United States Department of Agriculture

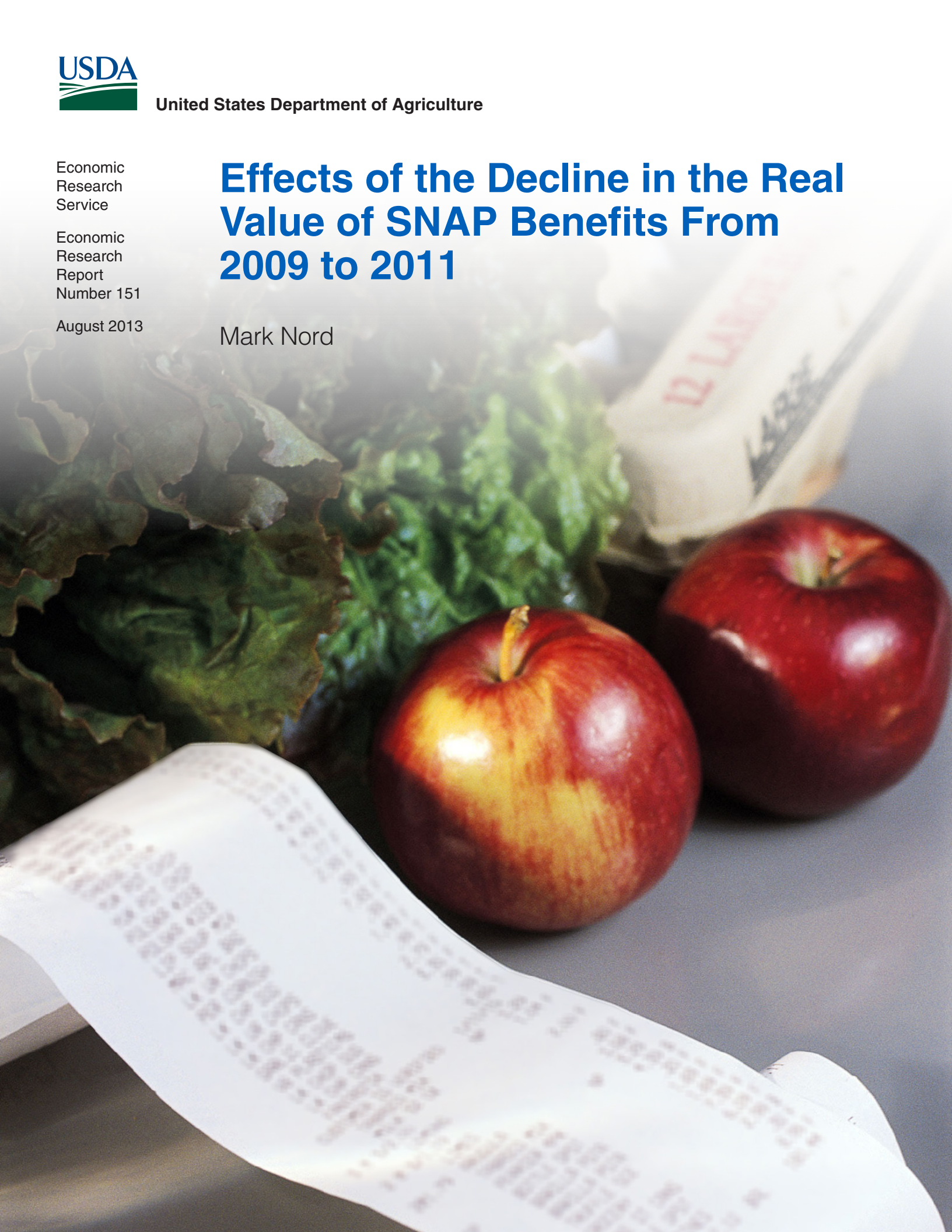
Economic Research Service

Economic Research Report Number 151

August 2013

Effects of the Decline in the Real Value of SNAP Benefits From 2009 to 2011

Mark Nord



United States Department of Agriculture

Economic Research Service
www.ers.usda.gov

Visit our website for more information on this topic:
www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-us.aspx

Access this report online:
www.ers.usda.gov/publications/err-economic-research-report/err151.aspx

Download the charts contained in this report:

- Go to the report's index page www.ers.usda.gov/publications/err-economic-research-report/err151.aspx
- Click on the bulleted item "Download ERR151.zip"
- Open the chart you want, then save it to your computer

Recommended citation format for this publication:

Nord, Mark. *Effects of the Decline in the Real Value of SNAP Benefits From 2009 to 2011,* ERR-151, U.S. Department of Agriculture, Economic Research Service, August 2013.

Cover photo credit: Thinkstock.

United States Department of Agriculture

Economic Research Service

Economic Research Report Number 151

August 2013

Effects of the Decline in the Real Value of SNAP Benefits From 2009 to 2011

Mark Nord, marknord@ers.usda.gov

Abstract

The value of Supplemental Nutrition Assistance Program (SNAP) benefits has declined due to inflation since the increase in benefit size in April 2009 mandated by the American Recovery and Reinvestment Act (ARRA). Earlier Economic Research Service (ERS) research documented improvements in food spending and food security from 2008 to 2009 that may have resulted from the ARRA SNAP-benefit increase. This report estimates the extent to which those gains may have been eroded from 2009 to 2011 as a result of the reduction in real value of SNAP benefits due to inflation in food prices. Changes in food spending and food security from 2009 to 2011 were compared between households that did and did not receive SNAP using Current Population Survey Food Security Supplement data. The difference-in-difference analyses, which also adjusted for differences in households' income, employment, and other characteristics, suggest that the decline in value of SNAP benefits may have resulted in an increase of 16.5 percent in the number of SNAP-recipient households with very low food security and a decline of 4.4 percent in median food spending by SNAP households. The size of these changes relative to the size of the reduction in the inflation-adjusted value of SNAP benefits was consistent with findings from the earlier ERS research on effects of the ARRA SNAP-benefit increase. Taken together, the two studies provide estimates of the effects that may be expected from potential future increases or decreases in SNAP benefits.

Keywords: Food security, food insecurity, food spending, SNAP, Supplemental Nutrition Assistance Program, ARRA, American Recovery and Reinvestment Act, inflation, food price inflation

Acknowledgments

The author thanks Alisha Coleman-Jensen, Mark Prell, John Kirlin, and David Smallwood, U.S. Department of Agriculture, Economic Research Service, as well as James Mabli, Mathematica Policy Research; Caroline Ratcliffe, Urban Institute; and Sangeetha Malaiyandi, USDA, Food and Nutrition Service for their reviews and suggestions. Thanks also to Priscilla Smith, USDA/ERS, for editorial assistance and to Wynnice Pointer-Napper, USDA/ERS, for production and graphics assistance.

Contents

Summary iv

Introduction 1

The 2009 ARRA Increase in SNAP Benefits Increased Food Spending and Improved Food Security of Low-Income Households 3

Food Price Inflation From 2009 to 2011 Reduced the ARRA SNAP Bonus by About Half 4

Data and Methods 6
Data 6
Measures 6
Analytic Methods 7

Findings 10

Robustness of the Findings 15

Limitations of the Findings 16

Conclusions 17

References 18

Appendix A: Calculation of Variables and Statistical Methods 20

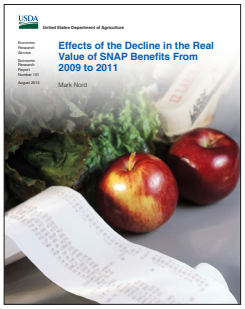
Appendix B: Multivariate Logistic and Quantile (Median) Regression Tables 23

Appendix C: Selection Into SNAP in 2011 Compared With 2009 27

United States Department of Agriculture

A report summary from the Economic Research Service

August 2013



Find the full report at *www.ers.usda.gov/publications/err-economic-research-report/err-151.aspx*

Effects of the Decline in the Real Value of SNAP Benefits From 2009 to 2011

Mark Nord

What Is the Issue?

Benefits provided by the Supplemental Nutrition Assistance Program (SNAP, formerly called the Food Stamp Program), were increased in 2009 by a provision of the American Recovery and Reinvestment Act (ARRA). Previous Economic Research Service (ERS) research found that low-income households' food spending increased and their food security improved following the ARRA SNAP-benefit increase. Subsequently, from 2009 to 2011, food-price inflation eroded about half of the value of the ARRA SNAP-benefit increase. This report examines whether, and to what extent, food spending declined and food security worsened as the inflation-adjusted value of SNAP benefits declined.

What Did the Study Find?

- From 2009 to 2011, food security worsened for SNAP recipient households, but not for low-income non-SNAP households, as the inflation-adjusted value of SNAP benefits declined due to inflation.
- Adjusted for inflation in food prices, the maximum SNAP benefit declined by about 7 percent, a reduction of about $47 per month for a family of four.
- The prevalence of very low food security among SNAP-recipient households increased by about 2.0 percentage points, after adjusting for differences in income, employment, and other household characteristics. This corresponds to an increase of 16.5 percent in the number of SNAP-recipient households with very low food security. Very low food security is a severe range of food insecurity in which the food intake of some household members is reduced below levels they consider appropriate.
- Food spending by SNAP-recipient households declined by 4.4 percent, amounting to a reduction of about $26 per month for a family of four.
- Changes in food spending and food security were disproportionately larger for households that received larger SNAP benefits.

