

**Empirical Bayes Shrinkage
Estimates of State Supplemental
Nutrition Assistance Program
Participation Rates in 2007-2009
for All Eligible People and the
Working Poor**

Final Report

February 2012

Karen Cunyningham
Laura Castner
Amang Sukasih

MATHEMATICA
Policy Research

Contract Number:
AG-3198-K-11-0005

Mathematica Reference Number:
06908.110

Submitted to:
U.S. Department of Agriculture
Food and Nutrition Service
3101 Park Center Drive
Room 1014
Alexandria, VA 22302
Project Officer: Jenny Genser
Task Leader: Christine Kissmer

Submitted by:
Mathematica Policy Research
1100 1st Street, NE
12th Floor
Washington, DC 20002-4221
Telephone: (202) 484-9220
Facsimile: (202) 863-1763
Project Director: Carole Trippe

**Empirical Bayes Shrinkage
Estimates of State Supplemental
Nutrition Assistance Program
Participation Rates in 2007-2009
for All Eligible People and the
Working Poor**

Final Report

February 2012

Karen Cunyningham
Laura Castner
Amang Sukasih

MATHEMATICA
Policy Research

CONTENTS

	EXECUTIVE SUMMARY.....	XI
I	INTRODUCTION	1
II	A STEP-BY-STEP GUIDE TO DERIVING STATE ESTIMATES	5
III	STATE ESTIMATES OF SUPPLEMENTAL NUTRITION ASSISTANCE PROGRAM PARTICIPATION RATES AND NUMBER OF ELIGIBLE PEOPLE FOR 2007 TO 2009 FOR ALL ELIGIBLE PEOPLE AND THE WORKING POOR.....	15
	REFERENCES	25
	APPENDIX A: THE ESTIMATION PROCEDURE: ADDITIONAL TECHNICAL DETAILS	27

TABLES

Table III.1.	Final Shrinkage Estimates of SNAP Participation Rates.....	17
Table III.2.	Final Shrinkage Estimates of Number of People Eligible for SNAP.....	18
Table III.3.	Approximate 90-Percent Confidence Intervals for Final Shrinkage Estimates for 2007, All Eligible People.....	19
Table III.4.	Approximate 90-Percent Confidence Intervals for Final Shrinkage Estimates for 2008, All Eligible People.....	20
Table III.5.	Approximate 90-Percent Confidence Intervals for Final Shrinkage Estimates for 2009, All Eligible People.....	21
Table III.6.	Approximate 90-Percent Confidence Intervals for Final Shrinkage Estimates for 2007, Working Poor.....	22
Table III.7.	Approximate 90-Percent Confidence Intervals for Final Shrinkage Estimates for 2008, Working Poor.....	23
Table III.8.	Approximate 90-Percent Confidence Intervals for Final Shrinkage Estimates for 2009, Working Poor.....	24
Table A.1.	Number of People Receiving SNAP Benefits, Monthly Average	47
Table A.2.	Estimated Percentage of Participants Who Are Correctly Receiving Benefits and Income Eligible under Federal SNAP Rules.....	48
Table A.3.	Estimated Number of Participants Who Are Correctly Receiving Benefits and Income Eligible under Federal SNAP Rules, Monthly Average.....	49
Table A.4.	Estimated Number of Working Poor Who Are Correctly Receiving Benefits and Income Eligible under Federal SNAP Rules, Monthly Average.....	50
Table A.5.	Estimated Percentage of People Eligible for SNAP.....	51
Table A.6.	Directly Estimated Number of People Eligible for SNAP	52
Table A.7.	Directly Estimated Number of Working Poor Eligible for SNAP.....	53
Table A.8.	CPS ASEC Population Estimate	54
Table A.9.	Population on July 1	55
Table A.10.	Percentage of Working Poor Participants Without Reported Earned Income But with Other Indicators of Earnings	56

Table A.11.	Direct Sample Estimates of SNAP Participation Rates.....	57
Table A.12.	Standard Errors of Direct Sample Estimates of SNAP Participation Rates .	58
Table A.13.	Definitions and Data Sources for Predictors	59
Table A.14.	Values for 2007 Predictors	60
Table A.15.	Values for 2008 Predictors	61
Table A.16.	Values for 2009 Predictors	62
Table A.17.	Regression Estimates of SNAP Participation Rates	63
Table A.18.	Standard Errors of Regression Estimates of SNAP Participation Rates	64
Table A.19.	Preliminary Shrinkage Estimates of SNAP Participation Rates.....	65
Table A.20.	Final Shrinkage Estimates of SNAP Participation Rates.....	66
Table A.21.	Standard Errors of Final Shrinkage Estimates of SNAP Participation Rates.....	67
Table A.22.	Final Shrinkage Estimates of Number of People Eligible for SNAP.....	68
Table A.23.	Final Shrinkage Estimates of Number of Working Poor Eligible for SNAP.	69
Table A.24.	Standard Errors of Final Shrinkage Estimates of Number of People Eligible for SNAP.....	70
Table A.25.	Standard Errors of Final Shrinkage Estimates of Number of Working Poor Eligible for SNAP.....	71

FIGURES

II.1	The Estimation Procedure	5
II.2	An Illustrative Regression Estimator.....	7
II.3	Shrinkage Estimation	11
A.1	Algorithm to Identify Working Poor Households.....	31

EXECUTIVE SUMMARY

The Supplemental Nutrition Assistance Program (SNAP) is a central component of American policy to alleviate hunger and poverty. The program's main purpose is "to permit low-income households to obtain a more nutritious diet . . . by increasing their purchasing power" (Food and Nutrition Act of 2008). SNAP is the largest of the domestic food and nutrition assistance programs administered by the U.S. Department of Agriculture's Food and Nutrition Service. During fiscal year 2011, the program served nearly 45 million people in an average month at a total annual cost of almost \$72 billion in benefits. The average monthly program benefit was about \$284 per household.

This report presents estimates that, for each state, measure the need for SNAP and the program's effectiveness in each of the three years from 2007 to 2009. The estimated numbers of people eligible for SNAP measure the need for the program. The estimated SNAP participation rates measure, state by state, the program's performance in reaching its target population. In addition to the participation rates that pertain to all eligible people, we derived estimates of participation rates for the "working poor," 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 the working poor were derived jointly using empirical Bayes shrinkage estimation methods and data from the Current Population Survey, the American Community Survey, and administrative records. The shrinkage estimator that was used averaged sample estimates of participation rates in each state with predictions from a regression model. The predictions were based on observed indicators of socioeconomic conditions in the states, such as the percentage of the total state population receiving SNAP benefits. The shrinkage estimates derived are substantially more precise than direct sample estimates from the Current Population Survey or the Survey of Income and Program Participation, the best sources of current data on household incomes used to model program eligibility. 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. This report describes our shrinkage estimator in detail.

I. INTRODUCTION

This report presents estimates of the Supplemental Nutrition Assistance Program (SNAP) participation rate and the number of people eligible for SNAP in each state for the years 2007 to 2009.¹ It also presents estimates of the participation rates for the working poor and the numbers of eligible working poor, where we define as “working poor” any person who was eligible for SNAP and lived in a household in which a member earned income from a job. These estimates were derived using “shrinkage” estimation methods. This introductory chapter overviews the advantages and some previous applications of shrinkage estimation. Chapter II describes how we derived shrinkage estimates, and Chapter III presents our state estimates for all eligible people and for the working poor. Technical details and additional information about our estimation methods are provided in Appendix A.

The principal challenge in deriving state estimates like those presented in this report is that two leading national surveys collecting current income data for families and used for estimating program eligibility—the Current Population Survey (CPS) and the Survey of Income and Program Participation (SIPP)—have small samples for most states. Thus, “direct” estimates—estimates based on data from one source for the state and time period in question—from these surveys are imprecise. For example, to calculate a direct estimate of Delaware’s 2009 SNAP participation rate, we use just 2009 data on households in the CPS from Delaware. Because of the potential errors introduced by the CPS surveying only a small number of families in Delaware rather than all families in the state, we can be confident—by a commonly used standard—only that Delaware’s SNAP participation rate in 2009 was between about 69 and 84 percent. This range is wide (but typical), reflecting our substantial uncertainty about what Delaware’s participation rate actually was.

¹ The estimates presented here are also reported and compared with one another in Cunyningham (2011).

To improve precision, statisticians have developed “indirect” estimators. These estimators “borrow strength” by using data from other states, time periods, or data sources. The assumption underlying indirect estimation is that what happened in other states in 2009 or what happened in Delaware (and other states) in other years is relevant to estimating what happened in Delaware in 2009. Using indirect estimation, the Census Bureau improved the precision of state poverty rates derived from the CPS by calculating two- and three-year averages (DeNavas-Walt et al. 2006).

A generally superior indirect estimator is the “shrinkage” estimator. A shrinkage estimator averages estimates obtained from different methods. For example, Fay and Herriott (1979) developed a shrinkage estimator that combined direct sample and regression estimates of per capita income for small places (population less than 1,000). Their estimates were used to allocate funds under the General Revenue Sharing Program. Shrinkage estimators have also been used to develop state estimates of income-eligible infants and children for allocating funds under the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) (Schirm 2000). To borrow strength across both space (states) and time, the current WIC eligibles estimator uses several years of CPS data and combines direct sample estimates with predictions from a regression model. The predictions of WIC eligibles are based on, for example, state poverty rates for children according to tax return data and median household income according to Census 2000. States with similar socioeconomic conditions, as reflected in these poverty rate and income statistics, are observed (and predicted) to have similar proportions of infants and children eligible for WIC. The shrinkage estimator uses data for all the states (with data for prior years and data from other sources) to estimate a regression model and formulate a prediction for Delaware. Then, the shrinkage estimator optimally averages the direct sample and regression estimates for Delaware to obtain a shrinkage estimate. This contrasts with the direct estimator that ignores systematic patterns across states, using, for example, only Delaware’s data to derive an estimate for Delaware, even though conditions may be similar in Virginia or Pennsylvania. In another application of shrinkage methods,

shrinkage estimates of poor school-aged children by state and county were used in allocating Title I compensatory education funds for disadvantaged youth (National Research Council 2000).

In these and other applications of shrinkage estimation, the gain in precision from borrowing strength via a shrinkage estimator can be substantial. For example, the confidence intervals for the shrinkage estimates of WIC eligibles in 1992 were, on average, 61 percent narrower than the corresponding confidence intervals for the direct estimates (Schirm 1995). To obtain that same gain in precision with a direct estimator would require—according to rough calculations—more than a six-fold increase in sample size. Therefore, we use an indirect estimator and borrow strength to derive state estimates of SNAP participation rates and counts of all eligible people and the eligible working poor (while recognizing that the gain in precision might not be as large as for the 1992 WIC estimates).

The shrinkage estimator we used combined direct sample and regression estimates and borrowed strength across states, over time, and between groups (all eligible people and the working poor). Like the estimators used in the other applications described in this chapter, our estimator also borrowed strength by using data from outside the main sample survey (the CPS), specifically, data from administrative records systems, the ACS, and government estimates. In all, our estimator used three sets of three-year averages of ACS data, and three years of CPS data, SNAP and National School Lunch Program

U.S. Census Bureau Data

The **Current Population Survey (CPS)** is conducted monthly by the U.S. Census Bureau 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 (ASEC) Supplement includes additional data on work experience, income, and noncash benefits, and has a sample size of close to 100,000 households.

The **American Community Survey (ACS)** is conducted monthly by the U.S. Census Bureau in every county, American Indian and Alaska Native Area, Hawaiian Home Land, and Puerto Rico. Designed to replace the decennial census long-form, it collects economic, social, demographic, and housing information on about three million households annually.

Population Estimates are published each year by the U.S. Census Bureau's Population Division. The estimates are developed using decennial census population estimates and 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>.

administrative data, population and personal income estimates, and tax return data for all states to obtain estimates for each state in each year (2007 to 2009) for all eligible people and for the working poor.

The shrinkage estimates derived for any one application are not guaranteed to be more accurate than estimates obtained using some other method. They have good statistical properties in general, however, and we have found for our specific application that as in previous applications, shrinkage estimation can greatly improve precision. Additional support for shrinkage estimators is provided by the findings from simulation studies. For example, in a comprehensive evaluation of the relative accuracy of alternative estimators of state poverty rates, Schirm (1994) found that shrinkage estimates are substantially more accurate than direct estimates or indirect estimates obtained from other methods that have been widely used.

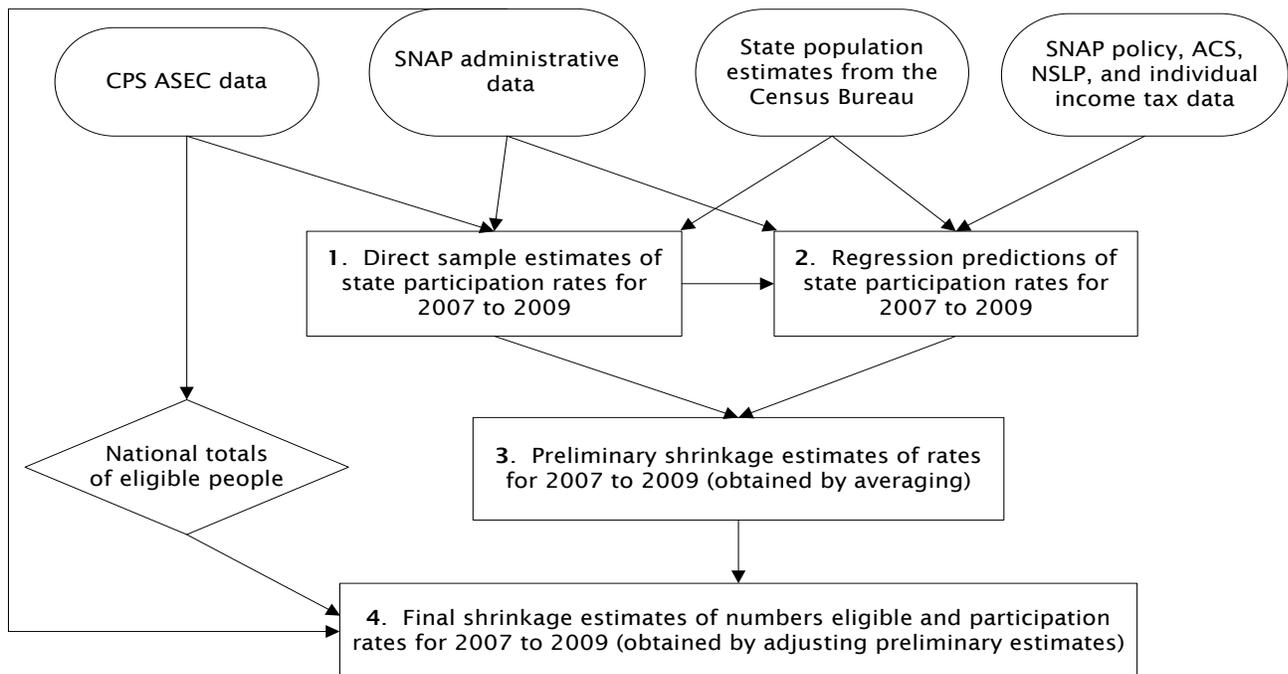
II. A STEP-BY-STEP GUIDE TO DERIVING STATE ESTIMATES

This chapter describes our procedure for estimating state SNAP participation rates for all eligible people and the working poor and the numbers of people eligible for SNAP benefits for 2007 to 2009. This procedure, summarized by the flow chart in Figure II.1, has the following four steps:

1. From CPS Annual Social and Economic Supplement (ASEC) data and SNAP administrative data, derive direct sample estimates of state SNAP participation rates for each of the three years 2007 to 2009.
2. Using a regression model, predict state SNAP participation rates based on administrative and ACS data.
3. Using “shrinkage” methods, average the direct sample estimates and regression predictions to obtain preliminary shrinkage estimates of state SNAP participation rates.
4. Adjust the preliminary shrinkage estimates 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.

Figure II.1. The Estimation Procedure



1. From CPS ASEC Data and SNAP Administrative Data, Derive Direct Sample Estimates of State SNAP Participation Rates for Each of the Three Years 2007 to 2009

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 administrative data to estimate numbers of participants in an average month in the fiscal year and we used CPS ASEC data to estimate numbers of eligibles in an average month. Because the ASEC collects family income data for the prior calendar year, we obtained estimates of eligibles in 2009, for example, from the 2010 CPS ASEC. To derive a participation rate for the working poor, we divided the number of working poor participants by the number of working poor people who were eligible.

As noted in Chapter I, direct sample estimates of participation rates are relatively imprecise. The standard errors for the estimates, reported in Appendix A along with the estimated rates, tend to be large, so our uncertainty about states' true rates is great. For example, according to commonly used statistical standards, we can be confident only that Delaware's participation rate for all eligible people in 2009 was between 69 percent and 84 percent. This range is so wide and our uncertainty so great because the CPS ASEC sample for Delaware is small. This lack of data, that is, the small number of sample observations that pertain directly to the target geographic area and time period—Delaware and 2009 in our example—is the fundamental problem of “small area estimation.”

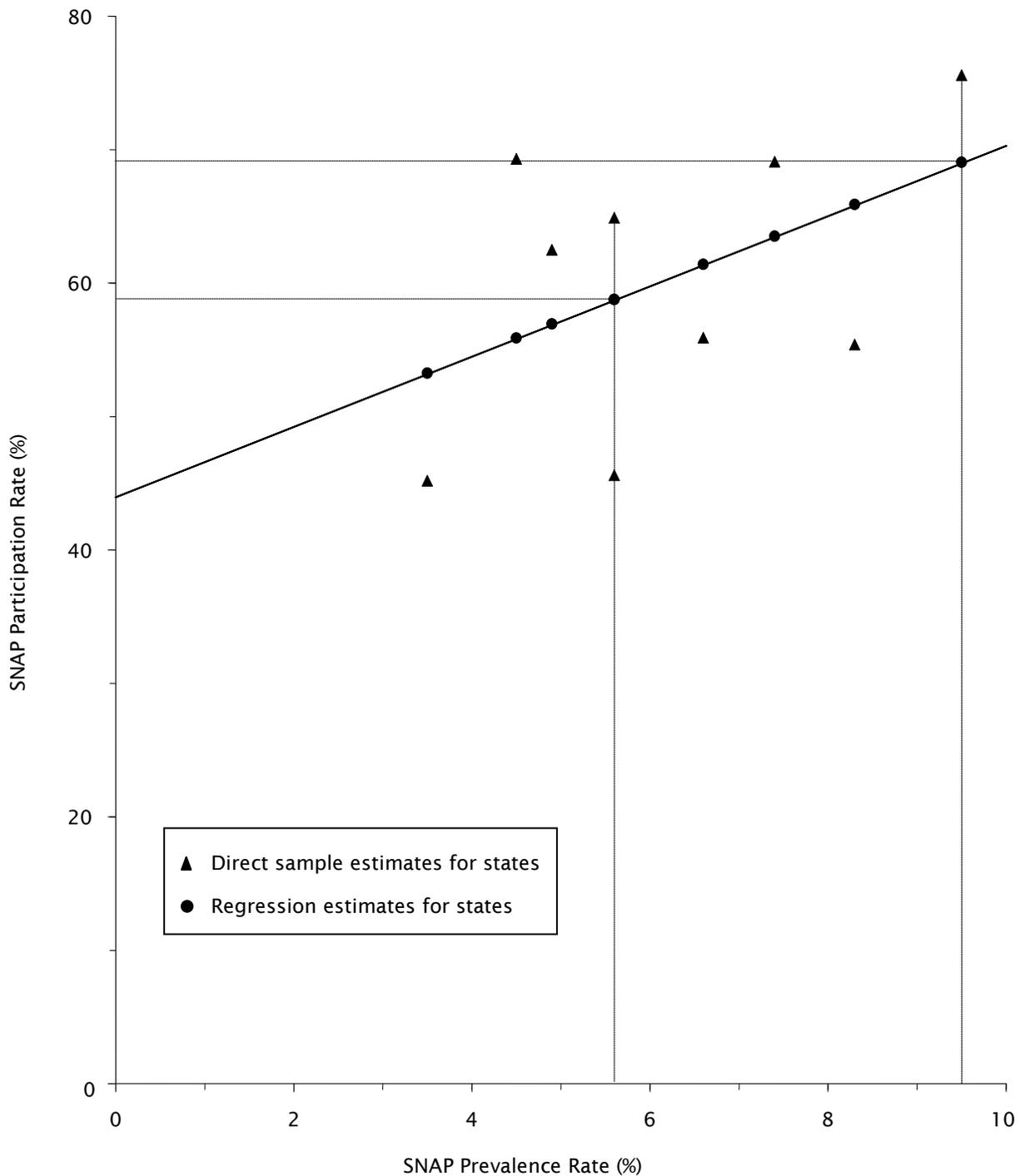
2. Using a Regression Model, Predict State SNAP Participation Rates Based on Administrative and ACS Data

Regression estimates are predictions based on nonsample or highly precise sample data, such as the ACS and administrative records data. The latter include records from government tax and transfer programs.

