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Abstract

The persistence of disadvantage across generations is a central concern for social policy in the United States. While an extensive literature has focused on economic mobility for income, much less is known about the mechanisms for mobility out of poverty or material hardship. This study provides the first estimates of the intergenerational transmission of food insecurity and poverty status from childhood into early adulthood. An advantage of studying the transmission of food insecurity is that it provides a direct measure of well-being compared to income-based poverty measures. In this study, we use panels of childhood and adult food security measures in the Panel Study of Income Dynamics over the survey years 1997 (using the Child Development Supplement) through early release data for 2017. Childhood food insecurity is associated with about 20 percentage points higher probability of food insecurity as an adult (or 10 percentage points conditional on income and wealth). The estimated transmission of food insecurity is robust to using different measures of food security as well as to applying instrumental variable methods for panel data that account for an individual's fixed ability endowment. This study establishes an important benchmark for measuring persistence in long-term family well-being and labor market outcomes.

Executive Summary

In this study we investigate the intergenerational transmission of food insecurity status across generations. Food insecurity is an important measure of economic wellbeing and has been shown in prior studies to be correlated with important child outcomes that are predictive of later mobility. As a consequence, like income and poverty, food insecurity status is likely to transmit across generations. Yet, nothing is known about the transmission of food insecurity as a measure of economic disadvantage. This study helps fill that gap.

Our initial estimates show that intergenerational correlations in food insecurity are around 0.1 to 0.2 among young adults aged 20 to 35, and transmission of food insecurity decreases with the severity of insecurity. To estimate the association between childhood food insecurity and adulthood earnings, we employed rank-rank slope estimates. Our analysis reveals that the percentile rank of childhood food insecurity is negatively correlated with the percentile rank in adult earnings by -0.338 (0.092) for IV estimates based on latent food security, and by -0.197 (0.142) for IV estimates using the food spending/Thrifty Food Plan (TFP).

Our study provides new insights about the extent of the transmission of economic disadvantages across generation. Our study also highlights that childhood food insecurity is associated with adulthood economic status.

1. INTRODUCTION

A major concern for public policy in the United States is the extent to which childhood poverty predetermines economic outcomes in future generations. Recent evidence has shown that income inequality is rising (Piketty, Saez, and Zucman, 2018), absolute economic mobility— doing better than one's parents—is falling (Chetty et al., 2017), and yet relative economic mobility has remained stable (Chetty et al., 2014b; Lee and Solon, 2009). Rising inequality and falling absolute mobility are complementary findings, however stable relative mobility suggests that policy successes in public education or safety net programs may have limited the negative effects expected of high inequality on upward mobility. However, little is known about intergenerational mobility out of poverty and welfare dependence, much less the social and political mechanisms related to persistent poverty. Since the foundational work of Becker and Tomes (1979, 1986), most intergenerational studies have focused on comparisons of income measures for parents and children, yet measures of consumption and material hardship are particularly relevant for understanding the role of policy interventions to support families rising out of poverty. In particular, food security is a critical measure of family well-being that has testable implications for the effects of childhood development on later adult outcomes as well as the effects of food assistance programs, which comprise one of the largest components of the U.S. safety net. About 4 out of 10 children experience poverty before age 18 (Ratcliffe, 2015), and spending on the 15 major federal food assistance programs has averaged over 100 billion dollars since the onset of the Great Recession (Hoynes and Schanzenbach, 2016; Oliveira, 2018). How well the safety net supports low-income families is fundamental to understanding the long-term pathway to opportunity in America.

This study provides first estimates of the intergenerational transmission of food insecurity as well as comparisons with intergenerational poverty status.[1] Policymakers and researchers have long been interested in the ways socioeconomic status is passed from one generation to another, and recent advances have extended beyond the standard measures of income mobility (Black and Devereaux, 2011; Solon, 1999). For example, new studies have documented the intergenerational transmission of wealth (Charles and Hurst, 2003; Fox, 2015; Scholz and Levine, 2004; Wolff, 2002), health (Black, Devereaux, and Salvanes, 2007; Currie and Moretti, 2007; Halliday, Mazumder, and Wong, 2018), consumption (Charles et al., 2014; Waldkirch, Ng, and Cox, 2004),

[1] There is a concurrent working paper by Gundersen, Kreider, and Pepper (2018) using partial identification to estimate bounds on the intergenerational transmission of food insecurity.

education, (Carneiro, Meghir, and Parey, 2013; Magnuson, 2007; Oreopoulos, Page, and Stevens, 2006; Page, 2006), and welfare dependence (Hartley, Lamarche, and Ziliak, 2017). The question addressed here is how childhood food insecurity influences the probability of food insecurity for the child as an adult.[2] Food security status can be correlated across generations primarily because of correlations in income or earning ability; however, plausible causal pathways may exist with implications for effective policy intervention. For example, food insecurity transmission could result from lower nutritional intake during childhood leading to lower human capital development, which suggests that adequate food assistance for families with children could moderate the disadvantage of family poverty. Another potential pathway is that children could learn through family culture related to household resource management such as food acquisition or preparation. Many American children will experience poverty at some point before age 18, yet the long-run effect of their poverty experience may depend on whether families are equipped to smooth consumption when disposable income runs low.

As of 2017, approximately 15.6 percent of children under age 18 lived in families with economic resources below the Supplemental Poverty Measure (SPM) threshold, and another 36.6 percent of children lived in low-income families with resources below twice the SPM threshold; that is, over half of all children were poor or low-income (Fox, 2018).[3] For the same year, 17.0 percent of children lived in food insecure households (Coleman-Jensen et al., 2018). Over the two decades since 1998, the percent of children in food insecure households has been around 17.8 percent until the Great Recession when it reached as high as 23.2 percent, an increase of about 30 percent that remained high 5 years after the recession's end (see Figure 1). Trends in poverty and food insecurity tracked very closely until the Great Recession when food insecurity increased and the SPM poverty rate continued on the same trend line. In part, this divergence during a time of heightened need reflects the fact that SPM poverty status considers a family's total resources, which includes cash transfers and the value of in-kind transfers such as food stamps/SNAP. During the Great Recession, families may have received increased public assistance that countered any

[2] The broader literature on economic mobility has focused on relative measures such as the intergenerational elasticity (IGE) or rank-rank slope within a given distribution of income or wealth (notably Chetty et al., 2014a, among others). Alternative measures with more relevance for upward mobility out of poverty include the conditional transition probability and directional rank mobility (Bhattacharya and Mazumder, 2008).

[3] The SPM definition of poverty is often used by the research community because of its needs threshold adjusted by family structure and geography, and it accounts for a family's total economic resources after taxes, transfers, and work-related and medical expenses.

decrease in earnings. Another reason that these measures may diverge is that poverty rates are income-based indicators of well-being and not direct measures of material hardship or deprivation (see, e.g., Dhongde and Haveman, 2017). Incomes may be low for some families who are otherwise doing well, for example, using savings to smooth living expenses while investing in education or entrepreneurship. At the same time, other families may have non-poor income yet experience hardship because a large proportion of that income is needed to service debts or support elderly or disabled family members (or poverty thresholds may simply be too low). For households that report some deprivation, such as skipping meals because money is tight, an indicator of food insecurity can provide a more direct measure of well-being.[4] Food insecurity and other measures of material hardship provide another way to understand poverty in America, including how disadvantage may be transmitted intergenerationally as well as the potential role of social policy.

The standard instrument for measuring food security is an 18-item questionnaire developed by the U.S. Department of Agriculture's Economic Research Service (USDA ERS). USDA produces official measures using its own nationally-representative survey that is implemented in the December supplement to the Current Population Survey (CPS) (see Coleman-Jensen et al., 2018), and the same questions have been implemented in other major public-use surveys such as the Panel Study of Income Dynamics (PSID) (for comparisons between CPS and PSID measures, see Tiehen, Vaughn, and Ziliak, 2018). The ideal dataset for intergenerational comparisons is the PSID, which has fielded consistent questions on food security as early as 1997 (in the Child Development Supplement) and subsequently in select main family surveys up to the early release data of the 2017 survey. (These data allow comparisons of food security in childhood over 4 survey years from 1997 to 2003, and again in adulthood over 3 survey years from 2014 to 2017.) In typical use, responses to the 18 questions are each recoded as binary indicators by which a positive response indicates some degree of food insecurity, and the number of positive responses can be mapped into a summary indicator of food security status (see Appendix A for a full list of questions). In the main estimates of this study, we explore the transmission effects across various measures of food security status and a Rasch measure of latent food security based on item response theory.

[4] A recent White House report has sparked debate about whether the War on Poverty, begun in the era of President Johnson in 1964, has solved poverty in America (see Council of Economic Advisers, 2018). The premise of this argument is based on trend comparisons for income and consumption-based poverty measures that are anchored to a given reference year (by which the trend comparisons depend on the relative values in the chosen reference year).

Intergenerational analysis of poverty and program participation is complicated by important sources of possible estimation bias. Specifically, estimating the effects of childhood food insecurity on adult food insecurity will be biased if childhood exposure is correlated with unobserved family persistence in other traits related to poverty and insecurity, and intergenerational transmission estimates typically suffer from some form of life-cycle measurement bias. First, it is difficult to identify the causal transmission of disadvantage separately from intra-family correlations in earning ability and geographic opportunity. For example, if unobserved earning ability is negatively correlated with food insecurity in both generations, then omitting this fixed endowment effect may lead to over-estimates of the effect of food insecurity transmission. In order to address potential selection bias related to an individual's fixed ability endowment, we use a Hausman and Taylor (1981) type of approach that leverages an individual's panel observations to instrument for time-invariant endogeneity related to their childhood food insecurity. An advantage of this method for eliminating fixed selection bias is that the Hausman-Taylor procedure, unlike the standard within transformation, does not drop time-invariant regressors such as the independent variable of interest, childhood food insecurity. Further, the Hausman-Taylor method can easily accommodate additional endogenous regressors allowing controls for the individual's current income or wealth, as long as there are more time-varying exogenous variables than there are time-invariant endogenous variables (namely, childhood food insecurity).

