Empirical Bayes Shrinkage Estimates of State Supplemental Nutrition Assistance Program Participation Rates in 2005-2007 for All Eligible People and the Working Poor

Final Report

June 2010

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EXECUTIVE SUMMARY

The Supplemental Nutrition Assistance Program (SNAP), formerly the Food Stamp Program, 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 2009, the program served 34 million people in an average month at a total annual cost of over $50 billion in benefits. The average monthly program benefit was about $276 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 2005 to 2007. 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 decennial census, 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 not only sample survey data but also census and administrative data. This report describes our shrinkage estimator in detail.

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I. INTRODUCTION

This report presents estimates of the Supplemental Nutrition Assistance Program (SNAP), formerly the Food Stamp Program, participation rate and the number of people eligible for SNAP in each state for the years 2005 to 2007.[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 the 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 Virginia's 2007 SNAP participation rate, we use just 2007 data on households in the CPS from Virginia. Because of the potential errors introduced by the CPS surveying only a small number of families in Virginia rather than all families in the state, though, we can be confident—by a commonly used standard—only that Virginia's SNAP participation rate in 2007 was between about 61 and 78 percent. This range is wide (but typical), reflecting our substantial uncertainty about what Virginia's participation rate actually was.

[1] The estimates presented here are also reported and compared with one another in Cunnyngham and Castner (2009).

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 2007 or what happened in Virginia (and other states) in other years is relevant to estimating what happened in Virginia in 2007. 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 Virginia. Then, the shrinkage estimator optimally averages the direct sample and regression estimates for Virginia to obtain a shrinkage estimate. This contrasts with the direct estimator that ignores systematic patterns across states, using, for example, only Virginia's data to derive an estimate for Virginia, even though conditions may be similar in Delaware or North Carolina. 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 and the decennial census. In all, our estimator used three-year averages of American

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 3 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.

Community Survey (ACS) data, and three years of CPS data, SNAP administrative data, population estimates, and tax return data for all states to obtain estimates for each state in each year (2005 to 2007) 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.

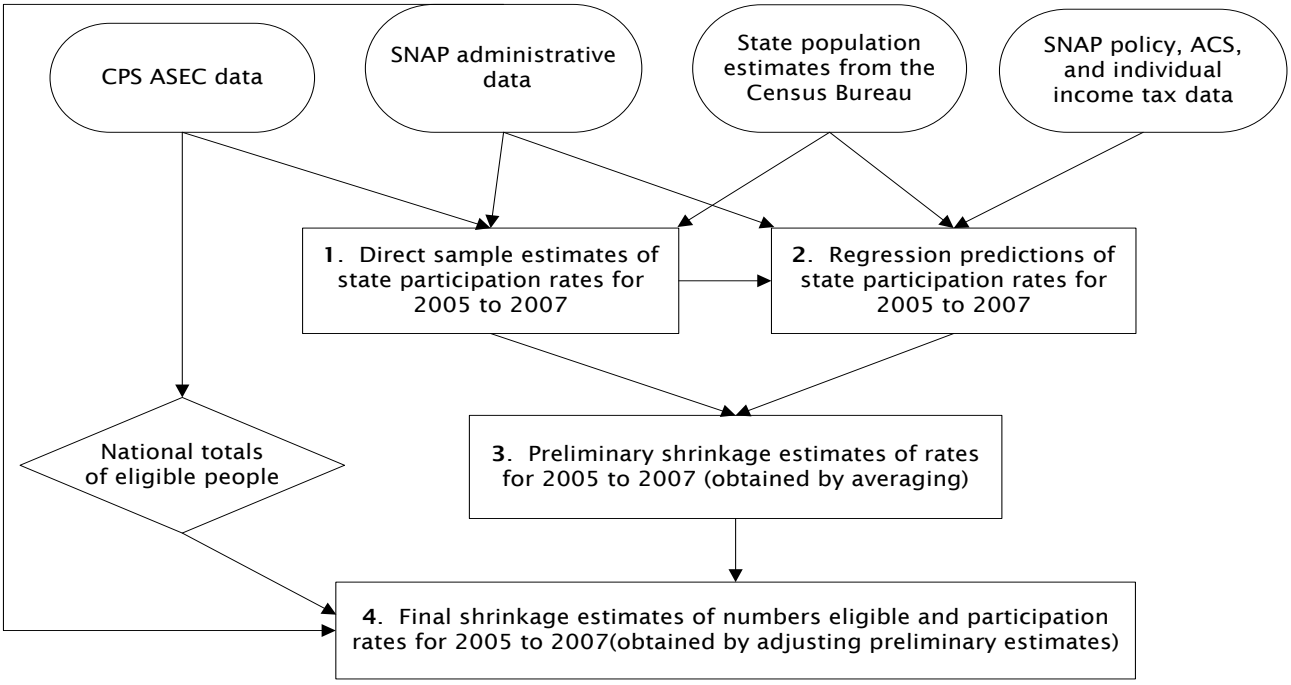
II. A STEP-BY-STEP GUIDE TO DERIVING STATE ESTIMATES

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 2005 to 2007. 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 2005 to 2007.
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 Data and SNAP Administrative Data, Derive Direct Sample Estimates of State SNAP Participation Rates for Each of the Three Years 2005 to 2007

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 data to estimate numbers of eligibles in an average month. Because the CPS collects family income data for the prior calendar year, we obtained estimates of eligibles in 2007, for example, from the 2008 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.

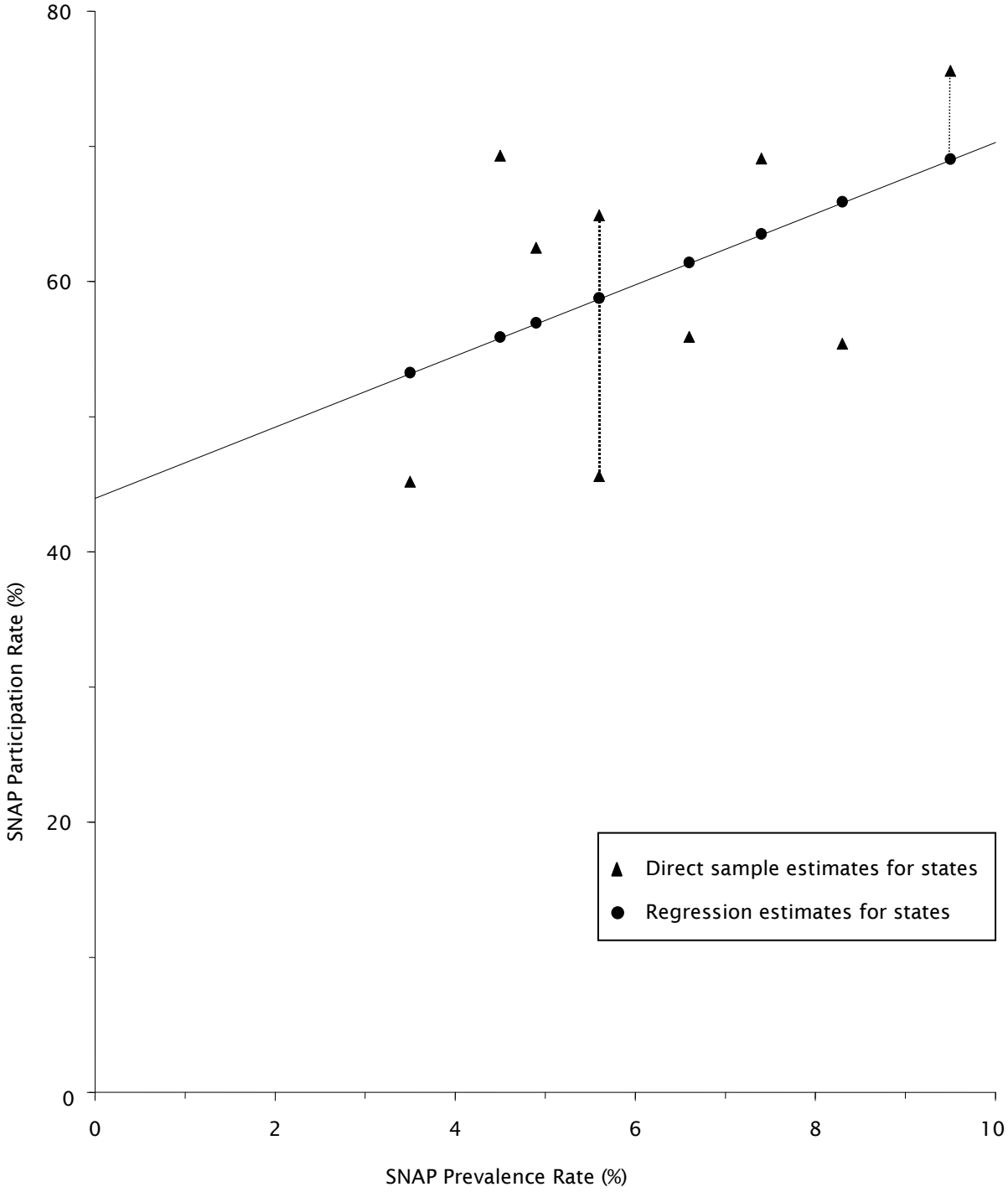
As noted in Chapter I, direct sample estimates of participation rates are relatively imprecise. The standard errors for the estimates, reported in Appendix A along with the estimated rates, tend to be large, so our uncertainty about states' true rates is great. For example, according to commonly used statistical standards, we can be confident only that Virginia's participation rate for all eligible people in 2007 was between 61 percent and 78 percent. This range is so wide and our uncertainty so great because the CPS sample for Virginia 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—Virginia and 2007 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

The main limitation of the sample estimates derived in the previous step is imprecision. Regression can reduce that imprecision. 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

Figure II.2. An Illustrative Regression Estimator



be used to predict each state's SNAP participation rate for eligible people. The SNAP prevalence rate is measured by the percentage of all people (eligible and ineligible combined) who received SNAP benefits, in contrast to the SNAP participation rate, which is measured by the percentage of eligible people who received SNAP benefits. The triangles in the figure correspond to direct sample estimates; a triangle shows the prevalence rate in a state (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 2005 to 2007 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 income-eligible for SNAP and correctly receiving SNAP benefits
- 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

- the percentage of households with a female householder, no husband present, and related children under 18 years according to 2005-2007 ACS three-year estimates
- the percentage of occupied housing units that were owner-occupied according to 2005-2007 ACS three-year estimates
- the percentage of renter-occupied housing units spending 30 percent or more of household income on rent and utilities according to 2005-2007 ACS three-year estimates
- the percentage of individuals under 200 percent of the federal poverty level according to 2005-2007 ACS three-year estimates
- the percentage of adults age 18 to 64 under 125 percent of the federal poverty level according to 2005-2007 ACS three-year estimates

The first two predictors are obtained from administrative data and population estimates and the other five predictors are from ACS 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 sample data from Virginia to estimate Virginia's participation rate in that year, even though Virginia, like nearly all states, has a small CPS 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 Virginia) to predict Virginia'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

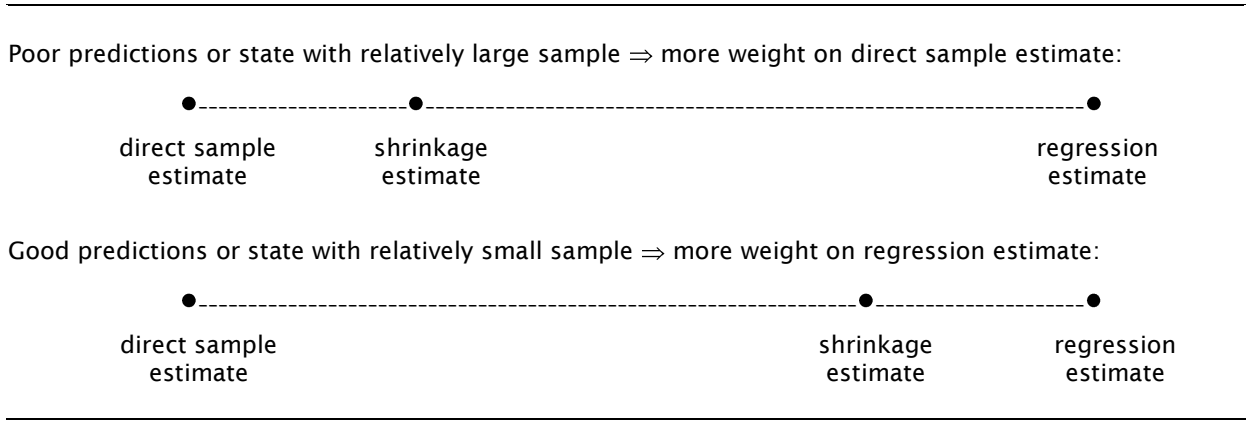
As noted before, the limitation of the direct sample estimator is imprecision. The limitation of the regression estimator is called "bias." Some states really have higher or lower participation rates than we expect (and predict with the regression estimator) based on the SNAP prevalence rate and other 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 census. Although the regression estimator borrows strength, using data from all the states and multiple years as well as administrative and census 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



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. Second, we adjusted the rates so that no state's estimated rate is 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 2007 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 39,290,066 for 2007, while the national total for 2007 estimated directly from the CPS was 38,921,885. 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 38,921,885 ÷ 39,290,066 (≈0.9906). 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 (Missouri) had fewer estimated eligibles than participants in 2007, implying a participation rate over 100 percent.[2] To cap participation rates at 100 percent, we performed a second adjustment. Specifically, we took eligibles away from the 50 states that had enough eligibles (that is, more eligibles than participants) and gave them to the state that did not have enough, stopping when the number of eligibles in that state equaled the number of participants. Eligibles were taken away from states 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 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.

[2] The number of individuals participating in SNAP has been over-reported for several years in Missouri. We hope to receive corrected data for Missouri and revise participant totals for all affected years in next year's report.

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III. STATE ESTIMATES OF SUPPLEMENTAL NUTRITION ASSISTANCE PROGRAM PARTICIPATION RATES AND NUMBER OF ELIGIBLE PEOPLE FOR 2005 TO 2007 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 2005 to 2007 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 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 Virginia's participation rate for all eligible people was 65 percent in 2007 (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 62 and 69 percent, an interval that is 44 percent as wide as the interval (61 to 78 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 50 percent as wide as the corresponding 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 Cunnyngham and Castner (2009), 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.