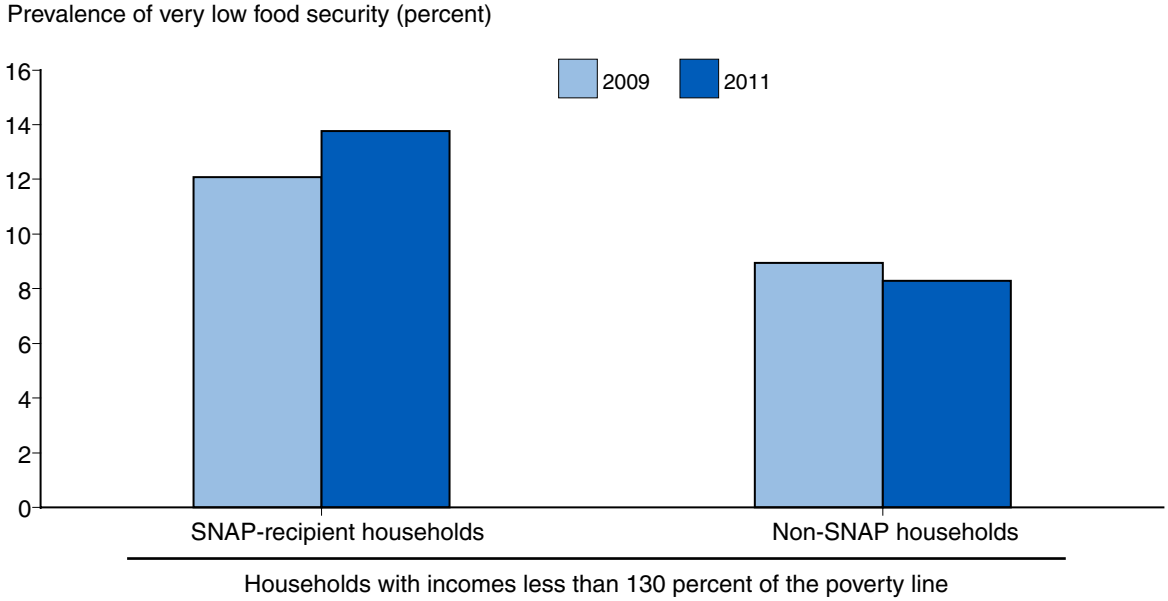
- Changes in food security and food spending by low-income non-SNAP households were small and not statistically significant.
- Results of the two studies suggest that increasing the maximum SNAP benefit by 10 percent ($69 per month for a family of four persons) would reduce the number of SNAP-recipient households with very low food security by about 22 percent, and reducing the maximum benefit by 10 percent would increase that number by about 29 percent.

How Was the Study Conducted?

The study used data on SNAP participation, food security, food spending, and other household characteristics from the 2009 and 2011 Current Population Survey Food Security Supplements (CPS-FSS). The CPS-FSS is an annual supplement to the monthly Current Population Survey, sponsored by USDA and administered by the U.S. Census Bureau. The CPS-FSS is a large, nationally representative survey of the civilian, noninstitutionalized population of the United States and is the source of data for USDA's series of annual reports on the food security of U.S. households.

The analyses compared changes from 2009 to 2011 in the prevalence of very low food security and food spending between households that received SNAP and similarly low-income households that did not receive SNAP.

Food security worsened for SNAP-recipient households, but not for low-income non-SNAP households, as the inflation-adjusted value of SNAP benefits declined from 2009 to 2011



SNAP = Supplemental Nutrition Assistance Program.

Note: The Federal poverty line for a family of four in 2011 was $22,811.

The higher prevalence of very low food security in SNAP-recipient households compared with non-SNAP households reflects the self-targeting of SNAP participation. Households with greater unmet food needs are more likely to enroll in the program, and their greater need is only partially offset by the program benefits.

Source: Calculated by USDA, Economic Research Service using data from the 2009 and 2011 Current Population Survey Food Security Supplements.

Effects of the Decline in the Real Value of SNAP Benefits From 2009 to 2011

Mark Nord

Introduction

This report examines changes in the food security and food spending of Supplemental Nutrition Assistance Program (SNAP) participants as the inflation-adjusted value of their SNAP benefits declined from 2009 to 2011. In 2009, the American Recovery and Reinvestment Act (ARRA) increased benefit levels in SNAP (formerly known as the Food Stamp Program) in order to stimulate the economy and improve the food security of low-income households during a period of unusually challenging economic conditions. ARRA specified that after the 2009 increase, SNAP benefits would remain constant in dollar terms—not adjusted for inflation—until food-price inflation would bring SNAP benefits, as calculated by the pre-ARRA rules, up to the new level. From 2009 to 2011, food-price inflation reduced the real value of the ARRA-SNAP "bonus" by about half, resulting in a reduction in the inflation-adjusted maximum SNAP benefit of about 7 percent. Because of the specific method by which SNAP benefits were adjusted under the ARRA provisions, both the 2009 increase in benefit size and the subsequent reduction due to inflation were greater, in percentage terms, for households receiving less than the maximum allotment than for households of the same size that received the maximum allotment. A reduction in the value of SNAP benefits on the scale realized from 2009 to 2011 would be expected to result in lower food spending and greater difficulty on the part of some households to meet their basic food needs.

Food security, in concept, means access by all people at all times to enough food for an active, healthy life (Anderson, 1990). Households that are food secure have consistent ability to obtain adequate food. In contrast, households that are food insecure are, at times, uncertain of having, or unable to acquire, adequate food for all household members because they have insufficient money and other resources for food.

SNAP provides monthly benefits for eligible low-income families and individuals (hereafter, "households") to purchase approved food items at authorized food stores. In an average month of fiscal year 2011 (October 2010 through September 2011), SNAP provided benefits to about 45 million people in the United States (15 percent of the population). The average benefit was about $134 per person per month, and annual Federal expenditures for the program were nearly $76 billion (USDA, Food and Nutrition Service, 2012). SNAP is the largest of USDA's food and nutrition assistance programs and the cornerstone of the Nation's programs for reducing food insecurity and hunger.

Knowing the extent to which SNAP benefit levels affect households' food spending and food security is important for program planning and policy development. ERS research found that the ARRA SNAP provisions increased food spending by SNAP-recipient households and improved their food security (Nord and Prell, 2011). Under current legislation (PL 111-296), the real value of SNAP

benefits will continue to decline if food prices continue to rise and will revert to pre-ARRA benefit formulas in November 2013 at the latest. Analysis of the effects of a decline in the real value of SNAP benefits on food spending and food security is an important complement to the earlier analysis of the increase in SNAP benefits for understanding these relationships.

The 2009 ARRA Increase in SNAP Benefits Increased Food Spending and Improved Food Security of Low-Income Households

In April 2009, a provision of ARRA increased SNAP benefits for each recipient household by an amount equal to 13.6 percent of the maximum benefit for households of that size. The increase was implemented as a constant dollar amount for each household size, so the increase was 13.6 percent for households receiving the maximum benefit, and a larger percentage for households that had some net income and were therefore eligible for less than the maximum benefit. USDA Food and Nutrition Service (FNS) administrative records, as well as ERS analysis of survey data, showed that the average increase was about 15 percent (Nord and Prell, 2011).

ERS analysis found that median food spending by all low-income households increased and the percentage of low-income households with very low food security declined from late 2008 to late 2009 (Nord and Prell, 2011).[1] Very low food security is a severe range of food insecurity in which the eating patterns of some household members are disrupted and their food intake is reduced below levels they consider appropriate. In most of these households, the respondent reported that he or she had been hungry at times during the month but did not eat because there was not enough money for food. These changes were greater after adjusting for differences in income, employment, and other household characteristics from 2008 to 2009. Households with incomes too high to qualify for SNAP (150 to 200 percent of the poverty line) showed a smaller increase in food spending and no improvement in food security. The difference in the 2008-09 change between households in the income range to be eligible for SNAP and those with somewhat higher incomes suggest that the ARRA SNAP-benefit increase contributed to the increase in food spending and may have accounted completely for the improvement in food security.

The primary analyses by Nord and Prell (2011) included all low-income households. Based on those estimates, and assuming that about half of the low-income households received SNAP, they estimated that the 13.6-percent increase in the maximum benefit may have reduced the number of SNAP-recipient households with very low food security by about 34 percent and raised food spending of SNAP recipients by 4.4 percent. Further analysis by Nord and Prell (2011) of low-income households comparing changes in food spending between households that reported receiving SNAP and those that did not suggested a larger increase in food spending (5.7 percent) than may have been attributable to the ARRA SNAP benefit increase.

[1]For their primary estimates, Nord and Prell (2011) analyzed all low-income households rather than differentiating by SNAP receipt because USDA identified low-income households as the target group for food security improvements through ARRA SNAP enhancements. In addition, examining food security among all low-income households, rather than differentiating by SNAP receipt, mitigated possible concern that self-selection into the program might have changed between 2008 and 2009 both because of the worsening economic conditions and because of the increase in SNAP benefits.

