Conclusion 00

Food Security Dynamics in the US

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29 Jan 2021 virtual seminar hosted by Mississippi State University

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Background

- Food security means that people have access at all times to sufficient and nutritious foods to enjoy an active and healthy life.
 - FS status has well-established, long-term economic, educational and health implications
- In US, \geq 10% of hhs food insecure in any given year since 1995
- > 2019 US prevalence = 10.5%; jumped \approx 4x w/COVID pandemic
- Understanding food security dynamics can inform effective policy design/evaluation. Scant empirical literature, due to data limits.
 - How long will newly food insecure remain FI?
 - Can we identify/target chronically FI separately from transitorily FI?

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Official US Food Security Measure

- Since 1995 US food security studies rely mainly on USDA official measure, based on Household Food Security Survey Module (HFSSM) supplement to the Current Population Survey (CPS).
- Hhs answer 10-18 questions. FS status based on affirmative responses standardized into 29 discrete values [0.0,9.3] and three ordinal categories (food security, low food security, and very low food insecurity)
- ► HFSSM is included in some other surveys (e.g., PSID, ECLS)

Limitations

- ▶ No extended hh panel of HFSSM-based measures exists.
 - CPS has \leq 2 obs/hh, \leq 1 yr apart.
 - PSID has 5 non-consecutive HFSSM waves (99, 01, 03, 15, 17)
 - ECLS only includes hhs w/children
- Ordinal measure limits capacity to study change in FI severity
- Result: no study has >5 obs/hh, or can study transitions/ persistence beyond discrete categorical status, suppressing policy-relevant within-category variation over time

Data

- We use Panel Study of Income Dynamics (PSID)
- Nationally representative hh panel survey, which included HFSSM (1999-2003, 2015-2017).
- We use balanced panel \approx 23,000 obs from \approx 2,700 hhs over 9 bi-ennial waves (2001-2017) since PSID began standardizing food expenditures aggregates

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A New Measure

- The Probability of Food Security (PFS) = estimated probability that hh food expenditures ≥ minimal cost of healthy diet, per USDA's Thrifty Food Plan (TFP) diet, reported monthly in USDA Cost of Food Reports.
- Adapt an econometric method (Cissé & Barrett, JDE 2018) that has been applied to study food security in the low-income world.

Advantages of PFS

- Food expenditures data more often available in hh surveys, enables longer panels. We construct PFS biennially over 17-yrs (2001-17), 9 obs/hh
- PFS is a continuous, decomposable measure in the Foster-Greer-Thorbecke (FGT 1984 EMTRA) tradition, enabling deeper study and groupwise decomposition of FI severity.

Conclusion

Constructing PFS (1)

1. Estimate the conditional mean of food expenditure per capita:

$$W_{ijt} = \sum_{\gamma=1}^{3} \beta_{M_{\gamma}} W_{ijt-1}^{\gamma} + \delta_M X_{ijt} + \omega_{Mt} + \theta_{Mj} + u_{Mijt}$$
(1)

▶ *i*, *j*, *t*: household, state, year

W: Annual food expenditure per capita Model

- X: Household characteristics
- ω, θ : Year and state FE
- 2. Estimate the conditional variance of food expenditure:

$$\hat{u}_{Mit}^2 = \sum_{\gamma=1}^3 \beta_{V_\gamma} W_{ijt-1}^\gamma + \delta_V X_{ijt} + \omega_{Vt} + \theta_{Vj} + u_{Vijt}$$
(2)

where \hat{u}_{Mit}^2 is the squared residual series from (1).

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Constructing PFS (2)

- 3. Construct household-period-specific food expenditure CD $F(\cdot)$ assuming $W_{ijt} \sim Gamma(\alpha, \beta)$ calibrating the parameters by the method of moments.
- 4. Define the PFS as $\hat{\rho}_{ijt} = 1 F\left(X_{ijt}, W_{ijt-1} | \underline{W_{ijt}}\right) \in [0, 1]$ where W_{ijt} is the cost of the TFP diet (by period and hh composition).
- 5. HH *i* is food secure in *t* iff $\hat{\rho}_{it} \ge \underline{P_t}$, where we set $\underline{P_t}$ (assumed probability threshold) to match sample-period FI prevalence to USDA population prevalence estimate from CPS.

