Children's Food Insecurity, Food Preparation Time and the Effects of Food Environment

Helen H. Jensen, Iowa State University
Oleksandr Zhylyevskyy, Iowa State University

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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 **socioeconomic** and **demographic** characteristics exacerbate or alleviate children's food insecurity?
4. How do household circumstances affect **food preparation time**?

Motivation

Incidence of food insecurity is substantial among low-income households with children (~43% when income < 130% FPL)

Food insecurity is linked to poor health, depression, other negative outcomes in physical, intellectual, and social development of children

Food preparation decisions influence nutritional content of foods consumed and can affect health outcomes

Better understanding of effects of food prices, food environment, other factors on food insecurity among children and of food preparation time can inform public policy and design of food assistance programs

Overview of Research

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

Develop an economic model of food insecurity and food preparation time, based on **household production approach** (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 security status and food preparation time; test hypotheses about effects of food prices and food environment

Economic Model: Notation

- $m \geq 1$ different commodities: $Z = (z_1, \ldots, z_m)'$
- z_1: children's food security; $\tilde{z}_1 = -z_1$: **children's food insecurity**
- $l \geq 1$ different market goods: $Y = (y_1, \ldots, y_l)'$
- $k \geq 1$ different time use activities: $T = (t_1, \ldots, t_k)'$
- t_1: **food preparation time** (including time in food acquisition and related travel)
- Socioeconomic and demographic characteristics H: household composition, income, etc.
- Location-specific attributes L: 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 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 food preparation time 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* = 13,474** households/respondents
- Food prices and 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)

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: (1) high, (2) marginal, (3) low, and (4) very low
- Referenced to last 12 months

Food preparation time includes time in seven ATUS activities, 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 & drink preparation/clean-up/presentation
(7) Travel related to grocery shopping

Selected Descriptive Statistics

Distribution of households by children's food security status:

Food Security Category	Count	Weighted Fraction, %
(1) High food security	11,600	85.91
(2) Marginal food security	911	6.80
(3) Low food security	897	6.73
(4) Very low food security	66	0.57
Total	13,474	100.00

Food preparation time:

	Fraction of Cases with Time = 0	Among Cases with Time > 0, Minutes per Day			
		Mean	Std. Dev.	Min	Max
All respondents	34.26%	79.20	69.33	1	995
Men	53.26%	56.15	54.84	1	660
Women	18.33%	90.26	72.76	1	995

Food Prices & Establishment Densities

Food-at-home price index: expenditure-weighted average of 50+ food group prices based on **QFAHPD** data, in real $ per 100 grams of food

Fast food price index: average of real prices of three fast food items in **ACCRA** (Chou et al., 2004; Powell, 2009)

Food establishment densities: number of food-related business establishments, as reported in **CBP**, per 10,000 residents for:

- Supermarkets and other general line grocery stores
- Convenience stores
- Specialty food stores
- Full-service restaurants
- Limited-service eating places

All these measures are location- and time-specific and are merged with individual sample records accordingly

Empirical Model

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

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

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 food preparation time contain **many zeroes** $\Rightarrow$ adopt **Tobit** approach. Latent variable:

$$t_{1,i}^{*} = X_i^{t\prime} \cdot \gamma + \eta_i$$

Observed food preparation time:

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

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:

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

Food insecurity and food preparation time 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