Food Price Inflation From 2009 to 2011 Reduced the ARRA SNAP Bonus by About Half

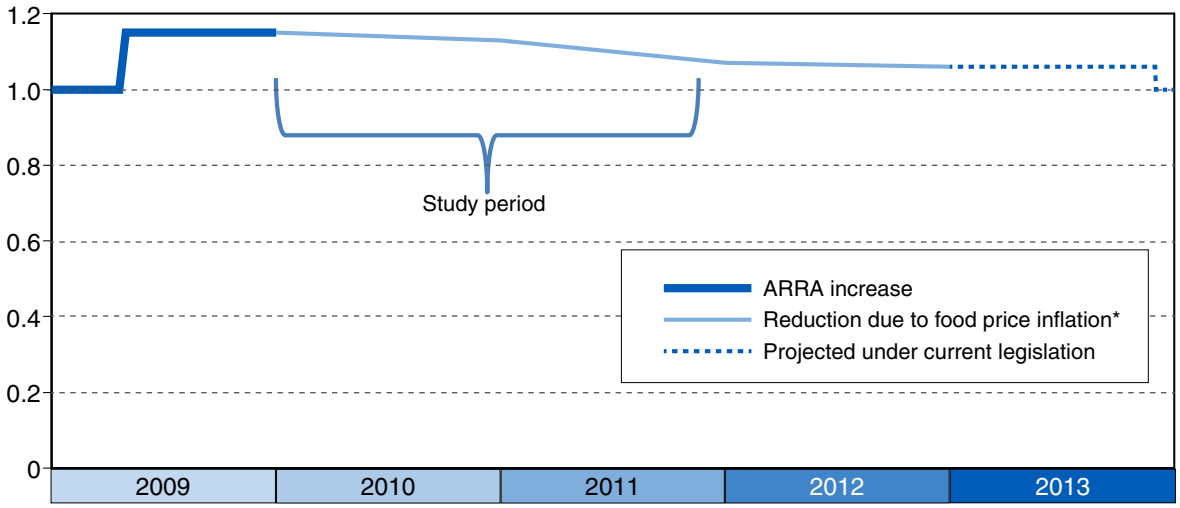
Prior to the ARRA SNAP-benefit increase in 2009, the maximum SNAP benefit for each household size was adjusted upward each year for inflation in food prices. Subsequent to the ARRA increase, maximum SNAP benefits have remained fixed in dollar terms. Their real value, then, has declined as food prices have risen, reducing the size of the ARRA SNAP "bonus" (fig. 1). This study examines changes in food spending and food security between surveys conducted in December 2009 and December 2011. The extent of food price inflation over this period depends to some extent on the "basket of food" on which inflation is calculated. From December 2009 to December 2011, the Consumer Price Index (CPI) for food rose by 6.3 percent, the CPI for food at home rose by 7.8 percent, and the cost of the Thrifty Food Plan (TFP) for a family of two adults and two young children rose by 7.9 percent (Bureau of Labor Statistics, 2012; U.S. Department of Agriculture, Food and Nutrition Service, 2012).[2]

Food price inflation as it affects SNAP recipients may be better represented by inflation in the CPI for food at home and by inflation in the cost of the TFP rather than inflation in prices of food overall.

Figure 1

Inflation-adjusted value of SNAP benefits

Real value of SNAP (indexed to December 2008)



ARRA = American Recovery and Reinvestment Act.

*Food price inflation was measured by change in the cost of the Thrifty Food Plan, which was essentially identical to change in the Consumer Price Index for food at home over this period.

Source: Calculated by USDA, Economic Research Service using data from the Bureau of Labor Statistics (2012); USDA, Center for Nutrition Policy and Promotion (2012), and Nord and Prell (2011).

[2]The Thrifty Food Plan (TFP) serves as a national standard for a nutritious, low-cost diet. It represents a set of "market baskets" of food that people in specific age and gender categories could consume at home to maintain a healthful diet that meets current dietary standards, taking into account the food consumption patterns of U.S. households. The mix of foods in the TFP is updated every 5 years, and in the interim, the quantities of each food in the TFP "market baskets" are fixed. Each month, USDA's Center for Nutrition Policy and Promotion updates the cost of the TFP, that is, the amount of money needed to purchase the "market baskets" of food based on national average food prices of that month. Year-to-year changes in the cost of TFP are the basis by which SNAP benefits were adjusted for food-price inflation prior to the increase mandated by ARRA.

SNAP benefits can only be spent on food to be prepared at home, and research has found that SNAP recipients spend a disproportionate share of their food budget on food at home (Wilde et al., 2009). The TFP represents a more basic basket of food products than that consumed by higher income consumers or the general population. If food prices faced by SNAP recipients increased by around 7 percent from 2009 to 2011, it would have represented a decline in the real value of SNAP benefits about half as large as the increase from 2008 to 2009 that was analyzed in the earlier ERS research (Nord and Prell, 2011).[3]

Consistency of the associations between changes in SNAP benefit levels and presumed outcomes in two time periods in which SNAP benefits changed in opposite directions will increase confidence in the cause-effect interpretation of the associations. If the changes in food spending and food security associated with the earlier increase in SNAP benefits were, in fact, caused by the SNAP benefit increase, then the subsequent decline in the real value of SNAP benefits by about half would be expected to result in about half the reduction in food spending and half the increase in prevalence of very low food security that were associated with the 2009 benefit increase. If changes in food spending and food security from 2009 to 2011 are in the expected direction and range, these findings will strengthen the conclusions of the earlier research. Such corroboration is important because any estimation of program effects from nonexperimental data can be distorted by other changes or events that occur during the study period but are not accounted for in the analysis.

[3]Inflation for nonfood items from 2009 to 2011 was somewhat lower than inflation in food prices. The Consumer Price Index (CPI) for all items rose by about 5 percent over this period. Overall inflation is taken into account in the multivariate models in this study by norming reported income to the Federal poverty line for the survey year. The poverty line is adjusted each year for CPI inflation.

Data and Methods

This section provides a brief overview of the data and methods used in the study. Additional details are in appendix A.

Data

Data are from the December 2009 and December 2011 CPS-FSS. The CPS-FSS is an annual, nationally representative survey conducted for USDA by the U.S. Census Bureau. It provides the data for USDA's annual reports on household food security in the United States (Coleman-Jensen et al., 2012). The survey included 45,363 households in 2009 and 43,634 in 2011. Food security and food spending statistics were calculated for all income ranges. The main multivariate analyses used data only for households with annual incomes below 130 percent of the poverty line, which is the gross income limit for SNAP eligibility.[4] Sample sizes for the low-income sample were 7,673 households in 2009 and 8,053 in 2011. Weights provided by the Census Bureau indicate how many households are represented by each interviewed household and were used for all calculations.

Measures

The food security of each household in the survey was measured by their responses to a series of 10 questions (plus an additional 8 if there were children in the household) about behaviors and conditions that characterize households when they are having difficulty meeting their food needs. Very low food security during the 30 days just prior to the survey, a primary outcome analyzed in this study, is a severe range of food insecurity in which eating patterns of some household members were disrupted and their food intake reduced below levels they consider appropriate because they lacked money and other resources for food.

Food spending is the second outcome analyzed in the study. Each household in the survey reported its usual weekly food spending after reporting how much it had spent for food in each of four kinds of places during the previous week. To adjust for differences in food needs by households of different size and age-gender composition, each household's usual weekly food spending was divided by the cost of the Thrifty Food Plan (TFP) for that household. The TFP serves as a national standard for a low-cost diet that meets national nutrition guidelines. This normalization was also used by Nord and Prell (2011) and is used to calculate food-spending statistics reported in USDA's annual food security report series (Coleman-Jensen et al., 2012). Households that did not report food spending or reported zero food spending were omitted from analyses of food spending, but were included in analyses of food security.

Households reported whether they had received SNAP benefits during the previous year, and, if so, in which months. If their last receipt was in November, they were asked on what day benefits were received. Receipt of SNAP during the 30 days prior to the survey was a key independent variable along with a variable indicating the survey year.

SNAP recipients were asked how much they received in SNAP benefits the last time they received benefits. Households with benefits larger than half the cost of the TFP for the household (about two-

[4]Findings were not sensitive to this income restriction. Robustness tests of the main models (reported later) that included households with incomes up to 185 percent of the poverty line yielded results similar to those in the main models.

thirds of SNAP-recipient households in each year) were classified as having received a large SNAP benefit; those with benefits less than half the cost of the TFP were classified as having received a small SNAP benefit. Households that depend more heavily on SNAP are expected to be affected to a greater extent by the decline in real value of SNAP benefits due to inflation because they spend little for food beyond their SNAP benefit (Edin et al., 2013). Households receiving relatively small benefits supplement SNAP with spending from other sources to meet their food needs and can more readily increase spending from those sources to offset a decline in SNAP benefits.

Covariates were included in the multivariate models to adjust for household characteristics that could have differed between the 2009 and 2011 samples. These included income, employment, household composition, race, Hispanic ethnicity, citizenship, education, metropolitan residence, and geographic region.

Analytic Methods

The prevalence of very low food security and the median TFP-adjusted food spending were compared between 2009 and 2011 for all households and for households in selected income ranges and SNAP-receipt categories. The change from 2009 to 2011 for SNAP recipients was compared with the change for nonrecipients. This unadjusted "difference-in-difference" is a crude estimate of the effect that the reduction in real value of SNAP benefits may have had on the outcome variables. (See box "What Is a Difference-in-Difference Analysis" on page 8.) The logic of this inference is that factors other than the change in real value of SNAP benefits would have affected both SNAP recipients and nonrecipients equally, but the change in the real value of SNAP benefits would have affected only SNAP recipients. This estimate could, however, be misleading, if changes in income, employment, or other characteristics that affect food security differed between SNAP recipients and nonrecipients.

Multivariate models were then estimated to adjust for population-level differences in other characteristics between 2009 and 2011. The model for very low food security was:

$$VLFS = f(Year, SNAP, Year \times SNAP, \mathbf{HHchar})$$

Where *VLFS* is very low food security, Year is the interview year, *SNAP* indicates whether the household received SNAP benefits, *Year* × *SNAP* is the interaction of interview year and SNAP receipt, and ***HHchar*** is a vector of household characteristics including income, employment, household composition, race, Hispanic ethnicity, citizenship, education, metropolitan residence, and geographic region.

The model was estimated using logistic regression. Marginal effects were calculated to represent the percentage-point difference in the probability of very low food security associated with interview year, SNAP receipt, and the interaction (*Year* × *SNAP*).[5] The marginal effect of the interaction term represents the adjusted difference-in-difference and is the best estimate in this study of the effect that the reduction in real value of SNAP benefits may have had on the probability that a SNAP-recipient household experienced very low food security.