Figure II.2 illustrates how the 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

Figure II.2. An Illustrative Regression Estimator



estimates; a triangle shows the prevalence rate in a state (read off the horizontal axis) and the sample estimate of the participation rate in that state (read off the 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 (that is, we “regress” the sample estimates on the predictor). Regression estimates of participation rates are points on that line, the circles in Figure II.2. 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 off 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.

To derive the regression estimates for 2007 to 2009 and for all eligible people and the working poor, we included all of the states, not just nine as in our illustrative example, and we used seven predictors, not just one. Adding six predictors improves our predictions. The seven predictors used measure:

- the percentage of the population receiving SNAP benefits
- the percentage of children age 5 to 17 approved to receive a free lunch under the National School Lunch Program
- the elderly combined poverty rate according to individual income tax data, namely, the percentage of elderly individuals who were not claimed on tax returns or were claimed on tax returns with adjusted gross income below the poverty level
- total personal income divided by the total population according to estimates from the U.S. Bureau of Commerce and the U.S. Census Bureau
- the percentage of occupied housing units that were owner-occupied according to American Community Survey three-year estimates

- the percentage of foreign-born individuals entering the United States in 2000 or later according to American Community Survey three-year estimates
- the percentage of individuals age 65 and over with income under 200 percent of the federal poverty level according to American Community Survey three-year estimates

These seven predictors were selected as the best from a longer list described in Appendix A, which provides complete definitions and sources for the predictors. Appendix A also 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 sample estimates, reflecting substantial gains in precision from regression for the states with the most error-prone direct sample estimates.

Comparing how the direct sample and regression estimators use data reveals how the regression estimator “borrows strength” to improve precision. When we derived direct sample estimates in Step 1, we used only one year’s CPS ASEC sample data from Delaware to estimate Delaware’s participation rate in that year, even though Delaware, like nearly all states, has a small CPS ASEC sample. Deriving regression estimates in this step, 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 Delaware) to predict Delaware’s participation rate in a given year. In other words, the regression estimator not only uses the sample 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 the working poor—by deriving estimates for the groups jointly.

The regression estimator improves precision by using more data. It uses that additional data to identify states with direct sample estimates that seem too high or too low because of sampling error, that is, error from drawing a sample—a subset of the population—that has a higher or lower participation rate than the entire state population has. For example, suppose a state has a low SNAP

prevalence rate and values for other predictors that are consistent with a low SNAP participation rate. Then, our regression estimator would predict a low participation rate for that state, implying that a direct sample estimate showing a high rate is too high. The regression estimate will be lower than the direct sample estimate for such a state. On the other hand, if the sample data for a state show a much 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 sample estimate.

3. Using “Shrinkage” Methods, Average the Direct Sample Estimates and Regression Predictions to Obtain Preliminary Shrinkage Estimates of State SNAP Participation Rates

As noted before, the limitation of the direct sample estimator is imprecision. The limitation of the regression estimator is called “bias.” Some states really have higher or lower participation rates than we expect (and predict with the regression estimator) based on the SNAP prevalence rate and other predictors used. Such errors in regression estimates reflect bias.

These limitations arise for the following reasons. The direct sample estimator uses relatively little information. It uses only the typically small number of sample observations for one state and one year to obtain an estimate for that state and year. It does not use sample data for other states or other years or data from other sources, such as administrative records or the ACS. 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 sample 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.

Using all of the information at hand, a shrinkage estimator addresses the limitations of the direct sample and regression estimators by combining the sample and regression estimates, striking a compromise. As illustrated in Figure II.3, a shrinkage estimator takes a weighted average of the

sample and regression estimates, weighting them according to their relative accuracy. We calculated weights using the empirical Bayes methods described in Appendix A. Generally, the more precise the direct sample estimate for a state, the closer the shrinkage estimate will be to it. The larger samples drawn in large states support more precise direct sample estimates, so shrinkage estimates tend to be closer to the direct sample estimates for large states. Given the precision of the direct sample estimate for a state, 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 and farther from the direct sample estimate when the regression line fits well than when the line fits poorly. Striking a compromise between the direct sample and regression estimators, the shrinkage estimator strikes a compromise between imprecision and bias. The direct sample 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 tradeoff between imprecision and bias.

Figure II.3. Shrinkage Estimation

Poor predictions or state with relatively large sample \Rightarrow more weight on direct sample estimate:



Good predictions or state with relatively small sample \Rightarrow more weight on regression estimate:



In the next step of our estimation procedure, we make some fairly small adjustments to the shrinkage estimates that we derive in this step. Thus, we call the estimates from this step “preliminary” and the estimates from the next step “final.”

4. Adjust the Preliminary Shrinkage Estimates to Obtain Final Shrinkage Estimates of State SNAP Participation Rates

We adjusted the preliminary shrinkage estimates of participation rates in two ways. First, we adjusted the rates so that the eligibles counts implied by the rates sum to the national eligibles count 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 the working poor). The following description of the adjustments will focus on the 2009 estimates for all eligible people. In Appendix A, we describe the results of the adjustments for other years and for the working poor and discuss our adjustment method in more detail.

To implement the first adjustment, we calculated preliminary estimates of eligibles counts 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. The state eligibles counts summed to 45,519,041 for 2009, while the national total for 2009 estimated directly from the CPS ASEC was 44,512,089. To obtain estimated eligibles counts for states that sum (aside from rounding error) to the direct estimate of the national total, we multiplied each of the preliminary eligibles counts by $44,512,089 \div 45,519,041$ (≈ 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, one state, Maine, had fewer estimated eligibles than participants in 2009, implying a participation rate over 100 percent. To cap participation rates at 100 percent, we performed a second adjustment. Specifically, we increased the number of eligibles in Maine so that the number of eligibles in that state equaled the number of participants. We reduced

the number of eligibles in the other 49 states and the District of Columbia by an equivalent number and in proportion to their numbers of eligibles. This adjustment, which moved very small numbers of eligibles among states, did not change the national total. Moreover, except for Maine, the state with a participation rate initially over 100 percent, this adjustment did not change any state's participation rate by more than eight-thousandths of a percentage point.

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 SUPPLEMENTAL NUTRITION ASSISTANCE PROGRAM PARTICIPATION RATES AND NUMBER OF ELIGIBLE PEOPLE FOR 2007 TO 2009 FOR ALL ELIGIBLE PEOPLE AND THE WORKING POOR

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 2007 to 2009 for all eligible people and for the working poor. These shrinkage estimates are relatively precise; they have much smaller standard errors and narrower confidence intervals than the CPS ASEC direct sample 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, while our best estimate is that Delaware’s participation rate for all eligible people was 77 percent in 2009 (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 71 and 83 percent, an interval that is just over 70 percent as wide as the interval (69 to 84 percent, as cited in Chapter I) around the direct sample estimate. A narrower interval means that we are less uncertain about the true value. According to our calculations, a shrinkage confidence interval for a participation rate is, on average, only about 68 percent as wide as the corresponding direct sample confidence interval. Thus, shrinkage substantially improves precision and reduces our uncertainty.

Despite the impressive gains in precision, however, substantial uncertainty about the true participation rates for some states remains even after the application of shrinkage methods. Nevertheless, as discussed in Cunyningham (2011), 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 2007 and 2008 presented in this report differ slightly from the estimates presented in Cunyningham and Castner (2010) and Cunyningham et al. (2011). There are several causes for the differences—two related to methodological updates and others related to the annual data update.

- **For the estimates presented in this report, we updated the methodology used to estimate numbers of eligibles.** The changes, described in Leftin et al. (2011), include use of a fiscal year eligibility file, an improved SNAP household formation methodology, SSI and TANF simulations, and enhanced net income and asset eligibility imputations.
- **For the estimates presented in this report, we updated the methodology used to calculate standard errors of participants.** This is similar to the update made for Cunyningham et al. (2011) to the methodology used to calculate standard errors of eligibles.
- **The shrinkage estimates use data from three years to estimate participation rates for each year.** Annually, data for the most recent year is added and data for the oldest year is dropped. As a result, the estimates for 2007 and 2008 presented in this report are based on 2007 to 2009 data while the corresponding estimates published in Cunyningham et al. (2011) are based on 2006 to 2008 data.
- **The shrinkage estimates incorporate 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 eligibles and eligible working poor.) While we place a premium on maintaining consistency in regression predictors from year to year, the methodological changes and differences between 2006 data (used in the previous estimates) and 2009 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.

Table III.1. Final Shrinkage Estimates of SNAP Participation Rates

	Final Shrinkage Estimates of SNAP Participation Rates (Percent)					
	All Eligible People			Working Poor		
	2007	2008	2009	2007	2008	2009
Alabama	68	70	74	62	63	66
Alaska	82	80	74	77	80	71
Arizona	63	67	71	53	60	62
Arkansas	78	77	73	75	72	71
California	51	53	53	34	33	36
Colorado	60	59	62	48	46	48
Connecticut	68	70	75	48	51	55
Delaware	74	74	77	65	67	66
District of Columbia	77	76	86	33	29	41
Florida	56	61	69	44	45	53
Georgia	64	68	74	58	58	66
Hawaii	69	73	67	53	57	51
Idaho	62	66	70	64	63	69
Illinois	87	87	85	69	69	68
Indiana	73	74	71	72	74	72
Iowa	84	85	86	80	79	80
Kansas	62	61	63	53	50	51
Kentucky	81	85	81	69	70	65
Louisiana	79	77	77	74	69	70
Maine	100	100	100	97	99	99
Maryland	58	63	70	44	49	55
Massachusetts	64	70	75	44	50	56
Michigan	98	97	95	94	96	95
Minnesota	66	66	69	54	52	54
Mississippi	66	68	71	64	63	68
Missouri	89	91	88	76	79	75
Montana	79	81	76	85	82	79
Nebraska	69	69	70	64	61	61
Nevada	55	59	61	41	44	49
New Hampshire	67	72	73	56	60	59
New Jersey	54	56	59	44	44	46
New Mexico	76	75	81	77	73	82
New York	62	66	68	53	51	58
North Carolina	64	68	71	59	62	64
North Dakota	70	79	76	67	71	70
Ohio	76	79	79	69	73	72
Oklahoma	76	74	75	65	63	64
Oregon	96	96	99	83	85	89
Pennsylvania	80	84	83	72	73	72
Rhode Island	62	66	68	43	46	50
South Carolina	77	81	83	64	70	71
South Dakota	70	76	78	70	74	79
Tennessee	84	86	89	67	69	74
Texas	61	62	62	52	50	50
Utah	60	62	63	53	56	54
Vermont	81	86	91	78	80	86
Virginia	66	68	70	56	57	59
Washington	84	87	91	63	69	72
West Virginia	88	87	86	94	89	90
Wisconsin	69	73	76	70	72	75
Wyoming	55	55	59	52	50	56
United States	69	71	72	57	58	60

Table III.2. Final Shrinkage Estimates of Number of People Eligible for SNAP

	Final Shrinkage Estimates of Number of People Eligible for SNAP (Thousands)					
	All Eligible People			Working Poor		
	2007	2008	2009	2007	2008	2009
Alabama	791	803	897	351	350	403
Alaska	67	68	86	31	33	41
Arizona	848	882	1,079	456	467	506
Arkansas	475	481	546	217	220	240
California	3,971	4,169	4,947	2,411	2,469	2,822
Colorado	408	420	508	213	220	264
Connecticut	298	309	331	128	126	134
Delaware	81	91	110	37	45	53
District of Columbia	108	113	119	37	38	30
Florida	2,157	2,385	2,812	1,020	1,052	1,220
Georgia	1,411	1,493	1,719	742	779	837
Hawaii	127	131	169	73	69	94
Idaho	136	150	192	71	84	99
Illinois	1,418	1,477	1,652	667	721	710
Indiana	779	821	957	347	325	420
Iowa	274	287	335	148	145	183
Kansas	289	297	337	160	173	181
Kentucky	727	724	847	311	252	310
Louisiana	799	838	912	379	391	417
Maine	147	158	185	57	58	66
Maryland	506	537	590	240	225	273
Massachusetts	672	676	769	200	237	289
Michigan	1,150	1,196	1,400	525	537	556
Minnesota	406	433	483	184	215	244
Mississippi	638	653	702	287	284	299
Missouri	741	754	879	351	383	402
Montana	98	98	118	43	40	50
Nebraska	172	174	189	89	99	104
Nevada	219	241	311	113	124	149
New Hampshire	84	86	105	35	36	42
New Jersey	758	761	841	307	294	318
New Mexico	299	314	352	150	166	173
New York	2,838	2,861	3,253	1,222	1,219	1,446
North Carolina	1,360	1,382	1,584	667	659	702
North Dakota	61	57	65	31	31	33
Ohio	1,360	1,435	1,707	580	573	698
Oklahoma	533	546	615	259	256	310
Oregon	418	436	521	216	201	234
Pennsylvania	1,386	1,394	1,549	545	537	629
Rhode Island	122	125	146	46	43	59
South Carolina	689	714	804	305	326	336
South Dakota	84	82	94	42	38	45
Tennessee	1,010	1,033	1,181	407	482	555
Texas	3,760	3,909	4,485	2,045	2,219	2,530
Utah	203	210	285	116	111	159
Vermont	58	61	69	21	28	29
Virginia	763	788	894	362	376	434
Washington	622	649	749	274	288	330
West Virginia	295	309	347	107	115	119
Wisconsin	511	522	640	245	269	303
Wyoming	40	41	44	20	22	19
United States	37,167	38,575	44,512	17,891	18,452	20,897

Table III.3. Approximate 90-Percent Confidence Intervals for Final Shrinkage Estimates for 2007, All Eligible People

	Approximate 90-Percent Confidence Intervals for 2007, All Eligible People			
	Participation Rate (Percent)		Number of Eligible People (Thousands)	
	Lower Bound	Upper Bound	Lower Bound	Upper Bound
Alabama	63	73	731	852
Alaska	75	89	61	73
Arizona	58	68	782	914
Arkansas	72	84	440	509
California	49	53	3,796	4,146
Colorado	55	65	375	442
Connecticut	62	74	271	324
Delaware	69	79	76	87
District of Columbia	71	83	99	117
Florida	52	60	2,021	2,293
Georgia	60	68	1,325	1,496
Hawaii	63	75	116	139
Idaho	56	68	122	150
Illinois	82	92	1,338	1,497
Indiana	68	78	725	833
Iowa	78	90	254	295
Kansas	57	67	266	312
Kentucky	75	87	677	777
Louisiana	74	84	746	853
Maine	93	100	137	157
Maryland	53	63	465	547
Massachusetts	59	69	623	721
Michigan	92	100	1,085	1,215
Minnesota	61	71	373	439
Mississippi	61	71	586	690
Missouri	84	94	696	786
Montana	72	86	89	106
Nebraska	63	75	157	187
Nevada	50	60	201	238
New Hampshire	61	73	77	92
New Jersey	49	59	694	823
New Mexico	70	82	275	323
New York	59	65	2,697	2,979
North Carolina	60	68	1,273	1,447
North Dakota	62	78	54	68
Ohio	72	80	1,282	1,437
Oklahoma	71	81	494	571
Oregon	90	100	390	445
Pennsylvania	75	85	1,299	1,472
Rhode Island	57	67	113	131
South Carolina	72	82	648	730
South Dakota	62	78	75	94
Tennessee	78	90	939	1,082
Texas	58	64	3,566	3,953
Utah	55	65	187	218
Vermont	75	87	54	63
Virginia	60	72	695	831
Washington	78	90	579	666
West Virginia	82	94	275	316
Wisconsin	64	74	472	549
Wyoming	49	61	36	44
United States	68	70	36,597	37,736

Table III.4. Approximate 90-Percent Confidence Intervals for Final Shrinkage Estimates for 2008, All Eligible People

	Approximate 90-Percent Confidence Intervals for 2008, All Eligible People			
	Participation Rate (Percent)		Number of Eligible People (Thousands)	
	Lower Bound	Upper Bound	Lower Bound	Upper Bound
Alabama	65	75	744	863
Alaska	73	87	62	74
Arizona	62	72	821	942
Arkansas	71	83	445	517
California	51	55	3,986	4,351
Colorado	54	64	387	454
Connecticut	64	76	284	334
Delaware	68	80	84	98
District of Columbia	69	83	103	123
Florida	57	65	2,230	2,539
Georgia	64	72	1,404	1,582
Hawaii	67	79	120	142
Idaho	60	72	136	165
Illinois	82	92	1,395	1,559
Indiana	69	79	766	876
Iowa	79	91	266	307
Kansas	56	66	271	323
Kentucky	79	91	673	776
Louisiana	72	82	786	890
Maine	93	100	148	168
Maryland	59	67	499	575
Massachusetts	65	75	626	726
Michigan	91	100	1,127	1,264
Minnesota	61	71	398	469
Mississippi	63	73	609	696
Missouri	86	96	709	799
Montana	74	88	89	106
Nebraska	63	75	159	189
Nevada	54	64	221	261
New Hampshire	66	78	79	93
New Jersey	51	61	696	826
New Mexico	69	81	289	339
New York	63	69	2,719	3,003
North Carolina	64	72	1,295	1,470
North Dakota	70	88	50	63
Ohio	75	83	1,356	1,514
Oklahoma	69	79	508	585
Oregon	89	100	406	465
Pennsylvania	79	89	1,310	1,478
Rhode Island	61	71	116	135
South Carolina	76	86	673	756
South Dakota	68	84	74	90
Tennessee	80	92	966	1,100
Texas	59	65	3,710	4,108
Utah	56	68	191	230
Vermont	80	92	57	65
Virginia	62	74	720	855
Washington	81	93	604	693
West Virginia	81	93	287	331
Wisconsin	68	78	486	559
Wyoming	50	60	37	45
United States	70	72	37,998	39,152

Table III.5. Approximate 90-Percent Confidence Intervals for Final Shrinkage Estimates for 2009, All Eligible People