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Household Dynamics - Spells Approach

Use hh-year-specific \widehat{PFS} to study dynamics by 2 different methods **1st Approach**

- Duration of unbroken sequence of HH FI observations.
- Hhs categorized based on FI status in consecutive waves.



- FI considered chronic if persists >2 years
- Yields spell length distn, exit rates conditional on FI status.

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Household Dynamics - Permanent Approach (1)

2nd Approach

- Based on mean intertemporal PFS (chronic) and deviation from mean (transient)
- Denote total *TFI_i* and chronic *CFI_i* from the *PFS* sequence of hh i and its chronic component, then

$$TFI_{i}(\alpha, PFS_{i1}, ..., PFS_{it}) = \frac{1}{T} \sum_{t=1}^{T} \left(1 - \frac{\min(PFS_{it}, \underline{P}_{t})}{\underline{P}_{t}} \right)^{\alpha} \quad (3)$$

$$CFI_{i}(\alpha, PFS_{i1}, ..., PFS_{it}) = \left(1 - \min\left[1, \frac{\sum_{t=1}^{T} PFS_{it}}{\sum_{t=1}^{T} \underline{P}_{t}}\right]\right)^{\alpha} \quad (4)$$

 α is aversion parameter, as in FGT, permits severity analysis

Household Dynamics - Permanent Approach (2)

- Households are classified into four categories.
 - 1. Persistently food insecure: $CFI_i > 0$ and $PFS_{it} < \underline{P_t} \forall t$
 - 2. Chronically but not persistently food insecure: $CFI_i > 0$ and $\exists t$ such that $PFS_{it} \ge P_t$
 - 3. Transiently food insecure: $CFI_i = 0$ and $\exists t$ such that $PFS_{it} < P_t$.
 - 4. Persistently food secure: $CFI_i = TFI_i = 0$
- Two methods do not overlap perfectly households can be categorized as chronically food insecure under the one method but as transiently food insecure under the other.
- While the permanent approach is less prone to measurement error and data truncation, it assumes a stationary process.

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Groupwise Aggregation

Aggregate PFS over hhs to generate group-specific estimates.

$$FGT_t(\alpha, PFS_{1t}, ..., PFS_{Nt}) = \frac{1}{N} \sum_{i=1}^{N} \left(1 - \frac{\min(PFS_{it}, \underline{P_t})}{\underline{P_t}} \right)^{\alpha}$$
(5)

- We generate three indices headcount ratio (HCR), food insecurity gap (FIG) and squared food insecurity gap (SFIG) for α = 0, 1, 2, respectively.
- Decompose into groupwise measures based on race, gender and education of hh head.

Validation of PFS

- PFS is strongly and positively correlated with the USDA measure
 - Spearman's rank correlation/Kendall's τ are 0.31/0.25
 - Stronger association at lower range Reg Fit Dist
- There exists broad consistency of associational patterns between the two measures and household attributes.
- These findings suggest that the PFS provides a useful complement to the USDA food security measure.

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Distribution and Conditional Persistence

Spell Length		
Survey waves (Years duration)	Proportion	Conditional Persistence (Std.Error)
1 (1-4)	0.53	0.48 (0.03)
2 (3-6)	0.19	0.64 (0.03)
3 (5-8)	0.07	0.77 (0.04)
4 (7-10)	0.05	0.77 (0.05)
5 (9-12)	0.04	0.83 (0.04)
6 (11-14)	0.02	0.85 (0.04)
7 (13-16)	0.02	0.87 (0.05)
8 (15-18)	0.01	0.88 (0.03)
9 (17+)	0.06	

Roughly half of food insecurity spells are transitory

The longer hhs remain food insecurity, the less likely they exit.