In terms of generational-specific estimation biases, additional potential biases are related to the 'window problem' when observing outcomes for limited ranges of the full lifetimes of each generation (Wolfe et al., 1996). In the intergenerational income literature, the ideal transmission parameter would be descriptive of the "permanent income" concept. Income can vary considerably over a lifetime, so using only one observation year in each generation, for instance, would provide a noisy proxy for average income over a lifetime (see Solon, 1992). For the food security context, childhood exposure to one year of marginal food security could be quite different from exposure to insecurity throughout childhood. Thus, a second potential source of bias is that the windows are too small to provide a useful measure of the true transmission effect. In the descriptive analysis, we examine the actual persistence of food insecurity throughout childhood, and in the main analysis we use multiple-year averages from the childhood period with some sensitivity analysis on the intensity of exposure. A third type of bias depends on the relative timing of the generational windows of observation within the life cycle. That is, if the parent's generation is observed later in

life, incomes may be higher and food insecurity prevalence lower; however, if the child is observed earlier in life as an adult, then the implications may be reversed.[5] The scenario just described is often referred to as life-cycle bias (Haider and Solon, 2006; Lee and Solon, 2009), and it is common given data constraints on the length of panel observations for both parent and child. For the analysis in this study, the timing of the first-generation observation is restricted to the individual during childhood ages 0 to 17, which will necessarily restrict the adult observation years to ages 35 and younger based on the years of data available with food security questions in the PSID. Lee and Solon (2009) suggest implementing an age adjustment in the estimation in order to address life-cycle bias. However, given that the childhood period in this study is well observed, focusing on transmission of food insecurity into young adulthood is not necessarily a disadvantage in that this point in the life cycle is arguably the primary interest for social policy.

Across a variety of measures of food security status and latent measures of food security, the estimated intergenerational correlation of food insecurity is approximately 0.2. Conditional on individual characteristics, including controls for income and wealth, this correlation lowers to around 0.1. The transmission pathway for childhood food insecurity remains strong even after using instrumental variable panel methods for addressing individuals' unobserved ability endowments. Persistence in food security is similar in magnitude to estimates for the persistence of self-reported health (Halliday, Mazumder, and Wong, 2018), and it is about half the magnitude as persistence in earnings across generations. Although low earnings and food deprivation measure different indicators of well-being, there is some evidence that childhood food insecurity leads to lower adult earnings, which supports the hypothesis of a childhood development mechanism. Moving from the 75th percentile of food insecure households to the 25th percentile (becoming more food secure) implies an increase in earnings by about 16 percentile ranks.

2. Conceptual Foundations and Methodology

Economic approaches to measure the transmission of economic status across generations draw mainly on Becker and Tomes's (1979, 1986) human capital model. This model is commonly used to explain parental investment in children based on a utility function that accounts for the children's future economic outcomes. The empirical approach in the literature typically identifies a

[5] The true relationship between food security over the life cycle is not well established in the data. Tiehen, Vaughn, and Ziliak (2018) show that age profiles in food security status are not consistent comparing estimates using data from the Current Population Survey relative to using the Panel Study of Income Dynamics.

reduced-form effect of the parent's outcome on the child's outcome as an adult, where the transmission mechanism is related to some unobserved parental investment or child learning. For example, nutritional intake is a specific investment for healthy child development and skill formation that affect long-run labor outcomes (Duncan et al., 1998; Elango et al., 2016; Heckman and Mosso, 2014; Ziol-Guest et al., 2012). Also, if a child experiences food insecurity, then this environmental exposure may cause a type of cultural learning that reinforces certain behavioral patterns. Does the family skip meals or find ways to make food stretch? Is it acceptable to visit food pantries, receive support from friends, or take up public assistance? Based on a given family culture, childhood food insecurity might have a direct effect on later food insecurity beyond the mechanical pathway of intergenerational correlations in income or wealth (Lindbeck, Nyberg, and Weibull, 1999). If an adult is predisposed toward food insecurity because of some childhood deprivation, then this individual may further experience reduced earning capability as an adult through lower health or productivity (Drèze and Sen, 1989).

Food security is a latent outcome, so modeling the transmission of food insecurity across generations requires defining either an indicator for a family's food security status or an estimate of the underlying measure that is not observed. A food security status indicator is typically constructed from the raw score total based on household responses to the 18-question USDA survey instrument.[6] The first 10 questions are specific to adults in the household, and the last 8 questions are directed toward children if any are present. Each of the 18 questions is recoded as a 1 if the response indicates some degree of food insecurity, and a 0 otherwise. Families with a raw score of 0 to 2 are considered food secure, although any positive response could be classified as marginal food secure. Families with a score of 3 or more are considered low food secure, and a status of very low food secure corresponds to a score of 6 or more for childless households or 8 or more for households with children (since households with children have a higher possible score out of 18 questions instead of 10). These score thresholds are chosen to fit the underlying model of latent food security, however, it is also possible to model changes in latent security directly, as well. Since the raw score is derived from 18 separate questions, each with an inherently different measure of severity, it is possible to recover an estimate of the latent measure of security using methods from item response theory (see, e.g., Rabbitt, 2013, 2018). For certain specifications, we use a latent food security measure estimated based on a one-parameter logistic model following Rasch (1960).

[6] See Coleman-Jensen et al. (2018) for an overview. For reference, the 18 questions are listed in Appendix A.

Further, the total raw score is a sufficient statistic for characterizing the latent food security of a household; even though any individual responses may not be equivalent in terms of severity, the total score creates an envelope of responses indicating increasing severity.

Given a panel of multiple observations per individual, the food insecurity F_{it} of individual i at time t can be written as a linear model such that

$$F_{it} = \beta F_{i,t_0} + \boldsymbol{q}'_{it}\theta + \alpha_i + \varepsilon_{it} \quad (1)$$

where F_{i,t_0} is the individual's childhood food security corresponding to time period t_0, $\mathbf{q}_{it}$ is a set of control variables, α_i is an individual's fixed effect, and ε_{it} is an idiosyncratic error term. (An intercept term and state and year fixed effects are included throughout, and they can be considered to be contained within $\mathbf{q}_{it}$.) The hypothesized value for the parameter of interest is a non-negative transmission effect of childhood food insecurity, $\beta \geq 0$.

The key question is how childhood food insecurity transmits to adult food insecurity, which the model can address by using indicator variables for food security status, $F_{it} \in \{0,1\}$, or by using some continuous measures for latent food insecurity for which the linear estimates could be mapped back into average partial effects for discrete changes in security status or interpreted generally as mobility estimates.

When interpreting the parameters from the model in equation (1), a primary interest is the degree to which food insecurity persists across generations without conditioning on any covariates. This general parameter for persistence can be thought of as the total intergenerational correlation inclusive of the direct transmission effect of childhood food insecurity and any other related factors, $\breve{\beta} = \beta + X\eta$, where X is the matrix of all other covariates in equation (1) and η is a vector of the partial correlations between the elements of X and F_{i,t_0}. The overall persistence of food insecurity, $\breve{\beta}$, can be compared with other estimates for socioeconomic persistence in the literature, such as income or health. As controls are included in the model, we can gain a clearer understanding of the transmission pathways for food insecurity. Values of β closer to 1 indicate higher persistence or transmission of food insecurity across generations, while values of β closer to 0 indicate more mobility with respect to food insecurity.

Identifying the transmission parameter of interest requires the ability to distinguish the effects of childhood food insecurity separately from unobserved heterogeneity that may be related to correlated earning ability or financial security across generations. Specifically, does any

intergenerational transmission mechanism for food insecurity remain after controlling for current income or wealth? Childhood food security can be expected to be correlated with some fixed endowment of ability that is unobserved and denoted by α_i, which would bias the estimated effects on current food insecurity. For example, estimates of the transmission parameter for childhood food insecurity would be biased if $\mathbb{E}\left[F_{i,t_0}\alpha_i\right] \neq 0$. Panel methods are available to address the portion of an individual's unobserved heterogeneity that is fixed over time, which we describe in the following sections.

3. Estimating the Intergenerational Transmission of Food Insecurity

The measure of childhood food insecurity does not vary over time once the individual has become an adult, so a standard panel model with fixed effects would eliminate both the individual's fixed unobserved characteristics as well as the main variable of interest. Instead, we propose to use a Hausman and Taylor (1981) type approach that uses within-panel information to instrument for any independent variables correlated with the individual's time-invariant heterogeneity. Given the key assumption that the model contains at least as many time-varying exogenous variables than time-invariant endogenous variables, each time-varying exogenous variable is able to identify its own effect while its mean deviation is available to instrument for an endogenous variable with no panel variation to instrument for itself. To be more concrete, the control variables in q_{it} can be partitioned according to the following characteristics denoted by subscripts shown in parentheses: time-varying (it), time-invariant (i), exogenous (1), and endogenous (2) such that $\mathbf{q}_{it}'\theta = \mathbf{x}_{1,it}'\rho_1 + \mathbf{x}_{2,it}'\rho_2 + \mathbf{w}_{1,i}'\phi_1 + \mathbf{w}_{2,i}'\phi_2$. For those variables that vary over time, $\left\{\mathbf{x}_{1,it}', \mathbf{x}_{2,it}'\right\}$, their $(k_1 + k_2)$ mean deviations are available as instruments for the set of $(k_2 + j_2)$ endogenous variables $\left\{\mathbf{x}_{2,it}', \mathbf{w}_{2,i}'\right\}$ where the endogenous variables are identified if $k_1 \geq j_2$. In the case where childhood food insecurity is the only time-invariant, endogenous variable $\left(\mathbf{w}_{2,it}' = \emptyset\right)$, this condition is easily satisfied when including any time-varying exogenous variables.

