State-Level Predictors of Food Insecurity and Hunger Among Households With Children

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Abstract

This report examines interstate variation in household food security. Using hierarchical modeling, we identify several contextual dimensions that appear linked to household food security: the availability and accessibility of Federal nutrition assistance programs, policies affecting economic well-being of low-income families, and States' economic and social characteristics. These dimensions comprise what we refer to as the State food security infrastructure. We find that a strong food security infrastructure particularly benefits families that are economically vulnerable yet have incomes above the poverty line. Almost all of the observed interstate differences in food security can be explained by cross-State differences in demographic and contextual characteristics.

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INTRODUCTION

Household food security – the assured access of all people to enough food for a healthy and active life – has received increasing attention from policymakers and researchers over the past decade. An emerging body of literature has linked food insecurity to a variety of negative outcomes, particularly for children (see, e.g., Dunifon and Kowaleski-Jones, 2003, and Olson, 1999), confirming the importance of food security as an indicator of well-being and a legitimate target of public concern.

Estimates of the prevalence of food insecurity are released annually, revealing substantial variability among demographic groups as well as across states. The most recent data show state-level food insecurity rates ranging from a low of 6.2 percent in Massachusetts to a high of 15.5 percent in Arkansas (Nord, Andrews, and Carlson, 2004). Research on the correlates of food insecurity has largely focused on individual and household characteristics, with less attention to the role of the economic, policy, and social contexts in which households reside. There are two purposes, then, of the current report: First, to further our understanding of the relationships between the characteristics of states and the food security of households, and second, to identify the relative role of household and state characteristics in explaining the wide variation in food security among states.

PRIOR RESEARCH

Since 1995, researchers have used a standardized set of 18 questions to measure food security among households, and these questions have been incorporated in several national surveys. The questions focus on conditions and behaviors that characterize households experiencing difficulty in meeting food-related needs due to financial constraints. Depending upon the number of affirmative responses, households are classified into one of three categories—food secure, food insecure without hunger, or food insecure with hunger. Households must respond affirmatively to three or more questions to be classified as food insecure.[1] Hunger is thus conceptualized as a severe form of food insecurity.

Stimulated by the developments in food security measurement, a growing body of work has begun to address the prevalence, causes, and consequences of food insecurity. Recent estimates indicate that 11.2 percent of American households are food insecure, including 3.5 percent that experience hunger. Among households with children, the corresponding rates are higher: 16.7 percent food insecure, including 3.8 percent that experience hunger (Nord, Andrews, and Carlson 2004).

Children in food-insecure households experience a variety of disruptions in their eating habits. Eighty-one percent of food-insecure households reported relying on only a few kinds of low-cost foods to feed their children; 52 percent reported that at times they couldn't afford to feed their children balanced meals; and one-quarter reported that at times they couldn't afford to give the children enough to eat (Nord, 2003b). Further, researchers have documented a variety of negative consequences of food insecurity, ranging from deficits in nutritional consumption (see, e.g., Kendall, Olson, and Frongillo

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[1]The food security scale includes questions about behaviors and conditions that range from less severe to very severe. At the less severe end of the spectrum, questions include, "We worried about whether our food would run out before we got money to buy more. Was that often, sometimes, or never true for you in the past 12 months?" and "The food we bought just didn't last, and we didn't have money to get more. Was that often, sometimes, or never true for you in the past 12 months?" At the mid-range of the spectrum, sample questions include "Did you or other adults in your household ever cut the size of your meals or skip meals because there wasn't enough money for food?" and "In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money for food?" At the most severe end of the spectrum, questions include "In the last 12 months, were you ever hungry but didn't eat because you couldn't afford enough food?" and "In the last 12 months, did you or other adults in your household ever not eat for a whole day because there wasn't enough money for food?"

1996) to poor outcomes on broader measures of well-being. For instance, Dunifon and Kowaleski-Jones (2003) find that children living in food-insecure households experience greater health problems and increased behavior problems than do children in food-secure households, while Winicki and Jemison (2003) find that food-insecure children have lower math scores.

Research on the determinants of food insecurity has largely focused on the role of sociodemographic characteristics of households and individuals. Not surprisingly, poverty and food insecurity are closely linked: the prevalence of food insecurity declines from 35.1 percent among poor households to 4.9 percent among households with income above 1.85 times the federal poverty line (Nord, Andrews, and Carlson, 2004). Nonetheless, poverty and food insecurity are distinct phenomena. More than half of poor households are not considered food insecure, and equally important, more than half of food-insecure households are not poor (Nord, Andrews, and Carlson, 2004). Food insecurity does not reach negligible levels until household income exceeds five times the poverty threshold (Nord and Brent, 2002). The factors that moderate the relationship between income and food security are not well understood.

In addition to poverty status, Nord and colleagues (2004) find that single parenthood, race (specifically, African ancestry), and Hispanic ethnicity are associated with higher rates of household food insecurity. Other research highlights the relationship between food insecurity and low education (Daponte and Stephens, 2004; Rose, Gundersen, and Oliveira, 1998), lack of home ownership (Rose, Gundersen, and Oliveira, 1998), lack of savings (Olson et al., 1997), recent changes in income (Gundersen and Gruber, 2001), unemployment (Daponte and Stephens, 2004), poor health status, and social isolation (Tarasuk, 2001).

Although research initially focused largely on individual and household characteristics, there have also been efforts to explore the role of contextual factors in contributing to food security outcomes. Such efforts have variously examined the role of food assistance programs, welfare policies, and

economic and social contexts, generally focusing on one or another of these factors rather than using a more integrative approach that simultaneously considers multiple factors.

Efforts to identify the impact of food assistance programs on food security status are complicated by self-selection of participants into programs on the basis of unobservable characteristics. For instance, Gundersen and Oliveira (2001) find that Food Stamp participants have higher levels of food insufficiency (a less detailed measure of households' difficulty meeting food needs) than nonparticipants, a result they attribute to selection. To address this, they use a simultaneous equations model in which exogenous variables are used to predict both Food Stamp participation and food insufficiency, and they find no difference in the food security levels of Food Stamp participants and nonparticipants. To date, there has been little research that examines the impact of participation in other nutrition assistance programs, such as WIC, the School Breakfast program, or the National School Lunch program, on food insecurity. A recent exception is Nord (2003c), who finds that seasonal differences in food insecurity (higher in the summer than the spring) are smaller in states with more widespread participation in the Summer Food Service program, providing suggestive evidence that the program helps ameliorate food insecurity among households with school-age children. In contrast to the limited research linking food assistance programs to reductions in food insecurity, there is a variety of evidence that participation in such programs is linked to improved nutritional outcomes (see, e.g., Devaney and Moffitt, 1991; Basiotis, Kramer-LeBlanc, and Kennedy, 1998; Bhattacharya and Currie, 2001; Oliveira and Gundersen, 2000).

Other research has examined potential linkages between welfare policies and food security. Cook et al. (2002) find that food insecurity is higher among children in families whose welfare benefits are eliminated or reduced, and that participation in the Food Stamp program does not mitigate this association. Borjas (2001) uses state variation in the availability of welfare benefits to immigrants to predict immigrants' food security status, finding evidence that a reduction in the availability of a variety of welfare benefits leads to an increase in food insecurity. On the other hand, Winship and Jencks (2002) find evidence that welfare reform—broadly defined to encompass the range of policy changes in the late

1990s, including expansions of the Earned Income Tax Credit (EITC)—did not increase food insecurity among single mothers, and in fact may have improved their food security. Their research does not attempt to isolate the role of specific policies.

Finally, there is some evidence from recent studies suggesting that economic and social contexts at the state and sub-state levels may be linked to food insecurity. Tapogna and colleagues (2004) find that state differences in residential mobility, peak unemployment, and housing costs are strong predictors of state hunger rates. Looking at sub-state factors, Bernell, Weber, and Edwards (2004) find evidence that food insecurity in Oregon is more common in the context of high unemployment and low wages, as well as among households experiencing greater residential mobility. Finally, Yang and Dunifon (2004), examining data from rural communities in New York, find that access to food outlets is not predictive of household food security.

Despite the rapidly increasing literature on food insecurity and its correlates, there has been little effort to develop an integrated model of food insecurity that incorporates both household and contextual characteristics. In particular, researchers have thus far not articulated a clear conceptual model to describe the potential interplay between individual and contextual factors as predictors of household food security. Furthermore, there have been only limited efforts to understand the extent to which household and contextual characteristics are able to explain cross-state differences in the prevalence of food insecurity. This report seeks to fill these gaps.

RESEARCH QUESTIONS AND CONCEPTUAL FRAMEWORK

We use hierarchical modeling to develop a model of food security that encompasses both sociodemographic and contextual characteristics. Our analyses are guided by the following key questions:

1. What is the association between contextual characteristics, measured here at the state level, and household food security?
2. Do contextual characteristics moderate the detrimental impact of low household income on food security?
3. How much does measurable variation in household characteristics and in contextual characteristics contribute to interstate variation in household food security?

This study is grounded in a conceptual framework that grows out of the emerging interest in the roles of the policy, economic, and social environments in contributing to household food security. Our underlying model posits that food insecurity is linked to inadequate household resources, but is also influenced by the strength of what we term the state food security infrastructure: a set of programs, policies, and economic and social attributes that affect the availability, accessibility, and affordability of food and the extent to which resources are available to households to meet their food-related needs. We expect the food security infrastructure to affect household food security both directly and by moderating the detrimental impact of low income. That is, economically vulnerable households will derive particular benefits from a strong food security infrastructure, and also may be particularly harmed by a weak one.

The concept of a food security infrastructure is relevant at a variety of levels, ranging from the national to the local. Some potentially relevant characteristics can be meaningfully described at the state level, whereas others are only meaningful, or are more meaningful, in a more local context. Here, we focus on the following broad components of the food security infrastructure that are relevant to the current state-level analysis: the availability and accessibility of federal nutrition assistance programs, policies that influence the financial resources available to low-income families, economic attributes of communities, and social characteristics of communities. We note, however, that there are at least two potentially important components of the food security infrastructure—the emergency food assistance

system, and the food marketing system—that we are not able to adequately capture with state-level variables and that we do not consider in this analysis. Furthermore, there is considerable intrastate variation, in addition to interstate variation, in many of the components discussed here.

Federal Nutrition Assistance Programs

Federal nutrition assistance programs—including the Food Stamp program, the School Breakfast and Lunch programs, and summer food programs—represent a major policy commitment to meeting the food-related needs of vulnerable segments of the population. Although federal in nature, these programs vary in important ways from state to state, and even from community to community, such that households in different geographic locations differ in the availability of these programs as sources of support. As a result, there is considerable variation in the extent to which programs are utilized by eligible families. [2]

The Food Stamp program, for instance, is available nationwide to all who meet stated income, asset, and other criteria. At the same time, states and localities differ in terms of certain criteria, such as vehicle restrictions, frequency with which eligibility recertification is required, number and location of application sites, availability of sites that are open during nonstandard hours, extent of outreach about program availability, and job search requirements (see, e.g., Gabor et al., 2003). Estimates of state participation rates among eligible persons range from under 50 percent to over 70 percent (Schirm and Castner, 2003) , and recent research has linked a variety of state-specific program characteristics to participation rates (Kornfeld, 2002).

Other programs exhibit still greater geographic variation. The availability of the School Breakfast program among states ranges from 42 percent to 100 percent of schools, and the ratio of low-income children participating in the breakfast program relative to those participating in the lunch program during

[2] Because there is very little state variation in the availability of the National School Lunch program (NSLP) it is not included in our discussion or analyses.

2001–2 ranged from 24 percent to 57 percent (Food Research and Action Center, 2002b). Similar variation is found in the summer meal programs, including the Summer Food Service program and the Summer School Lunch program[3], with the ratio of combined summer meal participants to low-income lunch participants during the school year ranging from 6.1 to 42.3 percent (Food Research and Action Center, 2003).

