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Food Security Improved Following the 2009 ARRA Increase in SNAP Benefits

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Abstract

The American Recovery and Reinvestment Act of 2009 increased benefit levels for the Supplemental Nutrition Assistance Program (SNAP, formerly known as the Food Stamp Program) and expanded SNAP eligibility for jobless adults without children. One goal of the program changes was to improve the food security of low-income households. We find that food expenditures by low-income households increased by about 5.4 percent and their food insecurity declined by 2.2 percentage points from 2008 to 2009. Food security did not improve for households with incomes somewhat above the SNAP eligibility range. These findings, based on data from the nationally representative Current Population Survey Food Security Supplement, suggest that the ARRA SNAP enhancements contributed substantially to improvements for low-income households.

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

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Contents

Summary

The American Recovery and Reinvestment Act (ARRA) of 2009 increased benefit levels for the Supplemental Nutrition Assistance Program (SNAP, formerly known as the Food Stamp Program) and expanded SNAP eligibility for jobless adults without children. The changes were intended to assist those most impacted by the recession, to create and save jobs, and to stimulate the economy. In this study, we examine whether the increased SNAP benefits provided by ARRA improved the food security of low-income households (that is, the extent to which they were consistently able to obtain adequate food).

What Is the Issue?

Federal policy officials and the American public want to know whether the funds spent under various provisions of ARRA have met the goals of Congress and the Administration. The U.S. Department of Agriculture has previously documented the extent and timing of the additional purchasing power and estimated the extent of economic activity that resulted from the SNAP changes under ARRA. This is the first study to examine how much ARRA's SNAP enhancements may have improved the food security of low-income households.

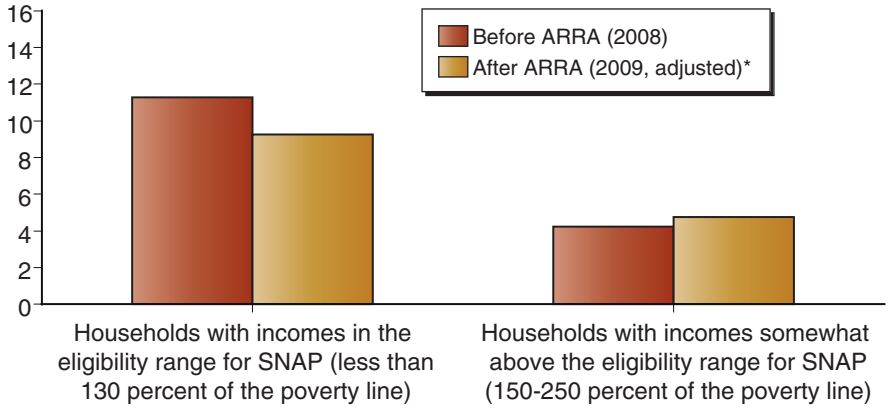
What Did the Study Find?

The food security of low-income households (those with incomes in the eligible range for SNAP) improved from 2008 to 2009, and a substantial share of that improvement may be due to the increase in SNAP benefits implemented under ARRA. From late 2008 (pre-ARRA) to late 2009 (post-ARRA), the following changes were estimated, taking into account changes in income, employment, and other household characteristics:

- Among all low-income households, the prevalence of food insecurity fell by 2.2 percentage points, and the prevalence of very low food security fell by 2.0 percentage points. Very low food security is a severe range of food insecurity that impacts the eating patterns of some household members and reduces their food intake below levels they consider appropriate.
- Participation of low-income households in SNAP increased by about 3 percentage points.
- The SNAP benefits received by the typical (median) participating household increased by about 16 percent.
- Food expenditures by the typical (median) low-income household increased by 5.4 percent of which an estimated 2.2 percent may have resulted from the ARRA SNAP changes.
- Among households with incomes just above the income-eligibility range for SNAP, food expenditures (adjusted for changes in food prices) increased by a smaller percentage than among low-income households, and the prevalence of food insecurity among such households did not decline.

The prevalence of very low food security declined among households with incomes in the eligibility range for SNAP, but not for households with incomes somewhat higher

Percent of households with very low food security



SNAP= Supplemental Nutrition Assistance Program.

ARRA= American Recovery and Reinvestment Act.

*Percentages for 2009 were regression-adjusted for differences between years in household income, employment, and other household characteristics between years.

Source: USDA, Economic Research Service calculations based on Current Population Survey Food Security Supplement (CPS-FSS) data.

- Food spending increased more among SNAP participants than among low-income non-SNAP households, closing a gap in food spending that had persisted since at least 2001.
- The combination observed in 2009 of a simultaneous increase in SNAP participation and an improvement in food security from the previous year had not occurred in any other recent year.

How Was the Study Conducted?

We analyzed data on SNAP participation, food security, food spending, and other household characteristics from the annual Current Population Survey Food Security Supplement (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 (46,000 households in 2009), nationally representative survey of the civilian, noninstitutionalized population of the United States and is the data source for the U.S. Department of Agriculture's series of annual reports on the food security of U.S. households.

The main analysis compared SNAP participation, SNAP benefits, food spending, and food security in December 2009 (about 8 months after ARRA increased SNAP benefits) with the corresponding statistics for December 2008 (about 1 year into the recession but before SNAP benefits increased). We conducted separate analyses for all low-income households, for low-income households by SNAP participation status, and for households with incomes above the SNAP eligibility range but below the U.S. median, and used multivariate regression methods to control for changes in income, employment, and other household characteristics from 2008 to 2009.

Introduction

The American Recovery and Reinvestment Act (ARRA) of 2009 made two policy changes in the Supplemental Nutrition Assistance Program (SNAP, formerly known as the Food Stamp Program) to improve the food security of low-income households during a period of challenging economic conditions. ARRA increased SNAP benefit levels for all recipients and expanded SNAP eligibility for jobless adults with no children.[1] In this study, we examined whether, and to what extent, the food security of low-income households improved, as intended, following these SNAP enhancements.

[1]"Jobless" is a general category that includes the unemployed and those not in the labor force. In other instances, "unemployed" is used to refer to those not employed but looking for work.

Food security means access to enough food by all people at all times for an active, healthy life (Anderson, 1990). Households that are *food secure* can consistently obtain adequate food. In contrast, households that are *food insecure* are, at times, unable to acquire adequate food for all household members because they lack the money and other resources for food.

SNAP provides monthly benefits for eligible low-income families and individuals (hereafter referred to as "households") to purchase approved food items at authorized foodstores. In an average month for fiscal year 2009 (ending September 30, 2009), SNAP provided benefits to 33.5 million people in the United States (11 percent of the population). The average benefit was about $125 per person per month, and total Federal expenditures for the program were $53.6 billion (USDA, Food and Nutrition Service, 2010b). SNAP is USDA's largest food and nutrition assistance program and is the cornerstone of the Nation's programs for reducing food insecurity and hunger.

One provision of ARRA (effective April 2009) increased SNAP benefits for each household by a dollar amount equal to 13.6 percent of the maximum benefit for that household size.[2] 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 the percentage increase was greater for households that had some net income and were therefore eligible for less than the maximum benefit. For example, a SNAP-participating household of four persons with no net income received a maximum benefit of $668 in April 2009—an increase of $80, or 13.6 percent, over the $588 the household received in March 2009 (table 1). A household of the same size, but eligible for half the maximum benefit (because they had $980 monthly net income), also received an increase of $80, amounting to 27.2 percent of the household's pre-ARRA benefit. A prospective estimate of the average increase in benefits across all SNAP households in fiscal 2009 was about 19 percent (USDA, Food and Nutrition Service, 2009).[3]

[2]Households are eligible to receive SNAP benefits based on household income, assets, and certain basic expenses. Households with no net income (net of allowable deductions) receive the maximum SNAP benefit, which varies depending on the number of qualifying persons in the household. If a household has net income, its SNAP benefits are reduced by 30 percent of its net income; it is expected that household members can provide for the remainder of their food needs from their own income.

[3]ARRA specified that the SNAP maximum monthly allotments would be fixed for the next several years until inflation adjustments to the pre-ARRA benefit levels exceed the ARRA increase.

A second provision of ARRA increased SNAP eligibility for some jobless adults. Prior to ARRA, many jobless, working age, nondisabled adults without children were limited to 3 months of SNAP benefits within any 3-year period. ARRA gave States an option to suspend that limitation through fiscal 2010 (USDA, Food and Nutrition Service, 2010a).

USDA sponsors an annual, nationally representative survey to monitor the extent and severity of food insecurity in U.S. households and has published statistical reports on household food security in the United States for each

Table 1

Maximum monthly SNAP benefits pre-ARRA and post-ARRA[1]

Number of people in the SNAP unit[2]	Maximum monthly SNAP benefits: Pre-ARRA in fiscal 2009 (October 1, 2008–March 31, 2009)	Maximum monthly SNAP benefits: Post-ARRA (beginning April 1, 2009)	ARRA increase in maximum monthly SNAP benefits
	Dollars		
1	176	200	24
2	323	367	44
3	463	526	63
4	588	668	80
5	698	793	95
6	838	952	114
7	926	1,052	126
8	1,058	1,202	144

SNAP= Supplemental Nutrition Assistance Program.

ARRA= American Recovery and Reinvestment Act.

[1]These benefit figures were applicable in the 48 contiguous States and the District of Columbia. Maximum benefits in Alaska and Hawaii are adjusted upward due to higher food prices.

[2]A SNAP unit may comprise all household members or a subset of related members who qualify for SNAP benefits. Each additional person beyond eight in the SNAP unit resulted in increments in maximum benefits of $132 pre-ARRA and $150 post-ARRA.

Source: USDA, Food and Nutrition Service, http://www.fns.usda.gov/snap/government/cola.htm.

year since 1995 (Nord et al., 2010). The research presented here used data for several years from that survey to examine pre-ARRA to post-ARRA changes in SNAP participation, food expenditures, and food security of households with annual incomes below 130 percent of the poverty line (hereafter referred to as "low-income households"). Multivariate analytic methods were used to account for changes in other factors besides ARRA that may have affected the outcomes, including household income, employment status, household composition, and demographics. Then a difference-in-difference analysis compared low-income households' pre-ARRA-to-post-ARRA differences in food expenditures and food security with the corresponding differences for households that had incomes above the eligibility range for SNAP but well below the U.S. median. The difference-in-difference analysis adjusted the multivariate results for effects of changes in other factors, such as a decline in food prices, that occurred during the study period but were not measured in the data.

Previous Estimates of the Stimulus Effects of the ARRA SNAP Enhancements

Measuring the effects of Government programs and policies informs Congress, the Administration, and the public on how well goals and objectives are being met. A 2009 memorandum from the Office of Management and Budget to the heads of executive departments and agencies stated, "Rigorous, independent program evaluations can be a key resource in determining whether Government programs are achieving their intended outcomes as well as possible and at the lowest possible cost."

The objectives of the ARRA SNAP provisions, as identified in the SNAP ARRA Recovery Plan (USDA, Food and Nutrition Service, 2010a), were:

1. Improve the food security of low-income households;
2. Create and save jobs;
3. Stimulate the economy; and
4. Stabilize the State agencies responsible for SNAP administration.[4]

[4]For this purpose, ARRA appropriated additional funds for States to support SNAP administration.

In this report, we assess the extent to which the ARRA increase in SNAP benefits and the expansion of SNAP eligibility may have met the first ARRA SNAP objective—improving the food security of low-income households.

USDA has documented elsewhere the extent and timing of the purchasing power created by the ARRA SNAP provisions and estimated the economic activity that resulted from the ARRA SNAP provisions. The Food and Nutrition Service (FNS), which administers USDA's food assistance programs at the Federal level, reported on three of the four ARRA-SNAP objectives in June 2010. With regard to the second and third objectives—creating and saving jobs and stimulating the economy—the injection of additional money into the economy began soon after the February 2009 passage of ARRA. In March 2009, USDA distributed to the States the additional administrative funding for fiscal 2009. In April 2009, the ARRA increase in SNAP benefits was implemented. About 97 percent of SNAP benefits are redeemed within 30 days of issuance. Drawing on earlier ERS research findings (Hanson and Gundersen, 2002), FNS estimated that increased SNAP benefits would create $36.8 billion of economic activity in the 5 years following ARRA and create or save 100,000 jobs in the first 2 years after implementation (USDA, Food and Nutrition Service, 2010a).[5] With regard to the fourth objective—stabilizing State agencies responsible for SNAP administration—FNS reported that the additional administrative funding specified by ARRA for fiscal 2009 had been forwarded to the States.

[5]ERS research findings published subsequent to this FNS report updated the estimated relationship between SNAP benefits and total economic activity (Hanson, 2010). The estimates do not differ substantially from those used by FNS.

USDA's annual household food security report (Nord et al., 2010) provided a preliminary indication of progress on the first ARRA-SNAP objective—improving the food security of low-income households. The prevalence of food insecurity and very low food security (a severe subcategory of food insecurity) remained unchanged from 2008 to 2009 even as unemployment continued to rise during the period (see box, "A Glance at Possible Effects of ARRA"). Furthermore, the prevalence of very low food security measured during the final 30 days prior to each survey (i.e., from mid-November to mid-December) declined somewhat from 2008 to 2009, and the decline was greatest for low-income households. This report documents a more rigorous analysis of the changes in food insecurity and very low food security from 2008 to 2009, disentangling, to the extent possible, the changes due to the ARRA SNAP enhancements from those due to other policy and economic changes during that period.