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

	Final Shrinkage Estimates of SNAP Participation Rates (Percent)					
	All Eligible People			Working Poor		
	2005	2006	2007	2005	2006	2007
Alabama	67	67	65	66	60	62
Alaska	63	71	70	59	61	57
Arizona	67	63	61	58	55	53
Arkansas	79	78	77	75	71	71
California	48	50	48	33	35	33
Colorado	51	53	55	35	41	43
Connecticut	66	71	69	50	54	53
Delaware	62	70	68	56	62	56
District of Columbia	71	80	78	42	42	39
Florida	64	60	57	52	51	48
Georgia	69	70	63	66	62	55
Hawaii	73	75	71	57	56	55
Idaho	56	54	50	53	51	50
Illinois	76	82	83	66	72	71
Indiana	71	76	74	71	75	72
Iowa	65	70	74	60	66	72
Kansas	55	57	57	47	49	49
Kentucky	80	80	83	76	72	81
Louisiana	82	78	74	84	71	68
Maine	90	94	91	88	93	92
Maryland	56	62	59	44	45	44
Massachusetts	54	62	65	35	41	49
Michigan	72	79	89	67	77	84
Minnesota	62	63	66	48	51	56
Mississippi	52	57	60	55	50	54
Missouri	96	100	100	96	100	100
Montana	64	63	64	59	61	63
Nebraska	62	65	64	55	55	56
Nevada	54	58	52	44	47	38
New Hampshire	62	64	66	49	51	58
New Jersey	58	60	59	45	45	47
New Mexico	69	71	67	69	69	63
New York	60	64	61	47	47	48
North Carolina	59	65	63	56	57	57
North Dakota	57	56	62	50	49	59
Ohio	64	69	69	57	61	60
Oklahoma	68	70	69	64	63	62
Oregon	81	81	87	67	72	75
Pennsylvania	72	75	76	66	68	73
Rhode Island	57	57	60	40	34	44
South Carolina	73	78	74	70	67	62
South Dakota	59	63	64	59	61	62
Tennessee	89	91	87	80	78	76
Texas	59	64	55	56	56	47
Utah	58	56	52	52	51	49
Vermont	69	72	73	58	63	67
Virginia	64	68	65	57	57	57
Washington	69	75	76	54	62	61
West Virginia	83	76	85	79	72	93
Wisconsin	58	61	64	54	57	62
Wyoming	54	54	47	57	50	49
United States	65	67	66	56	57	56

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		
	2005	2006	2007	2005	2006	2007
Alabama	783	792	821	312	335	352
Alaska	87	78	79	42	41	43
Arizona	799	820	878	385	476	452
Arkansas	464	472	482	210	226	228
California	4,040	3,970	4,215	2,219	2,244	2,469
Colorado	468	461	446	240	215	238
Connecticut	299	288	295	113	108	116
Delaware	90	85	89	42	43	43
District of Columbia	122	107	107	31	31	32
Florida	1,935	1,966	2,114	882	867	930
Georgia	1,307	1,299	1,438	578	669	786
Hawaii	126	117	124	65	64	70
Idaho	161	166	171	85	89	91
Illinois	1,497	1,457	1,482	661	640	647
Indiana	762	741	769	338	322	346
Iowa	309	313	312	145	156	165
Kansas	315	309	316	145	171	174
Kentucky	701	717	710	263	298	265
Louisiana	859	803	848	381	376	410
Maine	159	159	161	58	61	60
Maryland	492	465	498	191	224	241
Massachusetts	643	670	658	237	226	181
Michigan	1,335	1,307	1,259	638	576	588
Minnesota	398	406	405	181	162	179
Mississippi	735	707	700	302	330	339
Missouri	780	784	812	386	427	421
Montana	123	124	120	60	59	57
Nebraska	186	181	188	76	93	100
Nevada	221	202	232	88	100	125
New Hampshire	82	86	87	36	38	34
New Jersey	663	662	695	261	300	286
New Mexico	343	336	342	173	175	184
New York	2,858	2,742	2,885	1,102	1,296	1,354
North Carolina	1,319	1,305	1,384	538	564	699
North Dakota	71	71	69	38	37	34
Ohio	1,532	1,487	1,500	713	678	666
Oklahoma	597	598	594	284	286	267
Oregon	485	475	465	235	209	238
Pennsylvania	1,412	1,432	1,462	566	575	539
Rhode Island	128	126	125	51	40	46
South Carolina	701	671	723	297	325	311
South Dakota	94	92	93	42	48	48
Tennessee	929	928	966	355	392	356
Texas	3,888	3,801	4,140	2,146	2,087	2,260
Utah	222	228	233	127	122	125
Vermont	62	63	64	27	26	25
Virginia	739	725	768	299	333	356
Washington	730	702	692	346	326	287
West Virginia	310	339	306	118	135	108
Wisconsin	540	541	556	240	262	278
Wyoming	47	44	46	23	23	21
United States	37,951	37,418	38,922	17,370	17,907	18,671

Table III.3. Approximate 90-Percent Confidence Intervals for Final Shrinkage Estimates for 2005, All Eligible People

	Approximate 90-Percent Confidence Intervals for 2005, All Eligible People			
	Participation Rate (Percent)		Number of Eligible People (Thousands)	
	Lower Bound	Upper Bound	Lower Bound	Upper Bound
Alabama	63	70	740	825
Alaska	57	68	79	94
Arizona	63	70	759	839
Arkansas	75	84	438	489
California	46	51	3,852	4,229
Colorado	47	55	432	505
Connecticut	62	70	280	319
Delaware	57	67	83	97
District of Columbia	65	76	112	131
Florida	60	68	1,823	2,047
Georgia	65	72	1,235	1,380
Hawaii	68	78	117	135
Idaho	52	61	149	173
Illinois	72	80	1,423	1,572
Indiana	67	74	723	801
Iowa	62	68	293	324
Kansas	51	59	295	336
Kentucky	76	84	664	739
Louisiana	78	87	811	907
Maine	85	96	149	168
Maryland	51	60	453	531
Massachusetts	50	58	595	691
Michigan	68	76	1,265	1,406
Minnesota	58	66	370	425
Mississippi	46	57	654	816
Missouri	90	100	736	825
Montana	60	69	115	131
Nebraska	58	66	174	198
Nevada	50	59	203	239
New Hampshire	57	66	76	88
New Jersey	55	62	622	704
New Mexico	65	73	325	362
New York	58	63	2,730	2,987
North Carolina	56	63	1,246	1,392
North Dakota	52	61	65	76
Ohio	61	66	1,472	1,592
Oklahoma	64	72	563	630
Oregon	76	86	455	516
Pennsylvania	68	76	1,339	1,486
Rhode Island	54	61	120	136
South Carolina	69	77	663	739
South Dakota	54	63	87	101
Tennessee	84	94	878	980
Texas	56	62	3,691	4,084
Utah	54	62	207	237
Vermont	65	72	58	65
Virginia	60	68	698	781
Washington	64	73	682	777
West Virginia	76	89	287	334
Wisconsin	55	61	510	570
Wyoming	48	59	42	52
United States	64	66	37,337	38,564

Table III.4. Approximate 90-Percent Confidence Intervals for Final Shrinkage Estimates for 2006, All Eligible People

	Approximate 90-Percent Confidence Intervals for 2006, All Eligible People			
	Participation Rate (Percent)		Number of Eligible People (Thousands)	
	Lower Bound	Upper Bound	Lower Bound	Upper Bound
Alabama	63	71	747	838
Alaska	66	76	73	83
Arizona	60	67	777	864
Arkansas	74	82	448	496
California	48	52	3,827	4,119
Colorado	49	57	427	495
Connecticut	66	75	270	306
Delaware	65	74	80	91
District of Columbia	73	86	98	116
Florida	57	64	1,851	2,084
Georgia	67	73	1,240	1,361
Hawaii	70	79	109	124
Idaho	49	58	153	180
Illinois	78	86	1,391	1,525
Indiana	72	79	704	779
Iowa	66	74	296	329
Kansas	54	61	289	329
Kentucky	76	84	682	753
Louisiana	73	82	760	848
Maine	89	99	150	168
Maryland	57	66	431	500
Massachusetts	58	65	628	713
Michigan	75	83	1,248	1,368
Minnesota	59	67	379	433
Mississippi	52	63	641	775
Missouri	95	100	715	793
Montana	59	67	115	133
Nebraska	61	69	170	192
Nevada	53	62	185	219
New Hampshire	59	68	81	92
New Jersey	56	64	620	705
New Mexico	67	74	320	354
New York	61	67	2,607	2,883
North Carolina	62	68	1,239	1,373
North Dakota	52	61	66	77
Ohio	66	72	1,422	1,554
Oklahoma	67	74	573	625
Oregon	76	86	445	505
Pennsylvania	71	78	1,368	1,498
Rhode Island	53	60	119	134
South Carolina	73	82	636	707
South Dakota	59	67	85	98
Tennessee	86	95	883	974
Texas	61	67	3,627	3,982
Utah	52	60	213	244
Vermont	68	75	59	66
Virginia	64	72	685	767
Washington	70	79	660	745
West Virginia	70	81	316	363
Wisconsin	58	65	509	573
Wyoming	48	59	40	49
United States	66	69	36,844	37,991

Table III.5. 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	61	69	771	872
Alaska	64	75	72	85
Arizona	57	64	826	931
Arkansas	72	81	454	510
California	46	50	4,009	4,426
Colorado	51	59	411	481
Connecticut	65	73	277	314
Delaware	63	73	82	95
District of Columbia	72	84	99	116
Florida	53	61	1,960	2,270
Georgia	60	67	1,356	1,521
Hawaii	67	76	116	132
Idaho	45	54	156	187
Illinois	79	86	1,418	1,548
Indiana	70	77	731	807
Iowa	70	78	296	329
Kansas	54	60	298	333
Kentucky	79	88	672	748
Louisiana	70	78	803	893
Maine	86	96	152	171
Maryland	55	64	462	534
Massachusetts	61	70	615	702
Michigan	84	95	1,188	1,333
Minnesota	62	70	382	429
Mississippi	57	63	663	739
Missouri	94	100	736	831
Montana	60	69	112	129
Nebraska	59	69	174	202
Nevada	47	56	212	253
New Hampshire	63	69	83	91
New Jersey	55	63	650	741
New Mexico	63	71	321	363
New York	59	64	2,765	3,010
North Carolina	60	66	1,314	1,455
North Dakota	57	66	64	74
Ohio	66	72	1,440	1,562
Oklahoma	65	72	562	627
Oregon	81	92	436	494
Pennsylvania	72	80	1,392	1,534
Rhode Island	57	63	119	131
South Carolina	70	78	684	763
South Dakota	59	68	86	101
Tennessee	82	92	912	1,022
Texas	52	58	3,934	4,353
Utah	48	56	216	251
Vermont	69	76	61	68
Virginia	62	69	725	813
Washington	71	80	650	736
West Virginia	79	91	285	328
Wisconsin	60	67	528	584
Wyoming	42	53	40	51
United States	65	67	38,261	39,583

Table III.6. Approximate 90-Percent Confidence Intervals for Final Shrinkage Estimates for 2005, Working Poor

	Approximate 90-Percent Confidence Intervals for 2005, Working Poor			
	Participation Rate (Percent)		Number of Eligible People (Thousands)	
	Lower Bound	Upper Bound	Lower Bound	Upper Bound
Alabama	59	74	278	347
Alaska	50	68	36	49
Arizona	52	63	350	421
Arkansas	68	83	190	230
California	28	37	1,935	2,503
Colorado	30	40	205	275
Connecticut	43	58	96	129
Delaware	47	66	35	49
District of Columbia	31	53	23	39
Florida	46	59	770	993
Georgia	59	74	517	639
Hawaii	48	66	54	75
Idaho	47	59	75	95
Illinois	59	73	591	730
Indiana	64	78	303	372
Iowa	55	66	131	158
Kansas	41	53	127	162
Kentucky	68	83	238	288
Louisiana	75	92	343	420
Maine	78	97	52	64
Maryland	37	51	161	221
Massachusetts	27	42	188	285
Michigan	57	76	549	728
Minnesota	40	55	153	208
Mississippi	43	66	238	366
Missouri	86	100	345	427
Montana	52	66	53	68
Nebraska	48	61	67	85
Nevada	36	51	73	103
New Hampshire	42	57	30	41
New Jersey	38	51	223	298
New Mexico	62	76	154	191
New York	40	54	945	1,259
North Carolina	50	62	478	598
North Dakota	43	57	32	43
Ohio	51	62	643	782
Oklahoma	57	70	256	313
Oregon	57	76	202	268
Pennsylvania	59	73	505	627
Rhode Island	33	47	42	60
South Carolina	62	77	265	328
South Dakota	52	67	37	47
Tennessee	72	89	317	393
Texas	50	61	1,947	2,345
Utah	45	58	111	142
Vermont	51	66	24	31
Virginia	51	64	262	335
Washington	46	63	292	400
West Virginia	66	91	100	137
Wisconsin	48	60	214	267
Wyoming	47	67	19	28
United States	54	58	16,713	18,026

Table III.7. Approximate 90-Percent Confidence Intervals for Final Shrinkage Estimates for 2006, Working Poor

	Approximate 90-Percent Confidence Intervals for 2006, Working Poor			
	Participation Rate (Percent)		Number of Eligible People (Thousands)	
	Lower Bound	Upper Bound	Lower Bound	Upper Bound
Alabama	53	67	296	374
Alaska	53	69	35	46
Arizona	49	61	425	526
Arkansas	65	77	207	246
California	31	39	1,978	2,513
Colorado	35	47	184	247
Connecticut	46	62	92	123
Delaware	53	71	37	50
District of Columbia	31	53	23	38
Florida	45	57	763	973
Georgia	56	68	605	735
Hawaii	49	64	55	73
Idaho	44	58	77	101
Illinois	66	78	585	696
Indiana	68	82	291	353
Iowa	60	72	141	170
Kansas	43	55	150	192
Kentucky	65	79	268	327
Louisiana	63	79	333	420
Maine	89	100	55	68
Maryland	37	53	184	263
Massachusetts	34	47	189	263
Michigan	68	86	510	642
Minnesota	44	57	142	183
Mississippi	41	59	270	390
Missouri	92	114	371	457
Montana	53	69	51	67
Nebraska	48	62	82	105
Nevada	39	54	84	116
New Hampshire	44	59	32	44
New Jersey	39	51	259	341
New Mexico	62	77	157	194
New York	40	53	1,121	1,474
North Carolina	51	62	508	621
North Dakota	41	57	31	43
Ohio	55	66	615	742
Oklahoma	58	69	260	313
Oregon	62	81	182	235
Pennsylvania	62	74	521	631
Rhode Island	28	41	33	48
South Carolina	60	75	290	361
South Dakota	53	69	42	54
Tennessee	71	85	356	429
Texas	51	61	1,913	2,265
Utah	45	56	108	135
Vermont	55	70	23	29
Virginia	50	63	295	371
Washington	55	70	286	366
West Virginia	61	82	115	155
Wisconsin	51	63	233	292
Wyoming	41	58	19	28
United States	55	59	17,292	18,522

Table III.8. 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	54	69	310	393
Alaska	47	66	36	49
Arizona	47	59	404	501
Arkansas	64	79	205	252
California	29	37	2,167	2,771
Colorado	36	50	201	275
Connecticut	46	61	100	132
Delaware	48	65	37	49
District of Columbia	28	49	23	40
Florida	43	54	815	1,044
Georgia	48	61	695	876
Hawaii	46	63	59	81
Idaho	43	57	78	105
Illinois	64	77	590	703
Indiana	66	79	314	379
Iowa	66	79	150	180
Kansas	44	53	158	191
Kentucky	73	88	240	290
Louisiana	60	76	363	456
Maine	83	100	54	67
Maryland	36	51	200	283
Massachusetts	42	56	155	206
Michigan	74	94	517	659
Minnesota	49	63	158	201
Mississippi	46	62	287	390
Missouri	88	112	371	472
Montana	55	71	50	65
Nebraska	49	64	87	113
Nevada	30	45	101	149
New Hampshire	51	65	30	38
New Jersey	41	54	249	323
New Mexico	55	70	161	206
New York	42	53	1,187	1,522
North Carolina	51	63	627	770
North Dakota	52	67	30	39
Ohio	55	65	611	721
Oklahoma	56	69	242	293
Oregon	65	85	207	270
Pennsylvania	66	80	489	590
Rhode Island	37	51	39	53
South Carolina	56	69	278	345
South Dakota	54	70	42	54
Tennessee	68	85	316	395
Texas	43	51	2,058	2,462
Utah	43	55	110	141
Vermont	60	74	22	28
Virginia	50	63	317	396
Washington	53	68	252	322
West Virginia	79	100	92	123
Wisconsin	56	68	250	305
Wyoming	40	58	17	25
United States	54	58	18,022	19,320

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APPENDIX A

THE ESTIMATION PROCEDURE: ADDITIONAL TECHNICAL DETAILS

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

1. From CPS Data and SNAP Administrative Data, Derive Direct Sample Estimates of State SNAP Participation Rates for Each of the Three Years 2005 to 2007

Table A.1 displays direct sample estimates of participation rates for all eligible people and for the working poor, and Table A.2 presents standard errors for the direct sample estimates. The method for obtaining the standard errors is described later.