We view these programs as important components of the food security infrastructure, and expect that differences in their availability and accessibility would be linked to cross-state differences in household food security. In addition, we expect these programs to play an important role in moderating the association between low household income and food insecurity. That is, we hypothesize that economically vulnerable families would be better able to meet their food-related needs when nutrition assistance programs are more readily available to provide for at least a portion of such needs.

Policies Affecting Financial Resources

Policies that affect financial resources—particularly financial resources of economically vulnerable families—are also an important component of the food security infrastructure. When budgets are stretched to meet basic needs, expenditures on food are often the easiest to cut back. Conversely, increasing the financial resources available to financially stressed families may help ensure that food-related needs are adequately met. A variety of state policies may affect family financial resources. In the current paper, we focus on tax policy. States vary in their relative reliance on income, property, and sales taxes, and different tax regimes have different implications for low-income households. A recent study examined the overall tax burden facing low-income families by state, and state estimates ranged from 3.8 percent to 17.6 percent (Institute for Taxation and Economic Policy, 2003). Although a variety of other

[3] The Summer Food Service Program provides meals to children participating in camps and other recreational programs during the summer. The Summer School Lunch Program provides meals to students attending summer school.

policies may be relevant, we focus here on tax policy because of its broad relevance to the low income population, in contrast to other policies (such as welfare policies) that are relevant to more narrow subsets of low-income families.

Economic and Social Attributes of Communities

We expect food insecurity to be lower when economic conditions are more favorable. Job availability and quality in the community are central, not only because of the direct impact of jobs on family income (captured by our income variables), but also because quality job opportunities reduce economic uncertainty and increase the overall economic strength of a community. Likewise, the cost of living is expected to play an important role. There is substantial geographic variation in costs, particularly related to housing, and this has important implications for the availability of money for food. Census data reveal that state-level median rent in 2000 ranged from $401 to $779.

Finally, the social connections between members of a community may play an important role in influencing household food security. As described by Coleman (1988) and others, social support represents a stock of resources on which households can rely for potential assistance. These resources result from connections to friends and family members, and the support they provide can include financial or emotional support, as well as access to information. We expect that households may experience less food insecurity when there are strong connections among community members, both because of possibilities for mutual assistance and because of greater access to information about available resources.

DATA AND METHODS

Data

Data are from the 1998 through 2001 Food Security Supplements to the Current Population Survey (CPS-FSS).[4] The CPS-FSS uses an 18-item scale to classify households as food secure, food insecure without hunger, or food insecure with hunger over the past 12 months. Because there were two Food Security Supplements administered during 2001 (April and December), we have a total of five panels of data.

We limit our main analysis sample to households with children, because food insecurity is most prevalent among these households, and because the determinants of food insecurity may differ among different household types. In particular, some of the contextual variables in our analysis describe nutrition assistance programs targeting children, such as the school breakfast program and summer food program. Our sample includes a total of 70,942 households.

These data are supplemented with state-level data describing various aspects of the food security infrastructure. Those data are described in more detail below.

Models

Because our data consist of households clustered within states (or more precisely, within contexts that vary by state and year), we use hierarchical modeling for our analyses (Raudenbush and Bryk, 2002). Hierarchical modeling is ideally suited to the analysis of data with a nested structure, in which both individual and contextual characteristics are thought to affect outcomes of interest (Osborne, 2000). With nested data, dependency among observations is potentially problematic, and ordinary least squares (OLS) estimates can yield both inefficient parameter estimates and biased standard errors. With

[4]For detailed discussion of the CPS sample design, see http://www.bls.census.gov/cps/bmethdoc.htm.

hierarchical (or multilevel) models, some or all of the coefficients are treated as randomly varying by context, and these random coefficients can be explicitly modeled as functions of contextual characteristics. Such models allow errors to be dependent within contexts, thus implicitly controlling for unmeasured contextual characteristics that are correlated with the dependent variable.

Hierarchical models are particularly useful in formulating and empirically testing hypotheses about how contextual characteristics may affect household-level outcomes, both directly (in the case of random intercepts) and by moderating the impact of relevant household attributes (in the case of random slopes). Of course, one can also explore contextual effects using fixed-effects models that include dummy variables for each unique context; however, such models do not allow one to explore how specific contextual characteristics affect the outcome. Alternatively, one can include contextual characteristics in an OLS model, while ignoring residual within-group correlation. Hierarchical models, in contrast, allow for the estimation of the effects of specific contextual characteristics, while also controlling for unmeasured differences across contexts that are correlated with the outcome of interest. Furthermore, such models allow the analyst to obtain context-specific parameter estimates by augmenting within-context information with evidence from the broader sample (that is, by 'borrowing strength' from the full sample).

We present both a random intercept model and a random slopes model. Our random intercept model can be written as follows:

Level 1 Model

$$\text{Log}[p_{ij}/(1-p_{ij})] = \beta_{0j} + \beta_{10}X_{1ij} + \beta_{20}X_{2ij} + \ldots + \beta_{n0}X_{nij} \quad (1)$$

Level 2 Model

$$\beta_{0j} = \gamma_{00} + \gamma_{01}W_{1j} + \ldots + \gamma_{0q}W_{qj} + \mu_{0j} \quad (2),$$

Where p_{ij} is the probability that household *i* in state-year *j* is food insecure;

$\mathbf{X}_{ij}$ is a vector of sociodemographic characteristics of household *i* in state-year *j*;

$\mathbf{W}_j$ is a vector of characteristics representing the food security infrastructure in state-year *j*;

and u_{0j} is a random normal variable with mean of 0 and variance τ_{00}.

Note that the Level 2 unit is the state-year. Conceptually, this reflects the fact that the relevant contextual characteristics vary by state, and within states vary over time. Thus, the households in our sample can be thought of as nested within a total of 255 different contexts (50 states and the District of Columbia, each observed in five different periods).

In the Level 1 model (presented in Equation 1), the log-odds of household-level food insecurity is expressed as a function of various characteristics of an individual household *i*. The intercept from this model, $\beta_{0j,}$ is a random variable that varies among contexts. The slopes, β_{10} through β_{n0} , are assumed to be constant.

In the Level 2 model, the intercept from Level 1 (β_{0j}) is expressed as a function of context-specific variables $\mathbf{W_j}$ (Equation 2). These variables represent various components of the food security infrastructure in each state and year. The model implies, then, that there are systematic differences in food security across state-years that can be explained in part by characteristics of the state context. Substituting Equation 2 into Equation 1 results in a single prediction equation, in which errors are dependent within state-years.[5] The dependence of the errors is a key feature of this type of model, and has the effect of controlling for unmeasured contextual characteristics that are correlated with the outcome.

The model parameters do not include each of the state-specific intercepts β_{0j}, but rather, estimates of the mean intercept γ_{00} and the variance of the Level 2 error $\mu_{0j.}$ The individual intercepts can, however, be predicted, as can the level two errors, μ_{0j} . We discuss this in more detail below.

We also present a random slopes model, in which household income coefficients are assumed to be random, context-dependent variables. Our model can be expressed as follows:

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[5]Although our modeling approach explicitly allows for dependence among observations in each state-year context, it does not address potential dependence among observations in different years for the same state. Because of this, we may be underestimating true standard errors.

Level 1 Model

$$\text{Log}[p_{ij}/(1-p_{ij})] = \beta_{0j} + \beta_{1j}X_{1ij} + \beta_{2j}X_{2ij} + \beta_{3j}X_{3ij} + \beta_{4j}X_{4ij} + \beta_{50}X_{5ij} + \beta_{60}X_{6ij} + \ldots + \beta_{n0}X_{nij} \quad (3)$$

Level 2 Model

$$\beta_{0j} = \gamma_{00} + \gamma_{01}W_{1j} + \ldots + \gamma_{0q}W_{qj} + \mu_{0j} \quad (2)$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11}W_{1j} + \ldots \gamma_{1q}W_{qj} + \mu_{1j} \quad (4)$$

$$\beta_{2j} = \gamma_{20} + \gamma_{21}W_{1j} + \ldots \gamma_{2q}W_{qj} + \mu_{2j} \quad (5)$$

$$\beta_{3j} = \gamma_{30} + \gamma_{31}W_{1j} + \ldots \gamma_{3q}W_{qj} + \mu_{3j} \quad (6)$$

$$\beta_{4j} = \gamma_{40} + \gamma_{41}W_{1j} + \ldots \gamma_{4q}W_{qj} + \mu_{4j} \quad (7)$$

where u_{0j}, u_{1j}, u_{2j}, u_{3j}, and u_{4j} are random normal variables with means of 0 and variances τ_{00}, τ_{11}, τ_{22}, τ_{33}, and τ_{44}.

Here, X_{1ij} through X_{4ij} denote four income categories: poor, near poor (1.0 to 1.3 times the poverty line), low income (1.3 to 1.85 times the poverty line), and missing income (where the reference category is above 1.85 times poverty line)[6]. This model allows us to examine whether aspects of the state food security infrastructure moderate the relationship between household income and food security. The model reflects our assumption that contextual characteristics are of particular relevance to economically vulnerable households' efforts to maintain food security. In particular, we note that at least some aspects of the food security infrastructure—such as the availability and accessibility of nutrition assistance programs—are only relevant to lower-income households.

Our primary focus is on factors linked to food insecurity. However, we also estimate comparable models in which food insecurity with hunger—a severe level of food insecurity—is the dependent variable.

[6] These classifications are linked to household eligibility for food assistance programs. Children from poor or near-poor households may be eligible for free meals and for Food Stamps. Children from low-income households may be eligible for reduced-price meals.

Measures

Level 1 Measures

We include the following household-level variables in our model (see Table 1 for means and standard deviations): Income-to-poverty ratio (and ratio squared), highest education level in household, race/ethnicity of household head, home ownership, location (central city, other metropolitan, or nonmetropolitan), household structure (single mother, single father, couple, other), number of children, presence of employed person(s) in household, presence of elderly person(s) in household, presence of disabled person(s) in household, and presence of noncitizens in household. All continuous variables are entered as mean-centered variables in our models.

Level 2 Measures

We include a variety of Level 2 variables representing components of the food security infrastructure. For simplicity, we use the term "state-level variables" to refer to these variables. Note, however, that in most cases these variables vary by both state (50 states and Washington, D.C.) and time (five different time periods corresponding to the food security reference period of the five CPS-FSS panels). Thus, our Level 2 measures describe the context within which households are grouped, where that context is both state and time dependent. In a few instances, we have only a single state measure and apply it to all years. When the relevant reference year spans two calendar years, we construct the measures by prorating the values for each of the years. Variable means and standard deviations are shown in Table 1. As with the Level 1 variables, continuous variables are mean-centered in the models.