	Approximate 90-Percent Confidence Intervals for 2009, All Eligible People			
	Participation Rate (Percent)		Number of Eligible People (Thousands)	
	Lower Bound	Upper Bound	Lower Bound	Upper Bound
Alabama	69	79	836	957
Alaska	68	80	79	93
Arizona	66	76	1,003	1,155
Arkansas	67	79	504	588
California	51	55	4,749	5,145
Colorado	57	67	471	545
Connecticut	69	81	306	356
Delaware	71	83	102	118
District of Columbia	80	92	110	127
Florida	66	72	2,672	2,952
Georgia	70	78	1,626	1,811
Hawaii	62	72	155	182
Idaho	64	76	175	209
Illinois	81	89	1,568	1,736
Indiana	66	76	892	1,022
Iowa	80	92	310	360
Kansas	58	68	309	365
Kentucky	75	87	786	909
Louisiana	72	82	848	976
Maine	93	100	173	198
Maryland	65	75	551	629
Massachusetts	70	80	716	821
Michigan	90	100	1,324	1,476
Minnesota	64	74	447	519
Mississippi	67	75	657	746
Missouri	83	93	827	931
Montana	69	83	108	129
Nebraska	64	76	174	205
Nevada	56	66	286	336
New Hampshire	67	79	96	113
New Jersey	54	64	773	909
New Mexico	75	87	327	378
New York	65	71	3,098	3,408
North Carolina	67	75	1,491	1,677
North Dakota	67	85	58	73
Ohio	75	83	1,613	1,800
Oklahoma	70	80	571	658
Oregon	92	100	486	555
Pennsylvania	78	88	1,455	1,643
Rhode Island	64	72	137	156
South Carolina	78	88	759	849
South Dakota	70	86	84	103
Tennessee	83	95	1,104	1,258
Texas	59	65	4,260	4,710
Utah	58	68	261	310
Vermont	85	97	64	74
Virginia	64	76	821	966
Washington	85	97	699	799
West Virginia	80	92	324	371
Wisconsin	71	81	597	683
Wyoming	54	64	40	48
United States	71	73	43,886	45,138

Table III.6. Approximate 90-Percent Confidence Intervals for Final Shrinkage Estimates for 2007, Working Poor

	Approximate 90-Percent Confidence Intervals for 2007, Working Poor			
	Participation Rate (Percent)		Number of Eligible People (Thousands)	
	Lower Bound	Upper Bound	Lower Bound	Upper Bound
Alabama	55	69	311	391
Alaska	68	87	27	35
Arizona	46	59	401	511
Arkansas	68	82	197	237
California	31	37	2,193	2,629
Colorado	42	54	187	240
Connecticut	40	56	108	149
Delaware	58	72	33	42
District of Columbia	24	42	27	47
Florida	40	49	914	1,126
Georgia	53	63	676	808
Hawaii	45	60	63	83
Idaho	57	71	63	79
Illinois	62	75	605	728
Indiana	65	79	314	379
Iowa	72	88	133	163
Kansas	48	58	144	176
Kentucky	62	76	279	344
Louisiana	67	81	342	416
Maine	88	100	52	63
Maryland	38	50	207	272
Massachusetts	38	51	172	227
Michigan	86	100	480	571
Minnesota	48	61	162	206
Mississippi	57	72	253	320
Missouri	69	83	320	382
Montana	77	93	38	47
Nebraska	57	71	79	98
Nevada	36	47	100	127
New Hampshire	49	63	30	40
New Jersey	38	50	266	348
New Mexico	69	84	135	165
New York	47	58	1,097	1,347
North Carolina	54	65	603	731
North Dakota	56	77	26	35
Ohio	64	75	534	625
Oklahoma	58	71	234	284
Oregon	74	92	193	240
Pennsylvania	65	80	489	600
Rhode Island	37	50	39	53
South Carolina	58	69	277	333
South Dakota	62	79	37	47
Tennessee	60	73	366	448
Texas	48	56	1,889	2,201
Utah	47	59	102	129
Vermont	70	87	19	23
Virginia	49	63	319	405
Washington	56	71	242	307
West Virginia	84	100	96	117
Wisconsin	64	77	223	268
Wyoming	45	59	17	22
United States	56	59	17,413	18,369

Table III.7. Approximate 90-Percent Confidence Intervals for Final Shrinkage Estimates for 2008, Working Poor

	Approximate 90-Percent Confidence Intervals for 2008, Working Poor			
	Participation Rate (Percent)		Number of Eligible People (Thousands)	
	Lower Bound	Upper Bound	Lower Bound	Upper Bound
Alabama	56	69	312	389
Alaska	69	90	28	37
Arizona	53	66	415	519
Arkansas	65	79	198	242
California	30	36	2,249	2,690
Colorado	41	52	194	247
Connecticut	44	58	109	144
Delaware	60	75	40	50
District of Columbia	21	38	28	49
Florida	40	50	936	1,169
Georgia	53	64	706	853
Hawaii	50	64	60	78
Idaho	56	70	75	93
Illinois	63	75	657	786
Indiana	67	80	296	353
Iowa	71	87	130	159
Kansas	44	56	153	193
Kentucky	63	78	225	279
Louisiana	62	75	355	427
Maine	89	100	53	64
Maryland	44	55	199	250
Massachusetts	43	56	205	270
Michigan	88	100	493	582
Minnesota	45	59	185	244
Mississippi	56	69	255	313
Missouri	72	86	349	417
Montana	73	91	36	45
Nebraska	54	68	87	110
Nevada	38	50	108	140
New Hampshire	52	68	32	41
New Jersey	38	50	253	335
New Mexico	65	80	149	184
New York	46	56	1,094	1,344
North Carolina	56	67	597	721
North Dakota	60	83	26	36
Ohio	67	78	527	619
Oklahoma	57	69	231	281
Oregon	77	94	180	222
Pennsylvania	66	80	484	591
Rhode Island	40	52	38	49
South Carolina	63	76	296	357
South Dakota	66	82	34	42
Tennessee	63	76	436	528
Texas	47	54	2,051	2,387
Utah	48	63	96	126
Vermont	72	88	25	31
Virginia	51	64	332	420
Washington	61	76	255	320
West Virginia	80	98	103	128
Wisconsin	65	78	244	294
Wyoming	43	57	19	24
United States	56	59	17,962	18,943

Table III.8. Approximate 90-Percent Confidence Intervals for Final Shrinkage Estimates for 2009, Working Poor

	Approximate 90-Percent Confidence Intervals for 2009, Working Poor			
	Participation Rate (Percent)		Number of Eligible People (Thousands)	
	Lower Bound	Upper Bound	Lower Bound	Upper Bound
Alabama	59	73	361	445
Alaska	62	80	36	47
Arizona	55	69	451	560
Arkansas	64	78	217	262
California	33	39	2,584	3,059
Colorado	43	53	238	291
Connecticut	48	63	116	152
Delaware	58	74	47	60
District of Columbia	32	51	23	36
Florida	48	58	1,111	1,329
Georgia	61	71	770	904
Hawaii	45	57	82	105
Idaho	62	76	90	109
Illinois	62	74	648	772
Indiana	66	79	381	459
Iowa	72	88	164	201
Kansas	46	57	161	202
Kentucky	58	72	276	343
Louisiana	63	77	375	459
Maine	90	100	60	73
Maryland	49	62	241	304
Massachusetts	49	63	253	324
Michigan	87	100	510	602
Minnesota	47	61	213	276
Mississippi	62	75	270	329
Missouri	68	81	367	438
Montana	71	88	45	56
Nebraska	54	68	92	115
Nevada	43	55	131	167
New Hampshire	52	66	37	47
New Jersey	40	52	274	361
New Mexico	74	90	156	190
New York	52	63	1,308	1,583
North Carolina	58	70	637	767
North Dakota	59	80	28	37
Ohio	66	78	643	754
Oklahoma	58	70	280	339
Oregon	80	98	211	257
Pennsylvania	65	80	565	693
Rhode Island	44	56	52	66
South Carolina	65	78	305	367
South Dakota	71	87	41	50
Tennessee	67	80	506	604
Texas	46	54	2,326	2,734
Utah	47	61	140	179
Vermont	78	94	26	31
Virginia	53	66	386	482
Washington	65	80	294	365
West Virginia	81	99	107	131
Wisconsin	69	82	277	330
Wyoming	48	63	17	22
United States	58	61	20,357	21,436

REFERENCES

- Cunyngham, Karen. "Reaching Those in Need: State Supplemental Nutrition Assistance Program Participation Rates in 2009." Alexandria, VA: U.S. Department of Agriculture, Food and Nutrition Service, December 2011.
- Cunyngham, Karen E. and Laura A. Castner. "Reaching Those in Need: State Supplemental Nutrition Assistance Program Participation Rates in 2008." Alexandria, VA: U.S. Department of Agriculture, Food and Nutrition Service, December 2010.
- Cunyngham, Karen E., Laura A. Castner, and Allen L. Schirm. "Empirical Bayes Shrinkage Estimates of State Supplemental Nutrition Assistance Program Rates in 2006-2008 for All Eligible People and the Working Poor." Washington, DC: Mathematica Policy Research, Inc., February 2011.
- DeNavas-Walt, Carmen, Bernadette D. Proctor, and Cheryl Hill Lee. "Income, Poverty, and Health Insurance Coverage in the United States: 2005." *Current Population Reports*, series P60, no. 231. Washington, DC: U.S. Department of Commerce, U.S. Census Bureau, August 2006.
- Fay, Robert E., and Roger Herriott. "Estimates of Incomes for Small-Places: An Application of James-Stein Procedures to Census Data." *Journal of the American Statistical Association*, vol. 74, no. 366, June 1979, pp. 269-277.
- Leftin, Joshua, Esa Eslami, and Mark Strayer. "Trends in Supplemental Nutrition Assistance Program Participation Rates: Fiscal Year 2002 to Fiscal Year 2009." In *Current Perspectives on SNAP Participation*. Alexandria, VA: Food and Nutrition Service, U.S. Department of Agriculture, August 2011.
- Leftin, Joshua, Andrew Gothro, Esa Eslami, Daisy Ewell, and Katherine Bencio. "Technical Documentation for the Fiscal Year 2009 SNAP QC Database and QC Minimodel." Washington, DC: Mathematica Policy Research, October 2010.
- National Research Council, Committee on National Statistics, Panel on Estimates of Poverty for Small Geographic Areas. *Small-Area Income and Poverty Estimates: Priorities for 2000 and Beyond*, edited by Constance F. Citro and Graham Kalton. Washington, DC: National Academy Press, 2000.
- Schirm, Allen L. "The Evolution of the Method for Deriving Estimates to Allocate WIC Funds." Paper presented at the Workshop on Formulas for Allocating Program Funds, Committee on National Statistics, National Research Council, Washington, DC, April 26-27, 2000. Washington, DC: Mathematica Policy Research, April 2000.
- Schirm, Allen L. "State Estimates of Infants and Children Income Eligible for the WIC Program in 1992." Washington, DC: Mathematica Policy Research, May 1995.
- Schirm, Allen L. "The Relative Accuracy of Direct and Indirect Estimators of State Poverty Rates." *1994 Proceedings of the Section on Survey Research Methods*. Alexandria, VA: American Statistical Association, 1994.

APPENDIX A

THE ESTIMATION PROCEDURE: ADDITIONAL TECHNICAL DETAILS

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

1. From CPS ASEC Data and SNAP Administrative Data, Derive Direct Sample Estimates of State SNAP Participation Rates for Each of the Three Years 2007 to 2009

We derived direct sample estimates of participation rates for all eligible people for a given year according to:

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

where $Y_{1,i}$ is the estimated participation rate for all eligible people for state i ($i = 1, 2, \dots, 51$); P_i is the number of people participating in SNAP according to SNAP Program Operations data; $\varepsilon_{1,i}$ is the percentage of participating people who are correctly receiving benefits and income eligible under federal SNAP rules according to SNAP Quality Control (SNAP QC) data; $E_{1,i}$ is the number of people who are eligible for the SNAP according to the CPS ASEC, expressed as a percentage of the CPS ASEC population; and T_i is the resident population according to decennial census and administrative records (mainly vital statistics) data.^{1,2,3}

We adjusted P_i by $\varepsilon_{1,i}$ to exclude from our estimates of participants two groups that are not included in our estimates of eligibles. First, we excluded participants who were ineligible for SNAP

¹ P_i is adjusted to exclude from our estimate of participants those people who received SNAP benefits only because of a natural disaster and, thus, are not included in our estimate of eligibles. Because P_i is obtained from SNAP Program Operations data, which include the full population of SNAP cases, it is not subject to sampling error. Participant figures, including counts of participants eligible only through disaster assistance, were provided by the Food and Nutrition Service (FNS).

² We obtained estimates for 2007 to 2009 from the CPS ASEC samples for 2008 to 2010, for which the survey instruments collected family income data for the prior calendar years, that is, 2007 to 2009.

³ In broad terms, the population estimates derived by the Census Bureau are obtained by subtracting from 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). Population estimates are available at <http://www.census.gov/popest/datasets.html>.

but received benefits in error. Second, we excluded participants who would not pass the federal SNAP income tests but were eligible through state expanded categorical eligibility rules.⁴

We estimated the percentage of people who were eligible for SNAP according to:

$$(2) \quad E_{1,i} = 100 \frac{Z_{1,i}}{N_i},$$

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 out.”

We similarly derived sample estimates of participation rates for the working poor for a given year according to:

$$(3) \quad Y_{2,i} = 100 \frac{P_i(\varepsilon_{2,i} / 100)}{(E_{2,i} / 100)T_i}$$

and

$$(4) \quad E_{2,i} = 100 \frac{Z_{2,i}}{N_i},$$

where $Y_{2,i}$ is the estimated participation rate for the working poor for state i ; $\varepsilon_{2,i}$ is the percentage of participating people who are working poor, correctly receiving SNAP benefits, and income eligible 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 people for SNAP, and P_i, T_i and N_i are as defined above.⁵

⁴ Because we are unable to identify participants who would fail the SNAP asset test but were eligible through state expanded categorical eligibility rules, these people are included in estimates of participants. However, they are not included in estimates of eligibles.

⁵ We use the same adjustment methodology for eligible working poor participants as for all eligible participants.

We define as “working poor” any person who is eligible for SNAP and lives in a household in which a member earns money from a job. Working poor who are participating in SNAP are identified slightly differently in the SNAP QC data than in the CPS. In the SNAP QC data, they are identified not just by their earnings but also by other indicators of earnings that suggest a household was very likely to have a member who worked. Specifically, a household is identified as working poor if the household had earnings according to the edited SNAP QC datafile, or if prior to the editing process, multiple earnings indicators suggest that a member of the household was working (Figure A.1).⁶

Figure A.1. Algorithm to Identify Working Poor Households

<p>A household is identified as working poor if it meets one of the following criteria:</p> <ol style="list-style-type: none"> 1) Earnings in the edited SNAP QC data 2) Multiple indicators of earnings in the unedited SNAP QC data <ol style="list-style-type: none"> a) At least one person with recorded earned income AND <ol style="list-style-type: none"> i) A recorded earned income deduction or at least one person with a recorded workforce participation variable indicating he or she is employed <p>OR</p> ii) Recorded earned and unearned income that sum to the recorded total income, or recorded earned income with the earned income deduction already subtracted and unearned income that sum to the recorded total income (some states subtract the earned income deduction from income deemed by an ineligible member before recording it on the file) b) A recorded earned income deduction AND <ol style="list-style-type: none"> i) At least one person with a recorded workforce participation variable indicating that he or she is employed <p>OR</p> ii) Earnings implied by the recorded earned income deduction and recorded unearned income that sum to the recorded total income <p>OR</p> iii) Recorded 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)

⁶ Leftin et al (2010) describe the procedure for editing the SNAP QC data to ensure consistency between a household’s income and SNAP benefit.

We derived SNAP eligibility estimates for states 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 asset balances 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 ineligible for SNAP under provisions of the Personal Responsibility and Work Opportunity Reconciliation Act of 1996 (P.L. 104-193) and subsequent legislation pertaining to noncitizens and nonelderly nondisabled childless adults subject to work registration. Yet another limitation is that only annual, rather than monthly, income amounts are recorded.

Methods have been developed to address these data limitations. These methods—including 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 and nonelderly nondisabled childless adults, distributing annual amounts across months, and imputing net income—are described in Leftin et al (2011) and earlier reports in that series.^{7,8}

In addition to our point estimates of participation rates, we need estimates of their sampling variability. We can estimate the variances of $Y_{1,i}$ and $Y_{2,i}$ as follows:⁹

⁷ These reports also describe how we applied SNAP gross and net income tests and calculated the benefits for which an eligible household would qualify.

⁸ 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 (SSI) recipients in California who receive cash in lieu of SNAP benefits. We excluded these SSI recipients when identifying the members of SNAP households. It might be useful in other contexts, however, to consider participation rates among those eligible for the SNAP or a cash substitute.

⁹ Correctly-eligible rates are estimated from SNAP QC sample data and are subject to sampling error, although it is small relative to other sources of error in the estimated participation rates. In taking into account this sampling error when deriving the estimates presented here, we take into account its correlation with the sampling error associated with the identification of the working poor participants, also estimated using the SNAP QC data. That is, we take into account the correlation between $\varepsilon_{1,i}$, the correctly eligible rate, and $\varepsilon_{2,i}$, the correctly eligible working poor rate.

$$(5) \quad \text{var}(Y_{1,i}) = \text{variance due to } E_{1,i} \text{ when } \varepsilon_{1,i} \text{ is fixed} + \text{variance due to } \varepsilon_{1,i} \text{ when } E_{1,i} \text{ is fixed} \\ = \text{var}_{E_1|\varepsilon_1}(Y_{1,i}) + \text{var}_{\varepsilon_1|E_1}(Y_{1,i})$$

and

$$(6) \quad \text{var}(Y_{2,i}) = \text{variance due to } E_{2,i} \text{ when } \varepsilon_{2,i} \text{ is fixed} + \text{variance due to } \varepsilon_{2,i} \text{ when } E_{2,i} \text{ is fixed} \\ = \text{var}_{E_2|\varepsilon_2}(Y_{2,i}) + \text{var}_{\varepsilon_2|E_2}(Y_{2,i}).$$

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

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

$$(7) \quad \text{var}_{E_1|\varepsilon_1}(Y_{1,i}) = \frac{4}{160} \sum_{r=1}^{160} (Y_{1,i(r)} - Y_{1,i})^2,$$

where $Y_{1,i(r)}$ is the r th ($r = 1, 2, \dots, 160$) replicate estimate with the same form as $Y_{1,i}$ and calculated using the r th set of replicate weights.

The replicate estimates $Y_{1,i(r)}$ are obtained by replicating $E_{1,i}$; that is,

$$(8) \quad E_{1,i(r)} = 100 \frac{Z_{1,i(r)}}{N_{i(r)}}$$

and

$$(9) \quad Y_{1,i(r)} = 100 \frac{P_i(\varepsilon_{1,i}/100)}{(E_{1,i(r)}/100)T_i}.$$

Then, we can assess the degree of sampling variability (estimate the variance of $Y_{1,i}$) by using formula (7).

We obtain estimates of sampling error variances pertaining to the participation rates for the working poor in the same manner, substituting $Z_{2,b}$, the CPS sample estimate of the number of

eligible working poor in state i , for $Z_{1,i}$; $Z_{2,i(r)}$, the r th replicate estimate of $Z_{2,i}$ for $Z_{1,i(r)}$; $E_{2,i}$ for $E_{1,i}$; $E_{2,i(r)}$ for $E_{1,i(r)}$; $\varepsilon_{2,i}$ for $\varepsilon_{1,i}$; and $Y_{2,i(r)}$ for $Y_{1,i(r)}$, in Equations (7) to (9). This results in:

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

Next, based on Equation (1) we can estimate $\text{var}_{\varepsilon_1|E_1}(Y_{1,i})$ according to:

$$(11) \quad \text{var}_{\varepsilon_1|E_1}(Y_{1,i}) = \left(100 \frac{P_i}{T_i E_{1,i}} \right)^2 \text{var}(\varepsilon_{1,i}),$$

because P_i and T_i are constants (or, at least, subject to negligible sampling variability) and $E_{1,i}$ is held fixed at its point estimate. Also note that we estimated $\varepsilon_{1,i}$ (the correctly-eligible rate) and $\varepsilon_{2,i}$ (the percentage of participants who are working poor and correctly eligible) from the SNAP QC sample data as follows:

$$(12) \quad \varepsilon_{1,i} = 100 \frac{\sum_h m_{i,h} \varepsilon_{1,i,h}}{\sum_h m_{i,h}},$$

and

$$(13) \quad \varepsilon_{2,i} = 100 \frac{\sum_h m_{i,h} \varepsilon_{2,i,h}}{\sum_h m_{i,h}},$$

where b indexes households in a state's SNAP QC sample; $m_{i,h}$ equals the number of people in household b times the weight for household b ; $\varepsilon_{1,i,b}$ is an indicator that household b is eligible to receive SNAP benefits; and $\varepsilon_{2,i,b}$ is an indicator that household b is working poor and eligible to receive SNAP benefits.