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; P_i is the number of people participating in SNAP in the year in question according to SNAP Statistical Summary of Operations ("Program Operations") data; $\varepsilon_{1,i}$ is the percentage of participating people who are income eligible and correctly receiving benefits 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, expressed as a percentage of the CPS population; and T_i is the resident population according to decennial census and administrative records (mainly vital statistics) data. [1,2,3,4]

[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. The adjustment allows us to measure a state's participation rate under "normal" circumstances. 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 also adjusted P_i to exclude from our estimates of participants two additional groups. First, we exclude participants who were ineligible for SNAP but received benefits in error. Second, we exclude participants who would not pass the federal SNAP income tests but were eligible through state expanded categorical eligibility rules. These people cannot be identified in the CPS data and, thus, are not included in our estimates of eligibles.

Similarly, we derived sample estimates of participation rates for the working poor for a given year according to:

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

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, income eligible, and correctly receiving SNAP benefits according to SNAP QC data; $E_{2,i}$ is the number of people who are working poor and eligible for SNAP according to the CPS, expressed as a percentage of the CPS population; and P_i and T_i are as defined above.[5]

As noted, we estimated eligibility percentages rather than eligibility counts from the CPS. 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."

Table A.3 presents estimates of the number of people participating in SNAP, and Table A.4 presents the population totals. Table A.5 presents the percentages of participating people who are income eligible and correctly receiving SNAP benefits and who are working poor, income eligible, and correctly receiving SNAP benefits. Table A.6 displays direct sample estimates of SNAP eligibility percentages for all eligible people and for the working poor.

(continued)

[3] We obtained estimates for 2005 to 2007 from the CPS ASEC samples for 2006 to 2008, for which the survey instruments collected family income data for the prior calendar years, that is, 2005 to 2007.

[4] In broad terms, the population estimates derived by the Census Bureau in its Population Estimates Program 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.

[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] In Table A.7 we show the percentage of participating households that are correctly eligible and working poor based on the indicators that suggest a member was working. The first column shows the percentage of participants in households identified as working poor based on the edited SNAP QC datafile. The second column shows the additional percentage that were counted as working poor based on other household information.

We derived SNAP eligibility estimates for states by applying SNAP rules to CPS households. However, some key information needed to determine whether a household is eligible for SNAP is not collected in the CPS. 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.

[6] Wolkwitz and Ewell (2009) describe the procedure for editing the SNAP QC data to ensure consistency between a household's income and SNAP benefit.

Figure A.1. Algorithm to Identify Working Poor Households

A household is identified as working poor if it meets one of the following criteria:

1) Earnings in the edited SNAP QC data
2) Multiple indicators of earnings in the unedited SNAP QC data
   a) At least one person with recorded earned income AND
      i) A recorded earned income deduction or at least one person with a recorded workforce participation variable indicating he or she is employed

      OR

      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
      i) At least one person with a recorded workforce participation variable indicating that he or she is employed

      OR

      ii) Earnings implied by the recorded earned income deduction and recorded unearned income that sum to the recorded total income

      OR

      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)

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 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 and Wolkwitz (2009) and earlier reports in that series.[7,8]

[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.

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]

$$(3) \quad \text{var}(Y_{1,i}) = \text{variance due to } E_{1,i} \text{ when } \varepsilon_{1,i} \text{ is fixed} + \text{variance due to } \varepsilon_{1,i} \text{ when } E_{1,i} \text{ is fixed}$$
$$= \text{var}_{E_1|\varepsilon_1}(Y_{1,i}) + \text{var}_{\varepsilon_1|E_1}(Y_{1,i})$$

and

$$(4) \quad \text{var}(Y_{2,i}) = \text{variance due to } E_{2,i} \text{ when } \varepsilon_{2,i} \text{ is fixed} + \text{variance due to } \varepsilon_{2,i} \text{ when } E_{2,i} \text{ is fixed}$$
$$= \text{var}_{E_2|\varepsilon_2}(Y_{2,i}) + \text{var}_{\varepsilon_2|E_2}(Y_{2,i}).$$

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 $\varepsilon_{1,i}$ —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 the jackknife estimator proposed by Rao, Wu, and Yue (1992), treating CPS rotation groups as clusters. To obtain the first of these variances, for example, we let $Z_{1,i}$ equal the CPS sample estimate of the number of eligible people in state i (i = 1, 2, ..., 51) and $Z_{1,i,r}$ equal the contribution of rotation group r (r = 1, 2, ..., 8) to that estimate. In other words:

$$(5) \quad Z_{1,i} = \sum_{r=1}^{8} Z_{1,i,r} .$$

We also let N_i equal the CPS sample estimate of the population in state i and $N_{i,r}$ equal the contribution of rotation group r to that estimate. That is:

$$(6) \quad N_i = \sum_{r=1}^{8} N_{i,r} .$$

[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.

If, as described before, $E_{1,i}$ equals the CPS sample estimate of the percentage eligible in state *i*:

$$(7) \quad E_{1,i} = 100\frac{Z_{1,i}}{N_i}.$$

If we were to exclude the observations in rotation group *r*, we could estimate the percentage eligible in state *i* and the participation rate for state *i* by:

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

and

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

The "(*r*)" subscript indicates that rotation group *r* has been excluded. By excluding each of the eight rotation groups in turn, we obtain eight alternative estimates for the participation rate in state *i*. Then, we can assess the degree of sampling variability (estimate the variance of $Y_{1,i}$) by measuring the variability among the eight estimates according to:

$$(10) \quad \text{var}_{E_1|\varepsilon_1}(Y_{1,i}) = \frac{7}{8}\sum_{r=1}^{8}(Y_{1,i(r)} - Y_{1,i})^2.$$

The factor 7/8 enters this expression because the $Y_{1,i(r)}$ are obtained from samples that are only 7/8 the size of the full CPS sample for state *i* and, hence, are expected to be more variable than $Y_{1,i}$ (by a factor of 8/7). We obtain jackknife estimates of sampling error variances pertaining to the participation rates for the working poor in the same manner, substituting $Z_{2,i}$, the CPS sample estimate of the number of eligible working poor in state *i*, for $Z_{1,i}$; $Z_{2,i,r}$, the contribution of rotation group *r* to $Z_{2,i}$, 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 (5) to (9). This results in:

$$(11) \quad \text{var}_{E_2|\varepsilon_2}(Y_{2,i}) = \frac{7}{8}\sum_{r=1}^{8}(Y_{2,i(r)} - Y_{2,i})^2.$$

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

$$(12) \quad \text{var}_{\varepsilon_1|E_1}(Y_{1,i}) = \left(100\frac{P_i}{T_i E_{1,i}}\right)^2 \text{var}(\varepsilon_{1,i}),$$

since 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:

$$(13) \quad \varepsilon_{1,i} = 100\frac{\sum_h m_{i,h}\varepsilon_{1,i,h}}{\sum_h m_{i,h}},$$

and

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

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

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

where n_i is the total number of households from state i in the SNAP QC sample. Similarly, we estimate $\text{var}_{\varepsilon_2|E_2}(Y_{2,i})$ according to:

$$(16) \quad \text{var}_{\varepsilon_2|E_2}(Y_{2,i}) = \left(100\frac{P_i}{T_i E_{2,i}}\right)^2 \frac{1}{(\sum_h m_{i,h})^2}\left(\frac{n_i}{n_i - 1}\right)\sum_h m_{i,h}{}^2 \left(\varepsilon_{2,i,h} - \varepsilon_{2,i}\right)^2.$$

Summing the estimates from Equations (10) and (15)—as indicated by Equation (3)—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 (11) and (16)—as indicated by Equation (4)—and taking the square root of the sum provides an estimated standard error of the participation rate for the working poor. Estimated standard errors for the direct estimates of participation rates for all eligible people and for the working poor are presented in Tables A.3 and A.4, respectively.

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]

$$\begin{aligned}(17)\quad \operatorname{cov}(Y_{1,i}, Y_{2,i}) &= \text{covariance due to } E_{1,i} \text{ and } E_{2,i} \text{ when } \varepsilon_{1,i} \text{ and } \varepsilon_{2,i} \text{ are fixed} \\ &\quad + \text{covariance due to } \varepsilon_{1,i} \text{ and } \varepsilon_{2,i} \text{ when } E_{1,i} \text{ and } E_{2,i} \text{ are fixed} \\ &= \operatorname{cov}_{E_1E_2|\varepsilon_1\varepsilon_2}(Y_{1,i}, Y_{2,i}) + \operatorname{cov}_{\varepsilon_1\varepsilon_2|E_1E_2}(Y_{1,i}, Y_{2,i}).\end{aligned}$$

To derive an estimate of the first term in this expression, we obtained a jackknife estimate of the covariance due to $E_{1,i}$ and $E_{2,i}$ according to:

$$(18)\quad \operatorname{cov}_{E_1E_2|\varepsilon_1\varepsilon_2}(Y_{1,i}, Y_{2,i}) = \frac{7}{8}\sum_{r=1}^{8}(Y_{1,i(r)} - Y_{1,i})(Y_{2,i(r)} - Y_{2,i}).$$

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

$$(19)\quad \operatorname{cov}_{\varepsilon_1\varepsilon_2|E_1E_2}(Y_{1,i}, Y_{2,i}) = \left(100\frac{P_i}{T_iE_{1,i}}\right)\left(100\frac{P_i}{T_iE_{2,i}}\right)\operatorname{cov}(\varepsilon_{1,i}, \varepsilon_{2,i})$$

where:

$$(20)\quad \operatorname{cov}(\varepsilon_{1,i}, \varepsilon_{2,i}) = \frac{1}{(\sum_h m_{i,h})^2}\left(\frac{n_i}{n_i - 1}\right)\sum_h {m_{i,h}}^2 \quad \varepsilon_{1,i,h} - \varepsilon_{1,i} \quad \varepsilon_{2,i,h} - \varepsilon_{2,i} \ .$$

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

Because CPS samples from different years are not independent, participation rates for different years are correlated.[11] We derived a preliminary jackknife estimate of the correlation between $Y_{1,i,t}$ and $Y_{2,i,t-g}$, the sample estimate for all eligibles for one year and the sample estimate for the working poor for *g* years earlier, according to either:

$$(21) \quad \text{cov}(Y_{1,i,t}, Y_{2,i,t-g}) = \frac{7}{8}\left[\sum_{r=1}^{4}(Y_{1,i(r),t} - Y_{1,i,t})(Y_{2,i(r+4),t-g} - Y_{2,i,t-g}) + \sum_{r=5}^{8}(Y_{1,i(r),t} - Y_{1,i,t})(Y_{2,i(r-4),t-g} - Y_{2,i,t-g})\right],$$

if *g* is odd, or:

$$(22) \quad \text{cov}(Y_{1,i,t}, Y_{2,i,t-g}) = \frac{7}{8}\left[\sum_{r=1}^{8}(Y_{1,i(r),t} - Y_{1,i,t})(Y_{2,i(r),t-g} - Y_{2,i,t-g})\right],$$

if *g* is even.

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

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

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

[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.

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

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]

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 2005, 2006, and 2007, and three predicting SNAP participation rates for the working poor in 2005, 2006, and 2007. 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 income-eligible for SNAP and correctly receiving SNAP benefits
- 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
- the percentage of households with a female householder, no husband present, and related children under 18 years according to 2005-2007 American Community Survey (ACS) three-year estimates
- the percentage of occupied housing units that were owner-occupied according to 2005-2007 ACS three-year estimates
- the percentage of renter-occupied housing units spending 30 percent or more of household income on rent and utilities according to 2005-2007 ACS three-year estimates
- the percentage of individuals under 200 percent of the federal poverty level according to 2005-2007 ACS three-year estimates
- the percentage of adults age 18 to 64 under 125 percent of the federal poverty level according to 2005-2007 ACS three-year estimates

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

The values for the third through seventh predictors are the same in each of the six equations of our regression model. For the first two predictors, we used 2005 values in both equations for predicting 2005 participation rates, 2006 values in both equations for predicting 2006 rates, and 2007 values in both equations for predicting 2007 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 elderly individuals under 200 percent of poverty, median family income, and the percentage of individuals age 15 or older who are married. 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

[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.

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, 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.8. The values for the third through seventh predictors listed above are displayed in Table A.9. Values for the other predictors, which vary by year, are presented in Table A.10. Regression estimates of participation rates for all eligible people and the working poor are in Table A.11, and the standard errors for the regression estimates are in Table A.12.

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 7,531,524 equally-spaced points, starting with $\sigma_1 = 0.001$, $\sigma_2 = 0.001$, $\rho = -0.999$, $\eta_1 = 0.000$, $\eta_2 = 0.000$, and $\eta_{12} = -0.999$ and incrementing σ_1, σ_2, ρ, η_1, η_2, and η_{12} by 0.500, 0.750, 0.111, 0.500, 0.600, and 0.165, respectively, up to $\sigma_1 = 5.001$, $\sigma_2 = 7.501$, $\rho = 0.999$, $\eta_1 = 6.500$, η_2

[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.

