Food Insecurity among Households with Children: The Role of the State Economic and Policy Context

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ABSTRACT This article explores the correlates of geographic and temporal variation in food insecurity from 2002 to 2014, using data from the Current Population Survey's Food Security Supplements. We focus on the relationship between state economic and policy factors and household and child food security outcomes, using both an annual and a 30-day food security measure. At the policy level, we consider state differences in Supplemental Nutrition Assistance Program accessibility, School Breakfast Program availability, state Earned Income Tax Credit generosity, maximum unemployment insurance duration, and prevailing minimum wage. We find substantial evidence that the state economic and policy contexts play a role and that the link between policy characteristics and food security outcomes varies in plausible ways among households with differing levels of economic vulnerability.

INTRODUCTION

Food insecurity—or lack of assured access to sufficient food for a healthy and active life—jumped sharply in 2008 with the onset of the Great Recession and has remained persistently high, even as other economic indicators have shown signs of improvement (Coleman-Jensen et al. 2016). While food insecurity finally had a meaningful drop in 2015, rates were still elevated over prerecession levels, with 12.7 percent of all households and 16.6 percent of households with children being food insecure (Coleman-Jensen et al. 2016). Researchers have made great strides in identifying sociodemographic characteristics that are linked to food insecurity as well as, increasingly, household behaviors and processes (see, e.g., Gundersen and Ziliak 2014). The role of the broader economic, social, and policy context

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in which households reside is less well understood, particularly in the period surrounding the Great Recession. We do know, however, that food insecurity varies greatly among states—from 8.5 percent in North Dakota to 20.8 percent in Mississippi during 2015 (Coleman-Jensen et al. 2016). This article explores the role of contextual factors that vary across states and over time in contributing to the risk of food insecurity from 2002 to 2014. We focus on households with children because of their substantially higher rate of food insecurity relative to all households. This research builds on earlier work that examined similar questions in the 1996–2001 period (Bartfeld and Dunifon 2006), while focusing on a longer and more recent period and incorporating a broader array of policy variables as well as more nuanced measures of food security.

PAST RESEARCH

Early research on food insecurity focuses heavily on sociodemographic predictors, documenting the role of low income in combination with other factors spanning household structure, employment, education, race and ethnicity, and health and disability (see, e.g., Rose, Gundersen, and Oliveira 1998). More recently, research has looked at household predictors in more nuanced ways, with greater attention to household behaviors, processes, and capacities, while examining the roles of such factors as maternal health, mental health, parenting practices, financial behaviors, social supports, and substance abuse to understand why seemingly similar children and households differ in their food security outcomes (see Gundersen and Ziliak [2014] for a discussion of recent literature on childhood food insecurity). This body of work primarily focuses on the attributes, behaviors, and dynamics of individuals, families, and households. It is particularly useful for understanding why households with similar economic vulnerability may differ in their food security outcomes, while it is less relevant to understanding broad differences in risk across place and over time.

Another line of inquiry focuses on aspects of the broader context in which households reside, examining how dimensions of the social, economic, food, and policy environments are linked to food security outcomes. Much of this work focuses on the period preceding the jump in food insecurity at the start of the Great Recession, and much focuses on one or a small number of factors at a time, although work here is expanding fairly rapidly.

The economic context plays an important role. Higher unemployment rates and lower median wages are both predictive of food insecurity (Tapogna et al. 2004; Bartfeld and Dunifon 2006; Bernell, Weber, and Edwards 2006; Gundersen, Engelhard, and Waxman 2014; Nord, Coleman-Jensen, and Gregory 2014; Gundersen et al. 2015). Nord and colleagues' (2014) analysis of national trends in food insecurity over the 2001–12 period finds that a percentage point increase in peak unemployment is associated with a 0.5 percentage point increase in food insecurity, and Groover, Mills, and Davis (2012) find that rising unemployment during the Great Recession explains a significant portion of the increase in child food insecurity during that period. The state and local cost structure also plays a role, with greater risk of food insecurity being associated with higher prevailing rents and energy costs, although the evidence here precedes the recession of the late 2000s (Tapogna et al. 2004; Bartfeld and Dunifon 2006; Bernell et al. 2006; Nord and Kantor 2006; Bartfeld, Ryu, and Wang 2010).

The food assistance safety net has been examined as a potential influence on food insecurity. In the case of the Supplemental Nutrition Assistance Program (SNAP), the focus has been much more on the effect of participation than on the influence of specific policy differences across states and over time. That is, the effect of SNAP participation on the treated has been extensively studied (see Gregory, Rabbitt, and Ribar [2015] for a review), whereas the effect of SNAP as a feature of the policy environment and as a determinant of food security has received comparatively little attention. An exception is research linking the benefit increase stemming from the American Recovery and Reinvestment Act (ARRA) in 2009, and the subsequent phasing out and termination of those benefits by 2013, to a decline and a subsequent increase in food insecurity, respectively (Nord and Prell 2011; Nord 2013). In contrast, a set of policy changes available at state discretion and used with increasing frequency since the early 2000s—such as higher income limits, elimination of vehicle limits and liquid asset tests, lengthening of certification periods, and simplified reporting rules—have received little scrutiny with regard to their potential influence on food insecurity, although such policies have been linked to increased participation and, as such, have been used as instruments to identify the effects of participation on food security and other outcomes (Ratcliffe et al. 2011; Ganong and Liebman 2013; Mabli et al. 2014; Ziliak 2015). In light of the considerable policy interest in SNAP and the concern in some parts with historically high caseloads (see, e.g., Doar 2015), information on how poli-

cies to enhance access have influenced food insecurity—in addition to participation—is of interest.

In the case of the School Breakfast Program (SBP), Bartfeld and Ahn (2011) find that attending a participating school reduces the risk of marginal food security, and recent work by Arteaga and Heflin (2014) demonstrates that access to the National School Lunch Program (NSLP) reduces food insecurity among kindergarten entrants. Likewise, Huang, Barnidge, and Kim (2015) find that food insufficiency declines during the summer for recipients of free or reduced-price meals during the school year, but not for eligible nonrecipients, providing suggestive evidence of a beneficial role of school meals. Other work reveals benefits of summer meal programs for food security (Bartfeld and Dunifon 2006; Nord and Romig 2006; Miller 2016). With very limited exceptions, the literature on food assistance and food insecurity considers programs in isolation rather than as part of a broader set of policies and programs, even though there is substantial overlap in both eligibility and participation.

Attention to policies outside the food assistance arena is much more limited in the peer-reviewed literature. Borjas (2004) finds that more widespread access to welfare programs in the years surrounding welfare reform is linked to lower food insecurity risk among immigrants, and Heflin (2014) finds, counterintuitively, that the state Earned Income Tax Credit (EITC) rate is positively associated with food insufficiency. In one of the only studies to look comprehensively at the value of the combined economic safety net, Schmidt, Shore-Sheppard, and Watson (2016) find that a higher combined value of the benefits available through a package of means-tested programs including SNAP; the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC); school meals; EITC; Temporary Assistance to Needy Families (TANF); and Supplemental Security Income leads to a substantial reduction in food insecurity among single-parent households with children, with the value of both food programs and nonfood programs playing a role, although the authors were not able to document significant effects of the separate programs. Looking beyond tax and transfer policies, Sabia and Nielsen (2015) find no evidence linking minimum wages to food security.

Other work explores the relationship between food insecurity and the broader food environment. Recent studies link higher food prices to an increased risk of food insecurity (Gregory and Coleman-Jensen 2013; Zhang et al. 2013; Nord et al. 2014), and some evidence suggests that living in

proximity to supermarkets and grocery stores may be beneficial (Bartfeld et al. 2010; Bonanno and Li 2014). Nonetheless, firm evidence with regard to food environment and food insecurity remains elusive (Allard 2013; Carter, Dubois, and Tremblay 2014).

This study builds on past work by Bartfeld and Dunifon (2006), which was among the first studies to look comprehensively at a range of contextual factors linked to food insecurity, with a focus on households with children. That study introduced the concept of a food security infrastructure—namely, a set of programs, policies, and economic and social attributes that affect the likelihood of food insecurity—and finds that the food security infrastructure was particularly important for near-poor households. In particular, Bartfeld and Dunifon (2006) find evidence that, among near-poor households, factors including more accessible SNAP and summer meals, lower tax rates for low-income households, lower prevailing rents, lower unemployment rates, higher prevailing wages, and a lower share of households with a college degree (perhaps as a proxy for a lower cost of living) were all associated with reduced risk of food insecurity during the late 1990s. Other work has adapted that framework to focus on the 2001–5 period (Hess 2012). Here, we focus on a broader set of policies, paying new attention to nonfood programs and policies that are important components of the employment-linked safety net and using a more detailed characterization of SNAP policies than past work. We focus on a period that is both longer and more recent (2002–14) than past work, thus providing a wider range of contexts while spanning a period that includes the Great Recession and its aftermath. We use a more nuanced food security measure that differentiates among severities of food hardship, in contrast to the binary measure most commonly used (although see Gundersen et al. [2015] for recent work exploring the depth and severity of food insecurity), and we consider both annual and 30-day food security reference periods. We focus specifically on households with children, both because of their disproportionate risk for food insecurity vis-à-vis childless households and because the relevant policy environment is different for households with and without children.

