How Well Does SNAP Protect Families Against the Risk of Food Insecurity and Poor Health During Economic Downturns?

Thomas DeLeire
Georgetown University

Bradley Hardy
American University

Jay Bhattacharya
Stanford University

FINAL REPORT

UNIVERSITY OF KENTUCKY CENTER FOR POVERTY RESEARCH

HOW WELL DOES SNAP PROTECT FAMILIES AGAINST THE RISK OF FOOD INSECURITY AND POOR HEALTH DURING ECONOMIC DOWNTURNS?

Thomas DeLeire, Ph.D. (PI), Georgetown University

Bradley Hardy, Ph.D. (Co-I), American University

Jay Bhattacharya, M.D., Ph.D. (Consultant), Stanford University

April 4, 2017

ABSTRACT

Our research project addressed the question of how well SNAP and the social safety net protects families against the risk of food insecurity and poor health during economic downturns. Previous research has documented the relationship between reductions in family incomes and food insufficiency and has examined the effects of resources that mitigate the effects of income volatility. The U.S. social safety net, including SNAP, exists to mitigate the deleterious effects of swings in family income, particularly among low- and moderate-income households. This work compares outcomes for lower income families and higher income families in response to economic downturns. To the extent that nutritional, food security and food-related health outcomes are unaffected by economic downturns, there is implicit evidence that the social safety net is working to protect economically disadvantaged families.

EXECUTIVE SUMMARY

This study compares outcomes for families across the economic spectrum, from low to high income, in response to economic downturns. To the extent that nutritional, food security and food-related health outcomes are unaffected by economic downturns, there is implicit evidence that the social safety net is working to protect economically disadvantaged families.

We propose five hypotheses, which we explore using data from the National Health Interview Survey. These hypotheses are:

1. Low-income individuals and families have worse health and lower food security relative to higher income individuals and families.
2. Economic downturns lead to worse health and lower food security, on average.
3. The negative impact of economic downturns on health and food security are larger for low-income individuals and families relative to higher income individuals and families.
4. Participation in safety net programs, including SNAP, reduce the impact of both income and of economic downturns on health and food security.
5. Participation in safety net programs, including SNAP, helps mitigate the negative impact of economic downturns on low-income individuals and families.

Our results provide strong confirmation for our first hypothesis. The relationship between income and both food insecurity and health can be found across a large number if outcomes. Moreover, the size of this income gradient is large and economically meaningful.

However, we find mixed and inconclusive evidence for our remaining hypotheses. Food insecurity outcomes are strongly related to the unemployment rate, while of the health outcomes only self-reported health is modestly related to the unemployment rate. Moreover, only in the case of unbalanced meals do the adverse effects of state-level economic conditions fall disproportionately on lower and moderate income households. Given that this component of our initial hypotheses—that lower income individuals and families are uniquely impacted by economic shocks—was not realized, perhaps unsurprisingly we do not find evidence that food stamps buffer against these economic shocks among low and moderate-income households.

1. INTRODUCTION

Previous research (Leete & Bania 2010; Gundersen & Gruber 2001; Dahl, et al. 2014) has documented the relationship between reductions in family incomes and food insufficiency. Others have examined the effects of resources that mitigate the effects of income volatility (Blundell & Pistaferri 2003, Ribar & Hamrick 2003). The U.S. social safety net, including SNAP, exists to mitigate the deleterious effects of swings in family income, particularly among low- and moderate-income households (Blundell & Pistaferri 2003, Gundersen & Ziliak 2003). Learning the extent to which programs improve outcomes both food sufficiency and health outcomes for low-income people is a challenge because households tend to receive food assistance when they are most food insecure (Nord & Golla 2009; Mykerezi & Mills 2010; Ratcliffe, McKernan, & Zhang 2011).

Other work (Bhattacharya, et al. 2004) found that households are able to partially insure themselves and their children from the deleterious nutritional and food consumption consequences of unusually cold winters. This "insurance" could be the result of a number of channels: accessing social safety net programs such as SNAP, self-insurance (for example, by shifting to nutritionally sound, but less desirable foods, or through community support (e.g., Dehejia, et al. 2008).

This study compares outcomes for families across the economic spectrum, from low to high income, in response to economic downturns. To the extent that nutritional, food security and food-related health outcomes are unaffected by economic downturns, there is implicit evidence that the social safety net is working to protect economically disadvantaged families.

2. RESEARCH METHODS

The purpose of the study is to determine how well SNAP and the social safety net protects families against the risk of food insecurity and poor health during economic downturns.

Our theory-based hypotheses are:

6. Low-income individuals and families have worse health and lower food security relative to higher income individuals and families.
7. Economic downturns lead to worse health and lower food security, on average.
8. The negative impact of economic downturns on health and food security are larger for low-income individuals and families relative to higher income individuals and families.
9. Participation in safety net programs, including SNAP, reduce the impact of both income and of economic downturns on health and food security.
10. Participation in safety net programs, including SNAP, helps mitigate the negative impact of economic downturns on low-income individuals and families.

To explore these hypotheses, we use National Health Interview Survey Data (NHIS, described below) and do the following:

1. Compare measures of health (self-reported health, self-reported change in health, ever depressed, BMI) and food security (skip meals, unbalanced meals) among individuals and families by income quintile.
2. Determine whether these measures of health and food security vary with state-level measures of economic activity (the unemployment rate, the employment to population ratio).
3. Determine whether any association between economic activity and health and food security outcomes are larger among low-income adults and children than among higher income adults and children.
4. Determine whether states in which there is greater participation in SNAP have improved health and food security outcomes.
5. Determine safety net programs including SNAP reduce the impact of economic downturns on health and food insecurity of low-income individuals and families?

Our research design examines the role of economic downturns and recessions on the health and food security of low-income individuals. Two independent variables and their intersection or co-occurrence capture the health and food security consequences of economic recessions among low income individuals and families. These are (1) the state unemployment rate, (2) individual-level measures of income, and (3) an indicator of low-income status during a recession – combining information from variables (1) and (2). By calculating the statistical association between these economic variables and our measures of health and food security, we learn how low-income individuals and their families absorb negative economic shocks. The resulting models allow us to identify the relationship between low income individuals and families exposed to periods of high unemployment within their state of residence and both health and food security outcomes; this variation across states is therefore an important element of the research design.