= 10.200, and η_{12} = 0.981. For combination k of σ_1, σ_2, ρ, η_1, η_2, and η_{12} (k = 1, 2, ..., 7531524), we calculated a vector of shrinkage estimates:

$$(26) \quad \theta_k = (\Sigma_k^{-1} + V^{-1})^{-1}(\Sigma_k^{-1} X\hat{B}_k + V^{-1}Y),$$

a variance-covariance matrix:

$$(27) \quad U_k = (\Sigma_k^{-1} + V^{-1})^{-1} + (\Sigma_k^{-1} + V^{-1})^{-1}\Sigma_k^{-1} X(X'(\Sigma_k + V)^{-1} X)^{-1} X'\Sigma_k^{-1}(\Sigma_k^{-1} + V^{-1})^{-1},$$

and a probability:

$$(28) \quad p_k^* = |\Sigma_k + V|^{-1/2} |X'(\Sigma_k + V)^{-1} X|^{-1/2} \exp\left(-\frac{1}{2}(Y - X\hat{B}_k)'(\Sigma_k + V)^{-1}(Y - X\hat{B}_k)\right).$$

In these expressions, Y is a column vector of direct sample estimates (from Step 1) with 306 elements, six sample estimates for each of the 51 states. The first six elements of Y pertain to the first state, the next six to the second state, and so forth. For a given state, the first two elements are the 2005 sample estimates for all eligible people and the working poor, respectively; the second two elements are the 2006 estimates; and the final two elements are the 2007 estimates. The vector of shrinkage estimates, θ_k, has the same structure as the vector of sample estimates, Y. V is the (306 × 306) variance-covariance matrix for the sample estimates. Because state samples are independent in the CPS, V is block-diagonal with 51 (6 × 6) blocks. We described under Step 1 how we derived estimates for the elements of V. X is a (306 × 48) matrix containing values for each of the seven predictors (plus an intercept) for every state, every year (2005, 2006 and 2007), and both groups (all eligible people and the working poor). The first six rows of X pertain to the first state, the next six rows pertain to the second state, and so forth. The six rows for state i are given by:

$$(29) \quad X_i = \begin{pmatrix} x'_{i11} & \underline{0} & \underline{0} & \underline{0} & \underline{0} & \underline{0} \\ \underline{0} & x'_{i12} & \underline{0} & \underline{0} & \underline{0} & \underline{0} \\ \underline{0} & \underline{0} & x'_{i21} & \underline{0} & \underline{0} & \underline{0} \\ \underline{0} & \underline{0} & \underline{0} & x'_{i22} & \underline{0} & \underline{0} \\ \underline{0} & \underline{0} & \underline{0} & \underline{0} & x'_{i31} & \underline{0} \\ \underline{0} & \underline{0} & \underline{0} & \underline{0} & \underline{0} & x'_{i32} \end{pmatrix},$$

where x'_{it1} is a row vector for year t (t = 1 for 2005, t = 2 for 2006, and t = 3 for 2007) with eight elements (an intercept plus the seven predictors listed under Step 2) to predict participation rates for all eligible people. x'_{it2} 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, $x'_{it1} = x'_{it2}$. $\hat{B}_k$ 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^* 7,531,524 times (once for each combination of σ_1, σ_2, ρ, η_1, η_2, and η_{12}), we calculated the probability of ($\sigma_{1,k}$, $\sigma_{2,k}$, ρ_k, $\eta_{1,k}$, $\eta_{2,k}$, $\eta_{12,k}$):

$$(32) \quad p_k = \frac{p_k^*}{\sum_{k=1}^{7,531,524} p_k^*} ,$$

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 7,531,524 sets of shrinkage estimates, weighting each set θ_k by its associated probability p_k. Thus, our shrinkage estimates are:

$$(33) \quad \theta = \sum_{k=1}^{7,531,524} p_k \theta_k .$$

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:

$$(34) \quad U = \sum_{k=1}^{7,531,524} p_k U_k + \sum_{k=1}^{7,531,524} p_k (\theta_k - \theta)(\theta_k - \theta)' .$$

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:

$$(35) \quad R = \sum_{k=1}^{7,531,524} p_k R_k ,$$

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:

$$(36) \quad G = \sum_{k=1}^{7,531,524} p_k G_k + \sum_{k=1}^{7,531,524} p_k (R_k - R)(R_k - R)' ,$$

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

$$(37) \quad \hat{B} = \sum_{k=1}^{7,531,524} p_k \hat{B}_k .$$

Regression estimates of participation rates for all eligible people and the working poor were presented before in Table A.11. Preliminary shrinkage estimates of SNAP participation rates are displayed in Table A.13.

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 counts estimated directly from the CPS. Second, we adjusted the rates so that no state's estimated rate is greater than 100 percent. These adjustments were carried out for each year and each group separately. The following description of the adjustment will focus on the 2007 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 39,290,066 for 2007, while the national total for 2007 estimated directly from the CPS was 38,921,885. 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) by 38,921,885 ÷ 39,290,066 (≈0.9906).[15]

After carrying out this first adjustment, there were three instances were a state had fewer estimated eligibles than participants, implying participation rates over 100 percent.[16] To cap

[15] The adjustment factors for 2005 and 2006 for all eligible people were, respectively, 0.9839, and 0.9881. The direct estimates of the national totals for all eligibles for those years were 37,950,525 and 37,417,632. The adjustment factors for 2005, 2006, and 2007 for working poor eligibles were, respectively, 0.9624, 0.9687 and 0.9824. The direct estimates of the national totals for working poor eligibles for those years were 17,369,632, 17,907,063, and 18,671,402.

[16] Missouri had a participation rate for all eligibles of 104 percent in 2007 and 2006 and a participation rate for the working poor of 103 percent in 2006. There were no other rates over 100 percent. The number of individuals

participation rates at 100 percent, we performed a second adjustment when needed. Specifically, we took eligibles away from the 50 states that had enough eligibles (that is, more eligibles than participants) and gave them to the state that did not have enough, stopping when the number of eligibles in that state equaled the number of participants. Eligibles were taken away from states 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 the state with a participation rate initially over 100 percent, this adjustment did not change any state's participation rate for 2007 by more than seven-thousandths of a percentage point.[17]

Our final shrinkage estimates of the numbers of people eligible for SNAP were shown earlier in Table III.2 of Chapter III. From those 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). Participation rates for all states and all eligible people were shown in Chapter III, Table III.1. We derived final participation rates for the working poor in the same way. Our final estimates of the number of eligible working poor people were shown in Chapter III, Table III.2, and the final participation rates were shown in Chapter III, Table III.1.

(continued)
participating in SNAP has been over-reported for several years in Missouri. We hope to receive corrected data for Missouri and revise participant totals for all affected years in next year's report.

[17] For 2006, this adjustment did not change any state's participation rate by more than eight-hundredths of a percentage point, except for the state with a participation rate initially over 100 percent.

In Tables III.3 to III.5 of Chapter III, we reported approximate 90-percent confidence intervals for our final shrinkage estimates for all eligible people. In Tables III.6 to III.8 we reported the confidence intervals for the final shrinkage estimates for the working poor. The upper and lower bounds of the confidence intervals were calculated according to:

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

and:

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

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 (≈ 0.9906 for all eligible people for 2007), and $U(6i\text{-}1,6i\text{-}1)$ is the $(6i\text{-}1,6i\text{-}1)$ diagonal element of U, which was derived according to Equation (34).[18] 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.14 presents final shrinkage estimates of participation rates for all eligible people (values of $\theta_{F,1,i}$) and the working poor (values of $\theta_{F,2,i}$) and Table A.15 presents standard errors for the rates. Tables A.16 and A.17 display final shrinkage estimates of the numbers of all eligible people (values

[18] The square root of $U(6i\text{-}1,6i\text{-}1)$ is the standard error of the preliminary shrinkage estimate of the 2007 participation rate for all eligible people for state i. When deriving estimates for 2005 and 2006, we would use the $(6i\text{-}5,6i\text{-}5)$ and $(6i\text{-}3,6i\text{-}3)$ diagonal elements of U, respectively. When deriving estimates for the working poor for 2005, 2006, and 2007, we would use the $(6i\text{-}4,6i\text{-}4)$, $(6i\text{-}2,6i\text{-}2)$, and $(6i,6i)$ diagonal elements of U, respectively.

of $\psi_{F,1,i}$) and eligible working poor (values of $\psi_{F,2,i}$), respectively, and Tables A.18 and A.19 present the standard errors for those estimated counts.[19] Finally, Tables A.20 and A.21 show payment-error-adjusted numbers of, respectively, all people receiving SNAP benefits under normal program eligibility rules (values of $P_i(\varepsilon_{1,i}/100)$) and the working poor receiving SNAP benefits under normal program eligibility rules (values of $P_i(\varepsilon_{2,i}/100)$).

[19] The rates and counts for all eligible people in Tables A.14 and A.16 are the same as the rates and counts in Tables III.1 and III.2 of Chapter III, except for the number of digits displayed. Likewise, the rates and counts for the working poor in Tables A.14 and A.17 are the same as the rates and counts in Tables III.1 and III.2 of Chapter III, except for the number of digits displayed.

Table A.1. Direct Sample Estimates of SNAP Participation Rates

	Direct Sample Estimates of SNAP Participation Rates (Percent)					
	All Eligible People			Working Poor		
	2005	2006	2007	2005	2006	2007
Alabama	65.195	70.510	74.210	60.846	58.383	74.567
Alaska	59.796	62.371	71.175	56.441	59.200	67.756
Arizona	64.041	61.496	63.157	49.264	61.524	53.632
Arkansas	84.547	71.382	82.724	77.695	59.975	80.717
California	48.153	49.483	48.451	32.068	35.206	33.048
Colorado	47.515	55.278	54.765	29.009	40.052	48.450
Connecticut	59.922	74.864	61.288	40.205	59.813	43.464
Delaware	64.525	76.696	63.783	71.397	79.752	51.678
District of Columbia	69.536	89.528	80.419	35.258	36.944	35.638
Florida	60.938	59.275	55.015	48.921	47.242	45.232
Georgia	74.730	69.158	63.385	73.205	59.938	55.402
Hawaii	81.857	74.193	82.804	74.529	52.649	67.387
Idaho	60.524	60.285	52.184	52.276	55.195	54.845
Illinois	79.336	82.567	85.948	72.347	71.008	67.807
Indiana	65.338	75.742	73.617	72.172	83.372	73.277
Iowa	64.125	71.134	83.749	53.640	63.431	90.688
Kansas	57.384	53.322	53.562	48.373	47.804	42.664
Kentucky	72.360	77.020	77.743	67.853	66.458	74.536
Louisiana	82.070	79.452	77.539	82.849	75.277	80.211
Maine	85.566	103.772	92.719	82.745	115.389	95.076
Maryland	49.167	60.338	61.912	34.168	46.919	48.590
Massachusetts	51.978	54.608	58.793	36.301	29.702	41.948
Michigan	72.438	77.329	89.007	75.690	77.181	87.616
Minnesota	72.909	66.388	66.298	52.522	43.611	53.495
Mississippi	56.040	59.007	59.247	60.114	54.312	52.599
Missouri	103.685	106.976	100.478	105.168	121.836	110.253
Montana	61.399	62.965	61.822	51.353	69.009	63.700
Nebraska	65.873	70.704	73.864	49.204	56.257	72.749
Nevada	46.963	51.686	48.111	37.545	41.197	34.408
New Hampshire	56.233	61.728	66.826	50.913	50.492	51.035
New Jersey	60.034	53.047	49.888	43.570	39.439	46.599
New Mexico	66.999	72.790	76.408	69.017	73.258	72.698
New York	59.958	63.347	58.459	45.468	52.860	48.270
North Carolina	56.261	63.402	60.449	54.173	50.806	56.380
North Dakota	54.709	55.671	62.396	48.967	55.391	53.818
Ohio	63.604	67.631	65.370	58.023	63.163	54.601
Oklahoma	70.728	65.640	70.978	67.074	54.173	62.808
Oregon	85.336	88.893	93.868	70.535	76.057	91.828
Pennsylvania	73.454	75.461	79.468	70.917	68.843	73.245
Rhode Island	55.662	56.661	61.899	37.438	30.487	47.185
South Carolina	65.953	82.521	73.830	58.742	69.172	55.418
South Dakota	60.472	65.113	69.974	59.361	63.867	71.769
Tennessee	88.917	87.378	76.564	67.304	68.813	58.135
Texas	55.948	61.733	54.434	54.093	53.013	44.549
Utah	66.831	50.845	46.914	58.378	42.212	43.300
Vermont	80.508	80.751	69.469	67.426	71.229	60.482
Virginia	65.417	68.754	69.529	59.411	56.330	60.342
Washington	79.494	87.494	79.221	82.193	69.284	55.661
West Virginia	78.430	75.742	85.477	73.340	74.565	98.726
Wisconsin	55.687	61.474	61.686	53.794	58.611	64.411
Wyoming	51.680	56.063	43.153	68.317	51.593	41.242

Table A.2. 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		
	2005	2006	2007	2005	2006	2007
Alabama	3.696	4.801	9.119	8.352	7.650	11.154
Alaska	5.784	4.449	7.545	8.591	7.296	11.181
Arizona	3.770	4.580	7.205	4.738	7.680	7.581
Arkansas	6.658	4.872	5.859	9.918	5.116	9.114
California	1.469	1.148	1.561	2.729	2.800	2.755
Colorado	4.234	3.995	4.477	3.720	5.233	6.088
Connecticut	6.323	8.476	9.034	8.549	11.537	10.255
Delaware	8.641	5.395	7.818	18.555	20.146	8.620
District of Columbia	3.775	5.645	4.401	8.332	8.043	7.789
Florida	3.308	2.955	4.561	5.897	5.235	5.002
Georgia	4.025	2.752	3.896	8.262	5.206	6.371
Hawaii	13.731	6.615	9.884	16.701	8.203	13.725
Idaho	5.809	5.807	6.700	5.431	8.310	9.937
Illinois	4.664	4.922	3.330	10.169	6.049	5.747
Indiana	5.279	8.791	4.651	12.220	10.412	7.638
Iowa	3.141	6.775	8.501	5.384	8.409	8.296
Kansas	4.273	5.780	2.901	5.976	7.387	3.692
Kentucky	5.269	4.452	5.603	7.042	7.836	7.324
Louisiana	6.929	6.253	5.106	9.773	13.478	9.101
Maine	6.621	6.357	7.850	9.738	11.336	13.996
Maryland	4.841	6.995	4.704	5.865	11.256	7.745
Massachusetts	3.758	3.274	5.670	6.381	5.617	7.569
Michigan	3.226	2.844	6.705	10.482	8.336	15.397
Minnesota	8.900	6.338	3.911	9.782	5.703	7.363
Mississippi	4.642	4.554	2.224	10.290	6.963	6.365
Missouri	7.191	5.991	9.488	12.165	15.984	19.493
Montana	6.678	7.348	6.066	7.852	15.593	13.135
Nebraska	4.550	4.122	8.460	5.899	7.975	10.482
Nevada	4.109	9.533	5.256	6.587	8.471	6.559
New Hampshire	5.583	7.164	2.485	8.389	12.488	6.877
New Jersey	3.684	4.734	5.205	6.964	6.092	6.208
New Mexico	3.635	3.348	6.349	7.262	7.783	10.739
New York	1.951	2.636	1.763	6.152	5.553	4.716
North Carolina	4.018	4.143	4.078	8.361	5.930	7.869
North Dakota	4.505	5.059	5.950	6.245	8.914	7.640
Ohio	2.178	4.774	2.600	6.276	7.541	4.283
Oklahoma	6.540	2.541	5.177	8.657	5.082	6.658
Oregon	6.622	8.497	10.215	9.853	13.431	20.050
Pennsylvania	5.358	3.433	4.914	10.882	6.703	8.610
Rhode Island	3.141	3.188	2.338	6.425	5.378	8.216
South Carolina	4.249	5.559	4.545	8.197	8.596	6.267
South Dakota	4.997	6.170	9.469	7.630	10.976	11.166
Tennessee	6.383	5.246	6.924	10.124	5.813	9.880
Texas	2.723	2.723	2.396	4.856	4.230	3.290
Utah	6.024	4.781	5.305	6.853	5.224	7.349
Vermont	10.737	5.506	3.810	15.669	12.167	10.292
Virginia	4.302	5.650	5.193	11.252	7.207	6.618
Washington	7.351	8.729	8.038	16.098	9.167	8.086
West Virginia	6.044	3.957	5.401	13.946	8.630	18.172
Wisconsin	3.645	6.745	3.476	6.039	9.248	7.768
Wyoming	6.506	5.418	4.813	12.532	7.125	7.406