To calculate $\text{var}(\varepsilon_{1,i})$ and $\text{var}(\varepsilon_{2,i})$, Mathematica constructed 500 bootstrap replicate weights for the SNAP QC sample. The estimate $\varepsilon_{1,i}$ is then replicated 500 times, each using a set of bootstrap replicate weights. That is,

$$(14) \quad \varepsilon_{1,i(r)} = 100 \frac{\sum_h m_{i,h(r)} \varepsilon_{1,i,h}}{\sum_h m_{i,h(r)}}, \quad (r = 1, 2, \dots, 500),$$

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

Then:

$$(15) \quad \text{var}(\varepsilon_{1,i}) = \frac{1}{499} \sum_{r=1}^{500} (\varepsilon_{1,i(r)} - \bar{\varepsilon}_{1,i}^*)^2,$$

where

$$(16) \quad \bar{\varepsilon}_{1,i}^* = \frac{1}{500} \sum_{r=1}^{500} \varepsilon_{1,i(r)}.$$

Similarly, variances $\text{var}_{\varepsilon_2|E_2}(Y_{2,i})$ pertaining to the working poor can be calculated in the same manner, by substituting $\varepsilon_{2,i,b}$ for $\varepsilon_{1,i,b}$; $\varepsilon_{2,i(r)}$ for $\varepsilon_{1,i(r)}$; $\text{var}(\varepsilon_{2,i})$ for $\text{var}(\varepsilon_{1,i})$ in Equations (11) to (16), resulting in

$$(17) \quad \text{var}_{\varepsilon_2|E_2}(Y_{2,i}) = \left(100 \frac{P_i}{T_i E_{2,i}} \right)^2 \text{var}(\varepsilon_{2,i}).$$

Summing the estimates from Equations (7) and (11)—as indicated by Equation (5)—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 (17)—as indicated by Equation (6)—and taking the square root of the sum provides an estimated standard error of the participation rate for the working poor.

We estimated the covariance between the estimates of participation rates for all eligible people and the working poor, for a given year, according to:¹⁰

¹⁰ We do not need to include additional terms because the CPS and SNAP QC samples are independent.

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

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:

$$(19) \quad \text{cov}_{E_1 E_2 | \varepsilon_1 \varepsilon_2}(Y_{1,i}, Y_{2,i}) = \frac{4}{160} \sum_{r=1}^{160} (Y_{1,i(r)} - Y_{1,i})(Y_{2,i(r)} - Y_{2,i}).$$

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

$$(20) \quad \text{cov}_{\varepsilon_1 \varepsilon_2 | E_1 E_2}(Y_{1,i}, Y_{2,i}) = \left(100 \frac{P_i}{T_i E_{1,i}}\right) \left(100 \frac{P_i}{T_i E_{2,i}}\right) \text{cov}(\varepsilon_{1,i}, \varepsilon_{2,i})$$

where

$$(21) \quad \text{cov}(\varepsilon_{1,i}, \varepsilon_{2,i}) = \frac{1}{\left(\sum_h m_{i,h}\right)^2} \left(\frac{n_i}{n_i - 1}\right) \sum_h m_{i,h}^2 (\varepsilon_{1,i,h} - \varepsilon_{1,i})(\varepsilon_{2,i,h} - \varepsilon_{2,i}).$$

Because CPS samples from different years are not independent, participation rates for different years are correlated.¹¹ 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 eligibles for one year (year t) and the sample estimate for the working poor for g years earlier, as follows:

$$(22) \quad \text{cov}(Y_{1,i,t}, Y_{2,i,t-g}) = \frac{4}{160} \sum_{r=1}^{160} (Y_{1,i(r),t} - Y_{1,i,t})(Y_{2,i(r),t-g} - Y_{2,i,t-g}).$$

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

$$(23) \quad \text{corr}(Y_{1,i,t}, Y_{2,i,t-g}) = \frac{\text{cov}(Y_{1,i,t}, Y_{2,i,t-g})}{\sqrt{\text{var}(Y_{1,i,t}) \text{var}(Y_{2,i,t-g})}}.$$

¹¹ In contrast, SNAP QC samples from different years are independent. Hence, sampling variability in estimates from the CPS is the only source of intertemporal covariation between participation rates.

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 (23) by the average correlation between $Y_{1,i,t}$ and $Y_{2,i,t-g}$ across states:

$$(24) \quad \overline{\text{corr}}(Y_{1,t}, Y_{2,t-g}) = \frac{\sum_{i=1}^{51} (n_{i,t} + n_{i,t-g}) \text{corr}(Y_{1,i,t}, Y_{2,i,t-g})}{\sum_{i=1}^{51} (n_{i,t} + n_{i,t-g})},$$

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

$$(25) \quad \text{cov}(Y_{1,i,t}, Y_{2,i,t-g}) = \overline{\text{corr}}(Y_{1,t}, Y_{2,t-g}) \sqrt{\text{var}(Y_{1,i,t}) \text{var}(Y_{2,i,t-g})}.$$

Other intertemporal covariances—such as the covariance between the participation rates for the working poor in two different years—are similarly estimated. 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.¹²

Table A.1 presents estimates of the number of people participating in SNAP (values of P_j); Table A.2 presents the percentages of all and working poor participants who are income eligible and correctly receiving SNAP benefits (values of ε_{1i} and ε_{2i}); and Tables A.3 and A.4 show payment error-adjusted numbers of, respectively, all people and the working poor 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 for the working poor (values of E_{1i} and E_{2i}), the number of eligible people (values of Z_{1i}), the number of eligible working poor (values of Z_{2i}), and the population (values of N_j), respectively, and Table A.9

¹² All interstate covariances equal zero because state samples are independent in both the CPS and the SNAP QC.

presents the population totals (values of T_j). 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 sample estimates of participation rates for all eligible people and for the working poor (values of $Y_{1,i}$ and $Y_{2,i}$), and Table A.12 presents standard errors for the direct sample estimates.

2. Using a Regression Model, Predict State SNAP Participation Rates Based on Administrative and ACS Data

Our regression model consisted of six equations, with three predicting SNAP participation rates for all eligible people in 2007, 2008, and 2009, and three predicting SNAP participation rates for the working poor in 2007, 2008, and 2009. 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):

- the percentage of the population receiving SNAP benefits
- the percentage of children age 5 to 17 approved to receive a free lunch under the National School Lunch Program
- the elderly combined poverty rate according to individual income tax data, namely, the percentage of elderly individuals who were not claimed on tax returns or were claimed on tax returns with adjusted gross income below the poverty level
- total personal income divided by the total population according to estimates from the U.S. Bureau of Commerce and the U.S. Census Bureau
- the percentage of occupied housing units that were owner-occupied according to American Community Survey three-year estimates
- the percentage of foreign-born individuals entering the United States in 2000 or later according to American Community Survey three-year estimates
- the percentage of individuals age 65 and over with income under 200 percent of the federal poverty level according to American Community Survey three-year estimates

For the first four predictors, we used 2007 values in both equations for predicting 2007 participation rates, 2008 values in both equations for predicting 2008 rates, and 2009 values in both equations for predicting 2009 rates. For the last three predictors, we used 2005-2007 three-year values in both equations for predicting 2007 rates, 2006-2008 three-year estimates in both equations for predicting

2008 rates, and 2007-2009 three-year estimates in both equations for predicting 2009 rates. Because prediction errors were allowed to be correlated and intergroup and intertemporal correlations among direct sample estimates were taken into account as specified in the next step, the shrinkage estimates for a group (all eligible people or the working poor) 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 “best” model, we considered many other potential predictors measuring, for example, the percentage of households with a female householder, no husband present, and related children under 18 years and the percentage of renter-occupied housing units spending 30 percent or more of household income on rent and utilities. All of the predictors considered had three characteristics: (1) they are face valid, that is, 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.

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, judging performance by examining functions of the regression residuals, such as mean squared error.¹³ 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 eligibles for certain types of states categorized by, for example,

¹³ 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.

population size, region, and percentage of the population that is black or Hispanic. We found no strong evidence of correctable bias.

Definitions and data sources for the predictors in our best regression model are given in Table A.13. The values for the 2007, 2008, and 2009 predictors listed above are displayed in Tables A.14, A.15, and A.16, respectively. Regression estimates of participation rates for all eligible people and the working poor are in Table A.17, and the standard errors for the regression estimates are in Table A.18.

3. Using Shrinkage Methods, Average the Direct Sample Estimates and Regression Predictions to Obtain Preliminary Shrinkage Estimates of State SNAP Participation Rates

To average the direct sample estimates and the regression predictions, we used an empirical Bayes shrinkage estimator.¹⁴ The 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 η_{12} —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 7,136,532 equally-spaced points, starting with $\sigma_1 = 0.001$, $\sigma_2 = 0.001$, $\rho = -0.994$, $\eta_1 = 0.000$, $\eta_2 = 0.000$, and $\eta_{12} = -0.994$ and incrementing σ_1 , σ_2 , ρ , η_1 , η_2 , and η_{12} by 0.400, 0.700, 0.249, 0.450, 0.700, and 0.166, respectively, up to $\sigma_1 = 4.801$, $\sigma_2 = 7.701$, $\rho = 0.998$, $\eta_1 = 9.900$, $\eta_2 = 11.200$, and $\eta_{12} = 0.998$. For combination k of σ_1 , σ_2 , ρ , η_1 , η_2 , and η_{12} ($k = 1, 2, \dots, 7136532$), we calculated a vector of shrinkage estimates:

¹⁴ Although our shrinkage estimator averages direct sample and regression estimates, a state's shrinkage estimate for either all eligible people or the working poor in a given year does not have to be between the direct sample 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 sample and regression estimates. In the remaining cases, the shrinkage estimate is usually close to either the sample or regression estimate, and it is often close to both because the sample and regression estimates are close to each other.

all eligible people. x'_{it} is a row vector for year t with eight elements to predict participation rates for the working poor. $\underline{0}$ 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 the working poor. Thus, $x'_{it} = x'_{it} \cdot \hat{B}_k$ is a (48×1) vector of regression coefficients, and is given by:

$$(30) \quad \hat{B}_k = (X'(\Sigma_k + V)^{-1}X)^{-1}X'(\Sigma_k + V)^{-1}Y.$$

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

$$(31) \quad \Sigma_k^* = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix} \otimes \begin{pmatrix} \sigma_{1,k}^2 & \sigma_{1,k}\sigma_{2,k}\rho_k \\ \sigma_{1,k}\sigma_{2,k}\rho_k & \sigma_{2,k}^2 \end{pmatrix} + \begin{pmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{pmatrix} \otimes \begin{pmatrix} \eta_{1,k}^2 & \eta_{1,k}\eta_{2,k}\eta_{12,k} \\ \eta_{1,k}\eta_{2,k}\eta_{12,k} & \eta_{2,k}^2 \end{pmatrix}.$$

After calculating θ_k , U_k , and p_k^* 7,136,532 times (once for each combination of σ_1 , σ_2 , ρ , η_1 , η_2 , and η_{12}), we calculated the probability of $(\sigma_{1,k}, \sigma_{2,k}, \rho_k, \eta_{1,k}, \eta_{2,k}, \eta_{12,k})$:

$$(32) \quad p_k = \frac{p_k^*}{\sum_{k=1}^{7,136,532} p_k^*},$$

which is also an estimate of the probability that the shrinkage estimates θ_k are the true values. As Equation (32) 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 η_{12} and obtain a single set of shrinkage estimates, we calculated a weighted sum of the 7,136,532 sets of shrinkage estimates, weighting each set θ_k by its associated probability p_k . Thus, our shrinkage estimates are:

$$(33) \quad \theta = \sum_{k=1}^{7,136,532} p_k \theta_k.$$

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:

$$(34) \quad U = \sum_{k=1}^{7,136,532} p_k U_k + \sum_{k=1}^{7,136,532} p_k (\theta_k - \theta)(\theta_k - \theta)' .$$

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 η_{12} 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 η_{12} . 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:

$$(35) \quad R = \sum_{k=1}^{7,136,532} p_k R_k ,$$

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 $\eta_{12} = \eta_{12,k}$. The variance-covariance matrix is:

$$(36) \quad G = \sum_{k=1}^{7,136,532} p_k G_k + \sum_{k=1}^{7,136,532} p_k (R_k - R)(R_k - R)' ,$$

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

$$(37) \quad \hat{B} = \sum_{k=1}^{7,136,532} p_k \hat{B}_k .$$

Preliminary shrinkage estimates of SNAP participation rates are displayed in Table A.19.

4. Adjust the Preliminary Shrinkage Estimates to Obtain Final Shrinkage Estimates of State SNAP Participation Rates

We adjusted the preliminary shrinkage estimates of participation rates in two ways. First, we adjusted the rates so that the eligibles counts implied by the rates sum to the national eligibles count 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 the working poor). The following description of the adjustments will focus on the 2009 estimates for all eligible people.

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

$$(38) \quad \psi_{1,i} = \frac{P_i(\varepsilon_{1,i}/100)}{(\theta_{1,i}/100)},$$

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 (100 minus the payment error rate) figures used in Equation (1), and $\theta_{1,i}$ is the preliminary participation rate derived in Equation (33). The state eligibles counts from Equation (38) summed to 45,519,041 for 2009, while the national total for 2009 estimated directly from the CPS was 44,512,089. To obtain estimated eligibles counts for states that sum (aside from rounding error) to the direct estimate of the national total, we multiplied each of the eligibles counts from Equation (38) $44,512,089 \div 45,519,041 (\approx 0.9779)$.¹⁵

After carrying out this first adjustment, there were two instances where a state had fewer estimated eligibles than participants, implying a participation rate over 100 percent. Maine had preliminary estimated participation rates for all eligibles of 102 percent in 2009 and 104 percent in 2008. To cap participation rates at 100 percent, we increased the number of eligibles in Maine in 2008 and 2009 so that the number of eligibles in that state equaled the number of participants each year. We reduced the number of eligibles in the other 49 states and the District of Columbia by an equivalent number and in proportion to their numbers of eligibles. These adjustments, which were carried out separately for the two years, moved very small numbers of eligibles among states but did

¹⁵ The adjustment factors for 2007 and 2008 for all eligible people were, respectively, 0.9815, and 0.9800. The direct estimates of the national totals for all eligibles for those years were 37, 166,744 and 38,574,957. The adjustment factors for 2007, 2008, and 2009 for working poor eligibles were, respectively, 0.9803, 0.9734 and 0.9756. The direct estimates of the national totals for working poor eligibles for those years were 17,891,348, 18,452,242, and 20,896,668.

not change the national totals. Moreover, except for Maine, the state with participation rates initially over 100 percent, the adjustments did not change any state's participation rate by more than two-hundredths of a percentage point.

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

$$(39) \quad \theta_{F,1,i} = 100 \frac{P_i(\varepsilon_{1,i}/100)}{\psi_{F,1,i}},$$

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 participation rates for the working poor in the same way.

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 the working poor. The upper and lower bounds of the confidence intervals were calculated according to:

$$(40) \quad \text{Upper Bound}_i = F_i + 1.645 e_i$$

and:

$$(41) \quad \text{Lower Bound}_i = F_i - 1.645 e_i,$$

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 eligibles counts, the standard errors are, respectively:

$$(42) \quad e_i = \frac{1}{r} \sqrt{U(6i-1, 6i-1)}$$

and

$$(43) \quad e_i = \frac{\psi_{F,1,i}}{\theta_{F,1,i}} \frac{1}{r} \sqrt{U(6i-1, 6i-1)},$$

where r is the ratio used to adjust preliminary estimates of state eligibles counts to the direct estimate of the national total (≈ 0.9779 for all eligible people for 2009), and $U(6i-1,6i-1)$ is the $(6i-1,6i-1)$ diagonal element of U , which was derived according to Equation (34).¹⁶ 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.20 presents final shrinkage estimates of participation rates for all eligible people and the working poor (values of $\theta_{F,1,i}$ and $\theta_{F,2,i}$), and Table A.21 presents standard errors for the rates. Tables A.22 and A.23 display final shrinkage estimates of the numbers of all eligible people and eligible working poor (values of $\psi_{F,1,i}$ and $\psi_{F,2,i}$), respectively, and Tables A.24 and A.25 present the standard errors for those estimated counts.¹⁷

¹⁶ The square root of $U(6i-1,6i-1)$ is the standard error of the preliminary shrinkage estimate of the 2009 participation rate for all eligible people for state i . When deriving estimates for 2007 and 2008, we would use the $(6i-5,6i-5)$ and $(6i-3,6i-3)$ diagonal elements of U , respectively. When deriving estimates for the working poor for 2007, 2008, and 2009, we would use the $(6i-4,6i-4)$, $(6i-2,6i-2)$, and $(6i,6i)$ diagonal elements of U , respectively.

¹⁷ The rates in Table A.20 are the same as the rates in Table III.1 of Chapter III, except for the number of digits displayed. Likewise, the counts in Tables A.22 and A.23 are the same as the counts in Table III.2 of Chapter III, except for the number of digits displayed.