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Spell Length Conditional on the Start Year



Business cycle effect on food security

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Transition in Food Security Status

	N	(FI_{t-1}, FI_t)	(FI_{t-1},FS_t)	(FS_{t-1},FI_t)	(FS_{t-1}, FS_t)	Persistence*	Entry*
Year							
2003	2,164	0.06	0.04	0.04	0.85	0.61	0.05
2005	2,338	0.07	0.04	0.03	0.85	0.64	0.04
2007	2,431	0.07	0.03	0.04	0.86	0.69	0.04
2009	2,411	0.08	0.03	0.06	0.83	0.75	0.07
2011	2,540	0.09	0.05	0.04	0.81	0.63	0.05
2013	2,570	0.09	0.05	0.05	0.81	0.65	0.06
2015	2,569	0.08	0.06	0.04	0.82	0.59	0.05
2017	2,590	0.08	0.05	0.03	0.84	0.61	0.04
Gender							
Male	15,215	0.04	0.04	0.03	0.89	0.54	0.04
Female	4,398	0.21	0.08	0.08	0.63	0.72	0.11
Race							
White	13,150	0.05	0.04	0.04	0.88	0.56	0.04
Non-white	6,463	0.26	0.08	0.08	0.58	0.76	0.12
Highest Degree							
Less than HS	2,561	0.26	0.08	0.08	0.57	0.75	0.13
High school	5,998	0.10	0.06	0.06	0.77	0.61	0.07
Some college	4,967	0.07	0.04	0.04	0.85	0.64	0.04
College	6,087	0.02	0.02	0.02	0.93	0.47	0.02

At any moment, 60-75% remain food insecure 2 yrs later

Entry and persistence both higher during Great Recession and among hhs w/female, non-white, or poorly educated heads

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Empirical Strategy

Results

Conclusion

Persistence and Entry by Year



Prevalence, entry, persistence peak during Great Recession

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Persistence and Entry by Demographic Group



- Share of newly food insecure hhs increased 70% during Great Recession, o/w 30% was hhs whose head is female without a college education.
- Most FI groups also most persistent, so stable entry rate around Great Recession

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Chronic Food Insecurity from the Permanent Approach

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Ν	TFI	CFI	TFI-CFI	(CFI/TFI)	Chronic		Transient	Never food insecure
						Persistent Not persistent			
Total	22,324	0.124	0.092	0.032	0.744	0.026	0.066	0.210	0.698
Gender									
Male	17,291	0.076	0.044	0.032	0.577	0.010	0.034	0.191	0.765
Female	5,033	0.288	0.259	0.030	0.896	0.083	0.176	0.276	0.466
Race									
White	14,937	0.086	0.052	0.034	0.605	0.011	0.041	0.198	0.750
Non-white	7,387	0.345	0.327	0.018	0.947	0.113	0.213	0.283	0.390
Education									
Less than HS	3,307	0.355	0.318	0.036	0.898	0.114	0.205	0.338	0.344
High school	7,259	0.148	0.105	0.043	0.708	0.023	0.082	0.282	0.613
Some college	5,472	0.098	0.065	0.033	0.666	0.020	0.045	0.199	0.736
College	6,286	0.042	0.023	0.020	0.535	0.003	0.019	0.114	0.864

Nearly 70% hhs never food insecure

- Among remaining 30%, 74% of FI experience is chronic.
- Most vulnerable (TFI) groups have much higher CFI (90-95%), and even more transient FI

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TFI and CFI by Group



Educational attainment, gender and race key FI predictors

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Decomposing Variation in TFI/CFI

	Т	FI	C	FI
	R^2	%	R^2	%
Region	0.014	0.022	0.011	0.021
Highest degree achieved	0.030	0.047	0.019	0.036
Age	0.010	0.015	0.007	0.014
Gender	0.051	0.079	0.044	0.085
Race	0.044	0.069	0.026	0.050
Marital status	0.030	0.047	0.021	0.039
In(income per capita)	0.125	0.195	0.090	0.171
Food Assistance (SNAP, WIC, etc.)	0.285	0.443	0.260	0.495
Others	0.053	0.082	0.047	0.089
Total	0.643	0.999	0.525	1.000

- Regional fixed effects capture merely 2% of variation.
- Hh income and food assistance program participation capture \approx 2/3 of variation ... budget constraints the best FI predictors.