[5]The statistical significance of interactions in the logistic regression models were also based on marginal effects, since those calculations can be incorrect if based on the logistic coefficients and the standard errors calculated for them by most statistical software (Ai and Norton, 2003).

What Is a Difference-in-Difference Analysis?

Analysts often use a difference-in-difference analysis to adjust findings from survey data for unknown or unmeasured factors that may have affected the outcome of interest.

For example, in this study, the prevalence of very low food security of SNAP recipients was 12.08 percent in 2009 and 13.77 percent in 2011. The difference was an increase of 1.69 percentage points. This may have been the result of the decline in the real value of SNAP benefits, as hypothesized, but many other things also changed during that 2-year period. Those changes might account for some or all of the observed increase. Or, perhaps, the increase would have been greater in the absence of those changes.

To adjust for the effects of some of those changes, the 2009-11 difference for SNAP recipients is compared with the 2009-11 difference for low-income non-SNAP households. The difference between these two differences is referred to as the "difference-in-difference." Possible findings include these:

- If the prevalence for non-SNAP households also went up by 1.69 percentage points, the difference-in-difference would be zero and would indicate that factors other than the decline in value of SNAP benefits probably accounted for the deterioration of food security of SNAP recipients.
- If the prevalence of very low food security among non-SNAP households rose by 1 percentage point the difference-in-difference would be 0.69 percentage points and would suggest that the decline in SNAP benefits may have caused some of the deterioration in food security of SNAP recipients, but that other factors probably accounted for most of it.
- If the prevalence of very low food security among non-SNAP households was unchanged, the difference-in-difference would be 1.69 percentage point, and this would strengthen confidence that the decline in SNAP benefits caused, or was a major factor in the deterioration of food security of SNAP recipients.
- If the prevalence of very low food security among non-SNAP households declined by 1 percentage point, the difference-in-difference would be 2.69 percentage points, calculated as 1.69-(-1.0), and would suggest that the decline in SNAP benefits may have caused a greater deterioration in food security of SNAP recipients than that indicated in the simple difference, but that other factors partially offset the effects of the decline in SNAP benefits.

In fact, the prevalence of very low food security among low-income non-SNAP households in the CPS-FSS declined from 8.95 percent in 2009 to 8.28 percent in 2011, a difference of -0.67 percentage points. Thus, the observed difference-in-difference was 2.36 percentage points, calculated as the difference between the increase of 1.69 percentage points for SNAP-recipient households and the decline of 0.67 percentage points for non-SNAP households.

The difference-in-difference can be interpreted as the change that would have been observed among SNAP-recipient households in the absence of changes that affected the food security of non-SNAP households, assuming that those same changes occurred among SNAP households and affected them to the same extent as non-SNAP households.

In the multivariate analyses, the difference-in-difference is further adjusted for differences between 2009 and 2011 in income, employment, and other factors for which data are available in the CPS-FSS, in both SNAP and non-SNAP households.

The model for the multivariate analysis of food spending was similar except that it was estimated using quantile regression at the median. This technique estimates the association of median food spending with each variable, adjusted for the associations with the other variables in the model. Food spending is typically reported with considerable error, and reports include a small proportion of large outliers. Such outliers have no effect on the median (midpoint of the distribution), but can seriously distort the mean (arithmetic average) if the outliers represent reporting errors or represent rare and idiosyncratic conditions. Similarly, quantile regression estimates of the independent association of each covariate with the median are not affected by large outliers as estimates from linear regression would be.

The analyses of very low food security and food spending were repeated with SNAP receipt disaggregated into large and small SNAP benefit size. The interactions of each of these variables with survey year were included as the difference-in-difference estimators.

Findings

The prevalence of very low food security in the 30-day period just prior to the food security survey—the primary outcome examined in this study—was essentially unchanged from 2009 to 2011 at the national level (table 1). But this apparent stability resulted from two offsetting changes. The prevalence of very low food security declined among households with incomes higher than 185 percent of the Federal poverty line, from 1.53 percent in 2009 to 1.27 percent in 2011, while remaining essentially unchanged at around 10 percent for households with incomes less than 130 percent of the poverty line. The improvement among middle- and higher income households was offset by a decline in the proportion of households with incomes in that range, from 68.4 percent in 2009 to 66.5 percent in 2011, and an increase in the proportion with incomes below 130 percent of the poverty line, from 21.4 percent in 2009 to 23.7 percent in 2011.

Among low-income households—those with annual incomes less than 130 percent of the poverty line—changes in very low food security from 2009 to 2011 differed between SNAP-recipient households and non-SNAP households (table 1 and fig. 2).[6] Among households interviewed in the food

Table 1

Very low food security and food spending in 2009 and 2011 by household income and SNAP receipt

	Distribution of households by income[1]		Very low food security		Median food spending[2]	
	2009	2011	2009	2011	2009	2011
	———— *Percent* ————				*Ratio to cost of Thrifty Food Plan*	
All households	100.0	100.0	3.33	3.38	1.19*	1.16*
Annual income > 185 percent of poverty line	68.4	66.5	1.53*	1.27*	1.31*	1.26*
Annual income 130-185 percent of poverty line	10.2	9.8	5.23	5.43	.98	.96
Annual income < 130 percent of poverty line	21.4	23.7	9.91	10.16	.94	.93
Did not receive SNAP previous 30 days			8.95	8.28	.93	.93
Received SNAP previous 30 days			12.08	13.77	.94	.92
SNAP benefit > half Thrifty Food Plan cost			10.13*	13.35*	1.01	.99
SNAP benefit < half Thrifty Food Plan cost			16.77	15.86	.77	.76

SNAP = Supplemental Nutrition Assistance Program.

[1]Households that did not report income (about 8 percent in each year) were omitted from calculations of percentages of households in each income range and prevalence rates by income, but were included in the prevalence rates for all households. The prevalence rates for households that did not report income were near the average for households that did report income.

[2]Reported usual food spending was divided by the cost of the Thrifty Food Plan for the household prior to calculating the median. Households were omitted from the calculation of median food spending if they did not report usual food spending or reported zero usual food spending.

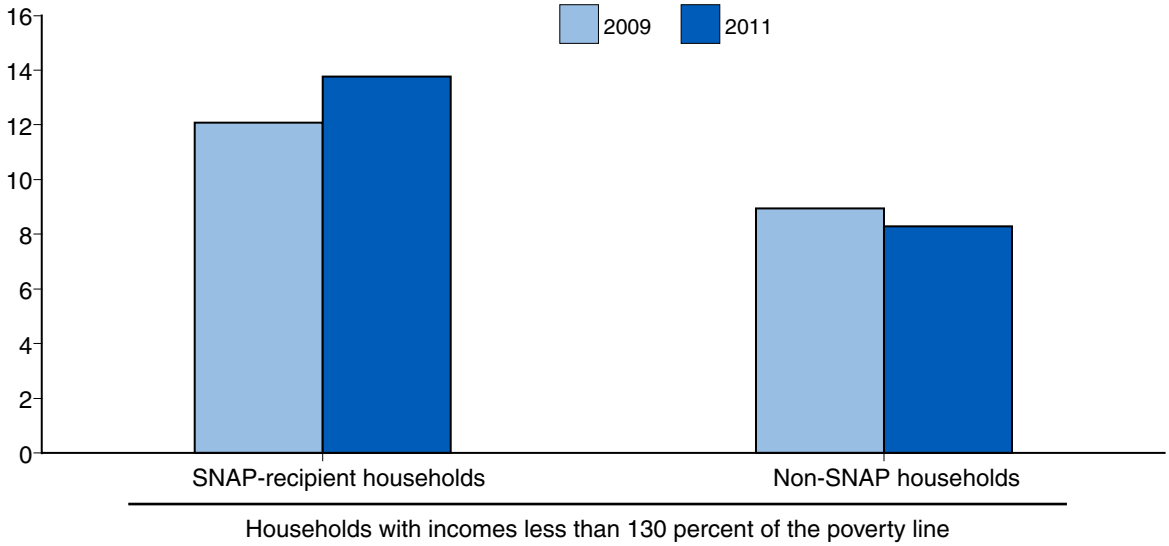
*= Difference from 2009 to 2011 is statistically significant with 95-percent confidence.

Source: Calculated by USDA, Economic Research Service using data from the December 2009 and December 2011 Current Population Survey Food Security Supplements.

[6]The higher prevalence of very low food security among SNAP recipients compared with low-income non-SNAP households in each year reflects the self-targeting of SNAP participation. Households with greater unmet food needs are more likely to apply for the program. Previous research has documented this self-targeting differential in food insecurity, which is only partly offset by the improvement in food security that results from the program benefits (Nord and Golla, 2009; Ratcliffe et al., 2011).

Figure 2

Food security worsened for SNAP recipient households, but not for low-income non-SNAP households, as the inflation-adjusted value of SNAP benefits declined from 2009 to 2011



SNAP = Supplemental Nutrition Assistance Program.

Note: The Federal poverty line for a family of four in 2011 was $22,811.

The higher prevalence of very low food security in SNAP-recipient households compared with non-SNAP households reflects the self-targeting of SNAP participation. Households with greater unmet food needs are more likely to enroll in the program, and their greater need is only partially offset by the program benefits.