	Variable(s)	Dimensions
Time-varying, exogenous:	$\mathbf{x}_{1,it}$	k_1
Time-varying, endogenous:	$\left\{\mathbf{x}_{2,it}'\right\}'$	k_2
Time-invariant, exogenous:	$\mathbf{w}_{1,it}$	j_1
Time-invariant, endogenous:	$\left\{F_{i,t_0}, \mathbf{w}_{2,it}'\right\}'$	j_2

Implementing a Hausman-Taylor approach efficiently requires constructing weights for a feasible generalized least squares (FGLS) transformation of an instrumental variable (IV) estimator. Estimates of the variance in the error term, σ_ε^2, are obtained by a fixed-effect estimation of equation (1) (time-invariant variables drop out of the equation, yet the residual estimate is consistent). Then, the within-individual means of the residual (constructed by fitting the fixed-effect estimates excluding the individual error α_i) can be regressed on the time-invariant variables, $\left\{F_{i,t_0}, \mathbf{w}'_{1,i}, \mathbf{w}'_{2,i}\right\}'$, using $\left\{\mathbf{x}'_{1,it}, \mathbf{w}'_{1,i}\right\}'$ as instruments, to obtain a consistent estimate of σ_α^2, the variance of the individual effect.[7] The FGLS weight is constructed as $\hat{\lambda} = 1 - \sqrt{\hat{\sigma}_\varepsilon^2/(\hat{\sigma}_\varepsilon^2 + T\hat{\sigma}_\alpha^2)}$. The final weighted estimation of the Hausman-Taylor procedure uses a transformation of the independent variable, $F_{it}^* = F_{it} - \hat{\lambda}\bar{F}_i$, where $\bar{F}_i = T^{-1}\sum_{t=1}^{T} F_{it}$. The same transformation is used for the independent variables (equivalent to multiplying by $(1-\hat{\lambda})$ for the time-invaraiant variables), and the instrumental variables are $\left[\left(\mathbf{x}_{1,it} - \bar{\mathbf{x}}_{1,i}\right)', \left(\mathbf{x}_{2,it} - \bar{\mathbf{x}}_{2,i}\right)', \mathbf{w}'_{1,i}, \bar{\mathbf{x}}'_{1,i}\right]'$. Additional assumptions can lead to more effieicnt IV estimation based on including other projections of the panel data (see Amemiya and MaCurdy, 1986; Breusch, Mizon, and Schmidt, 1989), and recent work has incorporated more robust estimation methods for implementing a Hausman-Taylor approach (see Baltagi and Bresson, 2012; Harding and Lamarche, 2014).

The baseline set of time-varying, exogenous controls in $\mathbf{x}_{1,it}$ includes a quadratic in the individual's age, indicators for number of family children (1, 2, 3, 4 or more), age of the youngest child, indicators for the presence of other adults besides head/spouse, anyone with a disability, or elderly family members, as well as state-level controls for the SPM poverty rate, unemployment include indicators for the individual's sex, race/ethnicity, and a quadratic in the parent's average age when the individual was observed as a child. The time-varying endogenous controls, $\mathbf{x}_{2,it}$, include the log of earnings and log of wealth.[8] Childhood food insecurity is the only time-invariant, endogenous variable included in the model.

[7] The residual from this step is an estimate of $\sigma_\alpha^2 + \sigma_\varepsilon^2/T$ for total year observations T, which allows the recovery of σ_α^2 given the estimate of σ_ε^2 in the first step.

[8] Since earnings measures contain zeroes and wealth can be zero or negative, we use the inverse hyperbolic sine transformation, $\ln\left(y_{it} + (y_{it}^2 + 1)^{1/2}\right)$, which can be interpreted similarly to the natural log transformation given that it closely approximates $\ln(2y_{it}) = \ln(2) + \ln(y_{it})$.

Potential biases may still exist when estimating the intergenerational transmission of food insecurity. In addition to identification threats from selection bias, estimates comparing food security across generations may be affected by life-cycle bias or measurement error in defining food insecurity.[9] The literature on intergenerational income mobility and socioeconomic persistence has emphasized the role of life-cycle biases when comparing limited observation windows for each generation, and these windows may be associated with different age profiles in the respective generations (Grawe, 2006; Haider and Solon, 2006; Lee and Solon, 2009; Wolfe et al., 1996). The importance of life-cycle bias is relative to the degree to which intergenerational estimates should be interpreted as a stable indicator of the transmission of lifetime characteristics. For income mobility studies, researchers are interested in approximating some notion of permanent income. A typical approach is to use multi-year averages and adjust for some polynomial function of age. Data limitations for food security measures may rule out long, multi-year averages. In order to offer a clear interpretation of the estimated persistence parameters, we restrict the sample to children under age 18 in the initial period and control for age profiles in later time periods, which are restricted to adults who were observed in childhood and are now over age 20 and have established their own family unit (with some estimates restricted to those who have children). Therefore, these estimates can be interpreted as the persistence of food insecurity during individuals' transitions to adulthood conditional on their childhood food insecurity.

For potential measurement error, the threat is relevant for the definition of food security as an outcome in either generation. Most food security measures depend on some self-reported questionnaire that is open to subjective interpretation. For example, identical families with the same food budget may disagree as to whether they did not eat because there was not enough money for food in the last 12 months. A particular estimation problem could arise if families were asked previously in the survey whether they received any food assistance and then were asked later in the survey if they had negative experiences relative to their food situation. The first questions may predispose individuals' responses to the follow-up questions. That is, a positive response to food assistance participation may correlate with positive responses to food insecurity questions as a justification for needing assistance. This positive correlation would lead toward an upward bias of the effect of food assistance on insecurity such that participants seem less food secure. In order to

[9] For example, see Hartley, Lamarche, and Ziliak (2017) for a study that addresses each of these potential biases in the case of intergenerational transmission of welfare participation.

test this relationship, we use multiple definitions of self-reported food security, and we contrast these outcomes with security defined by the ratio of food expenditure to budgetary needs by family characteristics and nutrient intake standards.

4. DATA

The Panel Study of Income Dynamics (PSID) is the longest-running longitudinal survey in the world, and it is the only data source that would allow a comparison of household food insecurity across generations.[10] For the first generation, we use four years of survey data that would correspond to an individual's childhood before age 18. The first PSID questions on food security were implemented in the 1997 Child Development Supplement (CDS), which was randomly assigned to a subset of PSID children ages 0 through 12. Subsequently, the next three main family surveys, fielded biennially in 1999, 2001, and 2003, included the same set of food security questions for all families. The next survey to include food security questions is the 2014 CDS, which was fielded to all children under age 18 (since the questions correspond to the household, individuals observed in this survey can include adults who were previously observed during childhood in the earlier food security surveys). The food security questions returned to the main family surveys for the next two survey years, 2015 and 2017 (available in early release data). Moreover, the PSID provides rich information on income and wealth resources as well as welfare benefits.

The main PSID surveys collect a wide range of individual and family characteristics as well as income, program participation, and expenditure measures for the prior year (T-1). After the 1997 survey, the main survey has been fielded every other year with some questions included for the year before the prior year (T-2). For the main variables of interest, family earnings measures are available in each year (using both T-1 and T-2 measures), food expenditure measures are available in the T-1 years beginning with the 1999 survey, and food security questions are asked only in the 1999, 2001, 2003, 2015, and 2017 main surveys as well as the CDS 1997 and 2014 surveys. The estimation sample is restricted to individuals who are observed as children under age 18 during the earlier survey years, 1997–2003. These individuals (N = 2797) are followed for all subsequent years in which their food security status is observable as an adult (at least 20 years old) who has started

[10] Public-use version of these data were obtained via the University of Michigan Survey Research Center (Panel Study of Income Dynamics, 2018).

their own family unit, which includes 3 years of food security questionnaire responses (T = 2014, 2015, 2017), or 8 years of food expenditure measures (T = 2000, 2002, . . . , 2014).

Food security measures in the PSID are constructed based on the standard set of 18 questions used by the USDA, such as whether the family has skipped meals during the last 12 months, for example. The food security questions are conceptually related to deprivation from lack of income, so it is not sufficient that someone indicates they skipped a meal unless it was due to a lack of economic resources. The first 10 questions are directed toward adults in the household, and the last 8 questions are directed toward children if any are present. Each household has a raw score that totals the positive responses, that is, each question to which the respondent admits to some degree of food insecurity. Following standard practice in the literature, we define three levels of food insecurity using these raw scores ranging from 0 to 18: marginal food secure (1-18), low food secure (3-18), and very low food secure (6-18 for families without children, or 8-18 for families with children given the additional child-focused questions).

Table 1 provides descriptive statistics for the estimation sample by food security status. On average, marginally food secure families have younger heads of household and are more likely to be unmarried householders, non-white, and less educated. Food insecure households spend about a third less on food than food secure households, even though they have approximately the same number of children present. Among families with at least one positive response to a food insecurity question, the average number of positive responses is about 4 out of 18 total questions (where a positive response indicates admitting some food insecure outcome). Also, among families who are at least marginally food secure, over half are also considered low food secure and nearly 1 in 5 are very low food secure based on the definitions above. About half of all public assistance recipients are classified as food insecure compared to only about 1 in 10 among the non-recipient population, and food insecurity is especially prevalent among SNAP recipients (see Appendix Figure A1).

For initial descriptive evidence, Table 2 shows a transition probability matrix for food security status across generations. Among individuals who were food secure as a child, the probability of being food secure as an adult is about 72 percent. For a low food secure childhood, the probability drops to nearly a 50:50 chance of food security. Individuals who were very low food secure as a child are more likely to be insecure as an adult than they are to be food secure, and they have a larger probability of being low food secure at about 32 percent instead of just marginal food secure at about 20 percent. These probabilities are age adjusted conditional on quadratics in the

ages of the individual as an adult and the parent's age when the individual was a child, though the differences from purely unconditional estimates are minor. Overall, these descriptive probabilities are strong motivation for understanding how childhood food security relates to outcomes as an adult.

As an additional measure of food insecurity, we use food expenditure values as a proportion of the USDA recommended Thrifty Food Plan (TFP), which corresponds to the nutrient intake needs that vary by individuals' age, sex, and family size. Based on evidence of the importance of the real purchasing power for food spending and food assistance, we adjust the dollar amounts of food needs using regional price indices (Basu, Wimer, and Seligman, 2016; Bronchetti, Christensen, and Hoynes, 2018; Ziliak and Gundersen, 2016).[11] Based on this ratio, we define food insecurity by cutoffs for low food spending or continuous measures by the ratio of food spending to food needs. Families who spend less than 100 percent of the USDA needs guidelines may be classified as "low spending", an alternative for food insecure.