CONCEPTUAL FRAMEWORK

Our framework posits, consistent with Bartfeld and Dunifon (2006), that households differ in their risk for food insecurity in accordance with

household characteristics that shape their economic security, as well as with a potentially broad range of attributes of the economic and policy context that affect food security either directly or via an influence on economic well-being. We further posit, again consistent with past work, that attributes of the economic and policy context may have differing relevance for households with different levels of underlying vulnerability, at least in part due to the targeting criteria of programs. We focus on the state context and limit our attention to three primary domains: economic characteristics, employment-linked policies and programs that affect incomes of vulnerable households, and federal food and nutrition assistance programs. For practical purposes, we further limit our attention to characteristics that vary both within and across states and that we can measure sufficiently well at the state-year level for the time span of the analysis.

ECONOMIC CHARACTERISTICS

Relevant economic characteristics include the availability and quality of jobs and the cost of living. The unemployment rate, which is a proxy for availability of jobs, varied dramatically over the 13 years of this study with substantial cross-state variation before, during, and after the Great Recession. Jobs also differed in quality over place and time, and prevailing wages were an important metric. States also differed in cost of living, with stark differences in housing costs across states and persistent increases over time, which may have had spillover effects on households' ability to meet food needs.

POLICIES AFFECTING HOUSEHOLD INCOME

Numerous policies affect household income. We focus on three that vary across states and over time and that have broad potential relevance to economically vulnerable households with some labor force attachment: minimum wages, the EITC, and unemployment insurance (UI).

The minimum wage is governed by both federal and state policy, where the higher of the two prevails. Over the time span of this study, the federal minimum wage increased from $5.15 to $7.25 per hour via stepwise increases in 2007, 2008, and 2009. Thirty-three states had minimum wages that exceeded the federal minimum for 1 or more years, with a maximum in 2014 of $9.50 per hour. A higher minimum wage would be beneficial to

food security to the extent that it increases wages but could be detrimental to food security to the extent that it leads to employment losses or higher consumer prices. In light of these potentially offsetting effects, we are agnostic on the expected net effect.

The EITC, which subsidizes earnings and increases net income for working households with children up to roughly twice the poverty line, depending on household composition, has a federal and often also a state component. The state credit, when present, is expressed as a percentage of the federal credit. While the federal credit has been stable in real terms over the period of this study (save for an increase for households with three or more children beginning in 2009), there are substantial differences across states and within states over time. Twenty-seven states had a credit during 1 or more of the years of this study, ranging from 3.5 to 50.0 percent of the federal credit, with the largest potential state credits worth over $2,000.

UI, which provides temporary partial wage replacement to the involuntarily unemployed, is governed by both state and federal policy. States make their own rules regarding the extent of work history required for eligibility. The maximum duration of benefits is normally capped at 26 weeks but is subject to temporary increases based on state economic conditions under standard extended benefit provisions as well as occasional time-limited legislation extending the potential benefit duration further. Such an extension happened during the 2002–4 period when maximum duration reached 72 weeks in some states, as well as during the Great Recession when it reached an unprecedented 99 weeks in some states (Valletta 2014).

FEDERAL FOOD SAFETY NET

Federal food and nutrition assistance programs address food insecurity via the provision of food (e.g., school meals) or benefits that can be used to purchase food (e.g., SNAP). Programs vary in important ways among states and over time, leading to substantial differences in program access. We expect that more accessible programs, all else being equal, will be associated with a lower risk of food insecurity. SNAP, for instance, has a nationwide eligibility threshold of 130 percent of the poverty line and a restrictive liquid asset test, but states have the option to use broad-based categorical eligibility (BBCE), which can raise the gross income limit or raise or eliminate asset

tests to conform to those used for TANF eligibility. States may raise or eliminate restrictions on the value of vehicles, and states have at their disposal various options that modify the ease of applying for and maintaining enrollment, including longer certification periods, simplified reporting requirements, and others (see Ziliak [2015] for a recent discussion of state SNAP policies and their influence on caseloads). For school meals, the SBP is less consistently available than the NSLP, with 77.7–100 percent of schools offering lunch also offering breakfast as of 2014, reflecting differences in both state laws and local decisions (FRAC 2015). Summer meal access also varies considerably, although meaningful metrics are not readily available. Other programs, including WIC and the NSLP, have less variation in availability across states or time and are not considered here.

DATA AND METHOD

DATA

Data are from the Current Population Survey's Food Security Supplements (CPS-FSS) spanning 2002–14, supplemented by state characteristics gathered from a variety of sources. The CPS-FSS was administered in December during each of the survey years included here. We limit our primary sample to households with minor children (190,554 households).

VARIABLES

Means and standard deviations for the dependent variables and contextual variables are shown in table 1. Dollar amounts are consumer price index (CPI) adjusted to 2012 dollars. In the models, all continuous variables are centered around their grand mean.

Outcome Variable: Food Insecurity

We consider two household-level food security measures in our main analyses, one using a 12-month reference period—the standard measure used in official food security statistics as well as most existing analyses of the CPS-FSS—and an alternative using a 30-day reference period. Because the current 30-day scale has only been included in the CPS-FSS since 2005, we limit our analyses with that measure to the 2005–14 period. Both measures use the 18-item food security scale for their respective time period and are defined here as four-category variables, with households

TABLE 1. Variable Means and Standard Deviations

	Mean	SD
Dependent variable:		
12-month food security measure:		
High food security	.700	.458
Marginal food security	.115	.319
Low food security	.133	.339
Very low food security	.052	.222
30-day food security measure:		
High food security	.822	.383
Marginal food security	.073	.260
Low food security	.073	.260
Very low food security	.032	.177
Context variable:		
Federal food program:		
SBP-NSLP school ratio (10s)	8.640	1.172
SNAP: BBCE	.497	.500
SNAP: one or more vehicles exempt from limits	.813	.390
SNAP: simplified reporting	.797	.402
SNAP: share with >3-month recertification	.968	.102
SNAP: noncitizens eligible	.179	.383
SNAP: no biometric testing	.794	.405
SNAP index	.706	.215
Economic policy:		
State EITC rate	.060	.102
Maximum UI weeks (10s)	4.874	2.575
Minimum hourly wage ($)	7.298	.799
Economic attribute:		
Unemployment rate	6.732	2.086
Median personal earnings when >0 ($1,000s)	31.313	3.709
Percentage with bachelor's degree	27.812	4.484
Low quartile contract rent ($100s)	5.487	1.350

Note.—All variables are based on the 2002–14 period except for the 30-day food security measures, which are based on the 2005–14 period. The means are weighted by supplemental household weights for the survey month. All dollar-based variables are in 2012 dollars. Models include the above variables as well as education, race, number of children, household structure, elderly member, disabled member, noncitizen member, home ownership, urbanicity, survey years, and states. SNAP = Supplemental Nutrition Assistance Program; SBP = School Breakfast Program; NSLP = National School Lunch Program; BBCE = broad-based categorical eligibility; EITC = Earned Income Tax Credit; UI = unemployment insurance. N = 190,554.

classified as fully food secure (no affirmative responses), marginally food secure (one to two affirmatives), having low food security (three to seven affirmatives), and having very low food security (eight or more affirmatives). Households that are fully or marginally secure are considered food secure under the typical dichotomous food security measure. Because research has variously identified marginal food security, low food security, and very low food security as clinically relevant with regard to a range of negative outcomes (Gundersen 2013), we prefer a four-category versus a dichotomous measure.

The annual and 30-day measures each capture the highest severity of food insecurity over their respective reference periods. Among households that are food insecure on an annual basis, then, those that experience food insecurity more frequently during the year will be more likely also to show up as food insecure in the 30-day measure than those whose food hardships are less frequent. Indeed, the rates of food insecurity in our sample by the annual and 30-day measures over the 2005–14 period when both are available are 18.9 and 10.6 percent, respectively. Additionally, those among the annually insecure whose food insecurity systematically occurs during a time of year other than the November to December reference period for the 30-day measure will be less likely to show up as food insecure in that measure, compared to those whose food insecurity has no particular pattern. The risk factors may thus differ between measures, to the extent that factors disproportionately influence frequent versus intermittent food security, or food insecurity during or outside of the November to December reference period. And, the measurement timing and precision of particular independent variables may also affect the relative ability of the annual versus 30-day models to detect effects.

Alternative Outcome Variables

As food security is not always experienced equally by all household members, we also estimate our primary models for food security specifically among children. We construct a three-category variable for child food insecurity, based on the eight child-referenced items that are included in the larger 18-item scale. Households with zero or one affirmative responses to the child-specific questions are classified as food secure, those with two to four affirmative responses are classified as having low food security among children, and those with five or more affirmative responses are classified as having very low food security among children. We use a three- versus four-category measure, as the established food security categories for children do not include a marginal food security category analogous to that for households overall (see Coleman-Jensen, McFall, and Nord [2013] for a discussion of food security among children).[1]

A limitation of the annual and 30-day food security measures is that they are only asked of households that pass an initial screen, specifically

1. The marginal food security category in the household measure denotes worry about running out of food, and that concept is not captured in the child-specific questions.

those who have income below 185 percent of the poverty line, who respond affirmatively to a food insufficiency question, or who respond affirmatively to an initial low-severity item on the food security scale. This screening procedure may thus differentially capture food insecurity among lower- versus higher-income households. As a sensitivity test, we reestimate our primary model on the single-item food insufficiency measure that is asked of all households. This is a single-question measure that differentiates among households that have enough of the kind of food they want to eat, enough food but not always the kinds they want, sometimes not enough, and often not enough.