Availability and Accessibility of Federal Food Assistance and Nutrition Programs. Unlike research seeking to link a household's program participation to food security or other nutritional outcomes, our approach is to treat food assistance programs as components of the food security infrastructure. We are interested in the extent to which differences (across states and over time) in the availability and

TABLE 1
Variable Means and Standard Deviation

	Mean	*SD*
Dependent Variables		
Food insecurity	.16	.36
Food insecurity with hunger	.04	.19
Level 1 Variables		
Income		
Income/poverty ratio	2.68	1.40
Ratio squared	9.32	8.08
Missing income	0.08	0.27
Education		
High school	0.26	0.44
Some college	0.33	0.47
College degree or more	0.34	0.47
Race		
Black	0.11	0.32
Hispanic	0.11	0.32
American Indian	0.02	0.12
Asian	0.04	0.19
Housing Tenure		
Rent	0.29	0.45
Live without paying	0.02	0.13
Location		
Central City	0.21	0.41
Nonmetropolitan	0.24	0.43
Missing	0.00	0.06
Number of Children		
2	0.38	0.48
3	0.15	0.36
4 or more	0.06	0.24
Family Type		
Single mother	0.19	0.39
Single father	0.05	0.21
Other household with children	0.09	0.28
Household Characteristics		
Any employed in household	0.93	0.26
Any elderly in household	0.04	0.19
Any disabled in household	0.05	0.23
Any noncitizens in household	0.11	0.31

(table continues)

TABLE 1, continued

	Mean	*SD*
Level 2 Variables		
Federal Food Programs		
Food Stamp recipients per 100 poor persons	59.39	15.05
Low-income School Breakfast participants per 100 low-income School Lunch participants	39.10	8.94
Low-income Summer Food Service program participants per 100 low-income School Lunch participants	14.20	9.15
Low-income Summer School Lunch participants per 100 low-income School Lunch participants	4.61	6.36
Economic Policies		
Low-income tax burden	10.48	2.25
Overall tax burden	9.82	1.19
Economic Attributes		
Unemployment rate	4.31	1.04
Poverty rate	11.60	3.23
Average wages per job ($1000s)	31.14	5.88
Median rent ($100s)	5.63	0.99
Social Attributes		
Percentage nonmovers	54.11	5.06
Survey Year		
1999	0.20	0.40
2000	0.20	0.40
April 2001	0.20	0.40
December 2001	0.20	0.40

Note: The means for the Level 1 variables are based on 70,942 households. The means for the Level 2 variables are based on 255 state-year contexts.

accessibility of programs are linked to differences in food security outcomes. We include the following measures:

- Food Stamps: To characterize accessibility of the Food Stamp program, we construct a measure of average monthly number of food stamp recipients divided by number of poor persons.[7] This ranges from 33 to 108 over the 255 state-years included here. Information on number of poor persons comes from the Census Bureau's Small Area Poverty Estimates.

- School Breakfast program: We characterize availability and accessibility of the School Breakfast program by the average number of students eating free or reduced-price breakfast per day for each 100 students eating free or reduced-price School Lunch. Participation in the School Lunch program is frequently used as a benchmark against which to measure School Breakfast participation, because the former is much more uniformly available and more consistently used than the latter. This ratio ranges from 19 to 56 in our sample. Differences in this variable reflect differences in the availability of the breakfast program, as well as differences in the extent to which students participate when the program is offered (see Food Research and Action center, 2002a, for a discussion of program qualities that may affect the attractiveness of the School Breakfast program to students.)

- Summer Meals: Summer meal programs include the Summer Food Service program and the Summer School Lunch program. The former provides meals at a variety of sites that may or may not also provide other programming, and participation is not formally linked to attendance in summer school programs. The latter provides lunches to low-income students attending school programs for the summer. We measure the availability and accessibility of these programs by the average daily participation per 100 participants in the free or reduced-price lunch program during the school year. In our sample, the Summer Food Service ratio ranges from 1.1 to 53.8, and the Summer School Lunch ratio ranges from .5 to 35.4.

There are potential biases associated with these variables. We treat higher participation among eligible families as a proxy for greater program accessibility. However, it is also likely that nutrition assistance programs are more widely used by families with higher levels of need, even after controlling for observable characteristics. If this is the case, our estimates of the relationship between greater program participation and food insecurity would be biased downward, making such relationships more difficult to

[7]This is not intended to be an estimate of the participation rate. Eligibility determination is complex, and some families with incomes above the poverty are eligible for food stamps, while some poor families are ineligible. We do assume, however, that states with higher ratios also have higher true participation rates among eligible families. We further assume that such states have more accessible programs, as per research linking state-specific program characteristics to participation rates (Kornfeld, 2002).

detect. Note, though, that unobserved characteristics that contribute to program participation are only a problem to the extent that they differ systematically across locations.

State Policies Affecting the Resources Available to Low-Income Families. As discussed earlier, we expect food security to be influenced not only by nutrition assistance programs, but also by other kinds of policies that affect resources available to low-income families. As noted above, we focus here on tax policy because of its broad relevance to low-income families.

- Our primary measure is an estimate of the mean percentage of income owed in state and local taxes by families in the bottom quintile of the state income distribution. This is available from the Institute for Taxation and Economic Policy, and is measured for 2002. Because of limitations in data availability, this measure varies by state but not time.[8]

- We also control for the average percentage of income owed in state and local taxes by all families, available from the Tax Foundation. We include this primarily as a control, to insure that any apparent impact of the low-income tax burden is not merely proxying for the overall tax burden.

Economic Attributes of Communities. We expect food insecurity to be lower in states with more favorable economic conditions and a lower cost of living. We include the following measures:

- State unemployment rate: State unemployment rate, available from the Bureau of Labor Statistics, is used to characterize job availability.

- Poverty rate: We expect states with higher poverty rates to have fewer collective resources, and thus higher rates of food insecurity.

- Average wages per job: Mean wages per job are available from the Bureau of Economic Analysis. We treat mean wages as a proxy for job quality in the state.

- Median rent: Median rent, available from the 2000 Census, is used as a partial proxy for local cost of living.

Social Context. We expect less food insecurity when there are stronger bonds among community members.

- We use residential stability, measured by Census data on the percentage of households living at the same address as five years earlier, to proxy for the strength of bonds among community

[8]This measure accounts for state EITC programs. We also experimented with including a separate indicator denoting existence of a state EITC program, but it was not substantively or statistically significant.

members. We expect that the greater the mobility of the population, the weaker the social bonds and the greater the likelihood of food insecurity.

***Other*.** Finally, we include dummy variables denoting survey year to control for unmeasured factors influencing food security that may differ over time. The year variables also control for year-to-year differences in the way households were screened out of the food security questions. Because of these screening differences, the year variables should only be treated as controls, and the coefficients should not be given substantive interpretation.

Predicting State Impacts on Food Insecurity

We are also interested in the additional risk of food insecurity associated with particular states, and in the extent to which these state-specific risks can be explained by observed household and contextual characteristics. We explore this question using the results from our random intercept model (equations 1-2) together with results from two other models—an empty model, which includes a random intercept but no Level 1 or Level 2 variables, and a household-level model, which includes a random intercept and also household-level variables, but no Level 2 variables. The context-specific impact is μ_{0j}, the Level 2 error.

Recall that context-specific intercepts (β_{0j}) and residuals (μ_{0j}) are not explicitly estimated as model parameters. Rather, the model parameters include the mean intercept (γ_{00}) and the variance of the Level 2 residual. For each of the three models, we generate empirical Bayes shrinkage estimates of μ_{0j}. These shrinkage estimates, μ_{0j}*, are estimates of the OLS residual μ_{0j}^ for a particular context, shrunken towards zero, where the shrinkage is proportional to the unreliability of μ_{0j}^.[9] Compared to μ_{0j}^, μ_{0j}* is

[9] The OLS residual is the difference between the within-context estimate of β_{0j} and the predicted value of β_{0j} based on the Level 2 model. In the case of the empty model and household-level model, the Level-2 prediction is simply γ_{00}. In the full model, the Level-2 prediction is based on the characteristics of the particular context. Thus, in the empty model, the OLS residual is the difference between the log-odds of the probability of food insecurity in a given context and the mean log-odds across contexts; in the household-level model, the OLS residual

biased towards zero but has a smaller mean squared error (Snijders and Bosker, 1999). Note that a limitation of this approach is that, the greater the unreliability of $\mu_{0j}^{\wedge}$, the greater will be the downward bias in the estimated residuals – what Raudenbush and Bryk (2002, pp.157-158) refer to as 'shrinkage as a self-fulfilling prophecy'. See Raudenbush and Bryk (2002) for a discussion of μ_{0j}* as an estimator of context-specific impacts.

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is the difference between the within-context intercept after controlling for household characteristics and the mean intercept across contexts (γ_{00}); and in the full model, the OLS residual is the difference between the within-context intercept and the predicted intercept based on the specific characteristics of that context. The EB estimator weights the OLS residual by its reliability λ, where $\lambda_j = \tau^2 / (\tau^2 + \sigma^2/n_j)$. Thus, the OLS estimate is given increasing weight when n_j is larger and when the estimated variance of μ_{0j} is greater.

RESULTS

Food Insecurity: Random Intercept Model

Table 2 presents coefficients and odds ratios from the random intercept model (Equations 1–2). Most of the household variables emerge as significant predictors of food insecurity, largely consistent with existing research. Important predictors of food insecurity include lower income[10], renting versus owning a home, single mother status, more children, lower education, having a disabled person or a noncitizen in the household, and race/ethnicity other than nonhispanic white.

Also in Table 2 are the coefficients and odds ratios for the contextual (Level 2) variables. Looking first at variables characterizing availability and accessibility of federal nutrition assistance programs, we find that greater state rates of participation in both the Summer Food Service program and the Summer School Lunch program are associated with a lower risk of food insecurity. As discussed above, these variables represent the extent to which summer meal programs are used by low-income children in a particular state, and thus are intended to capture variation in the availability, accessibility, and desirability of such programs. They do not indicate anything about the participation status of the household. The interpretation, then, is that households in states with more widely utilized summer meal programs have lower risk of food insecurity. In contrast, we find no relationship between the extent of state-level participation in either the Food Stamp or the School Breakfast program and food security outcomes.

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[10] The income-to-poverty coefficient, as well as the coefficient on the squared income-to-poverty ratio, are both negative, suggesting the risk of food insecurity declines at an increasing rate as needs-adjusted income increases. We explored this using an alternative specification involving dummy variables for narrowly defined income-to-poverty ranges. These coefficients indicate that the risk of food insecurity is largely constant at income levels below the poverty line, decreases rapidly until a ratio of 4.5, after which the decline tapers off. The remaining coefficients are robust across a variety of income specifications.

TABLE 2
Coefficients and Odds Ratios from Random Intercept Logistic Regression Analysis of Household Food Insecurity (N= 70,942)

Fixed Effect	*Coefficient*	*SE*	*Odds Ratio*
Intercept	-2.218***	0.066	-33.556
Level 1 Variables			
Income			
Income/poverty ratio	-0.482***	0.042	0.618
Ratio squared	-0.045***	0.009	0.956
Missing income	-0.011	0.049	0.989
Education			
High school	-0.120***	0.039	0.887
Some college	-0.174***	0.040	0.840
College degree or more	-0.705***	0.049	0.494
Race			
Black	0.183***	0.036	1.201
Hispanic	0.129***	0.041	1.138
American Indian	0.332***	0.077	1.394
Asian	-0.052	0.075	0.949
Housing Tenure			
Rent	0.418***	0.027	1.518
Live without paying	-0.019	0.083	1.019
Location			
Central city	0.101***	0.030	1.106
Nonmetropolitan	-0.091**	0.031	0.913
Missing	-0.234	0.257	0.791
Number of Children			
2	0.029	0.028	1.667
3	0.176***	0.034	1.192
4 or more	0.257***	0.044	1.293
Family Type			
Single mother	0.511***	0.030	1.667
Single father	0.053	0.053	1.054
Other household with children	0.105**	0.042	1.111
Household Characteristics			
Any employed in household	-0.180***	0.038	0.835
Any elderly in household	-0.306***	0.062	0.737
Any disabled in household	0.687***	0.041	1.987
Any noncitizens in household	0.100**	0.042	1.105

(table continues)

TABLE 2, continued

Fixed Effect	*Coefficient*	*SE*	*Odds Ratio*
Level 2 Variables			
Federal Food Programs			
Food Stamp recipients per 100 poor persons	-0.002	0.002	0.998
Low-income School Breakfast participants per 100 low-income School Lunch participants	-0.001	0.002	0.999
Low-income Summer Food Service program participants per 100 low-income School Lunch participants	-0.004*	0.002	0.996
Low-income Summer School Lunch participants per 100 low-income School Lunch participants	-0.010***	0.002	0.990
Economic Policies			
Low-income tax burden	0.012*	0.007	1.012
Overall tax burden	0.025	0.015	1.025
Economic Attributes			
Unemployment rate	0.053**	0.023	1.054
Poverty rate	0.003	0.009	1.003
Average wages per job ($1000s)	-0.035***	0.005	0.966
Median rent ($100s)	0.181***	0.030	1.198
Social Attributes			
Percentage nonmovers	-0.012***	0.004	0.988
Survey Year			
1999	-0.189***	0.043	0.828
2000	0.139**	0.050	1.149
April 2001	0.107**	0.049	1.113
December 2001	0.102**	0.049	1.107

Random Effect	*Variance Component*	*DF*	*Chi-Square*	*p-value*
Intercept	.009***	239	299.281	.005

*p<.1 **p<.05 ***p<.01

Note: The following variables have been centered around their grand mean: Food Stamp recipients per 100 poor persons, ratio of School Breakfast participants to School Lunch participants, ratio of Summer Food Service program recipients to Summer School Lunch participants, low-income tax burden, overall tax burden, unemployment rate, poverty rate, average wages per job, median rent, percentage nonmovers.