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

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

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

Food Insecurity: *Average Marginal Effects*

Food Security Outcome	*(3) Low*		*(4) Very Low*	
Selected Explanatory Variables	Estimate	(Std. Err.)	Estimate	(Std. Err.)
Unmarried couple household	0.0110*	(0.0062)	0.0014*	(0.0008)
Single female-headed household	0.0288***	(0.0037)	0.0038***	(0.0006)
Single male-headed household	0.0218***	(0.0077)	0.0029***	(0.0011)
# of children, age 0–4	0.0071***	(0.0023)	0.0009***	(0.0003)
# of children, age 5–12	0.0139***	(0.0017)	0.0018***	(0.0003)
# of children, age 13–17	0.0138***	(0.0024)	0.0018***	(0.0004)
African American householder	0.0163***	(0.0045)	0.0021***	(0.0006)
Hispanic householder	0.0190***	(0.0049)	0.0025***	(0.0007)
Real family income ($, thousands)	-0.0028***	(0.0002)	-0.0004***	(0.0000)
Income < 185% of poverty level	0.0240***	(0.0049)	0.0031***	(0.0007)
Food-at-home price index	-0.0893	(0.1374)	-0.0117	(0.0180)
Fast food price index	0.0200*	(0.0110)	0.0026*	(0.0015)
Density of supermarkets	-0.0006	(0.0030)	-0.0001	(0.0004)
Density of convenience stores	-0.0031*	(0.0018)	-0.0004*	(0.0002)
Density of specialty food stores	-0.0096*	(0.0057)	-0.0013*	(0.0008)
Density of full-service restaurants	0.0003	(0.0012)	0.0000	(0.0002)
Density of limited-service eating places	-0.0017	(0.0015)	-0.0002	(0.0002)
Fraction of households	0.0673		0.0057	

Food Prep. Time: *Average Marginal Effects*

Selected Explanatory Variables	Estimate, min/day	(Std. Err.)
Male in married couple	-48.2817***	(1.1342)
Female in unmarried couple	-3.7805	(3.2624)
Male in unmarried couple	-47.9443***	(3.9253)
Single female householder	-13.0695***	(1.6064)
Single male householder	-31.2319***	(3.1580)
# of children, age 0–4 years	6.4264***	(0.8654)
# of children, age 5–12 years	4.3608***	(0.6250)
# of children, age 13–17 years	4.2976***	(0.9052)
Age (years)	0.5028***	(0.0632)
Hispanic	5.0663***	(1.9712)
Foreign-born	10.3164***	(1.8250)
Real family income ($, thousands)	-0.0581	(0.0419)
Income < 185% of poverty level	4.1548**	(1.6814)
Metropolitan area	3.1764**	(1.5292)
Sunday	5.6434***	(1.8640)
Friday	-8.5873***	(2.2794)
Holiday	10.6885***	(3.2740)
May	-6.6161**	(3.2956)
June	-7.2748**	(3.3168)
July	-13.2133***	(4.0870)
Average food preparation time	52.06 min/day	

Summary and Implications

- Research examines children's food security as a "commodity" within household production framework
- Findings support hypothesized effects:
  - Food insecurity: household structure, income, fast food prices, food environment (convenience and specialty food stores)
  - Food preparation time: household structure/demographics, income, day-of-the-week, season
- Implications for policies and programs to reduce food insecurity among children:
  - Providing adequate food for children is especially challenging for single-headed and unmarried couple households
  - Social and food assistance programs that increase available financial resources to households support households in meeting food needs
  - Food environment matters: lower fast food prices and more available convenience and specialty food stores are associated with lower probability of food insecurity

Thank you!

Questions?

Details on Likelihood Contribution

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

$$L_i(\theta) = \int_{\mu_{\tilde{z}_{1,i}} - X_i^{z\prime}\beta}^{\mu_{\tilde{z}_{1,i}+1} - X_i^{z\prime}\beta} \int_{-\infty}^{-X_i^{t\prime}\gamma} f(\epsilon, \eta) d\eta d\epsilon$$

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

$$L_i(\theta) = f_\eta\left(t_{1,i} - X_i^{t\prime}\gamma\right) \cdot \int_{\mu_{\tilde{z}_{1,i}} - X_i^{z\prime}\beta}^{\mu_{\tilde{z}_{1,i}+1} - X_i^{z\prime}\beta} f_{\epsilon | t_{1,i} - X_i^{t\prime}\gamma}(\epsilon) d\epsilon$$