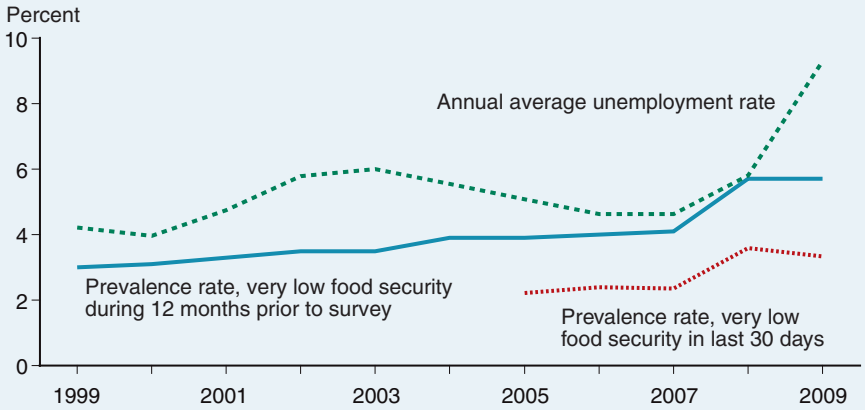
A Glance at Possible Effects of ARRA

USDA's annual food security report, *Household Food Security in the United States, 2009* (Nord et al., 2010) provided early evidence that ARRA SNAP provisions may have stabilized the food security of U.S. households. In spite of increased unemployment in 2009, the prevalence of very low food security either held steady or declined, depending on the period over which it was measured (see chart below).

The unemployment rate is a key measure of macroeconomic conditions, and previous research has found unemployment to be strongly associated with food insecurity at household, State, and national levels. The economic downturn that began in late 2007 is reflected in the increases in annual average unemployment rates for 2008 and 2009. From 2007 to 2008, the percentage of households with very low food security increased in tandem with the worsening economy. While the unemployment rate rose still further from 2008 to 2009, the prevalence of very low food security remained unchanged if measured over the entire year and declined somewhat if measured over the final 30 days before the survey (conducted in mid-December of each year). A possible explanation for the stability or improvement in food security in 2009 may be the implementation of ARRA SNAP enhancements in April 2009. Improvements in food security registered by the 30-day measure were most notable for low-income households and households with children—subpopulations that were more likely to benefit from the ARRA SNAP enhancements—further suggesting that those enhancements contributed to the improvement.

These trends and statistics are only suggestive of the role ARRA may have played. Our study used more rigorous analytic methods to provide more definitive evidence of the role ARRA enhancements may have played in improving the food security of low-income households. The small improvement in food security from 2008 to 2009 may indicate a more sizeable improvement *compared with what would have occurred* if the ARRA SNAP provisions had not been implemented. This improvement relative to the (unobserved) counterfactual is estimated using multivariate methods that account for such factors as household income and employment status. The comparison of these "adjusted" outcomes can be interpreted as the change that would have occurred in the absence of any changes in income, employment, and other household characteristics that are measured in the available data, and more nearly reflects the effect of the ARRA SNAP provisions.

The percentage of households with very low food security held steady or declined from 2008 to 2009 in spite of increasing unemployment



Source: USDA, Economic Research Service using food security statistics from *Household Food Security in the United States, 2009* (Nord et al., 2010) and unemployment statistics from the Bureau of Labor Statistics.

Analytic Framework, Data, and Key Variables

The ARRA SNAP provisions were expected to improve food security among low-income households through three links in a cause-and-effect chain:

1. The ARRA SNAP enhancements would increase the resources available to low-income households to buy food. This change would come from:
    a. Increased benefits to the participants;
    b. Increased participation of eligible households because the higher benefit level makes participation more attractive; and
    c. Increased eligibility of jobless households with no children because the SNAP time limits for such households were suspended in some States.
2. Additional resources for food to low-income households would increase their food expenditures.
3. Low-income households that increase their food expenditures would, *ceteris paribus*, experience improved food security.

Previous research supports the last two hypothesized links. However, that research has not been able to convincingly sort out causal processes. The ARRA SNAP enhancements provide a rare opportunity to study all the steps in the process jointly, and the exogenous character of the ARRA SNAP enhancements strengthens researchers' ability to attribute causality.

Analytic Framework

We examined the extent of changes among low-income households in three interrelated outcomes—SNAP participation, food expenditures, and food security—and whether those changes were consistent with those that were expected to result from the ARRA SNAP enhancements. The changes for low-income households were compared with changes for "nearly SNAP eligible households," defined as those with incomes from 150 percent to 250 percent of the poverty line, and therefore above the eligibility range for SNAP but well below the national median income. We used data from the annual Current Population Survey Food Security Supplement (CPS-FSS, described later in the report) for 2001-09. The main analysis compared post-ARRA conditions in December 2009 (about 8 months after the ARRA had increased SNAP benefits) with pre-ARRA conditions in December 2008 (about 1 year into the recession but before SNAP benefits had increased). Year-to-year changes were calculated for earlier years to provide a context for interpreting the 2008-09 changes.

Analytic complications caused by self-selection and under-reporting of SNAP participation were obviated by focusing the main analysis on changes among all low-income households. Those complications would bias separate estimates of changes among SNAP participants and low-income non-SNAP participants to an unknown extent.

Self-selection of more food-needy households into program participation is an important complicating factor in all survey-based research on the effect of food and nutrition assistance programs. For this study, accounting for self-selection would have been particularly important in separate analyses by SNAP participation status because the increase in SNAP benefits is likely to have changed the self-selection probabilities between the two time periods analyzed. Some households that would not have been motivated to participate by the pre-ARRA SNAP benefits would have participated post-ARRA due to the larger SNAP benefit. It is likely that, on average, households induced to participate by the larger benefits were better off than the average pre-ARRA participant and worse off than the average pre-ARRA nonparticipant. Thus, their change in participation status would improve the average food security of each subgroup even in the absence of any actual improvement in food security within any household due to SNAP benefits. However, the food security of all low-income households, SNAP participants and nonparticipants considered jointly, would improve only if the increased benefits and increased participation actually improved the food security of at least some households.

Both the increase in SNAP benefits for participating households and the increase in SNAP participation among low-income households would increase household food expenditures and improve household food security among low-income households as a group. The joint analysis of all low-income households did not estimate the separate effects of these two processes, but rather estimated the *combined* effects of the two processes on low-income households overall.

Participation in SNAP and other programs is underreported in all survey data, including the data used for this study. Some participating households did not report that they received program benefits and therefore they incorrectly appear in the data as nonparticipants. (Misreporting in the opposite direction is relatively rare.) Underreporting program participation is likely to mute the differences between reported participants and nonparticipants. Any improvement in food security due to the larger SNAP benefit would, to some extent, be observed for reported nonparticipants as well as for reported participants because some of the reported nonparticipants did, in fact, participate in SNAP. Misreported SNAP participation does not, however, affect the analytic results for all low-income households.

The results of the joint analysis of SNAP recipients and low-income nonrecipients understate the changes within the subpopulation that participates in SNAP. To the extent that the estimates represent the effects of the ARRA SNAP enhancements, the impact on SNAP participants will be diluted in the analyses by the inclusion of many non-SNAP households that were not affected by ARRA SNAP changes. Only about two-thirds of SNAP-eligible households participate in the program in any given month (USDA, Food and Nutrition Service, 2010c), and the low-income sample in the CPS-FSS includes a substantial number of ineligible households.[6] Taken together, these proportions suggest that only around *half* of the low-income households in the CPS-FSS sample were, in fact, SNAP participants. Thus, the effect on SNAP participants would be about *double* the size of a correctly estimated effect on the entire low-income CPS-FSS sample.

[6]Low income as measured in this study is only an approximation for SNAP eligibility. Actual eligibility determination considers recent and current income, rather than annual income, and considers many factors not measured in the CPS-FSS, such as assets, immigration documentation status, excess housing costs, employment costs, and child care costs.

Although primary attention is given to estimates for all low-income households, separate analyses were also conducted for SNAP participants and low-income non-SNAP households. The results for the subgroups, however, are interpreted cautiously, recognizing that they reflect, in part, the self-selection—and changes in self-selection—of more food-needy households into the program and are further complicated by misreported SNAP participation. The main conclusions of the study are based on the stronger evidence of changes among all low-income households, which are not affected by either self-selection or underreporting because they do not rely on SNAP participation status data.

Data Used in the Study

The CPS-FSS is an annual supplement to the monthly Current Population Survey. The supplement is sponsored by the U.S. Department of Agriculture (USDA) and administered by the U.S. Census Bureau. The CPS-FSS collects data on household food spending, use of Federal and community food assistance programs, and food security (the extent to which households are consistently able to obtain adequate food). The CPS-FSS is nationally representative of the civilian, noninstitutionalized population of the United States and is the datasource for USDA's series of annual reports on the food security of U.S. households (see, for example, Nord et al., 2010). The survey has been conducted annually since 1995 and has been conducted consistently in the same time period (mid-December) since 2001. Our primary analyses used CPS-FSS data for 2008 and 2009; comparative statistics on year-to-year changes in food security and SNAP participation for prior years were based on CPS-FSS data from 2001-2007. About 44,000 households were interviewed in the CPS-FSS for 2008, 46,000 for 2009, and an average of about 48,000 households each year from 2001 to 2007.

The core labor force portion of the CPS, to which the CPS-FSS is a supplement, collects information on household composition, demographics, income, employment, and other household characteristics. These data were used as control variables in the multivariate analyses to account for measured factors besides the implementation of ARRA's SNAP provision that can affect outcomes of SNAP participation, food expenditures, and food security. The income data were also used to identify households that were likely to have had incomes in the range eligible for SNAP and to identify nearly-SNAP-eligible households—those with incomes somewhat above that range.

All analyses used household supplement weights so that the sample represented the population of interest. Variances of the participation rates and prevalence rates were estimated as:

$$PQ*1.6/N$$

where P is the weighted point estimate of the percentage, Q is the complement of P (i.e., 100-P), 1.6 is the assumed design factor, and N is the number of unweighted households in the denominator. Variance estimates in the multivariate analyses were not adjusted for stratification or clustering but are not likely to be substantially distorted by design effects in these complex models.[7]

[7]The design factor of 1.6 is based on Cohen et al., 2002. CPS-FSS data do not include sample design data that would allow use of standard statistical methods for correcting variance estimates.

Measurement of Key Variables

Income. Annual household income is reported in ranges for the core labor force portion of the CPS. Income for each household was approximated at the center of the reported range and was divided by a poverty line for that household to adjust for household size and composition. We based household poverty lines on the Census Bureau's table of poverty thresholds for individuals and families for the year of the survey, taking into account the number of adults and children in the household and whether the household reference person was younger or older than 65.

Low-Income and Nearly-SNAP-Eligible Households. *Low-income households* were identified as those with annual incomes less than 130 percent of the poverty line and, therefore, likely to have been eligible for SNAP (see footnote 5). *Nearly-SNAP-eligible households* were identified as those with annual incomes from 150 to 250 percent of the poverty line. These served as a comparison group for low-income households in the difference-in-difference analyses.[8] Low-income households made up about 20 percent of all U.S. households in 2008 and 21 percent in 2009. Nearly-SNAP-eligible households made up about 19 percent of U.S. households in 2008 and 18 percent in 2009.

SNAP Participation. Analyses of SNAP participation were based on the reported receipt of SNAP benefits during the 30 days prior to the survey. Households in the CPS-FSS were asked whether anyone in the household received benefits from SNAP, Food Stamps, or their State food assistance program (if it was known by a name other than SNAP or Food Stamps). If they responded "yes," they were asked to report which months they received benefits. If they received benefits 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 14, 2008, and December 13, 2009.)

TFP-Adjusted Food Expenditures. Each household's usual food expenditure was expressed relative to the cost of USDA's Thrifty Food Plan (TFP) for that household at the time of the survey (a measure hereafter referred to as "TFP-Adjusted Food Expenditures"). This measure adjusts for differences in household size and age/sex composition within each year and adjusts for differences in food prices across years. Household food needs differ depending on the number, age, and gender 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 one year to the next, even if it buys exactly the same food items. The TFP-Adjusted Food Expenditure is a measure of the quantity and quality of food purchased, taking into account changes in food prices.[9]

Each household's usual weekly food spending was reported by CPS-FSS respondents after they reported their actual food spending during the previous week. Respondents were first asked how much their household 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

[8]Households with income from 130 to 150 percent of the poverty line—just above the SNAP gross income eligibility limit—were not included in the nearly-SNAP-eligible group because a substantial proportion were, in fact, eligible for SNAP, and many participated in the program. SNAP eligibility for such households results from several factors, including imprecise income measurement, income variability during the year, and adjunctive SNAP eligibility due to participation in other assistance programs (for which States set eligibility criteria). Bivariate and multivariate analyses (not shown) of households in this income range found no statistically significant changes in food expenditures or food security. The numbers of households in the analysis samples, however, were relatively small (just over 1,000 in each year) so some modest-sized changes may have occurred.

[9]The data used for this study cannot differentiate between quantities and qualities of food purchased, but the hypothesis tests did not depend on differentiating them. In contrast, distinguishing changes in quantities and qualities from changes in prices was important for the study.

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 weekly on food. Analyses by ERS researchers have found that food expenditures estimated from data collected by this method are consistent with estimates from the Consumer Expenditure (CE) Survey—the principal source of data on U.S. household expenditures for goods and services (Oliveira and Rose, 1996; Nord, 2009).

The Thrifty Food Plan serves as a national standard for a nutritious, low-cost diet. It represents a set of food "market baskets" that people in specific age and gender categories could consume at home to maintain a healthful diet that meets current dietary standards at low cost, taking into account the food consumption patterns of U.S. households. The mix of foods in the Thrifty Food Plan 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 (CNPP) updates the cost of the Thrifty Food Plan, that is, the amount of money needed to purchase the market baskets based on national average food prices for that month.[10]

[10]The CNPP updates the cost of the TFP monthly. Year-to-year changes in the cost of TFP are the basis by which SNAP benefits are adjusted for food-price inflation.