Table A.1. Number of People Receiving SNAP Benefits, Monthly Average

	Number of People Receiving SNAP Benefits (P)		
	2007	2008	2009
Alabama	545,955	571,591	679,138
Alaska	56,181	56,977	64,385
Arizona	544,688	627,660	813,987
Arkansas	379,768	377,082	411,144
California	2,048,185	2,217,782	2,670,341
Colorado	250,704	252,914	319,121
Connecticut	212,562	225,383	258,165
Delaware	67,185	74,429	90,933
District of Columbia	86,519	89,442	103,311
Florida	1,232,803	1,454,928	1,952,362
Georgia	950,038	1,021,155	1,286,078
Hawaii	89,629	96,551	114,599
Idaho	87,068	100,198	136,243
Illinois	1,246,400	1,299,404	1,455,566
Indiana	587,156	619,684	700,385
Iowa	238,349	255,789	295,106
Kansas	182,407	187,569	219,265
Kentucky	602,022	633,194	701,757
Louisiana	650,357	662,735	721,970
Maine	162,602	173,039	201,248
Maryland	317,825	359,985	454,196
Massachusetts	456,192	505,782	627,611
Michigan	1,204,409	1,256,373	1,450,272
Minnesota	276,414	293,918	344,784
Mississippi	426,116	447,181	505,920
Missouri	671,397	701,304	800,909
Montana	79,969	80,407	92,453
Nebraska	120,634	120,773	133,623
Nevada	122,224	144,494	200,056
New Hampshire	59,101	63,583	78,942
New Jersey	414,503	437,860	499,853
New Mexico	233,918	239,959	291,073
New York	1,801,984	1,952,991	2,322,742
North Carolina	882,946	946,978	1,137,294
North Dakota	45,122	48,412	53,070
Ohio	1,076,764	1,150,928	1,357,412
Oklahoma	421,316	419,029	472,892
Oregon	438,498	469,018	581,025
Pennsylvania	1,135,146	1,187,822	1,337,803
Rhode Island	76,315	84,868	102,303
South Carolina	545,293	589,763	687,508
South Dakota	60,246	62,945	73,981
Tennessee	864,870	911,253	1,072,055
Texas	2,422,198	2,515,558	2,988,535
Utah	123,475	134,180	185,282
Vermont	49,865	55,847	72,125
Virginia	515,032	545,079	651,725
Washington	536,333	578,561	761,220
West Virginia	269,343	276,800	305,960
Wisconsin	382,770	421,611	547,878
Wyoming	22,608	22,608	26,762
United States	26,273,404	28,023,376	33,412,367

Source: USDA, Food and Nutrition Service

Table A.2. Estimated Percentage of Participants Who Are Correctly Receiving Benefits and Income Eligible under Federal SNAP Rules

	Percentage Who Are Correctly Receiving Benefits and Income Eligible					
	All Participants ($\varepsilon_{1,t}$)			Working Poor Participants ($\varepsilon_{2,t}$)		
	2007	2008	2009	2007	2008	2009
Alabama	98.137	98.752	97.974	39.766	38.300	39.357
Alaska	97.421	95.726	98.687	42.904	45.536	45.374
Arizona	97.567	94.148	93.619	44.041	44.409	38.572
Arkansas	97.376	98.044	97.417	42.853	41.947	41.463
California	98.600	99.012	99.058	40.166	36.763	37.803
Colorado	97.907	98.771	99.047	40.786	40.232	39.636
Connecticut	95.662	95.731	96.392	28.986	28.490	28.669
Delaware	90.047	90.061	92.659	36.160	41.039	38.720
District of Columbia	96.186	96.225	98.734	14.115	12.606	11.948
Florida	98.012	99.616	99.713	36.559	32.661	33.144
Georgia	95.765	98.728	98.714	45.123	44.584	43.056
Hawaii	98.537	98.599	98.120	42.967	40.828	41.821
Idaho	97.770	98.219	98.558	52.258	52.605	50.199
Illinois	98.490	98.722	96.676	36.647	38.411	33.320
Indiana	96.645	97.696	97.623	42.643	38.730	43.314
Iowa	96.828	95.732	97.471	49.900	44.658	49.363
Kansas	98.877	97.073	97.243	46.434	46.173	42.558
Kentucky	98.181	97.686	98.352	35.545	27.903	28.701
Louisiana	96.650	97.062	97.056	42.945	40.605	40.545
Maine	90.016	91.403	92.160	34.211	33.189	32.786
Maryland	92.895	93.750	90.673	33.167	30.801	33.293
Massachusetts	94.102	94.228	92.087	19.478	23.329	25.739
Michigan	93.579	91.886	91.449	40.875	41.126	36.298
Minnesota	96.904	96.661	96.879	36.247	37.722	38.422
Mississippi	98.829	99.286	99.031	43.059	39.670	40.421
Missouri	98.647	98.099	96.967	39.854	43.256	37.565
Montana	96.909	98.051	97.716	45.248	41.210	43.127
Nebraska	98.908	99.334	99.437	46.856	49.526	47.277
Nevada	98.304	98.057	95.251	38.514	37.529	36.389
New Hampshire	96.134	97.225	96.549	33.213	34.384	31.327
New Jersey	98.407	97.721	98.429	32.744	29.360	29.220
New Mexico	97.609	97.940	98.256	49.268	50.279	48.586
New York	97.926	97.396	95.785	35.719	31.793	35.816
North Carolina	99.247	99.240	99.156	44.929	42.844	39.656
North Dakota	94.254	93.184	93.464	45.171	45.411	42.646
Ohio	96.437	98.897	98.966	37.173	36.141	37.096
Oklahoma	96.642	97.121	97.666	39.658	38.614	41.830
Oregon	91.873	89.631	88.344	40.883	36.622	35.976
Pennsylvania	98.138	98.779	96.143	34.660	32.985	33.973
Rhode Island	98.335	98.248	97.287	26.241	23.556	28.980
South Carolina	97.917	97.855	96.877	35.545	38.696	34.920
South Dakota	98.666	99.510	98.548	49.432	44.563	48.422
Tennessee	97.696	97.577	98.318	31.314	36.754	38.052
Texas	94.579	95.736	92.452	43.651	44.542	42.135
Utah	98.149	97.205	96.554	49.389	46.308	46.462
Vermont	94.288	93.951	86.669	33.256	39.947	34.074
Virginia	97.437	97.790	96.615	39.264	39.594	39.404
Washington	97.685	97.491	89.967	32.463	34.153	31.393
West Virginia	96.848	97.261	97.719	37.083	37.096	34.845
Wisconsin	92.477	90.210	89.020	45.026	45.653	41.689
Wyoming	95.971	98.742	97.049	45.665	47.719	39.890

Source: SNAP QC data

Table A.3. Estimated Number of Participants Who Are Correctly Receiving Benefits and Income Eligible under Federal SNAP Rules, Monthly Average

	Participants Correctly Receiving Benefits and Income Eligible		
	2007	2008	2009
Alabama	535,782	564,455	665,381
Alaska	54,732	54,542	63,540
Arizona	531,437	590,929	762,049
Arkansas	369,803	369,708	400,524
California	2,019,511	2,195,879	2,645,195
Colorado	245,458	249,805	316,080
Connecticut	203,341	215,761	248,851
Delaware	60,497	67,031	84,257
District of Columbia	83,219	86,065	102,003
Florida	1,208,297	1,449,341	1,946,763
Georgia	909,801	1,008,169	1,269,541
Hawaii	88,317	95,199	112,444
Idaho	85,126	98,413	134,278
Illinois	1,227,575	1,282,795	1,407,186
Indiana	567,458	605,405	683,734
Iowa	230,789	244,871	287,643
Kansas	180,358	182,078	213,220
Kentucky	591,068	618,541	690,191
Louisiana	628,566	643,261	700,714
Maine	146,368	158,163	185,471
Maryland	295,242	337,485	411,834
Massachusetts	429,284	476,587	577,945
Michigan	1,127,068	1,154,432	1,326,262
Minnesota	267,855	284,103	334,023
Mississippi	421,124	443,987	501,017
Missouri	662,315	687,972	776,616
Montana	77,496	78,840	90,342
Nebraska	119,317	119,969	132,870
Nevada	120,152	141,686	190,556
New Hampshire	56,815	61,818	76,217
New Jersey	407,899	427,883	491,997
New Mexico	228,326	235,015	285,998
New York	1,764,610	1,902,136	2,224,842
North Carolina	876,293	939,777	1,127,694
North Dakota	42,530	45,112	49,601
Ohio	1,038,402	1,138,237	1,343,372
Oklahoma	407,169	406,967	461,856
Oregon	402,862	420,385	513,303
Pennsylvania	1,114,014	1,173,320	1,286,201
Rhode Island	75,044	83,381	99,528
South Carolina	533,937	577,111	666,035
South Dakota	59,442	62,637	72,907
Tennessee	844,947	889,169	1,054,020
Texas	2,290,890	2,408,292	2,762,955
Utah	121,189	130,430	178,898
Vermont	47,017	52,469	62,510
Virginia	501,834	533,030	629,665
Washington	523,914	564,043	684,849
West Virginia	260,853	269,218	298,981
Wisconsin	353,974	380,335	487,723
Wyoming	21,697	22,323	25,972
United States	25,736,505	27,566,791	32,842,509

Table A.4. Estimated Number of Working Poor Who Are Correctly Receiving Benefits and Income Eligible under Federal SNAP Rules, Monthly Average

	Working Poor Correctly Receiving Benefits and Income Eligible		
	2007	2008	2009
Alabama	217,105	218,919	267,289
Alaska	24,104	25,945	29,214
Arizona	239,885	278,736	313,971
Arkansas	162,741	158,175	170,470
California	822,678	815,331	1,009,476
Colorado	102,252	101,752	126,487
Connecticut	61,612	64,213	74,012
Delaware	24,294	30,545	35,209
District of Columbia	12,212	11,275	12,344
Florida	450,697	475,196	647,092
Georgia	428,686	455,268	553,729
Hawaii	38,510	39,420	47,926
Idaho	45,500	52,709	68,392
Illinois	456,762	499,107	484,987
Indiana	250,383	240,004	303,362
Iowa	118,936	114,231	145,674
Kansas	84,699	86,605	93,314
Kentucky	213,987	176,678	201,414
Louisiana	279,298	269,104	292,723
Maine	55,627	57,429	65,981
Maryland	105,412	110,879	151,214
Massachusetts	88,855	117,996	161,538
Michigan	492,298	516,701	526,426
Minnesota	100,191	110,872	132,473
Mississippi	183,480	177,398	204,497
Missouri	267,575	303,353	300,864
Montana	36,184	33,136	39,872
Nebraska	56,524	59,814	63,173
Nevada	47,073	54,227	72,798
New Hampshire	19,629	21,862	24,730
New Jersey	135,726	128,555	146,058
New Mexico	115,247	120,648	141,422
New York	643,654	620,915	831,923
North Carolina	396,695	405,725	451,003
North Dakota	20,382	21,984	22,632
Ohio	400,269	415,961	503,543
Oklahoma	167,084	161,803	197,812
Oregon	179,269	171,763	209,031
Pennsylvania	393,438	391,799	454,487
Rhode Island	20,025	19,992	29,647
South Carolina	193,826	228,215	240,080
South Dakota	29,781	28,050	35,823
Tennessee	270,822	334,921	407,943
Texas	1,057,318	1,120,468	1,259,205
Utah	60,983	62,136	86,086
Vermont	16,583	22,309	24,576
Virginia	202,223	215,821	256,804
Washington	174,111	197,597	238,969
West Virginia	99,880	102,682	106,610
Wisconsin	172,347	192,476	228,403
Wyoming	10,324	10,788	10,675
United States	10,247,179	10,651,488	12,503,383

Table A.5. Estimated Percentage of People Eligible for SNAP

	Percentage of People Eligible for SNAP					
	All Eligible People ($E_{1,t}$)			Working Poor ($E_{2,t}$)		
	2007	2008	2009	2007	2008	2009
Alabama	15.881	16.106	20.088	6.312	7.180	9.302
Alaska	10.189	10.625	12.900	4.544	4.746	5.980
Arizona	13.109	14.068	17.688	7.171	6.933	8.391
Arkansas	16.437	16.378	20.343	7.536	7.449	8.528
California	11.031	11.659	13.602	6.621	6.981	7.796
Colorado	7.870	8.621	10.961	3.704	4.355	6.185
Connecticut	8.858	9.071	8.821	3.617	3.783	3.383
Delaware	10.101	11.098	12.426	4.722	5.432	5.822
District of Columbia	18.617	18.721	20.540	6.280	6.097	5.671
Florida	12.040	12.831	15.423	5.727	5.730	6.966
Georgia	14.592	15.082	17.950	7.494	7.845	8.648
Hawaii	9.401	10.560	14.034	5.379	6.110	7.749
Idaho	9.066	9.990	12.104	4.984	5.411	6.301
Illinois	10.476	11.064	13.342	5.109	5.487	6.089
Indiana	11.438	12.894	15.538	4.661	5.399	5.952
Iowa	8.578	8.553	10.464	4.168	4.373	5.723
Kansas	11.339	11.772	13.161	6.479	7.258	7.035
Kentucky	17.161	17.089	18.376	6.812	6.660	7.254
Louisiana	18.658	20.121	19.331	8.458	9.774	9.219
Maine	10.847	11.059	13.019	3.953	4.464	4.973
Maryland	8.951	9.764	10.778	3.970	4.406	4.504
Massachusetts	11.055	10.969	11.657	3.797	3.793	4.105
Michigan	11.513	12.437	15.078	5.036	5.625	6.196
Minnesota	7.827	8.507	9.885	3.763	4.736	5.372
Mississippi	23.348	23.447	25.695	1.500	10.513	10.701
Missouri	12.703	12.080	14.300	6.152	5.562	7.153
Montana	10.782	9.811	12.635	4.673	3.841	5.022
Nebraska	8.465	9.284	9.949	4.275	5.247	5.486
Nevada	8.861	9.101	11.632	4.770	4.610	5.444
New Hampshire	6.101	5.942	7.852	2.619	2.425	3.289
New Jersey	9.196	9.135	9.811	3.556	3.455	3.593
New Mexico	15.500	16.210	18.205	7.608	8.598	8.827
New York	14.963	14.839	16.637	6.334	6.261	6.933
North Carolina	15.409	14.970	16.772	7.400	6.660	7.713
North Dakota	9.745	9.676	10.545	5.136	5.057	5.387
Ohio	12.878	13.285	14.745	5.747	5.207	5.938
Oklahoma	15.703	14.308	14.898	7.567	6.937	7.461
Oregon	10.865	10.258	11.819	5.097	4.873	5.432
Pennsylvania	10.448	10.802	11.814	3.973	4.315	4.395
Rhode Island	11.297	11.756	14.734	4.211	4.774	6.253
South Carolina	15.284	15.932	17.277	7.504	6.533	6.382
South Dakota	9.477	10.402	12.262	4.348	5.356	5.795
Tennessee	17.119	17.938	18.698	7.472	8.592	9.336
Texas	16.474	16.596	18.485	9.168	9.261	10.544
Utah	8.074	6.465	8.789	4.600	3.548	5.312
Vermont	9.168	9.332	11.140	3.478	3.993	4.816
Virginia	9.345	10.309	11.664	4.504	4.769	5.334
Washington	9.356	9.275	10.774	4.625	3.884	4.725
West Virginia	16.137	15.256	17.946	5.612	4.635	5.069
Wisconsin	9.453	9.827	10.975	4.512	4.995	4.909
Wyoming	8.539	8.629	8.647	4.539	3.929	3.676

Source: CPS ASEC

Table A.6. Directly Estimated Number of People Eligible for SNAP

	Number of People Eligible for SNAP ($Z_{1,t}$)		
	2007	2008	2009
Alabama	725,786	760,231	937,898
Alaska	68,776	71,461	89,131
Arizona	834,797	919,655	1,151,971
Arkansas	461,018	462,982	580,168
California	4,003,838	4,277,614	5,004,848
Colorado	383,836	423,818	544,912
Connecticut	307,912	311,777	306,991
Delaware	87,131	95,734	109,856
District of Columbia	108,322	110,783	122,408
Florida	2,176,113	2,315,894	2,838,561
Georgia	1,385,186	1,440,727	1,736,010
Hawaii	119,154	132,809	175,543
Idaho	136,076	151,638	184,753
Illinois	1,329,165	1,405,466	1,703,301
Indiana	716,334	811,675	988,812
Iowa	254,746	255,772	313,447
Kansas	308,633	320,655	361,201
Kentucky	721,963	727,263	786,896
Louisiana	783,037	872,187	860,743
Maine	142,396	145,828	169,267
Maryland	498,138	540,820	610,802
Massachusetts	700,832	704,289	773,010
Michigan	1,142,845	1,220,806	1,479,870
Minnesota	406,207	435,631	514,297
Mississippi	677,684	681,704	732,379
Missouri	735,609	709,272	853,584
Montana	101,255	95,757	122,819
Nebraska	148,437	164,885	177,059
Nevada	227,530	235,138	306,188
New Hampshire	80,179	77,329	103,145
New Jersey	786,777	778,652	851,549
New Mexico	301,677	320,705	360,059
New York	2,852,337	2,869,443	3,191,730
North Carolina	1,414,999	1,385,253	1,567,823
North Dakota	59,915	60,625	66,690
Ohio	1,455,214	1,514,013	1,690,028
Oklahoma	557,631	509,074	541,674
Oregon	408,737	391,311	453,187
Pennsylvania	1,286,538	1,317,192	1,466,577
Rhode Island	117,910	122,718	152,166
South Carolina	670,110	712,124	778,597
South Dakota	74,708	82,959	98,143
Tennessee	1,052,854	1,109,157	1,169,159
Texas	3,905,134	4,015,233	4,557,991
Utah	214,573	178,394	246,073
Vermont	56,274	57,105	68,870
Virginia	718,084	798,733	907,186
Washington	609,001	606,622	723,358
West Virginia	289,697	274,427	323,900
Wisconsin	517,421	545,916	610,708
Wyoming	44,217	45,699	46,752
United States	37,166,743	38,574,956	44,512,087

Source: CPS ASEC

Table A.7. Directly Estimated Number of Working Poor Eligible for SNAP

	Number of Working Poor Eligible for SNAP (Z_2)		
	2007	2008	2009
Alabama	288,462	338,923	434,312
Alaska	30,674	31,916	41,318
Arizona	456,655	453,258	546,482
Arkansas	211,381	210,580	243,226
California	2,403,115	2,561,484	2,868,334
Colorado	180,627	214,116	307,475
Connecticut	125,715	130,032	117,741
Delaware	40,731	46,855	51,469
District of Columbia	36,541	36,081	33,799
Florida	1,035,031	1,034,217	1,282,145
Georgia	711,357	749,384	836,329
Hawaii	68,175	76,840	96,929
Idaho	74,813	82,125	96,179
Illinois	648,195	696,980	777,397
Indiana	291,882	339,834	378,773
Iowa	123,759	130,769	171,429
Kansas	176,339	197,687	193,087
Kentucky	286,557	283,417	310,636
Louisiana	354,947	423,692	410,492
Maine	51,898	58,860	64,655
Maryland	220,951	244,012	255,244
Massachusetts	240,716	243,546	272,229
Michigan	499,894	552,100	608,093
Minnesota	195,302	242,514	279,478
Mississippi	333,784	305,650	304,998
Missouri	356,268	326,574	426,980
Montana	43,881	37,491	48,817
Nebraska	74,967	93,186	97,627
Nevada	122,495	119,093	143,299
New Hampshire	34,421	31,563	43,209
New Jersey	304,218	294,541	311,867
New Mexico	148,078	170,103	174,577
New York	1,207,478	1,210,630	1,329,962
North Carolina	679,513	616,254	721,001
North Dakota	31,575	31,683	34,069
Ohio	649,407	593,399	680,625
Oklahoma	268,713	246,818	271,258
Oregon	191,740	185,908	208,285
Pennsylvania	489,175	526,139	545,523
Rhode Island	43,954	49,831	64,574
South Carolina	329,007	291,983	287,603
South Dakota	34,273	42,718	46,383
Tennessee	459,529	531,295	583,780
Texas	2,173,238	2,240,634	2,599,909
Utah	122,232	97,914	148,717
Vermont	21,347	24,438	29,772
Virginia	346,070	369,474	414,832
Washington	301,071	254,002	317,207
West Virginia	100,738	83,378	91,487
Wisconsin	246,958	277,505	273,182
Wyoming	23,503	20,808	19,875
United States	17,891,347	18,452,241	20,896,667