Economic Context

We use four variables to describe the economic context: The *unemployment rate* is the average monthly rate for the relevant year.[2] *Median annual earnings*, when positive, are from the American Community Survey (ACS) and provide a measure of how typical earnings vary across locations and over time. The *25th rent percentile*, also from the ACS, captures prevailing housing costs for economically vulnerable households. The *share of the population with a bachelor's degree* captures spillover effects of being in a better-educated state. It provides a metric of the overall earnings capacity of an area and likely also reflects costs of living not captured by the housing-cost measure, with which it is fairly highly correlated. Because the sampling scheme for the ACS differed before 2005, including fewer areas in each state, we also reestimate our primary model for the 2005–14 period as a sensitivity test.

Accessibility of Federal Food Assistance Programs

Our measures focus on SNAP and the SBP, both of which are subject to state and local decisions that influence accessibility.[3] We use the ratio of schools participating in the SBP to those participating in the NSLP to capture differ-

2. We also experimented with using the highest rate during the year, which was a weaker predictor, and with adding lagged unemployment, which did not improve the fit or substantively alter results.

3. Summer meal programs also vary substantially but lack proxies for availability that can meaningfully capture differences over states and time. We do add a measure of the ratio of summer meal to free-and-reduced-price school-year participants in one of our sensitivity tests, although this reflects both availability and need.

ences in the availability of school breakfast.[4] Across states and years, this ratio ranged from 0.436 to 1; between 2002 and 2014 the average across states increased from 0.795 to 0.919. Data are from the Food Research and Action Center's annual school breakfast reports and describe breakfast availability in October of each school year. Because the annual food security measure covers a calendar year, and thus spans parts of two school years with potentially different breakfast availability, the 30-day food security measure—which references the 30 days preceding the December survey date—may be better able to pick up school breakfast effects than the annual measure.

In the case of SNAP, states have numerous policy options influencing program accessibility. The literature on SNAP policies and program accessibility varies in the policies considered and to some degree in its findings; with the exception of Ganong and Liebman (2013) who consider an additive measure of eight state SNAP policies as a predictor of caseloads, researchers have not developed composite measures to characterize program accessibility. We therefore include a wide set of state SNAP policies that are conceptually relevant to households with children, that have evidence in the literature of a link to participation or caseloads, and for which we have state-level data for the time span of our study.[5] The six policies we use

4. Breakfast availability is affected to some degree by policies in some states that mandate availability in schools that have above a designated threshold of low-income students. Differences in availability may also reflect school-level need, which would bias estimated effects downward. Further, differences in availability at the school level do not necessarily translate uniformly into differences in access to low-income or at-risk children.

5. We examined a wide range of literatures including those focusing on participation at the microlevel and caseloads at the macrolevel; studies that varied in the scope of policies examined; and studies that focused on binary measures of participation as well as entry, exit, and duration. Our analysis nonetheless does not include all potentially relevant policies. The use of call centers for applications and the use of online application processes both have some evidence of a link to participation, yet neither has information available for the full observation period, nor have they been uniformly implemented across participating states. The literature also provides some evidence that per capita outreach spending may be either positively or negatively linked to participation, potentially due to endogeneity (see, e.g., Ratcliffe, McKernan, and Zhang 2011; Ziliak 2015). The use of transitional benefits for households leaving TANF, which is of potential relevance to the small share of households who are transitioning off of cash welfare at any given time, is of only narrow practical relevance in light of the very small share of households with children—even poor households with children—who receive TANF; we lack an appropriate policy measure to include here. The temporary increase in maximum SNAP benefits that was implemented as part of ARRA, while substantively important, is not compatible with our study in that there is no cross-state variation.

include BBCE (with links to participation found in Ratcliffe, McKernan, and Finegold 2008; Mabli, Martin, and Castner 2009; Klerman 2011; Mabli et al. 2011, 2014; Ganong and Liebman 2013; Ziliak 2015), waiving vehicle restrictions on at least one car (Ratcliffe 2008; Mabli et al. 2014), simplified reporting requirements for households with earnings (Mabli et al. 2011; Schwabish 2012; Ganong and Liebman 2013; Ziliak 2015), the absence of biometric testing of applicants (Burstein et al. 2009; Ratcliffe et al. 2011; Ziliak 2015), the waiving of rules banning SNAP receipt among legal immigrant adults who meet all other criteria (Ratcliffe et al. 2008, 2011), and the share of employed recipients with longer than 3-month recertification periods (Ratcliffe et al. 2008; Klerman and Danielson 2011; Ganong and Liebman 2013; Mabli et al. 2014).[6] All variables were obtained from the Economic Research Service's SNAP Policy Database (ERS USDA 2016). We do not attempt to fully characterize differences in program accessibility but, rather, differences stemming from the policies included.

We consider these initially as discrete policy indicators. We then identify a subset that are similarly associated with food insecurity in direction and magnitude—specifically, with coefficients that do not differ significantly from each other in our base models—and construct a simple additive index. Based on these criteria, the index includes all of the policies with the exception of BBCE, which we continue to include separately. The index is defined as the mean of the component policy indicators and increases from .56 to .81 over the 14-year period. We test its reliability by variously excluding one of the five policies at a time to assess whether results are contingent on any particular component. We discuss the index more in conjunction with our initial model results.

Employment-Linked Policies Affecting Households' Economic Well-Being

We include a variable denoting the state EITC rate, as a percentage of the federal credit, coded 0 for states with no state EITC. Data are from the University of Kentucky Center for Poverty Research National Welfare Da-

6. The share of states with BBCE increased from .18 to .78 over the period, including an increase from .29 to .69 in 2008–10; the share excluding at least one vehicle from assets increased from .61 to 1, reaching .96 in 2009; and the share with simplified reporting increased from .27 to 1, reaching .86 by 2005. The average share of working recipients with certification periods longer than 3 months increased from .81 to .99, the share without statewide biometric testing increased from .92 to .98, and the share extending SNAP eligibility to all otherwise eligible noncitizen adults declined from .18 to .06.

tabase (UKCPR 2016). Because state EITCs are expressed as a proportion of the federal credit, our measure in essence estimates the benefits associated with proportional increases in the existing federal EITC.[7] We include the CPI-adjusted value of the effective minimum wage at the end of the year—either the federal minimum or, when higher, the state minimum (obtained from UKCPR 2016).[8] Finally, we characterize the availability of UI as the average maximum benefit duration during the 12-month reference period; this is from data constructed by Farber and Valletta (2015) to examine the impact of extended unemployment benefits on unemployment spells (see also Valletta 2014) and reflects the interplay between state policy, state unemployment rates, and federal policy with regard to extended benefits.[9]

Fixed Effects

We include state and year fixed effects to control for unmeasured time-varying factors and for state differences beyond those captured by our other variables.

Household Characteristics

We include household characteristics that are typically linked to food insecurity, excluding those that are most likely to be influenced by the economic and policy variables in our model. Variables include highest household education; household structure; number of minor children; race/ethnicity of household head; location (central city, other metropolitan, or nonmetropolitan); home ownership; and indicators for elderly, noncitizen, or disabled household members. We do not control for variables such as income or employment status, so as not to dilute our estimates of contextual effects on food insecurity by obscuring those that occur via inter-

7. Analytically, this is essentially equivalent to the combined maximum federal and state EITC benefit for two-child households, in that the real value of the federal EITC was unchanged during the period of our study, such that the variation in practice comes from the state EITC.

8. Because of the midyear timing of some minimum wages increases, the 30-day (December) food security measure may be better able to detect minimum wage effects than the annual measure.

9. We are grateful to Rob Valetta for providing us with the data on maximum UI benefit duration. For detailed discussion of the data as well as the UI program, see Valletta (2014) and Farber and Valletta (2015).

mediate effects on economic well-being. We do not control for household participation in nutrition assistance programs, as our interest is, rather, in differences in the accessibility of programs across place and over time.