Throughout the health and food insecurity models, we account for state participation in SNAP as a potential moderator against adverse economic conditions. The econometric modeling approach will estimate repeated cross-section models with state and year fixed effects and individual-level controls (differences in differences). These take the form:

(1)
$$y_{ist} = X_{ist}\beta^1 + E_{st-1}\gamma^1 + I_{ist}\rho^1 + \left(E_{st-1} \times I_{ist}\right)\lambda^1 + \varphi_s + \theta_t + e_{it},$$

where:

i indicates an individual, s indicates a state, and t indicates a year,
y_{ist} is the outcome (measures of adult or child health; measures of family food insecurity)
X_{ist} is a set of individual level controls
E_{st-1} is a set of controls for the state of the economy in state s and year t-1, including measures such as the unemployment rate, gross state product, and the employment to population ratio;
I_{ist} is a set of indicators for the quintile of the income distribution in which an individual's family income falls;
φ_s is a set of state fixed effects, and
θ_t is a set of year fixed effects.

The key parameters of interest in Equation (1) comprise the vector λ, which indicate the degree to which the health and food security of lower income individuals are more responsive to economic downturns than are the health and food security of higher income individuals. These models will form the basis of

the empirical models designed to address our first three research questions. To address our fourth and fifth research questions, we will estimate the following model:

$$(2) \qquad y_{ist} = X_{ist}b^2 + E_{st-1}g^2 + I_{ist}\rho^2 + \left(E_{st-1} \; \acute{} \; I_{ist}\right)/^2 + P_{st}d + j_{\,s} + q_{\,t} + e_{it},$$

where:

P_{st} is a set of program indicators for the state participation rate in safety net transfer programs in state s and year t. We will allow P to vary only by state and year (not by individual) because of the issues related to selection into food assistance (and other) programs identified by previous research.

To assess the degree to which safety net programs mitigate the responsiveness of health and food security to economic downturns, we will compare the coefficients λ in Equation (2) to the coefficients λ in Equation (1). The percent decline in the size of these coefficients is an indication of the degree to which the safety net system mitigates the health and food security impact of economic downturns.

3. DATA

We use the NHIS 1997-2014 family file, household file, person file, sample child file, and sample adult file.

To augment the data, we use state identifiers to merge in state-year level economic variables such as the state-level unemployment rate and state-level employment-to-population. We also merge in state-year level measures of program participation, population and food security calculated from the Current Population Survey and the University of Kentucky Center for Poverty Research Welfare Database.

The unemployment rate data come from the Bureau of Labor Statistics Local Area Unemployment Statistics series, and employment and population data are drawn from the University of Kentucky Center for Poverty Research Welfare Database. State by year measures of food stamp program participation and food security will be calculated from the public use files of the Current Population Survey.

Health and Economic Shocks: Using NHIS measures of general self-reported health (including child health), body mass index, and hospitalizations, we estimate statistical models to understand how exposure to economic downturns affects the overall health and health decline of low income individuals and families. We use the same underlying predictive models to examine obesity among low income individuals and families. Finally, we will examine how adverse economic conditions among low income individuals and families relate to mental health, which is commonly associated with the onset of disease. These include alcohol consumption, low physical activity levels, as well as depression, nervousness, and anxiety.

Food Insecurity and Economic Shocks: We will use the same set of economic variables described above to better understand how adverse economic conditions among low income individuals and families impact their food security. The food security outcomes include the capacity of low income families to afford food, decisions on the size of meals, or whether to eat a meal at all.

Table 1 provides unweighted summary statistics on our main outcomes of interest as well as on our main independent variables. In general, the sample is overrepresented among black Americans, predominantly

female (58 percent), and mainly reporting good health. An important exception to this generalization is that, in an average year, over half the sample reports feeling depressed at least once.

Table 1. Summary Statistics, 1997-2014 NHIS

	Mean	Std. Dev.
Good Health	0.703	0.457
Health Status Down	0.153	0.360
BMI	28.972	7.144
Share with Unbalanced Meals	0.640	0.480
Share Skipping or Cutting Meals	0.382	0.486
Ever Depressed	0.572	0.495
Age	44.079	16.425
Male	0.416	0.493
Married	0.306	0.461
U.S. Citizen	0.870	0.336
High School	0.268	0.443
Some College	0.180	0.384
College	0.026	0.160
White	0.664	0.472
Black	0.246	0.431
Other	0.090	0.286
Family Income Quintile	1.508	0.956
State Unemployment Rate	7.649	1.888
Employment to Population Ratio	0.454	0.029
Share in Low Employment to Population group (bottom 25%)	0.593	0.491
High Food Stamp Participation	0.325	0.468
High Unemployment	0.600	0.490

4. RESULTS

We first present results on our food security outcomes (skipped meals, unbalanced meals). We then present results for our health outcomes (self-reported health, health decline over last 12 months, depression, and body mass index).

Food Security Outcomes

Table 2 presents our results for the outcome, unbalanced meals. Here, we measure economic activity using the lagged unemployment rate. We see similar results if we use the lagged employment-to-population ratio.

Table 2. Linear Probability of Reporting Unbalanced Meals

VARIABLES	(1)	(2)	(3)
Income Quintile 2	-0.0818***	-0.0818***	-0.0834***
	(0.009)	(0.009)	(0.012)
Income Quintile 3	-0.1104***	-0.1105***	-0.1061***
	(0.008)	(0.008)	(0.011)
Income Quintile 4	-0.1324***	-0.1324***	-0.1418***
	(0.009)	(0.009)	(0.012)
Top Income Quintile	-0.1460***	-0.1461***	-0.1422***
	(0.008)	(0.008)	(0.010)
Lagged High UR	0.0092***	0.0087***	0.0093***
	(0.001)	(0.001)	(0.002)
Quintile 2×High UR	-0.0040***	-0.0040***	-0.0044***
	(0.001)	(0.001)	(0.001)
Quintile 3×High UR	-0.0057***	-0.0056***	-0.0070***
	(0.001)	(0.001)	(0.001)
Quintile 4×High UR	-0.0072***	-0.0072***	-0.0064***
	(0.001)	(0.001)	(0.001)
Top Quintile ×High UR	-0.0081***	-0.0081***	-0.0090***
	(0.001)	(0.001)	(0.001)
High FS Participation			-0.0047
			(0.014)
High FS×High UR			-0.0015
			(0.002)
Quintile 2×High FS=1×High UR			0.0003
			(0.002)
Quintile 3×High FS=1×High UR			0.0023
			(0.002)
Quintile 4×High FS=1×High UR			-0.0021
			(0.002)
Top Quintile×High FS=1×High UR			0.0016
			(0.002)

Demographic controls	Yes	Yes	Yes
State Fixed effects	Yes	Yes	Yes
Observations	300,830	300,830	300,830
R-squared	0.102	0.102	0.102

Notes: *** indicates p-value < 0.001. Robust standard errors clustered at the state-level reported in parentheses.