Source: CPS ASEC

Table A.8. CPS ASEC Population Estimate

	CPS ASEC Population Estimate (N)		
	2007	2008	2009
Alabama	4,570,288	4,720,254	4,669,053
Alaska	674,995	672,556	690,930
Arizona	6,367,946	6,537,361	6,512,812
Arkansas	2,804,822	2,826,804	2,851,984
California	36,295,313	36,690,682	36,794,222
Colorado	4,877,134	4,916,322	4,971,302
Connecticut	3,476,085	3,437,145	3,480,082
Delaware	862,603	862,603	884,083
District of Columbia	581,847	591,773	595,955
Florida	18,073,837	18,048,799	18,404,657
Georgia	9,492,868	9,552,899	9,671,299
Hawaii	1,267,408	1,257,622	1,250,860
Idaho	1,501,022	1,517,839	1,526,374
Illinois	12,688,025	12,702,834	12,766,622
Indiana	6,262,633	6,294,783	6,363,733
Iowa	2,969,623	2,990,448	2,995,442
Kansas	2,721,828	2,723,776	2,744,580
Kentucky	4,206,967	4,255,709	4,282,219
Louisiana	4,196,757	4,334,705	4,452,651
Maine	1,312,747	1,318,687	1,300,126
Maryland	5,565,416	5,538,736	5,667,074
Massachusetts	6,339,513	6,420,947	6,631,452
Michigan	9,926,701	9,815,924	9,814,650
Minnesota	5,190,163	5,120,721	5,202,762
Mississippi	2,902,587	2,907,478	2,850,267
Missouri	5,791,038	5,871,351	5,969,110
Montana	939,097	976,072	972,076
Nebraska	1,753,474	1,776,043	1,779,585
Nevada	2,567,796	2,583,627	2,632,337
New Hampshire	1,314,181	1,301,416	1,313,692
New Jersey	8,555,736	8,524,347	8,679,729
New Mexico	1,946,264	1,978,390	1,977,807
New York	19,062,341	19,337,606	19,184,214
North Carolina	9,183,099	9,253,268	9,347,729
North Dakota	614,805	626,543	632,416
Ohio	11,300,411	11,396,858	11,462,068
Oklahoma	3,551,011	3,558,047	3,635,849
Oregon	3,761,927	3,814,888	3,834,542
Pennsylvania	12,313,327	12,194,553	12,413,502
Rhode Island	1,043,765	1,043,855	1,032,767
South Carolina	4,384,480	4,469,656	4,506,622
South Dakota	788,286	797,542	800,413
Tennessee	6,150,384	6,183,357	6,252,798
Texas	23,704,368	24,194,324	24,657,375
Utah	2,657,469	2,759,405	2,799,921
Vermont	613,788	611,954	618,243
Virginia	7,683,803	7,748,151	7,777,834
Washington	6,509,198	6,540,447	6,713,909
West Virginia	1,795,205	1,798,835	1,804,847
Wisconsin	5,473,464	5,555,255	5,564,644
Wyoming	517,862	529,622	540,698
United States	299,105,708	301,482,819	304,279,918

Source: CPS ASEC

Table A.9. Population on July 1

	Population on July 1(T)		
	2007	2008	2009
Alabama	4,637,904	4,677,464	4,708,708
Alaska	682,297	688,125	698,473
Arizona	6,362,241	6,499,377	6,595,778
Arkansas	2,842,194	2,867,764	2,889,450
California	36,226,122	36,580,371	36,961,664
Colorado	4,842,259	4,935,213	5,024,748
Connecticut	3,488,633	3,502,932	3,518,288
Delaware	864,896	876,211	885,122
District of Columbia	586,409	590,074	599,657
Florida	18,277,888	18,423,878	18,537,969
Georgia	9,533,761	9,697,838	9,829,211
Hawaii	1,276,832	1,287,481	1,295,178
Idaho	1,499,245	1,527,506	1,545,801
Illinois	12,779,417	12,842,954	12,910,409
Indiana	6,346,113	6,388,309	6,423,113
Iowa	2,978,719	2,993,987	3,007,856
Kansas	2,775,586	2,797,375	2,818,747
Kentucky	4,256,278	4,287,931	4,314,113
Louisiana	4,376,122	4,451,513	4,492,076
Maine	1,317,308	1,319,691	1,318,301
Maryland	5,634,242	5,658,655	5,699,478
Massachusetts	6,499,275	6,543,595	6,593,587
Michigan	10,050,847	10,002,486	9,969,727
Minnesota	5,191,206	5,230,567	5,266,214
Mississippi	2,921,723	2,940,212	2,951,996
Missouri	5,909,824	5,956,335	5,987,580
Montana	957,225	968,035	974,989
Nebraska	1,769,912	1,781,949	1,796,619
Nevada	2,567,752	2,615,772	2,643,085
New Hampshire	1,317,343	1,321,872	1,324,575
New Jersey	8,636,043	8,663,398	8,707,739
New Mexico	1,968,731	1,986,763	2,009,671
New York	19,422,777	19,467,789	19,541,453
North Carolina	9,064,074	9,247,134	9,380,884
North Dakota	638,202	641,421	646,844
Ohio	11,520,815	11,528,072	11,542,645
Oklahoma	3,612,186	3,644,025	3,687,050
Oregon	3,732,957	3,782,991	3,825,657
Pennsylvania	12,522,531	12,566,368	12,604,767
Rhode Island	1,055,009	1,053,502	1,053,209
South Carolina	4,424,232	4,503,280	4,561,242
South Dakota	797,035	804,532	812,383
Tennessee	6,172,862	6,240,456	6,296,254
Texas	23,837,701	24,304,290	24,782,302
Utah	2,663,796	2,727,343	2,784,572
Vermont	620,460	621,049	621,760
Virginia	7,719,749	7,795,424	7,882,590
Washington	6,464,979	6,566,073	6,664,195
West Virginia	1,811,198	1,814,873	1,819,777
Wisconsin	5,601,571	5,627,610	5,654,774
Wyoming	523,414	532,981	544,270
United States	301,579,895	304,374,846	307,006,550

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

	Percentage of Working Poor Participants Without Reported Earned Income		
	2007	2008	2009
Alabama	0.0	0.0	0.0
Alaska	0.0	0.0	0.5
Arizona	0.0	0.0	0.0
Arkansas	0.7	2.2	2.3
California	0.0	0.4	0.0
Colorado	0.7	0.0	0.0
Connecticut	0.2	0.3	0.7
Delaware	0.2	1.0	0.0
District of Columbia	1.4	0.0	0.0
Florida	0.0	0.3	0.0
Georgia	0.0	0.3	0.0
Hawaii	0.7	0.0	1.0
Idaho	0.0	0.0	0.0
Illinois	0.2	0.0	0.0
Indiana	0.2	0.2	0.0
Iowa	0.0	0.0	0.7
Kansas	0.4	1.3	0.0
Kentucky	0.0	0.0	0.0
Louisiana	0.0	0.0	0.0
Maine	0.9	0.1	0.0
Maryland	0.5	0.0	0.0
Massachusetts	0.0	1.5	1.2
Michigan	0.0	0.0	0.0
Minnesota	0.4	1.3	2.1
Mississippi	0.6	0.0	0.0
Missouri	0.6	0.4	0.1
Montana	0.4	1.1	0.3
Nebraska	0.0	0.0	0.0
Nevada	0.0	0.0	0.0
New Hampshire	0.0	0.0	0.5
New Jersey	0.8	1.7	0.2
New Mexico	0.1	0.0	0.0
New York	0.4	0.2	0.0
North Carolina	0.6	0.8	0.0
North Dakota	0.3	0.0	0.0
Ohio	0.0	0.0	0.0
Oklahoma	0.0	0.0	0.0
Oregon	0.0	0.0	0.7
Pennsylvania	0.7	0.8	3.5
Rhode Island	0.3	0.0	0.0
South Carolina	0.0	0.5	0.5
South Dakota	0.3	0.0	0.0
Tennessee	0.0	0.0	0.0
Texas	0.1	0.1	0.1
Utah	0.3	0.0	0.0
Vermont	0.0	0.3	0.2
Virginia	0.0	0.4	0.4
Washington	0.0	0.0	0.0
West Virginia	0.0	0.4	0.0
Wisconsin	0.2	0.2	0.0
Wyoming	0.0	1.5	0.0

Table A.11. Direct Sample Estimates of SNAP Participation Rates

	Direct Sample Estimates of SNAP Participation Rates (Percent)					
	All Eligible People ($Y_{1,t}$)			Working Poor ($Y_{2,t}$)		
	2007	2008	2009	2007	2008	2009
Alabama	72.745	74.927	70.346	74.166	65.184	61.025
Alaska	78.728	74.597	70.518	77.740	79.451	69.942
Arizona	63.718	64.631	65.320	52.578	61.856	56.730
Arkansas	79.160	78.713	68.141	75.977	74.041	69.178
California	50.536	51.489	52.613	34.299	31.926	35.034
Colorado	64.409	58.716	57.389	57.017	47.340	40.700
Connecticut	65.801	67.904	80.181	48.833	48.455	62.178
Delaware	69.249	68.931	76.608	59.488	64.178	68.328
District of Columbia	76.228	77.912	82.816	33.161	31.338	36.295
Florida	54.906	61.308	68.090	43.058	45.012	50.107
Georgia	65.399	68.931	71.955	60.005	59.844	65.146
Hawaii	73.573	70.018	61.863	56.071	50.111	47.753
Idaho	62.632	64.490	71.767	60.891	63.776	70.215
Illinois	91.696	90.276	81.695	69.963	70.829	61.691
Indiana	78.175	73.495	68.508	84.654	69.590	79.350
Iowa	90.319	95.625	91.389	95.810	87.250	84.626
Kansas	57.306	55.289	57.478	47.102	42.657	47.056
Kentucky	80.921	84.411	87.062	73.810	61.870	64.360
Louisiana	76.983	71.817	80.694	75.462	61.847	70.684
Maine	102.433	108.376	108.063	106.815	97.494	100.644
Maryland	58.545	61.080	67.042	47.126	44.477	58.906
Massachusetts	59.748	66.401	75.195	36.006	47.541	59.680
Michigan	97.401	92.799	88.226	97.264	91.843	85.223
Minnesota	65.927	63.847	64.165	51.290	44.758	46.829
Mississippi	61.735	64.404	66.052	54.610	57.393	64.738
Missouri	88.227	95.613	90.702	73.595	91.564	70.246
Montana	75.087	83.017	73.337	80.898	89.117	81.433
Nebraska	79.636	72.518	74.331	74.698	63.975	64.095
Nevada	52.808	59.516	61.982	38.429	44.974	50.595
New Hampshire	70.691	78.705	73.287	56.890	68.194	56.764
New Jersey	51.362	54.070	57.591	44.200	42.945	46.683
New Mexico	74.822	72.972	78.171	76.941	70.628	79.724
New York	60.717	65.846	68.432	52.316	50.946	61.409
North Carolina	62.742	67.887	71.673	59.146	65.881	62.331
North Dakota	68.381	72.685	72.717	62.185	67.779	64.949
Ohio	69.992	74.324	78.933	60.457	69.300	73.466
Oklahoma	71.781	78.056	84.081	61.126	64.009	71.911
Oregon	99.327	108.336	113.528	94.222	93.170	100.591
Pennsylvania	85.143	86.442	86.370	79.085	72.263	82.048
Rhode Island	62.967	67.323	64.138	45.075	39.751	45.021
South Carolina	78.963	80.436	84.519	58.383	77.577	82.477
South Dakota	78.692	74.847	73.192	85.938	65.093	76.095
Tennessee	79.961	79.433	89.530	58.720	62.462	69.397
Texas	58.335	59.708	60.312	48.380	49.780	48.189
Utah	56.345	73.973	73.102	49.773	64.205	58.205
Vermont	82.651	90.535	90.252	76.850	89.954	82.078
Virginia	69.560	66.330	68.486	58.162	58.059	61.083
Washington	86.617	92.618	95.383	58.226	77.490	75.897
West Virginia	89.248	97.235	91.550	98.273	122.064	115.575
Wisconsin	66.847	68.773	78.589	68.192	68.468	82.276
Wyoming	48.549	48.542	55.189	43.460	51.521	53.362

Table A.12. Standard Errors of Direct Sample Estimates of SNAP Participation Rates

	Standard Errors of Direct Sample Estimates of SNAP Participation Rates					
	All Eligible People			Working Poor		
	2007	2008	2009	2007	2008	2009
Alabama	4.877	5.502	4.456	7.328	6.955	6.794
Alaska	6.758	6.180	4.768	9.843	10.032	8.362
Arizona	4.156	3.518	4.300	5.454	5.801	6.078
Arkansas	6.036	7.155	6.033	8.164	9.605	6.897
California	1.417	1.456	1.338	2.016	1.887	1.950
Colorado	5.016	4.034	3.595	6.208	5.135	3.517
Connecticut	5.547	4.436	4.977	7.147	5.691	7.331
Delaware	4.932	5.281	4.763	7.701	7.387	7.007
District of Columbia	4.137	4.561	4.129	6.145	5.240	6.086
Florida	2.605	3.077	2.519	3.554	3.951	3.877
Georgia	3.089	3.220	3.305	4.256	5.187	4.679
Hawaii	5.964	5.036	3.942	6.509	5.631	4.558
Idaho	8.119	7.946	8.651	9.849	7.845	7.170
Illinois	4.376	4.022	3.213	5.865	5.245	5.059
Indiana	5.214	4.458	4.340	7.715	5.695	7.439
Iowa	6.762	5.450	6.817	10.276	8.412	9.722
Kansas	4.108	4.983	5.200	4.432	5.144	4.963
Kentucky	5.043	5.859	5.736	7.928	7.204	6.450
Louisiana	4.466	3.666	6.806	7.004	5.098	8.638
Maine	6.737	7.414	6.930	11.227	9.775	10.696
Maryland	3.982	3.405	3.890	5.220	4.232	6.218
Massachusetts	3.717	5.408	5.653	5.294	6.852	8.411
Michigan	4.988	5.149	4.281	8.530	7.882	8.028
Minnesota	5.093	5.507	4.557	5.724	7.443	7.363
Mississippi	5.970	3.294	3.176	8.734	4.840	5.361
Missouri	5.816	5.506	4.816	7.650	7.799	6.696
Montana	9.113	8.294	8.053	9.088	12.898	13.456
Nebraska	7.549	5.688	5.020	8.016	7.189	6.306
Nevada	3.847	4.298	4.347	4.002	5.340	5.769
New Hampshire	6.132	6.390	5.551	8.530	9.033	7.269
New Jersey	3.682	4.201	4.008	5.186	5.321	5.759
New Mexico	6.048	6.271	5.808	7.303	8.197	8.989
New York	2.037	2.269	2.267	3.994	3.948	4.447
North Carolina	3.359	3.702	3.545	5.091	5.034	5.862
North Dakota	7.532	13.373	12.002	10.894	14.608	10.937
Ohio	4.071	3.728	3.576	4.938	5.656	5.437
Oklahoma	5.148	4.470	6.224	5.708	5.606	6.980
Oregon	6.497	7.785	7.346	11.816	12.659	10.580
Pennsylvania	4.289	4.244	4.370	7.957	6.994	8.151
Rhode Island	4.102	4.570	3.456	5.953	5.096	4.787
South Carolina	4.049	4.474	4.492	4.656	8.051	8.566
South Dakota	10.134	9.720	10.632	8.679	8.731	9.068
Tennessee	6.195	4.716	5.820	6.552	5.997	5.906
Texas	2.212	2.232	2.048	2.888	2.783	2.747
Utah	3.601	6.541	5.650	4.866	8.945	6.401
Vermont	6.958	6.512	6.005	10.504	11.078	9.452
Virginia	8.325	6.975	5.983	8.512	8.216	6.730
Washington	5.717	6.418	6.868	7.729	9.703	9.783
West Virginia	6.101	7.403	6.142	9.777	15.221	12.745
Wisconsin	5.356	4.838	5.055	6.975	7.439	7.134
Wyoming	5.908	4.237	3.894	6.754	5.849	6.781

Table A.13. Definitions and Data Sources for Predictors

Predictor ^a	Definition	Principal Data Source ^b
SNAP prevalence rate	$100 \times \frac{\text{Individuals receiving SNAP benefits}}{\text{Resident population}}$	Counts of people receiving SNAP benefits are from SNAP Program Operations data.
Elderly combined poverty rate	$100 \times \frac{\text{Individuals age 65 or older not claimed on tax returns or claimed on tax returns with adjusted gross income below the poverty level}}{\text{Resident population age 65 and over}}$	All data for this predictor were obtained from the Census Bureau.
Free lunch rate	$100 \times \frac{\text{Children approved to receive a free lunch under the National School Lunch Program}}{\text{Resident population age 5 to 17}}$	Counts of children approved to receive a free lunch under the NSLP are from Program Operations data.
Regionally adjusted per-capita personal income	$1000 \times \frac{\text{Total personal income}}{\text{Resident population} \times \text{poverty guideline}}$	The data for constructing these predictors were obtained from the Bureau of Commerce and the Census Bureau
Owner-occupied housing rate	$100 \times \frac{\text{Owner-occupied housing units}}{\text{Occupied housing units}}$	The data for constructing these predictors were obtained from the American Community Survey Three-Year Estimates available at http://factfinder.census.gov .
Rate of foreign-born arriving in 2000 or later	$100 \times \frac{\text{Foreign-born who entered U.S. in 2000 or later}}{\text{Total foreign-born}}$	
Rate of elderly with income under 200 percent of poverty	$100 \times \frac{\text{Individuals age 65 and over with income under 200 percent of poverty}}{\text{Total individuals age 65 and over}}$	

^a Values for the first two predictors vary across the year-specific equations of our regression model, while values for the third through seventh predictors do not vary.

^b For the 2007, 2008, and 2009 estimates of the resident population, we used the July 1 population estimates released by the Census Bureau in May 2010, available at <http://www.census.gov/popest/datasets.html>.

Table A.14. Values for 2007 Predictors

	Values for 2007 Predictors						
	SNAP prevalence rate	Elderly combined poverty rate	Free lunch rate	Per-capita personal income	Foreign-born recent arrival rate	Owner-occupied housing rate	Elderly 200 percent of poverty rate
Alabama	11.772	50.964	40.381	3.232	40.8	71.3	32.4
Alaska	8.234	31.903	28.743	3.195	26.5	63.7	21.3
Arizona	8.561	45.100	32.814	3.277	31.3	68.6	24.2
Arkansas	13.362	50.677	42.734	3.004	34.7	68.0	33.6
California	5.654	44.498	38.272	4.196	20.0	58.4	24.0
Colorado	5.177	36.008	23.725	4.118	30.7	68.7	23.9
Connecticut	6.093	36.601	21.121	5.497	25.1	69.7	21.0
Delaware	7.768	34.777	29.634	3.996	33.0	73.6	23.4
District of Columbia	14.754	47.335	46.401	6.261	31.1	44.1	28.3
Florida	6.745	45.439	35.418	3.823	26.2	70.3	26.9
Georgia	9.965	48.047	40.526	3.345	34.9	67.9	30.0
Hawaii	7.020	39.093	26.197	3.411	21.2	58.9	20.2
Idaho	5.807	40.194	26.963	3.172	28.1	71.6	27.2
Illinois	9.753	39.871	32.303	4.114	23.5	70.1	26.0
Indiana	9.252	40.803	28.695	3.315	36.4	72.1	26.7
Iowa	8.002	36.249	24.304	3.495	33.0	73.3	27.6
Kansas	6.572	37.038	28.735	3.653	33.7	70.0	26.2
Kentucky	14.144	51.268	44.982	3.066	42.8	70.8	34.7
Louisiana	14.861	52.969	49.647	3.506	29.0	68.1	34.3
Maine	12.343	44.933	26.825	3.392	22.6	72.9	30.7
Maryland	5.641	37.182	24.016	4.632	31.4	69.4	21.3
Massachusetts	7.019	40.627	22.803	4.873	27.4	65.0	25.1
Michigan	11.983	38.600	27.619	3.440	28.4	75.1	26.3
Minnesota	5.325	34.619	24.077	4.101	33.1	75.8	25.1
Mississippi	14.584	56.283	53.461	2.852	39.7	70.9	36.9
Missouri	11.361	42.721	30.111	3.377	33.6	70.7	28.4
Montana	8.354	38.605	25.210	3.319	24.6	70.1	29.5
Nebraska	6.816	37.698	29.259	3.635	33.4	68.5	27.6
Nevada	4.760	37.949	26.672	3.963	26.6	61.0	23.5
New Hampshire	4.486	37.236	13.458	4.146	27.8	73.2	23.5
New Jersey	4.800	39.269	21.943	4.958	24.0	67.4	22.8
New Mexico	11.882	45.480	49.862	3.062	27.2	69.6	30.8
New York	9.278	48.192	32.227	4.636	20.8	55.6	28.4
North Carolina	9.741	46.423	37.488	3.363	37.5	68.4	30.2
North Dakota	7.070	36.647	18.924	3.605	42.6	66.5	32.4
Ohio	9.346	41.421	27.085	3.432	30.8	70.0	27.2
Oklahoma	11.664	45.564	45.634	3.494	33.6	68.3	29.7
Oregon	11.747	39.297	31.885	3.515	28.2	64.7	26.3
Pennsylvania	9.065	44.165	25.994	3.846	28.3	71.7	28.9
Rhode Island	7.234	45.298	27.772	3.974	22.7	63.3	25.8
South Carolina	12.325	47.228	42.562	3.095	39.3	70.3	30.6
South Dakota	7.559	35.832	28.238	3.568	40.1	69.1	30.2
Tennessee	14.011	49.346	38.682	3.325	40.3	70.1	32.5
Texas	10.161	47.906	46.668	3.707	26.9	65.2	29.9
Utah	4.635	36.502	20.337	2.987	32.8	71.9	21.7
Vermont	8.037	41.086	21.605	3.748	21.5	72.2	27.9
Virginia	6.672	39.109	23.500	4.159	30.7	69.7	24.0
Washington	8.296	35.067	27.047	4.108	28.0	65.6	23.3
West Virginia	14.871	53.001	42.869	2.935	28.3	74.9	33.8
Wisconsin	6.833	37.527	24.046	3.624	30.6	70.3	27.0
Wyoming	4.319	33.658	20.555	4.701	30.3	70.0	24.9