[a]Reference categories are less than high school, white, homeowner, metropolitan county (not central city), one child, married.

We also find some evidence that tax policy is associated with household food security. Our results suggest that the greater the state tax burden on low-income families, the greater the risk of food insecurity, although this is only marginally significant ($p<.1$). Specifically, each percentage-point increase in the low-income tax burden is associated with a 1.2 percent increase in the odds of food insecurity. The overall tax burden, in contrast, is not significantly related to food insecurity. Despite its lack of significance, we note that the coefficient is larger than that on the low-income tax burden, and the p-value only slightly higher (.11 vs .07). We interpret these results as offering suggestive evidence that the tax burden matters in regard to food insecurity, and more persuasive evidence that the burden on low-income households plays a role.

Economic characteristics of the state are strongly linked to food insecurity in this model. Median rent is among the strongest predictors of food insecurity: the results imply that a $100 increase in the median rent in a state is associated with a 20 percent increase in the odds of food insecurity. Focusing on job availability and quality, we find that higher average wages per job are linked to lower food insecurity, whereas higher unemployment rates are linked to higher food insecurity. Because the model controls for employment and income at the household level, we interpret these variables as indicators of the availability and quality of job opportunities households have faced over the past 12 months, as well of the overall economic strength of the state, rather than as proxies for current household circumstances. The poverty rate has no evident link to household food security, although needs-adjusted income at the household level is a strong predictor. Finally, we find that greater residential stability in the state (a higher percentage of the population living in the same house in 1995 and 2000) is linked to lower odds of food insecurity. As noted above, we interpret residential stability as a proxy for social connectedness among community members.[11]

[11] Tapogna and Suter examine the relationship between residential mobility and food insecurity, and find that intra-state moves have a stronger relationship to food insecurity than do inter-state moves. They interpret this as

As a sensitivity test, we estimate the same model on a sample of households without children (Table 3). In general, we expect to find similar predictors of food insecurity to those in our primary sample. However, we do not expect the variables denoting meals for children—including extent of participation in School Breakfast, and extent of participation in the Summer Food Service and Summer School Lunch programs—to be linked to household food insecurity for childless households. Results are mixed. As expected, we find that most predictors of food insecurity are similar to those in our sample of households with children. The state-level School Breakfast participation variable is not significant, as in our primary sample. Results for summer meals are ambiguous. State-level participation in the Summer Food Service program is no longer significant, consistent with expectations. On the other hand, state-level participation in the Summer School Lunch program continues to be significantly linked to household food security, although the coefficient is smaller than for our primary sample of households with children (-.007 versus -.01). Because it is not plausible that Summer School Lunch programs for children would have any impact on food security among childless households, these findings imply that the Summer School Lunch variable is correlated with unobserved differences among states, and that those differences may account for at least a portion of the apparent benefits of the Summer School Lunch program. Thus, our results regarding the apparent benefits of that program should be interpreted cautiously.

Food Insecurity: Random Slopes Model

Table 4 presents the results from the random slopes model. Here the relationship between income and food insecurity is allowed to vary by context, and state-level characteristics interact with household-level income status to predict food insecurity. Thus, the model tests whether state characteristics moderate the relationship between income and food insecurity. In order to better interpret the results of these

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suggestive evidence that the relationship between residential instability and food insecurity may reflect financial disruptions.

TABLE 3
Coefficients and Odds Ratios from Random Intercept Logistic Regression Analysis of Household Food Insecurity for Households without Children (N= 128,917)

Fixed Effect	*Coefficient*	*SE*	*Odds Ratio*
Intercept	-2.800***	0.055	0.061
Level 1 Variables			
Income			
Income/poverty ratio	-0.775***	0.027	0.462
Ratio squared	0.037***	0.004	1.038
Missing income	0.038	0.045	1.039
Education			
High school	-0.311***	0.033	0.733
Some college	-0.308***	0.036	0.735
College degree or more	-0.740***	0.043	0.477
Race			
Black	0.500***	0.034	1.649
Hispanic	0.292***	0.048	1.339
American Indian	0.567***	0.087	1.763
Asian	-0.263***	0.083	0.769
Housing Tenure			
Rent	0.653***	0.258	1.921
Live without paying	0.217***	0.076	1.242
Location			
Central City	0.115***	0.030	1.122
Nonmetropolitan	-0.111***	0.032	0.895
Missing	0.206	0.184	1.229
Household Characteristics			
Any employed in household	-0.028	0.031	0.972
Any elderly in household	-0.974***	0.032	0.378
Any disabled in household	0.901***	0.031	2.462
Any noncitizens in household	-0.156***	0.052	0.856

(table continues)

TABLE 3, continued

Fixed Effect	*Coefficient*	*SE*	*Odds Ratio*
Level 2 Variables			
Federal Food Programs			
Food Stamp recipients per 100 poor persons	-0.0001	0.001	1.000
Low-income School Breakfast participants per 100 low-income School Lunch participants	-0.001	0.002	0.999
Low-income Summer Food Service program participants per 100 low-income School Lunch participants	-0.002	0.002	0.998
Low-income Summer School Lunch participants per 100 low-income School Lunch participants	-0.007***	0.002	0.993
Economic Policies			
Low-income tax burden	0.010	0.007	1.010
Overall tax burden	0.021	0.015	1.021
Economic Attributes			
Unemployment rate	0.095***	0.023	1.100
Poverty rate	-0.007***	0.001	0.993
Average wages per job ($1000s)	-0.026***	0.005	0.974
Median rent ($100s)	0.135***	0.030	1.145
Social Attributes			
Percentage nonmovers	-0.013***	0.003	0.987
Survey Year			
1999	-0.103**	0.044	0.902
2000	0.027	0.047	1.027
April 2001	0.101**	0.049	1.106
December 2001	0.074	0.050	1.077

Random Effect	*Variance Component*	*DF*	*Chi-Square*	*p-value*
Intercept	0.010	239	320.11	0.001

*p<.1 **p<.05 ***p<.01

Note: The following variables have been centered around their grand mean: Food Stamp recipients per 100 poor persons, ratio of School Breakfast participants to School Lunch participants, ratio of low-income Summer Food Service program recipients to Summer School Lunch participants, low-income tax burden, overall tax burden, unemployment rate, poverty rate, average wages per job, median rent, percentage nonmovers.

[a]Reference categories are less than high school, white, homeowner, metropolitan county (not central city).

TABLE 4
Coefficients and Odds Ratios from Random Slope Logistic Regression Analysis of Household Food Insecurity (N= 70,942)

Fixed Effect	*Coefficient*	*SE*	*Odds Ratio*
Intercept	-2.445***	0.076	0.087
Level 1 Variables			
Income			
Poverty	1.406***	0.081	4.082
Near poverty (1–1.3 of poverty line)	1.184***	0.101	3.268
Low income (1.3–1.85 of poverty line)	0.935***	0.091	2.547
Missing poverty	0.280**	0.132	1.323
Education			
High school	-0.105***	0.039	0.900
Some college	-0.199***	0.041	0.819
College degree or more	-0.968***	0.050	0.380
Race			
Black	0.223***	0.036	1.250
Hispanic	0.178***	0.041	1.195
American Indian	0.350***	0.078	1.419
Asian	-0.015	0.075	0.985
Housing Tenure			
Rent	0.529***	0.027	1.697
Live without paying	0.140*	0.083	1.150
Location			
Central City	0.116***	0.031	1.123
Nonmetropolitan	-0.027	0.032	0.974
Missing	-0.175	0.257	0.839
Number of Children			
2	0.094***	0.028	1.098
3	0.300***	0.035	1.349
4 or more	0.423***	0.045	1.527
Family Type			
Single mother	0.598***	0.030	1.818
Single father	0.090*	0.053	1.095
Other household with children	0.176***	0.042	1.192
Household Characteristics			
Any employed in household	-0.213***	0.038	0.808
Any elderly in household	-0.243***	0.063	0.784
Any disabled in household	0.746***	0.042	2.109
Any noncitizens in household	0.146***	0.042	1.157

(table continues)

TABLE 4, continued

Fixed Effect	*Coefficient*	*SE*	*Odds Ratio*
Level 2 Variables			
Federal Food Programs			
Food Stamp recipients per 100 poor persons	0.001	0.002	1.001
Low-income School Breakfast participants per 100 low-income School Lunch participants	-0.003	0.004	0.997
Low-income Summer Food Service program participants per 100 low-income School Lunch participants	-0.005	0.003	0.995
Low-income Summer School Lunch participants per 100 low-income School Lunch participants	-0.013***	0.003	0.987
Economic Policies			
Low-income tax burden	0.006	0.010	1.006
Overall tax burden	0.030	0.023	1.030
Economic Attributes			
Unemployment rate	0.019	0.035	1.019
Poverty rate	0.023	0.014	1.023
Average wages per job ($1000s)	-0.032***	0.007	0.969
Median rent ($100s)	0.157***	0.045	1.170
Social Attributes			
Percentage nonmovers	-0.020***	0.006	0.980
Other			
1999	-0.202	0.068	0.817
2000	0.118*	0.070	1.125
April 2001	0.129*	0.075	1.138
December 2001	0.126	0.076	1.134
Cross-Level Interactions			
Poverty* Food Stamp recipients per 100 poor persons	-0.001	0.003	0.999
Poverty* Low-income School Breakfast participants per 100 low-income School Lunch participants	-0.002	0.005	0.998
Poverty* Low-income Summer Food Service program participants per 100 low-income School Lunch participants	0.002	0.005	1.002
Poverty*Low-income Summer School Lunch participants per 100 low-income School Lunch participants	0.008	0.005	1.008
Poverty* Low-income tax burden	0.003	0.016	1.003
Poverty* Overall tax burden	0.017	0.036	1.018
Poverty* Unemployment rate	0.002	0.054	1.000
Poverty* Poverty rate	-0.008	0.021	0.992

(table continues)

TABLE 4, continued

Fixed Effect	*Coefficient*	*SE*	*Odds Ratio*
Poverty* Average wages per job ($1000s)	-0.012	0.011	0.988
Poverty* Median rent ($100s)	0.017	0.071	1.017
Poverty* Percentage nonmovers	0.010	0.009	1.010
Poverty*1999	-0.006	0.102	0.994
Poverty*2000	0.026	0.108	1.026
Poverty*April 2001	-0.109	0.115	0.897
Poverty*December 2001	-0.052	0.114	0.950
Near poverty* Food Stamp recipients per 100 poor persons	-0.012**	0.005	0.988
Near poverty* Low-income School Breakfast participants per 100 low-income School Lunch participants	0.009	0.007	1.005
Near poverty* Low-income Summer Food Service program participants per 100 low-income School Lunch participants	0.005	0.007	1.005
Near poverty*Low-income Summer School Lunch participants per 100 low-income School Lunch participants	-0.001	0.007	0.869
Near poverty* Low-income tax burden	0.018	0.022	1.018
Near poverty* Overall tax burden	-0.035	0.050	0.965
Near poverty* Unemployment rate	0.116	0.075	1.123
Near poverty* Poverty rate	-0.060**	0.029	0.942
Near poverty* Average wages per job ($1000s)	-0.025	0.015	0.975
Near poverty* Median rent ($100s)	0.113	0.097	1.119
Near poverty* Percentage nonmovers	0.025*	0.013	1.026
Near poverty*1999	-0.019	0.132	0.981
Near poverty*2000	0.004	0.143	1.004
Near poverty*April 2001	-0.016	0.153	0.985
Near poverty*December 2001	-0.064	0.155	0.938
Low income* Food Stamp recipients per 100 poor persons	-0.010**	0.004	0.990
Low income* Low-income School Breakfast participants per 100 low-income School Lunch participants	0.005	0.006	1.005
Low income* Low-income Summer Food Service program participants per 100 low-income School Lunch participants	0.003	0.006	1.003
Low income*Low-income Summer School Lunch participants per 100 low-income School Lunch participants	0.004	0.006	1.004
Low income* Low-income tax burden	0.039**	0.018	1.040
Low income* Overall tax burden	-0.008	0.041	0.992