The results in these tables answer all 5 of our research questions (for the outcome, unbalanced meals). First, there is a strong income-gradient, with individuals in the bottom income quintile being more than 8 percentage points more likely to report unbalanced meals than individuals in the second income quintile, and almost 15 percentage points more likely to report unbalanced meals than individuals in the top income quintile (see Figure 1).

Figure 1
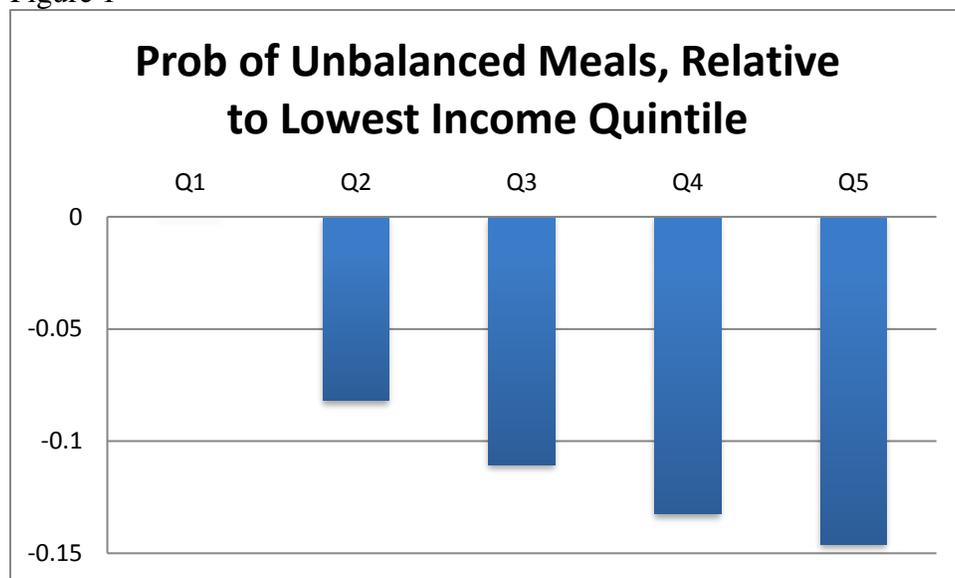
Second, the lagged unemployment rate is positively related to reporting unbalanced meals, and this relationship is economically meaningful. A 1-percentage point increase in the unemployment rate is associated with a 0.9 percentage point increase in the rate of reporting unbalanced meals.

Third, the impact of unemployment on unbalanced meals is largest for individuals in the lowest income quintile, and is almost non-existent among individuals in the highest income quintile (see Figure 2).

Figure 2

Impact of High UR on Unbalanced Meals, by Income Quintile
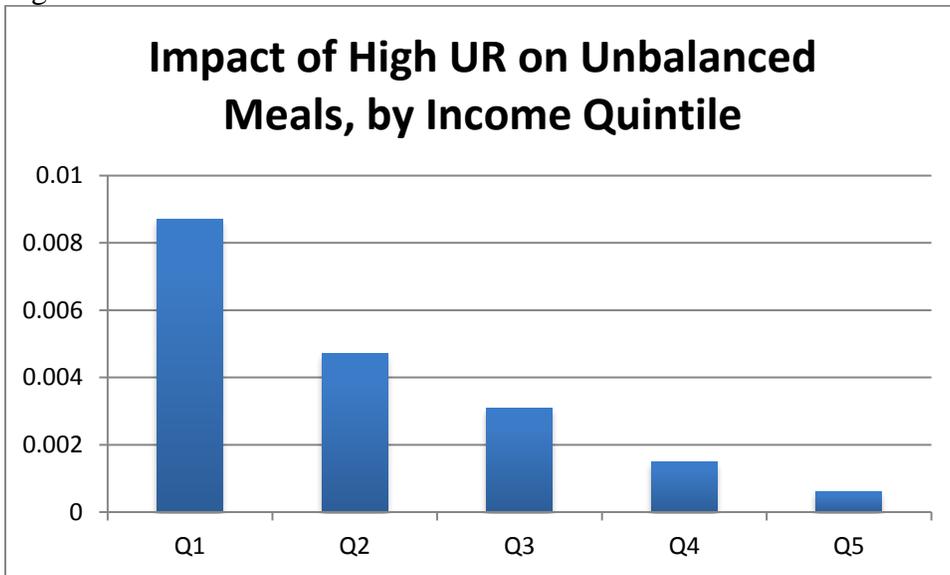
Fourth, states in which the SNAP participation rate is high have only slightly lower rates of unbalanced meals, and this reduction is not statistically different from zero. Fifth and finally, there is no evidence that the association between the unemployment rate, income, and unbalanced meals is statistically different between low SNAP participation states and high SNAP participation states.