Source: Calculated by USDA, Economic Research Service using data from the 2009 and 2011 Current Population Survey Food Security Supplements.

security survey, the percentage of SNAP-recipient households with very low food security increased by 1.69 percentage points (from 12.08 percent to 13.77 percent), while declining by 0.67 percentage points among non-SNAP households (from 8.98 percent to 8.28 percent). Although neither of these changes was statistically significant, the difference between them—the "difference-in-difference"—of 2.36 percentage points was statistically significant (p=.04).[7] (See box, "What Is a Difference-in-Difference Analysis?" on page 8 for details of this calculation.) For households that relied heavily on SNAP, the prevalence of very low food security increased by 3.22 percentage points, from 10.13 percent in 2009 to 13.35 percent in 2011. The difference-in-difference for these households, compared with non-SNAP households, was 3.89 percentage points, calculated as 3.22-(-0.67) and was statistically significant (p<.01). No deterioration from 2009 to 2011 was observed for SNAP-recipient households with benefits less than half the cost of the TFP, and the difference-in-difference compared with non-SNAP households was near zero and not statistically significant.

Median food spending relative to the cost of the TFP declined among middle-income and higher income households from 2009 to 2011, but it remained well above the cost of the TFP (26 percent above in 2011). Median food spending in both years was lower for low-income households, generally near or below the cost of the TFP. Changes within each of the low-income groups were small, and

[7]Statistical significance for the difference-in-difference is based on a one-tailed test, consistent with the directional hypothesis that very low food security would worsen among SNAP recipients due to the decline in real value of SNAP benefits.

none was statistically significant, nor was the difference-in-difference between any SNAP-recipient group and nonrecipients.

The overall changes in food security and food spending described above may have resulted from changes in many factors in addition to the effects of the decline in real value of SNAP benefits. Other concurrent changes in households' income, employment, and other characteristics may have added to, or offset the effect of the SNAP benefit decline. Multivariate regression models are considered next to adjust for such factors to the extent that they were measured in the surveys. Effects of changes in other characteristics not included in the models may remain and bias the multivariate results, but unless these effects differed between SNAP recipients and nonrecipients, they are accounted for by the difference-in-difference methodology.

After adjusting for differences in income, employment, and other household characteristics, the prevalence of very low food security increased over the 2-year period among SNAP recipients but remained almost unchanged among non-SNAP households (table 2, model 1). The change from 2009 to 2011 for non-SNAP households is represented by the coefficient on *"Interview in 2011,"* which is small (-0.19 percentage point marginal effect) and not statistically significant (p=.760). The marginal effect of 1.95 percentage points on the interaction, *"SNAP receipt x Interview in 2011"* represents the difference-in-difference for households with characteristics of the average low-income household. The adjusted difference-in-difference of 1.95 percentage points was somewhat smaller than the unadjusted estimate of 2.36 percentage points calculated from statistics in table 1, but remained statistically significant (p=.020). If this difference-in-difference reflects the effect of the decline in real value of SNAP benefits, it suggests that the decline resulted in an increase in the number of SNAP-recipient households with very low food security of about 16.5 percent. This is calculated as 1.95 / (13.77-1.95), where 13.77 percent is the prevalence of very low food security for SNAP recipients in 2011, and the denominator, then, is the counterfactual prevalence that would have been observed absent the increase of 1.95 percentage points. This is very near half the size of the reduction in the number of SNAP recipient households (34 percent) estimated by Nord and Prell (2011) to have been associated with the SNAP-benefit increase under ARRA—a benefit increase about twice as large as the 2009-11 reduction in benefit value.

As expected, the adjusted difference-in-difference was larger for households that depended more heavily on SNAP for their food spending than for those that received smaller SNAP benefits. The adjusted difference-in-difference for households receiving a large SNAP benefit was 2.81 percentage points (model 2, table 2). For those receiving a SNAP benefit less than half the cost of the TFP, the difference-in-difference (compared with low-income non-SNAP households) was small and not statistically significant.[8]

[8]Researchers who are familiar with the literature on the effects of self-selection of more food-needy households into SNAP and the difficulties this introduces into any attempt to estimate the ameliorative effect of SNAP on food insecurity may find the coefficients on the main effects of receipt of large and small SNAP benefits in model 2 illuminating. These coefficients represent the combined (opposite) effects of selection (households with greater food needs are more likely to participate in SNAP) and amelioration (participation in SNAP reduces very low food security). For households receiving a large SNAP benefit, this net association is a reduced likelihood of very low food security, compared with non-SNAP households, of 1.16 percentage points. For households that received a small SNAP benefit, however, the net association was an increased likelihood of very low food security of 4.96 percentage points. The ameliorative effect of SNAP is less for these households than for those getting a larger benefit, not only because their benefit is smaller, but also because they can shift spending of their own resources away from food and into other goods and services. (The reason their benefit is small is that they have other income.) As a result, for households receiving a small SNAP benefit, the selection effect predominates, while for those receiving a large SNAP benefit, the ameliorative effect predominates.

Table 2

Logistic regression of very low food security in 30 days prior to survey on survey year and SNAP receipt, with controls for household characteristics

	Model 1			Model 2		
Characteristic	Odds ratio	Marginal effect (per-centage points)[1]	P[2]	Odds ratio	Marginal effect (per-centage points)[1]	P[2]
Interview in 2011	0.979	-0.19	.760	0.981	-0.16	.788
Received SNAP in 30 days prior to survey	1.111	.92	.228			
Interaction: SNAP receipt x Interview in 2011	1.233	1.95	**.020**			
Received large SNAP benefit[3]				.872	-1.16	.200
Interaction: Large SNAP benefit x Interview in 2011				1.400	2.81	**.004**
Received small SNAP benefit[3]				1.648	4.96	<.001
Interaction: Small SNAP benefit x Interview in 2011				1.083	.88	.605
Both models also included variables representing income, employment, household composition, race, Hispanic ethnicity, citizenship, education, metropolitan residence, and geographic region. The complete models are presented in appendix table B-1.						
Number of cases		15,726			15,503	
Somers' D		.389			.401	

SNAP = Supplemental Nutrition Assistance Program.

Note: Somers' D measures how strongly the dichotomous dependent variable is associated with the combined explanatory variables in the model. It ranges from 0 to 1 with higher values indicating a stronger association.

[1]Marginal effects were calculated as the mean marginal effects for the sample. The marginal effects of interactions and the corresponding standard errors were calculated using the method outlined by Ai and Norton (2003) and Norton et al. (2004).

[2]Tabled p values (the probabilities of the null hypothesis), except for those of two interactions, are based on the usual 2-tailed test as provided by the statistical software. For the interactions, [SNAP receipt x Interview in 2011] and [Large SNAP benefit x Interview in 2011], **one-tailed p values are shown (in bold type)**, consistent with the directional hypothesis underlying this study (i.e., that these interactions would be positive because of the decline in inflation-adjusted SNAP benefit value). The p values of all interactions were calculated from the standard errors of the estimated mean marginal effects.

[3]Households receiving SNAP benefits were classified as receiving large SNAP benefits if their reported benefit was higher than half the cost of the Thrifty Food Plan for the household. Those receiving SNAP benefits less than that amount were classified as receiving small SNAP benefits. Households were omitted from the model 2 analysis if they reported SNAP receipt but did not report the benefit amount.

Source: Calculated by USDA, Economic Research Service using data from the December 2009 and December 2011 Current Population Survey Food Security Supplements.

Changes in food spending from 2009 to 2011, after adjusting for differences in income, employment, and other household characteristics, were generally consistent with the changes in very low food security, although somewhat weaker statistically. Adjusted median food spending declined for SNAP recipients while remaining essentially unchanged for non-SNAP households, although the coefficient for the difference in difference was only marginally significant (p=.052; table 3). The adjusted difference-in-difference amounted to 4.2 percent of the cost of the TFP. For those receiving a large SNAP benefit, the difference-in-difference was 4.8 percent of the cost of the TFP and was statistically significant (p=.03). The interaction for those receiving a small SNAP benefit was smaller (3.0 percent of the cost of the TFP) and was not statistically significant.

To compare the estimated difference-in-difference of 4.2 percent of the cost of the TFP with the corresponding estimate from Nord and Prell (2011), the difference-in-difference must be

expressed as a percentage of the estimated counterfactual level of food spending that would have been observed in 2011 absent the decline in the value of SNAP benefits. That counterfactual was 96.2 percent of the cost of the TFP, calculated as the sum of the observed median food spending for SNAP recipients in 2011 (92 percent of the cost of the TFP) plus the adjusted difference-in-difference of 4.2 percent of the cost of the TFP. Thus, the difference-in-difference of 4.2 percent of the cost of the TFP represented a decline of 4.4 percent from the counterfactual. This is somewhat larger than expected based on the estimated increase of 4.4 to 5.7 percent associated with an increase in SNAP benefits about twice as large as the 2009-11 reduction (Nord and Prell, 2011). However, the expected one-to-two ratio of the changes in food spending from the two studies is well within the margin of error.

Table 3

Quantile (median) regression of food spending relative to the Thrifty Food Plan on survey year and SNAP receipt, with controls for household characteristics

	Model 3		Model 4	
Characteristic	Coefficient	P[1]	Coefficient	P[1]
Interview in 2011	0.007	.628	0.005	.722
Received SNAP in 30 days prior to survey	.058	.002		
Interaction: SNAP receipt x Interview in 2011	-.042	**.052**		
Received large SNAP benefit[2]			.119	<.001
Interaction: Large SNAP benefit x Interview in 2011			-.048	**.031**
Received small SNAP benefit[2]			-.067	.010
Interaction: Small SNAP benefit x Interview in 2011			-.030	.348
Both models also included variables representing income, employment, household composition, race, Hispanic ethnicity, citizenship, education, metropolitan residence, and geographic region. The complete models are presented in appendix table B-2.				
Number of cases	14,821		14,645	

SNAP = Supplemental Nutrition Assistance Program.