(table continues)

TABLE 4, continued

Fixed Effect	*Coefficient*	*SE*	*Odds Ratio*	
Low income* Unemployment rate	0.117*	0.062	1.124	
Low income* Poverty rate	-0.061**	0.025	0.941	
Low income* Average wages per job ($1000s)	-0.005	0.012	0.995	
Low income* Median rent ($100s)	-0.001	0.001	0.999	
Low income* Percentage nonmovers	0.013	0.010	1.014	
Low income*1999	0.096	0.119	1.101	
Low income*2000	0.148	0.124	1.159	
Low income*April 2001	-0.058	0.133	0.943	
Low income*December 2001	-0.040	0.132	0.961	
Random Effect	*Variance Component*	*DF*	*Chi-Square*	*p-value*
Intercept variance	0.005	236	232.994	>.500
“Poverty” variance	0.028	236	272.532	0.051
“Near poverty” variance	0.022	236	229.921	>.500
“Low income” variance	0.016	236	218.846	>.500
“Missing poverty” variance	0.161	236	211.851	>.500

*p<.1 **p<.05 ***p<.01

Note: The following variables have been centered around their grand mean: Food Stamp recipients per 100 poor persons, ratio of School Breakfast participants to School Lunch participants, ratio of low-income Summer Food Service program recipients to School Lunch participants, low-income tax burden, overall tax burden, unemployment rate, poverty rate, average wages per job, median rent, percentage nonmovers.

[a]Reference categories are less than high school, white, homeowner, metropolitan county (not central city), one child, married.

interactions, household income is represented as a series of dummy variables rather than the continuous income-to-needs ratio used in the random intercept model. Four dummy variables are used, denoting poverty (less than 100 percent of the poverty line), near poverty (100–130 percent of the poverty line), low income (131–185 percent of the poverty line), and missing information. The omitted category is households above 185 percent of the poverty line.

The results for the Level 1 (household) variables are largely consistent with the random intercept model, with only minor exceptions. We therefore focus our discussion on the role of state characteristics, where these characteristics may influence overall food insecurity and may also moderate the relationship between income and food insecurity. Looking first at nutrition assistance programs, we again find no direct impact of the Food Stamp participation rate. However, we do find that a higher Food Stamp participation rate—which we treat as a proxy for a more accessible program—reduces the negative relationship between both near-poverty and low-income status and food security outcomes (see cross-level interactions in Table 4). That is, economically vulnerable families—but not poor families or higher-income families—have a lower risk of food insecurity in contexts characterized by a more accessible Food Stamp program. This makes sense in that eligible families who are closer to the eligibility cutoff, and therefore qualify for lower benefits than the poorest families, may be most responsive to differences in program accessibility, whereas higher income families who are ineligible for any assistance should not be influenced by the Food Stamp program. Higher participation in the Summer School Lunch program continues to be linked to lower food insecurity rates, whereas participation in the Summer Food Service program is no longer significant; neither of the summer food programs appear to moderate the impacts of poverty or low income, counter to our expectation. As in the random intercept model, the School Breakfast program does not emerge as a significant predictor of food insecurity.

We look next at policies affecting economic resources. The low-income tax burden is no longer a significant predictor of overall food insecurity; it does, however, appear to strengthen the relationship between low-income status and food insecurity—low-income households have a greater risk of food

insecurity when the low-income tax burden is higher. This is consistent with our expectations. As before, we find no significant relationship between the overall tax burden and the risk of food insecurity.

Turning to economic characteristics, we again find that higher average wages in a state are linked to lower odds of food insecurity. The unemployment rate is not linked to the overall food insecurity rate in this model; however, we find some evidence that higher unemployment may exacerbate the detrimental impact of low-income status on food insecurity ($p<.1$). Median rent continues to have a strong impact on food insecurity, but there do not seem to be any differential impacts for particular income groups. We also find that higher poverty rates are linked to lower food insecurity among near-poor and low-income households. While this may seem counterintuitive, it could indicate that the cost of living is lower in high-poverty areas, a situation that could contribute to greater food security for economically vulnerable families (Nord, 2003a). Finally, looking at social context, we find that greater residential stability in the state continues to be linked to lower food insecurity, although less so for near-poor households.

Notable in these results is the finding that none of the state characteristics in our model moderate the detrimental impact of poverty on food insecurity. In contrast, several characteristics—including the extent of Food Stamp participation, the tax burden on low-income households, the unemployment rate, and high poverty rates (which may proxy for lower cost of living)—serve to moderate the relationship between either near-poverty or low-income status and food insecurity. It appears, then, that the state context may be particularly important to families who are economically vulnerable even though they have incomes above the poverty line.

Can Household and State Characteristics Explain Interstate Differences in Food Insecurity?

An important focus of our inquiry is to ascertain the extent to which the identified household and state-level characteristics are able to explain the wide variation in state food insecurity rates. As described earlier, we explore this using results from three models—an empty model (shown in Appendix Table 1), which includes a random intercept but has no Level 1 or Level 2 variables; a household-level model (shown in Appendix Table 2), which includes a random intercept and also household-level

variables, but no Level 2 variables; and our previously-shown random intercept model (Table 2) which includes independent variables both at Level 1 and Level 2. The random components of the three models are summarized in Table 5. The variance of μ_{0j}, the Level 2 error, decreases from .071 in the empty model, to .040 in the household-level model, to .009 in the full model. Thus, almost all of the between-context variance in food insecurity can be explained by the household and contextual variables included in the model.

We examine this further by generating empirical Bayes estimates of the residual μ_{0j} for each unique context *j* (where *j* represents a particular state in a particular year). The odds ratios of the estimated residuals from the three models can be interpreted as the additional risk of food insecurity associated with a particular context, under three scenarios—without controlling for household or contextual differences, controlling for household differences, and controlling for both household and contextual differences.

Figure 1 illustrates the mean estimated impact of each state on the odds of food insecurity, based on the empty model that controls for neither household nor state characteristics. The 51 estimated state impacts are each calculated from the mean of the five different residuals estimated for each state (one for each of the different time periods), thus allowing us to present 51 rather than 255 unique impacts (separate estimates for each of the state-years are available on request). As is evident from this figure, and as we know from raw differences in state food insecurity rates, states differ widely in their odds of food insecurity. In the states with the greatest food insecurity problems, the odds of food insecurity are up to 36 percent greater than average, and in states with the least problems, the odds of food insecurity are up to 29 percent lower than average.

Figure 2 illustrates the mean impact of each state on the odds of food insecurity, this time based on the household-level model. Here, the estimated impacts reflect the state-specific additional risk of food insecurity, after controlling for differences in the sociodemographic characteristics of the population. A positive state residual implies that a state has a food insecurity rate higher than expected based on the

Table 5. Variance components from random intercept models (n=70,942).

Model	Fixed Effect		Random Effect	
	Intercept Coefficient	SE	Variance Component	p-value
Empty model	-1.728	.020	.071	.000
Level 1 variables	-2.197	.061	.040	.000
Level 1 and Level 2 variables	-2.218	.066	.009	.005

FIGURE 1
Estimated State Impacts on Odds of Food Insecurity (Empty Model)

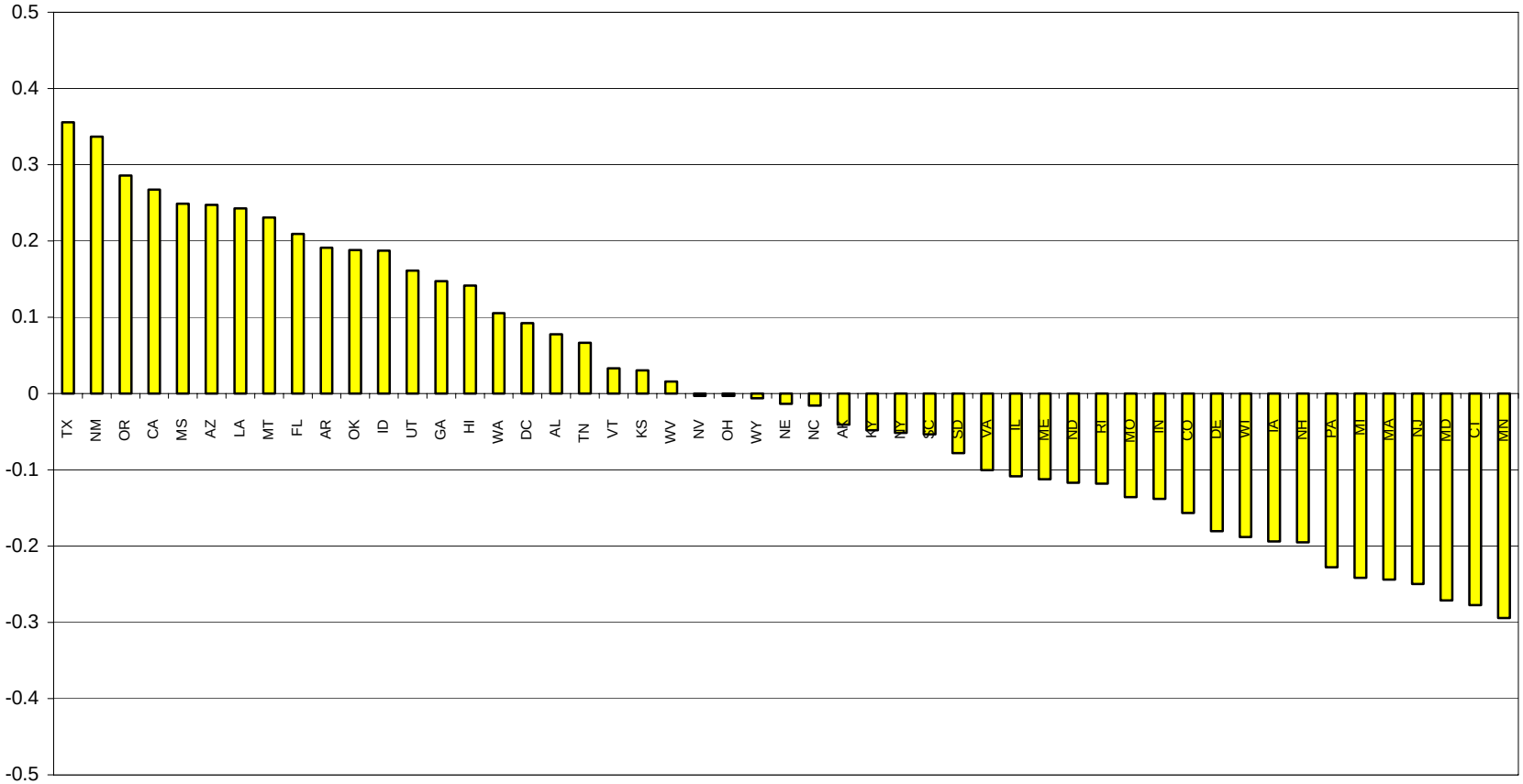
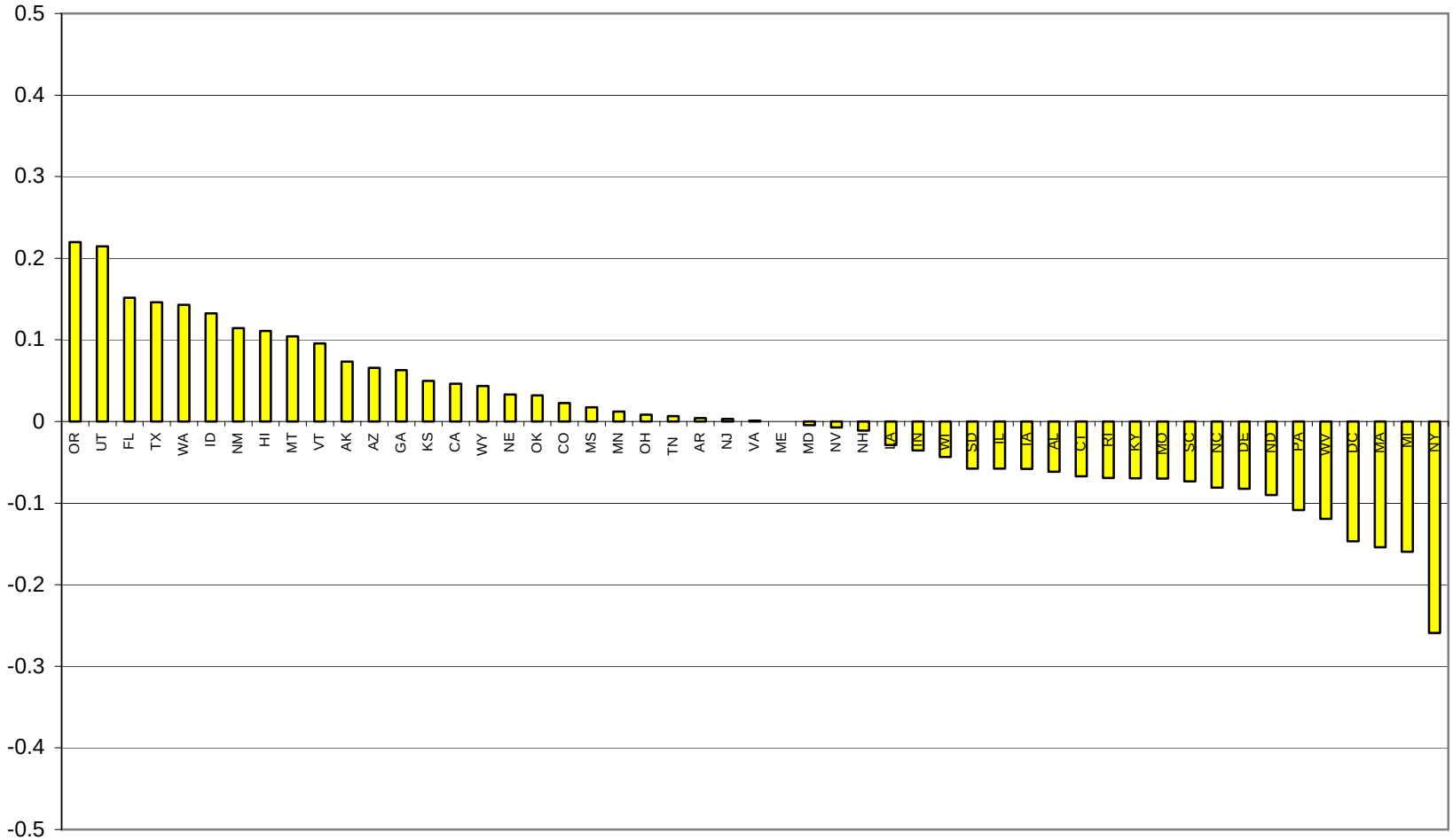