Table 3. Linear Probability of Skipping or Cutting Meals

VARIABLES	(1) w/ State FE	(2) w/ State FE	(3) w/ State FE
Quintile 20-40	0.0183	0.0183	0.0261
	(0.027)	(0.027)	(0.035)
Quintile 40-60	-0.0737***	-0.0746***	-0.1147***
	(0.028)	(0.028)	(0.037)
Quintile 60-80	-0.1675***	-0.1665***	-0.1818***
	(0.042)	(0.042)	(0.055)
Top 20	-0.2639***	-0.2662***	-0.2345***
	(0.052)	(0.052)	(0.072)
Lagged High UR	0.0145***	0.0096**	0.0079*
	(0.004)	(0.005)	(0.005)
Quintile 20-40×High UR	-0.0095***	-0.0095***	-0.0103***
	(0.003)	(0.003)	(0.004)
Quintile 40-60×High UR	-0.0056*	-0.0055*	-0.0012
	(0.003)	(0.003)	(0.004)
Quintile 60-80×High UR	0.0029	0.0028	0.0025
	(0.005)	(0.005)	(0.006)
Top 20×High UR	0.0039	0.0042	0.0002
	(0.006)	(0.006)	(0.008)
High SNAP Participation			-0.0963**
			(0.038)
Quintile 20-40×High SNAP=1			-0.0187
			(0.054)
Quintile 40-60×High SNAP=1			0.0998*
			(0.057)
Quintile 60-80×High SNAP=1			0.0662
			(0.085)
Top 20×High SNAP=1			-0.0577
			(0.107)
High SNAP×High UR			0.0044
			(0.004)
Quintile 20-40×High SNAP=1×High UR			0.0019
			(0.006)
Quintile 40-60×High SNAP=1×High UR			-0.0101
			(0.006)
Quintile 60-80×High SNAP=1×High UR			-0.0012
			(0.010)
Top 20×High SNAP=1×High UR			0.0075
			(0.012)
Demographic controls	Yes	Yes	Yes
State Fixed effects	Yes	Yes	Yes
Observations	65,961	65,961	65,961
R-squared	0.031	0.032	0.032

Table 3 presents the results for our second food security outcome, an indicator for whether families report skipping or cutting meals over the last 30 days. We find that, similar to the likelihood of reporting unbalanced meals, there is a strong income gradient to skipping or cutting meals, with individuals in the top 60 percent of the income distribution increasingly less likely to skip or cut meals. Persons in the third quintile (40-60) are 7 to 11 percentage points less likely to skip or cut meals relative to persons in the bottom quintile; those in the fourth quintile are 17 to 18 percentage points less likely to skip or cut meals relative to counterparts in the lowest quintile; and, finally, persons in the top quintile are 23 to 27 percentage points less likely to report skipping or cutting meals relative to those in the bottom quintile (see Figure 3).

Figure 3
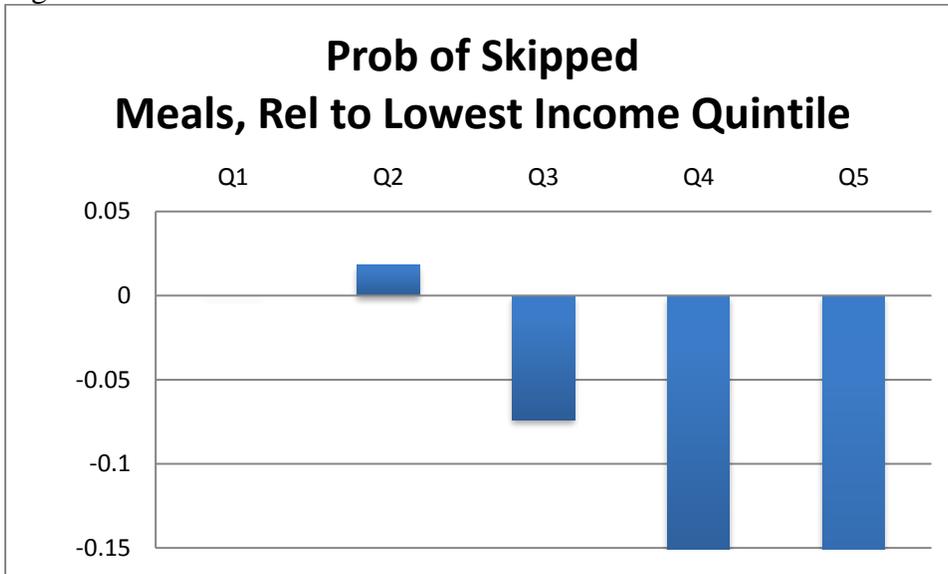
Second, the lagged unemployment rate is positively related to skipping or cutting meals, and this relationship is economically meaningful. A 1-percentage point increase in the unemployment rate is associated with a 0.8 to 1.4-percentage point increase in the rate of skipping or cutting meals.

Third, unlike in for the outcome "unbalanced meals" the link between unemployment and skipping meals is not found solely among individuals in the lowest two income quintiles (see Figure 4).

Figure 4

**Impact of High UR on Skipped Meals,
by Income Quintile**
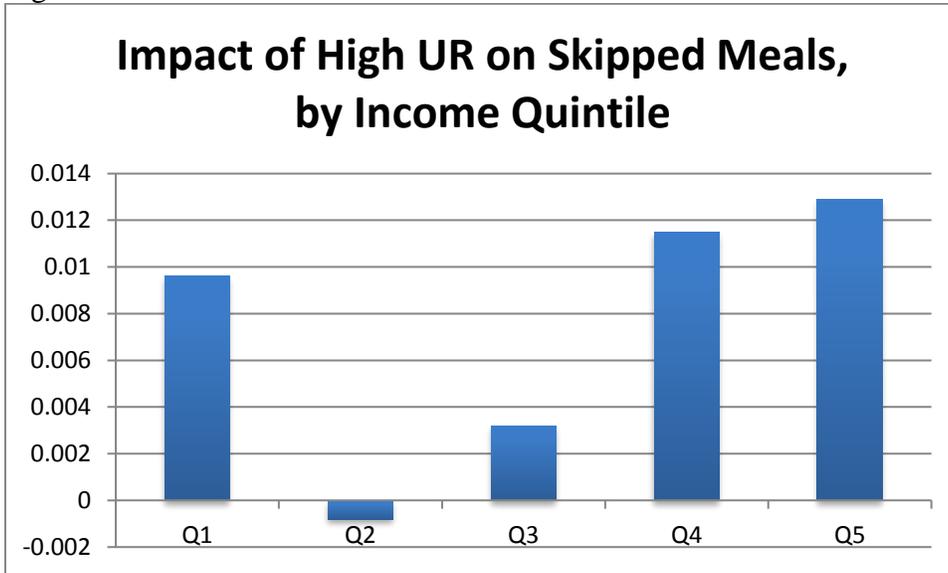
Finally, states in which the SNAP participation rate is high are from 6 to 10 percentage points less likely to report skipping or cutting meals, and this result is statistically significant and once again there is no evidence that the association between the unemployment rate, income, and skipping meals is statistically different between low SNAP participation states and high SNAP participation states.