Table A.3. Number of People Receiving SNAP Benefits, Monthly Average

	Number of People Receiving SNAP Benefits		
	2005	2006	2007
Alabama	533,881	538,680	545,955
Alaska	55,567	57,153	56,181
Arizona	550,291	540,782	544,688
Arkansas	372,517	380,120	379,768
California	1,990,919	1,999,656	2,048,185
Colorado	245,926	251,385	250,704
Connecticut	204,146	210,288	212,562
Delaware	61,586	65,698	67,185
District of Columbia	88,799	89,168	86,519
Florida	1,283,661	1,232,949	1,232,803
Georgia	917,940	936,342	950,038
Hawaii	93,548	87,942	89,629
Idaho	93,441	91,106	87,068
Illinois	1,158,271	1,225,093	1,246,400
Indiana	555,875	574,696	587,156
Iowa	206,696	225,717	238,349
Kansas	177,782	183,071	182,407
Kentucky	570,277	589,102	602,022
Louisiana	736,743	673,550	650,357
Maine	152,910	160,294	162,602
Maryland	288,943	305,395	317,825
Massachusetts	368,122	431,518	456,192
Michigan	1,047,594	1,133,793	1,204,409
Minnesota	259,937	263,986	276,414
Mississippi	387,814	407,482	426,116
Missouri	766,425	796,350	823,915
Montana	80,870	81,567	79,969
Nebraska	117,415	119,683	120,634
Nevada	121,707	117,920	122,224
New Hampshire	52,310	56,338	59,101
New Jersey	392,416	405,667	414,503
New Mexico	240,637	244,672	233,918
New York	1,754,861	1,785,914	1,801,984
North Carolina	799,747	854,407	882,946
North Dakota	42,204	42,576	45,122
Ohio	1,007,172	1,063,920	1,076,764
Oklahoma	424,402	435,519	421,316
Oregon	429,358	434,239	438,498
Pennsylvania	1,042,809	1,092,298	1,135,146
Rhode Island	76,085	73,195	76,315
South Carolina	521,125	534,294	545,293
South Dakota	56,095	58,466	60,246
Tennessee	848,739	863,745	864,870
Texas	2,418,865	2,575,076	2,422,198
Utah	133,263	131,753	123,475
Vermont	45,218	47,202	49,865
Virginia	488,481	506,656	515,032
Washington	508,472	535,768	536,333
West Virginia	262,442	267,630	269,343
Wisconsin	345,748	367,918	382,770
Wyoming	25,482	24,236	22,608

Source: USDA, Food and Nutrition Service

Table A.4. Population on July 1

	Population on July 1(T_j)		
	2005	2006	2007
Alabama	4,539,611	4,590,240	4,626,595
Alaska	669,411	677,450	681,111
Arizona	5,952,083	6,165,689	6,353,421
Arkansas	2,772,152	2,809,111	2,830,557
California	35,990,312	36,249,872	36,377,534
Colorado	4,673,724	4,766,248	4,842,770
Connecticut	3,486,490	3,495,753	3,489,868
Delaware	840,558	852,747	861,953
District of Columbia	582,049	585,459	587,868
Florida	17,736,027	18,057,508	18,199,526
Georgia	9,107,719	9,342,080	9,523,297
Hawaii	1,267,581	1,278,635	1,277,356
Idaho	1,425,894	1,463,878	1,496,145
Illinois	12,719,550	12,777,042	12,825,809
Indiana	6,257,121	6,302,646	6,335,862
Iowa	2,955,587	2,972,566	2,983,360
Kansas	2,741,665	2,755,817	2,777,382
Kentucky	4,171,016	4,204,444	4,236,308
Louisiana	4,495,670	4,243,288	4,373,310
Maine	1,312,222	1,314,910	1,315,398
Maryland	5,573,163	5,602,017	5,618,899
Massachusetts	6,429,137	6,434,389	6,467,915
Michigan	10,107,940	10,102,322	10,049,790
Minnesota	5,113,824	5,154,586	5,182,360
Mississippi	2,900,456	2,899,112	2,921,030
Missouri	5,787,885	5,837,639	5,878,399
Montana	935,784	946,795	956,624
Nebraska	1,754,042	1,763,765	1,769,473
Nevada	2,408,948	2,492,427	2,554,344
New Hampshire	1,303,112	1,311,821	1,312,256
New Jersey	8,657,445	8,666,075	8,653,126
New Mexico	1,916,331	1,942,302	1,964,402
New York	19,262,545	19,281,988	19,429,316
North Carolina	8,679,089	8,869,442	9,041,594
North Dakota	635,938	637,460	637,904
Ohio	11,459,776	11,463,513	11,477,641
Oklahoma	3,535,926	3,577,536	3,608,123
Oregon	3,629,959	3,691,084	3,735,549
Pennsylvania	12,367,276	12,402,817	12,419,930
Rhode Island	1,066,721	1,061,641	1,053,136
South Carolina	4,254,989	4,330,108	4,404,914
South Dakota	780,046	788,467	795,689
Tennessee	5,989,309	6,074,913	6,149,116
Texas	22,843,999	23,407,629	23,843,432
Utah	2,505,013	2,579,535	2,668,925
Vermont	619,736	620,778	620,748
Virginia	7,557,588	7,640,249	7,698,775
Washington	6,270,838	6,374,910	6,449,511
West Virginia	1,805,626	1,808,699	1,809,836
Wisconsin	5,540,473	5,572,660	5,598,893
Wyoming	506,541	512,757	523,252

Source: U.S. Census Bureau, Population Division

Table A.5. Percentage of Participants Who Are Income Eligible and Correctly Receiving Benefits

	Percentage of Participants Who Are Income Eligible and Correctly Receiving Benefits					
	All Eligible People			Working Poor		
	2005	2006	2007	2005	2006	2007
Alabama	97.877	98.723	98.137	38.824	37.019	39.766
Alaska	97.414	95.761	97.421	45.325	43.808	42.904
Arizona	96.574	96.105	97.567	40.385	48.534	44.041
Arkansas	98.534	97.185	97.376	42.554	42.230	42.853
California	98.355	98.880	98.600	36.284	39.238	40.166
Colorado	97.850	97.523	97.907	34.065	34.886	40.786
Connecticut	96.750	96.860	95.662	27.850	27.622	28.986
Delaware	91.008	90.461	90.047	38.774	41.148	36.160
District of Columbia	96.845	95.745	96.186	14.599	14.331	14.115
Florida	96.539	95.972	98.012	35.926	35.833	36.559
Georgia	97.740	97.214	95.765	41.866	44.032	45.123
Hawaii	98.017	99.081	98.537	39.496	41.130	42.967
Idaho	97.050	97.775	97.769	48.454	50.241	52.258
Illinois	98.545	97.815	98.490	37.714	37.673	36.646
Indiana	96.956	97.610	96.645	43.008	42.050	42.643
Iowa	97.186	97.267	96.828	42.247	45.652	49.900
Kansas	97.547	96.843	98.877	38.209	45.537	46.434
Kentucky	98.391	97.615	98.181	34.908	36.195	35.545
Louisiana	96.013	92.785	96.649	43.331	39.542	42.945
Maine	93.770	93.212	90.016	33.275	35.382	34.211
Maryland	94.796	94.134	92.895	29.156	33.170	33.167
Massachusetts	94.564	95.619	94.102	22.196	21.294	19.478
Michigan	91.476	91.026	93.579	40.547	39.075	40.875
Minnesota	85.079	96.639	96.904	27.492	31.201	36.247
Mississippi	97.752	99.241	98.829	42.644	40.446	43.059
Missouri	97.524	98.392	98.543	48.407	53.578	51.044
Montana	97.640	95.649	96.909	43.961	43.912	45.248
Nebraska	98.771	98.351	98.908	35.635	43.078	46.856
Nevada	98.476	98.530	98.304	31.457	39.533	38.514
New Hampshire	96.588	97.795	96.134	33.547	34.624	33.213
New Jersey	98.276	97.864	98.407	29.741	33.456	32.744
New Mexico	98.238	97.365	97.609	49.576	49.606	49.268
New York	98.096	98.138	97.926	29.546	33.895	35.719
North Carolina	97.989	98.547	99.246	37.643	37.414	44.929
North Dakota	95.009	93.996	94.254	44.138	42.578	45.171
Ohio	97.048	96.583	96.437	40.087	38.663	37.173
Oklahoma	95.498	96.818	96.642	42.605	41.719	39.658
Oregon	91.316	88.980	91.873	36.537	34.400	40.882
Pennsylvania	97.759	97.912	98.138	35.938	35.583	34.660
Rhode Island	96.846	97.995	98.335	26.979	18.815	26.241
South Carolina	97.664	97.508	97.917	39.713	41.047	35.545
South Dakota	98.235	98.962	98.665	44.228	49.835	49.432
Tennessee	97.395	97.375	97.696	33.550	35.195	31.314
Texas	95.435	94.078	94.579	49.359	45.457	43.651
Utah	97.347	97.685	98.149	49.096	46.909	49.389
Vermont	93.535	94.964	94.288	35.375	34.698	33.256
Virginia	97.011	97.033	97.437	35.122	37.350	39.264
Washington	98.861	97.984	97.684	37.019	37.864	32.463
West Virginia	97.723	95.921	96.848	35.442	36.056	37.083
Wisconsin	90.941	90.207	92.477	37.662	40.712	45.026
Wyoming	98.777	98.281	95.971	52.298	48.039	45.665

Table A.6. Direct Sample Estimates of Percentage of People Eligible for SNAP

	Direct Sample Estimates of Percentage of People Eligible for SNAP					
	All Eligible People			Working Poor		
	2005	2006	2007	2005	2006	2007
Alabama	17.656	16.431	15.605	7.504	7.441	6.293
Alaska	13.523	12.953	11.290	6.666	6.243	5.223
Arizona	13.942	13.707	13.244	7.579	6.919	7.040
Arkansas	15.661	18.423	15.793	7.360	9.528	7.123
California	11.299	11.023	11.458	6.259	6.148	6.843
Colorado	10.836	9.305	9.255	6.179	4.594	4.358
Connecticut	9.454	7.783	9.507	4.056	2.778	4.062
Delaware	10.334	9.087	11.004	3.979	3.975	5.454
District of Columbia	21.248	16.288	17.603	6.317	5.908	5.829
Florida	11.466	11.055	12.068	5.315	5.179	5.475
Georgia	13.182	14.089	15.072	5.764	7.363	8.125
Hawaii	8.837	9.185	8.350	3.911	5.373	4.474
Idaho	10.508	10.094	10.903	6.074	5.665	5.545
Illinois	11.311	11.359	11.136	4.747	5.087	5.252
Indiana	13.183	11.751	12.166	5.294	4.599	5.393
Iowa	10.599	10.383	9.237	5.508	5.465	4.396
Kansas	11.023	12.065	12.124	5.122	6.328	7.148
Kentucky	18.591	17.758	17.947	7.034	7.631	6.777
Louisiana	19.172	18.537	18.536	8.571	8.338	7.962
Maine	12.770	10.950	12.001	4.686	3.738	4.448
Maryland	9.996	8.505	8.487	4.424	3.854	3.861
Massachusetts	10.417	11.743	11.289	3.501	4.808	3.275
Michigan	13.088	13.211	12.600	5.552	5.682	5.591
Minnesota	6.625	7.455	7.796	3.206	3.664	3.614
Mississippi	23.323	23.639	24.334	9.485	10.467	11.942
Missouri	12.455	12.547	13.746	6.095	5.999	6.489
Montana	13.743	13.087	13.104	7.398	5.482	5.938
Nebraska	10.037	9.439	9.129	4.848	5.196	4.391
Nevada	10.594	9.019	9.777	4.233	4.540	5.356
New Hampshire	6.895	6.804	6.479	2.645	2.945	2.931
New Jersey	7.420	8.636	9.449	3.094	3.971	3.366
New Mexico	18.412	16.850	15.212	9.020	8.530	8.070
New York	14.905	14.349	15.536	5.920	5.939	6.863
North Carolina	16.049	14.973	16.033	6.403	7.094	7.782
North Dakota	11.525	11.277	10.685	5.982	5.134	5.937
Ohio	13.410	13.254	13.840	6.072	5.681	6.387
Oklahoma	16.206	17.956	15.899	7.624	9.375	7.373
Oregon	12.657	11.776	11.489	6.127	5.321	5.226
Pennsylvania	11.222	11.427	11.287	4.273	4.552	4.325
Rhode Island	12.410	11.924	11.512	5.140	4.255	4.030
South Carolina	18.136	14.580	16.418	8.280	7.322	7.940
South Dakota	11.682	11.270	10.676	5.358	5.786	5.215
Tennessee	15.522	15.845	17.947	7.064	7.272	7.576
Texas	18.062	16.765	17.651	9.662	9.433	9.954
Utah	7.749	9.813	9.679	4.474	5.676	5.277
Vermont	8.477	8.942	10.903	3.828	3.704	4.417
Virginia	9.585	9.359	9.375	3.821	4.397	4.353
Washington	10.084	9.412	10.254	3.652	4.593	4.850
West Virginia	18.110	18.739	16.862	7.024	7.155	5.590
Wisconsin	10.191	9.688	10.249	4.369	4.586	4.779
Wyoming	9.615	8.286	9.609	3.851	4.401	4.784

Table A.7. Percentage of SNAP Participants in Households with Earners, by Indicator of Earnings, 2007