ANALYSES

We estimate a series of generalized ordinal logistic regression models of food insecurity, operationalized as a four-category variable as described above; independent variables include household characteristics, contextual characteristics that vary by state and year, and state and year fixed effects. Models are estimated with clustered (by state-year) robust standard errors and are weighted to adjust for sample design. Our approach differs from Bartfeld and Dunifon (2006) in that we use state and year fixed effects rather than state-year random effects, thus relying on in-state variation over time in contextual characteristics to identify effects. Because our study covers a 14-year time span, relying on within-state variation is more feasible in this study than it was for Bartfeld and Dunifon (2006), who used a 5-year span and hence had substantially less variation.[10]

We initially estimated ordinal logistic regressions with standard proportional odds constraints. A Brant test indicated that for both the annual and 30-day models, the proportional odds assumption was violated; we thus estimate partial proportional odds models using gologit2 in Stata (Williams 2006), which tests for proportional odds across thresholds for each coefficient and relaxes the constraint for a given coefficient if the assumption is rejected. This approach preserves information contained in the ordering of the outcome categories, while imposing a less arbitrary structure than a fully proportional odds approach. We use a .05 threshold to relax the proportional odds constraint for each variable, although results are not substantively sensitive to varying this threshold. The resulting model yields three sets of coefficient estimates: fully secure relative to those with any indication of food hardship (including those with marginal food security, low food insecurity, and very low food security), food inse-

10. A random effects model provides greater efficiency but yields biased results if there are unmeasured time-invariant state characteristics correlated with food security and with the variables in our model. We compared bivariate logit models with fixed effects to equivalent random effects models (maintaining year effects but not state effects). A Hausman test rejected equivalence of coefficients between the random effects and fixed effects models, leading us to prefer the fixed effects approach.

cure relative to food secure (i.e., the standard bivariate distinction), and very low security relative to everyone else.

We also estimate our models for an at-risk sample of households below 300 percent of the poverty line. Food insecurity is much more common below this threshold than above it (30.1 vs. 3.8 percent), which may improve our ability to detect economic and policy effects. And, we estimate separate models for subgroups with differing levels of vulnerability based on education, looking separately at households whose highest education level is less than high school, high school, some college, and bachelor's degree or higher. These subgroups have annual food insecurity rates of 39, 27, 22, and 7 percent, respectively.

RESULTS

ANNUAL MEASURE

Table 2 panel A shows odds ratios of contextual variables from our partial proportional odds model using the annual food security measure, showing separate estimates for marginal food security, food insecurity, and very low food security. Results reveal strong associations for several of the variables, with odds ratios usually the same across severity thresholds, implying that effects on food hardship are proportional across a range of severities.[11] Each percentage point increase in unemployment rate increases the odds of food insecurity by almost 7 percent at all thresholds. Living in a state with a larger share of college-educated persons, net of one's own education level, is also associated with higher odds of food insecurity. Neither median earnings nor low-quartile rents are significant, although the odds ratios are in the expected direction.

Aspects of the policy context likewise matter. A higher state EITC is linked to reduced odds of food insecurity at all thresholds; the magnitude implies a state credit equal in size to the federal credit (notably larger than actual state credits, which range from 3.5 to 50 percent of the federal credit, among the 27 states that have a credit at some point over the analysis

11. As described earlier, our algorithm tests for significant differences in coefficients across thresholds and, when such differences are rejected, they are constrained to be identical. While most of the resulting odds ratios for the contextual variables are the same across thresholds, this is not the case for many of the household variables and state and year fixed effects in the model (not shown), consistent with rejection of the fully proportional odds model.

TABLE 2. Partial Proportional Odds Models of Food Insecurity among Households with Children, 2002–14

	Marginal, Low, or Very Low Food Security versus High Food Security		Low or Very Low Food Security versus High or Marginal Food Security		Very Low Food Security versus High, Marginal, or Low Food Security	
Context Variable	**OR**	**SE**	**OR**	**SE**	**OR**	**SE**
	A. 12-month food insecurity (N = 190,554)					
Federal food program:						
SBP-NSLP school ratio (10s)	.966	.020	.966	.020	.966	.020
SNAP: BBCE	1.077***	.026	1.077***	.026	1.077***	.026
SNAP: vehicle exemptions	.930**	.030	.930**	.030	.930**	.030
SNAP: simplified reporting	.946	.039	.946	.039	.946	.039
SNAP: >3-month recertification	.852	.070	.952	.077	.939	.174
SNAP: noncitizens eligible	.926	.055	.926	.055	.926	.055
SNAP: no biometric testing	.944	.040	.944	.040	.944	.040
Economic policy:						
State EITC rate	.553***	.111	.553***	.111	.553***	.111
Maximum UI weeks (10s)	.951***	.014	.970	.016	.927***	.020
Minimum hourly wage ($)	.993	.021	.993	.021	.993	.021
Economic attribute:						
Unemployment rate	1.068***	.013	1.068***	.013	1.068***	.013
Median personal earnings ($1,000s)	.986	.011	.986	.011	.986	.011
Percentage with bachelor's degree	1.037**	.015	1.037**	.015	1.037**	.015
Low quartile contract rent ($100s)	1.083	.058	1.083	.058	1.083	.058
	B. 30-day food insecurity, 2005–14 (N = 139,691)					
Federal food program:						
SBP-NSLP school ratio (10s)	.896***	.037	.896***	.037	.896***	.037
SNAP: BBCE	1.076**	.034	1.076**	.034	1.076**	.034
SNAP: vehicle exemptions	.869**	.057	.869**	.057	.869**	.057
SNAP: simplified reporting	.921	.060	.921	.060	.921	.060
SNAP: >3-month recertification	.620	.214	.620	.214	.620	.214
SNAP: noncitizens eligible	.974	.096	.974	.096	.974	.096
SNAP: no biometric testing	.906	.046	.906	.046	.906	.046
Economic policy:						
State EITC rate	1.288	.348	1.288	.348	1.288	.348
Maximum UI weeks (10s)	.956**	.019	.956**	.019	.956**	.019
Minimum hourly wage ($)	.931**	.029	.931**	.029	.931**	.029
Economic attribute:						
Unemployment rate	1.065***	.019	1.065***	.019	1.065***	.019
Median personal earnings ($1,000s)	1.025	.018	1.025	.018	1.025	.018
Percentage with bachelor's degree	1.004	.028	1.000	.028	1.006	.029
Low quartile contract rent ($100s)	.983	.079	.983	.079	.983	.079

Note.—The model also controls for education, race, number of children, household structure, elderly member, disabled member, noncitizen member, home ownership, urbanicity, survey years, and states. Coefficients are constrained to be the same across thresholds for variables that meet a proportional odds test ($p < .05$). Continuous variables have been centered around their mean. Dollar variables are expressed in 2012 dollars. Models are weighted by the supplemental household weights for the survey month. Standard errors are clustered by state-year. OR = odds ratio; SNAP = Supplemental Nutrition Assistance Program; SBP = School Breakfast Program; NSLP = National School Lunch Program; BBCE = broad-based categorical eligibility; EITC = Earned Income Tax Credit; UI = unemployment insurance.

** $p < .05$.

*** $p < .01$.

period) would correspond to a 45 percent reduction in the odds of food insecurity. Each additional potential 10 weeks of UI is associated with a 4.9 percent reduction in odds of food insecurity at the marginal threshold and a substantially larger effect of 7.3 percent at the most severe threshold.[12] The real value of the minimum wage is not significant.

For food assistance policies, the share of schools offering breakfast is not significant at any threshold, although odds ratios are in the expected direction. In the case of the various SNAP policies, the use of BBCE is, counterintuitively, associated with higher odds of food insecurity, while waiving the limit on the value of at least one vehicle is associated with a reduction in odds. The other SNAP policies all have coefficients that are consistent with beneficial effects on food security as well, although they are not significant. Notably, this pattern of results, in both approximate magnitude and significance, is the same when we include the six SNAP policies one at a time rather than as a group (results not shown).

Finally, the household variables (not shown) are consistent with well-established food security patterns.

THIRTY-DAY MEASURE

We estimate an analogous model using the 30-day measure for 2005–14 (table 2, panel B). In terms of economic context, only the unemployment rate is significant and is similar in magnitude to the annual measure. The potential duration of UI remains significantly linked to reduced food insecurity, and the SNAP policies are broadly similar as well: BBCE is again linked to higher odds of food insecurity, and waiving vehicle restrictions to lower odds; the other policies are all in the expected direction, although they are not significant. When SNAP policies are included separately, simplified reporting is also strongly significant, while the other SNAP variables have similar magnitudes and directions to the full model (not shown). The EITC is not significant in this model. But, the share of schools with breakfast is significantly linked to lower food insecurity risk across thresholds, as is the minimum wage—thus providing evidence of effects not seen in the annual model.[13]

12. The influence of UI persists even when we model the impact of the unemployment rate more flexibly to account for potential nonlinearities.

13. Because the differences in results compared to the annual measure could potentially reflect the shorter sample period (starting in 2005 vs. 2002), we reestimated the annual mea-

MODELS WITH COMPOSITE SNAP MEASURE

To improve our precision in estimating associations between SNAP accessibility and food security outcomes, we combined five of the six SNAP policies into a single accessibility index. To do so, we identified policies with coefficients that do not differ significantly from each other in our base models—a group that includes all except BBCE—and constructed a composite index based on their average value. The index thus characterizes the degree of accessibility and flexibility as manifested by the five component policies, all assumed for this purpose to have the same association with food security (consistent with the results in table 2). To ensure that the results for the index are not dependent on any single component, we constructed five test indexes, each of which excludes one of the policies, with the excluded policy entered separately.