Health Outcomes

We now turn to examining how state SNAP participation interacts with or buffers the links between income, unemployment, and health. Our null hypothesis that lower income individuals report negative health outcomes is confirmed in Table 4, where we discuss overall self-reported health status.

We find that higher income respondents are more likely to report good health, defined as either good or excellent. Compared to the lowest quintile, we find that individuals in the second quintile are 8 percentage points more likely to report good or excellent health, 12 percent more likely among the third quintile, 13 percent more likely among the fourth quintile, and 14 to 15 percentage points more likely among the top quintile (see Figure 5).

14

Figure 5

Prob of Good Health, Relative to Lowest Income Quintile
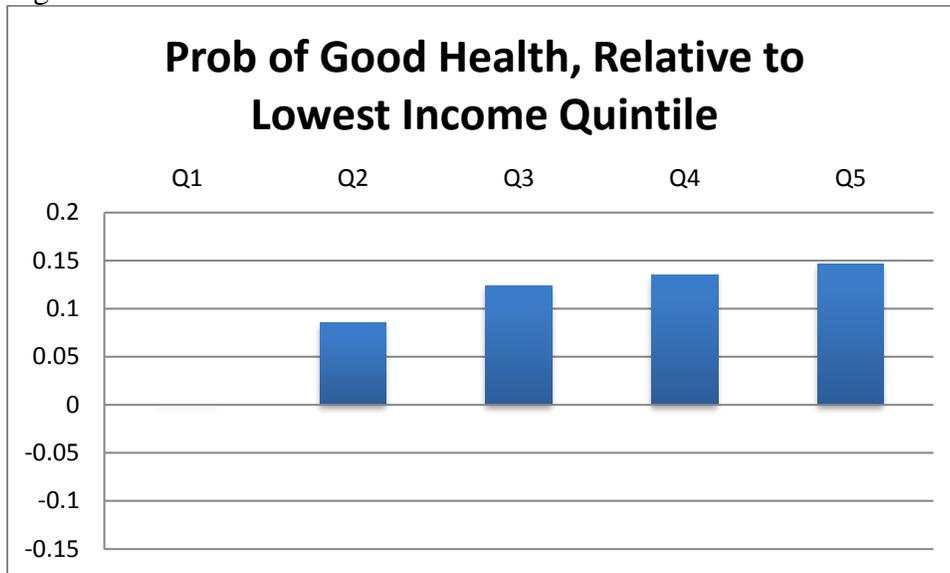
While statistically significant, unemployment has no economically meaningful relationship to self-reported health. High food stamp participation is also unrelated to good health, and it does not impact the unemployment-income link to health.

Table 4. Linear Probability of Reporting Good health

VARIABLES	(1) w/ State FE	(2) w/ State FE	(3) w/ State FE
Quintile 20-40	0.0855***	0.0855***	0.0824***
	(0.003)	(0.003)	(0.003)
Quintile 40-60	0.1235***	0.1234***	0.1184***
	(0.003)	(0.003)	(0.003)
Quintile 60-80	0.1354***	0.1353***	0.1302***
	(0.003)	(0.003)	(0.003)
Top 20	0.1468***	0.1468***	0.1432***
	(0.003)	(0.003)	(0.003)
Lagged High UR	0.0006**	0.0006**	-0.0001
	(0.000)	(0.000)	(0.000)
Quintile 20-40×High UR	-0.0003	-0.0003	0.0004
	(0.000)	(0.000)	(0.000)
Quintile 40-60×High UR	-0.0012***	-0.0012***	0.0001
	(0.000)	(0.000)	(0.000)
Quintile 60-80×High UR	-0.0002	-0.0002	0.0010*
	(0.000)	(0.000)	(0.001)
Top 20×High UR	-0.0002	-0.0002	0.0007
	(0.000)	(0.000)	(0.000)
High FS Participation			-0.0060
			(0.005)
Quintile 20-40×High FS=1			0.0102
			(0.007)
Quintile 40-60×High FS=1			0.0114
			(0.007)
Quintile 60-80×High FS=1			0.0155*
			(0.008)
Top 20×High FS=1			0.0087
			(0.007)
High FS×High UR			0.0022***
			(0.001)
Quintile 20-40×High FS=1×High UR			-0.0022**
			(0.001)
Quintile 40-60×High FS=1×High UR			-0.0035***
			(0.001)
Quintile 60-80×High FS=1×High UR			-0.0036***
			(0.001)
Top 20×High FS=1×High UR			-0.0025***
			(0.001)
Demographic controls	Yes	Yes	Yes
State Fixed effects	Yes	Yes	Yes
Observations	984,567	984,567	984,567
R-squared	0.118	0.118	0.118

In Table 5, we examine the link between state SNAP participation and the likelihood of reporting declining health over the last 12 months.

Here, the consistent income gradient with respect to health continues to be evident. Specifically, individuals from higher income quintiles are increasingly less likely to report declining health over the past year (see Figure 6). Although there appears to be little to no unemployment relationship with declining health in our models, there is a modest, positive association between higher SNAP participation and reporting declining health.

