.001	48.071	27.7	74.3	11.2
Arkansas	15.746	21.283	17.472	52.021	21.8	72.7	11.3
California	11.329	16.938	14.049	45.981	32.3	80.5	8.9
Colorado	9.087	13.690	11.757	36.692	39.2	81.9	6.2
Connecticut	12.335	14.874	12.558	36.792	38.3	78.7	6.9
Delaware	15.886	16.489	14.278	35.955	30.9	76.1	7.7
District of Columbia	21.159	25.794	24.160	44.914	56.7	80.6	13.0
Florida	18.060	18.180	13.327	49.171	28.4	72.1	9.5
Georgia	17.653	18.567	15.643	48.664	29.9	78.7	11.2
Hawaii	13.254	15.008	12.570	39.919	31.4	81.1	6.9
Idaho	11.911	12.806	10.310	41.974	26.0	76.5	6.5
Illinois	15.907	13.870	11.427	39.815	32.9	78.5	8.4
Indiana	12.578	13.757	12.185	40.947	24.9	77.4	9.3
Iowa	12.531	13.225	10.750	36.053	26.8	79.1	6.6
Kansas	9.426	13.340	11.882	37.429	31.7	79.3	7.2
Kentucky	17.377	19.707	16.033	50.665	23.3	72.7	11.9
Louisiana	18.414	22.255	19.113	50.937	23.2	75.5	13.9
Maine	15.238	16.534	12.797	44.037	30.1	73.8	7.8
Maryland	13.028	14.578	12.139	37.283	38.8	81.3	6.2
Massachusetts	11.582	15.254	13.017	38.396	41.5	78.9	7.1
Michigan	15.844	15.511	14.113	39.374	27.8	74.0	10.1
Minnesota	9.047	10.538	8.685	33.895	34.7	80.5	5.4
Mississippi	21.286	22.117	18.063	54.845	20.8	71.5	16.5
Missouri	13.900	16.744	14.444	43.496	27.8	76.1	8.8
Montana	11.538	14.640	12.468	39.783	30.6	75.9	7.6
Nebraska	9.193	10.934	8.545	37.029	30.2	81.4	7.4
Nevada	14.579	17.427	14.674	44.762	23.6	77.3	9.0
New Hampshire	7.992	11.008	8.474	34.832	35.7	79.7	5.3
New Jersey	10.136	12.764	9.871	39.290	37.6	79.5	7.1
New Mexico	21.782	19.822	17.208	47.143	26.5	73.6	13.0
New York	15.390	16.646	13.506	45.463	35.0	77.4	10.0
North Carolina	16.404	18.608	15.456	47.390	29.4	76.1	10.5
North Dakota	7.022	12.675	10.664	34.242	29.1	82.2	6.6
Ohio	14.444	15.614	12.789	41.125	26.8	75.7	10.3
Oklahoma	15.311	19.943	17.219	47.021	24.6	76.2	9.6
Oregon	19.374	17.160	14.849	40.540	32.2	75.1	8.0
Pennsylvania	14.280	15.264	12.656	42.129	29.7	75.5	8.6
Rhode Island	16.580	16.628	13.578	43.477	32.7	75.8	7.6
South Carolina	16.437	20.142	16.967	46.302	26.8	74.2	10.7
South Dakota	11.487	11.296	9.739	31.562	27.5	80.0	9.1
Tennessee	18.641	17.477	13.696	49.208	25.7	75.4	11.0
Texas	13.579	15.521	12.742	47.306	28.4	82.5	9.5
Utah	7.544	10.866	9.262	35.289	31.8	83.9	5.1
Vermont	13.575	12.203	10.438	37.916	36.9	77.1	4.6
Virginia	10.282	15.163	12.706	38.615	37.0	80.4	7.1
Washington	14.957	12.970	10.780	35.817	34.2	78.5	7.0
West Virginia	19.984	21.509	17.510	52.420	19.6	67.3	12.8
Wisconsin	13.966	11.904	9.834	37.240	28.4	78.1	6.8
Wyoming	5.559	12.539	10.705	35.312	26.2	82.2	3.8

Table A.17. Values for FY 2016 predictors

	SNAP prevalence rate	Tax nonfiler rate	Non-elderly tax nonfiler rate	Elderly combined poverty and nonfiler rate	Bachelor's degree rate	Household earnings rate	Child under 50 percent of poverty rate
Alabama	17.504	22.015	18.325	51.010	24.7	71.8	11.5
Alaska	11.102	15.543	14.583	33.398	29.6	86.0	6.2
Arizona	13.897	21.594	18.730	47.520	28.9	74.3	11.0
Arkansas	14.258	21.830	18.078	52.155	22.4	72.7	10.3
California	11.044	17.468	14.623	45.738	32.9	80.5	8.1
Colorado	8.602	14.329	12.512	36.446	39.9	82.1	5.0
Connecticut	12.030	15.126	12.576	37.579	38.6	79.4	6.0
Delaware	15.489	16.960	14.805	35.805	31.0	75.9	6.6
District of Columbia	19.672	26.408	24.362	47.687	56.8	80.4	15.9
Florida	16.724	19.926	15.302	49.675	28.6	72.0	9.1
Georgia	16.808	19.968	17.121	48.889	30.5	79.1	10.2
Hawaii	12.370	15.414	12.861	40.504	31.9	80.4	5.2
Idaho	11.030	12.850	10.494	41.159	27.6	77.1	7.0
Illinois	14.915	14.503	11.941	40.347	34.0	78.5	7.6
Indiana	11.179	14.229	12.663	40.847	25.6	77.9	8.7
Iowa	12.160	13.573	11.272	35.604	28.4	79.1	6.2
Kansas	8.730	14.017	12.628	37.384	32.8	79.4	5.7
Kentucky	15.019	20.139	16.485	50.510	23.4	72.6	11.8
Louisiana	19.040	23.230	20.119	51.332	23.4	74.6	12.5
Maine	14.226	16.363	12.733	43.328	30.1	74.6	6.6
Maryland	12.355	15.044	12.620	37.263	39.3	81.5	5.9
Massachusetts	11.419	15.347	13.099	38.189	42.7	79.1	6.6
Michigan	14.835	15.707	14.302	39.221	28.3	74.2	9.3
Minnesota	8.666	10.740	8.971	33.305	34.8	79.9	5.6
Mississippi	19.517	22.880	18.927	54.588	21.8	72.4	14.3
Missouri	13.309	17.055	14.769	43.357	28.5	76.0	9.0
Montana	11.229	14.766	12.757	39.456	31.0	75.4	6.7
Nebraska	9.218	11.333	9.064	36.924	31.4	81.0	5.8
Nevada	14.962	17.909	15.099	45.202	23.5	77.5	8.1
New Hampshire	7.376	11.071	8.536	34.491	36.6	80.4	3.0
New Jersey	9.801	13.063	10.047	39.603	38.6	79.6	5.8
New Mexico	22.597	20.871	18.400	47.017	27.2	73.0	13.4
New York	14.964	17.015	13.644	46.233	35.7	77.3	9.6
North Carolina	15.442	19.100	16.028	47.030	30.4	76.3	9.3
North Dakota	7.181	13.157	11.302	34.121	29.6	82.3	6.3
Ohio	13.841	15.980	13.199	40.863	27.5	75.9	9.9
Oklahoma	15.630	21.019	18.416	47.723	25.2	76.4	10.0
Oregon	17.985	17.747	15.666	39.825	32.7	75.9	7.3
Pennsylvania	14.576	15.365	12.779	41.776	30.8	75.2	8.1
Rhode Island	16.174	16.707	13.766	42.704	34.1	75.2	7.6
South Carolina	15.474	20.437	17.320	45.925	27.2	74.3	11.5
South Dakota	11.141	11.208	9.919	30.602	28.9	80.0	9.8
Tennessee	16.742	17.858	14.158	48.822	26.1	75.2	10.4
Texas	13.505	17.109	14.445	48.017	28.9	82.5	9.5
Utah	7.221	11.101	9.540	35.051	32.6	83.9	4.9
Vermont	12.788	12.021	10.380	37.209	36.4	76.2	8.3
Virginia	9.821	15.470	13.009	38.589	38.1	80.1	6.8
Washington	13.891	13.119	11.029	35.382	35.1	78.8	5.9
West Virginia	19.530	22.270	18.343	52.441	20.8	67.4	11.1
Wisconsin	12.612	12.050	10.167	36.279	29.5	77.8	6.5
Wyoming	5.788	14.031	12.300	36.481	27.1	80.4	4.4