5. Persistence in Food Insecurity

We begin with descriptive evidence on the persistence of food insecurity within families over time by showing correlations to an initial observation in 1996 (from the 1997 CDS survey) for a cohort of children ages 0 to 12.[12] The results in Figure 2 correspond to correlations estimated separately by year conditional on a set of exogenous covariates. During the early years while the followed individuals are still in the age range of 4-18, the within-family persistence of food insecurity is around a correlation of 0.25. At nearly 20 years after the initial period, the individuals are aged 18-30 in 2014, and some have started their own families by this time. In 2014, the food insecurity correlation is about 0.222 (0.047) for marginal food security and 0.209 (0.065) for low food security, with standard errors given in parentheses. These estimates are controlling for whether an individual has become the head/spouse of their own family, which is about 60 percent of the sample. If we restrict the sample to individuals who have become householders in 2014, then the intergenerational estimates for food insecurity transmission become 0.177 (0.042) for marginal food security and 0.144 (0.076) for low food security. Persistence is higher within the same family unit,

[11] For USDA food plans by month, see https://www.cnpp.usda.gov/USDAFoodPlansCostofFood. These estimates use guidelines for June 2015. Consumer price indices for urban consumers by region and Census division are used to adjust values by year and location.

[12] These estimates define the initial food insecurity status as $F_{i,t_0=1996}$ for equation (1) and assume that $\{\gamma, \delta, \theta_2'\}' = \mathbf{0}$.

yet there is no statistically significant difference when comparing to individuals who have started their own new families.[13]

As a comparison, we next reproduce Figure 2 estimates with an alternative measure of food insecurity based on low food spending defined as food expenditure less than the USDA Thrifty Food Plan adjusted for cost of living by region (see Figure 3).[14] To provide another reference for comparison, we also show estimates of the income IGE (the IGE may differ from other estimates given the subsample of PSID families with children under age 13 in 1996, and no attempt is made here to account for life-cycle and measurement biases). Persistence in food expenditure and income decays more steeply than persistence in food insecurity defined by the USDA questionnaire. These estimates, relative to the initial year of 1998, the first year food expenditure is consistently available, range from a correlation of low food spending of 0.499 (0.029) in 2000 to 0.129 (0.029) in 2014, a decrease of about three-fourths. The income IGE during this period ranges from 0.404 (0.042) in 2000 to 0.211 (0.034) in 2014, which is a decrease of just less than half. The change in persistence for self-reported food insecurity in Figure 2 was a decrease of about three-tenths, a much flatter gradient relative to income or food expenditure measures. The differences between persistence in reported food security and low food expenditure are suggestive of the need for further research to distinguish how each relates to potential transmission mechanisms.

To compare the distribution of food expenditure as a ratio of the Thrifty Food Plan by reported food security status, see Appendix Figure A4. Alternatively, to compare these distributions for food expenditure as a ratio of the U.S. Census official poverty needs threshold, see Appendix Figure A5. In results not shown here, we have reproduced the correlation estimates for many cutoff values and find similar qualitative results.

6. Intergenerational Transmission of Food Insecurity

Next, we estimate equation (1) by defining the measure of childhood food insecurity where t_0 corresponds to years the individual is under age 18, and F_{i,t_0} is an average of any childhood

[13] For sensitivity analysis on the choice of food security threshold definitions, see results in Appendix Figure A2 with estimates by threshold of positive responses from 1 to all 18 survey questions. The panels show results that vary by the choice to condition on covariates and the use of sample weights. We use weights throughout to account for potentially endogenous heterogeneity related to oversampling low-income and racial minority families (for detailed discussion on this practice, see Solon, Haider, and Wooldridge (2015). Appendix Figure A3 shows results for marginal food secure, low food secure, and very low food secure status using the same four panels for estimates that are unconditional/conditional, weighted/unweighted.

[14] The cutoff of 100 percent of the USDA Thrifty Food Plan is straightforward, still it is somewhat arbitrary.

observations in 1996, 1998, 2000, and 2002. These estimates are restricted to individuals who have become adults and started their own families by the observation years 2013, 2014, or 2016, or in the case of insecurity based on food expenditures, adult observations are additionally available for years 2008, 2010, and 2012. In Table 3, panel A shows correlations by food security status: marginal food secure, low food secure, and very low food secure. The odd columns show unconditional correlations that only adjust for life-cycle by controlling for quadratics in the individual's current age as an adult and the parent's average age during the individual's childhood. These unconditional correlations represent a composite of all of the factors that determine persistence across generations, which is an estimate of $\breve{\beta} = \beta + X\eta$. The correlations shown in even columns include the baseline model covariates discussed in Section II, which includes a set of exogenous controls as well as measures of welfare participation, income, and wealth. These estimates show the sensitivity of the intergenerational transmission of food insecurity, yet the welfare participation effects should not be interpreted causally given the negative selection into welfare participation.

Based on the discrete food security status measures in panel A, the persistence of food insecurity appears to be declining with the degree of hardship: marginal food security is correlated by 0.178 (0.018) in column (1) compared to an intergenerational correlation of 0.138 (0.031) for low food security in column (3) and 0.070 (0.039) for very low food security in column (5). Panel B of Table 3 changes from discrete indicators of food security status to continuous measures of latent food security. To better compare generational outcomes using these continuous measures based on the entire 18-question survey, we now restrict the sample to families with children. Columns (1) and (2) use the raw score out of a possible 0 to 18, for which 0 corresponds to food secure families and 18 would be the most food insecure. Although the estimates for the raw score measure are less informative, it provides a transparent comparison before switching focus to the latent measures. Columns (3)-(6) rely on an estimate of the latent food security where a low value again corresponds to food secure and higher values food insecure (see Appendix Figure A6 for a visual mapping of latent scores to the food security statuses used above). The actual latent measure for food security is used in columns (3) and (4), and a percentile rank of latent food security is used in columns (5) and (6), where again the ranking is increasing with insecurity such that all of the signs of effects can be interpreted similarly.

The intergenerational correlations in continuous food security measures are generally consistent across the continuous measures used. Results in columns (5) and (6) provide a rank-rank

slope for food security mobility, and these results are the most comparable with the discrete measures for marginal food secure families. The unconditional correlation in intergenerational latent food security is about 0.2, which is approximately the same magnitude of estimated found by Halliday, Mazumder, and Wong (2018) for self-reported health reported. The conditional estimates of food insecurity transmission are closer to 0.1 after accounting for income and wealth among other covariates.

The last set of results in Table 3 show intergenerational correlations for an alternative measure of food insecurity in panel C: food spending relative to a family's needs as defined by the USDA's Thrifty Food Plan (TFP). Any measure of food insecurity may have limitations, thus comparisons across different measures offer a chance to validate the transmission effects. For self-reported food insecurity, one may be concerned that the responses are subjective, reported with error, or influenced by the ordering of questions. For instance, if food assistance is self-reported immediately prior to food security questions within the survey, the respondent may be inclined to justify the need for assistance by providing stronger responses of insecurity. Likewise, food spending per family needs may not accurately reflect levels of deprivation and may be more closely related to correlations in income. The results in panel C, however, seem to be consistent with those of continuous latent food security measures in panel B. Generally, the magnitudes for food spending per TFP as a proxy for insecurity yields larger magnitudes in the intergenerational correlation. Even when controlling for income and wealth in column (6), for example, families experience more persistence in food insecurity according to spending/TFP than to responses to the 18-question USDA instrument. These estimates corroborate that persistence in food insecurity is not a mechanical effect of low incomes or subjective survey responses. Based on these results, the estimates of persistence in latent food security as measured by percentile rank in columns (5) and (6) of panel B could be considered the most informative and perhaps the more conservative estimates.

In an attempt to correct for the presence of selection bias, we next present Hausman-Taylor-type IV estimates. Table 4 presents results for rank-rank latent food security defined by USDA questionnaire responses in column (1), and food security defined by low food spending in column (2). The transmission estimates of persistent insecurity are larger for latent food security in column (1), however, there are only three years of observations for adulthood food insecurity. Additional observations years are available for adult food spending per TFP needs, which allows us to restrict

estimates in column (2) to individuals observed at least 5 years. The intergenerational transmission effect of food insecurity, controlling for income and wealth, is approximately 0.269.

7. Discussion and Policy Implications

Intergenerational correlations in food insecurity are around 0.1 to 0.2 among young adults aged 20 to 35, and transmission of food insecurity is decreasing with the severity of insecurity. These are the first estimates of persistent food insecurity across generations, and therefore an important benchmark for intergenerational poverty and deprivation. Our evidence suggests that the transmission mechanism is not a spurious correlation driven by persistence in earning ability given that the magnitude of childhood food insecurity effects do not go away when controlling for income or wealth, or when instrumenting for an individual's fixed ability endowment.

An important general question is how much intergenerational associations between food insecurity and earnings are interrelated. Table 5 shows the rank-rank slope estimates comparing childhood food insecurity to adulthood earnings. If the causal mechanism for persistent food insecurity is related to human capital development, then one might expect childhood food insecurity to lead to lower earnings as an adult. These results suggest that the percentile rank of childhood food insecurity is negatively correlated with the percentile rank in adult earnings by -0.338 (0.092) for IV estimates based on latent food security (column (3)), and by -0.197 (0.142) for IV estimates using food spending/TFP (column (6)). The results based on latent food security in column (3) imply that moving from the 75th to the 25th percentile ranks in latent food insecurity (that is, improving food security) would lead to a 16 percentile rank improvement in adult earnings (or a 9 percent rank improvement based on childhood spending/needs). For comparison, Appendix Table A1 provides rank-rank estimates for childhood and adult earnings, which are unconditionally correlated by 0.398 (0.027) using the same individuals from the main estimation sample.[15]

[15] This rank-rank estimates for family earnings is somewhat smaller than IGE estimates for income in the literature, although the sample here is restricted by age and family structure and does not attempt to account for the same life-cycle adjustments as the IGE literature.