[1]Tabled p values (the probabilities of the null hypothesis), except for those of two interactions, are based on the usual 2-tailed test as provided by the statistical software. For the interactions, [SNAP receipt x Interview in 2011] and [Large SNAP benefit x Interview in 2011], **one-tailed p values are shown (in bold type)**, consistent with the directional hypothesis underlying this study (i.e., that these interactions would be negative because of the decline in inflation-adjusted SNAP benefit value).

[2]Households receiving SNAP benefits were classified as receiving large SNAP benefits if their reported benefit was higher than half the cost of the Thrifty Food Plan for the household. Those receiving SNAP benefits less than that amount were classified as receiving small SNAP benefits.

Source: Calculated by USDA, Economic Research Service using data from the December 2009 and December 2011 Current Population Survey Food Security Supplements.

Robustness of the Findings

Several alternative samples and specifications were explored to assess the robustness of the findings described above. Results (not shown) were generally consistent with those from the primary models, and are summarized briefly as follows:

- The logistic regression and quantile (median) regression analyses were repeated with the sample expanded to include households with incomes up to 185 percent of the poverty line. Results were similar, and the statistical significance of coefficients of interest did not change.
- The analyses were repeated using unweighted data. Results did not change substantially.
- The logistic regression analyses were repeated as linear probability models (using ordinary least squares regression). This avoids analytic difficulties in estimating and interpreting interactions. Results were consistent with those from logistic regression. The difference-in-difference estimates were essentially the same as the mean marginal effects estimated in the logistic regression models. The difference-in-difference estimates for SNAP receipt (corresponding to that in model 1) and for large SNAP benefit (corresponding to that in model 2) were more strongly significant in the linear probability models than in the logistic models.
- The logistic regression models (models 1 and 2 in table 2) were repeated with the dependent variable as food insecurity instead of very low food security. It was expected that the SNAP x year interactions would be weaker for these models because SNAP receipt is not expected to alleviate less severe outcomes of food insecurity to as great an extent as it alleviates more severe outcomes. Consistent with this expectation, the results were qualitatively similar to those for very low food security but were weaker and not statistically significant.

An analysis was also conducted to assess whether the extent of economic disadvantage of households that participated in SNAP compared with those of non-SNAP households differed between 2009 and 2011. Results of that analysis are presented in appendix C. In short, self-selection based on observed characteristics changed little from 2009 to 2011. Unless self-selection on unobserved characteristics changed to a considerably greater extent, the change would not substantially affect the findings presented above.

Limitations of the Findings

Two factors with opposite and potentially important effects on the results could not be accounted for in the study. Receipt of SNAP and benefits from other assistance programs is underreported in most major surveys (Meyer et al., 2008). Analysis (not shown) of the data used in this study found that the number of households estimated to be receiving SNAP was substantially smaller than the number of households reported in administrative data. This misreporting of SNAP receipt by some SNAP-recipient households would have weakened the difference-in-difference results because households that received SNAP but did not report it in the survey would have been classified as nonrecipients in the analysis but would have been affected by the reduction in real value of SNAP benefits.

The second potential confounding factor is that information on asset holding is not collected in the CPS-FSS. Households with substantial financial assets are usually not eligible for SNAP even though their income may be low. Some of the households in the comparison group for the difference-in-difference analysis—non-SNAP households with incomes below 130 percent of the poverty line—may have had substantial assets and drawn on them to support consumption of food and other needs. This may have protected some households in the comparison group from some factors that negatively affected SNAP recipients but were not accounted for in the models. The effect of this factor cannot be ruled out, but in each of the multivariate models, the difference-in-difference was driven almost entirely by deterioration of food security and food spending among SNAP recipients. Coefficients on interview year (which, because of the inclusion of the interaction of interview year with SNAP receipt, indicates change for non-SNAP recipients) were small and not nearly statistically significant (p=.76 in the model for very low food security and p=.63 in the model for food spending.)

Conclusions

The results of these analyses, taken together with the results of the earlier ERS analysis of changes concurrent with the implementation of the SNAP-benefit increase under ARRA, provide a consistent picture of how changes in SNAP benefits affect food security and food spending. The earlier analysis estimated that the SNAP-benefit increase under ARRA reduced the number of SNAP-recipient households with very low food security by about 34 percent. The present study estimates an effect nearly half that size (14 percent)[9] associated with the loss of about half of the ARRA SNAP-benefit increase to food-price inflation. The earlier analysis estimated that food spending by SNAP-recipient households increased by between 4.4 and 5.7 percent as a result of the ARRA SNAP-benefit increase. The present study estimates that a loss of about half of that added benefit reduced spending by 4.4 percent. The reduction in food spending from 2009 to 2011 is greater than expected relative to the increase from 2008 to 2009. However, a difference of about half of the 2008-09 change, which would be consistent with the changes in real value of benefits, is well within the combined margin of error of the two estimates.

Changes in food security and food spending from 2009 to 2011 were larger among households that received relatively large SNAP benefits than among those that received smaller SNAP benefits. This further strengthens the conclusion that the observed associations represent effects of the reduction in real value of SNAP benefits. Households that receive a relatively small SNAP benefit may increase or decrease their spending for food out of their other resources to offset changes in their SNAP benefit. Food budgets of households that rely heavily on SNAP benefits for their food purchases are more closely tied to the value of those benefits.

The concurrence of the two studies increases confidence that the results of both represent primarily effects of the benefit changes and not effects of other coincidental changes or events. Taken together, the two studies suggest that an increase in the maximum SNAP benefits of 10 percent ($69 per month for a family of four persons) would reduce the number of SNAP recipient households with very low food security by about 22 percent (4.9 million households). A decrease in the maximum SNAP benefits by 10 percent would increase the prevalence of very low food security among recipients by about 29 percent (6.5 million households).[10] Estimated effects on food spending are less concordant between the two studies, but are likely to be in the range of 3 to 6 percent for a 10-percent change in maximum SNAP benefit.

[9]To compare the results of the current study with that of the earlier study, the increase in very low food security is calculated here relative to the observed value in 2011 (13.77 percent).

[10]These two estimates, 22 percent and 29 percent, are calculated from the same underlying relationship. Because the benefit level and number of recipient households with very low food security are inversely related—that is, they move in opposite directions—the percentage changes in very low food security associated with upward and downward changes in benefit levels differ. Estimated numbers of households are based on the average monthly participation of 22.3 million households in fiscal year 2012.

References

Ai, Chunrong, and Edward C. Norton. 2003. "Interaction terms in logit and probit models," *Economics Letters* 80(1):123-129.

Anderson, S.A. (ed.). 1990. "Core Indicators of Nutritional State for Difficult-To-Sample Populations," *Journal of Nutrition* 120(11S):1557-1600. Report by the Life Sciences Research Office, Federation of American Societies for Experimental Biology, for the American Institute of Nutrition.

Bureau of Labor Statistics, 2012. *CPI Tables*, http://www.bls.gov/cpi/tables.htm (tables for December 2009 and December 2011), downloaded November 14, 2012.

Coleman-Jensen, Alisha, Mark Nord, Margaret Andrews, and Steven Carlson. 2012. *Household Food Security in the United States in 2011*, ERR-141, USDA, Economic Research Service, http://www.ers.usda.gov/publications/err-economic-research-report/err141.aspx

Edin, Kathryn, Melody Boyd, James Mabli, Jim Ohls, Julie Worthington, Sara Greene, Nicholas Redel, and Swetha Sridharan. 2013. *SNAP Food Security In-Depth Interview Study: Final Report*, USDA, Food and Nutrition Service, http://www.fns.usda.gov/ORA/menu/Published/SNAP/FILES/Participation/SNAPFoodSec.pdf

Meyer, Bruce D., Wallace K.C. Mok, and James X. Sullivan. 2008. *The Under-Reporting of Transfers in Household Surveys: Its Nature and Consequences*, NBER Working Paper 15181. Cambridge, Massachusetts: National Bureau of Economic Research, http://www.nber.org/programs/ag/rrc/08-12%20Meyer,%20Mok,%20Sullivan%20FINAL.pdf

Nord, Mark. 2013. "Youth Are Less Likely To Be Food Insecure Than Adults in the Same Household," *Journal of Hunger and Environmental Nutrition* 8(2):146-163.

Nord, Mark. 2009. *Food Spending Declined and Food Insecurity Increased for Middle-Income and Low-Income Households from 2000 to 2007*, EIB-61, USDA, Economic Research Service, http://www.ers.usda.gov/publications/eib-economic-information-bulletin/eib61.aspx.

Nord, Mark, and Anne Marie Golla. 2009. *Does SNAP Decrease Food Insecurity? Untangling the Self-Selection Effect*, ERR-85, U.S. Department of Agriculture, Economic Research Service, http://www.ers.usda.gov/publications/err-economic-research-report/err85.aspx

Nord, Mark and Mark Prell. 2011. *Food Security Improved Following the 2009 ARRA Increase in SNAP Benefits*, ERR-116, USDA, Economic Research Service, http://www.ers.usda.gov/publications/err-economic-research-report/err116.aspx

Norton, Edward C., Hua Wang, and Chunrong Ai. 2004. "Computing interaction effects and standard errors in logit and probit models," *The Stata Journal* 4(2): 154-167.

Oliveira, Victor, and Donald Rose. 1996. *Food Expenditure Estimates From the 1995 CPS Food Security Supplement: How Do They Compare with the Consumer Expenditure Survey?,* Staff Report No. AGES9617, USDA, Economic Research Service.

Ratcliffe, Caroline, Signe-Mary McKernan, and Sisi Zhang. 2011. "How Much Does the Supplemental Nutrition Assistance Program Reduce Food Insecurity?," *American Journal of Agricultural Economics* 93(4):1082-1098.

