

Household Financial, Time, and Environmental Constraints and Low Food Security among Children

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UKCPR Progress Report Conference

Champaign, IL

May 17, 2013

Research Objectives

Main goal: to better understand circumstances of families experiencing low and very low food security among children:

1. How do **food prices** affect children's food insecurity?
2. What is the importance of **local food environment** for children's food insecurity?
3. Which **demographic** and **socioeconomic** characteristics exacerbate or alleviate children's food insecurity?
4. How do household circumstances affect **time in food preparation**?

Overview of Research

Conceptualize children's food security as a "commodity" produced by households with children

Develop an economic model of food insecurity and time in food preparation, based on **household production framework** (Becker, 1965; Pollak and Wachter, 1975)

Assemble a large dataset of households with children, by **matching data** across several national surveys

Jointly estimate equations for children's food insecurity and time in food preparation; test hypotheses about effects of local food environment

Dependent Variables

Food security status is determined via responses by adult proxy to 8 child-specific questions in 18-item Household Food Security Survey Module in FSS:

- **Four** ordered categories of children's food security
- Referenced to last 12 months

Time in food preparation includes time in seven activities (ATUS lexicon), measured **in minutes** on the reference day:

- (1) Food and drink preparation
- (2) Food presentation
- (3) Kitchen and food clean-up
- (4) Food and drink preparation, presentation, and clean-up, n.e.c.
- (5) Grocery shopping
- (6) Travel related to food and drink preparation, clean-up, and presentation
- (7) Travel related to grocery shopping

Economic Model: Notation

- $m \geq 1$ different commodities: $Z = (z_1, \dots, z_m)'$
- z_1 : children's food security; $\tilde{z}_1 = -z_1$: **children's food insecurity**
- $l \geq 1$ different market goods: $Y = (y_1, \dots, y_l)'$
- $k \geq 1$ different time use activities: $T = (t_1, \dots, t_k)'$
- t_1 : **time in food preparation** (including time in food acquisition and related travel)
- Demographic and socioeconomic characteristics H : household composition, income, etc.
- Location-specific attributes L : local food prices, food establishment densities, etc.

Economic Model: Setup

Decision-maker in household i maximizes utility:

$$\max_{Z_i, Y_i, T_i} U(Z_i; H_i)$$

Subject to:

Production technology constraint: $F(Z_i, Y_i, T_i; H_i, L_i) = 0$

Time endowment constraint: $Q(T_i; H_i) = 0$

Budget constraint: $B(Y_i, T_i; H_i, L_i) = 0$

Non-negativity constraints: $Z_i, Y_i, T_i \geq 0$

Equations for children's food insecurity and time in food preparation come from the problem solution:

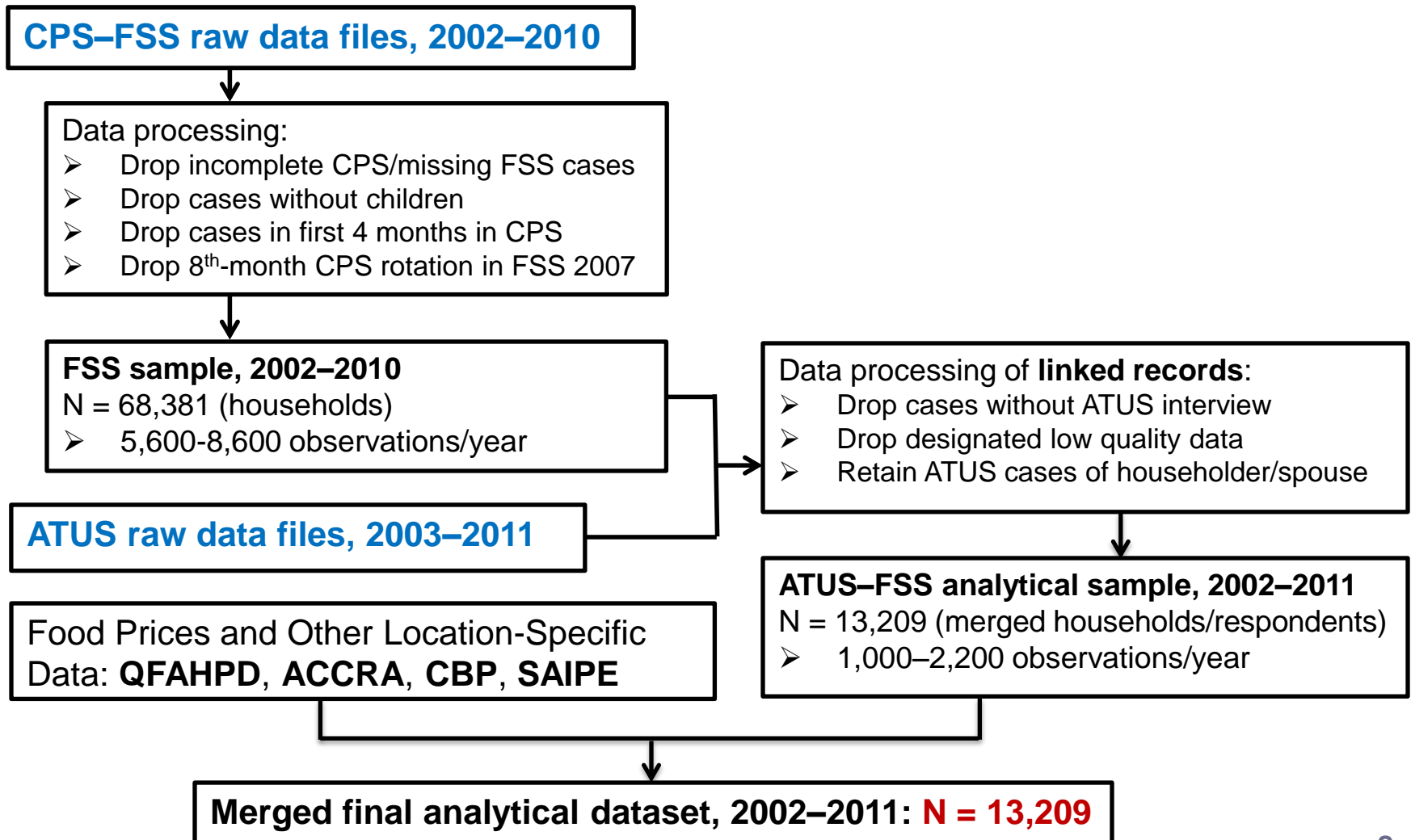
$$\tilde{z}_{1,i} = \tilde{z}_1(H_i, L_i)$$

$$t_{1,i} = t_1(H_i, L_i)$$

Data

- Households with children, pooled across multiple years:
 - Food Security Supplement (**FSS**) of CPS, 2002–2010
 - American Time Use Survey (**ATUS**), 2003–2011
 - Matched analytical sample: **N = 13,209** households/respondents
- Food prices and other location-specific data:
 - Quarterly Food-at-Home Price Database (**QFAHPD**, *source*: ERS)
 - **ACCRA** database (*source*: Council for Community and Economic Research, C2ER)
 - County Business Patterns data (**CBP**, *source*: Census Bureau)
 - Small Area Income and Poverty Estimates (SAIPE) program database, American FactFinder database (*source*: Census Bureau)

Data Processing



Selected Descriptive Statistics

Distribution of households by children's food security status:

Food Security Category	Count	Weighted Fraction, %
(1) High/marginal food security	11,391	86.19
(2) Marginal food security	881	6.68
(3) Low food security	871	6.55
(4) Very low food security	66	0.58
Total	13,209	100.00

Time in food preparation (minutes per day):

	Fraction of Cases with Time = 0	Among Cases with Time > 0 (minutes/day)				
		Mean	Std. Dev.	Median	Min	Max
All respondents	34.14%	79.20	69.28	60	1	995
Men	53.16%	56.20	54.73	40	1	660
Women	18.27%	90.20	72.72	70	1	995

Local Food Price Indices

Food-at-home price index:

- Based on food price data in **QFAHPD** (\$ per 100g of food)
- Expenditure-weighted average of 50+ food group prices (real \$)
- Location- and time-specific: by market area and year-quarter
- Merged with ATUS–FSS records using a procedure of Gregory and Coleman-Jensen (2013)

Fast food price index:

- Based on individual food item prices in **ACCRA** database
- Same as fast food price index of Chou et al. (2004), Powell (2009): average of prices of three fast food items (real \$)
- Location- and time-specific: by metropolitan area and year-quarter
- Merged with ATUS–FSS records by CBSA and state FIPS codes

Food Establishment Densities

Main source: County Business Patterns (**CBP**) database

Businesses are classified using 6-digit NAICS code

We create densities—number of establishments per 10,000 local residents—for 5 groups of establishments:

- **Supermarkets** and other general line grocery stores
- **Convenience stores**
- **Specialty food stores**
 - Meat markets; fish and seafood markets; fruit and vegetable markets; baked goods stores; confectionery and nut stores; all other specialty food stores; retail bakeries
- **Full-service restaurants**
- **Limited-service eating places**

Empirical Model

Data on food insecurity are **ordered categorical** \Rightarrow adopt **ordered probit approach**. Latent variable:

$$\tilde{z}_{1,i}^* = X_i^{z'} \cdot \beta + \epsilon_i$$

Observed food insecurity:

$$\tilde{z}_{1,i} = k \text{ if and only if } \mu_k < \tilde{z}_{1,i}^* \leq \mu_{k+1}$$

Data on time in food preparation contain **many zeros** \Rightarrow adopt **Tobit approach**. Latent variable:

$$t_{1,i}^* = X_i^{t'} \cdot \gamma + \eta_i$$

Observed time in food preparation:

$$t_{1,i} = 0 \text{ if } t_{1,i}^* \leq 0; t_{1,i} = t_{1,i}^* \text{ if } t_{1,i}^* > 0$$

Note: X_i^z and X_i^t are explanatory variables based on H_i and L_i

Estimation Approach

Error terms might be correlated; we specify:

$$\begin{pmatrix} \epsilon_i \\ \eta_i \end{pmatrix} | X_i \sim N \left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 & \rho \cdot \sigma \\ \rho \cdot \sigma & \sigma^2 \end{pmatrix} \right)$$

Food insecurity and time in food preparation equations are estimated **jointly**, by using maximum likelihood method:

$$\hat{\theta}_{MLE} = \arg \max_{\theta} \sum_{i=1}^n \ln L_i(\theta)$$

θ : parameter vector, $L_i(\theta)$: likelihood contribution (see Appendix)

After estimation, we compute **average marginal effects** (AME):

$$AME(\tilde{z}_1 = k) = \frac{1}{n} \sum_{i=1}^n \frac{\partial}{\partial X_i} \Pr[\tilde{z}_{1,i} = k | X_i; \hat{\theta}_{MLE}]$$

$$AME(t_1) = \frac{1}{n} \sum_{i=1}^n \frac{\partial}{\partial X_i} E[t_{1,i} | X_i; \hat{\theta}_{MLE}]$$

Food Insecurity: *Average Marginal Effects*

<i>Food Security Outcome</i>	<i>(3) Low</i>		<i>(4) Very Low</i>	
	Estimate	(Std. Err.)	Estimate	(Std. Err.)
Selected Explanatory Variables				
Single female-headed household	0.0257**	(0.0037)	0.0034**	(0.0006)
Single male-headed household	0.0145**	(0.0068)	0.0019**	(0.0009)
Children, age 0–4	0.0075***	(0.0023)	0.0010**	(0.0003)
Children, age 5–12	0.0136***	(0.0017)	0.0018***	(0.0003)
Children, age 13–17	0.0137***	(0.0025)	0.0018***	(0.0004)
African American householder	0.0168**	(0.0045)	0.0022***	(0.0006)
Householder of race other than White/AA	0.0106*	(0.0063)	0.0014*	(0.0009)
Hispanic householder/spouse	0.0156***	(0.0048)	0.0021***	(0.0007)
Education: bachelor's degree	-0.0328***	(0.0060)	-0.0044***	(0.0009)
Education: graduate degree	-0.0346***	(0.0072)	-0.0046***	(0.0011)
Real family income (\$, thousands)	-0.0029**	(0.0002)	-0.0004***	(0.0000)
Income < 185% of poverty level	0.0215***	(0.0049)	0.0029***	(0.0007)
Food-at-home price index	-0.0897	(0.1379)	-0.0120	(0.0185)
Fast food price index	0.0187*	(0.0111)	0.0025*	(0.0015)
Density of supermarkets	-0.0014	(0.0030)	-0.0002	(0.0004)
Density of convenience stores	-0.0036*	(0.0018)	-0.0005*	(0.0003)
Density of specialty food stores	-0.0082	(0.0058)	-0.0011	(0.0008)
Density of full-service restaurants	0.0004	(0.0012)	0.0001	(0.0002)
Density of limited-service eating places	-0.0017	(0.0015)	-0.0002	(0.0002)
Fraction of households	0.0655		0.0058	