Figure 6

Prob of Declining Health, Relative to Lowest Income Quintile
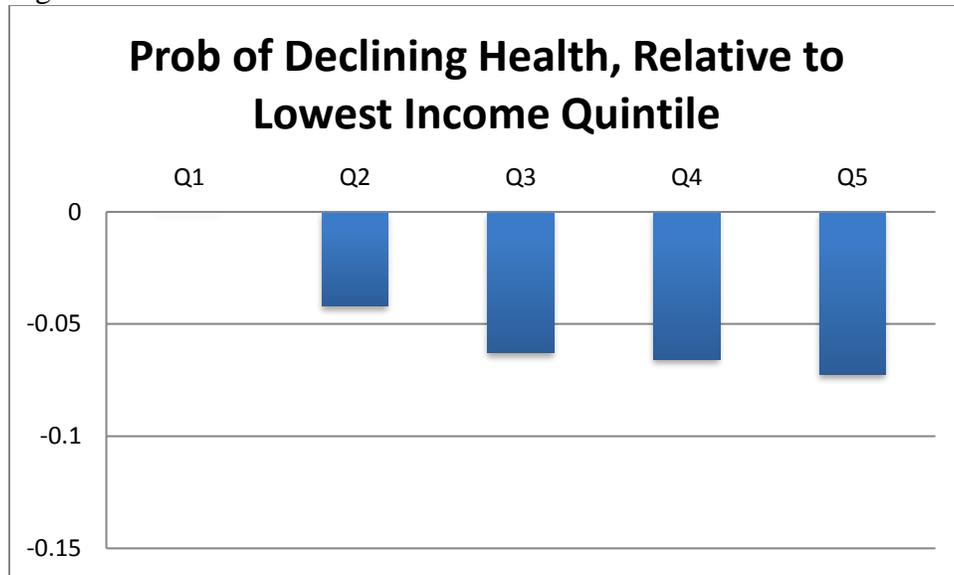
Table 5. Linear Probability of Reporting Declining Health.

VARIABLES	(1) w/ State FE	(2) w/ State FE	(3) w/ State FE
Quintile 20-40	-0.0421***	-0.0421***	-0.0399***
	(0.004)	(0.004)	(0.004)
Quintile 40-60	-0.0628***	-0.0628***	-0.0586***
	(0.004)	(0.004)	(0.004)
Quintile 60-80	-0.0657***	-0.0657***	-0.0606***
	(0.004)	(0.004)	(0.005)
Top 20	-0.0727***	-0.0727***	-0.0727***
	(0.004)	(0.004)	(0.004)
Lagged High UR	-0.0006	-0.0006	0.0002
	(0.000)	(0.000)	(0.000)
Quintile 20-40×High UR	-0.0004	-0.0004	-0.0008
	(0.001)	(0.001)	(0.001)
Quintile 40-60×High UR	0.0007	0.0007	-0.0001
	(0.001)	(0.001)	(0.001)
Quintile 60-80×High UR	0.0001	0.0001	-0.0008
	(0.001)	(0.001)	(0.001)
Top 20×High UR	0.0000	0.0000	-0.0002
	(0.001)	(0.001)	(0.001)
High SNAP Participation			0.0198***
			(0.006)
Quintile 20-40×High UR=1			-0.0104
			(0.010)
Quintile 40-60×High UR=1			-0.0177*
			(0.010)
Quintile 60-80×High UR=1			-0.0238**
			(0.012)
Top 20×High UR=1			0.0033
			(0.010)
High SNAP×High UR			-0.0031***
			(0.001)
Quintile 20-40×High SNAP=1×High UR			0.0016
			(0.001)
Quintile 40-60×High SNAP=1×High UR			0.0032**
			(0.001)
Quintile 60-80×High SNAP=1×High UR			0.0040**
			(0.002)
Top 20×High SNAP=1×High UR			0.0004
			(0.001)
Demographic controls	Yes	Yes	Yes
State Fixed effects	Yes	Yes	Yes
Observations	430,306	430,306	430,306
R-squared	0.026	0.026	0.026

We next explore, in Table 6, the likelihood of reporting ever having depression, and how this relates to income, unemployment, and SNAP participation. First, we find that persons in the top two quintiles are 11 to 15 percentage points less likely to ever report depressive symptoms, compared to those within the lowest income quintile (see Figure 7). There is no relationship, however, between the lagged unemployment rate and reporting ever being depressed. We do observe that respondents in high SNAP participation states are 12 percentage points more likely to report ever having depressive symptoms than respondents in low SNAP participation states.

Figure 7
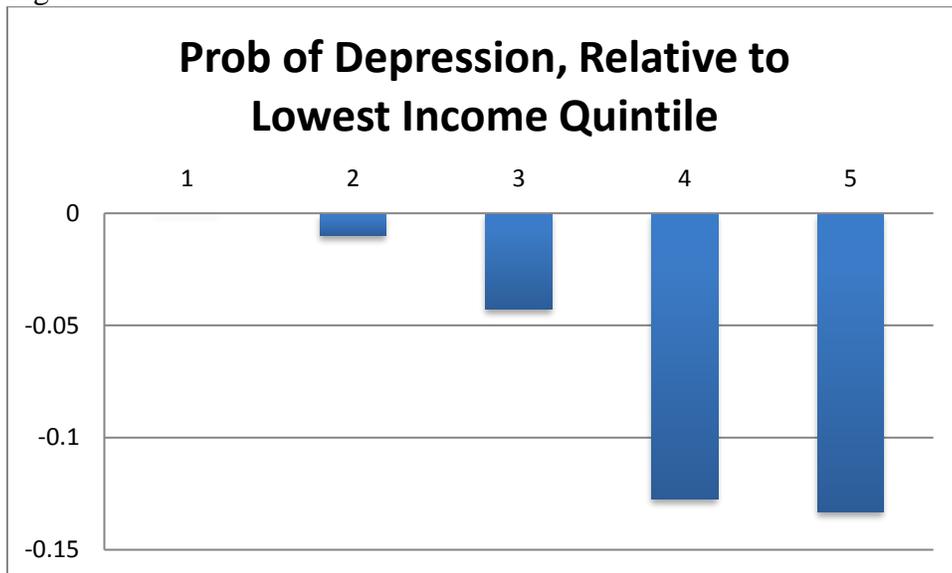
Table 6. Linear Probability of Reporting Ever Having Depressive Symptoms.