FIGURE 2
Estimated State Impacts on Odds of Food Insecurity,
Based on Model with Household-Level Variables



observed characteristics of its population. As expected, the magnitude of these impacts is considerably smaller once population differences are taken into consideration. Results illustrate that some, but not all, of the interstate differences in food insecurity can be explained by differences in the prevalence of households with identified characteristics linked to greater risk.

Next we look at estimated state impacts, after controlling for state as well as household variables. A positive state residual implies that a state has a food insecurity rate higher than expected based on the observed characteristics of its population and the observed contextual characteristics. As Figure 3 illustrates, the remaining state-specific impacts are dramatically lower. At the high end, net of measured household and state characteristics, states only confer an added risk of up to 5 percent on the odds of food insecurity; at the low end, states only confer an added risk reduction of up to 5 percent**.** These results suggest that almost all of the observed interstate differences in food insecurity can be explained by differences in population and contextual characteristics included in this model.

It is informative to examine how states differ in the relative importance of household and contextual variables in explaining high or low levels of food insecurity. Figure 4 illustrates the estimated state-specific residuals from each of the three models, looking at the 12 states with the greatest risk of food insecurity prior to introducing any controls. As is evident in this figure, states vary greatly in the extent to which their high risk of food insecurity can be explained by their particular demographics. In Oregon, for instance, there is only a modest decrease in the state-specific impact on the odds of food insecurity once household characteristics are controlled.[12] In Louisiana, on the other hand, the increased risk of food insecurity can be entirely explained by household characteristics. Figure 5 shows a similar comparison, this time looking at the 12 states with the lowest risk of food insecurity prior to introducing

[12]This is consistent with Edwards and Weber (2003), who find, in a study of hunger in Oregon, that little of the state's high hunger rate can be attributed to the demographics of the population. Rather, they find that Oregon's high hunger rate reflects above-average hunger rates among almost all demographic groups, and they recommend examining policy and other contextual factors that could play a role.

FIGURE 3
Estimated State Impacts on Odds of Food Insecurity,
Based on Model with Household-Level and State-Level Variables

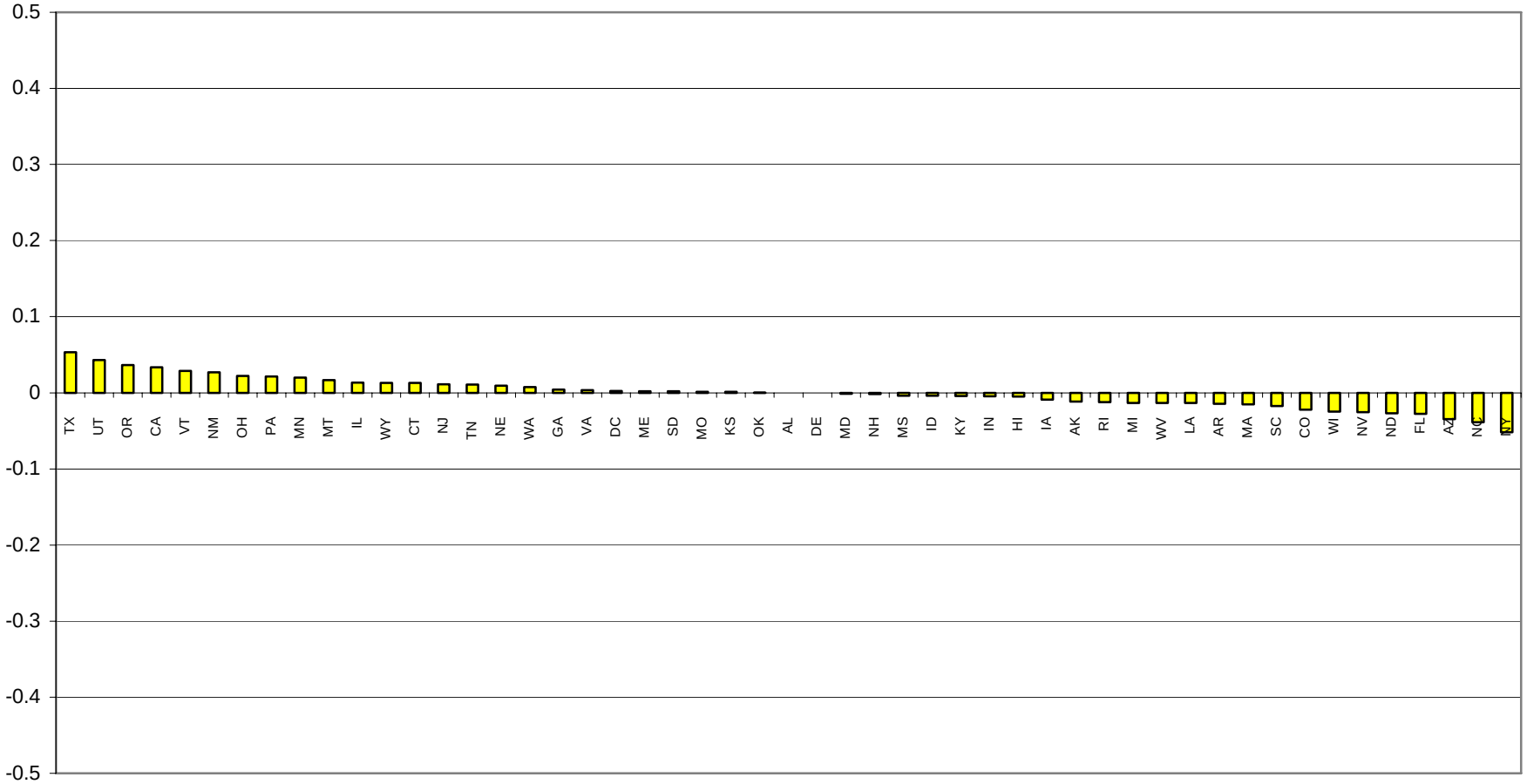


FIGURE 4
State Impacts on Odds of Food Insecurity (High Food Insecurity States)

