

Food Security Dynamics in the United States: Insights using a New Measure

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Background

- ▶ Understanding food security dynamics can inform effective policy design/evaluation.
 - ▶ How long will newly food insecure households remain food insecure?
 - ▶ Can we identify/target recurrent FI separately from transitory FI?
- ▶ Important limitations to the existing, official measure (HFSM):
 - ▶ Limited study of dynamics b/c no extended household panel data exist → >5 obs/hh
 - ▶ Ordinal measure limits capacity to study change in FI severity
- ▶ This study investigates long-term FS dynamics using a new measure which is continuous and available over long-term.

A New Measure

- ▶ The Probability of Food Security (PFS) = estimated probability that hh food expenditures \geq 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.
- ▶ Food exp data more often available in HH surveys than HSFM → enables use of longer panels
- ▶ Continuous, decomposable measure in the Foster–Greer–Thorbecke (FGT 1984 EMTRA) tradition, enabling deeper study and groupwise decomposition of FI severity.

Data & Methodology (1)

- ▶ We use balanced panel $\approx 23,000$ obs from $\approx 2,700$ hhs over 9 biennial waves (2001-2017)
- ▶ We define the PFS as below.

$$\hat{\rho}_{it} = 1 - F(X_{it}, W_{it-1} | \underline{W}_{it}) \in [0, 1]$$

- ▶ $F(\cdot)$: Food expenditure CDF
- ▶ X : Household characteristics
- ▶ W : Annual food expenditure per capita
- ▶ \underline{W} : cost of the TFP diet

Data & Methodology (2)

- ▶ HH i is food secure in t iff $\hat{\rho}_{it} \geq \underline{P}_t$, where we set \underline{P}_t (assumed probability threshold) to match sample-period FI prevalence to USDA population prevalence estimate from CPS.
- ▶ PFS is strongly and positively correlated with the HFSM, and there exists broad consistency of associational patterns between the two measures and household attributes.
- ▶ PFS provides a useful complement to the HFSM, one more amenable to study dynamics of prevalence and severity.

Household Dynamics - Spells Approach

Use hh-year-specific 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.

t	t-1	
	Food Insecure (FI)	Food Secure (FS)
FI	(FI_{t-1}, FI_t) (1)	(FI_{t-1}, FS_t) (2)
FS	(FS_{t-1}, FI_t) (3)	(FS_{t-1}, FS_t) (4)

- ▶ FI considered recurrent if persists ≥ 2 waves
- ▶ Yields spell length distribution, exit rates conditional on FI status.

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

$$TFI_i(\alpha, PFS_{i1}, \dots, PFS_{it}) = \frac{1}{T} \sum_{t=1}^T \left(1 - \frac{\min(PFS_{it}, \underline{P}_t)}{\underline{P}_t} \right)^\alpha \quad (1)$$

$$CFI_i(\alpha, PFS_{i1}, \dots, PFS_{it}) = \left(1 - \min \left[1, \frac{\sum_{t=1}^T PFS_{it}}{\sum_{t=1}^T \underline{P}_t} \right] \right)^\alpha \quad (2)$$

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 $PFS_{it} \geq \underline{P}_t$
 3. Transiently food insecure: $CFI_i = 0$ and $\exists t$ such that $PFS_{it} < \underline{P}_t$.
 4. Persistently food secure: $CFI_i = TFI_i = 0$
- ▶ Two methods do not overlap perfectly - households can be transiently FI under one method but not under the other.
- ▶ While the permanent approach is less prone to measurement error and data truncation problems, it assumes stationarity.

Groupwise Aggregation

- ▶ Aggregate PFS over hhs to generate group-specific estimates.

$$FGT_t(\alpha, PFS_{1t}, \dots, PFS_{Nt}) = \frac{1}{N} \sum_{i=1}^N \left(1 - \frac{\min(PFS_{it}, \underline{P_t})}{\underline{P_t}} \right)^\alpha \quad (3)$$

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

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	.