Details on Food Insecurity Measure

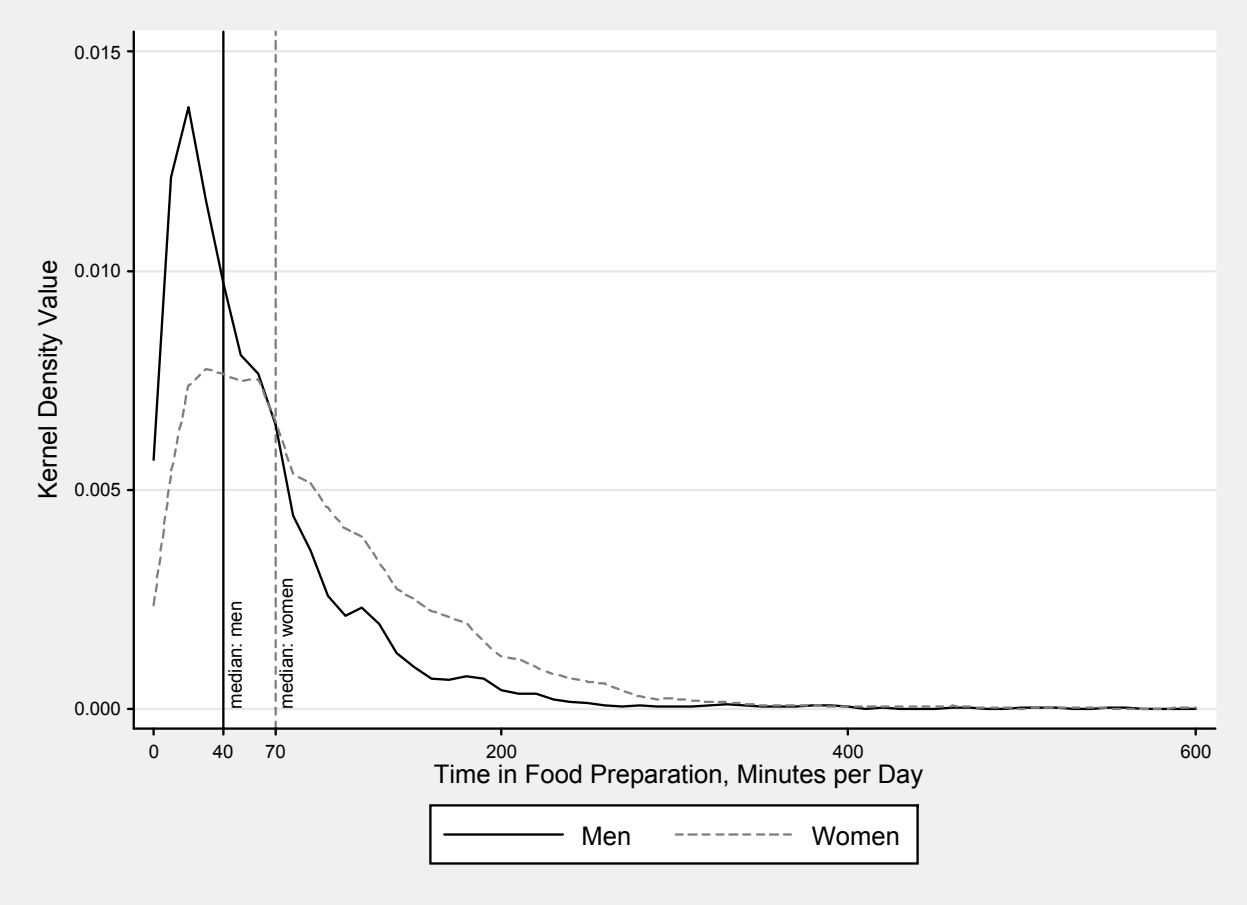
Children's food security status is determined via responses by adult proxy to 8 child-specific questions in 18-item Household Food Security Survey Module in FSS

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 ⇒ 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 ⇒ less food insecurity among children
- Group C: effects of socioeconomic characteristics on food insecurity
  - More income ⇒ less food insecurity
  - Higher educational attainment ⇒ less food insecurity
  - More children in household ⇒ 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 ⇒ more time in food preparation
  - More income, more education ⇒ less time in food preparation
  - Amount of time in food preparation varies with day-of-the-week, season

Data Processing