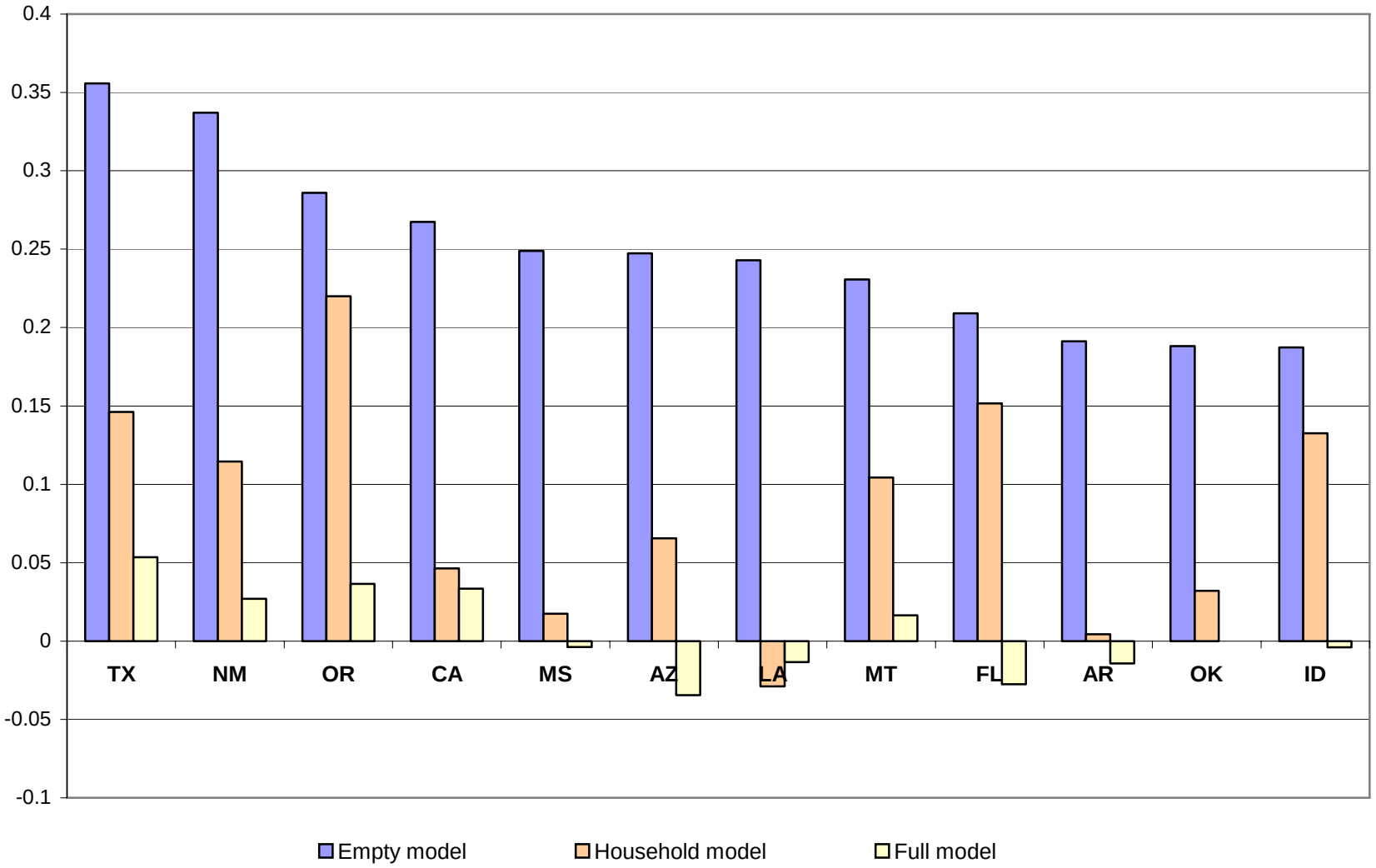
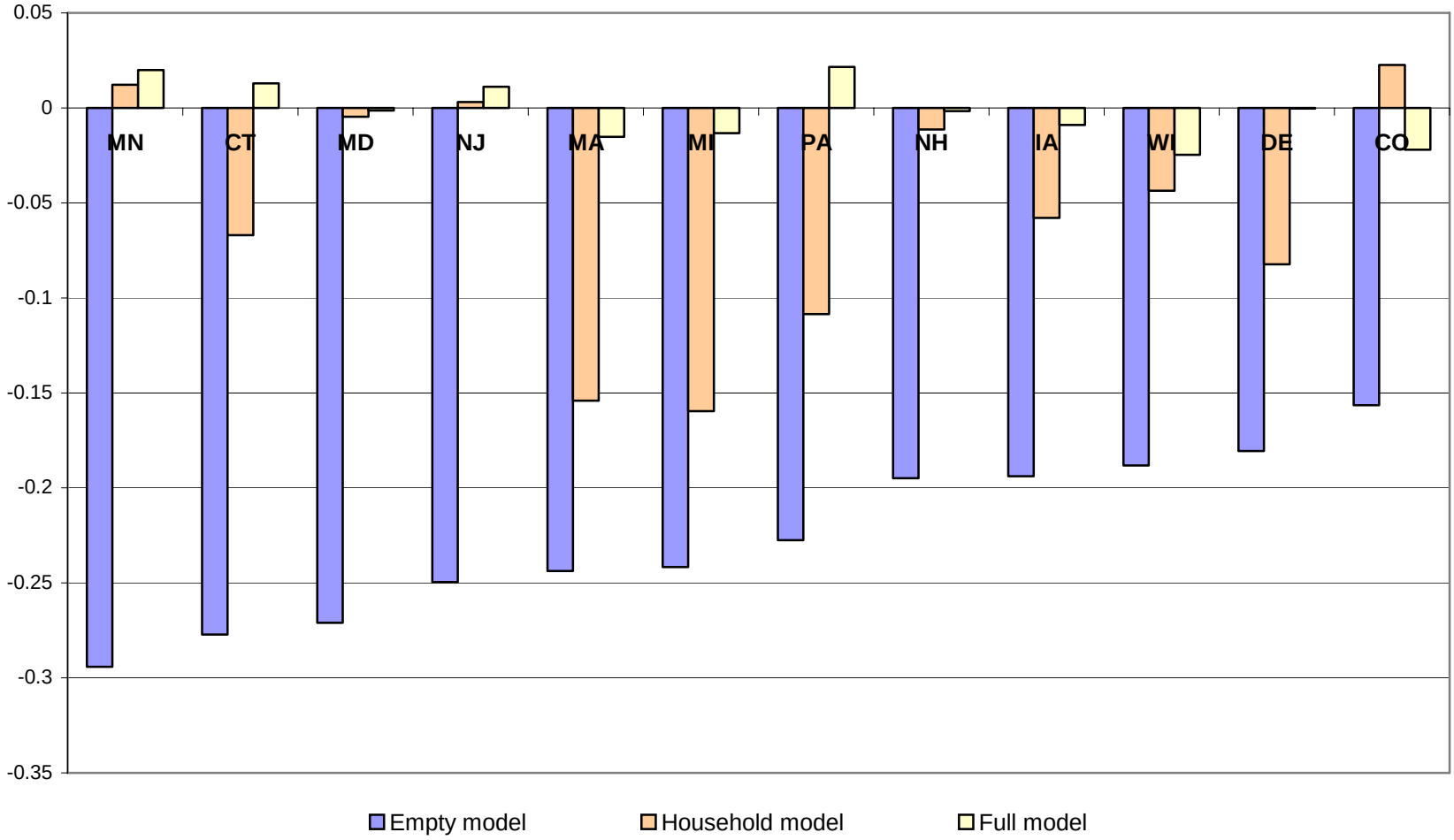


FIGURE 5
State Impacts on Odds of Food Insecurity (Low Food Insecurity States)



any controls. Again, states vary widely in the extent to which their high performance (that is, low food insecurity) can be explained by having a low-risk population. Minnesota, Maryland, and New Hampshire, for instance, appear to confer no particular food security benefit after accounting for household characteristics, whereas Michigan, Massachusetts, and Pennsylvania continue to fare considerably better than average even after controlling for demographics. These kinds of analyses are useful in identifying states that fare better or worse given the specific demographics of their residents.

Hunger Models

Our primary results focus on food insecurity. We also consider similar models using food insecurity with hunger, an extreme form of food insecurity, as the dependent variable. These models allow us to examine the extent to which household and contextual factors are linked to actual reductions in food intake, as compared to being linked to less extreme outcomes involving difficulties in meeting food-related needs.

Results for the random intercept model are shown in Table 6. Most of the household-level variables that are linked to food insecurity are also linked to hunger, although there are some exceptions. As with food insecurity, hunger is more common among households with lower incomes, no employed persons, one or more members with a disability, one or more noncitizens, lower educational levels, female headship, and renters as compared to homeowners. Unlike food insecurity, there are no significant differences in the risk of hunger according to number of children, most race and ethnicity categories (including blacks, whites, and Hispanics), or between households in central cities relative to other metropolitan areas. On the other hand, differences in the risk of hunger between rural and metropolitan areas are more pronounced than are differences in the risk of food insecurity, and households headed by a single male have significantly higher risk of hunger than do households headed by a couple, whereas there was no comparable difference for these households in the risk of food insecurity. Several of the same contextual factors that are linked to food insecurity are likewise linked to hunger. Hunger is more prevalent among households in states with higher unemployment, lower wages, higher rent, lower

TABLE 6
Coefficients and Odds Ratios from Random Intercept Logistic Regression Analysis of Household Hunger (N=70,942)

Fixed Effect	*Coefficient*	*SE*	*Odds Ratio*
Intercept	-4.164***	0.116	0.016
Level 1 Variables			
Income			
Income/poverty ratio	-0.423***	0.081	0.655
Ratio squared	-0.075***	0.020	0.928
Missing income	0.331***	0.099	1.392
Education			
High school	-0.126*	0.063	0.882
Some college	0.043	0.066	1.044
College degree or more	-0.524***	0.093	0.592
Race			
Black	-0.045	0.061	0.996
Hispanic	-0.107	0.073	0.899
American Indian	0.233*	0.124	1.262
Asian	-0.312**	0.144	0.732
Housing Tenure			
Rent	0.413***	0.050	1.511
Live without paying	-0.129	0.161	0.879
Location			
Central City	0.061	0.053	1.063
Nonmetropolitan	-0.177***	0.057	0.838
Missing	-0.289	0.520	0.749
Number of Children			
2	-0.043	0.050	0.958
3	0.087	0.061	1.091
4 or more	0.107	0.076	1.113
Family Type			
Single mother	0.720***	0.053	2.054
Single father	0.268***	0.100	1.307
Other household with children	0.199**	0.078	1.220
Household Characteristics			
Any employed in household	-0.227***	0.058	0.797
Any elderly in household	-0.269	0.112	0.764
Any disabled in household	0.793***	0.062	2.210
Any noncitizens in household	0.163**	0.074	1.178

(table continues)

TABLE 6, continued

Fixed Effect	*Coefficient*	*SE*	*Odds Ratio*
Level 2 Variables			
Federal Food Programs			
Food Stamp recipients per 100 poor persons	-0.003	0.003	0.997
Low-income School Breakfast participants per 100 low-income School Lunch participants	0.001	0.004	1.001
Low-income Summer Food Service program participants per 100 low-income School Lunch participants	-0.003	0.004	0.997
Low-income Summer School Lunch participants per 100 low-income School Lunch participants	-0.013	0.004	0.987
Economic Policies			
Low-income tax burden	0.013	0.012	1.013
Overall tax burden	0.024	0.027	1.024
Economic Attributes			
Unemployment rate	0.101**	0.040	1.106
Poverty rate	-0.014	0.016	0.986
Average wages per job ($1000s)	-0.035***	0.008	0.966
Median rent ($100s)	0.222***	0.054	1.249
Social Attributes			
Percentage nonmovers	-0.211***	0.006	0.810
Survey Year			
1999	-0.210***	0.765	0.811
2000	0.128	0.080	1.137
April 2001	0.149*	0.086	1.161
December 2001	0.066	0.086	1.068

Random Effect	*Variance Component*	*DF*	*Chi-Square*	*p-value*
Intercept Variance	0.020	239	267.68	0.098

*p<.1 **p<.05 ***p<.01

Note: The following variables have been centered around their grand mean: Food Stamp recipients per 100 poor persons, ratio of School Breakfast participants to School Lunch participants, ratio of low-income Summer Food Service program recipients to School Lunch participants, low-income tax burden, overall tax burden, unemployment rate, poverty rate, average wages per job, median rent, percentage nonmovers.

[a]Reference categories are less than high school, white, homeowner, metropolitan county (not central city), one child, married.

residential stability, and lower participation in the Summer School Lunch program. In the case of unemployment and residential stability, the magnitude of the relationships to hunger are substantially larger than are the relationships to food insecurity. Unlike food insecurity, we find no significant impact of the Summer Food Service program (as distinct from the Summer School Lunch program) or of the tax burden on low-income households.

We also estimate a random slopes model predicting hunger, shown in Table 7. The contextual factors that were significant in the random intercept model continue to be significant in this model. However, we find almost no contextual factors that moderate the relationship between income and hunger. This differs from our analogous food insecurity model, in which Food Stamp participation, unemployment rates, and the tax burden on low-income households all appear to moderate the link between near-poverty and/or low-income status and the odds of food insecurity.