	Percentage of SNAP Participants in Households with Earners		
	Earned Income in Household	No Earned Income, Other Indicator of Earnings	Total
Alabama	40.5	0.0	40.5
Alaska	44.2	0.0	44.2
Arizona	45.2	0.0	45.2
Arkansas	43.7	0.3	44.0
California	40.7	0.0	40.7
Colorado	41.4	0.3	41.7
Connecticut	30.6	0.1	30.7
Delaware	43.0	0.1	43.0
District of Columbia	14.5	0.2	14.7
Florida	37.3	0.0	37.3
Georgia	47.1	0.0	47.1
Hawaii	43.5	0.3	43.7
Idaho	53.5	0.0	53.5
Illinois	37.1	0.1	37.2
Indiana	44.1	0.1	44.2
Iowa	51.5	0.0	51.5
Kansas	46.8	0.2	47.0
Kentucky	36.3	0.0	36.3
Louisiana	44.4	0.0	44.4
Maine	40.8	0.3	41.1
Maryland	38.0	0.2	38.2
Massachusetts	24.2	0.0	24.2
Michigan	45.4	0.0	45.4
Minnesota	37.8	0.2	38.0
Mississippi	43.3	0.3	43.6
Missouri	51.2	0.7	51.9
Montana	46.6	0.2	46.7
Nebraska	47.4	0.0	47.4
Nevada	39.2	0.0	39.2
New Hampshire	34.5	0.0	34.5
New Jersey	33.1	0.3	33.4
New Mexico	50.4	0.0	50.5
New York	36.4	0.1	36.5
North Carolina	45.0	0.3	45.3
North Dakota	50.4	0.1	50.5
Ohio	38.5	0.0	38.5
Oklahoma	41.0	0.0	41.0
Oregon	46.4	0.0	46.4
Pennsylvania	35.1	0.2	35.3
Rhode Island	26.6	0.1	26.7
South Carolina	36.3	0.0	36.3
South Dakota	50.6	0.1	50.7
Tennessee	32.1	0.0	32.1
Texas	47.9	0.0	48.0
Utah	50.5	0.1	50.6
Vermont	37.9	0.0	37.9
Virginia	40.3	0.0	40.3
Washington	33.3	0.0	33.3
West Virginia	38.3	0.0	38.3
Wisconsin	50.9	0.1	51.0
Wyoming	47.6	0.0	47.6

Table A.8. Definitions and Data Sources for Predictors

Predictor[a]	Definition	Principal Data Source[b]
Income eligible SNAP prevalence rate	$100 \times \frac{\text{Income-eligible individuals correctly receiving SNAP benefits}}{\text{Resident population}}$	Counts of people receiving SNAP benefits are from SNAP Program Operations data.
Elderly combined poverty rate	$100 \times \frac{\text{Individuals age 65 or older not claimed on tax returns or claimed on tax returns with adjusted gross income below the poverty level}}{\text{Resident population of people age 65 or older}}$	All data for this predictor were obtained from the Census Bureau.
Single mother household rate	$100 \times \frac{\text{Female-headed households with no husband present and related children under 18 years}}{\text{Total households}}$	The data for constructing these predictors were obtained from the 2005-2007 American Community Survey 3-Year Estimates available at http://factfinder.census.gov.
Owner-occupied housing rate	$\frac{\text{Owner-occupied housing units}}{\text{Occupied housing units}}$	
High rental housing cost rate	$\frac{\text{Renter-occupied units spending 30 percent or more of household income on rent and utilities}}{\text{Renter-occupied housing units}}$	
Individual 200 percent of poverty rate	$\frac{\text{Individuals under 200 percent of the federal poverty level}}{\text{Total individuals}}$	
Nonelderly adult 125 percent of poverty rate	$100 \times \frac{\text{Adults age 18 to 64 under 125 percent of the federal poverty level}}{\text{Total adults age 18 to 64}}$	

[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 estimates of the resident population, we used the July 1 population estimates released by the Census Bureau in May 2009. For the 2006 and 2005 estimates, we used the population estimates released in May 2008. All the population estimates are available at http://www.census.gov/popest/datasets.html.

Table A.9. Values for Temporally Constant Predictors

	Values for Temporally Constant Predictors				
	Single mother household rate	Owner-occupied housing rate	High rental housing cost rate	Individual 200 percent of poverty rate	Nonelderly adult 125 percent of poverty rate
Alabama	10.1	71.3	40.1	37.7	19.4
Alaska	8.9	63.7	37.8	25.9	12.9
Arizona	8.4	68.6	45.6	34.3	17.0
Arkansas	9.1	68.0	41.1	40.8	20.8
California	8.5	58.4	51.5	32.1	15.8
Colorado	7.1	68.7	46.7	28.0	14.3
Connecticut	8.1	69.7	46.6	19.9	9.5
Delaware	9.2	73.6	44.6	25.0	12.4
District of Columbia	11.6	44.1	46.0	34.2	19.9
Florida	8.3	70.3	51.9	32.1	15.4
Georgia	10.5	67.9	44.6	33.3	16.3
Hawaii	7.7	58.9	46.1	23.4	11.0
Idaho	6.7	71.6	39.6	35.0	16.7
Illinois	8.5	70.1	46.2	28.2	14.1
Indiana	8.2	72.1	43.2	30.1	14.7
Iowa	6.7	73.3	39.3	28.6	13.9
Kansas	7.4	70.0	39.8	30.4	14.9
Kentucky	8.6	70.8	39.6	37.4	19.8
Louisiana	11.6	68.1	42.6	39.7	21.4
Maine	6.9	72.9	42.7	31.1	15.2
Maryland	9.3	69.4	45.0	20.4	9.6
Massachusetts	7.8	65.0	47.4	22.3	11.6
Michigan	8.5	75.1	47.6	30.1	16.1
Minnesota	6.6	75.8	44.5	24.0	11.6
Mississippi	13.0	70.9	42.0	44.3	24.1
Missouri	8.5	70.7	42.1	32.4	16.0
Montana	6.2	70.1	38.6	35.5	17.8
Nebraska	7.0	68.5	37.4	29.8	14.0
Nevada	8.1	61.0	47.3	28.6	12.8
New Hampshire	6.5	73.2	44.0	19.8	9.1
New Jersey	8.0	67.4	47.8	21.1	9.9
New Mexico	9.6	69.6	42.9	40.9	21.6
New York	9.4	55.6	48.0	30.2	15.7
North Carolina	9.3	68.4	42.5	34.8	17.4
North Dakota	5.5	66.5	35.4	30.4	15.0
Ohio	8.8	70.0	44.6	30.2	15.5
Oklahoma	8.7	68.3	40.3	38.2	19.9
Oregon	7.1	64.7	46.6	32.5	17.2
Pennsylvania	7.6	71.7	43.0	28.8	14.1
Rhode Island	8.8	63.3	45.6	26.1	13.3
South Carolina	10.5	70.3	40.1	36.0	18.1
South Dakota	6.9	69.1	34.3	32.3	15.5
Tennessee	9.2	70.1	41.1	36.2	18.4
Texas	9.8	65.2	44.3	38.1	19.3
Utah	6.3	71.9	40.9	29.6	13.8
Vermont	7.2	72.2	45.6	26.9	13.1
Virginia	8.3	69.7	42.1	24.3	11.4
Washington	7.4	65.6	45.1	27.8	14.4
West Virginia	6.8	74.9	38.4	39.6	22.0
Wisconsin	7.0	70.3	42.2	26.8	12.9
Wyoming	6.2	70.0	28.7	26.8	11.9

Table A.10. Values for Temporally Variable Predictors

	Values for Temporally Variable Predictors					
	Income-eligible SNAP prevalence rate			Elderly combined poverty rate		
	2005	2006	2007	2005	2006	2007
Alabama	11.511	11.586	11.580	55.810	53.857	51.097
Alaska	8.086	8.079	8.036	37.461	35.688	32.102
Arizona	8.929	8.429	8.365	48.745	47.662	46.045
Arkansas	13.241	13.151	13.065	55.127	53.091	50.531
California	5.441	5.455	5.552	48.669	47.296	45.317
Colorado	5.149	5.144	5.069	40.573	38.369	35.414
Connecticut	5.665	5.827	5.827	42.722	40.024	36.679
Delaware	6.668	6.969	7.019	40.030	37.377	34.287
District of Columbia	14.775	14.582	14.156	51.826	49.847	47.891
Florida	6.987	6.553	6.639	49.786	48.503	46.321
Georgia	9.851	9.744	9.553	52.537	50.446	47.844
Hawaii	7.234	6.815	6.914	43.415	41.820	40.433
Idaho	6.360	6.085	5.690	45.718	43.362	40.066
Illinois	8.974	9.379	9.571	45.584	43.108	40.037
Indiana	8.613	8.900	8.956	45.992	43.249	40.714
Iowa	6.797	7.386	7.736	42.315	39.797	36.275
Kansas	6.325	6.433	6.494	42.677	39.734	37.135
Kentucky	13.452	13.677	13.952	55.851	54.098	51.438
Louisiana	15.735	14.728	14.373	58.992	55.612	53.132
Maine	10.927	11.363	11.127	50.607	47.861	44.538
Maryland	4.915	5.132	5.254	42.381	40.342	37.556
Massachusetts	5.415	6.413	6.637	46.193	43.453	40.394
Michigan	9.481	10.216	11.215	44.084	41.298	38.270
Minnesota	4.830	4.949	5.169	40.198	37.621	34.105
Mississippi	13.070	13.949	14.417	61.410	59.735	56.449
Missouri	12.914	13.422	13.812	48.073	45.471	42.341
Montana	8.438	8.240	8.101	44.417	41.572	38.143
Nebraska	6.612	6.674	6.743	43.861	41.174	37.895
Nevada	4.975	4.662	4.704	42.620	40.569	38.045
New Hampshire	3.877	4.200	4.330	42.639	39.811	36.056
New Jersey	4.455	4.581	4.714	44.439	42.231	39.347
New Mexico	12.336	12.265	11.623	50.014	48.181	45.971
New York	8.937	9.090	9.082	53.035	50.996	48.519
North Carolina	9.029	9.493	9.692	50.850	48.565	45.644
North Dakota	6.305	6.278	6.667	42.410	40.175	36.545
Ohio	8.529	8.964	9.047	46.780	44.138	40.968
Oklahoma	11.462	11.786	11.285	50.304	48.188	45.502
Oregon	10.801	10.468	10.785	44.085	41.852	39.218
Pennsylvania	8.243	8.623	8.970	49.809	46.757	43.724
Rhode Island	6.908	6.756	7.126	51.659	48.798	45.180
South Carolina	11.961	12.032	12.121	51.958	49.713	46.777
South Dakota	7.064	7.338	7.471	41.805	39.306	35.684
Tennessee	13.802	13.845	13.741	54.483	52.241	49.168
Texas	10.105	10.350	9.608	51.708	49.999	47.784
Utah	5.179	4.989	4.541	40.765	39.291	36.840
Vermont	6.825	7.221	7.574	46.776	43.963	40.623
Virginia	6.270	6.435	6.518	44.113	42.229	39.520
Washington	8.016	8.235	8.123	39.798	38.032	35.021
West Virginia	14.204	14.193	14.413	58.451	56.050	52.883
Wisconsin	5.675	5.956	6.322	43.908	41.005	37.506
Wyoming	4.969	4.645	4.147	39.932	37.387	33.824

Table A.11. Regression Estimates of SNAP Participation Rates

	Regression Estimates of SNAP Participation Rates (Percent)					
	All Eligible People			Working Poor		
	2005	2006	2007	2005	2006	2007
Alabama	65.260	65.596	63.930	64.080	57.623	60.343
Alaska	62.408	71.074	69.616	54.455	56.905	52.660
Arizona	66.039	63.075	60.187	58.223	54.940	53.925
Arkansas	77.642	78.004	75.603	74.804	72.112	71.905
California	46.194	47.779	45.753	28.023	30.450	29.482
Colorado	51.241	52.556	54.776	36.776	41.542	44.007
Connecticut	65.447	70.002	68.730	51.205	54.172	54.848
Delaware	60.601	68.049	67.275	53.541	59.151	55.095
District of Columbia	68.973	77.536	75.930	44.778	44.377	42.027
Florida	63.731	59.805	57.157	52.772	51.717	50.150
Georgia	66.103	68.552	61.814	61.645	57.998	51.752
Hawaii	71.250	73.636	70.098	53.395	53.682	52.438
Idaho	54.573	51.825	48.400	51.408	49.535	48.917
Illinois	73.581	80.057	80.392	63.416	69.857	69.354
Indiana	70.494	75.236	73.596	64.553	68.665	67.271
Iowa	63.356	68.779	72.160	57.561	63.314	68.917
Kansas	54.315	57.326	57.556	48.017	50.217	51.736
Kentucky	79.986	80.196	83.615	74.987	71.376	81.502
Louisiana	80.748	76.518	72.974	77.167	65.132	63.124
Maine	88.708	91.867	89.394	81.632	86.058	87.742
Maryland	55.412	61.294	58.776	44.517	45.105	43.909
Massachusetts	54.857	63.162	66.400	35.099	42.479	50.760
Michigan	70.997	78.699	89.049	60.913	71.778	79.418
Minnesota	60.479	61.713	65.000	50.453	54.553	59.699
Mississippi	49.910	55.844	59.220	50.764	46.352	51.693
Missouri	93.712	102.392	102.491	89.340	96.842	95.159
Montana	63.565	62.500	64.148	57.708	58.986	62.725
Nebraska	59.731	62.418	61.207	54.730	54.934	56.683
Nevada	55.060	58.197	52.602	42.867	45.825	37.666
New Hampshire	60.168	62.343	63.581	47.432	49.819	56.688
New Jersey	57.258	60.053	58.882	41.580	42.861	45.218
New Mexico	67.524	69.274	65.317	63.737	64.218	58.762
New York	59.817	63.791	62.140	40.291	39.784	42.289
North Carolina	59.494	64.499	63.743	54.420	55.682	56.329
North Dakota	55.774	55.619	61.326	46.843	46.140	57.894
Ohio	63.279	68.872	69.779	54.075	58.334	59.590
Oklahoma	67.626	71.497	68.617	62.705	64.348	63.066
Oregon	78.697	79.611	85.097	62.963	68.186	72.666
Pennsylvania	70.316	72.983	74.571	61.896	63.523	69.905
Rhode Island	55.803	55.335	57.886	39.765	34.431	43.449
South Carolina	72.118	76.461	73.402	72.155	69.462	66.183
South Dakota	56.938	61.746	62.342	54.839	56.987	59.173
Tennessee	87.885	90.132	87.361	84.582	82.756	82.533
Texas	59.919	64.118	55.885	53.806	54.706	46.503
Utah	57.242	56.320	51.896	51.233	51.964	49.936
Vermont	67.029	69.849	72.414	56.059	60.323	66.223
Virginia	62.184	66.222	63.679	53.908	53.775	54.211
Washington	66.826	72.854	74.187	52.075	60.072	59.984
West Virginia	81.698	74.864	84.555	74.364	67.653	89.369
Wisconsin	58.318	61.390	64.187	48.610	51.632	57.448
Wyoming	53.277	53.282	47.653	53.532	46.803	47.486