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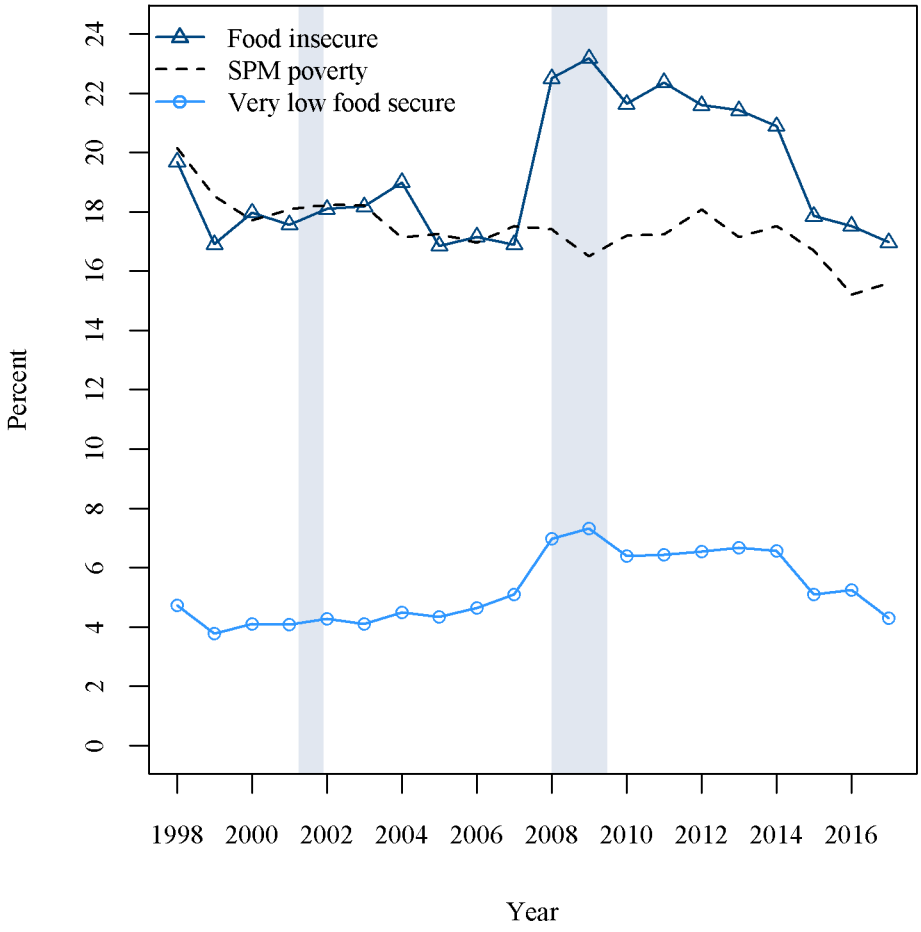
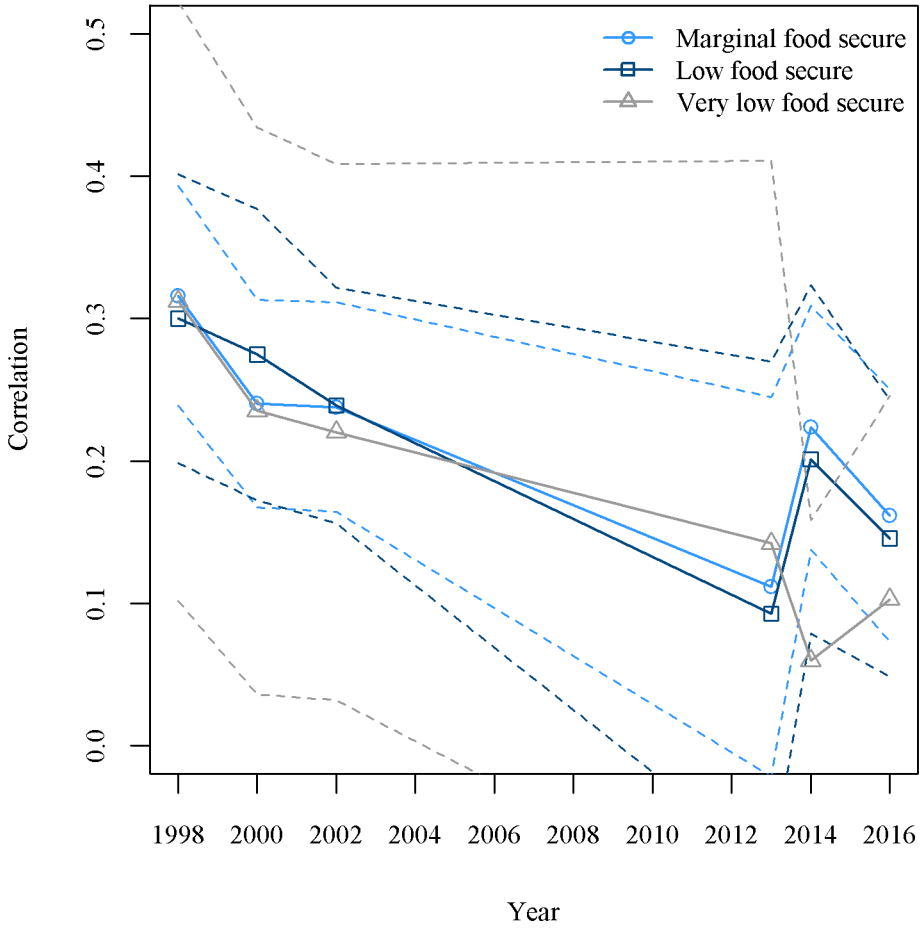
Figure 1. Percent of Children by Household Food Security and Poverty Status, 1998-2017



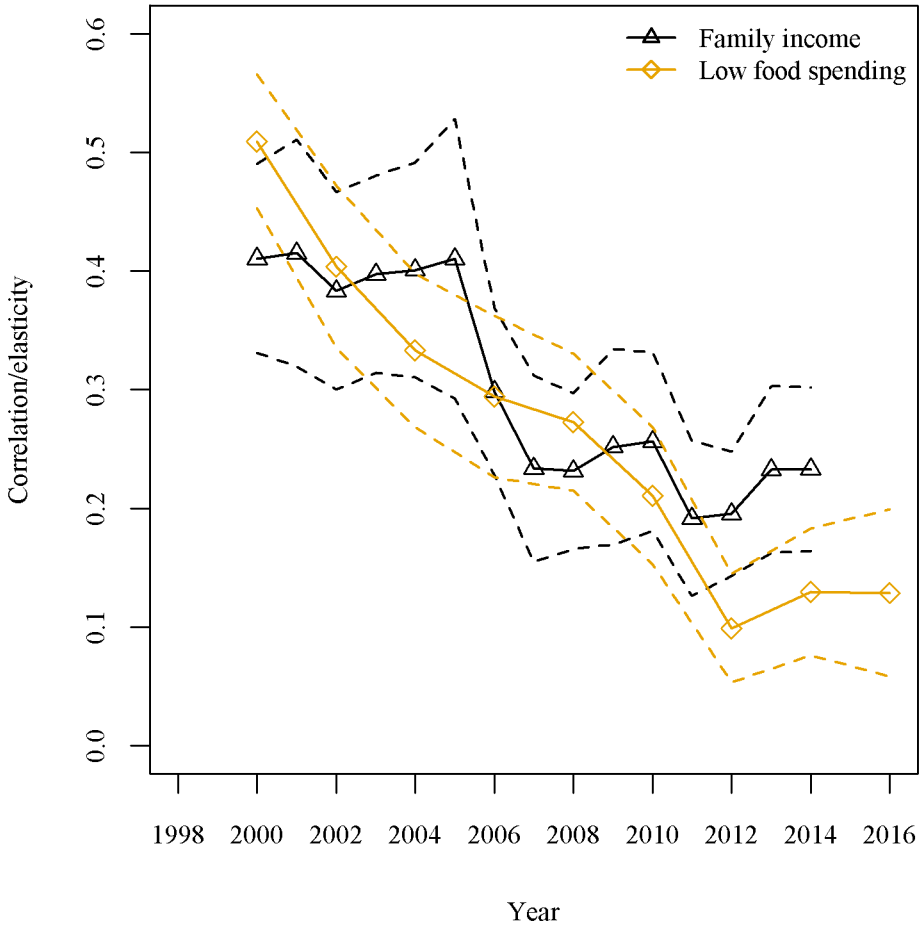
Notes: Shaded regions indicate recessions according to the National Bureau of Economic Research. Food insecure status is inclusive of those classified as low food secure or very low food secure (Coleman-Jensen et al., 2018, Table 1A). SPM poverty denotes the percent of children in families with economic resources (after taxes, transfers, and certain expenses) below the Supplemental Poverty Measure threshold.

Figure 2. Within-Family Persistence in Food Security Status Relative to 1996



Notes: The estimates above represent results from separate estimation equations by year with 95-percent point-wise confidence intervals based on robust covariance estimates with state-level clustering. These estimates are conditional on the exogenous baseline covariates while also using PSID core longitudinal sample weights. Marginal food secure denotes at least 1 positive response to the 18 food security questions, low food secure denotes at least 3 positive responses, and very low food secure denotes at least 6 positive responses for families with no children or at least 8 positive responses for families with children.

Figure 3. Within-Family Persistence in Family Income and Low Food Expenditure Relative to 1998



Notes: The estimates above represent results from separate estimation equations by year with 95-percent point-wise confidence intervals based on robust covariance estimates with state-level clustering. These estimates are conditional on the exogenous baseline covariates while also using PSID core longitudinal sample weights. Family earnings denotes the log of a three-year moving average for total family earnings, and low spending denotes food expenditure less than the USDA Thrifty Food Plan adjusted for regional price differences.