Food Security. Household food security—access by all household members at all times to enough food for active healthy living—is the "bottom-line" outcome variable in this study. Food security is measured in the CPS-FSS by responses to a series of questions about food-related conditions and behaviors that typically occur in households having difficulty meeting their food needs (Hamilton et al., 1997a; Hamilton et al., 1997b; Bickel et al., 2000; Nord et al., 2010). The questions cover food access problems across a wide range of severity, from worrying about running out of food to not eating for a whole day. Each question specifies a lack of money or other resources to obtain food as the reason for the condition or behavior, so the measure is not affected by behaviors such as dieting to lose weight or fasting for religious reasons.

Based on the number of food-insecure conditions reported, households are classified as either food secure or food insecure. Food-insecure households are further classified as having low food security or very low food security. Very low food security is a severe range of food insecurity characterized by reduced food intake and disrupted eating patterns of one or more household member (usually adults) due to inadequate food resources.

The standard food security measure, on which USDA's annual food security reports are based, represents conditions over the 12-month period prior to the survey. Because the ARRA increase in SNAP benefits occurred part way through 2009 (in April), the 12-month scale for 2009 could register food insecurity that occurred either before or after the increase. This would introduce an unknown amount of bias into a pre-ARRA/post-ARRA comparison based on the 12-month scale. To avoid this problem, we used a measure of food security based on households' experiences over the 30-day period just prior to the survey, thus comparing conditions in mid-November to mid-December in 2009 with the same period in 2008. The 30-day scale is based on the same concepts and statistical methods as the standard 12-month scale (Nord et al., 2006, Appendix E).[11]

[11]Since December 2005, the CPS-FSS has collected 30-day food security data for all questions that make up the 12-month scale. These data support a full-range 30-day scale consistent in cognitive content with the 12-month scale. Prior to 2005, 30-day information was collected for only a subset of the more severe items in the scale and supported the more limited 30-day scale described by Nord (2002). In this study, the full-range 30-day scale was used for all analyses except the year-to-year changes in very low food security from 2004 to 2005 and earlier years, which used the older limited-range 30-day scale.

Research Challenges and Methods

The period studied—from late 2008 to late 2009—was a time of unusually rapid and diverse economic changes. Income and employment fell for U.S. households in general. Food prices declined. These changing economic conditions could have affected household food spending and food security, even in the absence of the ARRA SNAP provisions. For this study, we used multivariate and difference-in-difference methods to account for changes in these economic conditions. The resulting estimates represent the effects of the ARRA SNAP enhancements, while holding constant, to the extent possible, other economic factors.

Unadjusted Comparisons Pre-ARRA to Post-ARRA

SNAP participation rates were calculated as percentages of households with incomes less than 130 percent of the poverty line. Prevalence rates of food insecurity and very low food security were calculated as percentages of households in select income ranges and SNAP participation statuses. Prevalence rates were compared between 2008 and 2009, and odds ratios for the changes were calculated to compare across subpopulations with different prevalence rates and with coefficients from the multivariate models (see box, "Using Odds Ratios to Assess Changes Over Time").

TFP-Adjusted Food Expenditures were compared across years using medians rather than means (averages). Medians were used because they are more robust to measurement errors, which appear to be substantial in these food expenditure data.[12] The value of SNAP benefits were also expressed as ratios to the cost of the TFP and compared across years using both medians and means.

Multivariate (Adjusted) Comparisons Pre-ARRA to Post-ARRA

Multivariate regression methods were used to account for year-to-year differences in households' economic circumstances other than those caused by the ARRA SNAP enhancements, that could have affected households' SNAP participation, food spending, and food security. Logistic regression methods were used to assess changes in SNAP participation rates and prevalence rates of food insecurity and very low food security. Quantile regression models (estimated at the 50th percentile) were used to assess changes in the median amount of SNAP benefits and TFP-Adjusted Food Expenditures. Linear regression models were also estimated for SNAP benefits and TFP-Adjusted Food Expenditures as robustness checks on the quantile regression results.

The multivariate models included controls for income (quadratic in ratio of income to poverty), employment and labor force status of the adults in the household (seven categories), household composition and structure (seven categories), presence of an elderly person, race and Hispanic ethnicity (three categories), citizenship status, education of most highly educated adult (four categories), and residence by metropolitan area (four categories) and geographic region (four categories). The multivariate models and descriptions of the control variables are provided in the appendix.

[12]Means were also compared and adjusted means estimated as robustness checks, using data from all households and using "trimmed" data, omitting the lowest and highest 5 percent of households to reduce the effects of outliers that are more likely to be reporting or data entry errors. The interpretation of results, however, was based primarily on the medians.

Using Odds Ratios To Compare Outcomes Over Time

Odds ratios are often used in medical and social science research to assess the effects of treatments, policies, and programs. The use of odds ratios solves several analytic problems that arise when comparing outcomes in percentages, proportions, or probabilities.

A percentage is transformed to its corresponding odds by dividing by its complement. For example, in 2008, 25.03 percent of low-income households were food insecure. The odds of food insecurity for this population was 0.334, calculated as 25.03/(100-25.03). In 2009, the odds of food insecurity in low-income households was 0.314, calculated as 23.87/(100-23.87). The decline of 1.16 percentage points in food insecurity from 2008 to 2009 can be expressed as an odds ratio of 0.94, calculated as 0.314/0.334, and may be expressed as a 6-percent decline in the odds of food insecurity.

Odds ratios are often preferable for comparing changes in percentages across time or in subpopulations where the base prevalence of the condition of interest differs greatly. In many cases, program effects measured as odds ratios are similar across subpopulations even though the base prevalence of the condition varies widely—a trait not shared by other measures, such as the change measured in percentage points.

A second important analytic property of odds ratios is that they give identical results regardless of whether the occurrence of a condition or the absence of the condition is analyzed. In the calculation above, for example, the change of just over 1 percentage point in the prevalence of food insecurity and food security appears larger relative to the percentage of households that were food insecure (25.03 percent in 2008) than to the percentage that were food secure (74.97 percent). Calculated as percentages, the change could be described either as:

- *A 4.6-percent decline in food insecurity*—a drop of 1.16 percentage points relative to an initial prevalence of 25.03 percent; or
- *A 1.5-percent increase in food security*—a gain of 1.16 percentage points relative to an initial prevalence of 74.97 percent.

In principle, either statement is a valid expression of the observed change, but it is not clear which should be used analytically. The odds ratio solves this problem. The odds and odds ratios for food security are simply the inverse of the corresponding statistics for food insecurity. The natural logarithms of the odds and odds ratios (the functional form in which they are actually estimated in multivariate analyses) are identical in magnitude for food security and for food insecurity; they differ only in having opposite signs.

This study used odds ratios to examine pre-ARRA to post-ARRA changes in the SNAP participation rate, the prevalence of food insecurity, and the prevalence of very low food security. In addition to the advantages described above, using odds ratios allowed the change for each outcome on a simple "unadjusted" basis to be compared with "adjusted" changes once factors, such as income and employment status, were taken into account, since the analytic software calculates the results of those multivariate analyses in odds ratios.

Each regression model included a dummy variable identifying data for households in the 2009 CPS-FSS. The coefficient on this variable provides an adjusted odds ratio or adjusted change in median that represents the estimated change from 2008 to 2009 that would have occurred if income, employment, and other characteristics included in the models had remained the same. For the logistic regression models, the percentage-point change from 2008 to 2009 was calculated by applying the adjusted odds ratio to the corresponding 2008 percentage. For the quantile and linear regression models, the adjusted percentage change from 2008 to 2009 was calculated as the ratio of the adjusted change in the median to the corresponding median value in 2008 (multiplied by 100 to convert to percentage).

Difference-in-Difference Comparisons Pre-ARRA to Post-ARRA

Multivariate analyses can account for changes in conditions only if they vary across households within each year and are measured in the data used for analysis but cannot differentiate the effects of other factors that changed from year-to-year. The decline in food prices (described later) from 2008 to 2009 was not accounted for by the multivariate analyses and could have important implications for the study. This food price decline would probably have increased inflation-adjusted food expenditures and improved food security conditions among low-income households independent of any changes due to ARRA.

To provide an estimate of changes in food expenditures and food security that may be attributable to ARRA—separate from effects of the decline in food prices—we used difference-in-difference methods. Outcomes for low-income households—the study's primary focus—were compared with outcomes for households with incomes from 150 to 250 percent of the poverty line—incomes likely to make them ineligible for SNAP but well below the U.S. median. (Hereafter these are referred to as "nearly-SNAP-eligible households"). The decline in food prices is likely to have affected food expenditures and food security of nearly-SNAP-eligible households similarly to low-income households. The ARRA SNAP enhancements, however, could not have directly affected the nearly-SNAP-eligible households because almost no households in that income range were eligible for SNAP. This difference-in-difference approach nets out the effects of year-to-year changes in food prices and any other factors that impacted the two groups similarly. Thus, the difference-in-difference results for TFP-Adjusted Food Expenditures and food security are the best estimates available in these analyses of the changes for low-income households that may be attributable to the ARRA SNAP enhancements.

In the preferred specifications, difference-in-difference estimates were calculated from models estimated separately for households in the two income ranges. These models allow outcome variables to be associated with household characteristics differently in the two income ranges. To check the robustness of the results, single-equation models were also estimated, in which households in both income ranges were included in a single model. In these models, the coefficient on an interaction variable between survey year (post-ARRA) and income range can be interpreted directly as the difference-in-difference estimate.

SNAP Participation Increased

Expected Changes

One mechanism by which ARRA could improve food security is by attracting more households to participate in SNAP through increased benefits. Across the years, some low-income households have not participated in SNAP even though they were eligible. Inference from economic principles suggests that the benefits nonparticipating eligible households would receive is not sufficient to cover their application and participation costs, considering money, time, and psychological costs (Burstein et al., 2009; Bartlett et al., 2004).[13] In fiscal 2008, the year prior to ARRA, an estimated 41 million individuals were eligible for SNAP benefits in a typical month, but only 27 million (66 percent) received them (USDA, Food and Nutrition Service, 2010c).[14]

Suspending time limits for some jobless adults without children was also expected to increase SNAP participation, although the proportion of low-income households affected by this provision is relatively small.

In a post-ARRA month, the SNAP caseload can be divided conceptually into two groups—referred to in this report as *ARRA-induced participants* and *noninduced participants*. This conceptual differentiation is useful for understanding ARRA effects on observed outcomes even though the two groups cannot be reliably distinguished in the data. The ARRA increase in SNAP benefits was expected to change the cost-benefit calculation in favor of participation for some eligible households that otherwise would be nonparticipants. In addition, the ARRA expansion of SNAP eligibility for jobless adults without children enabled some to participate who would not otherwise have been eligible. Regardless of which ARRA provision prompted their participation, these households became ARRA-induced participants. In contrast, noninduced participants are households that would have been SNAP participants regardless of whether ARRA had been implemented. ARRA-induced participants are not equivalent to households that entered SNAP after passage of ARRA. Some households that entered SNAP post-ARRA would have participated in SNAP even if the pre-ARRA level of benefits had still been in effect. Such a household is both a new entrant and a noninduced participant. Some households remained in SNAP post-ARRA that would have left the program under pre-ARRA eligibility or benefit arrangements. They are ARRA-induced participants but are not new entrants.

According to USDA administrative data, the SNAP caseload increased from 28.4 million participants in 2008 to 33.7 million in 2009, an increase of about 19 percent, and one of the largest single-year increases in SNAP history (USDA, Food and Nutrition Service, 2010b). This large increase in SNAP participation might seem to demonstrate that the ARRA SNAP changes prompted increased participation. It is impossible, however, to determine from the administrative data alone how much of the participation increase was attributable to ARRA, and how much was due to changing economic conditions. For example, the national unemployment rate averaged 9.3 percent in 2009, compared with 5.8 percent in 2008 (U.S. Bureau of Labor Statistics, 2010), and previous research has shown that the SNAP caseload is associated with the unemployment rate (Hanson and Gundersen, 2002). Thus, the SNAP caseload would probably have increased from 2008 to 2009 even if the ARRA SNAP

[13]This description of nonparticipation assumes that the household is making a fully informed decision about whether to participate in SNAP. In practice, some households might not know they are eligible for SNAP or may not know the amount of SNAP benefits they would receive if they were to apply. Outreach efforts by FNS are designed to increase program awareness and increase participation by eligible households.

[14]Households eligible for larger benefits, however, are more likely to apply. FNS estimates that participating households accounted for 84 percent of the total value of benefits for which all households (participating and nonparticipating) were eligible.

provisions had not been implemented. The multivariate analysis accounts for effects of changes in income, employment, and other household factors for which data are available in the CPS-FSS, providing an estimate of the change in SNAP participation that may be attributable to the ARRA SNAP changes.

Findings

Reported SNAP participation as a percentage of low-income households increased by 3.3 percentage points, from 27.7 percent in 2008 to 31.0 percent in 2009 (table 2). After adjusting for changes in household conditions, SNAP participation increased by 3.03 percentage points from 2008 to 2009. Since this model took into account household income, employment, and other household factors, the results can be interpreted as an estimate of the year-to-year difference in SNAP participation among similar households in those 2 years. As such, the adjusted increase must be attributable to changes from 2008 to 2009 in factors other than those included in the multivariate model. It is likely that some of the adjusted increase in SNAP participation was due to ARRA, but other factors cannot be ruled out.