Table A.18. Regression estimates of SNAP participation rates

	All eligible people			Working poor people		
	FY 2014	FY 2015	FY 2016	FY 2014	FY 2015	FY 2016
Alabama	77.88	81.54	83.64	66.08	72.04	74.39
Alaska	77.84	79.92	69.24	65.12	68.19	60.26
Arizona	68.58	70.44	71.76	56.76	60.53	63.98
Arkansas	68.63	68.70	68.33	58.91	63.63	64.06
California	60.62	62.62	68.20	49.82	54.51	58.93
Colorado	75.35	73.15	75.38	63.88	59.20	63.04
Connecticut	86.48	86.83	87.38	72.26	69.77	71.14
Delaware	95.97	99.43	96.47	81.25	82.64	82.23
District of Columbia	97.33	98.87	95.53	54.61	61.64	61.70
Florida	88.52	89.80	88.52	75.58	78.68	74.16
Georgia	83.57	83.56	84.61	68.08	72.07	71.53
Hawaii	86.07	81.61	82.64	73.01	70.48	70.88
Idaho	84.28	81.32	82.98	81.12	76.05	80.17
Illinois	97.08	97.87	97.34	84.62	83.37	83.34
Indiana	83.61	81.82	77.47	81.12	75.42	77.74
Iowa	89.40	86.13	83.86	81.13	76.98	75.22
Kansas	78.05	74.75	75.36	74.03	65.31	70.94
Kentucky	83.61	80.49	74.99	73.63	72.99	70.33
Louisiana	73.10	76.25	82.67	59.55	67.21	72.98
Maine	95.34	87.94	90.06	81.95	76.29	77.70
Maryland	90.58	87.32	87.06	72.93	70.39	69.35
Massachusetts	88.82	82.46	88.46	72.63	64.58	71.68
Michigan	99.78	99.00	96.71	93.52	85.68	91.49
Minnesota	86.82	82.11	82.57	81.34	70.87	75.43
Mississippi	83.61	85.07	82.74	69.99	76.49	74.31
Missouri	79.90	80.96	82.22	73.07	71.58	76.26
Montana	82.41	80.85	85.51	78.00	70.54	79.98
Nebraska	75.88	73.56	77.63	72.41	66.66	71.52
Nevada	67.15	77.14	80.52	60.25	70.66	73.66
New Hampshire	80.49	75.79	78.05	74.09	64.99	67.93
New Jersey	77.71	76.43	81.82	67.69	64.07	68.73
New Mexico	93.65	104.29	110.12	79.61	89.10	95.98
New York	86.50	84.57	89.80	71.32	70.58	74.76
North Carolina	77.51	82.17	84.98	64.78	70.92	73.31
North Dakota	64.86	63.54	60.61	63.78	57.04	56.81
Ohio	85.21	85.62	83.09	77.86	75.49	75.52
Oklahoma	72.39	74.69	76.97	61.46	66.77	69.51
Oregon	110.02	110.06	106.96	92.40	91.58	90.52
Pennsylvania	85.91	87.70	95.21	79.11	76.64	85.42
Rhode Island	92.50	94.39	101.16	78.18	79.92	85.62
South Carolina	76.72	81.38	78.29	64.47	70.17	69.11
South Dakota	89.56	89.00	82.17	84.13	78.33	77.76
Tennessee	95.18	89.81	88.47	81.50	80.59	78.62
Texas	73.21	69.57	72.73	62.44	63.86	64.76
Utah	70.38	69.25	69.64	65.59	62.39	65.00
Vermont	104.00	100.19	101.59	93.98	84.75	92.58
Virginia	76.85	72.76	74.76	63.76	59.37	62.12
Washington	102.80	101.36	99.96	90.02	85.16	85.56
West Virginia	86.09	90.04	94.97	78.77	81.94	87.31
Wisconsin	99.42	96.21	93.92	92.64	85.78	87.10
Wyoming	59.24	57.60	56.48	59.33	55.17	56.95