U.S. Department of Agriculture, Center for Nutrition Policy and Promotion. 2012. *Cost of Food at Home: U.S. Average at Four Cost Levels*, http://www.cnpp.usda.gov/USDAFoodCost-Home.htm (tables for December 2009 and December 2011) downloaded November 14, 2012.

U.S. Department of Agriculture, Food and Nutrition Service. 2012. *Supplemental Nutrition Assistance Program Participation and Costs,* http://www.fns.usda.gov/pd/SNAPsummary.htm (downloaded November 15, 2012).

Wilde, Parke E., Lisa M. Troy, and Beatrice L. Rogers. 2009. "Food Stamps and Food Spending: An Engel Function Approach," *American Journal of Agricultural Economics* 91(2): 416-430.

Appendix A: Calculation of Variables and Statistical Methods

This appendix provides descriptions of each of the variables in the multivariate models that are summarized in tables 2 and 3 and presented in detail in appendix B,J and provides further technical details on the estimation models.

Calculation of dependent variables and covariates in the multivariate models

Very low food security in the 30 days prior to the survey is measured by responses of 1 adult in each household to a series of 10 questions (18 if there are children in the household) about conditions and behaviors that characterize households when they are having difficulty obtaining enough food. In the CPS-FSS, each question is initially asked with reference to the past 12 months. Affirmative responses are followed up with *"Did this happen in the last 30 days?"* Responses to the 30-day followup questions are used to construct the 30-day food security scale used in this study. Households that affirm six or more of the questions (eight or more, including the child-referenced questions if there are children in the household) are classified as having very low food security. A list of the questions can be found on the ERS website (http://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-us/measurement.aspx) or in Coleman-Jensen et al., 2012.

Food spending relative to the cost of the Thrifty Food Plan (TFP)—Each household's usual weekly food spending was reported by CPS-FSS respondents after they were given a chance to reflect on the household's actual food spending during the previous week. Respondents were first asked to report the amounts their households had spent on food in the week prior to the interview (including any purchases made with SNAP benefits) at each of four kinds of places: supermarkets and grocery stores; other stores such as meat markets, produce stands, bakeries, warehouse clubs, and convenience stores; restaurants, fast food places, cafeterias, and vending machines; and "any other kind of place." Total spending for food, based on responses to this series of questions, was verified with the respondent, and the respondent was then asked how much the household usually spent on food during a week (including any purchases made with SNAP benefits). Analyses by ERS researchers have found that food expenditures estimated from data collected by this method are consistent with estimates from the Consumer Expenditure Survey (CEX)—the principal source of data on U.S. household expenditures for goods and services (Oliveira and Rose, 1996; Nord 2009).

The household's usual food expenditure was expressed as a ratio to the cost of the TFP for that household at the time of the survey. This measure adjusts for differences in household size and age-sex composition within each year and adjusts for differences in food prices across years. Households' food needs differ depending on the number, ages, and genders of household members. The cost of the TFP provides a basis for comparing food spending patterns across diverse households within a survey year. Price inflation can cause a household's food expenditures to change from year to year even if it buys exactly the same food items.[11]

[11]If the typical basket of food consumed by low-income households differs from the TFP, then the food-price inflation they face may differ from inflation in the TFP. Any such differences should not bias the difference-in–difference analysis, however. An incorrect inflation adjustment will affect both SNAP recipients and nonrecipients, and will, therefore, be picked up in the coefficient for the main effect of the Interview in 2011 variable, leaving the coefficient on Interaction: SNAP receipt × Interview in 2011 (representing the difference-in-difference) unaffected.

Interview in 2011 is a binary variable with value 0 for households interviewed in 2009 and value 1 for households interviewed in 2011.

Received SNAP in 30 days prior to survey—The household respondent is asked whether anyone in the household received benefits from SNAP, Food Stamps, or the program name used for SNAP in their State (if different than SNAP or Food Stamps). If they responded "yes," they were asked which months SNAP or Food Stamp benefits were received. If benefits were received in November, but not in December, they were asked on which day in November they received benefits. Households were classified as having received SNAP during the previous 30 days if they had received benefits within 30 days of the earliest date on which interviews were conducted (December 13 in 2009 and December 11 in 2011.)

Received large SNAP benefit or received small SNAP benefit—Households whose SNAP benefit exceeded half of the cost of the TFP for the household (about two-thirds of SNAP-recipient households in each year) were classified as having received a large SNAP benefit. Those receiving benefits equal to or less than half the cost of the TFP were classified as having received a small SNAP benefit. SNAP-recipient households that did not report the amount of benefit received (1.4 percent) were omitted from analysis in which the size of SNAP benefits was included.

Income (ratio to poverty line)—Annual household income is reported in ranges in the core labor force portion of the CPS. Income for each household was approximated as the center of the reported range. The poverty line for each household was assigned from the Census Bureau's table of poverty thresholds for the year of the survey, based on the number of adults and the number of children in the household and whether the household reference person was younger or older than 65. A quadratic specification for income was explored in each model (i.e., including income-squared along with the income), but the coefficient on the squared term was small and not statistically significant, so only the linear variable was retained.

Income in lowest reported category—A binary variable indicates whether the household reported annual income in the lowest income range (less than $5,000). This category may include a mixture of households that have very low income and low resources and other households that have temporarily low income but have other resources to draw on. There is evidence of this in the present study in that the odds ratio on this variable is less than 1 and statistically significant in the logistic regression models (appendix table B-1), indicating that households with incomes reported in the lowest category have better food security than expected given their reported income and other characteristics.

Labor force status, proportion of adults—The labor force status of each adult (age 18 or older) was assigned in one of six categories, based on the variables *monthly labor force recode* (PEMLR) and *full/part-time work status* (PRWKSTAT) in the core labor force portion of the CPS. The six categories are: employed full time, employed part time for noneconomic reasons (the individual was not seeking full-time work), employed part time for economic reasons (the individual wanted to work more hours but could not find a full-time job), unemployed (looking for work), out of the labor force-retired, out of the labor force-disabled, out of the labor force-not retired or disabled. The labor force status variables in the models represent the proportion of adults in each category. The proportion working full time was omitted to avoid collinearity, since the proportions add to 1. Models were explored with more extensive specification of the labor force status of adults, but gains in overall model fit were modest, and the coefficients on the variables of interest were essentially unchanged.

Household composition was represented by a set of six dummy variables. The reference category was *married couple with child/children*. In some cases, the SNAP unit may comprise only a subset of household members, but there is not enough information in the CPS-FSS to differentiate SNAP units from households. Furthermore, income, food security, and food spending are all reported for the entire household, and resources, including SNAP benefits, are, in most cases, shared at the household level.

Number of children ages 0-5 years, 6-11 years, and 12-17 years adjusts both for the difference in expenses for older versus younger children and also for the greater extent to which adults shield younger children from food insecurity even if the adults are food insecure (Edin et al., 2013; Nord, 2013).

Race and Hispanic ethnicity of the household reference person is represented by a set of three dummy variables for Black non-Hispanic, Hispanic, and American Indian or Alaska Native. The reference category is White non-Hispanic and Asian non-Hispanic. Those who reported their race as American Indian or Alaska Native and also reported Hispanic ethnicity were classified as American Indian or Alaska Native.

Noncitizen household reference person identifies households in which the reference person is not a U.S. citizen either by birth or by naturalization. Documentation status for noncitizens is not known for CPS respondents.

Educational attainment of graduation most highly educated adult is represented by a set of three dummy variables with high school graduation or GED as the reference category.

Metropolitan/nonmetropolitan residence is represented by a set of three dummy variables with metropolitan, not in principal city as the reference category. These would generally be households in the suburban and exurban areas outside the incorporated city or cities at the heart of the metropolitan area.

Census Region is represented by a set of three dummy variables with Northeast as the reference category. The composition of the regions is as follows: ***Northeast***: Maine, New Hampshire, Vermont, Connecticut, Massachusetts, Rhode Island, New York, New Jersey, Pennsylvania; ***Midwest***: Ohio, Indiana, Illinois, Michigan, Wisconsin, Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas; ***South***: Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida, Kentucky, Tennessee, Alabama, Mississippi, Arkansas, Louisiana, Oklahoma, Texas; ***West***: Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada, Washington, Oregon, California, Alaska, Hawaii.

Multivariate models

Data processing and model estimations were conducted using SAS 9.2 (SAS Institute Inc., Cary, NC). The size, marginal effect, and statistical significance of interactions in logistic regression are not well represented by the logistic coefficients (Ai and Norton, 2003). Marginal effects and standard errors for the interactions in the multivariate logistic regression models were calculated in SAS data steps following Norton et al. (2004).

Appendix B: Multivariate Logistic and Quantile (Median) Regression Tables

Appendix table B-1 and appendix table B-2 present the complete results of the regression models that are presented in summary form in tables 2 and 3 in the "Findings" section of the report.