In past research, multivariate models have generally underestimated increases in SNAP caseload during periods of substantial and sustained caseload growth. This may result from several processes:

- The existence of a larger pool of households with recent SNAP experience who are ready and willing to rejoin if a need arises; or
- A reduction of stigma as SNAP participation is considered more socially acceptable when a larger share of acquaintances are participating or when economic conditions are considered to be difficult.

Some of the increased SNAP participation from 2008 to 2009 could also have resulted from increases in adjunctive eligibility. Thus, the increased SNAP participation in 2009 is consistent with the hypothesis that the ARRA SNAP enhancements played a substantial role, but the evidence is not definitive.

Table 2
Snap participation pre-ARRA (2008) and post-ARRA (2009) among households with annual incomes less than 130 percent of the poverty line

SNAP participation (percent of households)		Change from 2008 to 2009					
		Unadjusted			Adjusted for differences in income, employment, and other household characteristics[1]		
2008	2009	Difference (percentage points)[2]	Odds ratio	p	Difference (percentage points)[2]	Odds ratio	p
27.74	31.04	3.30	1.17	<.001	3.03	1.16	<.001

SNAP= Supplemental Nutrition Assistance Program.

ARRA= American Recovery and Reinvestment Act.

[1]The logistic regression model adjusted for household income, household employment, household composition, race and Hispanic ethnicity, U.S. citizenship, education (of most highly educated adult in the household), residence relative to metropolitan area, and census region.

[2]Difference in percentage points corresponding to the 2009:2008 odds ratio evaluated at the 2008 percentage.

Source: USDA, Economic Research Service calculations based on data from the 2008 and 2009 Current Population Survey Food Security Supplement (CPS-FSS).

SNAP Benefits Increased

Expected Increase

USDA's Food and Nutrition Service calculated that benefits would increase by an average of 19 percent for households in SNAP at the time the ARRA benefit increase went into effect. However, the average percentage increase from December 2008 to December 2009—the period that can be measured in the CPS-FSS—is likely to have been somewhat less, because the ARRA-induced participants were likely, on average, to be somewhat better off than the noninduced participants and, therefore, eligible for a smaller benefit.

Findings

The median value of SNAP benefits reported by survey respondents with annual incomes less than 130 percent of the poverty line increased by 17.0 percent, relative to the cost of the TFP, from 2008 to 2009 (table 3). After adjusting for differences in income, employment, and other household characteristics, SNAP benefits increased by 16.1 percent. About 4 percent of the increase reflected a decline in TFP costs, so the increases in dollar terms (adjusted for household size but not for changes in food prices to be more directly comparable with the FNS prospective estimate) were about 13 percent (unadjusted) and 12 percent (adjusted).

Table 3

Value of SNAP benefits relative to the cost of the Thrifty Food Plan (TFP) pre-ARRA (2008) and post-ARRA (2009) among households that received SNAP benefits in the last 30 days before the food security surveys

	Value of SNAP benefits (ratio to cost of TFP)		Change from 2008 to 2009			
			Unadjusted		Regression-adjusted[1]	
Analysis sample	2008	2009	Percent	p	Percent	p
Median for SNAP participant households with incomes less than 130 percent of the poverty line	.529	.619	17.0	<.001	16.1	<.001
Median for SNAP participant households at all income levels	.500	.608	21.6	<.001	16.9	<.001
Mean for SNAP participant households with incomes less than 130 percent of the poverty line	.556	.659	18.5	<.001	18.1	<.001
Mean for SNAP participant households at all income levels	.530	.637	20.2	<.001	19.0	<.001

SNAP= Supplemental Nutrition Assistance Program.

ARRA= American Recovery and Reinvestment Act.

[1]Adjusted medians were estimated using quantile regression at the 50th percentile. Adjusted means were estimated using linear regression. All regressions included controls for household income, household employment, household composition, race and Hispanic ethnicity, U.S. citizenship, education (of most highly educated adult in the household), residence relative to metropolitan area, and census region.

Source: USDA, Economic Research Service calculations based on data from the 2008 and 2009 Current Population Survey Food Security Supplement (CPS-FSS).

The increase in SNAP benefits among low-income SNAP households was smaller than the 19 percent average projected by FNS. In part, this smaller increase reflects the limitation of this analysis sample to households with annual incomes less than 130 percent of the poverty line. It may also reflect a change in caseload composition. The limitation of the analysis sample to low-income SNAP households was imposed so that the results would reflect changes in the same population as those for food expenditures and food security reported in the next section. However, some households with annual incomes higher than 130 percent of the poverty line were eligible for SNAP during the November-December reference period, either because their income was temporarily lower or because they were adjunctively eligible due to participation in another program. Such households were, in general, eligible for a smaller benefit, and, therefore experienced a larger percentage increase in benefits under ARRA. When SNAP-participant households of all income levels were included in the analysis sample, the adjusted increase in median SNAP benefits relative to the cost of the TFP was 16.9 percent, corresponding to a change in dollar terms of about 12.9 percent.

Analysis of the SNAP benefits increase based on means and linear regression may be more directly comparable with the FNS prospective estimates. The adjusted increase from 2008 to 2009 in the mean benefit relative to the cost of the TFP was 19.0 percent, corresponding to an increase in dollar terms of about 15.0 percent. This is lower than the 19 percent estimated prospectively by FNS, but is near the actual change reported in FNS administrative data (14.8-percent increase in average household benefits from December 2008 to December 2009; USDA Food and Nutrition Service, 2010b).

TFP-Adjusted Food Expenditures Increased Among Low-Income Households

Expected Changes

Calculating the changes in TFP-Adjusted Food Expenditures that were expected to result from the ARRA increase in SNAP benefits and the change in food prices involved several steps, drew on a range of previous research evidence, and relied on several assumptions about the survey's data.

Several previous studies examined the relationship between food expenditures and SNAP benefits. One review of this work stated:

> "The FSP [Food Stamp Program, predecessor to SNAP] is virtually certain to result in increased food purchases, if for no other reason than that the program increases households' incomes and the income elasticity for food is positive. That is, increasing a household's income by $1,000 per year would always be expected to increase its food expenditures by some fraction of that amount. Economists have debated whether giving households coupons that must be spent on food consumed at home is more effective at increasing food expenditures than simply giving them a nonearmarked income supplement… a substantial body of evidence shows that coupons are more effective than cash in increasing food expenditures. This idea is often expressed in terms of the *marginal propensity to spend on food*, or MPSF. This quantity represents the increase in food expenditures per dollar increase in income." (Fox et al., 2004, p. 35, emphasis in original).

The conclusion of Fox et al. that food-targeted "coupons" (which now take the form of SNAP Electronic Benefits Transfer (EBT) Cards) are "more effective than cash in increasing food expenditures" means that there are, effectively, two values for the marginal propensity to spend on food, with a higher value for SNAP benefits than for cash income. In the remainder of this report, these marginal propensities are designated as MPS_{FSNAP} and MPS_{FCASH}, respectively. Estimating MPS_{FSNAP} presents considerable methodological challenges, and estimates using different methods have differed considerably. Most of the estimates summarized by Fox et al. (2004) are in the range of .25 to .50. Based on more recent research, Hanson (2010) suggests a range of .26 to .35 as most relevant to current program conditions; expectations in the present study are based on that range.

The expected size of the change in a household's food expenditures (in dollars) due to ARRA is the product of the MPS_{FSNAP} for that household and its change in SNAP benefits (in dollars). The relationship can be written as:

$$[\Delta \text{ (Food Expenditures)}] = [MPS_{FSNAP}]*[\Delta \text{ (SNAP Benefits)}].$$

Aggregating this expected change across SNAP participants is not straightforward, because neither of the determinants is constant across SNAP households. For any post-ARRA SNAP participant, the increase in SNAP benefits depends on whether or not ARRA affected the household's participation. ARRA increased the level of SNAP benefits for noninduced participants by

the amounts shown in the last column of table 1. ARRA-induced participants would have received no SNAP benefits in the absence of ARRA. Therefore, for ARRA-induced participants, the increases in resources that resulted from ARRA were the full post-ARRA amounts of SNAP benefits for which they were eligible. Thus, ARRA added relatively more to the resources of ARRA-induced participants than to those of noninduced participants eligible for the same benefit amount and, *ceteris paribus*, would have added relatively more to the food expenditures of the induced participants.

MPS_{FSNAP} also differs across SNAP households. Noninduced SNAP households that spent little or none of their own resources for food, relying completely or almost completely on SNAP benefits for their food spending, were likely to increase their food spending by the full amount of the ARRA increase. SNAP benefits can only be spent for food, and those households would not have been able to reduce out-of-pocket food purchases that were already minimal or zero. The MPS_{FSNAP} for this subgroup would have been at or very close to 1.0. On the other hand, households that spent substantially more for food than the amount of their SNAP benefits, using their own cash out-of-pocket, may not have increased food spending by the full amount of the ARRA increase. Although they were likely to increase their food spending somewhat, this subgroup may have reduced their out-of-pocket spending for food to some extent. Research reviewed by Fox et al. (2004) supports the hypothesis that households tend to exhibit this substitution behavior with SNAP benefits. For those receiving relatively small SNAP benefits, the MPS_{FSNAP} may differ little from the expected MPS_{FCASH}.

The expected percentage change in food expenditures by all low-income households would be substantially smaller than the percentage change in SNAP benefits, even if food expenditures increased by the full dollar amount of the ARRA increase. Assuming that about half of low-income households participated in SNAP in 2008, and that SNAP benefits accounted for about 60 percent of their total food expenditures (based on CPS-FSS data, analysis not shown), then total SNAP benefits accounted for approximately 30 percent of total food spending by all low-income households.

Food prices declined during the study period (2008-09), and the decline in food prices was expected to boost the quantity and quality of food purchased by both low-income and nearly-SNAP-eligible households, as measured by TFP-Adjusted Food Expenditure (see box, "Demand for Food Was Expected To Increase Due to Decline in Food Prices"). The expected increase was estimated based on the size of the price changes and the MPS_{FSNAP} estimated from previous research. In general, the expected increase in the quantity of food purchased depends on:[15]

- The change in food prices relative to the prices of other goods; and
- The price elasticity of demand for food.

The change in food prices relative to the prices of other goods is approximately equal to the percentage change in food prices less the percentage change in the consumer price index (CPI) for other goods. From late-2008 to late-2009, the change in food prices relative to other goods for low-income households was probably between -4.4 and -5.8 percent. The former estimate

[15]"Quantity," as used here, refers not to pounds or volume of food, but to "quality-adjusted quantity" (that is, additional expenditure may represent either an increase in quantity, quality, or some mixture). This concept of quality-adjusted quantity is represented by the TFP-Adjusted Food Expenditure.

Demand for Food Was Expected to Increase Due to Decline in Food Prices

Food prices declined, on average, from late-2008 to late-2009.[1] The extent of the decline depends partly on what combination of foods—"market basket"—is used to aggregate changes in the prices of individual food items. From December 2008 to December 2009, the cost of the Thrifty Food Plan (TFP) declined by 3.5 to 4.0 percent, depending on household composition (calculated based on data from USDA's Center for Nutrition Policy and Promotion). Over about the same period, the Consumer Price Index (CPI) for Food at Home, which includes a broader set of foods than the TFP, declined somewhat less, about 2.7 percent (calculated based on data from the Bureau of Labor Statistics). Meanwhile, the CPI without food and energy prices, increased from 2008 to 2009 by about 1.8 percent (calculated based on data from the Bureau of Labor Statistics). Thus, not only did food prices decline during the study period, but food prices fell while the prices of other goods and services rose. Together, these two changes resulted in a decrease in the *relative* price of food (relative to other goods and services) that was even larger than the percentage decline in the cost of the TFP or the CPI for Food at Home.

According to the economic "law of demand," a decline in the price of a product relative to prices of other goods and services increases the quantity of that product that households are willing and able to purchase (if other market factors remain the same or are taken into account statistically). Therefore, it was expected that households would, on average, have increased their TFP-Adjusted Food Expenditures from 2008 to 2009 in the absence of any other changes.

It was important to estimate the effect of declining food prices on food expenditures and food security so as not to attribute those changes to the ARRA SNAP provisions that took place during the same time period. Households across the income spectrum experienced the decline in the price of foods. The effects of the decline in food prices on food expenditures and food security of nearly-SNAP-eligible households (those with incomes a bit higher than the SNAP eligibility level but below the national median) should be similar to the effects on low-income households. Thus, changes in food expenditures and food security among nearly-SNAP-eligible households, adjusted for changes in income, employment, and other relevant household characteristics, were considered proxies for the changes that would have been observed in low-income households in the absence of the ARRA SNAP provisions.

[1]The decline in food prices followed 2 years of unusually high food price inflation in 2007 and 2008.

is based on changes in the CPI for Food at Home and the CPI without food and energy; the latter estimate is based on the change in the cost of the TFP (down 4.0 percent at most) and the change in CPI without food and energy.

The price elasticity of demand for food is the amount by which the quantity of food purchased changes in response to changes in food prices, so long as changes in other factors affecting food purchases remain the same. A recent study estimated U.S. consumer demand systems for six broad categories of consumer goods (Taylor and Houttakker, 2009). The study's estimates of price elasticity of demand for food consumed at home ranged from -0.25 to -0.76 and averaged -0.49. This means that an increase in food prices of 10 percent results in a decrease in quantity demanded of 4.9 percent. Based on this estimate, the

decline in food prices of 4.4 to 5.8 percent from late 2008 to late 2009 would result in an increase in quantity demanded of 2.2 to 2.9 percent.