Table 3 shows the odds ratios for the SNAP variables from a model that uses the primary SNAP index as well as models that use each of the subindexes. Each model includes the BBCE dummy and, for the models with the subindexes, the omitted SNAP policy. Across all models, the SNAP index and subindexes are significantly linked to reduced odds of food insecurity. The coefficient on the primary index indicates that the most accessible package of SNAP policies is associated with a 28.4 percent reduction in the odds of annual food insecurity and a 40.8 percent reduction in 30-day food insecurity, although it is offset in both cases by increased odds of 7.8 percent in conjunction with BBCE. Results are also significant for all subindexes, although the coefficients are a little bit smaller in magnitude, consistent with them capturing the effect of a package of four as compared to five policy options. All other contextual variables have coefficients that are very similar in magnitude, and unchanged in significance, compared to the models in table 2 (not shown).

AT-RISK SAMPLE

To improve our ability to detect effects, we replicate our models on an at-risk sample of households—those below three times the poverty line

sure over the 2005–14 period (not shown). The results for annual food security are substantively the same for both periods. As such, the differences between the annual and 30-day models do not seem attributable to the differing time periods. This also serves as a sensitivity test for the sampling change in the ACS beginning in 2005; the coefficients of ACS-based variables are similar in the 2005–14 model and the 2002–14 model.

TABLE 3. SNAP Coefficients from Partial Proportional Odds Models of Annual Food Insecurity among Households with Children

	Annual Food Security						30-Day Food Security					
	Marginal, Low, or Very Low Food Security versus High Food Security		Low or Very Low Food Security versus High or Marginal Food Security		Very Low Food Security versus High, Marginal, or Low Food Security		Marginal, Low, or Very Low Food Security versus High Food Security		Low or Very Low Food Security versus High or Marginal Food Security		Very Low Food Security versus High, Marginal, or Low Food Security	
	OR	SE	OR	SE	OR	SE	OR	SE	OR	SE	OR	SE
Model A—primary SNAP index:												
SNAP index	.716***	.070	.716***	.070	.716***	.070	.592***	.077	.592***	.077	.592***	.077
Broad-based categorical eligibility	1.078***	.026	1.078***	.026	1.078***	.026	1.077**	.034	1.077**	.034	1.077**	.034
Model B—subindex 1:												
SNAP subindex 1	.773**	.079	.773**	.079	.773**	.079	.694***	.067	.694***	.067	.694***	.067
Broad-based categorical eligibility	1.078***	.026	1.078***	.026	1.078***	.026	1.077**	.034	1.077**	.034	1.077**	.034
Waive vehicle restrictions	.930**	.030	.930**	.030	.930**	.030	.863**	.055	.863**	.055	.863**	.055
Model C—subindex 2:												
SNAP subindex 2	.757***	.064	.757***	.064	.757***	.064	.639***	.102	.639***	.102	.639***	.102
Broad-based categorical eligibility	1.079***	.026	1.079***	.026	1.079***	.026	1.076**	.034	1.076**	.034	1.076**	.034
Simplified reporting	.941	.037	.941	.037	.941	.037	.921	.057	.921	.057	.921	.057
Model D—subindex 3:												
SNAP subindex 3	.794***	.067	.731***	.063	.750***	.074	.669***	.070	.669***	.070	.669***	.070

Broad-based categorical eligibility	1.076***	.026	1.076***	.026	1.076***	.026	1.077**	.034	1.077**	.034	1.077**	.034
Recertification >3 months	.854	.072	.972	.080	.920	.170	.612	.205	.612	.205	.612	.205
Model E—subindex 4:												
SNAP subindex 4	.766***	.063	.766***	.063	.766***	.063	.646***	.070	.646***	.070	.646***	.070
Broad-based categorical eligibility	1.078***	.026	1.078***	.026	1.078***	.026	1.075**	.034	1.075**	.034	1.075**	.034
Noncitizens eligible	.927	.054	.927	.054	.927	.054	.976	.096	.976	.096	.976	.096
Model F—subindex 5:												
SNAP subindex 5	.753***	.068	.753***	.068	.753***	.068	.621***	.108	.621***	.108	.621***	.108
Broad-based categorical eligibility	1.078***	.026	1.078***	.026	1.078***	.026	1.078**	.034	1.078**	.034	1.078**	.034
No biometric testing	.946	.040	.946	.040	.946	.040	.917	.043	.917	.043	.917	.043
N	190,554						139,691					

Note.—The primary SNAP (Supplemental Nutrition Assistance Program) index is composed of the mean of policy indicators denoting waiving vehicle restrictions, simplified reporting, recertification periods >3 months, noncitizen eligibility, and no biometric testing; the subindexes variously exclude one policy at a time. The models also control for education, race, number of children, household structure, elderly member, disabled member, noncitizen member, home ownership, urbanicity, survey years, and states. Coefficients are constrained to be the same across thresholds for variables that meet a proportional odds test ($p < .05$). Continuous variables have been centered around their mean. Dollar variables are expressed in 2012 dollars. Models are weighted by the supplemental household weights for the survey month. Standard errors are clustered by state-year. OR = odds ratio.

** $p < .05$.

*** $p < .01$.

(table 4). The most notable differences are for the SNAP policies: the estimated effect of vehicle limit exemptions is larger, and the effect of longer certification periods is now significant. Likewise, when the individual SNAP policies are replaced by the index (panel B), the effect is larger than for the full sample. BBCE, however, is no longer significant, in contrast to the counterintuitive positive association seen in the full sample. The same pattern is evident for the 30-day measure (not shown). Finally, unlike the full sample, higher prevailing rent is associated with higher food insecurity risk at the most severe threshold.

SUBGROUP ANALYSES

Education

We examine the role of contextual factors among four education subgroups, under the assumption that differences in employment and earnings capacity across groups create different vulnerabilities as well as different potentials for leverage. We use the SNAP index and the BBCE dummy to capture SNAP policies and focus on annual food security.

For the least educated (table 5, panel A), only the share with a bachelor's degree is significant among the economic and demographic indicators and is linked to higher odds of very low food security. All of the food policies are significant: more widely available school breakfast is linked to reduced odds of food insecurity at the standard threshold; more accessible SNAP is strongly associated with reduced food insecurity; and BBCE, counterintuitively, is associated with higher odds of food insecurity. None of the employment-linked safety net policies are significant.

For high school–educated households (table 5, panel B), higher unemployment is significantly linked to higher odds of food insecurity, while a larger share with a bachelor's degree continues to be significant. Policies are broadly relevant, with benefits from more widely available school breakfast, more accessible SNAP policies, and a longer period of UI eligibility, while EITC is in the expected direction but is not significant at conventional levels. The BBCE coefficient is neither positive nor significant for this group.

Turning to the group with some college (table 5, panel C), almost all of the policies again appear to be important, including more accessible SNAP policies, more generous EITC, longer UI eligibility, and also a higher minimum wage. School breakfast is no longer significant, and BBCE has an

TABLE 4. Partial Proportional Odds Models of 12-Month Food Insecurity among Low-Income Households with Children below 300 Percent of Poverty Line, 2002–14

	Marginal, Low, or Very Low Food Security versus High Food Security		Low or Very Low Food Security versus High or Marginal Food Security		Very Low Food Security versus High, Marginal, or Low Food Security	
Context Variable	**OR**	**SE**	**OR**	**SE**	**OR**	**SE**
	A. With separate SNAP variables (N = 97,589)					
Federal food program:						
SBP-NSLP school ratio (10s)	.998	.024	.998	.024	.998	.024
SNAP: BBCE	1.033	.028	1.033	.028	1.033	.028
SNAP: vehicle exemptions	.883***	.035	.883***	.035	.883***	.035
SNAP: simplified reporting	.921	.040	.921	.040	.921	.040
SNAP: >3-month recertification	.829**	.069	.965	.075	.916	.171
SNAP: noncitizens eligible	.951	.049	.951	.049	.951	.049
SNAP: no biometric testing	.961	.039	.961	.039	.961	.039
Economic policy:						
State EITC rate	.426***	.083	.426***	.083	.426***	.083
Maximum UI weeks (10s)	.941***	.015	.958**	.017	.906***	.020
Minimum hourly wage ($)	.998	.024	.998	.024	.998	.024
Economic attribute:						
Unemployment rate	1.077***	.014	1.077***	.014	1.077***	.014
Median personal earnings ($1,000s)	.992	.011	.992	.011	.992	.011
Percentage with bachelor's degree	1.043**	.018	1.043**	.018	1.043**	.018
Low quartile contract rent ($100s)	1.066	.064	1.066	.064	1.066	.064
	B. With SNAP index and BBCE (N = 97,589)					
Federal food program:						
SBP-NSLP school ratio (10s)	.997	.024	.997	.024	.997	.024
SNAP index	.648***	.066	.648***	.066	.648***	.066
SNAP: BBCE	1.035	.028	1.035	.028	1.035	.028
Economic policy:						
State EITC rate	.424***	.080	.424***	.080	.424***	.080
Maximum UI weeks (10s)	.951***	.015	.965**	.016	.914***	.019
Minimum hourly wage ($)	.994	.025	.994	.025	.994	.025
Economic attribute:						
Unemployment rate	1.070***	.014	1.070***	.014	1.070***	.014
Median personal earnings ($1,000s)	.989	.012	.989	.012	.989	.012
Percentage with bachelor's degree	1.043**	.018	1.043**	.018	1.043**	.018
Low quartile contract rent ($100s)	1.061	.064	1.067	.065	1.134**	.069

Note.—The model also controls for education, race, number of children, household structure, elderly member, disabled member, noncitizen member, home ownership, urbanicity, survey years, and states. Coefficients are constrained to be the same across thresholds for variables that meet a proportional odds test ($p < .05$). Continuous variables have been centered around their mean. Dollar variables are expressed in 2012 dollars. Models are weighted by the supplemental household weights for the survey month. Standard errors are clustered by state-year. OR = odds ratio; SNAP = Supplemental Nutrition Assistance Program; SBP = School Breakfast Program; NSLP = National School Lunch Program; BBCE = broad-based categorical eligibility; EITC = Earned Income Tax Credit; UI = unemployment insurance.