Table 1. Descriptive Statistics

	Food secure	Marginal food secure	Full sample
Food security raw score	–	3.905	0.740
		(3.125)	(2.047)
Marginal food secure?	–	1.000	0.189
		(0.000)	(0.392)
Low food secure?	–	0.531	0.101
		(0.499)	(0.301)
Very low food secure?	–	0.193	0.037
		(0.395)	(0.188)
Family earnings (thousands)	81.692	29.006	71.714
	(122.508)	(25.412)	(112.756)
Food expenditure (thousands)	9.872	6.434	9.208
	(5.249)	(4.121)	(5.229)
Receives food stamps/SNAP?	0.063	0.323	0.112
	(0.244)	(0.468)	(0.315)
Age of head of household	40.012	35.399	39.138
	(10.155)	(10.520)	(10.383)
Race: Black/African-American?	0.140	0.321	0.174
	(0.347)	(0.467)	(0.379)
Race: White/Caucasian?	0.799	0.593	0.760
	(0.401)	(0.491)	(0.427)
Race: Other?	0.019	0.022	0.020
	(0.137)	(0.148)	(0.139)
Married family?	0.758	0.478	0.705
	(0.428)	(0.500)	(0.456)
Number of children in family	1.816	1.861	1.825
	(1.105)	(1.353)	(1.156)
Parent education high school or less?	0.225	0.420	0.262
	(0.417)	(0.494)	(0.440)

Notes: Sample means are shown with standard errors in parentheses. Estimates are weighted using individuals' core longitudinal sample weights. Food secure denotes no positive responses to the 18 food security questions, marginal food secure denotes at least 1 positive response to the 18 food security questions, low food secure denotes at least 3 positive responses, and very low food secure denotes at least 6 positive responses for families with no children or at least 8 positive responses for families with children.

Table 2. Transition Probabilities Conditional on Childhood Food Security and Age Adjustments

	Adult food security status			
	Food secure	Marginal food secure	Low food secure	Very low food secure
Childhood food security status				
Food secure	72.2%	12.2%	11.9%	3.7%
Marginal food secure	60.1%	15.7%	15.3%	8.9%
Low food secure	54.2%	19.0%	16.0%	10.9%
Very low food secure	41.4%	20.2%	31.8%	6.6%

Notes: The transition probabilities represent the expected adult food security status given each childhood status conditional on a quadratic in both the individual's current age in adulthood and the parent's average age during childhood. The rows sum to 100 percent indicating the full distribution of outcomes for each childhood food security status. Food secure denotes no positive responses to the 18 food security questions, marginal food secure denotes at least 1 positive response to the 18 food security questions, low food secure denotes at least 3 positive responses, and very low food secure denotes at least 6 positive responses for families with no children or at least 8 positive responses for families with children.

Table 3. Estimates of Intergenerational Food Security Correlations

A. Discrete Measures of Food Security Status						
	Marginal food secure		Low food secure		Very low food secure	
	(1)	(2)	(3)	(4)	(5)	(6)
Childhood food insecurity	0.178	0.102	0.138	0.051	0.070	0.022
	(0.018)	(0.022)	(0.031)	(0.038)	(0.039)	(0.051)
Baseline covariates	No	Yes	No	Yes	No	Yes
Number of individuals	2797	2797	2797	2797	2797	2797
Observations	6591	6591	6591	6591	6591	6591
B. Continuous Measures of Latent Food Security for Families with Children						
	Raw score (0-18)		Latent food security		Percentile rank food security	
	(1)	(2)	(3)	(4)	(5)	(6)
Childhood food insecurity	0.196	0.113	0.201	0.108	0.202	0.110
	(0.071)	(0.092)	(0.053)	(0.078)	(0.051)	(0.071)
Baseline covariates	No	Yes	No	Yes	No	Yes
Number of individuals	1246	1246	1246	1246	1246	1246
Observations	3235	3235	3235	3235	3235	3235
C. Measures of Food Spending by Thrifty Food Plan (TFP) Needs for Families with Children						
	Food spending below TFP needs		Log food spending per TFP needs		Percentile rank food spending/TFP	
	(1)	(2)	(3)	(4)	(5)	(6)
Childhood food insecurity	0.219	0.125	0.289	0.131	0.430	0.300
	(0.050)	(0.048)	(0.044)	(0.033)	(0.055)	(0.051)
Baseline covariates	No	Yes	No	Yes	No	Yes
Number of individuals	1645	1645	1645	1645	1645	1645
Observations	6265	6265	6265	6265	6265	6265

Notes: The intergenerational measures for childhood outcomes correspond to the same measures in adulthood as indicated by the column headers. In panel C, columns (3) and (4) correspond to the negative of log food spending per TFP in order to be consistent with the direction of effects relative to other estimates. Robust standard errors with state-level clustering are shown in parentheses. All specifications above use PSID core longitudinal weights in estimation. Marginal food secure denotes at least 1 positive response to the 18 food security questions, low food secure denotes at least 3 positive responses, and very low food secure denotes at least 6 positive responses for families with no children or at least 8 positive responses for families with children.

Table 4. Hausman-Taylor IV Estimates of Intergenerational Rank-Rank Food Security

	Latent food security	Food spending per Thrifty Food Plan
	(1)	(2)
Childhood food insecurity	0.621	0.162
	(0.433)	(0.191)
Panel std. dev., σ_α	0.429	0.280
Std. dev. of error, σ_ε	0.297	0.150
$\rho = (\sigma_\alpha^2/(\sigma_\alpha^2 + \sigma_\varepsilon^2))^{1/2}$	0.676	0.777
Number of individuals	1242	654
Observations	3215	3646

Notes: Childhood food security corresponds to the same measure defined for the adult outcome, which is indicated by the column headings. Robust standard errors with state-level clustering are shown in parentheses. All specifications above use PSID core longitudinal weights in estimation.

Table 5. Intergenerational Rank-Rank Estimates of
Childhood Food Insecurity and Adulthood Family Earnings

Dependent variable:	Adulthood family earnings (percentile rank)					
Independent variable:	Food security			Food spending/Thrifty Food Plan		
	(1)	(2)	(3)	(4)	(5)	(6)
Childhood food insecurity	-0.195	-0.061	-0.338	-0.211	-0.086	-0.197
	(0.018)	(0.013)	(0.092)	(0.045)	(0.023)	(0.142)
Quadratic age controls	Yes	Yes	Yes	Yes	Yes	Yes
Exogenous covariates	No	Yes	Yes	No	Yes	Yes
Hausman-Taylor IV	No	No	Yes	No	No	Yes
Panel std. dev., σ_α			0.177			0.158
Std. dev. of error, σ_ε			0.069			0.071
$\rho = (\sigma_\alpha^2/(\sigma_\alpha^2 + \sigma_\varepsilon^2))^{1/2}$			0.869			0.833
Number of individuals	1725	1725	1252	1645	1645	1375
Observations	9445	9431	8341	8835	8824	8511

Notes: The dependent variable for all columns is the adulthood family earnings percentile rank, and the columns represent childhood food insecurity percentile ranks by food security questionnaire, (1)-(3), and food spending per needs according to the Thrifty Food Plan, (4)-(6). Robust standard errors with state-level clustering are shown in parentheses. All specifications above use PSID core longitudinal weights in estimation.

APPENDIX A.

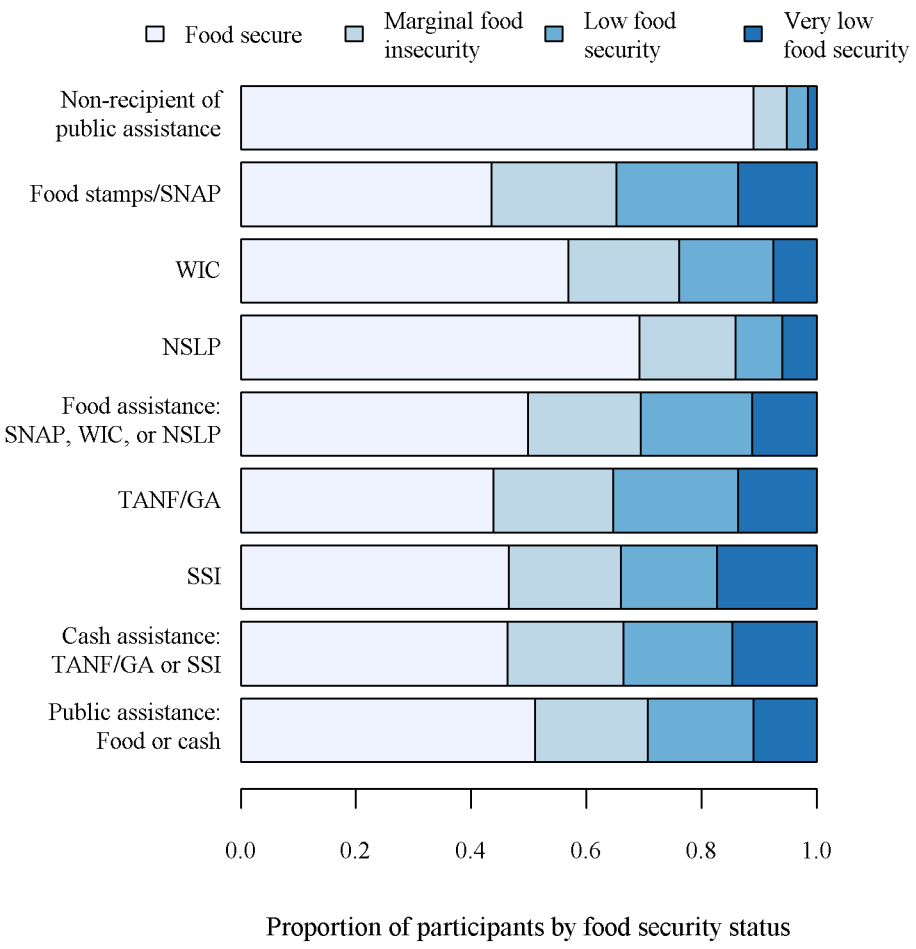
Questionnaire used to assess food security (Coleman-Jensen et al., 2018):

1. We worried whether our food would run out before we got money to buy more." Was that often, sometimes, or never true for you in the last 12 months?
2. The food that 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 last 12 months?
3. We couldn't afford to eat balanced meals." Was that often, sometimes, or never true for you in the last 12 months?
4. In the last 12 months, did you or other adults in the household ever cut the size of your meals or skip meals because there wasn't enough money for food? (Yes/No)
5. (If yes to question 4) How often did this happen|almost every month, some months but not every month, or in only 1 or 2 months?
6. In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money for food? (Yes/No)
7. In the last 12 months, were you ever hungry, but didn't eat, because there wasn't enough money for food? (Yes/No)
8. In the last 12 months, did you lose weight because there wasn't enough money for food? (Yes/No)
9. 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? (Yes/No)
10. (If yes to question 9) How often did this happen|almost every month, some months but not every month, or in only 1 or 2 months?