Table A.15. Values for 2008 Predictors

	Values for 2008 Predictors						
	SNAP prevalence rate	Elderly combined poverty rate	Free lunch rate	Per-capita personal income	Foreign-born recent arrival rate	Owner-occupied housing rate	Elderly 200 percent of poverty rate
Alabama	12.220	52.387	41.319	3.266	42.1	71.3	38.8
Alaska	8.280	30.692	32.142	3.409	28.3	64.1	21.6
Arizona	9.657	47.305	33.341	3.332	32.4	68.3	28.8
Arkansas	13.149	52.382	43.400	3.130	36.2	67.8	41.1
California	6.063	46.270	39.345	4.255	22.0	57.8	30.1
Colorado	5.125	37.860	24.952	4.175	32.6	68.3	28.6
Connecticut	6.434	37.948	21.797	5.458	27.4	69.6	24.8
Delaware	8.494	36.782	31.830	3.918	34.7	73.5	26.6
District of Columbia	15.158	47.752	52.737	6.435	36.3	44.6	31.4
Florida	7.897	47.744	36.761	3.791	28.1	70.3	31.8
Georgia	10.530	49.531	41.011	3.382	37.0	67.8	35.6
Hawaii	7.499	40.330	25.420	3.549	24.9	58.9	22.3
Idaho	6.560	43.064	27.709	3.202	31.0	71.3	32.9
Illinois	10.118	41.517	33.142	4.128	25.4	69.8	30.7
Indiana	9.700	42.803	29.908	3.352	37.9	72.0	31.8
Iowa	8.543	38.205	26.415	3.640	36.8	73.4	33.0
Kansas	6.705	38.323	31.954	3.774	35.2	69.9	30.4
Kentucky	14.767	53.036	42.098	3.099	46.7	70.4	41.6
Louisiana	14.888	53.551	50.556	3.502	32.3	68.3	40.8
Maine	13.112	46.928	28.340	3.529	24.0	72.8	37.0
Maryland	6.362	38.638	22.981	4.674	33.6	69.4	24.9
Massachusetts	7.729	42.009	23.412	4.939	29.9	64.9	30.1
Michigan	12.561	40.668	31.089	3.392	29.8	74.7	31.1
Minnesota	5.619	36.897	24.283	4.168	36.5	75.3	30.0
Mississippi	15.209	57.061	53.646	2.948	44.7	70.8	45.9
Missouri	11.774	44.869	30.338	3.528	36.1	70.5	34.3
Montana	8.306	40.492	25.275	3.360	27.3	69.5	34.6
Nebraska	6.778	39.543	30.339	3.802	35.1	68.7	33.3
Nevada	5.524	40.174	29.558	3.972	29.0	60.5	28.1
New Hampshire	4.810	39.091	14.234	4.214	27.9	72.9	28.0
New Jersey	5.054	40.567	22.712	4.995	26.7	67.3	26.2
New Mexico	12.078	46.894	49.185	3.240	28.6	69.4	36.4
New York	10.032	49.410	37.917	4.736	23.3	55.6	33.0
North Carolina	10.241	47.923	37.439	3.421	39.9	68.1	36.2
North Dakota	7.548	37.417	19.290	3.869	43.3	66.3	38.6
Ohio	9.984	43.554	28.333	3.483	32.7	69.6	32.4
Oklahoma	11.499	46.701	46.057	3.490	34.8	68.1	35.5
Oregon	12.398	41.686	35.966	3.529	29.9	64.4	31.7
Pennsylvania	9.452	45.814	25.777	3.859	30.5	71.4	34.1
Rhode Island	8.056	46.983	31.775	4.004	24.3	62.8	32.8
South Carolina	13.096	48.660	43.031	3.153	39.4	70.3	36.8
South Dakota	7.824	37.313	27.971	3.750	36.5	69.0	36.1
Tennessee	14.602	50.995	39.523	3.380	41.6	70.0	38.1
Texas	10.350	48.481	47.471	3.669	29.1	65.1	35.3
Utah	4.920	38.637	20.321	3.110	35.4	72.1	25.6
Vermont	8.992	42.501	22.943	3.755	26.2	72.4	31.9
Virginia	6.992	40.563	23.917	4.277	33.4	69.3	28.3
Washington	8.811	36.976	26.829	4.148	29.8	65.6	26.6
West Virginia	15.252	54.386	44.115	3.070	32.5	74.4	40.0
Wisconsin	7.492	39.798	25.229	3.665	32.5	70.3	32.0
Wyoming	4.242	35.361	20.908	4.714	34.3	69.8	29.7

Table A.16. Values for 2009 Predictors

	Values for 2009 Predictors						
	SNAP prevalence rate	Elderly combined poverty rate	Free lunch rate	Per-capita personal income	Foreign-born recent arrival rate	Owner-occupied housing rate	Elderly 200 percent of poverty rate
Alabama	14.423	53.505	42.578	3.143	44.9	70.3	38.1
Alaska	9.218	33.297	31.845	3.257	31.4	64.0	20.4
Arizona	12.341	49.564	34.644	3.132	33.6	67.6	28.9
Arkansas	14.229	53.628	44.590	3.054	37.0	67.1	40.3
California	7.225	47.690	42.507	4.008	23.8	57.1	29.9
Colorado	6.351	39.772	25.390	3.941	34.4	67.7	27.9
Connecticut	7.338	39.458	22.501	5.187	30.8	69.2	24.2
Delaware	10.273	38.633	36.798	3.763	39.7	73.1	25.5
District of Columbia	17.228	47.507	49.605	6.407	38.3	44.9	31.1
Florida	10.532	49.631	38.479	3.664	30.4	69.3	31.9
Georgia	13.084	50.494	41.766	3.201	39.5	67.3	35.4
Hawaii	8.848	40.926	28.341	3.446	26.0	57.9	21.7
Idaho	8.814	45.070	28.368	2.983	33.0	71.1	32.6
Illinois	11.274	43.401	34.384	3.948	27.3	68.8	30.2
Indiana	10.904	44.334	32.105	3.195	41.1	71.1	31.6
Iowa	9.811	39.773	27.460	3.544	39.3	72.8	32.3
Kansas	7.779	39.788	33.628	3.699	38.7	68.9	30.3
Kentucky	16.267	54.068	48.481	3.043	50.6	69.5	40.5
Louisiana	16.072	54.243	51.968	3.535	35.4	68.0	40.1
Maine	15.266	48.623	30.255	3.437	26.8	72.8	36.1
Maryland	7.969	39.688	24.150	4.548	35.4	69.2	24.2
Massachusetts	9.519	43.316	24.711	4.677	32.1	64.7	29.4
Michigan	14.547	42.411	33.458	3.234	33.1	73.9	30.8
Minnesota	6.547	38.683	25.406	3.943	40.0	74.2	29.5
Mississippi	17.138	57.897	54.270	2.866	47.9	70.1	45.7
Missouri	13.376	46.391	32.451	3.386	39.8	69.7	33.4
Montana	9.482	42.877	25.717	3.278	27.8	68.5	33.2
Nebraska	7.437	41.488	26.317	3.700	39.9	67.9	32.6
Nevada	7.569	42.087	30.701	3.551	31.0	59.6	28.3
New Hampshire	5.960	40.920	15.052	4.012	30.4	72.8	26.3
New Jersey	5.740	42.148	24.267	4.711	29.5	66.7	26.0
New Mexico	14.484	48.080	49.685	3.129	29.5	69.2	35.9
New York	11.886	50.508	38.026	4.377	25.9	55.4	32.7
North Carolina	12.124	49.379	38.154	3.271	42.3	67.7	35.6
North Dakota	8.204	38.815	19.632	3.837	46.1	66.0	37.6
Ohio	11.760	45.216	30.454	3.353	35.1	68.9	31.9
Oklahoma	12.826	48.481	46.874	3.376	37.7	67.4	34.8
Oregon	15.188	43.747	34.576	3.403	32.1	63.9	31.3
Pennsylvania	10.613	47.517	26.440	3.783	33.4	70.9	33.4
Rhode Island	9.713	48.248	31.333	3.893	25.8	63.0	31.9
South Carolina	15.073	50.046	43.784	3.046	43.3	70.1	36.3
South Dakota	9.107	38.863	28.843	3.599	36.2	68.2	34.7
Tennessee	17.027	52.194	41.215	3.226	42.8	69.5	37.4
Texas	12.059	49.983	55.661	3.631	31.6	64.2	34.9
Utah	6.654	40.476	23.088	2.978	37.7	71.8	25.4
Vermont	11.600	44.133	24.901	3.676	26.0	71.7	31.6
Virginia	8.268	41.613	25.183	4.157	36.0	68.5	27.6
Washington	11.423	38.504	28.066	4.045	32.3	65.1	26.0
West Virginia	16.813	54.898	45.749	3.021	37.0	73.9	40.4
Wisconsin	9.689	42.040	26.954	3.523	34.9	69.4	31.5
Wyoming	4.917	37.123	20.963	4.539	36.9	69.8	30.2

Table A.17. Regression Estimates of SNAP Participation Rates

	Regression Estimates of SNAP Participation Rates (Percent)					
	All Eligible People			Working Poor		
	2007	2008	2009	2007	2008	2009
Alabama	66.971	69.231	73.544	57.997	58.711	63.018
Alaska	83.306	81.986	75.749	73.409	75.441	67.026
Arizona	64.301	68.853	72.285	50.947	57.099	60.287
Arkansas	77.534	76.237	72.965	72.254	68.599	68.120
California	45.330	47.674	47.792	30.896	30.364	32.675
Colorado	60.313	59.830	62.902	50.324	48.749	52.044
Connecticut	66.595	68.229	72.705	44.661	47.558	51.211
Delaware	74.650	73.916	76.247	62.942	64.764	63.241
District of Columbia	75.566	74.092	84.310	33.264	29.359	41.771
Florida	53.536	57.726	66.191	46.457	46.756	55.130
Georgia	61.881	64.506	71.084	53.077	53.387	61.396
Hawaii	68.545	72.212	66.093	53.624	58.318	52.179
Idaho	60.544	63.549	67.648	61.735	60.430	66.267
Illinois	80.873	80.918	79.891	71.438	71.317	71.702
Indiana	74.809	75.889	73.638	66.174	68.623	66.002
Iowa	77.595	78.196	78.908	75.513	73.804	74.925
Kansas	64.150	62.798	64.690	57.988	54.832	55.882
Kentucky	76.955	81.020	76.526	69.080	70.883	65.470
Louisiana	81.092	79.783	78.904	73.700	69.576	70.227
Maine	94.680	98.816	96.440	94.269	95.663	96.155
Maryland	60.291	64.850	71.546	41.203	47.243	52.287
Massachusetts	64.058	70.316	74.538	47.213	51.339	57.287
Michigan	98.799	97.297	95.559	92.001	94.027	93.075
Minnesota	64.005	63.408	67.052	58.354	55.391	58.056
Mississippi	69.997	71.819	75.388	65.539	63.443	69.234
Missouri	84.378	85.677	82.800	75.866	77.200	74.283
Montana	79.165	80.187	75.795	82.832	79.074	76.669
Nebraska	63.995	63.717	64.472	59.388	56.289	56.498
Nevada	53.436	56.959	59.259	42.134	43.385	48.673
New Hampshire	63.048	67.382	68.372	55.676	58.640	58.609
New Jersey	55.804	58.106	60.064	40.083	39.469	41.566
New Mexico	76.159	74.475	80.645	74.056	69.579	78.843
New York	62.263	66.189	67.679	45.682	43.552	49.555
North Carolina	63.283	66.475	69.372	54.834	55.809	59.329
North Dakota	67.215	76.834	73.231	66.636	70.359	68.920
Ohio	77.093	79.957	78.515	70.190	72.457	71.727
Oklahoma	72.787	70.178	70.697	62.659	60.597	61.169
Oregon	90.684	90.323	92.063	79.331	81.508	85.186
Pennsylvania	73.154	77.055	75.523	67.415	68.151	66.992
Rhode Island	59.834	64.602	66.462	48.668	51.651	55.753
South Carolina	74.794	78.235	79.701	65.189	69.914	71.415
South Dakota	68.362	74.493	75.685	65.964	70.319	74.662
Tennessee	82.740	85.420	87.753	71.635	73.899	77.903
Texas	62.040	62.422	62.114	53.405	51.089	50.796
Utah	60.875	61.851	62.655	54.657	56.681	55.502
Vermont	77.336	82.510	86.822	76.879	77.004	83.905
Virginia	65.224	67.173	69.687	52.236	53.352	54.912
Washington	78.248	80.676	84.962	64.431	68.332	72.479
West Virginia	88.576	86.993	85.911	86.961	81.361	82.400
Wisconsin	69.138	72.743	75.298	65.810	66.853	69.888
Wyoming	59.536	59.649	64.070	50.651	47.316	53.181

Table A.18. Standard Errors of Regression Estimates of SNAP Participation Rates

	Standard Errors of Regression Estimates of SNAP Participation Rates					
	All Eligible People			Working Poor		
	2007	2008	2009	2007	2008	2009
Alabama	4.924	4.820	4.813	5.890	5.746	5.747
Alaska	5.701	6.010	5.623	7.023	7.599	7.047
Arizona	4.993	4.975	5.023	5.937	5.959	5.989
Arkansas	4.715	4.716	4.709	5.595	5.582	5.593
California	5.049	5.052	5.058	5.966	5.963	6.006
Colorado	4.599	4.630	4.592	5.373	5.435	5.381
Connecticut	5.404	5.273	5.199	6.504	6.293	6.334
Delaware	4.943	5.009	5.141	5.962	6.063	6.336
District of Columbia	6.553	6.763	6.698	8.187	8.021	8.398
Florida	4.786	4.859	4.743	5.669	5.746	5.605
Georgia	4.610	4.607	4.558	5.426	5.423	5.354
Hawaii	5.548	5.609	5.347	6.668	6.813	6.471
Idaho	4.760	4.704	4.664	5.612	5.513	5.502
Illinois	4.842	4.814	4.730	5.822	5.777	5.694
Indiana	4.633	4.592	4.579	5.453	5.408	5.383
Iowa	4.747	4.754	4.771	5.580	5.608	5.625
Kansas	4.658	4.724	4.744	5.447	5.588	5.609
Kentucky	4.930	5.054	5.024	5.877	6.056	6.051
Louisiana	4.929	4.850	4.806	5.920	5.793	5.747
Maine	5.322	5.485	5.347	6.693	6.894	6.747
Maryland	4.924	4.866	4.880	5.868	5.768	5.853
Massachusetts	4.731	4.786	4.701	5.613	5.685	5.606
Michigan	5.184	5.123	5.039	6.387	6.298	6.230
Minnesota	4.948	4.918	4.853	5.837	5.819	5.775
Mississippi	5.105	5.109	5.097	6.145	6.131	6.145
Missouri	4.649	4.638	4.569	5.512	5.498	5.390
Montana	5.180	5.073	4.989	6.275	6.133	6.028
Nebraska	4.758	4.762	4.800	5.571	5.616	5.657
Nevada	4.827	4.851	4.896	5.676	5.724	5.794
New Hampshire	4.914	4.906	4.920	5.882	5.855	5.904
New Jersey	4.875	4.894	4.895	5.776	5.794	5.867
New Mexico	5.242	5.066	5.058	6.339	6.126	6.204
New York	5.064	5.001	4.949	6.167	5.946	5.936
North Carolina	4.633	4.641	4.623	5.465	5.473	5.458
North Dakota	6.205	6.407	6.215	7.690	7.950	7.520
Ohio	4.547	4.559	4.507	5.358	5.380	5.300
Oklahoma	4.697	4.664	4.571	5.570	5.521	5.386
Oregon	5.030	5.006	5.068	6.097	6.069	6.213
Pennsylvania	4.688	4.711	4.686	5.618	5.631	5.605
Rhode Island	4.772	4.754	4.728	5.671	5.627	5.627
South Carolina	4.727	4.634	4.653	5.590	5.471	5.506
South Dakota	5.413	5.348	5.354	6.445	6.440	6.391
Tennessee	4.896	4.836	4.783	5.835	5.758	5.714
Texas	4.786	4.756	4.966	5.659	5.623	5.970
Utah	5.056	5.120	5.005	6.044	6.154	5.991
Vermont	5.008	4.822	4.983	6.139	5.805	6.133
Virginia	4.590	4.590	4.585	5.383	5.385	5.402
Washington	4.782	4.751	4.819	5.707	5.661	5.806
West Virginia	5.205	5.068	4.911	6.371	6.135	5.932
Wisconsin	4.635	4.596	4.561	5.431	5.399	5.349
Wyoming	5.034	5.018	5.114	5.936	5.973	6.114