** $p < .05$.

*** $p < .01$.

TABLE 5. Partial Proportional Odds Models of Annual Food Insecurity among Households with Children, by Highest Household Education, 2002–14

Context Variable	Marginal, Low, or Very Low Food Security versus High Food Security		Low or Very Low Food Security versus High or Marginal Food Security		Very Low Food Security versus High, Marginal, or Low Food Security		Marginal, Low, or Very Low Food Security versus High Food Security		Low or Very Low Food Security versus High or Marginal Food Security		Very Low Food Security versus High, Marginal, or Low Food Security	
	OR	SE	OR	SE	OR	SE	OR	SE	OR	SE	OR	SE
	A. High school incomplete (N = 12,210)						B. High school graduate (N = 42,306)					
Federal food program:												
SBP-NSLP school ratio (10s)	.937	.051	.890**	.049	.934	.059	.938**	.030	.938**	.030	.938**	.030
SNAP index	.415***	.113	.415***	.113	.415***	.113	.724**	.118	.724**	.118	.724**	.118
BBCE	1.255***	.095	1.255***	.095	1.255***	.095	.984	.040	.984	.040	.984	.040
Economic policy:												
State EITC rate	1.060	.702	1.318	.874	.465	.359	.573	.193	.573	.193	.573	.193
Maximum UI weeks (10s)	1.040	.052	1.040	.052	1.040	.052	.949**	.023	.949**	.023	.949**	.023
Minimum hourly wage ($)	1.013	.060	1.013	.060	1.013	.060	1.002	.032	1.002	.032	1.002	.032
Economic attribute:												
Unemployment rate	1.038	.029	1.038	.029	1.038	.029	1.059***	.019	1.059***	.019	1.059***	.019
Median personal earnings ($1,000s)	.982	.030	.982	.030	.982	.030	.998	.019	.998	.019	.998	.019
Percentage with bachelor's degree	1.087	.046	1.077	.046	1.119**	.049	1.064***	.025	1.064***	.025	1.064***	.025
Low quartile contract rent ($100s)	1.121	.165	1.121	.165	1.121	.165	.977	.081	.956	.079	1.031	.084

	C. Some college (N = 61,421)						D. Bachelor's degree (N = 74,617)					
Federal food program:												
SBP-NSLP school ratio (10s)	.987	.029	.987	.029	.987	.029	1.016	.040	1.016	.040	1.016	.040
SNAP index	.692***	.091	.558***	.079	.649**	.112	1.044	.153	1.044	.153	1.044	.153
BBCE	1.088**	.043	1.088**	.043	1.088**	.043	1.100	.054	1.100	.054	1.100	.054
Economic policy:												
State EITC rate	.446**	.140	.446**	.140	.446**	.140	.519	.195	.519	.195	.519	.195
Maximum UI weeks (10s)	.927***	.021	.950**	.023	.873***	.028	.979	.028	.970	.030	.856***	.038
Minimum hourly wage ($)	.933**	.031	.933**	.031	.933**	.031	1.100**	.049	1.100**	.049	1.100**	.049
Economic attribute:												
Unemployment rate	1.064***	.019	1.039**	.019	1.061***	.025	1.107***	.023	1.107***	.023	1.107***	.023
Median personal earnings ($1,000s)	.965**	.016	.977	.017	.968	.018	1.006	.020	1.022	.021	1.018	.022
Percentage with bachelor's degree	1.011	.023	1.000	.023	1.012	.024	1.030	.034	1.030	.034	1.030	.034
Low quartile contract rent ($100s)	1.055	.091	1.055	.091	1.055	.091	1.344***	.135	1.344***	.135	1.344***	.135

Note.—The model also controls for education, race, number of children, household structure, elderly member, disabled member, noncitizen member, home ownership, urbanicity, survey years, and states. Coefficients are constrained to be the same across thresholds for variables that meet a proportional odds test ($p < .05$). Continuous variables have been centered around their mean. Dollar variables are expressed in 2012 dollars. Models are weighted by the supplemental household weights for the survey month. Standard errors are clustered by state-year. OR = odds ratio; SNAP = Supplemental Nutrition Assistance Program; SBP = School Breakfast Program; NSLP = National School Lunch Program; BBCE = broad-based categorical eligibility; EITC = Earned Income Tax Credit; UI = unemployment insurance.

** $p < .05$.

*** $p < .01$.

unexpected, positive coefficient. On the economic side, a higher unemployment rate continues to be linked to higher food insecurity, while higher median earnings per job is linked to lower insecurity; the share with a bachelor's degree is no longer significant.

Among the best-educated households (table 5, panel D), the unemployment rate continues to be important, and higher prevailing rent is now strongly linked to an increased risk of food insecurity, while policies are less relevant and in some cases are counterintuitive. School breakfast and the SNAP index are not significant, and UI is significant at only the most severe threshold. BBCE is not significant, while a higher minimum wage shows a counterintuitive, positive link to food insecurity.

Predicted Probabilities of Food Insecurity

To better illustrate the magnitude of estimated effects, we use the above models to compute differences in the predicted probability of food insecurity at the standard threshold (i.e., the combined probability of low or very low food security) in accordance with differences in selected contextual characteristics. Our predictions estimate food insecurity across all sample members, holding all other variables fixed while simulating, one at a time, the following contextual conditions: an unemployment rate of 6.2 percent (the state-year mean, a little lower than the mean of 6.7 percent at the household level) versus 5.2 percent; 26 weeks of maximum UI (the norm in most states when extensions are not in place) versus 36 weeks (still substantially lower than the maximum of 99 weeks in some states at the peak of the recession);[14] no state EITC versus a credit set at 16.6 percent of the federal credit, which is the mean of such credits among the state-years with credits in our sample period; a minimum wage of $7.25 (the federal minimum since 2009) versus a minimum of $8.25; none of the more accessible SNAP policies versus all of the policies (including the five in the composite index as well as the separately entered BBCE, when significant); and 86.4 percent of schools offering school breakfast (the mean across state-years in our sample) versus 96.4 percent.

14. The available length of UI is tied, albeit in complex and varying ways, to the unemployment rate. As such, we focus on changes in UI duration that are relatively small compared to the range seen over the sample period, since our predictions are for the stylized instance of holding all else in the model constant.

Table 6 shows the predicted food insecurity rates associated with each of the above scenarios among the full sample, using both annual and 30-day measures, and also among the at-risk and education subsamples using the annual measure; predictions are only shown when the variable in question is significant at one or more thresholds. As a reference, the actual annual and 30-day food insecurity rates in the sample are 18.7 and 10.4 percent, respectively (see table 1).

In the full sample, a drop from 6.2 to 5.2 percent in the unemployment rate is associated with a predicted decline from 17.9 to 17.0 percent in annual food insecurity and 10.1 to 9.6 percent on a 30-day basis. The effects are broadly similar in scale in the at-risk sample and across education groups. The offsetting effects of UI are also evident. An additional 10 weeks over the 26-week norm reduces predicted annual food insecurity by half a percentage point, from 19.7 to 19.2 percent, with moderately larger effects in the high school and some college groups.

TABLE 6. Predicted Food Insecurity Rate for Households with Children, 2002–14 (Annual Rate) and 2005–14 (30-Day Rate) (%)

	Unemployment Rate		Maximum UI Weeks		State EITC Rate		Minimum Wage		SNAP Policies		Breakfast-Lunch School Ratio	
	5.2%	6.2%	26.0	36.0	0	.166	$7.25	$8.25	None	All	.864	.964
Annual food security measure:												
Full sample	17.0	17.9	19.7	19.2	18.9	17.6			20.9	17.7		
At-risk sample (<300% poverty)	27.9	29.3	32.1	31.3	31.0	28.3			36.2	27.8		
High school incomplete									49.7	35.5	39.5	36.8
High school graduate	25.4	26.5	29.6	28.6					31.4	25.4	27.2	26.3
Some college	20.6	21.2	24.0	23.1	22.5	20.3	21.8	20.9	27.8	19.9		
Bachelor's degree	5.7	6.2					6.5	7.2				
30-day food security measure:												
Full sample	9.6	10.1	11.8	11.4			10.7	10.2	13.8	9.7	10.8	9.9

Note.—Predictions are based on models from tables 3 and 4 and are the predicted share of households that have either low or very low food security based on own household and contextual characteristics, adjusted to have column-specified value of contextual variable. Predictions only shown when relevant coefficient was significant. SNAP policies include broad-based categorical eligibility, vehicle exemptions, simplified reporting, >3-month certification, some noncitizen eligibility, and lack of biometric testing; broad-based categorical eligibility excluded in at-risk sample and high school sample because of lack of significance. UI = unemployment insurance; EITC = Earned Income Tax Credit; SNAP = Supplemental Nutrition Assistance Program.