(Questions 11-18 were asked only if the household included children age 0-17)

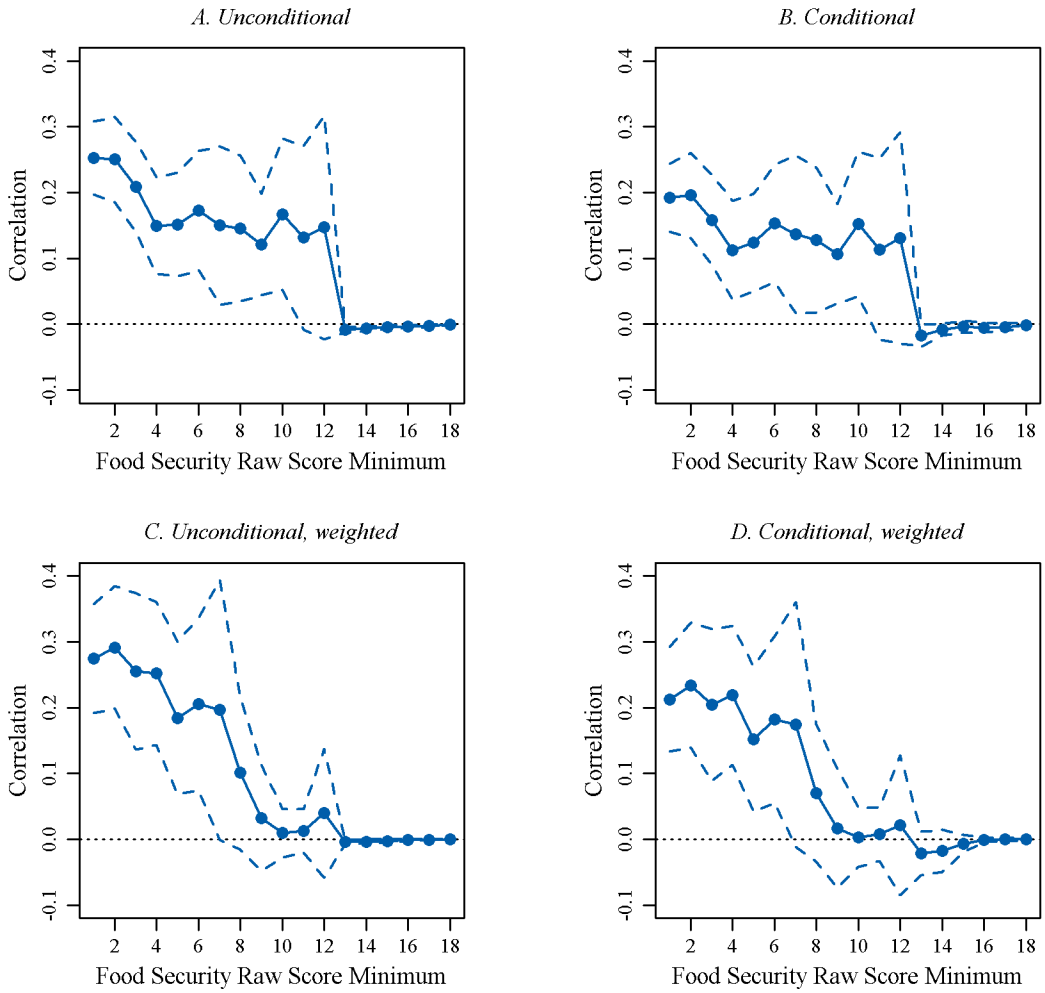
11. \We relied on only a few kinds of low-cost food to feed our children because we were running out of money to buy food." Was that often, sometimes, or never true for you in the last 12 months?
12. \We couldn't feed our children a balanced meal, because we couldn't afford that." Was that often, sometimes, or never true for you in the last 12 months?
13. \The children were not eating enough because we just couldn’t afford enough food." Was that often, sometimes, or never true for you in the last 12 months?
14. In the last 12 months, did you ever cut the size of any of the children's meals because there wasn't enough money for food? (Yes/No)
15. In the last 12 months, were the children ever hungry but you just couldn't afford more food? (Yes/No)
16. In the last 12 months, did any of the children ever skip a meal because there wasn't enough money for food? (Yes/No)
17. (If yes to question 16) How often did this happen|almost every month, some months but not every month, or in only 1 or 2 months?
18. In the last 12 months did any of the children ever not eat for a whole day because there wasn't enough money for food? (Yes/No)

Figure A1. Distribution of Food Security Status
by Assistance Program Participation



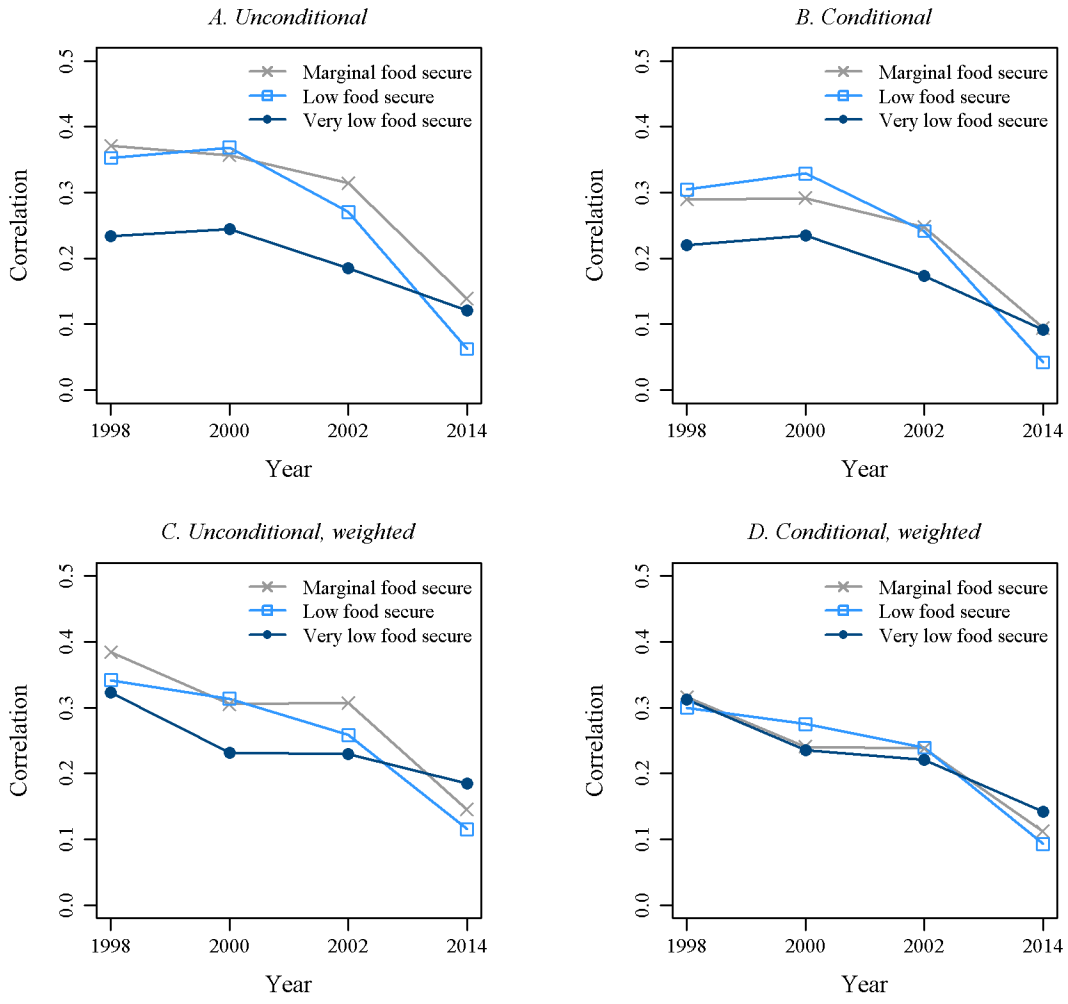
Notes: Food secure denotes no positive responses to the 18 food security questions, marginal food secure denotes at least 1 positive response, low food secure denotes at least 3 positive responses, and very low food secure denotes at least 6 positive responses for families with no children or at least 8 positive responses for families with children. *Abbreviations:* Special Supplemental Nutrition Program for Women, Infants, and Children (WIC); National School Lunch Program (NSLP); Temporary Assistance for Needy Families (TANF); and, Supplemental Security Income (SSI).