Food Prep. Time: *Average Marginal Effects*

Selected Explanatory Variables	Estimate (min/day)	(Std. Err.)
Male in married couple	-48.2636***	(1.1327)
Single female householder	-11.5056***	(1.5865)
Single male householder	-33.6961***	(2.7926)
Children, age 0–4 years	6.3372***	(0.8741)
Children, age 5–12 years	4.4556***	(0.6325)
Children, age 13–17 years	4.4419***	(0.9128)
Householder of race other than White/AA	5.6672**	(2.2966)
Age of householder/spouse (years)	0.4760***	(0.0628)
Hispanic householder/spouse	4.3683**	(1.8213)
Education: high school degree	-8.2383***	(2.3627)
Education: some college	-9.3032***	(2.3572)
Education: bachelor's degree	-7.9674***	(2.5011)
Foreign-born householder/spouse	7.8008***	(1.6779)
Real family income (\$, thousands)	-0.0884**	(0.0425)
Income < 185% of poverty level	3.0927*	(1.7039)
Metropolitan area	2.8026*	(1.5474)
South region	-6.3267***	(2.0778)
Sunday	5.6820***	(1.8757)
Friday	-8.2363***	(2.2953)
Holiday	11.9073***	(3.3186)
June	-7.0530**	(3.3468)
July	-13.9172***	(4.1257)
Average time in food preparation (min/day)	52.16	

Summary and Preliminary Conclusions

- Research:
 - Analyze children's food security as a "commodity" within household production framework
 - Utilize data from large, nationally representative surveys of households and economic areas
 - Test hypotheses about effects of socio-demographic factors and local food environment on:
 - Food insecurity
 - Time in food preparation
- Findings support hypothesized effects:
 - Food insecurity: household structure, income, fast food prices, local food environment (convenience stores)
 - Time in food preparation: household structure/demographics, income, day-of-week, season

Thank you!

Questions?

Details on Likelihood Contribution

When $t_{1,i} = 0$, the likelihood contribution is:

$$L_i(\theta) = \int_{\mu_{\tilde{z}_{1,i}} - X_i^{z'} \beta}^{\mu_{\tilde{z}_{1,i+1}} - X_i^{z'} \beta - X_i^{t'} \gamma} \int_{-\infty}^{\infty} f(\epsilon, \eta) d\eta d\epsilon$$

When $t_{1,i} > 0$, the likelihood contribution is:

$$L_i(\theta) = f_{\eta}(t_{1,i} - X_i^{t'} \gamma) \cdot \int_{\mu_{\tilde{z}_{1,i}} - X_i^{z'} \beta}^{\mu_{\tilde{z}_{1,i+1}} - X_i^{z'} \beta} f_{\epsilon|t_{1,i} - X_i^{t'} \gamma}(\epsilon) d\epsilon$$