In the case of the EITC, offering a state credit equal to 16.6 percent of the federal credit—the average size when it is available—sizably reduces predicted annual food insecurity among the overall sample, from 18.9 to 17.6 percent. The predicted decline is larger among the at-risk sample—from 31 to 28.3 percent; among households with some college the predicted decline in food insecurity is from 22.5 to 20.3 percent.

For the minimum wage, 30-day food insecurity is estimated to decline modestly, from 10.7 to 10.2 percent, in conjunction with a minimum wage $1 above the federal wage floor. For the annual measure, while there are no predicted effects in the overall sample, there are offsetting effects in the some-college and college subgroups.

The predicted annual food insecurity rate associated with all six of the more accessible SNAP policies (i.e., a mean score of 1 on the five-policy index as well as use of BBCE) is 17.7 percent, compared to 20.9 percent in the absence of any of the policies. The effect is somewhat larger for 30-day food insecurity, with predicted rates of 9.7 percent with the full set of policies versus 13.8 percent with none. If we look more narrowly at the at-risk sample, the predicted annual food insecurity rates with and without the policies are 27.8 and 36.2 percent.

Finally, the predicted 30-day food insecurity rate falls from 10.8 to 9.9 percent in the full sample, in conjunction with a 10-percentage-point increase in the share of schools offering breakfast over the 86.4 percent baseline. With the annual measure, there are predicted gains in the two lowest education groups, including from 39.5 to 36.8 percent for those without a high school degree.

ALTERNATIVE ESTIMATES AND SENSITIVITY TESTS

We conducted a range of sensitivity tests and alternative specifications to assess the robustness of our findings. Results that are not shown are available on request.

Alternative Outcome Measure: Food Security among Children

Food insecurity is not necessarily experienced to the same degree among all household members. To assess whether contextual factors shape children's direct experience of food insecurity, we reestimated our main models on a three-category outcome measure describing food insecurity among children (table 7). The results are qualitatively similar to those for

TABLE 7. Partial Proportional Odds Models of Child Food Insecurity among Households with Children, 2002–14

	Low or Very Low Food Security versus Food Security		Very Low Food Security versus Food Security or Low Food Security	
Context Variable	**OR**	**SE**	**OR**	**SE**
	A. 12-month food insecurity (N = 190,086)			
Federal food program:				
SBP-NSLP school ratio (10s)	.965	.033	.965	.033
SNAP: BBCE	1.055	.037	1.055	.037
SNAP: vehicle exemptions	.901**	.039	.901**	.039
SNAP: simplified reporting	.937	.048	.937	.048
SNAP: >3-month recertification	.796**	.087	.796**	.087
SNAP: noncitizens eligible	.860**	.060	.860**	.060
SNAP: no biometric testing	.931	.047	.931	.047
Economic policy:				
State EITC rate	.557**	.163	.557**	.163
Maximum UI weeks (10s)	.929***	.021	.929***	.021
Minimum hourly wage ($)	1.005	.031	1.005	.031
Economic attribute:				
Unemployment rate	1.069***	.018	1.069***	.018
Median personal earnings ($1,000s)	1.007	.016	1.007	.016
Percentage with bachelor's degree	1.032	.021	1.032	.021
Low quartile contract rent ($100s)	.889	.060	.943	.066
	B. 30-day food insecurity, 2005–14 (N = 139,331)			
Federal food program:				
SBP-NSLP school ratio (10s)	.937	.061	.937	.061
SNAP: BBCE	1.088	.055	1.088	.055
SNAP: vehicle exemptions	.859	.078	.603***	.081
SNAP: simplified reporting	.845	.075	.845	.075
SNAP: >3-month recertification	.442***	.138	.442***	.138
SNAP: noncitizens eligible	.805	.107	.805	.107
SNAP: no biometric testing	.869**	.048	.869**	.048
Economic policy:				
State EITC rate	1.088	.596	1.088	.596
Maximum UI weeks (10s)	.938**	.029	.938**	.029
Minimum hourly wage ($)	.952	.046	.952	.046
Economic attribute:				
Unemployment rate	1.049	.029	1.049	.029
Median personal earnings ($1,000s)	1.030	.029	1.070**	.032
Percentage with bachelor's degree	.991	.041	.991	.041
Low quartile contract rent ($100s)	.828	.095	.828	.095

Note.—The model also controls for education, race, number of children, household structure, elderly member, disabled member, noncitizen member, home ownership, urbanicity, survey years, and states. Coefficients are constrained to be the same across thresholds for variables that meet a proportional odds test ($p < .05$). Continuous variables have been centered around their mean. Dollar variables are expressed in 2012 dollars. Models are weighted by the supplemental household weights for the survey month. Standard errors are clustered by state-year. OR = odds ratio; SBP = School Breakfast Program; NSLP = National School Lunch Program; SNAP = Supplemental Nutrition Assistance Program; BBCE = broad based categorical eligibility; EITC = Earned Income Tax Credit; UI = unemployment insurance.

** $p < .05$.

*** $p < .01$.

household-level food insecurity (table 2), although fewer of the coefficients are statistically significant. A higher unemployment rate is associated with increased odds of child food insecurity in the annual model, while the relationship is positive but not significant in the 30-day model. A longer period of UI eligibility is associated with reduced odds of child food insecurity in both the annual and 30-day models, similar to the relationships seen earlier in the household models. The generosity of the state EITC is linked to reduced odds of child food insecurity in the annual model, as was also the case for household food insecurity. But, neither a higher minimum wage nor more widespread availability of school breakfast is significantly linked to food insecurity among children in either time period, whereas both were significant in the 30-day household model. More accessible SNAP policies are linked to reduced child food insecurity. BBCE—which had a counterintuitive, positive association with food insecurity in the household models—is not significant for either outcome period in the child models, while several of the other access-enhancing policies appear to be beneficial with significant coefficients.

Alternative Outcome Measure: Food Insufficiency

Using food insufficiency—a single question, available only for the 12-month period and from which we constructed a four-category outcome measure—results were almost the same (not shown). The only substantive differences from the 12-month household food security model are that EITC generosity was not significant in the food insufficiency model, while breakfast availability was negative and significant. Overall, the consistency across outcomes is striking.

Alternative Breakfast Accessibility Measure

As an alternative measure, we considered the ratio of free and reduced-price students in breakfast programs relative to those eating school lunch. This has the advantage of capturing the influence of local policies that enhance access beyond simple availability, such as those that serve universal free meals and breakfast in the classroom; however, it may be influenced by differential participation in high-need states and years, which would bias estimated effects downward. With this measure, the breakfast coefficient is no longer significant in the 30-day model, although it is significant in the annual model (not shown).

Childless Households

As a falsification test, we estimated our models on a sample of childless households with working-age heads. While some of the contextual factors are of potential relevance across household types, we expect others to be beneficial only for households with children. In particular, neither EITC nor school breakfast should influence food security among childless households. If these, nonetheless, were significantly linked to food insecurity, it would suggest the associations in our main sample may be artifacts and not causal.[15]

While the household and economic context variables have similar associations to those in our primary sample, the only significant policy variables are several of the SNAP policies—specifically, beneficial effects of vehicle exemptions in the annual model and simplified reporting and longer certification periods in the 30-day model (results not shown). Neither the EITC nor the school breakfast measures show any evidence of a role, as expected. The duration of UI and the amount of minimum wage are not significant for either measure, although in principle they are relevant to this group. It may be that childless households have weaker formal labor force attachment such that UI and minimum wage would be less relevant, or childless households may be better able to withstand longer periods of income volatility or loss, and higher wages may be less critical given fewer people to support. Overall, the persistence of the role of economic factors, coupled with the lack of significance for variables that are not theoretically relevant in this sample, increases our confidence that our results for our primary sample are meaningful.

ADDITIONAL VARIABLES

We conducted additional analyses with a range of other contextual variables that we ultimately excluded because of lack of evidence or lack of adequate measures. We comment briefly on several of these analyses.

15. We did not attempt to identify additional policies that would be appropriate to include for childless households, as our intent is not to develop a comprehensive model for these households but merely to conduct falsification tests; we focus solely on replicating our existing models.

TANF Benefit Level

We added the monthly TANF benefit for three-person households and, as an alternative, the combined TANF-SNAP benefit. Neither is significant, nor do they influence the rest of the model. In light of very low rates of TANF cash assistance nationwide in the time frame of this study, TANF seems of less potential relevance than the more far-reaching policies we included in our final models, so in the interest of parsimony we excluded it.

Food Costs

At least some research suggests that food costs may be linked to food insecurity. Unfortunately, we lack a good state-level measure of food costs for the range of years in our sample. However, we do have access to state-year estimates of total costs for a fixed market basket for state-years in the 2009–13 range, as provided by Feeding America from their Map the Meal Gap study (Gundersen et al. 2014). We estimated our primary model for the 2009–13 period and found no evidence of influence.