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

	All eligible people			Working poor people		
	FY 2014	FY 2015	FY 2016	FY 2014	FY 2015	FY 2016
Alabama	3.373	3.392	3.419	4.814	4.839	4.886
Alaska	4.899	4.647	4.719	7.359	6.896	6.466
Arizona	3.561	3.552	3.583	5.073	5.070	5.234
Arkansas	3.664	3.611	3.665	5.263	5.159	5.351
California	3.559	3.498	3.423	5.079	4.980	4.896
Colorado	3.469	3.484	3.583	4.956	4.933	5.084
Connecticut	3.492	3.460	3.490	4.979	4.909	4.984
Delaware	3.944	3.931	4.145	5.714	5.651	5.934
District of Columbia	5.601	5.341	5.272	7.966	7.999	8.621
Florida	3.948	4.035	3.897	5.865	5.944	5.665
Georgia	3.517	3.499	3.507	5.034	4.997	5.043
Hawaii	3.731	3.414	3.565	5.363	4.879	5.069
Idaho	3.755	3.681	3.565	5.387	5.270	5.170
Illinois	3.457	3.497	3.451	4.941	4.955	4.937
Indiana	3.939	3.875	3.799	5.714	5.495	5.543
Iowa	3.653	3.658	3.685	5.274	5.251	5.184
Kansas	3.653	3.628	3.757	5.262	5.139	5.428
Kentucky	3.392	3.326	3.569	4.858	4.729	5.120
Louisiana	3.583	3.597	3.573	5.118	5.200	5.091
Maine	3.569	3.578	3.587	5.184	5.180	5.177
Maryland	3.695	3.549	3.607	5.316	5.068	5.140
Massachusetts	3.613	3.597	3.586	5.172	5.131	5.182
Michigan	4.283	4.154	4.019	6.261	5.846	5.866
Minnesota	3.539	3.493	3.539	5.071	4.941	5.076
Mississippi	3.629	3.927	3.744	5.216	5.752	5.334
Missouri	3.448	3.380	3.317	4.933	4.752	4.739
Montana	3.561	3.521	3.666	5.121	4.970	5.303
Nebraska	3.455	3.653	3.460	4.943	5.197	4.946
Nevada	3.423	3.367	3.457	4.867	4.787	4.948
New Hampshire	3.649	3.732	3.716	5.256	5.314	5.322
New Jersey	3.647	3.689	3.652	5.286	5.287	5.227
New Mexico	3.681	3.796	4.118	5.265	5.346	5.835
New York	3.381	3.375	3.497	4.853	4.837	5.020
North Carolina	3.208	3.186	3.217	4.541	4.508	4.558
North Dakota	4.422	3.899	4.015	6.573	5.557	5.664
Ohio	3.603	3.487	3.655	5.196	4.968	5.150
Oklahoma	3.478	3.569	3.487	4.946	5.086	4.989
Oregon	3.986	3.995	4.097	5.737	5.683	5.895
Pennsylvania	3.362	3.294	3.374	4.812	4.640	4.810
Rhode Island	3.319	3.514	3.536	4.730	5.034	5.049
South Carolina	3.687	3.367	3.536	5.299	4.786	5.055
South Dakota	3.908	4.472	5.142	5.694	6.458	7.203
Tennessee	3.669	3.539	3.521	5.304	5.077	5.035
Texas	3.861	3.878	3.854	5.578	5.589	5.636
Utah	3.586	3.512	3.544	5.119	4.988	5.028
Vermont	3.968	4.419	4.220	5.756	6.389	6.216
Virginia	3.409	3.448	3.447	4.863	4.878	4.940
Washington	3.614	3.606	3.614	5.166	5.115	5.168
West Virginia	4.162	3.847	3.956	6.152	5.472	5.691
Wisconsin	3.620	3.581	3.525	5.172	5.075	5.070
Wyoming	3.815	3.993	3.943	5.492	5.760	5.714

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

	All eligible people			Working poor people		
	FY 2014	FY 2015	FY 2016	FY 2014	FY 2015	FY 2016
Alabama	80.13	82.62	84.67	67.90	74.02	75.90
Alaska	78.24	80.31	69.63	63.51	65.66	57.32
Arizona	67.80	69.85	71.62	56.96	59.76	63.46
Arkansas	70.28	70.79	70.48	60.34	63.92	65.68
California	63.38	66.46	70.10	49.34	55.46	58.55
Colorado	75.72	73.22	76.18	66.54	61.17	66.51
Connecticut	88.32	88.47	89.05	71.46	67.61	70.09
Delaware	95.47	99.64	96.17	82.09	83.88	83.47
District of Columbia	95.99	97.38	94.12	54.17	61.32	61.52
Florida	88.60	88.48	89.35	73.09	75.15	72.57
Georgia	84.08	82.27	84.17	68.76	71.22	71.10
Hawaii	84.40	80.46	81.38	71.05	69.80	69.44
Idaho	84.30	80.60	82.34	81.43	75.71	79.15
Illinois	98.34	100.35	99.01	80.24	79.86	79.26
Indiana	83.78	81.51	77.66	79.75	72.64	76.22
Iowa	91.00	87.35	85.27	82.79	78.07	76.39
Kansas	77.18	74.23	74.91	74.34	65.85	71.61
Kentucky	82.73	79.34	74.20	72.02	71.70	68.19
Louisiana	72.11	75.90	81.40	60.48	68.52	73.26
Maine	94.28	87.22	88.07	82.50	76.55	77.29
Maryland	91.99	88.72	88.55	74.05	71.30	70.42
Massachusetts	88.19	82.22	88.31	66.70	59.38	64.89
Michigan	100.08	99.39	97.05	94.10	85.49	92.37
Minnesota	86.31	81.65	81.85	81.72	73.08	76.71
Mississippi	81.10	83.06	80.56	67.53	72.80	71.15
Missouri	84.85	86.15	86.97	71.53	70.85	74.47
Montana	81.79	80.42	84.89	77.79	70.45	79.57
Nebraska	75.81	73.68	77.91	73.74	67.80	72.99
Nevada	66.64	77.39	81.16	59.79	71.29	74.20
New Hampshire	80.68	76.36	78.17	74.28	65.60	68.06
New Jersey	74.66	74.51	79.14	66.46	62.89	66.19
New Mexico	90.89	101.57	106.90	82.29	92.59	97.87
New York	86.90	84.77	90.38	75.73	74.42	78.01
North Carolina	76.68	81.27	84.06	65.28	72.44	75.77
North Dakota	64.51	62.64	60.52	63.24	55.66	56.93
Ohio	84.73	85.25	82.73	78.45	76.89	77.54
Oklahoma	74.63	76.66	79.55	56.88	63.31	66.56
Oregon	112.45	112.51	109.67	90.94	89.78	88.77
Pennsylvania	86.52	88.76	96.35	80.62	78.94	88.07
Rhode Island	93.93	95.76	102.30	80.25	81.20	87.35
South Carolina	76.22	80.09	77.55	66.29	72.81	70.92
South Dakota	88.24	87.15	80.76	85.58	79.45	78.81
Tennessee	96.98	92.32	90.40	78.90	78.85	76.46
Texas	71.34	68.05	71.43	63.95	65.13	67.68
Utah	69.05	67.52	68.43	63.63	61.45	62.95
Vermont	105.16	100.31	102.79	94.76	84.26	93.34
Virginia	76.82	71.69	73.55	70.02	64.43	67.89
Washington	103.38	102.53	100.69	87.29	83.60	84.53
West Virginia	83.97	88.37	92.95	79.72	83.39	88.16
Wisconsin	97.58	94.35	91.67	94.52	87.59	88.31
Wyoming	58.26	56.36	54.60	58.76	54.13	55.47