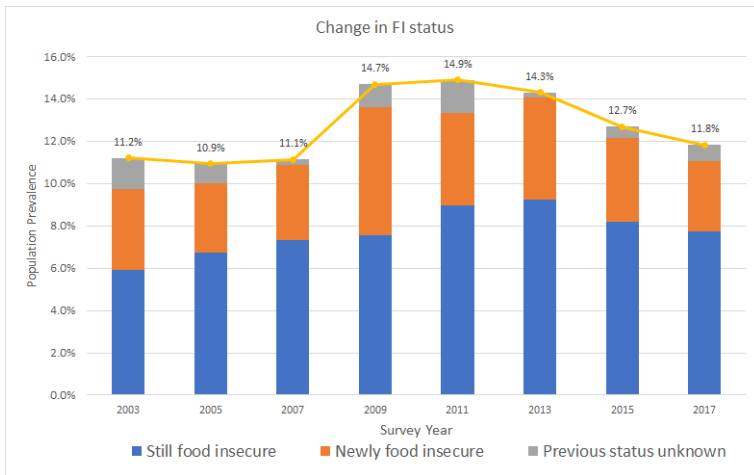
- ▶ Roughly half of food insecurity spells are transitory
- ▶ The longer hhs remain food insecure, the less likely they exit.

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

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

Persistence and Entry by Year



- Prevalence, entry, persistence peak during Great Recession

Chronic Food Insecurity from the Permanent Approach

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	N	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 the remaining 30%, 74% of FI experience is chronic
- ▶ Most vulnerable (TFI) groups have much higher CFI (90-95%), and even more transient FI

Decomposing Variation in TFI/CFI

	TFI		CFI	
	R^2	%	R^2	%
Region	0.027	0.042	0.019	0.036
Highest degree achieved	0.052	0.079	0.037	0.072
Age	0.008	0.012	0.004	0.008
Gender	0.063	0.096	0.060	0.116
Race	0.093	0.141	0.064	0.124
Marital status	0.043	0.066	0.029	0.056
ln(income per capita)	0.152	0.232	0.112	0.217
Food Assistance (SNAP, WIC, etc.)	0.166	0.253	0.148	0.287
Others	0.051	0.078	0.043	0.084
Total	0.655	0.998	0.517	0.999

- ▶ Regional fixed effects capture merely 4% of variation. Fig
- ▶ Hh income and food assistance program participation capture \approx 1/2 of variation ... budget constraints the best FI predictors.

Pre-, During and Post-Great Recession FI By Group

Prevalence	2003	2011	2017
High School or below, Non-White, Female	0.64	0.66	0.58
High School or below, Non-White, Male	0.30	0.29	0.26
High School or below, White, Female	0.26	0.33	0.33
High School or below, White, Male	0.09	0.14	0.13
College, Non-White, Female	0.37	0.46	0.28
College, Non-White, Male	0.11	0.16	0.11
College, White, Female	0.13	0.14	0.10
College, White, Male	0.02	0.06	0.04
Total	0.11	0.15	0.12

- ▶ The most food insecure groups in 2003 became less food insecure in 2017 relative to 2003, while the most food secure in 2003 became less food secure in 2007

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 with some spatial variation
- ▶ Race/Gender/Educational correlation w/income results in huge groupwise differences in FI, both in prevalence and in severity.

Thank you

Questions and/or comments are highly appreciated.