TABLE 7
Coefficients and Odds Ratios from Random Slope Logistic Regression Analysis of Household Hunger (N= 70,942)

Fixed Effect	*Coefficient*	*SE*	*Odds Ratio*
Intercept	-4.647***	0.153	0.00959
Level 1 Variables			
Income			
Poverty	1.881***	0.152	6.560
Near poverty (1–1.3 of poverty line)	1.569***	0.189	4.802
Low income (1.3–1.85 of poverty line)	1.216***	0.189	3.374
Missing poverty	1.009***	0.252	2.743
Education			
High school	-0.120*	0.063	0.887
Some college	0.026	0.066	1.026
College degree or more	-0.770	0.094	0.463
Race			
Black	-0.018	0.061	0.982
Hispanic	-0.074	0.073	0.929
American Indian	0.241*	0.125	1.273
Asian	-0.292**	0.144	0.747
Housing Tenure			
Rent	-0.499***	0.050	0.607
Live without paying	-0.032	0.161	0.969
Location			
Central City	0.067	0.054	1.069
Nonmetropolitan	-0.140**	0.056	0.869
Missing	-0.229	0.521	0.795
Number of Children			
2	-0.003	0.050	0.997
3	0.167***	0.061	1.182
4 or more	0.220***	0.076	1.246
Family Type			
Single mother	0.787***	0.054	2.197
Single father	0.297***	0.097	1.346
Other household with children	0.255***	0.078	1.290
Household Characteristics			
Any employed in household	-0.255***	0.058	0.775
Any elderly in household	-0.221*	0.116	0.802
Any disabled in household	0.823***	0.063	2.277
Any noncitizens in household	0.212***	0.074	1.236

(table continues)

TABLE 7, continued

Fixed Effect	*Coefficient*	*SE*	*Odds Ratio*
Level 2 Variables			
Federal Food Programs			
Food Stamp recipients per 100 poor persons	0.0002	0.005	1.000
Low-income School Breakfast participants per 100 low-income School Lunch participants	0.002	0.008	1.002
Low-income Summer Food Service program participants per 100 low-income School Lunch participants	-0.007	0.007	0.993
Low-income Summer School Lunch participants per 100 low-income School Lunch participants	-0.019***	0.007	0.981
Economic Policies			
Low-income tax burden	-0.006	0.021	0.994
Overall tax burden	0.123**	0.053	1.131
Economic Attributes			
Unemployment rate	0.206***	0.078	1.131
Poverty rate	0.011	0.030	1.011
Average wages per job ($1000s)	-0.035**	0.015	0.966
Median rent ($100s)	0.293***	0.100	1.340
Social Attributes			
Percentage nonmovers	-0.040***	0.012	0.961
Survey Year			
1999	-0.089	0.160	0.915
2000	0.368**	0.161	1.445
April 2001	0.575***	0.166	1.777
December 2001	0.265	0.174	1.303
Cross-Level Interactions			
Poverty* Food Stamp recipients per 100 poor persons	-0.005	0.006	0.995
Poverty* Low-income School Breakfast participants per 100 low-income School Lunch participants	-0.001	0.010	0.999
Poverty* Low-income Summer Food Service program participants per 100 low-income School Lunch participants	0.005	0.009	1.005
Poverty*Low-income Summer School Lunch participants per 100 low-income School Lunch participants	0.009	0.009	1.009
Poverty* Low-income tax burden	0.021	0.028	1.021
Poverty* Overall tax burden	-0.116*	0.066	0.890
Poverty* Unemployment rate	-0.147	0.097	0.863
Poverty* Poverty rate	-0.028	0.038	0.972

(table continues)

TABLE 7, continued

Fixed Effect	*Coefficient*	*SE*	*Odds Ratio*
Poverty* Average wages per job ($1000s)	-0.000	0.019	1.00
Poverty* Median rent ($100s)	-0.094	0.124	0.910
Poverty* Percentage nonmovers	0.024	0.015	1.024
Poverty*1999	-0.244	0.192	0.783
Poverty*2000	-0.332*	0.197	0.717
Poverty*April 2001	-0.718***	0.207	0.488
Poverty*December 2001	-0.294	0.210	0.745
Near poverty* Food Stamp recipients per 100 poor persons	-0.005	0.009	0.995
Near poverty* Low-income School Breakfast participants per 100 low-income School Lunch participants	-0.0004	0.135	1.000
Near poverty* Low-income Summer Food Service program participants per 100 low-income School Lunch participants	0.016	0.012	1.016
Near poverty*Low-income Summer School Lunch participants per 100 low-income School Lunch participants	0.005	0.011	1.005
Near poverty* Low-income tax burden	0.024	0.037	1.024
Near poverty* Overall tax burden	-0.129	0.089	0.879
Near poverty* Unemployment rate	-0.020	0.134	0.980
Near poverty* Poverty rate	-0.061	0.053	0.941
Near poverty* Average wages per job ($1000s)	-0.008	0.026	0.992
Near poverty* Median rent ($100s)	0.011	0.017	1.011
Near poverty* Percent non-movers	0.021	0.022	1.021
Near poverty*1999	-0.136	0.243	0.873
Near poverty*2000	-0.468*	0.264	0.626
Near poverty*April 2001	-0.421	0.273	0.656
Near poverty*December 2001	-0.343	0.286	0.710
Low income* Food Stamp recipients per 100 poor persons	-0.008	0.008	0.992
Low income* Low-income School Breakfast participants per 100 low-income School Lunch participants	-0.004	0.013	0.996
Low income* Low-income Summer Food Service program participants per 100 low-income School Lunch participants	0.002	0.011	1.002
Low income*Low-income Summer School Lunch participants per 100 low-income School Lunch participants	0.008	0.011	1.008
Low income* Low-income tax burden	0.051	0.035	1.052
Low income* Overall tax burden	-0.146*	0.083	0.864

(table continues)

TABLE 7, continued

Fixed Effect	*Coefficient*	*SE*	*Odds Ratio*	
Low income* Unemployment rate	-0.144	0.121	0.866	
Low income* Poverty rate	-0.030	0.048	0.970	
Low income* Average wages per job ($1000s)	-0.005	0.025	0.995	
Low income* Median rent ($100s)	-0.251	0.162	0.778	
Low income* Percentage nonmovers	0.030	0.021	1.030	
Low income*1999	0.160	0.244	1.174	
Low income*2000	-0.105	0.249	0.900	
Low income*April 2001	-0.362	0.264	0.696	
Low income*December 2001	-0.044	0.266	0.957	
Random Effect	*Variance Component*	*DF*	*Chi-Square*	*p-value*
Intercept variance	0.005	238	208.314	>.500
“Poverty” variance	0.029	238	216.242	>.500
“Near poverty” variance	0.019	238	214.204	>.500
“Low income” variance	0.030	238	227.677	>.500
“Missing poverty” variance	0.097	238	225.925	>.500

*p<.1 **p<.05 ***p<.01

Note: The following variables have been centered around their grand mean: Food Stamp recipients per 100 poor persons, ratio of School Breakfast participants to School Lunch participants, ratio of low-income Summer Food Service program recipients to School Lunch participants, low-income tax burden, overall tax burden, unemployment rate, poverty rate, average wages per job, median rent, percentage nonmovers.

[a]Reference categories are less than high school, white, homeowner, metropolitan county (not central city), one child, married.

CONCLUSIONS

This report examines interstate variation in household food security. Using a multilevel framework, we have identified several contextual dimensions that appear linked to food security among households: the availability and accessibility of federal nutrition assistance programs, policies affecting economic well-being of low-income families (focusing here on tax policy), economic characteristics of communities, and social characteristics of communities. Together, these constitute key elements of what we term the food security infrastructure—a set of programs, policies, and community attributes that affect the availability, accessibility, and affordability of food and the extent to which resources are available to households to meet their food-related needs.

Overall, our findings lend strong support to the concept of a food security infrastructure that promotes household food security among community members. We find some evidence supporting a role for each of the dimensions, sometimes in affecting the overall risk of food insecurity and sometimes in moderating the detrimental impact of low household income. This framework is useful in understanding food insecurity, and has important implications for efforts to ameliorate food-related hardships. We document potentially important roles for the Food Stamp and summer meal programs in reducing the risk of food insecurity among families with children, suggesting that efforts to enhance the accessibility of these programs could be beneficial. Further, we demonstrate that policies outside of the nutrition area (here, tax policy) can either help or hinder families' ability to meet food-related needs. This suggests that efforts to increase food security would benefit from a broad focus on the range of policies that affect family economic well-being, rather than a narrow focus limited to nutrition assistance programs. We highlight the relationship between economic characteristics and household food security outcomes, thus confirming the importance of quality job opportunities as a component of the food security infrastructure. And we document a large and very robust link between median rent and food insecurity, which suggests that efforts to ensure affordable housing would be a vital part of efforts to increase food security. Finally, our findings with regard to a connection between residential stability in the community and reduced

prevalence of food insecurity suggest that social capital may play an important role. Furthermore, we find that most of the factors that are linked to food insecurity are also linked to hunger, a more extreme outcome.

Contrary to our expectations, we find no evidence that any of the state characteristics moderate the heightened risk of food insecurity associated with being poor. However, our results do suggest that families who are above the poverty line yet still economically vulnerable may be better able to maintain food security in the context of a more accessible Food Stamp program, a lower tax burden for households in the lower income ranges, and a stronger labor market. This pattern of results suggests that there may be a particularly vulnerable segment of the population, those who are in precarious financial circumstances yet who have not fallen into poverty, whose ability to meet food-related needs is most affected by the economic and policy context.

Readers should exercise caution in their interpretation of the apparent relationship between summer meals and food security. While we find statistically significant coefficients on both summer meal variables (state-level Summer Food Service program participation and state-level Summer School Lunch program participation), two aspects of our findings suggest caution. First, we find that state-level Summer School Lunch participation (though not Summer Food Service program participation) is also linked to lower odds of food insecurity among childless households, a result with no theoretical justification, suggesting that the former may be proxying for other unmeasured state attributes. Second, we find no evidence that summer meal programs have a greater impact on food security for poor, near-poor, or low-income households—those for which such programs are most relevant—than for higher income households. This differs from our findings for state-level Food Stamp participation and for the low-income tax burden, where the only significant relationships to food security are among near-poor and low-income households, a more theoretically consistent pattern. Further analysis of the relationship between summer meal programs and food insecurity is essential to understanding the potential benefits of such programs.

A second focus of our analysis was to determine the extent to which cross-state variation in food insecurity could be explained by the household and state characteristics in our model. We find that both types of variables are important in explaining cross-state variation, although their relative importance varies among states. Overall, it appears that the bulk of the interstate differences in food security can be explained by cross-state differences in both demographics and contextual characteristics.

These findings have important implications for our understanding of interstate variation in food security rates. In particular, our results illustrate that a high (or low) food insecurity rate can imply very different things in different states. In some states, it merely indicates that a state has a high-risk population (more poverty, more single-mother households, etc); in other states, it reflects unexpected food insecurity despite a lower-risk population. It would be valuable to provide estimates of "excess food insecurity" as a way of identifying states that fare better or worse than would be expected based on the characteristics of their residents. Efforts to strengthen the food security infrastructure may be particularly valuable in states that have unexpectedly high rates of food insecurity given the characteristics of their residents.

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APPENDIX TABLE 1
Empty Model

Fixed Effect	***Coefficient***	***SE***	***Odds Ratio***	
Intercept	-1.728***	0.020	0.178	
Random Effect	***Variance Component***	***DF***	***Chi-Square***	***p-value***
Intercept	0.071	254	938.313	.000

APPENDIX TABLE 2
Random Intercept Model with Household Variables Only

Fixed effect	*Coefficient*	*SE*	*Odds Ratio*
Intercept	-2.197***	0.061	0.111
Level 1 Variables			
Income			
Income/poverty ratio	-0.477***	0.042	0.621
Ratio squared	-0.047***	0.009	0.954
Missing income	-0.016	0.049	0.984
Education			
High school	-0.120***	0.039	0.887
Some college	-0.166***	0.040	0.847
College degree or more	-0.698***	0.050	0.498
Race			
Black	0.167***	0.036	1.182
Hispanic	0.143**	0.041	1.154
American Indian	0.361***	0.077	1.434
Asian	0.008	0.073	1.008
Housing Tenure			
Rent	0.419***	0.027	1.521
Live without paying	0.030	0.082	1.031
Location			
Central city	0.097***	0.031	1.102
Nonmetropolitan	-0.067**	0.031	0.935
Missing	-0.300	0.260	0.740
Number of Children			
2	0.031	0.028	1.032
3	0.174***	0.034	1.190
4 or more	0.259***	0.044	1.296
Family Type			
Single mother	0.508***	0.030	1.662
Single father	0.053	0.053	1.055
Other household with children	0.112***	0.042	1.118
Household Characteristics			
Any employed in household	-0.178***	0.038	0.837
Any elderly in household	-0.308***	0.062	0.735
Any disabled in household	0.679***	0.041	1.972
Any noncitizens in household	0.105**	0.042	1.111

(table continues)

APPENDIX TABLE 2, continued

Random Effect	*Variance Component*	*DF*	*Chi-Square*	*p-value*
Intercept	0.040	254	543.184	0.000