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

	All eligible people			Working poor people		
	FY 2014	FY 2015	FY 2016	FY 2014	FY 2015	FY 2016
Alabama	82.15	84.87	86.90	69.35	75.84	78.61
Alaska	80.20	82.49	71.45	64.87	67.28	59.36
Arizona	69.51	71.75	73.50	58.19	61.24	65.72
Arkansas	72.05	72.71	72.33	61.63	65.49	68.03
California	64.97	68.26	71.94	50.40	56.83	60.64
Colorado	77.62	75.21	78.18	67.97	62.67	68.89
Connecticut	90.54	90.88	91.39	72.99	69.28	72.59
Delaware	97.87	100.00	98.69	83.86	85.95	86.45
District of Columbia	98.41	100.03	96.59	55.34	62.83	63.72
Florida	90.83	90.89	91.69	74.66	77.00	75.17
Georgia	86.19	84.51	86.39	70.23	72.97	73.64
Hawaii	86.52	82.65	83.51	72.58	71.52	71.92
Idaho	86.42	82.80	84.50	83.18	77.58	81.98
Illinois	100.00	100.00	100.00	81.96	81.83	82.09
Indiana	85.89	83.73	79.70	81.46	74.43	78.94
Iowa	93.28	89.72	87.51	84.56	79.99	79.11
Kansas	79.12	76.25	76.88	75.94	67.47	74.17
Kentucky	84.81	81.49	76.15	73.57	73.47	70.63
Louisiana	73.93	77.97	83.54	61.78	70.21	75.88
Maine	96.65	89.60	90.38	84.28	78.44	80.05
Maryland	94.30	91.13	90.88	75.64	73.06	72.93
Massachusetts	90.40	84.46	90.63	68.13	60.84	67.21
Michigan	100.00	100.00	99.60	96.12	87.59	95.67
Minnesota	88.48	83.87	84.00	83.48	74.88	79.45
Mississippi	83.13	85.32	82.68	68.98	74.59	73.70
Missouri	86.98	88.49	89.25	73.07	72.59	77.13
Montana	83.85	82.61	87.12	79.46	72.19	82.41
Nebraska	77.72	75.69	79.95	75.32	69.48	75.59
Nevada	68.32	79.50	83.29	61.08	73.04	76.85
New Hampshire	82.71	78.44	80.23	75.88	67.22	70.49
New Jersey	76.54	76.54	81.21	67.89	64.44	68.55
New Mexico	93.18	100.00	100.00	84.06	94.87	100.00
New York	89.08	87.08	92.75	77.36	76.25	80.80
North Carolina	78.60	83.48	86.27	66.68	74.22	78.48
North Dakota	66.13	64.35	62.11	64.60	57.04	58.96
Ohio	86.86	87.57	84.90	80.13	78.78	80.31
Oklahoma	76.51	78.74	81.64	58.11	64.87	68.93
Oregon	100.00	100.00	100.00	92.89	91.99	91.94
Pennsylvania	88.69	91.18	98.88	82.35	80.88	91.22
Rhode Island	96.29	98.36	100.00	81.97	83.20	90.47
South Carolina	78.14	82.27	79.59	67.71	74.60	73.45
South Dakota	90.45	89.52	82.88	87.42	81.41	81.62
Tennessee	99.42	94.83	92.77	80.60	80.79	79.19
Texas	73.13	69.90	73.30	65.33	66.74	70.10
Utah	70.79	69.35	70.23	65.00	62.96	65.20
Vermont	100.00	100.00	100.00	96.80	86.34	96.67
Virginia	78.75	73.64	75.49	71.52	66.02	70.31
Washington	100.00	100.00	100.00	89.17	85.66	87.55
West Virginia	86.08	90.78	95.40	81.43	85.45	91.31
Wisconsin	100.04	96.91	94.07	96.55	89.75	91.47
Wyoming	59.73	57.90	56.04	60.03	55.47	57.45

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

	All eligible people			Working poor people		
	FY 2014	FY 2015	FY 2016	FY 2014	FY 2015	FY 2016
Alabama	2.510	2.604	2.626	3.849	3.962	3.918
Alaska	3.807	3.458	3.793	6.298	5.597	4.684
Arizona	2.292	2.268	2.353	3.300	3.293	3.579
Arkansas	2.503	2.245	2.222	3.881	3.760	4.278
California	1.527	1.792	1.572	2.368	2.665	2.552
Colorado	2.908	3.053	3.191	4.116	4.332	4.522
Connecticut	3.212	3.241	3.200	4.321	4.161	4.408
Delaware	3.194	3.480	3.548	4.847	5.121	5.394
District of Columbia	4.310	3.854	3.643	6.082	6.191	7.119
Florida	2.228	2.416	2.516	3.938	4.201	4.151
Georgia	2.526	2.432	2.382	3.803	3.613	3.559
Hawaii	3.031	2.791	2.856	4.032	3.733	3.882
Idaho	3.135	2.769	2.547	4.565	4.249	4.157
Illinois	2.687	2.872	2.630	3.819	3.930	3.844
Indiana	3.165	2.964	2.898	4.603	3.938	4.397
Iowa	3.232	3.164	3.338	4.744	4.593	4.461
Kansas	2.714	2.793	2.972	4.256	4.095	4.580
Kentucky	2.497	2.444	2.638	3.793	3.861	4.183
Louisiana	2.270	2.325	2.056	3.338	3.784	3.767
Maine	2.990	3.225	2.995	4.603	4.741	4.510
Maryland	3.045	3.069	3.090	4.652	4.418	4.556
Massachusetts	3.067	2.984	3.031	4.534	4.432	4.353
Michigan	3.301	3.272	3.004	5.158	4.790	4.903
Minnesota	2.938	2.971	2.931	4.224	4.445	4.562
Mississippi	2.333	2.673	2.870	3.948	4.387	4.083
Missouri	3.429	3.502	3.368	4.200	4.131	4.043
Montana	3.008	2.958	3.083	4.146	3.853	4.474
Nebraska	2.764	2.926	2.766	4.104	4.174	4.223
Nevada	2.421	2.585	2.803	3.463	3.674	4.158
New Hampshire	3.054	3.165	3.142	4.511	4.568	4.692
New Jersey	2.737	2.906	2.880	4.268	4.260	4.102
New Mexico	3.243	3.389	3.671	4.101	4.290	4.563
New York	2.152	2.153	2.262	3.785	3.690	3.892
North Carolina	2.157	2.124	2.160	3.283	3.332	3.635
North Dakota	3.560	3.171	3.110	5.645	4.589	4.976
Ohio	2.498	2.514	2.539	3.938	3.682	3.993
Oklahoma	2.744	2.883	2.898	3.301	3.616	3.929
Oregon	3.706	3.703	3.603	4.891	4.607	4.969
Pennsylvania	2.415	2.523	2.647	3.942	3.898	4.212
Rhode Island	3.085	3.321	3.279	4.681	4.895	4.944
South Carolina	2.644	2.435	2.605	3.893	3.801	3.793
South Dakota	3.637	4.053	4.694	5.157	5.513	6.121
Tennessee	3.016	2.984	2.904	4.106	3.965	3.968
Texas	1.717	1.796	1.656	2.888	3.130	3.305
Utah	2.976	2.702	2.825	3.971	3.858	3.650
Vermont	3.580	3.903	3.721	5.413	5.783	5.912
Virginia	2.830	2.679	2.541	4.816	4.496	4.624
Washington	3.004	3.017	2.884	4.300	4.295	4.485
West Virginia	3.375	3.472	3.546	5.135	4.260	4.692
Wisconsin	3.006	2.973	2.865	4.582	4.379	4.327
Wyoming	2.904	3.167	2.876	4.377	4.545	4.401