VARIABLES	(1) w/ State FE	(2) w/ State FE	(3) w/ State FE
Quintile 20-40	-0.0101	-0.0101	0.0135
	(0.030)	(0.030)	(0.037)
Quintile 40-60	-0.0429	-0.0427	-0.0220
	(0.028)	(0.028)	(0.035)
Quintile 60-80	-0.1275***	-0.1274***	-0.1073***
	(0.032)	(0.032)	(0.041)
Top 20	-0.1330***	-0.1326***	-0.1452***
	(0.027)	(0.027)	(0.035)
Lagged High UR	0.0005	0.0012	0.0048
	(0.004)	(0.004)	(0.004)
Quintile 20-40×High UR	-0.0064*	-0.0064*	-0.0081*
	(0.003)	(0.003)	(0.004)
Quintile 40-60×High UR	-0.0040	-0.0040	-0.0058
	(0.003)	(0.003)	(0.004)
Quintile 60-80×High UR	0.0025	0.0025	0.0004
	(0.004)	(0.004)	(0.005)
Top 20×High UR	0.0008	0.0007	0.0012
	(0.003)	(0.003)	(0.004)
High SNAP Participation			0.1191***
			(0.044)
Quintile 20-40×High UR=1			-0.0778
			(0.061)
Quintile 40-60×High UR=1			-0.0698
			(0.057)
Quintile 60-80×High UR=1			-0.0586
			(0.067)
Top 20×High UR=1			0.0421
			(0.056)
High SNAP×High UR			-0.0128**
			(0.005)
Quintile 20-40×High SNAP=1×High UR			0.0052
			(0.007)
Quintile 40-60×High SNAP=1×High UR			0.0058
			(0.007)
Quintile 60-80×High SNAP=1×High UR			0.0059
			(0.008)
Top 20×High SNAP=1×High UR			-0.0020
			(0.006)
Demographic controls	Yes	Yes	Yes
State Fixed effects	Yes	Yes	Yes
Observations	60,350	60,350	60,350
R-squared	0.040	0.040	0.041

Finally, we examine how BMI relates to income, unemployment, and SNAP participation in Table 7. Here, as across all of our models, middle income quintiles report consistently higher body mass index scores (see Figure 8) than either individuals in the lowest or highest income quintiles. The lagged unemployment rate is unrelated to BMI. Food stamp participation levels are positively associated with body mass index, but only for individuals in the lowest income quintile. In this instance, there is no clear linkage to the state unemployment rate, nor do food stamps appear to provide any particular buffering for low and moderate income residents against higher BMI.

Figure 8
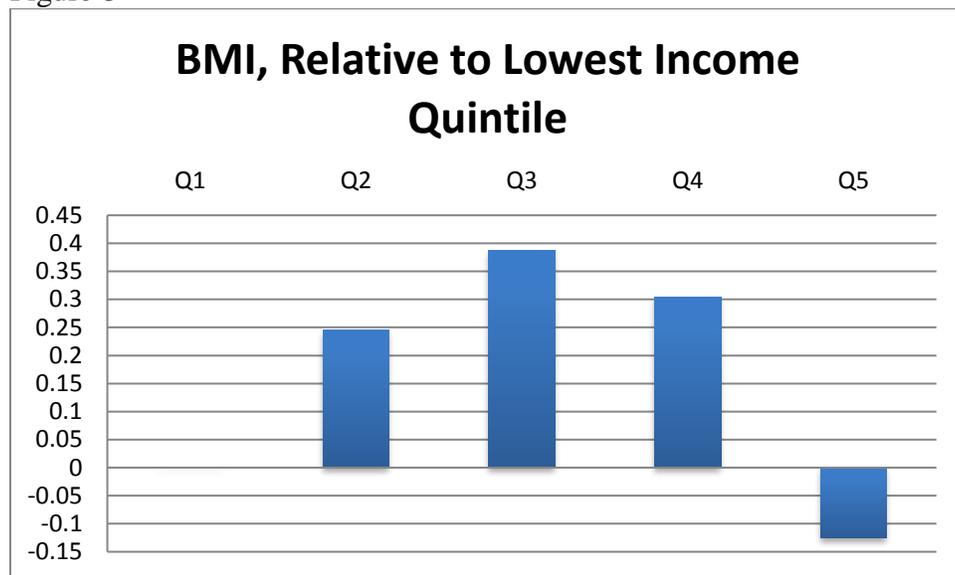
Table 7. OLS Determinants of BMI

VARIABLES	(1) w/ State FE	(2) w/ State FE	(3) w/ State FE
Quintile 20-40	0.2449***	0.2476***	0.2819***
	(0.081)	(0.081)	(0.089)
Quintile 40-60	0.3867***	0.3889***	0.3908***
	(0.080)	(0.080)	(0.088)
Quintile 60-80	0.3046***	0.3067***	0.3440***
	(0.094)	(0.094)	(0.104)
Top 20	-0.1247	-0.1260	-0.1271
	(0.081)	(0.081)	(0.091)
Lagged High UR	-0.0025	-0.0028	0.0063
	(0.008)	(0.008)	(0.009)
Quintile 20-40×High UR	-0.0184	-0.0189	-0.0212
	(0.012)	(0.012)	(0.014)
Quintile 40-60×High UR	-0.0377***	-0.0381***	-0.0337**
	(0.012)	(0.012)	(0.014)
Quintile 60-80×High UR	-0.0473***	-0.0476***	-0.0469***
	(0.014)	(0.014)	(0.016)
Top 20×High UR	-0.0741***	-0.0739***	-0.0683***
	(0.012)	(0.012)	(0.014)

	(1)	(2)	(3)
High FS Participation			0.2828**
			(0.132)
Quintile 20-40×High FS=1			-0.2568
			(0.219)
Quintile 40-60×High FS=1			-0.1436
			(0.212)
Quintile 60-80×High FS=1			-0.4256*
			(0.251)
Top 20×High FS=1			-0.2178
			(0.207)
High FS×High UR			-0.0485***
			(0.018)
Quintile 20-40×High FS=1×High UR			0.0222
			(0.031)
Quintile 40-60×High FS=1×High UR			-0.0005
			(0.029)
Quintile 60-80×High FS=1×High UR			0.0300
			(0.035)
Top 20×High FS=1×High UR			0.0080
			(0.028)
Age	0.0173***	0.0173***	0.0173***
	(0.001)	(0.001)	(0.001)
Male	0.6510***	0.6510***	0.6509***
	(0.018)	(0.018)	(0.018)
Survey Year	0.1011***	0.1034***	0.1022***
	(0.003)	(0.003)	(0.003)
Interview Quarter	0.0118	0.0119	0.0121
	(0.008)	(0.008)	(0.008)
Married	0.6300***	0.6303***	0.6289***
	(0.021)	(0.021)	(0.021)
Citizen	1.0070***	1.0072***	1.0121***
	(0.040)	(0.040)	(0.040)
High School	-0.1399***	-0.1401***	-0.1400***
	(0.024)	(0.024)	(0.024)
Some College	-0.6234***	-0.6233***	-0.6236***
	(0.024)	(0.024)	(0.024)
College	-1.1747***	-1.1747***	-1.1740***
	(0.035)	(0.035)	(0.035)
White	0.8599***	0.8618***	0.8599***
	(0.039)	(0.039)	(0.039)
Black	2.7770***	2.7784***	2.7775***
	(0.047)	(0.047)	(0.047)
Participation Rate		-0.1457***	
		(0.037)	
Observations	418,550	418,550	418,550
R-squared	0.039	0.039	0.039