Based on these principles and assumptions, the expected changes in food expenditures by low-income households and by nearly-SNAP-eligible households can be summarized as follows:

- Average TFP-adjusted SNAP benefits among all low-income households increased by about 29 percent—the combined effects of the increase in median SNAP benefits among participants (16.1 percent) and the increase in participation (11 percent).[16]
- If average MPS_{FSNAP} is in the range of .26 to .35, then the increase in food spending would be between 7.54 and 10.15 percent of average SNAP benefits among all low-income households in 2008 (calculated as 29 percent x .26 and 29 percent x .35).
- A change in food spending in that range would represent an increase of between 2.3 percent and 3.0 percent of average food spending for all low-income households (calculated as 30 percent of the change in average SNAP benefits). The difference-in-difference result for low-income households is expected to be in this range.
- An additional increase in average TFP-Adjusted Food Expenditure of 2.2 to 2.9 percent is expected for both low-income households and nearly-SNAP-eligible households due to the decline in food prices. Added to the range in the previous bullet, this gives an expected range of 4.5 to 5.9 percent for the multivariate estimate of the increase among low-income households.

[16]The combined effect is calculated as 1.161 x 1.11.

Findings

Median TFP-Adjusted Food Expenditures rose by 5.4 percent from 2008 to 2009 for all low-income households (adjusting for income, employment, and other household characteristics, table 4). This change is within the range of the expected increase (4.5-5.9 percent). The corresponding change for nearly-SNAP-eligible households was 3.2 percent, somewhat higher than the expected range of 2.2 to 2.9 percent.

Based on the change for nearly-SNAP-eligible households, about 3.2 percent of the increase for low-income households may have resulted from the decline in food prices (together with other factors that changed from 2008 to 2009 but were not measured in the CPS-FSS data). The difference-in-difference estimate of 2.2 percent (5.4 percent less 3.2 percent) is the best from this study of the average increase in food spending by low-income households that may have resulted from the ARRA SNAP enhancements. The 2.2-percent estimated increase is just below the expected range (2.3-3.0 percent). Considering the uncertainties in the assumptions underlying the expectations and the extent to which distributional issues may affect estimates based on medians and quantile regressions, the observed increase is reasonably consistent with expectations.

The increase in food expenditures by SNAP participants that may be due to the ARRA benefit increase is nearly twice the 2.2 percent estimated for all

Table 4

Median food expenditures relative to the cost of the Thrifty Food Plan (TFP) pre-ARRA (2008) and post-ARRA (2009), by income

Variable	Median		Change from 2008 to 2009			
			Unadjusted		Regression-adjusted[1]	
	2008	2009	Percent	p	Percent	p
Food expenditures for households with incomes less than 130 percent of the poverty line (low-income households)	.888	.940	5.9	<.001	5.4	<.001
Food expenditures for households with incomes from 150 to 250 percent of the poverty line (nearly-SNAP-eligible households)	1.013	1.057	4.4	.010	3.2	.004

SNAP= Supplemental Nutrition Assistance Program.

ARRA= American Recovery and Reinvestment Act.

[1]Adjusted medians were estimated using quantile regression at the 50th percentile with controls for household income, household employment, household composition, race and Hispanic ethnicity, U.S. citizenship, education (of most highly educated adult in the household), residence relative to metropolitan area, and census region.

Source: USDA, Economic Research Service calculations based on data from the 2008 and 2009 Current Population Survey Food Security Supplement (CPS-FSS).

low-income households, considering that about half of low-income households in the CPS-FSS participated in 2008 and about 56 percent in 2009.

We assessed the robustness of these results in two additional analyses. First, the models for low-income and nearly-SNAP-eligible households were re-estimated using means and linear regression models rather than medians and quantile regression models (analysis not shown). Households with TFP-Adjusted Food Expenditures below the 5th percentile and above the 95th percentile were omitted to reduce the effects of outliers that appeared to be serious reporting errors. The results were qualitatively similar to those in table 4. The estimated increases in TFP-Adjusted Food Expenditures were somewhat smaller for both groups, but the difference-in-difference estimate (with adjustments for changes in household characteristics) was slightly larger in magnitude than that based on table 4 and was statistically significant.

The second robustness check was a single-equation model of the difference-in-difference. The estimates in table 4 were based on separate models for low-income households and nearly-SNAP-eligible households. The separate models allow the association between each household characteristic and food expenditure to be associated differently in the two samples. The single-equation model was estimated by including households in both income ranges in the analysis sample (analysis not shown). This model constrained the associations of each household characteristic with food expenditure to be the same in the two income ranges. Variables were added to the model to identify households from the low-income sample (binary) and the interaction between the low-income dummy variable and the post-ARRA variable. The coefficient of interest was that on the interaction, which can be interpreted directly as the difference-in-difference estimate. In a second specification, two additional interactions were introduced—between the low-income dummy variable and

income and between the low-income dummy variable and income-squared. This specification relaxed the constraint that income be associated similarly with food expenditure in both income ranges. The results were qualitatively similar to those in table 4, but the difference-in-difference estimate was smaller (1.9 percentage points in the single-equation model compared with 2.5 percentage points in table 4) and was not statistically significant (p=.31). The more flexible model in table 4, however, may be a preferred specification; it seems likely that food expenditures could be associated differently with some household characteristics in the two income ranges.

Food Security Improved Among Low-Income Households

Expected Changes

The increase in TFP-Adjusted Food Expenditures by low-income households from 2008 to 2009 was expected to improve the food security of low-income households. In most households, the majority of food consumed by household members is purchased—either from supermarkets or grocery stores to be eaten at home or from cafeterias, restaurants, or vending machines to be eaten outside the home. Limited spending for food is, therefore, the main mechanism by which constrained household resources result in food insecurity. TFP-Adjusted Food Expenditures take into account inflation or deflation in food prices in the TFP. Thus, from 2008 to 2009, the increase in TFP-Adjusted Food Expenditures by low-income households was expected to decrease the prevalence of food insecurity and very low food security as long as other factors affecting food security conditions remained the same or were taken into account in the study's multivariate methodology.

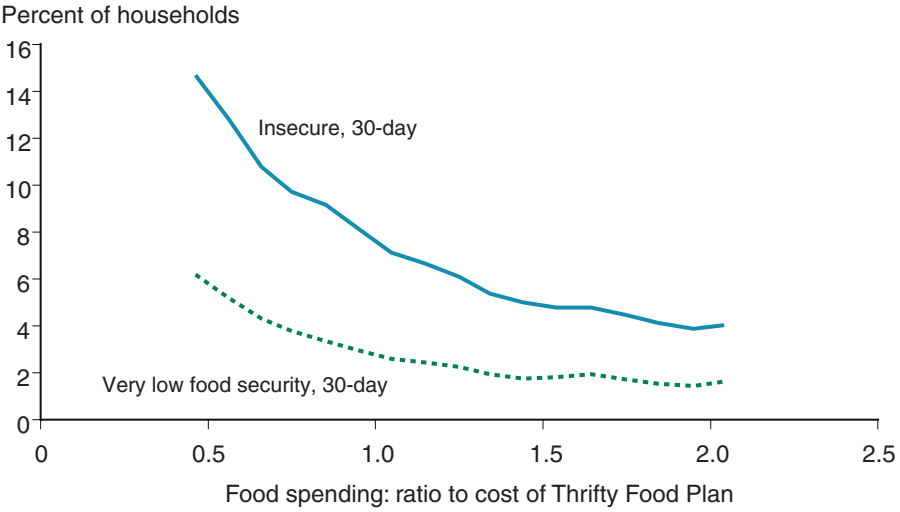
Two approaches were used to approximate the expected change in prevalence rates of food insecurity and very low food security given the 5.4-percent increase in median TFP-Adjusted Food Expenditures. First, the association across years between annual statistics on median food expenditure and the two prevalence rates for low-income households from 2001 to 2009 were examined (analysis not shown). The associations implied that an increase of 5.4 percent in median TFP-Adjusted Food Expenditures would result in a decline of 3.6 percentage points in food insecurity and 3.2 percentage points in very low food security. This estimate provides only a rough approximation, of course, since many year-to-year differences in conditions among low-income households are not taken into account.

The second approach examined the relationships between TFP-Adjusted Food Expenditures and prevalence rates of food insecurity and very low food security across households (fig. 1). Food insecurity was about 15 percent for households that spent half the cost of the TFP, and fell to 4 percent for those spending twice the cost of the TFP. Very low food security fell from about 6 percent to 1.7 percent across the same range. Based on the slope of the curves near the cost of the TFP (1.0 on the horizontal axis), the observed increase in median TFP-Adjusted Food Expenditures were expected to cause a decline of 0.38 percentage points in food insecurity and a decline of 0.15 percentage points in very low food security. The considerable difference between the estimates from these two approaches reflects limitations of observational data to shed light on this relationship. The "natural experiment" of the ARRA SNAP enhancements offers a rare opportunity to bring a stronger methodology to bear on the issue.

Food security was expected to improve for nearly-SNAP-eligible households, as well as for low-income households, because of the decline in food prices, although the extent of the improvement was expected to be smaller for the former. Again, the difference in the improvement between the two groups may reflect the effects of ARRA SNAP enhancements on the food security of low-income households.

Figure 1

Prevalence of food insecurity and very low food security, by food expenditure as a ratio to the cost of the Thrifty Food Plan (TFP)



Notes: Depicts the bivariate relationship using data from 2005 to 2009; 2005 was the first year for which data were collected to calculate the current 30-day measures of food security. Households were grouped in narrow ranges by TFP-Adjusted Food Expenditures, and, within each range the prevalence rates and mean TFP-Adjusted Food Expenditures were calculated.

Source: USDA, Economic Research Service calculations based on data from the 2005-2009 Current Population Survey Food Security Supplement (CPS-FSS).

Findings

From 2008 to 2009, the prevalence of food insecurity fell by 1.16 percentage points among low-income households, and the prevalence of very low food security fell by 1.38 percentage points (table 5). Adjusted for differences in income, employment, and other household characteristics, these declines were somewhat greater, 2.2 and 2.0 percentage points, respectively (table 5 and figs. 2 and 3). These changes were in the range between expectations based on the two different approaches; they were about 60 percent of the expected declines based on year-to-year aggregate statistics for low-income households, and were much greater than expectations based on associations across households.

Food insecurity worsened somewhat from 2008 to 2009 among nearly-SNAP-eligible households in the CPS-FSS sample, rather than improving, in spite of the decline in food prices. The adjusted differences, however, were relatively small and were not statistically significant (indicated by p values of .772 and .133). Thus, the food security of low-income households not only improved at both levels of severity, but improved in comparison with nearly-SNAP-eligible households.

Single-equation estimates of the difference-in-difference analysis were almost identical to those in table 5. Difference-in-difference estimates for food insecurity overall and for very low food security were slightly stronger based on single-equation models.[17]

The 2008-09 estimated changes in food security conditions among low-income households were consistent with the expected outcomes based on

[17]Recognizing that interactions in logistic regression may not always admit of direct interpretation, the single-equation models were also estimated as linear probability models using ordinary least squares (OLS) regression. Those results were also consistent with the results reported in table 5.

Table 5

Prevalence of food insecurity and very low food security pre-ARRA (2008) and post-ARRA (2009)

Sample and variable analyzed	Percent of households)		Bivariate (no controls)			Adjusted for differences in income, employment, and other household characteristics[1]		
	2008	2009	Difference[2]	Odds ratio	p	Difference[2]	Odds ratio	p
Low-income households (incomes less than 130 percent of the poverty line) (2008 N=6,998; 2009 N=7,574)								
Prevalence of food insecurity	25.03	23.87	-1.16	.94	.198	-2.20	.89	.002
Prevalence of very low food security	11.27	9.89	-1.38	.86	.033	-2.00	.80	<.001
Nearly-SNAP-eligible households (incomes from 150 to 250 percent of the poverty line) (2008 N=7,076; 2009 N=6,980)								
Prevalence of food insecurity	11.51	12.37	.86	1.09	.214	.16	1.02	.772
Prevalence of very low food security	4.22	5.08	.86	1.21	.056	.53	1.13	.133

SNAP= Supplemental Nutrition Assistance Program.

ARRA= American Recovery and Reinvestment Act.

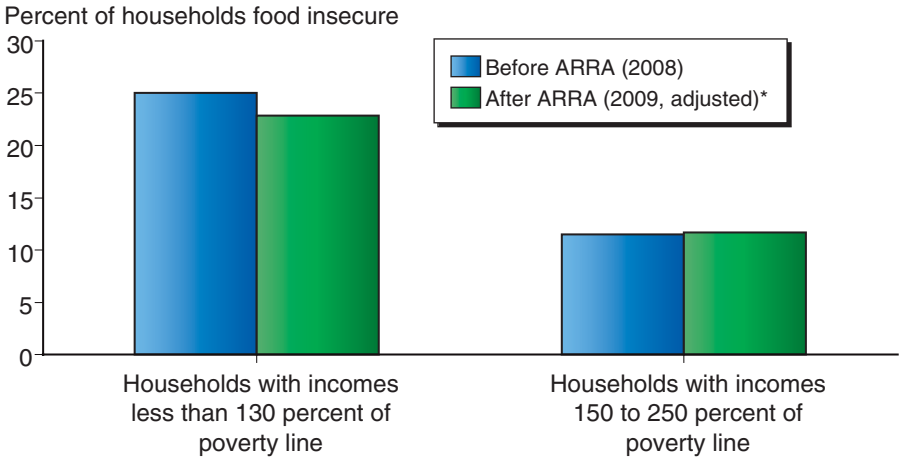
[1]Logistic regression models controlled for household income, household employment, household composition, race and Hispanic ethnicity, U.S. citizenship, education (of most highly educated adult in the household), residence relative to metropolitan area, and census region.