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

	FY 2014	FY 2015	FY 2016
Alabama	1,055,120	1,013,928	940,709
Alaska	108,600	98,051	115,119
Arizona	1,280,538	1,216,908	1,130,042
Arkansas	661,304	626,809	575,488
California	6,096,010	5,843,813	5,441,979
Colorado	602,908	616,308	573,955
Connecticut	402,306	419,654	406,099
Delaware	125,338	125,242	122,464
District of Columbia	129,087	130,001	128,763
Florida	3,586,514	3,614,015	3,409,708
Georgia	1,964,027	2,015,673	1,880,061
Hawaii	197,064	201,635	190,121
Idaho	223,272	218,829	202,344
Illinois	1,808,696	1,853,883	1,745,218
Indiana	1,020,866	969,482	901,717
Iowa	375,096	371,834	357,345
Kansas	370,084	358,240	325,298
Kentucky	906,836	903,042	825,449
Louisiana	1,140,853	1,095,744	1,061,140
Maine	204,917	191,732	176,433
Maryland	719,579	743,976	716,678
Massachusetts	836,147	820,825	729,573
Michigan	1,503,283	1,401,859	1,285,499
Minnesota	497,055	483,746	469,306
Mississippi	758,129	719,061	680,007
Missouri	977,626	949,612	896,093
Montana	133,256	129,321	120,498
Nebraska	209,822	217,803	205,295
Nevada	479,958	451,516	445,902
New Hampshire	115,769	116,424	103,540
New Jersey	1,035,659	1,061,629	967,395
New Mexico	429,687	412,857	426,667
New York	3,164,096	3,196,323	2,955,569
North Carolina	1,806,222	1,716,893	1,609,011
North Dakota	63,792	64,999	69,926
Ohio	1,841,213	1,734,595	1,715,187
Oklahoma	745,434	720,463	720,383
Oregon	662,769	649,726	606,726
Pennsylvania	1,781,916	1,798,665	1,653,490
Rhode Island	159,876	155,424	146,616
South Carolina	1,015,615	930,659	883,200
South Dakota	108,969	108,236	113,868
Tennessee	1,311,029	1,281,425	1,186,101
Texas	4,840,904	4,744,976	4,559,640
Utah	319,795	320,939	305,649
Vermont	76,735	70,347	67,515
Virginia	1,158,672	1,140,918	1,052,876
Washington	871,598	884,783	826,941
West Virginia	389,131	373,492	341,623
Wisconsin	694,448	694,925	640,086
Wyoming	58,374	54,840	59,771

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

	FY 2014	FY 2015	FY 2016
Alabama	449,256	454,529	387,358
Alaska	55,892	45,751	57,843
Arizona	752,383	661,059	592,718
Arkansas	316,806	278,422	270,335
California	3,482,710	3,435,585	3,139,972
Colorado	318,734	350,131	309,401
Connecticut	176,399	186,960	192,261
Delaware	61,892	59,320	58,955
District of Columbia	45,191	48,380	45,284
Florida	1,551,366	1,619,626	1,557,030
Georgia	987,272	1,014,186	956,160
Hawaii	109,428	118,378	106,871
Idaho	124,776	134,792	113,426
Illinois	852,822	932,629	900,800
Indiana	502,699	508,647	428,151
Iowa	201,985	208,871	199,909
Kansas	192,197	196,960	161,191
Kentucky	364,794	360,510	300,730
Louisiana	527,648	500,536	451,334
Maine	90,075	82,324	79,230
Maryland	322,559	352,149	361,279
Massachusetts	300,902	322,056	277,937
Michigan	677,788	602,089	604,373
Minnesota	267,156	265,831	257,780
Mississippi	321,816	293,751	316,411
Missouri	431,851	438,455	375,015
Montana	59,370	58,493	56,183
Nebraska	108,099	114,403	113,165
Nevada	235,703	238,970	236,527
New Hampshire	52,342	53,791	44,667
New Jersey	489,822	464,804	421,671
New Mexico	214,372	212,396	200,563
New York	1,488,777	1,513,472	1,277,538
North Carolina	757,864	869,112	845,297
North Dakota	31,396	30,228	34,012
Ohio	802,523	816,747	784,338
Oklahoma	371,436	371,687	350,429
Oregon	294,519	303,597	256,137
Pennsylvania	703,699	775,853	754,813
Rhode Island	67,837	62,185	61,526
South Carolina	467,465	440,628	397,953
South Dakota	54,070	56,823	55,234
Tennessee	582,309	578,643	516,547
Texas	2,754,902	2,538,399	2,615,195
Utah	183,439	198,395	175,219
Vermont	30,925	30,106	28,164
Virginia	573,205	544,661	505,566
Washington	363,754	424,198	415,160
West Virginia	134,534	145,066	118,626
Wisconsin	343,390	364,155	321,078
Wyoming	29,660	29,921	29,937