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Groupwise Food Insecurity Prevalence and Severity



Vast groupwise gaps - HCR/SFIG of most FI groups (POC, women, no high school education) is 28/112 x that of most FS group (white, men, college grads).

▶ HCR and SFIG strongly, positively correlated, but higher HCR does not imply higher SFIG.

Food Insecurity by Group and Year



- HCR surge from 2007-9 mostly driven by white-headed hhs (pprox 81% of the increase).
- SFIG increased steadily 2001-9, even when prevalence was relatively stable. Pre-recession surge was mainly among white, male-headed hhs, while post-recession recovery mostly occurred in women of color-headed hh w/ low education.

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Summary of Findings

- Roughly half of food insecurity episodes are short-term, ≤ 2 yrs.
- ► FI persistence + (-) correlated with spell length (business cycle).
- 70% of households never experience food insecurity, but more than half of the food insecurity experience is chronic.
- Household budget constraints are the best food insecurity predictors, while there exists little spatial variation.
- Race/Gender/Educational correlation w/income results in huge groupwise differences in FI, both in prevalence and in severity.

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Questions and/or comments are highly appreciated.

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Summary Statistics

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	To	tal	SF	RC	SE	0
	mean	sd	mean	sd	mean	sd
Household Head						
Age	56.35	13.62	56.58	12.17	53.19	23.84
Race						
White	0.85	0.35	0.91	0.24	0.01	0.20
Color	0.15	0.35	0.09	0.24	0.99	0.20
Married	0.61	0.48	0.63	0.42	0.30	0.90
Female	0.22	0.41	0.20	0.35	0.50	0.98
Highest educational degree						
Less than high school	0.11	0.31	0.10	0.26	0.24	0.84
High school	0.27	0.44	0.27	0.39	0.35	0.93
Some college	0.25	0.43	0.25	0.38	0.27	0.87
College	0.37	0.48	0.39	0.43	0.14	0.68
Employed	0.65	0.47	0.66	0.42	0.58	0.97
Disabled	0.19	0.39	0.19	0.34	0.23	0.83
Household						
Income per capita	40.26	30.43	41.60	27.30	21.71	35.24
Food expenditure per capita	3.65	2.11	3.73	1.87	2.51	3.55
Family size	2.22	1.16	2.22	1.02	2.26	2.67
% of children	0.10	0.19	0.10	0.17	0.16	0.47
Food Assistance						
Food stamp	0.05	0.22	0.04	0.18	0.22	0.81
Child meal	0.04	0.19	0.03	0.15	0.18	0.75
WIC	0.01	0.11	0.01	0.08	0.05	0.42
Elderly meal	0.01	0.07	0.00	0.06	0.02	0.24
Change in status						
No longer employed	0.08	0.27	0.08	0.23	0.10	0.58
No longer married	0.01	0.11	0.01	0.10	0.01	0.19
No longer owns house	0.03	0.16	0.03	0.14	0.03	0.33
Became disabled	0.07	0.26	0.07	0.23	0.07	0.51
N	22.	556	16.0	602	5.9	54

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Model Selection

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	(1)	(2)	(3)	(4)	(5)
Variables	W_{ijt}	W_{ijt}	W _{ijt}	W _{ijt}	W _{ijt}
W _{ijt-1}	0.131***	0.250***	0.298***	0.323***	0.274**
	(0.00)	(0.01)	(0.03)	(0.07)	(0.12)
W_{iit-1}^2		-0.0126***	-0.0241***	-0.0349	-0.00300
		(0.00)	(0.01)	(0.02)	(0.06)
W_{iit-1}^3			0.000754**	0.00237	-0.00569
			(0.00)	(0.00)	(0.01)
W_{iit-1}^4				-0.0000771	0.000782
				(0.00)	(0.00)
W_{iit-1}^5					-0.0000323
					(0.00)
Controls	Y	Y	Y	Y	Y
Fixed Effects	Y	Y	Y	Y	Y
AIC	98.36	98.25	98.24	98.24	98.24
* - 0.10 **	***	. 0.01			