Table A.12. Standard Errors of Regression Estimates of SNAP Participation Rates

	Standard Errors of Regression Estimates of SNAP Participation Rates					
	All Eligible People			Working Poor		
	2005	2006	2007	2005	2006	2007
Alabama	2.746	2.764	2.697	5.606	5.414	5.496
Alaska	3.482	3.305	3.601	6.725	6.334	6.596
Arizona	2.464	2.419	2.491	5.005	4.940	5.002
Arkansas	2.876	2.762	2.945	5.544	5.406	5.649
California	2.866	2.817	2.892	5.775	5.753	5.696
Colorado	2.910	2.918	3.135	5.640	5.685	5.909
Connecticut	2.847	2.856	2.787	5.587	5.572	5.491
Delaware	3.119	3.069	3.178	6.190	6.175	6.095
District of Columbia	4.087	4.558	4.272	8.316	8.050	8.027
Florida	2.971	2.941	3.092	5.893	5.780	5.809
Georgia	2.801	2.761	2.793	5.583	5.455	5.489
Hawaii	3.154	3.052	2.981	6.310	5.824	5.994
Idaho	2.817	2.896	2.964	5.428	5.565	5.651
Illinois	2.608	2.626	2.737	5.288	5.295	5.422
Indiana	2.468	2.491	2.520	5.039	5.054	5.068
Iowa	2.526	2.555	2.581	5.046	5.082	5.162
Kansas	2.566	2.611	2.584	5.064	5.143	5.079
Kentucky	2.930	2.805	3.059	5.767	5.631	6.102
Louisiana	3.017	2.880	2.715	5.958	5.631	5.614
Maine	3.411	3.338	3.343	6.465	6.340	6.477
Maryland	3.100	3.116	3.074	5.953	6.005	5.986
Massachusetts	2.892	2.845	2.811	5.763	5.577	5.703
Michigan	3.130	3.118	3.536	6.394	6.330	6.725
Minnesota	2.750	2.815	2.782	5.495	5.476	5.507
Mississippi	4.111	3.965	3.291	8.257	7.309	6.952
Missouri	3.540	3.605	4.035	6.697	6.750	7.612
Montana	2.901	2.919	3.036	5.486	5.674	5.799
Nebraska	2.682	2.694	2.768	5.289	5.256	5.315
Nevada	3.057	3.019	3.134	6.085	5.916	6.203
New Hampshire	2.884	2.944	2.778	5.696	5.644	5.626
New Jersey	2.709	2.759	2.701	5.394	5.411	5.432
New Mexico	2.836	2.797	2.838	5.747	5.633	5.672
New York	2.748	2.835	2.748	5.782	5.652	5.681
North Carolina	2.441	2.409	2.419	5.032	4.899	4.903
North Dakota	3.182	3.156	3.209	5.983	6.083	6.036
Ohio	2.399	2.407	2.453	4.964	4.961	4.970
Oklahoma	2.545	2.515	2.567	5.127	5.099	5.161
Oregon	3.292	3.222	3.398	6.505	6.190	6.583
Pennsylvania	2.634	2.571	2.632	5.301	5.151	5.302
Rhode Island	2.824	2.862	2.704	5.793	5.686	5.623
South Carolina	2.826	2.769	2.868	5.630	5.480	5.590
South Dakota	2.969	2.964	3.108	5.649	5.654	5.745
Tennessee	3.119	2.961	3.146	5.914	5.704	5.970
Texas	2.553	2.527	2.539	5.207	5.111	5.143
Utah	2.653	2.711	2.711	5.196	5.245	5.304
Vermont	2.574	2.560	2.546	5.212	5.126	5.187
Virginia	2.625	2.658	2.640	5.251	5.244	5.265
Washington	2.891	2.865	2.990	5.798	5.616	5.736
West Virginia	4.293	3.894	4.320	8.192	7.739	8.730
Wisconsin	2.441	2.457	2.400	4.933	4.914	4.894
Wyoming	3.742	3.771	4.031	7.040	6.933	7.161

Table A.13. Preliminary Shrinkage Estimates of SNAP Participation Rates

	Preliminary Shrinkage Estimates of SNAP Participation Rates (Percent)					
	All Eligible People			Working Poor		
	2005	2006	2007	2005	2006	2007
Alabama	65.677	66.293	64.588	63.863	57.607	60.601
Alaska	61.499	69.616	68.874	57.149	59.258	55.716
Arizona	65.464	62.584	59.945	55.514	53.423	52.083
Arkansas	77.909	77.337	75.949	72.648	68.629	70.019
California	47.685	49.173	47.433	31.328	33.844	32.732
Colorado	50.559	52.548	54.516	33.601	39.407	42.232
Connecticut	64.921	69.884	68.243	48.565	52.208	52.318
Delaware	61.032	68.934	67.555	54.272	60.179	55.495
District of Columbia	69.619	78.717	76.751	40.505	40.460	37.929
Florida	63.011	59.417	56.585	50.342	49.325	47.630
Georgia	67.523	69.169	62.646	63.974	59.613	53.603
Hawaii	71.649	73.829	70.606	54.836	54.671	53.863
Idaho	55.499	52.905	49.232	51.246	49.633	48.917
Illinois	75.007	81.215	82.005	63.631	69.773	69.379
Indiana	69.571	74.742	73.091	68.135	72.654	71.070
Iowa	64.007	69.347	73.137	58.090	64.104	70.757
Kansas	54.103	56.709	56.563	45.212	47.230	47.710
Kentucky	78.699	79.186	82.423	72.754	69.358	79.290
Louisiana	81.026	76.793	73.395	80.601	68.563	66.969
Maine	88.935	92.747	89.816	84.290	89.621	90.559
Maryland	54.749	60.986	58.709	42.479	43.870	42.896
Massachusetts	53.238	60.829	64.612	33.219	39.331	48.359
Michigan	70.607	77.969	88.583	64.031	74.483	82.313
Minnesota	61.112	62.055	65.446	45.857	49.176	54.859
Mississippi	50.725	56.442	59.540	52.749	48.373	53.220
Missouri	94.243	102.695	102.649	92.492	99.898	98.040
Montana	63.121	62.157	63.689	56.820	58.564	62.137
Nebraska	61.361	64.322	62.877	52.801	53.506	55.484
Nevada	53.283	56.904	51.218	41.937	45.149	36.956
New Hampshire	60.697	63.003	64.846	47.325	49.612	56.627
New Jersey	57.227	59.224	58.112	43.057	43.776	46.587
New Mexico	67.764	69.915	66.143	66.390	67.127	61.681
New York	59.252	63.095	60.540	45.274	45.197	46.693
North Carolina	58.446	63.692	62.689	53.867	54.872	55.784
North Dakota	55.601	55.490	61.244	47.725	47.236	58.418
Ohio	62.777	68.229	68.542	54.525	58.758	59.062
Oklahoma	66.826	69.574	67.860	61.166	61.388	61.388
Oregon	79.479	80.358	85.782	64.207	69.341	73.850
Pennsylvania	71.023	73.738	75.438	63.720	65.374	71.694
Rhode Island	56.525	56.114	59.306	38.704	33.242	43.011
South Carolina	71.404	76.618	73.105	67.122	65.257	61.135
South Dakota	57.599	62.289	62.978	56.879	58.951	61.304
Tennessee	87.520	89.489	86.577	77.161	75.057	74.813
Texas	58.420	62.923	54.772	53.538	54.282	45.962
Utah	57.438	55.651	51.454	49.731	49.161	47.751
Vermont	67.484	70.678	72.306	56.033	60.666	65.643
Virginia	63.061	66.936	64.655	55.306	55.031	55.766
Washington	67.794	73.848	74.912	52.384	60.265	59.594
West Virginia	81.344	74.731	84.350	75.752	69.344	90.914
Wisconsin	57.271	60.579	63.064	52.207	55.270	61.002
Wyoming	52.771	53.125	47.000	54.682	48.021	48.001

Table A.14. Final Shrinkage Estimates of SNAP Participation Rates

	Final Shrinkage Estimates of SNAP Participation Rates (Percent)					
	All Eligible People			Working Poor		
	2005	2006	2007	2005	2006	2007
Alabama	66.755	67.149	65.247	66.361	59.515	61.685
Alaska	62.508	70.515	69.577	59.384	61.220	56.712
Arizona	66.538	63.392	60.557	57.686	55.192	53.014
Arkansas	79.187	78.335	76.724	75.489	70.902	71.271
California	48.467	49.808	47.918	32.553	34.964	33.317
Colorado	51.389	53.227	55.073	34.915	40.711	42.987
Connecticut	65.986	70.786	68.940	50.465	53.936	53.253
Delaware	62.033	69.824	68.245	56.395	62.172	56.487
District of Columbia	70.761	79.734	77.535	42.089	41.800	38.607
Florida	64.045	60.184	57.163	52.311	50.959	48.482
Georgia	68.631	70.062	63.286	66.476	61.587	54.562
Hawaii	72.825	74.782	71.328	56.981	56.481	54.827
Idaho	56.410	53.588	49.735	53.250	51.276	49.791
Illinois	76.237	82.264	82.843	66.119	72.083	70.620
Indiana	70.712	75.707	73.838	70.800	75.060	72.341
Iowa	65.058	70.242	73.884	60.362	66.226	72.022
Kansas	54.991	57.441	57.141	46.981	48.793	48.563
Kentucky	79.990	80.209	83.264	75.599	71.654	80.708
Louisiana	82.356	77.784	74.144	83.753	70.833	68.167
Maine	90.394	93.944	90.732	87.587	92.589	92.179
Maryland	55.648	61.773	59.308	44.140	45.322	43.663
Massachusetts	54.112	61.615	65.271	34.518	40.634	49.224
Michigan	71.765	78.976	89.488	66.535	76.949	83.785
Minnesota	62.114	62.856	66.114	47.651	50.805	55.840
Mississippi	51.557	57.170	60.148	54.812	49.975	54.172
Missouri	95.790	100.000	100.000	96.109	100.000	99.793
Montana	64.156	62.959	64.339	59.042	60.503	63.249
Nebraska	62.368	65.153	63.519	54.867	55.278	56.476
Nevada	54.157	57.639	51.741	43.578	46.644	37.617
New Hampshire	61.693	63.817	65.508	49.176	51.255	57.640
New Jersey	58.166	59.989	58.706	44.741	45.225	47.420
New Mexico	68.876	70.818	66.819	68.987	69.350	62.784
New York	60.224	63.910	61.158	47.044	46.694	47.528
North Carolina	59.404	64.514	63.329	55.974	56.689	56.782
North Dakota	56.514	56.207	61.870	49.592	48.801	59.463
Ohio	63.807	69.110	69.242	56.657	60.704	60.118
Oklahoma	67.922	70.472	68.552	63.558	63.421	62.486
Oregon	80.783	81.395	86.658	66.719	71.637	75.171
Pennsylvania	72.188	74.690	76.208	66.212	67.539	72.976
Rhode Island	57.452	56.839	59.912	40.217	34.342	43.780
South Carolina	72.576	77.607	73.851	69.747	67.418	62.228
South Dakota	58.544	63.093	63.622	59.104	60.904	62.401
Tennessee	88.956	90.644	87.461	80.179	77.542	76.150
Texas	59.379	63.736	55.331	55.632	56.080	46.784
Utah	58.381	56.370	51.979	51.676	50.788	48.605
Vermont	68.591	71.590	73.044	58.225	62.675	66.817
Virginia	64.096	67.800	65.315	57.469	56.853	56.763
Washington	68.906	74.802	75.677	54.432	62.261	60.660
West Virginia	82.679	75.696	85.211	78.714	71.640	92.540
Wisconsin	58.210	61.362	63.708	54.249	57.100	62.093
Wyoming	53.636	53.811	47.480	56.821	49.611	48.859

Table A.15. 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		
	2005	2006	2007	2005	2006	2007
Alabama	2.200	2.340	2.425	4.461	4.186	4.425
Alaska	3.176	2.836	3.400	5.531	4.969	5.615
Arizona	2.029	2.050	2.190	3.241	3.558	3.445
Arkansas	2.631	2.448	2.695	4.437	3.701	4.472
California	1.374	1.109	1.441	2.532	2.531	2.475
Colorado	2.420	2.379	2.617	3.080	3.654	4.035
Connecticut	2.622	2.707	2.630	4.486	4.723	4.443
Delaware	2.929	2.713	2.935	5.753	5.694	4.989
District of Columbia	3.305	4.141	3.633	6.873	6.536	6.367
Florida	2.246	2.166	2.543	4.021	3.749	3.636
Georgia	2.322	1.986	2.211	4.288	3.653	3.812
Hawaii	3.059	2.807	2.833	5.664	4.725	5.138
Idaho	2.509	2.583	2.733	3.635	4.203	4.350
Illinois	2.302	2.308	2.204	4.216	3.786	3.751
Indiana	2.196	2.338	2.209	4.403	4.372	4.127
Iowa	1.974	2.263	2.415	3.480	3.775	3.939
Kansas	2.169	2.235	1.930	3.459	3.569	2.847
Kentucky	2.596	2.391	2.709	4.387	4.310	4.594
Louisiana	2.790	2.607	2.394	5.161	4.999	4.691
Maine	3.176	3.143	3.132	5.655	5.833	5.841
Maryland	2.690	2.797	2.623	4.206	4.897	4.575
Massachusetts	2.458	2.369	2.631	4.279	4.020	4.299
Michigan	2.302	2.196	3.131	5.654	5.350	6.154
Minnesota	2.617	2.564	2.305	4.409	3.893	4.098
Mississippi	3.458	3.300	1.984	7.092	5.532	5.004
Missouri	3.342	3.277	3.851	6.254	6.532	7.296
Montana	2.644	2.659	2.686	4.380	4.939	4.921
Nebraska	2.443	2.394	2.782	3.884	4.120	4.319
Nevada	2.660	2.955	2.780	4.483	4.486	4.369
New Hampshire	2.573	2.600	1.891	4.568	4.666	4.181
New Jersey	2.170	2.332	2.334	3.918	3.750	3.708
New Mexico	2.246	2.161	2.499	4.500	4.470	4.669
New York	1.641	1.951	1.571	4.082	3.863	3.574
North Carolina	1.995	2.007	1.953	3.786	3.458	3.541
North Dakota	2.673	2.707	2.829	4.301	4.789	4.514
Ohio	1.521	1.868	1.712	3.344	3.449	3.007
Oklahoma	2.330	1.880	2.262	3.912	3.526	3.660
Oregon	3.075	3.084	3.271	5.642	5.589	6.060
Pennsylvania	2.283	2.051	2.236	4.354	3.934	4.152
Rhode Island	2.141	2.110	1.763	4.184	3.839	4.208
South Carolina	2.387	2.496	2.437	4.504	4.424	4.062
South Dakota	2.609	2.688	2.991	4.505	4.770	4.829
Tennessee	2.962	2.694	3.010	5.234	4.359	5.105
Texas	1.825	1.807	1.702	3.133	2.867	2.545
Utah	2.437	2.345	2.341	3.770	3.472	3.699
Vermont	2.365	2.298	2.128	4.651	4.557	4.431
Virginia	2.198	2.320	2.274	4.225	3.926	3.808
Washington	2.750	2.770	2.840	5.148	4.594	4.493
West Virginia	3.806	3.133	3.680	7.517	6.499	8.059
Wisconsin	1.980	2.201	1.922	3.639	3.860	3.691
Wyoming	3.378	3.321	3.442	6.076	5.294	5.436