[2]Difference in percentage points corresponding to the 2009:2008 odds ratio evaluated at the 2008 percentage.

Source: USDA, Economic Research Service calculations based on data from the 2008 and 2009 Current Population Survey Food Security Supplement (CPS-FSS).

Figure 2

The prevalence of food insecurity declined among households with incomes in the eligibility range for SNAP, but not for households with incomes somewhat higher



SNAP= Supplemental Nutrition Assistance Program.

ARRA= American Recovery and Reinvestment Act.

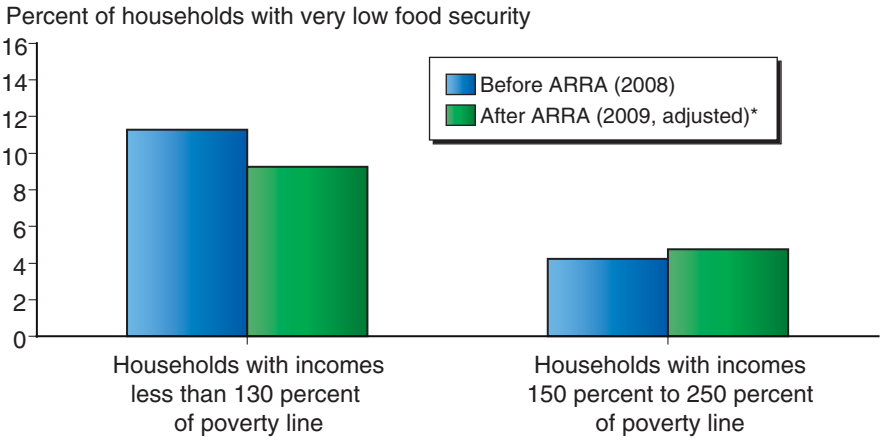
*Percentages for 2009 were regression-adjusted for differences between years in household income, employment, and other household characteristics.

Source: USDA, Economic Research Service calculations based on Current Population Survey Food Security Supplement (CPS-FSS) data.

economic models of behavior. Considering that the adjusted differences take into account most important household-level factors, and that difference-in-difference estimates adjust to a considerable extent for changes in food prices and other year-to-year changes that affected households across the middle and lower income range, the results strongly suggest that ARRA improved food security for low-income households.

Figure 3

The prevalence of very low food security declined among households with incomes in the eligibility range for SNAP, but not for households with incomes somewhat higher



SNAP= Supplemental Nutrition Assistance Program.

ARRA= American Recovery and Reinvestment Act.

*Percentages for 2009 were regression-adjusted for differences between years in household income, employment, and other household characteristics.

Source: USDA, Economic Research Service calculations based on Current Population Survey Food Security Supplement (CPS-FSS) data.

TFP-Adjusted Food Expenditures Increased More for SNAP Households Than for Low-Income Non-SNAP Households

Expected Differences

Absent any misreporting of SNAP participation and changes in self-selection into SNAP, it is clear that any changes in food expenditures and food security caused by the ARRA SNAP benefit increase would be seen only among SNAP participants. Misreporting and changes in self-selection, however, could have substantial effects on the comparisons in outcomes between SNAP households and low-income non-SNAP households.

Misreporting (primarily failure to report SNAP participation) would reduce the size of pre-to-post-ARRA differences between SNAP households and low-income non-SNAP households. The increased SNAP benefits and eligibility would improve outcomes for households that received SNAP but failed to report it in the survey, thus registering a pre-ARRA to post-ARRA improvement for reported nonparticipants.

It is less clear how these comparisons would be affected by the changes in self-selection that resulted from the ARRA SNAP enhancements. The effects depend on the characteristics of the ARRA-induced participants. Although that group was probably heterogeneous, it seems likely that ARRA-induced participants would, on average, have been better off than noninduced participant households in 2009 and worse off than nonparticipant households; households with great unmet food needs would be more likely than better-off households to have participated even without the ARRA benefit increase.[18] The change in participation status of the ARRA-induced SNAP participant households would, therefore, have improved food security for both SNAP participants and low-income non-SNAP households in 2009, but the effect on the difference between the two groups is not clear.

Findings

Median TFP-Adjusted Food Expenditures increased from 2008 to 2009 by a larger increment for SNAP participants than for low-income nonparticipants (table 6). Adjusted for differences in household income, employment, and other household characteristics, median food expenditures increased by 9.1 percent among SNAP-participant households compared with 3.4 percent among low-income non-SNAP households.

Within the CPS-FSS low-income sample, food security improved more among SNAP participants than among nonparticipants (table 7). The difference in improvement between the two groups, however, was not statistically significant either for the prevalence of food insecurity overall or for very low food security. That is, the changes were within a range that could have resulted from random differences between the CPS-FSS sample and the population.

[18]This assumption focuses on changes expected to result from the ARRA increase in SNAP benefits. Effects of the expanded eligibility for jobless adults with no children on the food security of SNAP participants are difficult to predict. The number of households that would have been affected by this change, however, was small relative to the total number of SNAP households, so any effects on the prevalence of food insecurity among participants are likely to have been small compared with the effects of increased benefits.

Table 6

Median food expenditures relative to the cost of the Thrifty Food Plan (TFP) pre-ARRA (2008) and post-ARRA (2009) in households with annual incomes less than 130 percent of the poverty line, by SNAP participation status

Analysis sample	Median food expenditure (ratio to TFP)		Change from 2008 to 2009			
			With no controls		With controls[1]	
	2008	2009	Percent	p	Percent	p
Households that received SNAP benefits in the 30 days before the food security survey	.851	.944	10.9	<.001	9.1	<.001
Households that did not receive SNAP benefits in the 30 days before the food security survey	.903	.933	3.3	.052	3.4	.017

SNAP= Supplemental Nutrition Assistance Program.

ARRA= American Recovery and Reinvestment Act.

[1]Estimated using quantile regression with controls for household income, household employment, household composition, race and Hispanic ethnicity, U.S. citizenship, education (of most highly educated adult in the household), residence relative to metropolitan area, and census region.

Source: USDA, Economic Research Service calculations based on data from the 2008 and 2009 Current Population Survey Food Security Supplement (CPS-FSS).

Table 7

Prevalence of food insecurity and very low food security pre-ARRA (2008) and post-ARRA (2009), by SNAP participation status

Severity level analyzed and SNAP status	Percent of households		Bivariate (no controls)			Adjusted for differences in income, employment, and other household characteristics[1]		
	2008	2009	Difference[2]	Odds ratio	p	Difference[2]	Odds ratio	p
Food insecurity								
Prevalence of food insecurity for SNAP-participant households	33.51	30.95	-2.56	.89	.159	-3.52	.85	.016
Prevalence of food insecurity for low-income non-SNAP households	21.77	20.69	-1.08	.94	.289	-1.90	.89	.022
Very low food security								
Prevalence of very low food security for SNAP-participant households	14.38	12.08	-2.30	.82	.082	-2.98	.77	.004
Prevalence of very low food security for low-income non-SNAP households	10.08	8.90	-1.18	.87	.106	-1.68	.82	.004

SNAP= Supplemental Nutrition Assistance Program.

ARRA= American Recovery and Reinvestment Act.

[1]Regression models controlled for household income, household employment, household composition, race and Hispanic ethnicity, U.S. citizenship, education (of most highly educated adult in the household), residence relative to metropolitan area, and census region.

[2]Difference in percentage points corresponding to the 2009:2008 odds ratio evaluated at the 2008 percentage.

Source: USDA, Economic Research Service calculations based on data from the 2008 and 2009 Current Population Survey Food Security Supplement (CPS-FSS).

An Historical Perspective on Pre-ARRA to Post-ARRA Changes

The combination of a simultaneous increase in SNAP participation and improvement in food security from the previous year that was observed in 2009 has not occurred in any other recent year. In 6 of the 8 years since 2001, SNAP participation, on an adjusted basis, increased year to year, as indicated by odds ratios greater than 1.0 (table 8).[19] With the exception of 2003-2004, the increases were statistically significant at the 5 percent level. However, an increase in SNAP participation was accompanied by a decline in the prevalence of very low food security among low-income households in only two periods (2008-09 and 2002-03) and was statistically significant only in 2008-09. Among reported SNAP participants, the prevalence of very low food security declined in the same two periods and was statistically significant in both. In all other years, the prevalence of very low food security worsened (among both low-income households overall and among low-income SNAP participants), although not all of the annual increments were statistically significant.

The uniqueness of the combination of changes from 2008 to 2009 further suggests that ARRA contributed to the improvement in food security among low-income households. The somewhat similar changes from 2002 to 2003 may have resulted partly from the implementation of provisions from the 2002 Farm Bill that also expanded eligibility and increased benefits for some SNAP participants.

[19]This analysis considered only the years since 2001 because, prior to 2001, the CPS-FSS was not conducted in the same month in successive years.

Table 8

Year-to-year changes in SNAP participation and the prevalence of very low food security among low-income households, adjusted for changes in household income, employment, and other household characteristics[1]

	SNAP participation		Prevalence of very low food security (all low-income households)		Prevalence of very low food security (low-income households that received SNAP benefits)	
Period	Odds ratio	p	Odds ratio	p	Odds ratio	p
2008-09	1.158	<.001	0.804	<.001	0.766	.004
2007-08	1.175	.001	1.366	<.001	1.115	.327
2006-07	.904	.036	1.045	.521	1.142	.237
2005-06	.960	.343	1.080	.230	1.078	.470
2004-05	1.127	.005	1.064	.283	1.134	.189
2003-04	1.014	.778	1.113	.105	1.188	.162
2002-03	1.402	<.001	.924	.236	.735	.018
2001-02	1.201	<.001	1.142	.034	1.077	.492

SNAP= Supplemental Nutrition Assistance Program.

Notes: Results in shaded cells are statistically significant with p<.10. Tabled statistics come from logistic regression models that controlled for household income, household employment, household composition, race and Hispanic ethnicity, U.S. citizenship, education (of most highly educated adult in the household), residence relative to metropolitan area, and census region. The sample for each period included households in the Current Population Survey Food Security Supplement for the 2 years. The statistics are for a dummy variable representing households in the second year.

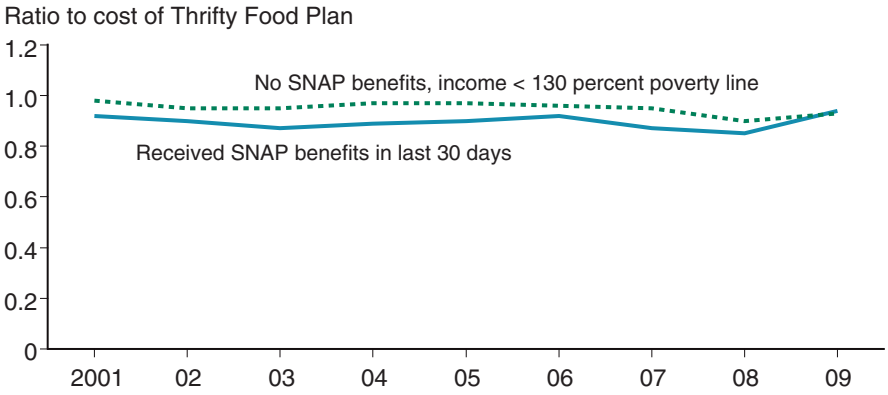
[1]SNAP participation and very low food security were assessed during the 30-day period prior to the food security survey (conducted in mid-December). The older 30-day food security measure described by Nord (2002) was used for comparisons from 2001-02 through 2004-05. The full-range 30-day measure was used for comparisons for 2005-06 through 2008-09.

Source: USDA, Economic Research Service calculations based on Current Population Survey Food Security Supplement (CPS-FSS) data.

The larger increases in food expenditures from 2008 to 2009 by low-income SNAP participants relative to low-income nonparticipants resulted in median spending becoming essentially equal by the two groups in 2009. (The sample median was slightly higher for SNAP participants, but the difference was small and was not statistically significant.) This equalization represented a change not only from 2008, but from a pattern that had persisted since at least 2001 (fig. 4). From 2001 to 2008, median food spending by SNAP participants ranged from 4 to 8 percent less than that by low-income non-SNAP households. In 2009, for the first time in the decade, median food spending by SNAP participants equaled that of non-participants.

Figure 4

Food spending relative to the cost of the Thrifty Food Plan (TFP), by SNAP status



SNAP= Supplemental Nutrition Assistance Program.

Source: USDA, Economic Research Service using statistics from USDA's annual food security reports (Nord et al., *Household Food Security in the United States, 2009* and corresponding reports for earlier years).

Conclusions

The food security of low-income households improved from 2008 to 2009, and our results suggest that ARRA's SNAP increase in benefits and eligibility played a substantial role in the improvement. Food security improved among low-income households but not among households with incomes just above the SNAP eligibility range. This pattern remained and was statistically significant when regression adjusted for differences in income, employment, and other household characteristics. The hypothesis that the increase in SNAP benefits due to ARRA was largely responsible for these patterns is strengthened by the corresponding pattern of changes in food spending. Inflation-adjusted food spending increased from 2008 to 2009 among low-income households, and the extent of the increase was greater than that among households with incomes just above the SNAP eligibility range but below the national median.