Figure A2. Within-Family Household Food Security Correlations Between 1996 and 2015 by Minimum Raw Score



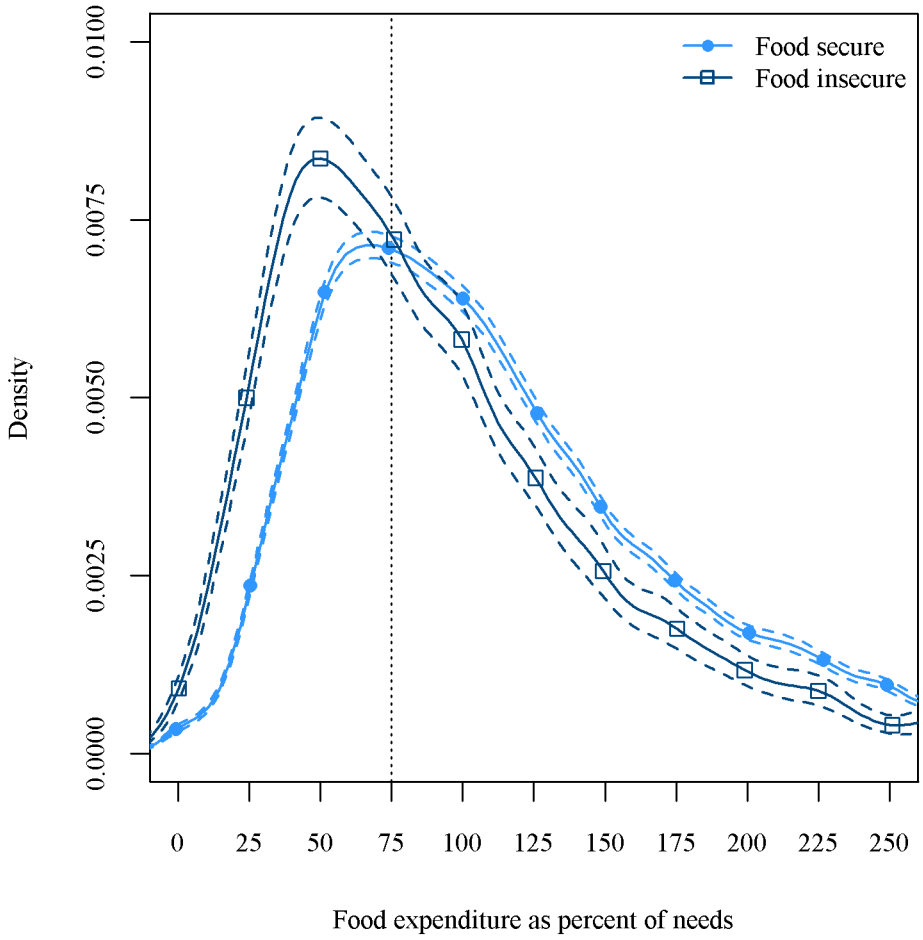
Notes: Estimates above are conditional on the baseline controls and use the PSID core longitudinal sample weights, and each point represents a separate estimation with 90-percent point-wise confidence intervals. These food security raw scores correspond to the number of questions regarding food security to which individuals gave a positive response indicating some degree of food insecurity.

Figure A3. Within-Family Household Food Insecurity
Correlations Relative to 1996



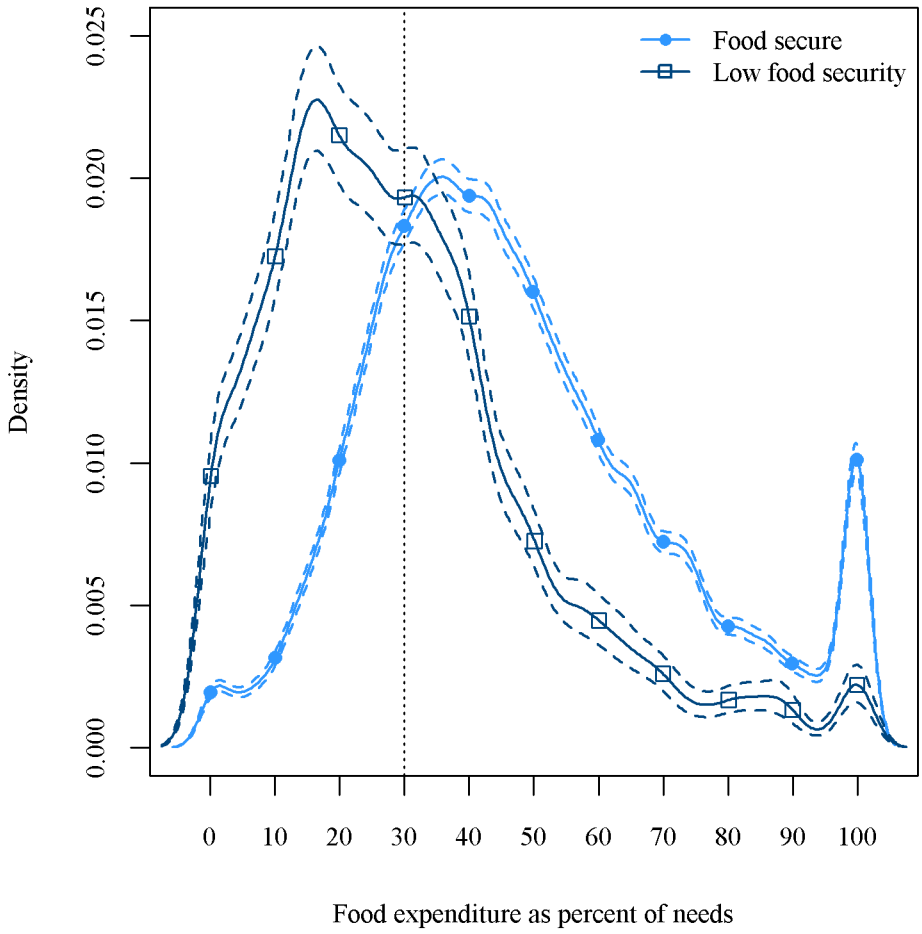
Notes: Estimates above are conditional on the baseline controls and use the PSID core longitudinal sample weights, and each point represents a separate estimation with 90-percent point-wise confidence intervals. Marginal food secure denotes at least 3 positive responses to the 18 food security questions, low food secure denotes at least 3 positive responses, and very low food secure denotes at least 6 positive responses for families with no children or at least 8 positive responses for families with children.

Figure A4. Distribution of Food Expenditure as a Percent of Needs (USDA Thrifty Food Plan) by Food Security Status



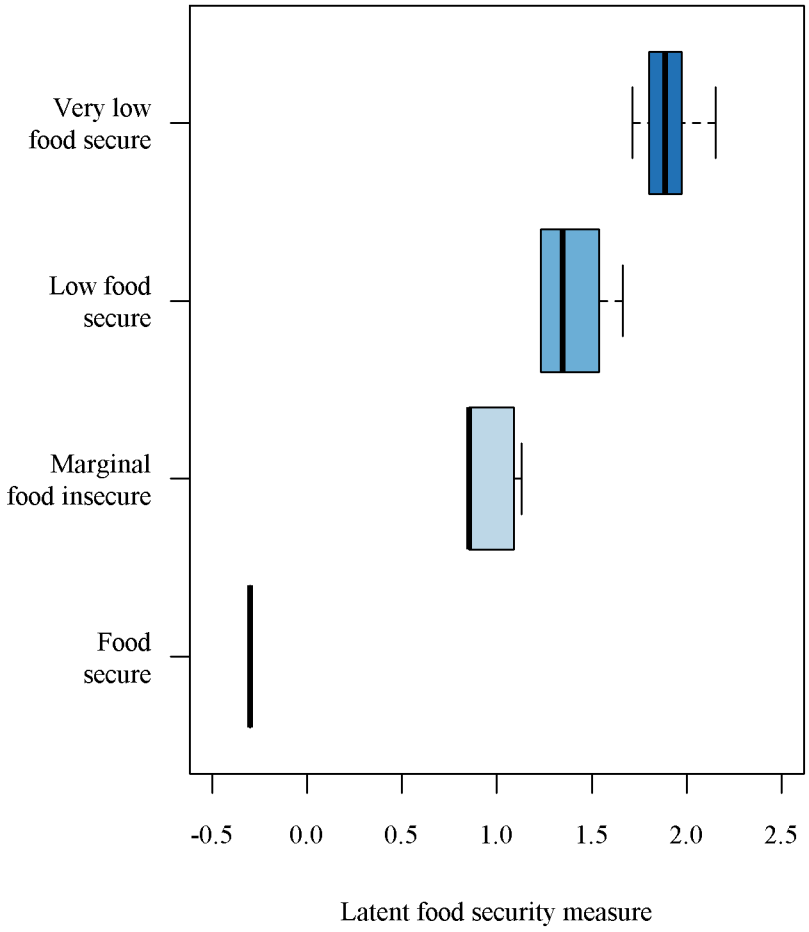
Notes: Food secure denotes no positive responses to the 18 food security questions, and low food secure denotes at least 3 positive responses. The 75-percent cutoff corresponds to the largest mean difference in low food spending probability by food secure or low food secure statuses. While the percent of needs x-axis is abbreviated for illustration purposes, the density mass of food secure individuals above the 250-percent threshold of needs is much greater than those who are low food secure.

Figure A5. Distribution of Food Expenditure as a Percent of Needs (Official Poverty Threshold) by Food Security Status



Notes: Food secure denotes no positive responses to the 18 food security questions, and low food secure denotes at least 3 positive responses. The 30-percent cutoff corresponds to the largest mean difference in low food spending probability by food secure or low food secure statuses. The percent of the poverty needs threshold on the x-axis is capped at 100 percent.

Figure A6. Relationship between Latent Food Security and Food Security Status Indicators



Notes: Food secure denotes no positive responses to the 18 food security questions, marginal food secure denotes at least 1 positive response to the 18 food security questions, low food secure denotes at least 3 positive responses, and very low food secure denotes at least 6 positive responses for families with no children or at least 8 positive responses for families with children. The box plots represent the median and interquartile range of the latent measure of food security, and the extreme lines show the range of values excluding outliers.

Table A1. Intergenerational Rank-Rank Estimates of Family Earnings Using the Main Estimation Sample and Methods

	(1)	(2)	(3)
Childhood family earnings	0.398	0.263	0.749
	(0.027)	(0.030)	(0.134)
Quadratic age controls	Yes	Yes	Yes
Exogenous covariates	No	Yes	Yes
Hausman-Taylor IV	No	No	Yes
Panel std. dev., σ_α			0.223
Std. dev. of error, σ_ε			0.105
$\rho = (\sigma_\alpha^2/(\sigma_\alpha^2 + \sigma_\varepsilon^2))^{1/2}$			0.819
Number of individuals	1725	1725	1252
Observations	9445	9431	8341

Notes: Robust standard errors with state-level clustering are shown in parentheses. All specifications above use PSID core longitudinal weights in estimation. The exogenous covariates used in columns (2) and (3) correspond to the baseline covariates without controls for the logs of earnings and wealth.