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

	FY 2014	FY 2015	FY 2016
Alabama	32,487	31,406	28,638
Alaska	5,195	4,150	6,156
Arizona	42,551	38,831	36,436
Arkansas	23,152	19,541	17,808
California	144,374	154,874	119,744
Colorado	22,763	25,254	23,597
Connecticut	14,381	15,111	14,325
Delaware	4,122	4,200	4,435
District of Columbia	5,697	5,057	4,891
Florida	88,640	96,987	94,246
Georgia	57,997	58,558	52,221
Hawaii	6,956	6,875	6,550
Idaho	8,161	7,389	6,143
Illinois	48,179	50,598	44,774
Indiana	37,910	34,642	33,028
Iowa	13,097	13,236	13,728
Kansas	12,795	13,249	12,667
Kentucky	26,903	27,339	28,805
Louisiana	35,295	32,987	26,309
Maine	6,388	6,967	5,889
Maryland	23,416	25,291	24,540
Massachusetts	28,582	29,278	24,577
Michigan	47,507	44,425	39,056
Minnesota	16,632	17,299	16,496
Mississippi	21,441	22,748	23,780
Missouri	38,835	37,944	34,058
Montana	4,818	4,675	4,295
Nebraska	7,520	8,501	7,153
Nevada	17,137	14,824	15,113
New Hampshire	4,308	4,742	4,084
New Jersey	37,315	40,699	34,556
New Mexico	15,069	12,978	13,110
New York	77,015	79,783	72,602
North Carolina	49,952	44,109	40,575
North Dakota	3,460	3,234	3,527
Ohio	53,349	50,267	51,662
Oklahoma	26,938	26,631	25,758
Oregon	18,627	18,188	17,384
Pennsylvania	48,898	50,248	44,584
Rhode Island	5,161	5,298	4,393
South Carolina	34,633	27,805	29,121
South Dakota	4,415	4,948	6,496
Tennessee	40,078	40,712	37,395
Texas	114,541	123,061	103,762
Utah	13,547	12,625	12,384
Vermont	2,382	2,611	2,274
Virginia	41,950	41,902	35,702
Washington	23,493	24,294	22,496
West Virginia	15,376	14,423	12,790
Wisconsin	21,027	21,520	19,635
Wyoming	2,860	3,029	3,090

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

	FY 2014	FY 2015	FY 2016
Alabama	24,930	23,745	19,308
Alaska	5,426	3,806	4,565
Arizona	42,670	35,545	32,283
Arkansas	19,949	15,986	17,005
California	163,624	161,136	132,169
Colorado	19,303	24,202	20,313
Connecticut	10,443	11,228	11,677
Delaware	3,578	3,535	3,679
District of Columbia	4,967	4,767	5,060
Florida	81,821	88,366	86,015
Georgia	53,460	50,209	46,214
Hawaii	6,080	6,179	5,769
Idaho	6,848	7,382	5,753
Illinois	39,733	44,795	42,190
Indiana	28,405	26,914	23,853
Iowa	11,331	11,992	11,276
Kansas	10,772	11,953	9,956
Kentucky	18,807	18,946	17,814
Louisiana	28,509	26,979	22,410
Maine	4,920	4,975	4,465
Maryland	19,836	21,296	22,572
Massachusetts	20,023	23,461	18,008
Michigan	36,373	32,928	30,982
Minnesota	13,517	15,781	14,806
Mississippi	18,417	17,275	17,535
Missouri	24,821	24,951	19,661
Montana	3,098	3,122	3,051
Nebraska	5,891	6,873	6,323
Nevada	13,365	12,020	12,801
New Hampshire	3,112	3,656	2,973
New Jersey	30,793	30,728	25,236
New Mexico	10,460	9,604	8,908
New York	72,840	73,243	61,546
North Carolina	37,312	39,013	39,160
North Dakota	2,743	2,432	2,871
Ohio	39,440	38,172	39,002
Oklahoma	21,098	20,721	19,980
Oregon	15,508	15,206	13,846
Pennsylvania	33,689	37,395	34,864
Rhode Island	3,874	3,659	3,363
South Carolina	26,874	22,448	20,556
South Dakota	3,189	3,848	4,143
Tennessee	29,665	28,398	25,892
Texas	121,774	119,037	123,328
Utah	11,206	12,157	9,812
Vermont	1,729	2,016	1,723
Virginia	38,598	37,092	33,258
Washington	17,539	21,269	21,271
West Virginia	8,484	7,232	6,097
Wisconsin	16,296	17,767	15,192
Wyoming	2,163	2,452	2,294

APPENDIX B

DATA FOR FIGURES IN CUNNYNGHAM (2019)

Table B.1a. How many people were eligible in 2016? What percentage participated? (States)

Eligible people (thousands)	State	Lower bound of confidence interval	FY 2016 participation rate	Upper bound of confidence interval
607	Oregon *	94	100	100
427	New Mexico *	94	100	100
68	Vermont *	94	100	100
147	Rhode Island *	95	100	100
827	Washington *	95	100	100
1,745	Illinois *	96	100	100
1,285	Michigan *	95	100	100
1,653	Pennsylvania *	95	99	100
122	Delaware *	93	99	100
129	District of Columbia *	91	97	100
342	West Virginia *	90	95	100
640	Wisconsin *	89	94	99
1,186	Tennessee *	88	93	98
2,956	New York *	89	93	96
3,410	Florida *	88	92	96
406	Connecticut *	86	91	97
717	Maryland *	86	91	96
730	Massachusetts *	86	91	96
176	Maine *	85	90	95
896	Missouri	84	89	95
357	Iowa	82	88	93
120	Montana	82	87	92
941	Alabama	83	87	91
1,880	Georgia	82	86	90
1,609	North Carolina	83	86	90
1,715	Ohio	81	85	89
202	Idaho	80	84	89
469	Minnesota	79	84	89
1,061	Louisiana	80	84	87
190	Hawaii	79	84	88
446	Nevada	79	83	88
114	South Dakota	75	83	91
680	Mississippi	78	83	87
720	Oklahoma	77	82	86
967	New Jersey *	76	81	86
104	New Hampshire *	75	80	85
205	Nebraska *	75	80	85
902	Indiana *	75	80	84
883	South Carolina *	75	80	84
574	Colorado *	73	78	83
325	Kansas *	72	77	82
825	Kentucky *	72	76	80
1,053	Virginia *	71	75	80
1,130	Arizona *	70	74	77
4,560	Texas *	71	73	76
575	Arkansas *	69	72	76
5,442	California *	69	72	75
115	Alaska *	65	71	78
306	Utah *	66	70	75
70	North Dakota *	57	62	67
60	Wyoming *	51	56	61

*State's participation rate is significantly different from the national participation rate of 85 percent.