In addition to assessing the effects of ARRA's SNAP enhancements, the findings of this study demonstrate the effectiveness of SNAP in combating food insecurity. Estimating the effects of SNAP on food security is complicated by the self-selection of more food-needy households into the program. While SNAP benefits presumably lessen the severity of food insecurity for participants, participation in SNAP is voluntary, and households with greater unmet food needs are, in general, more likely to participate. These two processes, self-selection and the ameliorating effect of benefits, produce opposite and partially offsetting associations between SNAP participation and food insecurity in observational data. Untangling the two effects has presented great methodological difficulties (Ratcliffe and McKernan, 2010; Nord and Golla, 2009; Yen et al., 2008; Gundersen and Oliveira, 2001). The "natural experiment" of ARRA's SNAP benefit increase offers the rare opportunity of an exogenous change that sheds light on the overall effects of SNAP.

If ARRA's increase in SNAP benefits was largely responsible for the contemporaneous improvement in food security among low-income households, then the full effect of the program on participants must be considerably greater than the improvement from 2008 to 2009 among all low-income households. The improvements would have been concentrated almost entirely among households that participated in SNAP (approximately half of low-income households). Furthermore, the improvements would represent only the marginal effect of an increase of about 16 percent in program benefits received, while the median SNAP benefit pre-ARRA was about three times as large as the marginal change in benefits and the maximum benefit was about six times as large as the marginal change. With those relationships in mind, the 20-percent decline in the odds of very low food security and 11-percent decline in the odds of food insecurity among all low-income households suggest a sizeable overall program effect in combating food insecurity.

Under current law, the inflation-adjusted value of SNAP benefits will decline to pre-ARRA levels over the next several years. Congress did not intend the ARRA SNAP changes to be permanent. The Act specified that the maximum benefit levels were to remain fixed in dollar terms at the higher level until they were surpassed by standard SNAP benefits, which were expected to

rise due to inflation in food prices. Subsequent Congressional Acts have mandated a return to pre-ARRA benefit formulas in November 2013. The special eligibility waiver for jobless adults without children lapsed in October 2010. In isolation, these changes would be expected to erode the food security improvements realized in 2009, but the number of food-insecure household could still decline if improvements in the economy reduce the number of low-income households.

Our findings also raise questions about the adequacy of pre-ARRA SNAP benefit levels for combating food insecurity and very low food security. The marginal effect of an increase in SNAP benefits on food security may decline as benefit levels rise. At some level, further increases in benefits would have little to no additional effect on food security. The adequacy of SNAP benefits varies across households, depending on household food needs, local food prices, nonfood consumption needs of the household, and food management and preparation skills, among other factors. So there is no single benefit level that is "adequate." The patterns of change observed in this study suggest that pre-ARRA benefit levels were in a range where the marginal positive effect of an increase in benefits was substantial.

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Appendix: Multivariate Regression Models

Appendix tables 1-8 present the regression models from which the adjusted odds ratios and changes in TFP-Adjusted Food Expenditures in tables 2-7 were estimated.

The variables in the regression models were calculated as follows (CPS-FSS variable names are in upper case in parentheses):

Post ARRA—This dummy variable identifies households interviewed in the December 2009 CPS-FSS, after the implementation of the ARRA SNAP benefit increase (versus those interviewed in the December 2008 CPS-FSS). The coefficients on *Post ARRA* in the logistic regression models are the adjusted odds ratios in tables 2, 5, and 7. The coefficients on *Post ARRA* in the quantile regression models were used to calculate the "changes from 2008 to 2009 with controls" values in tables 3, 4, and 6.

Income (ratio to poverty line)—Combined income of all family members from all sources in the 12 months prior to the survey is reported in 16 categories (HUFAMINC). We approximated income for each household at the center of the reported range and divided by a poverty line for that household to adjust for household size and composition. We based household poverty lines on the Census Bureau's table of poverty thresholds for individuals and families for the year of the survey, taking into account the numbers of adults and children in the household and whether the household reference person was younger or older than 65. The square of this ratio was also entered to allow for a nonlinear (quadratic) association.

In our analyses, we treated each household in the CPS-FSS data (comprising all individuals living together in an owned or rented unit) as a single economic unit. The CPS-FSS collects data on SNAP receipt, food spending, and food security at the household level, so analysis at the household level is the only feasible approach. Not all multimember households are "families" as defined in the Census Bureau poverty thresholds and poverty statistics, and may not be coterminous with SNAP units as defined for administrative purposes. The proportion of households with multiple economic units is small, however, so these approximations are not likely to distort analytic results substantially.

Income in lowest reported category—Identifies households that reported annual income in the lowest category (less than $5,000). Previous research has found that some households in this category have relatively high consumption even though their income is low. In some cases, income may be only temporarily low and the household can maintain consumption levels by drawing on assets or credit.

Labor force status of primary earner—The employment/labor force status of the primary earner in each household was assigned in a two-step process. First, the status of each adult in the household was assigned based on the "monthly labor force recode" (PEMLR) and "full-time/part-time work status" (PRWKSTAT). Those variables are, in turn, calculated by the Census Bureau based on a detailed series of questions about each adult's employ-

ment, working hours, unemployment, job searches, and the reasons for not working. The categories are:

1. Employed full time;
2. Not in the labor force—retired;
3. Employed part time for noneconomic reasons (i.e., do not want to work more hours);
4. Employed part time for economic reasons (i.e., want to work more hours, unable to find a job with more hours);
5. Unemployed—looking for work;
6. Not in the labor force due to disability; and
7. Not in the labor force for reasons other than retirement or disability.

The primary earner was then identified as the adult with the lowest numbered status, and that status was assigned to the household.

Household composition—Household composition was assigned in one of seven categories, depending on the number of adults, whether or not children were present (and whether their parent was in the primary family), and the marital status of the household reference person. Cohabiting couples with children were assigned as single male with child/children, single female with child/children, or other household with child/children, depending on the sex of the household reference person and the relationships of children in the household. The categories are:

- Married couple with child/children;
- Single male with child/children;
- Single female with child/children;
- Other household with child/children (i.e., children in complex living arrangements, such as children of unmarried partner, housemate, or border);
- Two or more adults—no child;
- Male living alone; or
- Female living alone.

One or more elderly persons in the household—At least one person in the household was 65 years old or older.

Race and Hispanic ethnicity—Based on race (PDTRACE) and Hispanic ethnicity (PRDTHSP) of household reference person. Non-Hispanic persons reporting a race other than Black or more than one race were not separately identified and were included with White-non-Hispanics in the reference category for the regression analyses.

Noncitizen household reference person—Household reference person foreign born and not a citizen of the United States (PRCITSHP=5).

Educational attainment of most highly educated adult—Based on the highest value of PEEDUCA among all adults in the household.

Metropolitan/nonmetropolitan residence—Based on variables GTCBSAST and GTMETSTA, which operationalize the 2003 Office of Management and Budget delineation. The reference category comprises households within a metropolitan area but not in the "principal city." In most cases, this means in suburban or exurban areas outside of the incorporated area of any of the large densely populated cities of the metropolitan area. The category, "Metropolitan—not specifically identified" refers to households within metropolitan areas for which the location inside or outside of principal cities was not identified to avoid possible breach of confidentiality (about 17 percent of metropolitan households).

Census Region—The four census regions are:

- Northeast: Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont
- Midwest: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin
- South: Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia
- West: Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming

Appendix table 1

Logistic regression of SNAP participation in the 30 days prior to survey on post-ARRA versus pre-ARRA period, with controls for household characteristics[1]

Characteristic	Odds ratio	p
Intercept	0.860	.435
Post-ARRA	1.158	<.001
Income (ratio to poverty line)	1.290	.586
Income (ratio to poverty line) squared	.280	<.001
Income in lowest reported category	.595	<.001
Labor force status of primary earner (reference: employed full time)		
Out of labor force—retired	2.143	<.001
Part-time for noneconomic reasons	1.278	.003
Part-time for economic reasons	1.817	<.001
Unemployed	2.706	<.001
Out of labor force—disabled	5.579	<.001
Out of labor force—not retired or disabled	2.087	<.001
Household composition (reference: married couple with child/children)		
Single male with child/children	.824	.167
Single female with child/children	1.846	<.001
Other household with child/children	1.644	<.001
Two or more adults—no child	.409	<.001
Male living alone	.253	<.001
Female living alone	.389	<.001
One or more elderly persons in the household	.659	<.001
Race and Hispanic ethnicity (reference: White non-Hispanic)		
Black non-Hispanic	1.300	<.001
Hispanic	1.088	.185
Noncitizen household reference person	.586	<.001
Educational attainment of most highly educated adult (reference: high school or GED)		
Less than high school	1.217	<.001
Some college—no 4-year degree	.890	.021
Bachelor degree or higher	.444	<.001
Metropolitan/nonmetropolitan residence (reference: metropolitan, not in principle city)		
Metropolitan—principal city	1.109	.056
Metropolitan—not specifically identified	1.136	.050
Not in metropolitan area	1.129	.043
Census region (reference: Northeast)		
Midwest	1.005	.940
South	.668	<.001
West	.554	<.001
Number of cases	14,572	
Somers' D	.566	

SNAP= Supplemental Nutrition Assistance Program.

ARRA= American Recovery and Reinvestment Act.

[1]The sample comprised households with annual incomes less than 130 percent of the Federal poverty line.

Source: USDA, Economic Research Service calculations based on data from the December 2008 and December 2009 Current Population Survey Food Security Supplements (CPS-FSS).

Appendix table 2

Quantile regression at median of SNAP benefits (ratio to Thrifty Food Plan) on post-ARRA versus pre-ARRA period, with controls for household characteristics[1]

Characteristic	Coefficient	p
Intercept	0.555	<.001
Post-ARRA	.085	<.001
Income (ratio to poverty line)	.334	.027
Income (ratio to poverty line) squared	-.280	.006
Income in lowest reported category	.186	<.001
Labor force status of primary earner (reference: employed full time)		
Out of labor force—retired	.013	.704
Part-time for noneconomic reasons	.029	.296
Part-time for economic reasons	.060	.028
Unemployed	.076	<.001
Out of labor force—disabled	-.014	.541
Out of labor force—not retired or disabled	.132	<.001
Household composition (reference: married couple with child/children)		
Single male with child/children	.031	.503
Single female with child/children	.070	<.001
Other household with child/children	.053	.020
Two or more adults—no child	-.093	<.001
Male living alone	.029	.414
Female living alone	.059	.051
One or more elderly persons in the household	-.183	<.001
Race and Hispanic ethnicity (reference: White non-Hispanic)		
Black non-Hispanic	-.047	.005
Hispanic	-.040	.039
Noncitizen household reference person	-.104	<.001
Educational attainment of most highly educated adult (reference: high school or GED)		
Less than high school	-.014	.384
Some college, no 4-year degree	-.002	.868
Bachelor degree or higher	.000	.994
Metropolitan/nonmetropolitan residence (reference: metropolitan, not in principle city)		
Metropolitan—principal city	.000	.985
Metropolitan—not specifically identified	-.007	.743
Not in metropolitan area	-.041	.010
Census region (reference: Northeast)		
Midwest	-.082	<.001
South	-.128	<.001
West	-.106	<.001
Number of cases	4,091	

SNAP= Supplemental Nutrition Assistance Program.

ARRA= American Recovery and Reinvestment Act.

[1]The sample comprised households with annual incomes less than 130 percent of the Federal poverty line that received SNAP benefits in the 30 days prior to the survey and reported the amount of benefit received.

Source: USDA, Economic Research Service calculations based on data from the December 2008 and December 2009 Current Population Survey Food Security Supplements (CPS-FSS).

Appendix table 3

Quantile regression at median of usual food spending (ratio to Thrifty Food Plan) on post-ARRA versus pre-ARRA period, with controls for household characteristics, by income range[1]

	Income <130 percent of poverty line		Income 150-250 percent of poverty line	
Characteristic	Coefficient	p	Coefficient	p
Intercept	0.887	<.001	0.304	.340
Post-ARRA	.048	<.001	.032	.004
Income (ratio to poverty line)	-.198	.135	.529	.098
Income (ratio to poverty line) squared	.140	.076	-.108	.179
Income in lowest reported category	-.023	.525		
Labor force status of primary earner (reference: employed full time)				
Out of labor force—retired	-.013	.611	.007	.753
Part-time for noneconomic reasons	-.040	.067	-.006	.850
Part-time for economic reasons	-.057	.067	-.014	.790
Unemployed	-.010	.676	-.033	.355
Out of labor force—disabled	-.039	.057	-.042	.463
Out of labor force—not retired or disabled	.044	.107	.061	.385
Household composition (reference: married couple with child/children)				
Single male with child/children	.018	.692	.043	.524
Single female with child/children	.100	<.001	.127	<.001
Other household with child/children	.050	.092	-.022	.540
Two or more adults—no child	.097	<.001	.089	<.001
Male living alone	.327	<.001	.363	<.001
Female living alone	.333	<.001	.304	<.001
One or more elderly persons in the household	-.085	<.001	-.063	.001
Race and Hispanic ethnicity (reference: White non-Hispanic)				
Black non-Hispanic	-.057	.001	-.098	<.001
Hispanic	-.051	.014	-.032	.141
Noncitizen household reference person	-.006	.814	-.005	.860
Educational attainment of most highly educated adult (reference: high school or GED)				
Less than high school	.004	.832	.004	.909
Some college, no 4-year degree	.024	.115	.023	.105
Bachelor degree or higher	.083	<.001	.056	<.001
Metropolitan/nonmetropolitan residence (reference: metropolitan, not in principle city)				
Metropolitan—principal city	.005	.778	-.015	.381
Metropolitan—not specifically identified	-.022	.187	-.014	.484
Not in metropolitan area	-.046	<.001	-.070	<.001
Census region (reference: Northeast)				
Midwest	-.087	<.001	-.049	.009
South	-.045	.016	.013	.503
West	-.024	.269	.008	.717
Number of cases	13,773		13,435	

ARRA= American Recovery and Reinvestment Act.