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Summary Statistics

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	Total		SRC		SEO	
	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		16,602		5,954	

Model Selection

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Variables	(1) W_{ijt}	(2) W_{ijt}	(3) W_{ijt}	(4) W_{ijt}	(5) W_{ijt}
W_{ijt-1}	0.131*** (0.00)	0.250*** (0.01)	0.298*** (0.03)	0.323*** (0.07)	0.274** (0.12)
W_{ijt-1}^2		-0.0126*** (0.00)	-0.0241*** (0.01)	-0.0349 (0.02)	-0.00300 (0.06)
W_{ijt-1}^3			0.000754** (0.00)	0.00237 (0.00)	-0.00569 (0.01)
W_{ijt-1}^4				-0.0000771 (0.00)	0.000782 (0.00)
W_{ijt-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

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

Cut-off PFS

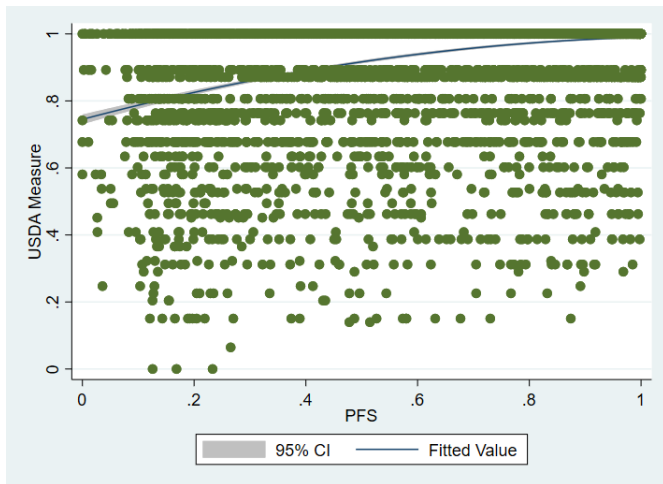
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Regression of the PFS on USDA measure

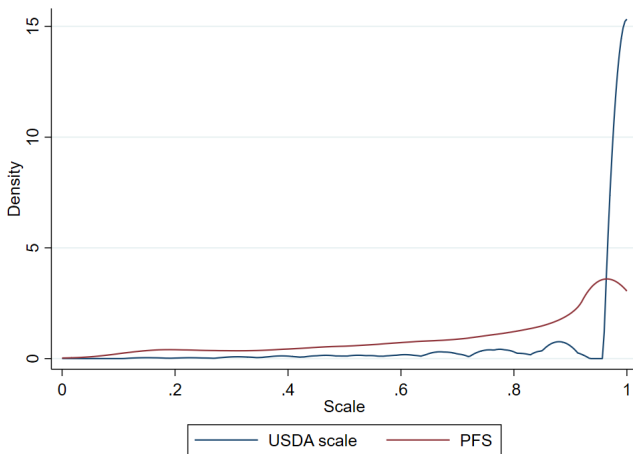
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	(1)	(2)	(3)	(4)
	USDA	USDA	USDA	USDA
PFS	0.179*** (0.02)	0.463*** (0.08)	0.181*** (0.02)	0.438*** (0.08)
PFS ²		-0.216*** (0.05)		-0.197*** (0.05)
Fixed Effects	N	N	Y	Y
N	11,793	11,793	11,793	11,793
R ²	0.116	0.127	0.137	0.145

Scatterplot and Fitted Line

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Distribution of Food Security Measures

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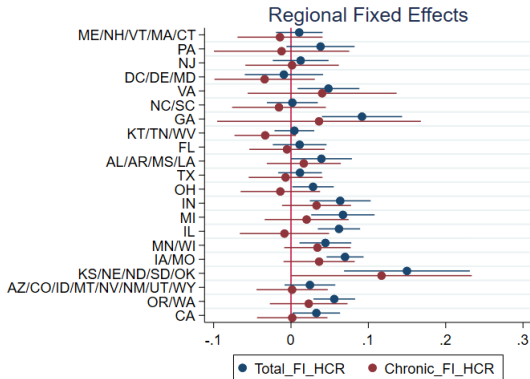
Association with Household Attributes

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	Continuous		Binary	
	(1) USDA b/se	(2) PFS b/se	(3) USDA b/se	(4) PFS 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)
ln(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 ²	0.217	0.667	0.168	0.471

Spatial Variation of TFI/CFI

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► Midwestern states exhibits significantly higher TFI/CFI