Details on Food Insecurity Measure

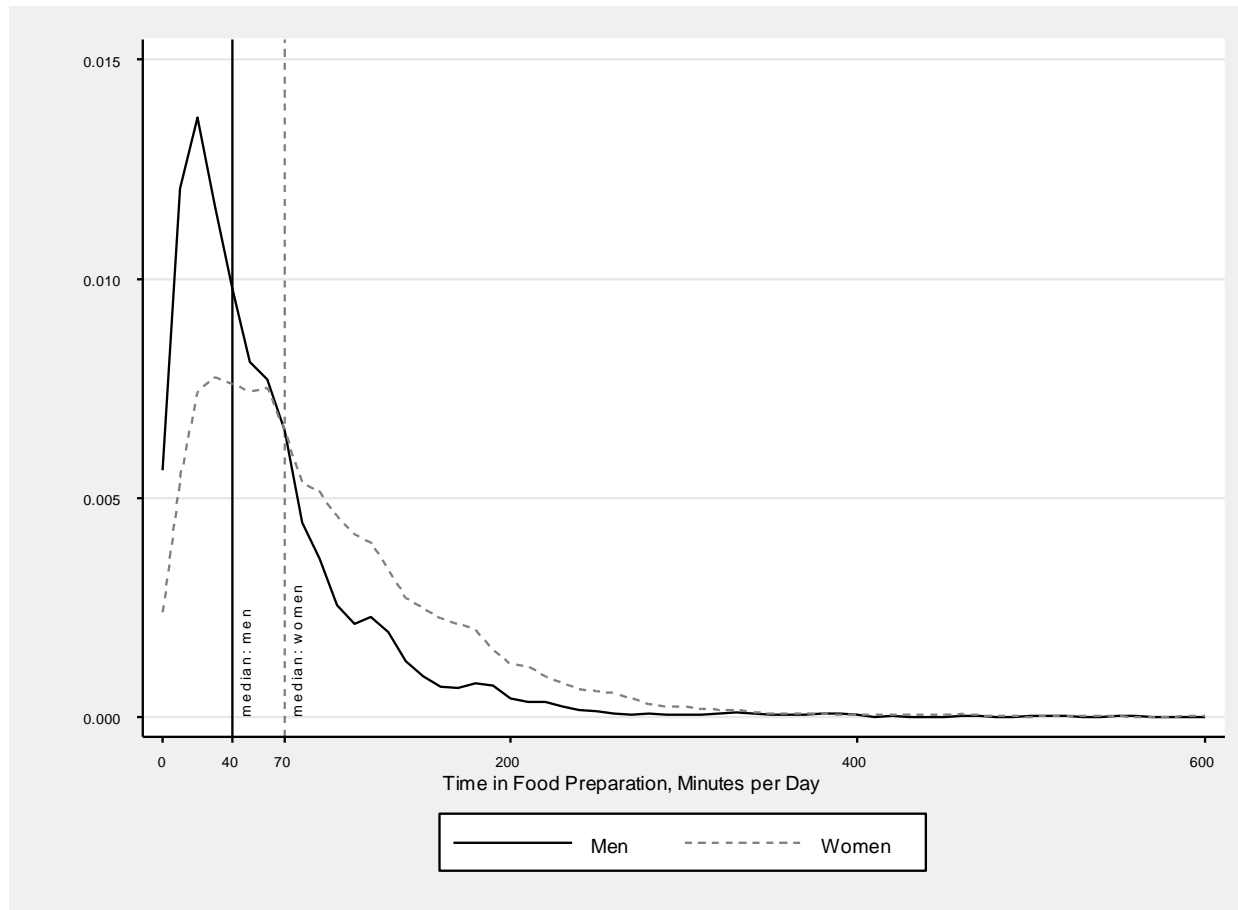
Children's food security status is determined via responses by adult proxy to 8 child-specific questions in 18-item Household Food Security Survey Module in FSS

Four ordered categories of children's food security:

- (1) High/marginal: raw score of 0
- (2) Marginal: raw score of 1
- (3) Low: raw score of 2–4
- (4) Very low: raw score of 5–8

We focus on HFSSM items referenced to last 12 months

Details on Time in Food Preparation



Kernel Densities of Time in Food Preparation (Conditional on Time > 0)

Details on Research Hypotheses

- Group A: effects of food prices on food insecurity
 - Higher prices of food at home and fast food \Rightarrow more food insecurity among children
- Group B: effects of food environment on food insecurity
 - Higher density of supermarkets/other food stores, and higher density of full-service restaurants and limited-service eating places \Rightarrow less food insecurity among children
- Group C: effects of socioeconomic characteristics on food insecurity
 - More income \Rightarrow less food insecurity
 - Higher educational attainment \Rightarrow less food insecurity
 - More children in household \Rightarrow more food insecurity
- Group D: effects of household circumstances on time in food preparation
 - Men spend less time in food preparation than women
 - Householders in single-headed households spend less time than married women
 - More children in household \Rightarrow more time in food preparation by householder/spouse
 - More income, more education \Rightarrow less time in food preparation
 - Amount of time in food preparation varies with day-of-the-week, season