Table B.1b. How many people were eligible in 2016? What percentage participated? (Regions and national)

Eligible people (thousands)	Region	Lower bound of confidence interval	FY 2016 participation rate	Upper bound of confidence interval
4,585	Northeast	89	92	95
6,757	Midwest	89	92	94
4,983	Mid-Atlantic	87	89	91
11,414	Southeast	85	87	89
3,028	Mountain Plains	79	81	84
8,959	Western	76	78	80
7,343	Southwest	75	77	79
47,070	United States	84	85	86

Table B.2a. How many working poor people were eligible in 2016? What percentage participated? (States)

Eligible people (thousands)	State	Lower bound of confidence interval	FY 2016 participation rate	Upper bound of confidence interval
201	New Mexico *	92	100	100
28	Vermont *	87	97	100
604	Michigan *	88	96	100
256	Oregon *	84	92	100
321	Wisconsin *	84	91	99
119	West Virginia *	84	91	99
755	Pennsylvania *	84	91	98
62	Rhode Island *	82	90	99
415	Washington *	80	88	95
59	Delaware *	78	86	95
56	Montana *	75	82	90
901	Illinois *	76	82	88
113	Idaho *	75	82	89
55	South Dakota	72	82	92
1,278	New York *	74	81	87
784	Ohio *	74	80	87
79	Maine	73	80	87
258	Minnesota	72	79	87
517	Tennessee	73	79	86
200	Iowa	72	79	86
428	Indiana	72	79	86
387	Alabama	72	79	85
845	North Carolina	73	78	84
375	Missouri	70	77	84
237	Nevada	70	77	84
451	Louisiana	70	76	82
113	Nebraska	69	76	83
1,557	Florida	68	75	82
161	Kansas	67	74	82
316	Mississippi	67	74	80
956	Georgia	68	74	79
398	South Carolina	67	73	80
361	Maryland	65	73	80
192	Connecticut	65	73	80
107	Hawaii	66	72	78
301	Kentucky	64	71	78
45	New Hampshire	63	70	78
506	Virginia	63	70	78
2,615	Texas *	65	70	76
350	Oklahoma *	62	69	75
309	Colorado *	61	69	76
422	New Jersey *	62	69	75
270	Arkansas *	61	68	75
278	Massachusetts *	60	67	74
593	Arizona *	60	66	72
175	Utah *	59	65	71
45	District of Columbia *	52	64	75
3,140	California *	56	61	65
58	Alaska *	52	59	67
34	North Dakota *	51	59	67
30	Wyoming *	50	57	65

*State's participation rate is significantly different from the national participation rate of 75 percent.

Table B.2b. How many working poor people were eligible in 2016? What percentage participated? (Regions and national)

Eligible people (thousands)	Region	Lower bound of confidence interval	FY 2016 participation rate	Upper bound of confidence interval
3,297	Midwest	81	84	88
2,266	Mid-Atlantic	75	79	83
1,961	Northeast	74	78	83
5,277	Southeast	72	76	79
1,509	Mountain Plains	70	73	77
3,888	Southwest	68	72	76
4,919	Western	64	67	70
23,117	United States	73	75	77

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

	All eligible people			Working poor people		
	FY 2014	FY 2015	FY 2016	FY 2014	FY 2015	FY 2016
Alabama	82	85	87	69	76	79
Alaska	80	82	71	65	67	59
Arizona	70	72	74	58	61	66
Arkansas	72	73	72	62	65	68
California	65	68	72	50	57	61
Colorado	78	75	78	68	63	69
Connecticut	91	91	91	73	69	73
Delaware	98	100	99	84	86	86
District of Columbia	98	100	97	55	63	64
Florida	91	91	92	75	77	75
Georgia	86	85	86	70	73	74
Hawaii	87	83	84	73	72	72
Idaho	86	83	84	83	78	82
Illinois	100	100	100	82	82	82
Indiana	86	84	80	81	74	79
Iowa	93	90	88	85	80	79
Kansas	79	76	77	76	67	74
Kentucky	85	81	76	74	73	71
Louisiana	74	78	84	62	70	76
Maine	97	90	90	84	78	80
Maryland	94	91	91	76	73	73
Massachusetts	90	84	91	68	61	67
Michigan	100	100	100	96	88	96
Minnesota	88	84	84	83	75	79
Mississippi	83	85	83	69	75	74
Missouri	87	88	89	73	73	77
Montana	84	83	87	79	72	82
Nebraska	78	76	80	75	69	76
Nevada	68	79	83	61	73	77
New Hampshire	83	78	80	76	67	70
New Jersey	77	77	81	68	64	69
New Mexico	93	100	100	84	95	100
New York	89	87	93	77	76	81
North Carolina	79	83	86	67	74	78
North Dakota	66	64	62	65	57	59
Ohio	87	88	85	80	79	80
Oklahoma	77	79	82	58	65	69
Oregon	100	100	100	93	92	92
Pennsylvania	89	91	99	82	81	91
Rhode Island	96	98	100	82	83	90
South Carolina	78	82	80	68	75	73
South Dakota	90	90	83	87	81	82
Tennessee	99	95	93	81	81	79
Texas	73	70	73	65	67	70
Utah	71	69	70	65	63	65
Vermont	100	100	100	97	86	97
Virginia	79	74	75	72	66	70
Washington	100	100	100	89	86	88
West Virginia	86	91	95	81	85	91
Wisconsin	100	97	94	97	90	91
Wyoming	60	58	56	60	55	57
Mid-Atlantic Region	85	85	89	75	73	79
Midwest Region	94	93	92	86	81	84
Mountain Plains Region	82	81	81	73	69	73
Northeast Region	90	87	92	76	74	78
Southeast Region	87	87	87	72	76	76
Southwest Region	75	74	77	65	68	72
Western Region	72	75	78	58	63	67
United States	83	83	85	70	72	75

Table B.4. How did your state rank in 2016?

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

Table B.5a. How did your state compare with other states in 2016 for all eligibles? (Oregon–Maryland)

	OR	NM	VT	RI	WA	IL	MI	PA	DE	DC	WV	WI	TN	NY	FL	CT	MD
OR	-	-	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
VT	H	-	-	-	-	-	L	L	-	L	L	L	L	L	L	L	L
RI	H	-	-	-	-	-	L	L	L	L	L	L	L	L	L	L	L
WA	H	H	-	-	-	-	-	-	-	L	L	L	L	L	L	L	L
IL	H	H	-	-	-	-	-	-	-	-	L	L	L	L	L	L	L
MI	H	H	H	H	-	-	-	-	-	-	-	L	L	L	L	L	L
PA	H	H	H	H	-	-	-	-	-	-	-	L	L	L	L	L	L
DE	H	H	-	H	-	-	-	-	-	-	-	-	-	L	L	L	L
DC	H	H	H	H	H	-	-	-	-	-	-	-	-	-	-	-	-
WV	H	H	H	H	H	H	-	-	-	-	-	-	-	-	-	-	-
WI	H	H	H	H	H	H	H	H	-	-	-	-	-	-	-	-	-
TN	H	H	H	H	H	H	H	H	-	-	-	-	-	-	-	-	-
NY	H	H	H	H	H	H	H	H	H	-	-	-	-	-	-	-	-
FL	H	H	H	H	H	H	H	H	H	-	-	-	-	-	-	-	-
CT	H	H	H	H	H	H	H	H	H	-	-	-	-	-	-	-	-
MD	H	H	H	H	H	H	H	H	H	-	-	-	-	-	-	-	-
MA	H	H	H	H	H	H	H	H	H	H	-	-	-	-	-	-	-
ME	H	H	H	H	H	H	H	H	H	-	-	-	-	-	-	-	-
MO	H	H	H	H	H	H	H	H	H	H	-	-	-	-	-	-	-
IA	H	H	H	H	H	H	H	H	H	H	H	H	-	H	-	-	-
MT	H	H	H	H	H	H	H	H	H	H	H	H	-	H	-	-	-
AL	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	-	-
GA	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	-	-
NC	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
ID	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
LA	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
NV	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
MS	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
NJ	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
NE	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
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
KS	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
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
TX	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
CA	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
UT	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 2016 for all eligibles? (Massachusetts–Oklahoma)