Table A.19. Preliminary Shrinkage Estimates of SNAP Participation Rates

	Preliminary Shrinkage Estimates of SNAP Participation Rates (Percent)					
	All Eligible People			Working Poor		
	2007	2008	2009	2007	2008	2009
Alabama	66.455	68.849	72.561	60.647	60.851	64.709
Alaska	80.081	78.599	72.485	75.540	77.534	69.137
Arizona	61.503	65.675	69.055	51.535	58.131	60.587
Arkansas	76.472	75.298	71.688	73.535	69.997	69.401
California	49.917	51.612	52.286	33.445	32.140	34.906
Colorado	58.989	58.238	60.858	46.964	44.959	46.700
Connecticut	67.038	68.461	73.542	47.084	49.459	53.898
Delaware	72.901	72.116	74.805	63.651	65.555	64.387
District of Columbia	75.564	74.505	84.135	32.200	28.702	40.341
Florida	54.979	59.546	67.682	43.323	43.950	51.758
Georgia	63.294	66.154	72.22	56.635	56.870	64.573
Hawaii	67.985	71.252	65.089	51.734	55.481	49.951
Idaho	61.283	64.221	68.427	62.461	61.438	67.207
Illinois	84.970	85.11	83.289	67.156	67.359	66.673
Indiana	71.499	72.273	69.851	70.809	71.980	70.436
Iowa	82.566	83.669	83.901	78.756	76.943	77.848
Kansas	61.240	59.996	61.876	51.915	48.783	50.167
Kentucky	79.807	83.668	79.635	67.413	68.278	63.474
Louisiana	77.174	75.198	75.162	72.224	67.008	68.535
Maine	97.891	102.004	99.767	95.152	96.194	96.867
Maryland	57.230	61.568	68.234	43.116	47.998	54.103
Massachusetts	62.703	69.046	73.511	43.604	48.398	54.607
Michigan	96.209	94.612	92.614	91.850	93.613	92.346
Minnesota	64.773	64.216	67.57	53.292	50.264	52.893
Mississippi	64.777	66.652	69.827	62.753	60.840	66.632
Missouri	87.762	89.397	86.376	74.719	77.110	72.937
Montana	77.918	79.189	74.56	83.401	80.023	77.402
Nebraska	68.123	67.549	68.579	62.610	59.064	59.470
Nevada	53.811	57.629	59.894	40.661	42.557	47.783
New Hampshire	65.996	70.541	71.212	54.967	58.378	57.764
New Jersey	52.785	55.107	57.205	43.344	42.558	44.837
New Mexico	74.955	73.282	79.38	75.209	70.592	79.869
New York	61.029	65.139	66.868	51.631	49.582	56.146
North Carolina	63.245	66.613	69.612	58.280	59.937	62.672
North Dakota	68.354	77.884	74.327	65.500	69.418	67.816
Ohio	74.958	77.724	76.966	67.709	70.690	70.336
Oklahoma	75.041	72.99	73.485	63.271	61.432	62.313
Oregon	94.680	94.552	96.406	81.249	83.224	87.167
Pennsylvania	78.907	82.466	81.176	70.820	70.962	70.492
Rhode Island	60.361	65.129	66.529	42.573	44.869	49.007
South Carolina	76.053	79.167	81.001	62.331	68.100	69.757
South Dakota	69.074	74.858	76.153	69.033	72.090	77.081
Tennessee	82.098	84.368	87.273	65.258	67.586	71.742
Texas	59.805	60.365	60.233	50.674	49.151	48.558
Utah	58.703	60.73	61.318	51.618	54.329	52.780
Vermont	79.107	84.448	88.541	76.861	77.410	83.810
Virginia	64.532	66.321	68.903	54.811	55.907	57.693
Washington	82.645	85.169	89.378	62.202	66.868	70.704
West Virginia	86.683	85.389	84.131	91.760	86.603	87.555
Wisconsin	68.049	71.335	74.489	68.831	69.631	73.443
Wyoming	53.565	53.554	58.136	51.210	48.720	54.209

Table A.20. Final Shrinkage Estimates of SNAP Participation Rates

	Final Shrinkage Estimates of SNAP Participation Rates (Percent)					
	All Eligible People			Working Poor		
	2007	2008	2009	2007	2008	2009
Alabama	67.710	70.266	74.208	61.866	62.513	66.325
Alaska	81.595	80.217	74.131	77.058	79.652	70.862
Arizona	62.664	67.027	70.623	52.570	59.719	62.099
Arkansas	77.917	76.848	73.316	75.013	71.909	71.133
California	50.860	52.675	53.473	34.117	33.018	35.777
Colorado	60.104	59.436	62.240	47.908	46.187	47.866
Connecticut	68.305	69.870	75.211	48.031	50.810	55.243
Delaware	74.278	73.600	76.504	64.931	67.346	65.995
District of Columbia	76.991	76.039	86.045	32.848	29.486	41.348
Florida	56.017	60.772	69.219	44.194	45.151	53.051
Georgia	64.490	67.516	73.860	57.773	58.424	66.185
Hawaii	69.269	72.719	66.566	52.774	56.997	51.198
Idaho	62.441	65.543	69.981	63.717	63.116	68.885
Illinois	86.576	86.862	85.180	68.505	69.199	68.337
Indiana	72.849	73.761	71.437	72.232	73.946	72.195
Iowa	84.126	85.391	85.806	80.339	79.045	79.792
Kansas	62.397	61.231	63.281	52.959	50.115	51.419
Kentucky	81.315	85.391	81.443	68.768	70.143	65.059
Louisiana	78.632	76.746	76.868	73.676	68.839	70.246
Maine	99.741	100.000	100.000	97.064	98.822	99.285
Maryland	58.311	62.835	69.783	43.983	49.309	55.454
Massachusetts	63.887	70.468	75.180	44.480	49.720	55.970
Michigan	98.026	96.560	94.717	93.696	96.171	94.651
Minnesota	65.996	65.538	69.104	54.363	51.637	54.213
Mississippi	66.001	68.024	71.413	64.014	62.502	68.296
Missouri	89.419	91.237	88.337	76.221	79.217	74.758
Montana	79.390	80.819	76.254	85.077	82.209	79.334
Nebraska	69.410	68.939	70.136	63.869	60.678	60.955
Nevada	54.828	58.816	61.254	41.479	43.719	48.976
New Hampshire	67.243	71.993	72.830	56.072	59.973	59.206
New Jersey	53.783	56.242	58.504	44.215	43.720	45.956
New Mexico	76.371	74.791	81.182	76.721	72.520	81.863
New York	62.182	66.480	68.386	52.669	50.937	57.547
North Carolina	64.440	67.984	71.193	59.452	61.574	64.236
North Dakota	69.646	79.487	76.015	66.816	71.315	69.509
Ohio	76.374	79.324	78.713	69.070	72.621	72.092
Oklahoma	76.458	74.492	75.154	64.543	63.110	63.869
Oregon	96.469	96.499	98.595	82.882	85.497	89.343
Pennsylvania	80.398	84.164	83.020	72.244	72.900	72.252
Rhode Island	61.501	66.470	68.040	43.429	46.095	50.230
South Carolina	77.490	80.797	82.841	63.583	69.960	71.498
South Dakota	70.379	76.399	77.882	70.421	74.059	79.006
Tennessee	83.649	86.104	89.254	66.570	69.433	73.533
Texas	60.935	61.608	61.601	51.692	50.494	49.770
Utah	59.812	61.980	62.710	52.656	55.813	54.098
Vermont	80.601	86.187	90.552	78.406	79.524	85.902
Virginia	65.751	67.686	70.468	55.913	57.434	59.133
Washington	84.206	86.922	91.408	63.452	68.695	72.469
West Virginia	88.320	87.147	86.041	93.604	88.969	89.741
Wisconsin	69.334	72.803	76.180	70.215	71.533	75.277
Wyoming	54.577	54.656	59.456	52.240	50.051	55.563

Table A.21. Standard Errors of Final Shrinkage Estimates of SNAP Participation Rates

	Standard Errors of Final Shrinkage Estimates of SNAP Participation Rates					
	All Eligible People			Working Poor		
	2007	2008	2009	2007	2008	2009
Alabama	3.157	3.173	3.045	4.322	4.179	4.181
Alaska	4.216	4.390	3.726	5.762	6.347	5.587
Arizona	2.992	2.806	3.048	3.861	4.047	4.054
Arkansas	3.416	3.509	3.425	4.214	4.334	4.099
California	1.367	1.407	1.305	1.875	1.792	1.830
Colorado	2.988	2.886	2.775	3.584	3.412	2.940
Connecticut	3.699	3.412	3.453	4.680	4.275	4.618
Delaware	3.255	3.385	3.369	4.418	4.504	4.641
District of Columbia	3.796	4.163	3.907	5.406	4.936	5.592
Florida	2.147	2.400	2.101	2.798	3.039	2.879
Georgia	2.381	2.448	2.425	3.119	3.351	3.217
Hawaii	3.851	3.764	3.247	4.501	4.453	3.792
Idaho	3.878	3.842	3.824	4.305	4.130	4.022
Illinois	2.958	2.930	2.632	3.841	3.770	3.629
Indiana	3.093	3.021	2.952	4.119	3.959	4.057
Iowa	3.805	3.752	3.894	4.922	4.909	4.987
Kansas	3.076	3.249	3.247	3.272	3.531	3.461
Kentucky	3.403	3.683	3.626	4.381	4.512	4.316
Louisiana	3.191	2.904	3.292	4.361	3.892	4.303
Maine	4.071	4.305	4.133	5.645	5.734	5.673
Maryland	2.874	2.724	2.832	3.649	3.388	3.865
Massachusetts	2.851	3.185	3.120	3.734	4.100	4.176
Michigan	3.385	3.382	3.143	4.941	4.825	4.762
Minnesota	3.260	3.307	3.128	3.974	4.289	4.225
Mississippi	3.275	2.749	2.737	4.560	3.894	4.069
Missouri	3.301	3.326	3.193	4.102	4.265	3.976
Montana	4.315	4.225	4.077	5.112	5.355	5.221
Nebraska	3.700	3.626	3.567	4.265	4.314	4.175
Nevada	2.816	2.956	2.963	3.106	3.517	3.608
New Hampshire	3.578	3.637	3.534	4.510	4.606	4.410
New Jersey	2.787	2.922	2.879	3.623	3.696	3.830
New Mexico	3.766	3.654	3.596	4.700	4.713	4.849
New York	1.880	2.008	1.984	3.265	3.175	3.329
North Carolina	2.511	2.616	2.544	3.464	3.526	3.598
North Dakota	4.899	5.493	5.308	6.465	6.993	6.284
Ohio	2.665	2.657	2.632	3.329	3.532	3.472
Oklahoma	3.348	3.197	3.253	3.756	3.727	3.726
Oregon	3.900	3.977	4.006	5.411	5.442	5.428
Pennsylvania	3.062	3.106	3.070	4.465	4.445	4.483
Rhode Island	2.909	3.040	2.736	3.830	3.693	3.545
South Carolina	2.839	2.854	2.836	3.517	3.960	3.995
South Dakota	4.830	4.734	4.764	5.095	5.085	4.997
Tennessee	3.607	3.413	3.539	4.101	4.016	3.964
Texas	1.916	1.911	1.883	2.397	2.329	2.436
Utah	2.853	3.483	3.276	3.732	4.573	4.041
Vermont	3.783	3.636	3.687	5.082	4.873	5.022
Virginia	3.576	3.550	3.500	4.040	4.068	3.957
Washington	3.603	3.633	3.711	4.521	4.674	4.757
West Virginia	3.795	3.804	3.583	5.562	5.694	5.413
Wisconsin	3.175	3.111	3.117	3.989	4.073	4.001
Wyoming	3.533	3.262	3.228	4.237	4.156	4.355

Table A.22. Final Shrinkage Estimates of Number of People Eligible for SNAP

	Final Shrinkage Estimates of Number of People Eligible for SNAP		
	2007	2008	2009
Alabama	791,292	803,317	896,637
Alaska	67,078	67,993	85,713
Arizona	848,066	881,631	1,079,035
Arkansas	474,612	481,089	546,296
California	3,970,724	4,168,737	4,946,739
Colorado	408,389	420,291	507,842
Connecticut	297,697	308,803	330,868
Delaware	81,448	91,074	110,135
District of Columbia	108,089	113,186	118,546
Florida	2,157,003	2,384,886	2,812,453
Georgia	1,410,765	1,493,232	1,718,840
Hawaii	127,499	130,912	168,921
Idaho	136,330	150,152	191,879
Illinois	1,417,928	1,476,824	1,652,010
Indiana	778,945	820,773	957,116
Iowa	274,337	286,764	335,223
Kansas	289,051	297,365	336,942
Kentucky	726,893	724,367	847,453
Louisiana	799,378	838,174	911,577
Maine	146,748	158,163	185,470
Maryland	506,325	537,097	590,163
Massachusetts	671,944	676,321	768,751
Michigan	1,149,769	1,195,564	1,400,231
Minnesota	405,865	433,493	483,362
Mississippi	638,061	652,696	701,579
Missouri	740,681	754,047	879,151
Montana	97,616	97,551	118,475
Nebraska	171,901	174,021	189,447
Nevada	219,142	240,899	311,088
New Hampshire	84,494	85,868	104,652
New Jersey	758,424	760,790	840,975
New Mexico	298,969	314,232	352,289
New York	2,837,802	2,861,216	3,253,345
North Carolina	1,359,854	1,382,352	1,584,004
North Dakota	61,065	56,754	65,252
Ohio	1,359,620	1,434,920	1,706,672
Oklahoma	532,536	546,317	614,547
Oregon	417,608	435,639	520,616
Pennsylvania	1,385,619	1,394,088	1,549,278
Rhode Island	122,021	125,442	146,278
South Carolina	689,035	714,276	803,999
South Dakota	84,460	81,986	93,612
Tennessee	1,010,106	1,032,658	1,180,921
Texas	3,759,558	3,909,083	4,485,237
Utah	202,617	210,439	285,276
Vermont	58,333	60,878	69,032
Virginia	763,232	787,510	893,546
Washington	622,175	648,907	749,222
West Virginia	295,350	308,925	347,487
Wisconsin	510,533	522,416	640,218
Wyoming	39,755	40,844	43,683

Table A.23. Final Shrinkage Estimates of Number of Working Poor Eligible for SNAP

	Final Shrinkage Estimates of Number of Working Poor Eligible for SNAP		
	2007	2008	2009
Alabama	350,925	350,196	402,999
Alaska	31,280	32,573	41,226
Arizona	456,314	466,752	505,598
Arkansas	216,952	219,965	239,648
California	2,411,317	2,469,352	2,821,535
Colorado	213,434	220,307	264,254
Connecticut	128,279	126,375	133,972
Delaware	37,415	45,355	53,352
District of Columbia	37,178	38,238	29,853
Florida	1,019,834	1,052,464	1,219,764
Georgia	742,011	779,256	836,644
Hawaii	72,973	69,162	93,610
Idaho	71,410	83,512	99,285
Illinois	666,743	721,254	709,687
Indiana	346,635	324,566	420,203
Iowa	148,043	144,513	182,567
Kansas	159,934	172,815	181,478
Kentucky	311,177	251,886	309,583
Louisiana	379,087	390,918	416,712
Maine	57,310	58,115	66,456
Maryland	239,670	224,865	272,686
Massachusetts	199,767	237,317	288,619
Michigan	525,424	537,271	556,168
Minnesota	184,300	214,714	244,356
Mississippi	286,626	283,824	299,431
Missouri	351,058	382,945	402,449
Montana	42,531	40,307	50,258
Nebraska	88,501	98,576	103,640
Nevada	113,488	124,035	148,641
New Hampshire	35,007	36,454	41,769
New Jersey	306,966	294,041	317,817
New Mexico	150,216	166,367	172,752
New York	1,222,067	1,218,992	1,445,617
North Carolina	667,263	658,922	702,105
North Dakota	30,505	30,827	32,560
Ohio	579,505	572,778	698,477
Oklahoma	258,874	256,382	309,715
Oregon	216,291	200,900	233,963
Pennsylvania	544,601	537,449	629,040
Rhode Island	46,111	43,371	59,023
South Carolina	304,835	326,208	335,783
South Dakota	42,290	37,875	45,342
Tennessee	406,829	482,369	554,768
Texas	2,045,411	2,219,044	2,530,062
Utah	115,815	111,328	159,129
Vermont	21,150	28,053	28,609
Virginia	361,672	375,767	434,286
Washington	274,396	287,642	329,753
West Virginia	106,705	115,413	118,796
Wisconsin	245,456	269,074	303,420
Wyoming	19,763	21,555	19,213

Table A.24. Standard Errors of Final Shrinkage Estimates of Number of People Eligible for SNAP

	Standard Errors of Estimates of Number of People Eligible for SNAP		
	2007	2008	2009
Alabama	36,897	36,283	36,797
Alaska	3,466	3,722	4,309
Arizona	40,486	36,915	46,574
Arkansas	20,809	21,973	25,523
California	106,705	111,378	120,774
Colorado	20,302	20,416	22,649
Connecticut	16,122	15,083	15,194
Delaware	3,569	4,190	4,851
District of Columbia	5,329	6,198	5,384
Florida	82,679	94,200	85,382
Georgia	52,084	54,154	56,443
Hawaii	7,087	6,777	8,242
Idaho	8,467	8,805	10,486
Illinois	48,442	49,829	51,057
Indiana	33,076	33,627	39,560
Iowa	12,406	12,603	15,217
Kansas	14,247	15,785	17,291
Kentucky	30,419	31,252	37,732
Louisiana	32,441	31,722	39,040
Maine	5,990	6,285	7,364
Maryland	24,952	23,294	23,952
Massachusetts	29,981	30,573	31,908
Michigan	39,698	41,891	46,469
Minnesota	20,050	21,878	21,882
Mississippi	31,663	26,384	26,891
Missouri	27,344	27,493	31,777
Montana	5,306	5,101	6,335
Nebraska	9,164	9,156	9,638
Nevada	11,257	12,110	15,048
New Hampshire	4,496	4,340	5,079
New Jersey	39,296	39,543	41,393
New Mexico	14,743	15,356	15,608
New York	85,801	86,431	94,419
North Carolina	52,977	53,200	56,610
North Dakota	4,295	3,923	4,557
Ohio	47,434	48,081	57,084
Oklahoma	23,321	23,451	26,604
Oregon	16,884	17,960	21,156
Pennsylvania	52,778	51,466	57,294
Rhode Island	5,771	5,740	5,883
South Carolina	25,242	25,240	27,529
South Dakota	5,796	5,082	5,727
Tennessee	43,551	40,947	46,829
Texas	118,203	121,260	137,132
Utah	9,665	11,829	14,904
Vermont	2,738	2,569	2,811
Virginia	41,507	41,319	44,388
Washington	26,618	27,128	30,420
West Virginia	12,691	13,488	14,471
Wisconsin	23,375	22,330	26,199
Wyoming	2,573	2,439	2,372

Table A.25. Standard Errors of Final Shrinkage Estimates of Number of Working Poor Eligible for SNAP

	Standard Errors of Estimates of Number of Working Poor Eligible for SNAP		
	2007	2008	2009
Alabama	24,517	23,408	25,407
Alaska	2,339	2,595	3,250
Arizona	33,514	31,630	33,006
Arkansas	12,187	13,257	13,811
California	132,512	134,014	144,309
Colorado	15,968	16,274	16,230
Connecticut	12,500	10,632	11,200
Delaware	2,546	3,033	3,752
District of Columbia	6,119	6,400	4,037
Florida	64,578	70,849	66,199
Georgia	40,061	44,691	40,662
Hawaii	6,224	5,403	6,934
Idaho	4,825	5,465	5,797
Illinois	37,385	39,295	37,686
Indiana	19,768	17,377	23,611
Iowa	9,069	8,975	11,410
Kansas	9,880	12,178	12,217
Kentucky	19,825	16,203	20,539
Louisiana	22,440	22,104	25,527
Maine	3,333	3,372	3,797
Maryland	19,885	15,450	19,004
Massachusetts	16,769	19,568	21,536
Michigan	27,710	26,958	27,982
Minnesota	13,473	17,833	19,043
Mississippi	20,419	17,681	17,839
Missouri	18,895	20,618	21,403
Montana	2,555	2,626	3,308
Nebraska	5,910	7,009	7,098
Nevada	8,498	9,977	10,949
New Hampshire	2,816	2,800	3,111
New Jersey	25,154	24,854	26,484
New Mexico	9,202	10,811	10,232
New York	75,755	75,980	83,619
North Carolina	38,881	37,736	39,327
North Dakota	2,952	3,023	2,944
Ohio	27,934	27,855	33,636
Oklahoma	15,063	15,139	18,068
Oregon	14,121	12,787	14,215
Pennsylvania	33,657	32,768	39,030
Rhode Island	4,067	3,475	4,165
South Carolina	16,860	18,467	18,761
South Dakota	3,059	2,600	2,868
Tennessee	25,061	27,897	29,907
Texas	94,831	102,370	123,829
Utah	8,209	9,121	11,886
Vermont	1,371	1,719	1,673
Virginia	26,129	26,617	29,060
Washington	19,552	19,572	21,647
West Virginia	6,340	7,386	7,166
Wisconsin	13,946	15,321	16,127
Wyoming	1,603	1,790	1,506

MATHEMATICA **Policy Research**

www.mathematica-mpr.com

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

Princeton, NJ ■ Ann Arbor, MI ■ Cambridge, MA ■ Chicago, IL ■ Oakland, CA ■ Washington, DC

Mathematica[®] is a registered trademark of Mathematica Policy Research