* p < 0.10, ** p < 0.05, *** p < 0.01

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Cut-off PFS

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Regression of the PFS on USDA measure

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	(1)	(2)	(3)	(4)
	USDA	USDA	USDA	USDA
PFS	0.179***	0.463***	0.181***	0.438***
	(0.02)	(0.08)	(0.02)	(0.08)
PFS ²		-0.216***		-0.197***
		(0.05)		(0.05)
Fixed Effects	N	N	Y	Y
Ν	11,793	11,793	11,793	11,793
R^2	0.116	0.127	0.137	0.145

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Scatterplot and Fitted Line

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Distribution of Food Security Measures

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Association with Household Attributes

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	Conti	nuous	Bir	lary		
	(1)	(2)	(3)	(4)		
	USDA	PFS	USDA	PFS		
	b/se	b/se	b/se	b/se		
Age	-0.001 (0.00)	0.009*** (0.00)	-0.002 (0.00)	0.005*** (0.00)		
Age ² /1000	0.020*** (0.01)	-0.077*** (0.01)	0.035*** (0.01)	-0.041** (0.02)		
Female	-0.013 (0.01)	-0.065*** (0.01)	-0.019 (0.01)	-0.067*** (0.02)		
Color	-0.003 (0.01)	-0.064*** (0.01)	-0.001 (0.01)	-0.060*** (0.01)		
Married	0.009 (0.01)	0.038*** (0.01)	0.020* (0.01)	0.052*** (0.01)		
In(income per capita)	0.025*** (0.01)	0.103*** (0.01)	0.038*** (0.01)	0.093*** (0.01)		
Family size	0.004 (0.00)	-0.035*** (0.00)	0.004 (0.01)	-0.032*** (0.01)		
% of children	0.045*** (0.01)	0.114*** (0.02)	0.070*** (0.02)	0.125*** (0.03)		
Less than high school	-0.014* (0.01)	-0.018* (0.01)	-0.021 (0.02)	-0.031 (0.02)		
Some college	0.002 (0.01)	0.027*** (0.01)	0.002 (0.01)	0.025** (0.01)		
College	-0.001 (0.01)	0.027*** (0.01)	-0.001 (0.01)	0.009 (0.01)		
Employed	0.010* (0.01)	-0.002 (0.01)	0.021** (0.01)	0.007 (0.01)		
Disabled	-0.041*** (0.01)	-0.038*** (0.01)	-0.065*** (0.01)	-0.032** (0.01)		
Food stamp	-0.112*** (0.02)	-0.319*** (0.01)	-0.189*** (0.03)	-0.546*** (0.03)		
Child meal	-0.016 (0.02)	-0.083*** (0.01)	-0.040 (0.03)	-0.184*** (0.03)		
WIC	0.004 (0.02)	-0.034* (0.02)	-0.007 (0.04)	-0.157*** (0.05)		
Elderly meal	0.013 (0.03)	-0.007 (0.03)	0.035 (0.05)	-0.039 (0.06)		
No longer employed	-0.005 (0.01)	-0.034*** (0.01)	0.004 (0.01)	-0.026 (0.02)		
No longer married	-0.018 (0.01)	-0.033*** (0.01)	-0.038 (0.02)	0.003 (0.02)		
No longer owns house	-0.002 (0.01)	0.002 (0.01)	0.007 (0.02)	0.022 (0.02)		
Became disabled	0.023** (0.01)	-0.008 (0.01)	0.030 (0.02)	-0.027 (0.02)		
Fixed Effects	Y	Y	Y	Y		
N	9842	9842	9842	9842	_	
R [∠]	0.217	0.667	0.168 < 🗆	0.471		

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Food Security Dynamics in the US

Spatial Variation of TFI/CFI

Back



There are no noticeable regional variation - only five Midwestern states exhibits statistically significantly higher TFI/CFI, but their magnitude is quite small.

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