Appendix table B-1

Logistic regression of very low food security in 30 days prior to survey on survey year and SNAP receipt, with controls for household characteristics

Characteristic	Model 1		Model 2	
	Odds ratio	P[1]	Odds ratio	P[1]
Intercept	0.074	<.001	0.080	<.001
Interview in 2011	.979	.760	.981	.788
Received SNAP in 30 days prior to survey	1.111	.228		
Interaction: SNAP receipt x Interview in 2011	1.233	**.020**		
Received large SNAP benefit[2]			.872	.200
Interaction: Large SNAP benefit x Interview in 2011			1.400	**.006**
Received small SNAP benefit[2]			1.648	<.001
Interaction: Small SNAP benefit x Interview in 2011			1.083	.605
Income (ratio to poverty line)	.709	.003	.680	<.001
Income in lowest reported category	.765	.010	.764	.010
Labor force status, proportion of adults (reference: all adults employed full time)				
Out of labor force—retired	.764	.110	.764	.112
Part-time for noneconomic reasons	1.209	.192	1.215	.180
Part-time for economic reasons	2.379	<.001	2.402	<.001
Unemployed	2.663	<.001	2.721	<.001
Out of labor force—disabled	3.102	<.001	3.048	<.001
Out of labor force, not retired or disabled	1.582	<.001	1.602	<.001
Household composition (reference: married couple with child/children)				
Single male with child/children	.893	.501	.882	.456
Single female with child/children	1.101	.325	1.132	.207
Other household with child/children	.645	.262	.629	.237
Two or more adults, no child	1.358	.017	1.350	.020
Male living alone	1.427	.009	1.420	.010
Female living alone	1.643	<.001	1.651	<.001
Number of children ages 0-5 years	.759	<.001	.769	<.001
Number of children ages 6-11 years	.972	.571	.971	.564
Number of children ages 12-17 years	1.253	<.001	1.243	<.001
One or more elderly in the household	.554	<.001	.539	<.001
Race and Hispanic ethnicity (reference: White non-Hispanic)				
Black non-Hispanic	.974	.714	.974	.723
Hispanic	.999	.988	.976	.776
American Indian or Alaska Native	1.216	.300	1.204	.327

continued—

Appendix table B-1

Logistic regression of very low food security in 30 days prior to survey on survey year and SNAP receipt, with controls for household characteristics—Continued

Characteristic	Model 1		Model 2	
	Odds ratio	P[1]	Odds ratio	P[1]
Noncitizen household reference person	.926	.442	.908	.337
Educational attainment of most highly educated adult (reference: high school or GED)				
Less than high school	1.156	.054	1.183	.027
Some college, no 4-year degree	1.085	.223	1.079	.261
Bachelor degree or higher	.730	.003	.720	.002
Metropolitan/nonmetropolitan residence (reference: metropolitan, not in principal city)				
Metropolitan, principal city	.803	.001	.803	.002
Metropolitan, not specifically identified	.804	.011	.802	.011
Not in metropolitan area	.683	<.001	.672	<.001
Census Region (reference: Northeast)				
Midwest	1.178	.086	1.141	.170
South	1.197	.037	1.152	.103
West	1.324	.003	1.280	.010
Number of cases	15,726		15,503	
Somers' D	0.389		0.401	

SNAP = Supplemental Nutrition Assistance Program.

Note: Somers' D measures how strongly the dichotomous dependent variable is associated with the combined explanatory variables in the model. It ranges from 0 to 1 with higher values indicating a stronger association.

[1]Tabled p values (the probabilities of the null hypothesis), except for those of two interactions, are based on the usual 2-tailed test as provided by the statistical software. For the interactions, [SNAP receipt x Interview in 2011] and [Large SNAP benefit x Interview in 2011], one-tailed p values are shown (in bold type), consistent with the directional hypothesis underlying this study (i.e., that these interactions would be positive because of the decline in inflation-adjusted SNAP benefit value). The p values for all interactions were calculated from the standard errors of the estimated mean marginal effects, following Ai and Norton (2003) and Norton et al. (2004).

[2]Households receiving SNAP benefits were classified as receiving large SNAP benefits if their reported benefit was higher than half the cost of the Thrifty Food Plan for the household. Those receiving SNAP benefits less than that amount were classified as receiving small SNAP benefits. Households were omitted from the analysis if they reported SNAP receipt but did not report the benefit amount.

Source: Calculated by USDA, Economic Research Service using data from the December 2009 and December 2011 Current Population Survey Food Security Supplements.

Appendix table B-2

Quantile (median) regression of food spending relative to the Thrifty Food Plan on survey year and SNAP receipt, with controls for household characteristics

Characteristic	Model 3		Model 4	
	Coefficient	P[1]	Coefficient	P[1]
Intercept	0.941	<.001	0.937	<.001
Interview in 2011	.007	.628	0.005	.722
Received SNAP in 30 days prior to survey	.058	.002		
Interaction: SNAP receipt x Interview in 2011	-.042	**.052**		
Received large SNAP benefit[2]			.119	<.001
Interaction: Large SNAP benefit x Interview in 2011			-.048	**.031**
Received small SNAP benefit[2]			-.067	.010
Interaction: Small SNAP benefit x Interview in 2011			-.030	.348
Income (ratio to poverty line)	.009	.682	.014	.534
Income in lowest reported category	.022	.352	.014	.550
Labor force status, proportion of adults (reference: all adults employed full time)				
Out of labor force—retired	-.049	.119	-.056	.072
Part-time for non-economic reasons	-.058	.036	-.064	.039
Part-time for economic reasons	-.097	<.001	-.114	<.001
Unemployed	-.064	.006	-.074	.002
Out of labor force—disabled	-.111	<.001	-.111	<.001
Out of labor force, not retired or disabled	-.051	.049	-.045	.087
Household composition (reference: married couple with child/children)				
Single male with child/children	.044	.148	.036	.202
Single female with child/children	.069	<.001	.068	<.001
Other household with child/children	.042	.297	.034	.349
Two or more adults, no child	.032	.250	.026	.290
Male living alone	.278	<.001	.272	<.001
Female living alone	.308	<.001	.303	<.001
Number of children ages 0-5 years	.028	.008	.020	.038
Number of children ages 6-11 years	-.040	<.001	-.038	<.001
Number of children ages 12-17 years	-.037	<.001	-.038	<.001
One or more elderly in the household	-.102	<.001	-.086	<.001
Race and Hispanic ethnicity (reference: White non-Hispanic)				
Black non-Hispanic	-.056	<.001	-.059	<.001
Hispanic	-.053	.012	-.039	.028
American Indian or Alaska Native	-.005	.920	-.001	.981
Non-citizen household reference person	-.021	.326	-.020	.331

continued—

Appendix table B-2

Quantile (median) regression of food spending relative to the Thrifty Food Plan on survey year and SNAP receipt, with controls for household characteristics—Continued

Characteristic	Model 1		Model 2	
	Odds ratio	P[1]	Odds ratio	P[1]
Educational attainment of most highly educated adult (reference: high school or GED)				
Less than high school	.028	.112	.021	.189
Some college, no 4-year degree	.027	.036	.026	.076
Bachelor degree or higher	.075	<.001	.089	<.001
Metropolitan/nonmetropolitan residence (reference: metropolitan, not in principal city)				
Metropolitan, principal city	.026	.082	.026	.049
Metropolitan, not specifically identified	-.015	.363	-.011	.482
Not in metropolitan area	-.036	.010	-.029	.039
Census Region (reference: Northeast)				
Midwest	-.103	<.001	-.103	<.001
South	-.057	.002	-.055	<.001
West	-.050	.005	-.051	.007
Number of cases	14,821		14,645	

SNAP = Supplemental Nutrition Assistance Program.

[1]Tabled p values (the probabilities of null hypotheses), except for those of two interactions, are based on the usual 2-tailed test as provided by the statistical software. For the interactions, [SNAP receipt x Interview in 2011] and [Large SNAP benefit x Interview in 2011], **one-tailed p values are shown (in bold type)**, consistent with the directional hypothesis underlying this study (i.e., that these interactions would be negative because of the decline in inflation-adjusted SNAP benefit value).

[2]Households receiving SNAP benefits were classified as receiving large SNAP benefits if their reported benefit was higher than half the cost of the Thrifty Food Plan for the household. Those receiving SNAP benefits less than that amount were classified as receiving small SNAP benefits.

Source: Calculated by USDA, Economic Research Service using data from the December 2009 and December 2011 Current Population Survey Food Security Supplements.

Appendix C: Selection Into SNAP in 2011 Compared With 2009

Results of the analyses in this report could be biased if the basis on which households self-selected into the program changed from 2009 to 2011 and if those differences were not fully reflected by the covariates in the regression models. Participation in SNAP is voluntary for households that meet eligibility requirements, and a substantial number of eligible households do not apply in any given year. The extensive set of covariates in the models adjusts for self-selection to a considerable extent, but some self-selection bias may remain. For example, the CPS-FSS does not collect information on asset holdings. If SNAP households, on average, had less wealth in 2011 than in 2009, that could account for some or all of the worse food insecurity and lower food spending observed in the study.

It is not possible to examine directly the extent to which self-selection on unobserved characteristics may have differed between 2009 and 2011. However, it is possible to examine whether, and to what extent, selection on *observed* characteristics may have changed between the 2 years. This analysis provides indirect evidence about the extent to which selection on unobserved characteristics may have differed in the 2 years.

To examine selection on observed characteristics, a logistic regression model of very low food security on household characteristics was estimated using only the 2009 data for households with incomes less than 130 percent of the poverty line (analysis not shown). Covariates were similar to those in Model 1 (appendix table B-1), except that the variables for interview year and SNAP participation were omitted and income, employment, and household structure were specified in more detail. The regression coefficients were then used to calculate predicted probabilities of very low food security for SNAP participants and nonparticipants in 2009 and 2011. The mean predicted probabilities for each of the four groups represent the extent of economic disadvantage based on observed variables as it relates to food insecurity.

On average, conditions associated with food security were better in 2011 than in 2009 for both SNAP recipients and nonrecipients, but the changes were small for both groups. Among SNAP recipients, the mean predicted probability of very low food security fell by 0.37 percentage points, from 11.61 percent to 11.24 percent. Among non-SNAP households, the mean fell by 0.45 percentage points, from 9.16 to 8.71 percent. Thus, the difference-in-difference was 0.08 percentage points.

The multivariate models adjusted for these differences on observed characteristics. Unless selection on unobserved variables (vis-à-vis very low food security) was considerably larger than selection on observed variables, the change in self-selection would constitute at most a modest bias relative to the estimated difference-in-difference marginal effect of 1.95 percentage points.