Summer Food Programs

We lack a measure of differences in availability of summer meal programs but do have a measure of the ratio of summer meal participants to low-income NSLP participants—which is influenced by availability but also by need. It yields an insignificant coefficient, with no substantive effects on the rest of the model.

DISCUSSION AND CONCLUSION

Our analyses indicate that the economic and policy environments have had a substantial influence on the presence and severity of food insecurity among households with children over the 2002–14 period. The policies contributing to this influence go beyond food assistance to include policies targeting incomes among economically vulnerable families that are connected to the labor force, including UI, EITCs, and, potentially, minimum wages. We find that most factors that influence food security appear to do so in a generally consistent fashion across a broad severity spectrum. Furthermore, these effects extend, in some cases, not only to food security at the household level but also to food security among children. We demonstrate, too, that the time period over which food security is assessed matters. The reasons underlying the differences between 30-day and annual

effects are not always clear, although the differences seem to be broadly consistent with how policies are measured and the ways in which they might realistically affect families. Collectively, the policies we consider appear to be most consistently relevant to households whose heads have at least a high school education but not a college degree, although food assistance policies are also beneficial to the least educated.

POLICY INFLUENCES

We find robust evidence that a set of policies that shape the ease and extent to which families can gain and maintain access to SNAP are also linked to reduced food insecurity overall and in particular among economically vulnerable households. By combining multiple dimensions of SNAP accessibility into a composite index, we have more leverage to detect effects than we do for each policy on its own; we find strong evidence that the number of access-enhancing policies makes a difference. Furthermore, SNAP policies that enhance access appear to be beneficial to children's food security, in addition to food security at the household level. That policies aimed at enhancing access appear to translate not only to higher caseloads but also to reduced food hardship is highly germane to the ongoing policy debate over the merits of liberalized SNAP. In combination with evidence linking increases and subsequent decreases in the SNAP benefit level to declines and subsequent increases in the risk of food insecurity (Nord and Prell 2011; Nord 2013), our findings help to highlight the way in which policy decisions around program attributes can strengthen or weaken the success of SNAP in responding effectively to food security challenges among vulnerable households.

We find counterintuitive evidence for BBCE, although its lack of significance in the at-risk sample—where SNAP policies most credibly play a role—implies that the effects in the larger sample may potentially be artifacts to the extent that they depend on the inclusion of households for whom SNAP is not realistically relevant. BBCE expanded rapidly across states during the height of the Great Recession, with unemployment rates higher in implementing states (Ganong and Liebman 2013); its implementation may be correlated with unmeasured economic distress as well. Regardless, the role of BBCE warrants further study.[16]

16. Furthermore, researchers have found that, even in states whose formal policies indicate asset waivers (a component of BBCE), online information as well as online eligibility cal-

We also find evidence that more widely available school breakfast may help offset household food insecurity. Our more robust findings with regard to 30-day as compared to annual effects are plausible, given that school breakfast is not available year-round; food hardship that is prevented during the school year, and therefore during the 30-day reference period, may emerge during summer months, making annual effects likely to be smaller than monthly effects. The evidence of annual effects in the two lowest education groups, moreover, is consistent with existing evidence on patterns of program participation (Bartfeld 2015).

Our findings regarding policies outside of the food assistance realm are of particular interest. In contrast to a fairly extensive body of work seeking to tie food assistance programs to food security outcomes, our study joins a much more limited body of work focusing on how nonfood programs and policies may shape food security (see, e.g., Sabia and Nielsen 2015; Schmidt et al. 2016) and is encouraging in that regard.

The robust negative relationship between the maximum duration of UI and the risk of food insecurity, at both the household and the child levels, is particularly notable. To our knowledge, this is the first evidence of a link between UI and food security, although earlier work finds that receipt of UI among households without financial wealth leads to higher food consumption (Bloemen and Stancanelli 2005). It makes sense, of course, that longer potential UI receipt would be linked to food security, as income volatility and job loss are well-established predictors of food insecurity (Gundersen and Gruber 2001; Heflin 2016). That longer benefits are protective against food hardship is also consistent with recent evidence that income drops sharply and poverty spikes among individuals who exhaust their UI benefits (Rothstein and Valletta 2014). Our findings add to a small body of work showing effects of extended unemployment benefits on outcomes that go beyond employment, income, and poverty (see, e.g., Hsu, Matsa, and Melzer [2014] regarding extended UI benefits preventing an estimated 1.4 million foreclosures during the Great Recession).

We also find robust evidence that the generosity of the state EITC matters for food security—a relationship that, to our knowledge, our study is the first to document. This adds to existing evidence from Schmidt and

culators frequently do not reflect this, such that the actual policies may be unclear to potential participants (Heflin, Mueser, and Cronin 2015).

colleagues (2016) indicating that the value of a combined set of benefits, including EITC, reduces the risk of food insecurity. While our work does not speak directly to the federal EITC, it nonetheless seems reasonable that the federal credit (for households with children) would have similar kinds of effects as the state credit, insofar as they both reach the same households and are delivered at roughly the same time and in the same manner. Our finding of a beneficial effect of EITC on food security, both among households and specifically among children, contributes to an extensive body of research that finds EITC to be beneficial over numerous dimensions including, for instance, declines in unsecured debt (Shaefer, Song, and Shanks 2013), test scores (Dahl and Lochner 2012), low birth weight (Hoynes, Miller, and Simon 2015), and poverty (Ben-Shalom, Moffitt, and Scholz 2011). Certainly, the literature on how households use their EITC benefits is consistent with it having beneficial effects on food security. Not only do recipients report using their refunds for food (Goodman-Bacon and McGranahan 2008), they also report deferring other bills in anticipation of refund checks, suggesting that the EITC may have potential for smoothing more urgent consumption needs during the year (see, e.g., Mendenhall et al. 2012). Less readily apparent is why effects are only evident for the annual versus the 30-day measure.[17]

Our findings likewise offer some evidence, albeit inconsistent, that higher minimum wages may be beneficial. This is most evident with regard to the 30-day measure, where we find a robust effect on household food security, although not on food security at the child level. In the case of the annual measure, the offsetting results for some-college and college-degree households are more puzzling. Our finding of beneficial effects largely with the 30-day versus annual measure also warrants further investigation. One explanation is that higher minimum wages may reduce the frequency of food hardships among those who are food insecure at some point over the course of a year; another is that the minimum wage is defined as of year end and is thus more precisely aligned with the 30-day reference period.

17. This could reflect that the benefits of the EITC are attributable to the prior year's refund, typically received during the spring. However, when we include both current and lagged values (not shown), the current is the only significant predictor, suggesting that the explanation lies elsewhere.

ECONOMIC INFLUENCES

Looking beyond policies to the broader economic context, we find—consistent with other work—that the unemployment rate is a robust predictor of food insecurity. The magnitude of the effects we document is somewhat larger than other estimates for the same time period (see, e.g., Nord et al. 2014), which may reflect, in part, that our models also include offsetting effects associated with UI that are responsive, albeit in a way that varies with state and year, to the unemployment rate. We also find, consistent with past work (Bartfeld and Dunifon 2006), that living in an area with a higher share of college-educated persons is associated with a higher risk of food insecurity, although not for those who themselves have at least some college education. These associations may stem from different cost and opportunity structures in areas characterized by higher versus lower education levels that put those with less education at a disadvantage. We find only limited evidence that housing costs play a role, unlike past work.

METHODOLOGICAL CONTRIBUTIONS AND CHALLENGES

Methodologically, our analyses have used more varied and nuanced measures of food insecurity than is typical, considering both a shorter-duration measure in addition to the conventional annual measure and also a measure that captures a fuller spectrum of food hardships. In doing so, we gain insights that might be otherwise overlooked. We confirm that, in general, the predictors of food hardship that we identify operate in a broadly similar fashion across the food security spectrum, and we are able to document effects that do not show up with a bivariate measure in all cases because we are able to leverage variation in food hardship across a wider range. Likewise, by examining food insecurity with a 30-day in addition to a 12-month measure, we find some evidence of effects that we might otherwise miss.

We also note a number of limitations and caveats to the research presented here. Most important, there are a potentially vast number of potential contextual influences on food security, of which we have only included a limited subset. Our inclusion of two-way fixed effects to capture unmeasured state and time variation helps to control for unmeasured differences across place and time, although it does not rule out policy influences that are correlated with those included here. On the economic side, while we have broadly controlled for the current economic climate, other work finds

that policies such as state minimum wages are also responsive to economic trajectories and that not controlling thoroughly for state-specific trends tends to underestimate potential benefits (see, e.g., Allegretto et al. 2013). It is also important to note the many potential interactions among the policy and economic variables in our analyses, which we do not attempt to capture. Limitations notwithstanding, our findings shed new light on the importance of the safety net—both food assistance and broader employment-linked programs and policies—to the well-being of vulnerable families.

NOTE

Judith Bartfeld is the Meta Schroeder Beckner Outreach Professor, School of Human Ecology, at University of Wisconsin–Madison and a food security research and policy specialist at University of Wisconsin Extension. Her research focuses on the patterns, causes, and consequences of food insecurity at the local, state, and national levels and on participation in and outcomes of food assistance programs.

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