	MA	ME	MO	IA	MT	AL	GA	NC	OH	ID	MN	LA	HI	NV	SD	MS	OK
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
WA	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
MI	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
DE	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
WV	-	-	-	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
TN	-	-	-	-	-	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
FL	-	-	-	-	-	L	L	L	L	L	L	L	L	L	L	L	L
CT	-	-	-	-	-	-	-	L	L	L	L	L	L	L	L	L	L
MD	-	-	-	-	-	-	-	-	L	L	L	L	L	L	L	L	L
MA	-	-	-	-	-	-	-	-	L	L	L	L	L	L	L	L	L
ME	-	-	-	-	-	-	-	-	L	L	L	L	L	L	L	L	L
MO	-	-	-	-	-	-	-	-	-	-	-	L	-	L	-	L	L
IA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	L
MT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	L
AL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	L
GA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	L
NC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	L
OH	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ID	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MN	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LA	H	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HI	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NV	H	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SD	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MS	H	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OK	H	H	H	H	H	H	H	H	-	-	-	-	-	-	-	-	-
NJ	H	H	H	H	H	H	H	H	-	-	-	-	-	-	-	-	-
NH	H	H	H	H	H	H	H	H	-	-	-	-	-	-	-	-	-
NE	H	H	H	H	H	H	H	H	H	H	-	-	-	-	-	-	-
IN	H	H	H	H	H	H	H	H	H	H	-	-	-	-	-	-	-
SC	H	H	H	H	H	H	H	H	H	H	-	-	-	-	-	-	-
CO	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	-
KY	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
TX	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
CA	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
UT	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

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Table B.5c. How did your state compare with other states in 2016 for all eligibles? (New Jersey–Wyoming)

	NJ	NH	NE	IN	SC	CO	KS	KY	VA	AZ	TX	AR	CA	AK	UT	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
WA	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
MI	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
DE	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
WV	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
TN	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
FL	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
MD	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
ME	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
IA	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
AL	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
NC	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
OH	-	-	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
ID	-	-	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
MN	-	-	-	-	-	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
HI	-	-	-	-	-	L	L	L	L	L	L	L	L	L	L	L	L
NV	-	-	-	-	-	-	L	L	L	L	L	L	L	L	L	L	L
SD	-	-	-	-	-	-	-	L	L	L	L	L	L	L	L	L	L
MS	-	-	-	-	-	-	L	L	L	L	L	L	L	L	L	L	L
OK	-	-	-	-	-	-	-	L	L	L	L	L	L	L	L	L	L
NJ	-	-	-	-	-	-	-	L	L	L	L	L	L	L	L	L	L
NH	-	-	-	-	-	-	-	-	L	L	L	L	L	L	L	L	L
NE	-	-	-	-	-	-	-	-	-	L	L	L	L	L	L	L	L
IN	-	-	-	-	-	-	-	-	-	L	L	L	L	L	L	L	L
SC	-	-	-	-	-	-	-	-	-	L	L	L	L	L	L	L	L
CO	-	-	-	-	-	-	-	-	-	-	L	L	L	L	L	L	L
KS	-	-	-	-	-	-	-	-	-	-	-	-	L	-	L	L	L
KY	H	-	-	-	-	-	-	-	-	-	-	-	L	-	L	L	L
VA	H	H	-	-	-	-	-	-	-	-	-	-	-	-	L	L	L
AZ	H	H	H	H	H	-	-	-	-	-	-	-	-	-	-	L	L
TX	H	H	H	H	H	H	-	-	-	-	-	-	-	-	-	L	L
AR	H	H	H	H	H	H	-	-	-	-	-	-	-	-	-	L	L
CA	H	H	H	H	H	H	H	H	-	-	-	-	-	-	-	L	L
AK	H	H	H	H	H	H	-	-	-	-	-	-	-	-	-	L	L
UT	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 2016 participation rate for all eligible people		
Above 92 percent (top quarter)	**Between 80 and 92 percent**	**Below 80 percent (bottom quarter)**
Oregon	Florida	Colorado
New Mexico	Connecticut	Kansas
Vermont	Maryland	Kentucky
Rhode Island	Massachusetts	Virginia
Washington	Maine	Arizona
Illinois	Missouri	Texas
Michigan	Iowa	Arkansas
Pennsylvania	Montana	California
Delaware	Alabama	Alaska
District of Columbia	Georgia	Utah
West Virginia	North Carolina	North Dakota
Wisconsin	Ohio	Wyoming
Tennessee	Idaho	
New York	Minnesota	
	Louisiana	
	Hawaii	
	Nevada	
	South Dakota	
	Mississippi	
	Oklahoma	
	New Jersey	
	New Hampshire	
	Nebraska	
	Indiana	
	South Carolina	

Table B.7. Supporting detail for Cunnyngham (2019)

Description	States		
In 18 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 Maine Maryland	Massachusetts Michigan New Mexico New York Oregon Pennsylvania	Rhode Island Tennessee Vermont Washington West Virginia Wisconsin
In 17 states, the participation rate for all eligible people was significantly lower than the national rate	Alaska Arizona Arkansas California Colorado Indiana	Kansas Kentucky Nebraska New Hampshire New Jersey North Dakota	South Carolina Texas Utah Virginia Wyoming
In 15 states, the participation rate for eligible working poor people was significantly higher than the national rate	Delaware Idaho Illinois Michigan Montana	New Mexico New York Ohio Oregon Pennsylvania	Rhode Island Vermont Washington West Virginia Wisconsin
In 12 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 Massachusetts New Jersey North Dakota	Oklahoma Texas Utah Wyoming
In 29 states and the District of Columbia, the participation rate for working poor people was significantly lower than the rate for all eligible people	Alabama Alaska Arizona California Colorado Connecticut Delaware District of Columbia Florida Georgia	Hawaii Illinois Iowa Louisiana Maine Maryland Massachusetts Mississippi Missouri New Hampshire	New Jersey New York North Carolina Oklahoma Oregon Pennsylvania Rhode Island South Carolina Tennessee Washington
In 7 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	Connecticut District of Columbia Florida	Illinois Maryland Massachusetts	Oregon Washington

Improving public well-being by conducting high quality, objective research and data collection