DISCUSSION AND CONCLUSION

We hypothesized that (1) Low-income individuals and families have worse health and lower food security relative to higher income individuals and families; (2) Economic downturns lead to worse health and lower food security, on average; (3) The negative impact of economic downturns on health and food security are larger for low-income individuals and families relative to higher income individuals and families; (4) Participation in safety net programs, including SNAP, reduce the impact of both income and of economic downturns on health and food security; and (5) Participation in safety net programs, including SNAP, helps mitigate the negative impact of economic downturns on low-income individuals and families.

Our results provide strong confirmation for our first hypothesis. The relationship between income and both food insecurity and health can be found across a large number if outcomes. Moreover, the size of this income gradient is large and economically meaningful.

However, we find mixed and inconclusive evidence for our remaining hypotheses. Food insecurity outcomes are strongly related to the unemployment rate, while of the health outcomes only self-reported health is modestly related to the unemployment rate. Moreover, only in the case of unbalanced meals do the adverse effects of state-level economic conditions fall disproportionately on lower and moderate income households. Given that this component of our initial hypotheses—that lower income individuals and families are uniquely impacted by economic shocks—was not realized, perhaps unsurprisingly we do not find evidence that food stamps buffer against these economic shocks among low and moderate-income households.

We do find that food stamp participation, alone, is positively associated with a lowered likelihood of skipping or cutting meals, but that it is also associated with an increased likelihood of worsened health over the past 12 months, as well as increased rates of reported depression and higher BMI for individuals in the lowest income quintile. In the same models where large depression correlations emerge, we also find that individuals residing in high unemployment states with high food stamp participation are, at the margin, less likely to report depression.

In many instances, the sample sizes across our 6 models vary according the availability of the outcome variables we choose to examine. In some instances, including assessments of food insecurity variables, researchers should return to these questions as time elapses, so as to capture greater variation in economic conditions and how these relate to outcomes. Additionally, the regression modeling will benefit from larger sample sizes.

Our measure of state SNAP participation equals the number of state SNAP recipients as a share of the state population. This potentially mis-measures participation rates, and extensions of this study could employ newer methods of estimating participation.

Our study provides evidence that lower income Americans are at higher risk of both poor health, depression, and food insecurity. In some instances, this link is heightened by unemployment, but in many instances the economy's impact seems to be muted—perhaps by the functioning of the social safety net and programs like SNAP. In the baseline, the state SNAP participation rate is associated with improved food security. At the same time, respondents in these same states were more likely to be obese, report declining health over the past 12 months, and to report depression at any time. This

association is more likely a reflection of the work-conditions facing today's SNAP recipients, many of whom are likely to face part-time work conditions and flat wages (Hardy, Smeeding, and Ziliak 2017). Future work on this subject can incorporate a refined definition of SNAP participation. Another important extension would include further stratifying the sample by race and gender, to understand whether economic shocks impose differential effects across demographics.

REFERENCES

Bhattacharya, Jayanta, Thomas DeLeire, Steven Haider, and Janet Currie. (2003). "Heat or Eat? Cold Weather Shocks and Nutrition in Poor American Families." *American Journal of Public Health* 93(7):1149-1154.

Blundell, Richard and Luigi Pistaferri. 2003. "Income Volatility and Household Consumption: The Impact of Food Assistance Programs." *Journal of Human Resources*, 38: 1032–1050.

Dahl, Molly, Thomas DeLeire, and Shannon Mok (2014). "Food Insufficiency and Income Volatility in U.S. Households: The Effects of Imputed Earnings in the Survey of Income and Program Participation" *Applied Economic Perspectives & Policy* volume 36, number 3, pp. 416– 437.

Gundersen, Craig and Joseph Gruber. 2001. "The Dynamic Determinants of Food Insufficiency." *Second Food Security Measurement and Research Conference, Volume II: Papers,* Margaret Andrews and Mark Prell, eds., U.S. Department of Agriculture, Economic Research Service, FANRR-11-2, pp. 92–110.

Gundersen, Craig and James P. Ziliak. 2003. "The Role of Food Stamps in Consumption Stabilization," *Journal of Human Resources*, 38: 1051-1079.

Hardy, Bradley, Timothy Smeeding, and James P. Ziliak. 2017. "The Changing Safety Net for Low Income Parents and Their Children: Structural or Cyclical Changes in Income Support Policy?" Working Paper.

Leete, Laura and Neil Bania. 2010. "The Effect of Income Shocks on Food Insufficiency." *Review of Economics of the Household*, 8 (4): 505–526.

Mykerezi, Elton and Bradford Mills. 2010. "The Impact of Food Stamp Program Participation on Household Food Insecurity." *American Journal of Agricultural Economics*, 92 (5): 1379–1391.

Nord, Mark and Anne Maria Golla. 2009. "Does SNAP Decrease Food Insecurity? Untangling the Self-Selection Effect." U.S. Department of Agriculture, Economic Research Service, Economic Research Report No. 85.

Ratcliffe, Caroline, Signe-Mary McKernan, and Sisi Zhang. 2011. "How Much Does the Supplemental Nutrition Assistance Program Reduce Food Insecurity?" *American Journal of Agricultural Economics*, 93(4): 1082–98.

Ribar, David C. and Karen S. Hamrick. 2003. "Dynamics of Poverty and Food Sufficiency." U.S. Department of Agriculture, Economic Research Service, Food Assistance and Nutrition Research Report No. 36.