Table A.16. Final Shrinkage Estimates of Number of People Eligible for SNAP

	Final Shrinkage Estimates of Number of People Eligible for SNAP		
	2005	2006	2007
Alabama	782,783	791,966	821,162
Alaska	86,597	77,615	78,664
Arizona	798,700	819,846	877,574
Arkansas	463,529	471,588	481,989
California	4,040,210	3,969,730	4,214,536
Colorado	468,269	460,594	445,695
Connecticut	299,323	287,746	294,955
Delaware	90,352	85,115	88,649
District of Columbia	121,532	107,074	107,331
Florida	1,934,933	1,966,116	2,113,770
Georgia	1,307,275	1,299,220	1,437,614
Hawaii	125,909	116,517	123,820
Idaho	160,760	166,228	171,159
Illinois	1,497,191	1,456,678	1,481,823
Indiana	762,182	740,958	768,521
Iowa	308,772	312,560	312,365
Kansas	315,364	308,650	315,637
Kentucky	701,462	716,945	709,872
Louisiana	858,921	803,447	847,755
Maine	158,620	159,045	161,318
Maryland	492,215	465,379	497,811
Massachusetts	643,317	669,667	657,694
Michigan	1,335,327	1,306,793	1,259,471
Minnesota	397,671	405,870	405,143
Mississippi	735,288	707,340	700,145
Missouri	780,301	783,545	811,911
Montana	123,076	123,918	120,451
Nebraska	185,948	180,667	187,845
Nevada	221,303	201,578	232,216
New Hampshire	81,898	86,334	86,732
New Jersey	663,023	661,796	694,823
New Mexico	343,224	336,391	341,709
New York	2,858,409	2,742,400	2,885,317
North Carolina	1,319,200	1,305,131	1,383,712
North Dakota	70,952	71,201	68,740
Ohio	1,531,865	1,486,855	1,499,662
Oklahoma	596,705	598,336	593,952
Oregon	485,340	474,702	464,887
Pennsylvania	1,412,201	1,431,901	1,461,802
Rhode Island	128,254	126,194	125,258
South Carolina	701,269	671,306	722,988
South Dakota	94,126	91,704	93,430
Tennessee	929,254	927,882	966,085
Texas	3,887,676	3,800,973	4,140,304
Utah	222,210	228,320	233,151
Vermont	61,662	62,613	64,368
Virginia	739,329	725,106	768,323
Washington	729,514	701,813	692,296
West Virginia	310,197	339,136	306,127
Wisconsin	540,158	540,872	555,623
Wyoming	46,928	44,265	45,697

Table A.17. Final Shrinkage Estimates of Number of Working Poor Eligible for SNAP

	Final Shrinkage Estimates of Number of Working Poor Eligible for SNAP		
	2005	2006	2007
Alabama	312,342	335,065	351,958
Alaska	42,412	40,898	42,502
Arizona	385,251	475,549	452,495
Arkansas	209,991	226,405	228,342
California	2,219,098	2,244,076	2,469,217
Colorado	239,939	215,414	237,865
Connecticut	112,662	107,693	115,698
Delaware	42,343	43,482	43,008
District of Columbia	30,801	30,571	31,632
Florida	881,591	866,983	929,624
Georgia	578,107	669,445	785,693
Hawaii	64,842	64,040	70,241
Idaho	85,025	89,267	91,381
Illinois	660,669	640,273	646,778
Indiana	337,669	321,956	346,110
Iowa	144,665	155,594	165,139
Kansas	144,589	170,853	174,410
Kentucky	263,325	297,576	265,141
Louisiana	381,165	376,002	409,725
Maine	58,092	61,255	60,348
Maryland	190,856	223,509	241,425
Massachusetts	236,710	226,136	180,516
Michigan	638,409	575,741	587,579
Minnesota	180,709	162,123	179,426
Mississippi	301,721	329,786	338,702
Missouri	386,022	426,668	421,432
Montana	60,214	59,200	57,210
Nebraska	76,259	93,268	100,086
Nevada	87,856	99,943	125,140
New Hampshire	35,685	38,058	34,055
New Jersey	260,853	300,097	286,216
New Mexico	172,930	175,013	183,560
New York	1,102,134	1,296,395	1,354,256
North Carolina	537,839	563,902	698,640
North Dakota	37,563	37,147	34,277
Ohio	712,609	677,620	665,794
Oklahoma	284,491	286,489	267,398
Oregon	235,129	208,520	238,478
Pennsylvania	566,004	575,481	539,139
Rhode Island	51,040	40,101	45,742
South Carolina	296,721	325,301	311,475
South Dakota	41,976	47,840	47,725
Tennessee	355,147	392,039	355,645
Texas	2,146,105	2,087,301	2,259,990
Utah	126,609	121,689	125,466
Vermont	27,473	26,132	24,819
Virginia	298,531	332,850	356,256
Washington	345,807	325,828	287,027
West Virginia	118,168	134,696	107,932
Wisconsin	240,035	262,323	277,561
Wyoming	23,454	23,468	21,130

Table A.18. Standard Errors of Final Shrinkage Estimates of Number of People Eligible for SNAP

	Standard Errors of Estimates of Number of People Eligible for SNAP		
	2005	2006	2007
Alabama	25,801	27,644	30,566
Alaska	4,400	3,127	3,850
Arizona	24,350	26,560	31,778
Arkansas	15,403	14,763	16,954
California	114,552	88,559	126,943
Colorado	22,050	20,621	21,208
Connecticut	11,892	11,022	11,267
Delaware	4,266	3,312	3,818
District of Columbia	5,676	5,570	5,036
Florida	67,848	70,881	94,174
Georgia	44,236	36,883	50,307
Hawaii	5,289	4,380	4,925
Idaho	7,150	8,025	9,420
Illinois	45,199	40,927	39,486
Indiana	23,669	22,919	23,027
Iowa	9,371	10,088	10,224
Kansas	12,439	12,031	10,675
Kentucky	22,769	21,409	23,128
Louisiana	29,102	26,975	27,410
Maine	5,573	5,329	5,577
Maryland	23,790	21,108	22,050
Massachusetts	29,218	25,790	26,553
Michigan	42,827	36,395	44,130
Minnesota	16,757	16,581	14,144
Mississippi	49,317	40,895	23,130
Missouri	27,224	23,768	29,119
Montana	5,073	5,242	5,036
Nebraska	7,285	6,650	8,240
Nevada	10,870	10,352	12,497
New Hampshire	3,416	3,523	2,508
New Jersey	24,740	25,773	27,666
New Mexico	11,192	10,282	12,801
New York	77,868	83,871	74,213
North Carolina	44,293	40,665	42,738
North Dakota	3,356	3,434	3,148
Ohio	36,517	40,249	37,139
Oklahoma	20,468	15,991	19,630
Oregon	18,475	18,017	17,572
Pennsylvania	44,654	39,388	42,957
Rhode Island	4,779	4,691	3,692
South Carolina	23,068	21,624	23,891
South Dakota	4,194	3,914	4,399
Tennessee	30,943	27,620	33,303
Texas	119,459	107,923	127,529
Utah	9,275	9,514	10,516
Vermont	2,126	2,013	1,878
Virginia	25,352	24,856	26,790
Washington	29,112	26,032	26,016
West Virginia	14,279	14,058	13,239
Wisconsin	18,376	19,429	16,789
Wyoming	2,955	2,736	3,318

Table A.19. 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		
	2005	2006	2007
Alabama	20,997	23,600	25,250
Alaska	3,950	3,325	4,208
Arizona	21,648	30,701	29,402
Arkansas	12,342	11,834	14,327
California	172,602	162,661	183,437
Colorado	21,165	19,365	22,329
Connecticut	10,014	9,444	9,652
Delaware	4,319	3,988	3,798
District of Columbia	5,030	4,788	5,216
Florida	67,759	63,881	69,727
Georgia	37,291	39,767	54,896
Hawaii	6,445	5,366	6,582
Idaho	5,803	7,328	7,983
Illinois	42,124	33,677	34,352
Indiana	21,000	18,780	19,745
Iowa	8,341	8,881	9,031
Kansas	10,646	12,517	10,224
Kentucky	15,282	17,927	15,092
Louisiana	23,488	26,573	28,195
Maine	3,751	3,865	3,824
Maryland	18,184	24,186	25,294
Massachusetts	29,340	22,405	15,764
Michigan	54,253	40,091	43,157
Minnesota	16,719	12,443	13,168
Mississippi	39,040	36,562	31,287
Missouri	25,119	26,205	30,812
Montana	4,467	4,840	4,451
Nebraska	5,398	6,962	7,654
Nevada	9,037	9,627	14,534
New Hampshire	3,315	3,470	2,470
New Jersey	22,840	24,920	22,381
New Mexico	11,281	11,296	13,651
New York	95,625	107,407	101,839
North Carolina	36,378	34,451	43,571
North Dakota	3,258	3,651	2,602
Ohio	42,058	38,559	33,305
Oklahoma	17,512	15,950	15,664
Oregon	19,882	16,291	19,226
Pennsylvania	37,218	33,571	30,675
Rhode Island	5,309	4,489	4,396
South Carolina	19,162	21,378	20,334
South Dakota	3,200	3,752	3,693
Tennessee	23,184	22,069	23,844
Texas	120,844	106,862	122,944
Utah	9,236	8,332	9,547
Vermont	2,195	1,903	1,646
Virginia	21,950	23,018	23,900
Washington	32,704	24,078	21,262
West Virginia	11,284	12,238	9,400
Wisconsin	16,103	17,759	16,500
Wyoming	2,508	2,508	2,351

Table A.20. Number of People Receiving SNAP Benefits under Normal Eligibility Rules, Adjusted for Payment Error, Monthly Average

	Payment Error-Adjusted Number of People Receiving SNAP Benefits under Normal Rules		
	2005	2006	2007
Alabama	522,545	531,804	535,782
Alaska	54,130	54,731	54,732
Arizona	531,437	519,716	531,437
Arkansas	367,054	369,419	369,803
California	1,958,169	1,977,257	2,019,511
Colorado	240,638	245,160	245,458
Connecticut	197,510	203,685	203,341
Delaware	56,049	59,431	60,497
District of Columbia	85,998	85,374	83,219
Florida	1,239,230	1,183,281	1,208,297
Georgia	897,192	910,251	909,801
Hawaii	91,693	87,134	88,317
Idaho	90,685	89,079	85,126
Illinois	1,141,421	1,198,326	1,227,575
Indiana	538,952	560,959	567,458
Iowa	200,881	219,549	230,789
Kansas	173,422	177,290	180,358
Kentucky	561,102	575,053	591,068
Louisiana	707,372	624,950	628,566
Maine	143,384	149,413	146,368
Maryland	273,906	287,482	295,242
Massachusetts	348,110	412,615	429,284
Michigan	958,299	1,032,041	1,127,068
Minnesota	247,009	255,112	267,855
Mississippi	379,096	404,389	421,124
Missouri	747,447	783,547	811,907
Montana	78,961	78,018	77,496
Nebraska	115,972	117,710	119,317
Nevada	119,852	116,186	120,152
New Hampshire	50,525	55,096	56,815
New Jersey	385,652	397,000	407,899
New Mexico	236,396	238,225	228,326
New York	1,721,455	1,752,667	1,764,610
North Carolina	783,665	841,997	876,293
North Dakota	40,098	40,020	42,530
Ohio	977,441	1,027,570	1,038,402
Oklahoma	405,294	421,661	407,169
Oregon	392,071	386,384	402,862
Pennsylvania	1,019,435	1,069,490	1,114,014
Rhode Island	73,686	71,727	75,044
South Carolina	508,953	520,978	533,937
South Dakota	55,105	57,860	59,442
Tennessee	826,631	841,073	844,947
Texas	2,308,443	2,422,575	2,290,890
Utah	129,728	128,704	121,189
Vermont	42,295	44,825	47,017
Virginia	473,880	491,623	501,834
Washington	502,679	524,965	523,914
West Virginia	256,467	256,713	260,853
Wisconsin	314,427	331,890	353,974
Wyoming	25,170	23,820	21,697

Table A.21. Number of Working Poor Receiving SNAP Benefits under Normal Eligibility Rules, Adjusted for Payment Error, Monthly Average

	Payment Error-Adjusted Number of Working Poor Receiving SNAP Benefits under Normal Rules		
	2005	2006	2007
Alabama	207,274	199,414	217,104
Alaska	25,186	25,038	24,104
Arizona	222,235	262,463	239,886
Arkansas	158,521	160,525	162,742
California	722,385	784,625	822,674
Colorado	83,775	87,698	102,252
Connecticut	56,855	58,086	61,613
Delaware	23,879	27,033	24,294
District of Columbia	12,964	12,779	12,212
Florida	461,168	441,803	450,700
Georgia	384,305	412,290	428,686
Hawaii	36,948	36,171	38,511
Idaho	45,276	45,773	45,500
Illinois	436,830	461,529	456,756
Indiana	239,071	241,660	250,381
Iowa	87,323	103,044	118,936
Kansas	67,929	83,365	84,699
Kentucky	199,072	213,225	213,989
Louisiana	319,238	266,335	279,296
Maine	50,881	56,715	55,628
Maryland	84,244	101,300	105,413
Massachusetts	81,708	91,887	88,857
Michigan	424,768	443,030	492,302
Minnesota	86,109	82,366	100,192
Mississippi	165,379	164,810	183,481
Missouri	371,003	426,668	420,559
Montana	35,551	35,818	36,184
Nebraska	41,841	51,557	56,524
Nevada	38,285	46,617	47,073
New Hampshire	17,548	19,506	19,629
New Jersey	116,708	135,720	135,725
New Mexico	119,298	121,372	115,247
New York	518,491	605,336	643,651
North Carolina	301,049	319,668	396,699
North Dakota	18,628	18,128	20,382
Ohio	403,745	411,343	400,265
Oklahoma	180,816	181,694	167,085
Oregon	156,875	149,378	179,267
Pennsylvania	374,765	388,672	393,442
Rhode Island	20,527	13,772	20,026
South Carolina	206,954	219,312	193,824
South Dakota	24,810	29,137	29,781
Tennessee	284,752	303,995	270,825
Texas	1,193,928	1,170,552	1,057,314
Utah	65,427	61,804	60,983
Vermont	15,996	16,378	16,583
Virginia	171,564	189,236	202,222
Washington	188,231	202,863	174,110
West Virginia	93,015	96,497	99,880
Wisconsin	130,216	149,787	172,346
Wyoming	13,327	11,643	10,324

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