[1]About 5 percent of households did not report their food spending and were omitted from these analyses.

Source: USDA, Economic Research Service calculations based on data from the December 2008 and December 2009 Current Population Survey Food Security Supplements (CPS-FSS).

Appendix table 4

Logistic regression of food insecurity[1] in 30 days prior to survey on post-ARRA versus pre-ARRA period, with controls for household characteristics, by income range

	Income <130 percent of poverty line		Income 150-250 percent of poverty line	
Characteristic	Odd ratio	p	Odd ratio	p
Intercept	0.290	<.001	2.518	.489
Post-ARRA	.886	.002	1.016	.772
Income (ratio to poverty line)	2.006	.121	.105	.099
Income (ratio to poverty line) squared	.523	.017	1.524	.225
Income in lowest reported category	.908	.417		
Labor force status of primary earner (reference: employed full time)				
Out of labor force—retired	.728	.001	.414	<.001
Part-time for noneconomic reasons	.883	.116	1.122	.314
Part-time for economic reasons	1.833	<.001	2.175	<.001
Unemployed	2.163	<.001	3.192	<.001
Out of labor force—disabled	2.268	<.001	1.919	<.001
Out of labor force—not retired or disabled	1.098	.265	.869	.512
Household composition (reference: married couple with child/children)				
Single male with child/children	1.102	.470	1.160	.383
Single female with child/children	1.305	<.001	1.169	.110
Other household with child/children	1.012	.905	.985	.927
Two or more adults—no child	.969	.640	.886	.113
Male living alone	.787	.003	.651	<.001
Female living alone	.918	.272	.859	.111
One or more elderly persons in the household	.655	<.001	.551	<.001
Race and Hispanic ethnicity (reference: White non-Hispanic)				
Black non-Hispanic	1.088	.116	.935	.410
Hispanic	1.293	<.001	1.040	.635
Noncitizen household reference person	1.014	.841	.997	.976
Educational attainment of most highly educated adult (reference: high school or GED)				
Less than high school	1.027	.629	1.182	.104
Some college—no 4-year degree	1.160	.002	1.021	.738
Bachelor degree or higher	.692	<.001	.588	<.001
Metropolitan/nonmetropolitan residence (reference: metropolitan, not in principle city)				
Metropolitan—principal city	.868	.005	1.077	.266
Metropolitan—not specifically identified	.876	.034	.946	.493
Not in metropolitan area	.720	<.001	.663	<.001
Census region (reference: Northeast)				
Midwest	.999	.990	1.236	.023
South	1.003	.957	1.267	.006
West	.994	.930	1.136	.173
Number of cases	14,572		14,056	
Somers' D	.330		.398	

ARRA= American Recovery and Reinvestment Act.

[1]Food insecure households include both those with low and very low food security.

Source: USDA, Economic Research Service calculations based on data from the December 2008 and December 2009 Current Population Survey Food Security Supplements (CPS-FSS).

Appendix table 5

Logistic regression of very low food security in 30 days prior to survey on post-ARRA versus pre-ARRA period, with controls for household characteristics, by income range

	Income <130 percent of poverty line		Income 150-250 percent of poverty line	
Characteristic	Odd ratio	p	Odd ratio	p
Intercept	0.121	<.001	0.086	.222
Post-ARRA	.804	<.001	1.131	.133
Income (ratio to poverty line)	1.707	.399	.922	.969
Income (ratio to poverty line) squared	.538	.105	.887	.819
Income in lowest reported category	.817	.214		
Labor force status of primary earner (reference: employed full time)				
Out of labor force—retired	.632	.002	.474	<.001
Part-time for noneconomic reasons	.801	.054	.904	.594
Part-time for economic reasons	1.787	<.001	2.341	<.001
Unemployed	2.148	<.001	2.682	<.001
Out of labor force—disabled	1.905	<.001	2.203	<.001
Out of labor force—not retired or disabled	1.112	.359	1.125	.683
Household composition (reference: married couple with child/children)				
Single male with child/children	1.149	.470	.882	.688
Single female with child/children	1.149	.148	1.461	.014
Other household with child/children	.897	.482	.799	.443
Two or more adults—no child	1.401	<.001	1.390	.007
Male living alone	1.344	.006	1.144	.371
Female living alone	1.483	<.001	1.400	.023
One or more elderly persons in the household	.536	<.001	.418	<.001
Race and Hispanic ethnicity (reference: White non-Hispanic)				
Black non-Hispanic	.986	.845	.982	.879
Hispanic	1.065	.453	.895	.393
Noncitizen household reference person	.773	.011	.848	.321
Educational attainment of most highly educated adult (reference: high school or GED)				
Less than high school	1.086	.283	1.438	.012
Some college—no 4-year degree	1.192	.009	1.007	.940
Bachelor degree or higher	.619	<.001	.456	<.001
Metropolitan/nonmetropolitan residence (reference: metropolitan, not in principle city)				
Metropolitan—principal city	.792	<.001	.950	.607
Metropolitan—not specifically identified	.875	.112	.757	.028
Not in metropolitan area	.654	<.001	.558	<.001
Census region (reference: Northeast)				
Midwest	.960	.662	1.321	.048
South	.973	.746	1.137	.334
West	1.076	.427	1.283	.081
Number of cases	14,572		14,056	
Somers' D	.329		.437	

ARRA= American Recovery and Reinvestment Act.

Source: USDA, Economic Research Service calculations based on data from the December 2008 and December 2009 Current Population Survey Food Security Supplements (CPS-FSS).

Appendix table 6

Quantile regression at median of usual food spending (ratio to Thrifty Food Plan) on post-ARRA versus pre-ARRA period, with controls for household characteristics, by SNAP participation during 30 days prior to the survey[1]

	SNAP-participant households		Non-SNAP households	
Characteristic	Coefficient	p	Coefficient	p
Intercept	0.924	<.001	0.780	<.001
Post-ARRA	.077	<.001	.031	.017
Income (ratio to poverty line)	-.112	.585	-.010	.958
Income (ratio to poverty line) squared	.068	.613	.040	.728
Income in lowest reported category	.025	.625	.012	.798
Labor force status of primary earner (reference: employed full time)				
Out of labor force—retired	-.079	.138	-.003	.921
Part-time for noneconomic reasons	.020	.624	-.072	.010
Part-time for economic reasons	-.015	.695	-.099	.003
Unemployed	-.001	.973	-.022	.520
Out of labor force—disabled	-.065	.036	-.005	.874
Out of labor force—not retired or disabled	.068	.166	.006	.859
Household composition (reference: married couple with child/children)				
Single male with child/children	.019	.785	.079	.206
Single female with child/children	.101	<.001	.074	.002
Other household with child/children	.075	.072	.012	.725
Two or more adults—no child	.018	.692	.123	<.001
Male living alone	.234	<.001	.361	<.001
Female living alone	.323	<.001	.359	<.001
One or more elderly persons in the household	-.030	.507	-.102	<.001
Race and Hispanic ethnicity (reference: White non-Hispanic)				
Black non-Hispanic	-.008	.816	-.090	<.001
Hispanic	-.017	.655	-.047	.031
Noncitizen household reference person	-.049	.236	.022	.282
Educational attainment of most highly educated adult (reference: high school or GED)				
Less than high school	.014	.643	-.006	.789
Some college—no 4-year degree	.006	.813	.053	.004
Bachelor degree or higher	.088	.038	.082	.002
Metropolitan/nonmetropolitan residence (reference: metropolitan, not in principle city)				
Metropolitan—principal city	-.018	.595	.009	.659
Metropolitan—not specifically identified	-.053	.071	-.027	.235
Not in metropolitan area	-.055	.039	-.034	.063
Census region (reference: Northeast)				
Midwest	-.111	<.001	-.095	<.001
South	-.120	<.001	-.020	.351
West	-.116	.001	-.003	.906
Number of cases	4,082		9.691	

SNAP= Supplemental Nutrition Assistance Program.

ARRA= American Recovery and Reinvestment Act.

[1]Both samples were limited to households with annual incomes less than 130 percent of the Federal poverty line. About 5 percent of low-income households did not report their food spending and were omitted from the analyses.

Source: USDA, Economic Research Service calculations based on data from the December 2008 and December 2009 Current Population Survey Food Security Supplements (CPS-FSS).

Appendix table 7

Logistic regression of food insecurity in 30 days prior to survey on post-ARRA versus pre-ARRA period, with controls for household characteristics, by SNAP participation during 30 days prior to the survey[1]

	SNAP-participant households		Non-SNAP households	
Characteristic	Odd ratio	p	Odd ratio	p
Intercept	0.407	.003	0.283	<.001
Post-ARRA	.850	.016	.891	.022
Income (ratio to poverty line)	.973	.970	1.535	.480
Income (ratio to poverty line) squared	1.100	.837	.577	.122
Income in lowest reported category	.892	.522	.849	.317
Labor force status of primary earner (reference: employed full time)				
Out of labor force—retired	.809	.235	.668	<.001
Part-time for noneconomic reasons	.950	.726	.857	.105
Part-time for economic reasons	1.592	.001	1.945	<.001
Unemployed	1.640	<.001	2.562	<.001
Out of labor force—disabled	2.489	<.001	1.744	<.001
Out of labor force—not retired or disabled	1.444	.006	.868	.212
Household composition (reference: married couple with child/children)				
Single male with child/children	1.230	.355	1.021	.901
Single female with child/children	1.182	.116	1.438	<.001
Other household with child/children	.923	.614	1.084	.547
Two or more adults—no child	1.403	.010	.893	.158
Male living alone	.796	.159	.830	.048
Female living alone	.950	.721	.957	.641
One or more elderly persons in the household	.861	.281	.614	<.001
Race and Hispanic ethnicity (reference: White non-Hispanic)				
Black non-Hispanic	.921	.337	1.179	.018
Hispanic	1.073	.498	1.362	<.001
Noncitizen household reference person	1.082	.559	1.000	.996
Educational attainment of most highly educated adult (reference: high school or GED)				
Less than high school	.937	.467	1.074	.325
Some college—no 4-year degree	1.101	.239	1.206	.002
Bachelor degree or higher	.961	.805	.673	<.001
Metropolitan/nonmetropolitan residence (reference: metropolitan, not in principle city)				
Metropolitan—principal city	.896	.222	.868	.023
Metropolitan—not specifically identified	.874	.206	.878	.096
Not in metropolitan area	.768	.008	.682	<.001
Census region (reference: Northeast)				
Midwest	.956	.670	1.048	.612
South	.918	.377	1.135	.114
West	.850	.166	1.150	.105
Number of cases	4,268		10,304	
Somers' D	.235		.354	

SNAP= Supplemental Nutrition Assistance Program.

ARRA= American Recovery and Reinvestment Act.

[1]Both samples were limited to households with annual incomes less than 130 percent of the Federal poverty line. Food insecure households include both those with low and very low food security.

Source: USDA, Economic Research Service calculations based on data from the December 2008 and December 2009 Current Population Survey Food Security Supplements (CPS-FSS).

Appendix table 8

Logistic regression of very low food security in 30 days prior to survey on post-ARRA versus pre-ARRA period, with controls for household characteristics, by SNAP participation during 30 days prior to the survey[1]

	SNAP-participant households		Non-SNAP households	
Characteristic	Odd ratio	p	Odd ratio	p
Intercept	0.150	<.001	0.129	<.001
Post-ARRA	.766	.004	.818	.004
Income (ratio to poverty line)	2.562	.373	.758	.742
Income (ratio to poverty line) squared	.421	.204	.874	.785
Income in lowest reported category	.943	.817	.685	.087
Labor force status of primary earner (reference: employed full time)				
Out of labor force—retired	.736	.239	.571	.002
Part-time for noneconomic reasons	.932	.739	.758	.045
Part-time for economic reasons	1.276	.252	2.038	<.001
Unemployed	1.537	.008	2.572	<.001
Out of labor force—disabled	1.878	<.001	1.611	<.001
Out of labor force—not retired or disabled	1.276	.203	1.004	.980
Household composition (reference: married couple with child/children)				
Single male with child/children	1.440	.234	1.008	.973
Single female with child/children	1.009	.957	1.372	.011
Other household with child/children	.821	.421	.972	.889
Two or more adults—no child	2.129	<.001	1.216	.089
Male living alone	1.452	.082	1.343	.022
Female living alone	1.487	.044	1.534	.001
One or more elderly persons in the household	.603	.012	.547	<.001
Race and Hispanic ethnicity (reference: White non-Hispanic)				
Black non-Hispanic	.761	.022	1.146	.143
Hispanic	.887	.406	1.114	.303
Noncitizen household reference person	.658	.056	.809	.072
Educational attainment of most highly educated adult (reference: high school or GED)				
Less than high school	.957	.721	1.172	.113
Some college—no 4-year degree	1.152	.206	1.229	.014
Bachelor degree or higher	.771	.281	.624	<.001
Metropolitan/nonmetropolitan residence (reference: metropolitan, not in principle city)				
Metropolitan—principal city	.820	.109	.795	.007
Metropolitan—not specifically identified	.892	.417	.868	.179
Not in metropolitan area	.683	.005	.622	<.001
Census region (reference: Northeast)				
Midwest	.798	.114	1.121	.368
South	.846	.196	1.129	.283
West	.852	.317	1.297	.031
Number of cases	4,268		10,304	
Somers' D	.314		.359	

SNAP= Supplemental Nutrition Assistance Program.

ARRA= American Recovery and Reinvestment Act.

[1]Both samples were limited to households with annual incomes less than 130 percent of the Federal poverty line.

Source: USDA, Economic Research Service calculations based on data from the December 2008 and December 2009 Current Population Survey Food Security Supplements (CPS-FSS).