United States Department of Agriculture

Farm Household Income Volatility: Assessing Risk in Farming using Panel Data from a National Survey

24th annual Pacioli Workshop
Pristina, Kosovo

Nigel Key, Daniel Prager, and Christopher Burns
Economic Research Service, USDA

The views expressed are those of the authors and should not be attributed to the Economic Research Service or USDA

Why Is Farm Household Income Volatile?

- Farm household income = farm income + off-farm income
  - Farm income is share of farm-related income that accrues to principal operator household (can be negative)
  - Off-farm income includes off-farm wages and salaries, other business income, capital gains, and transfers to the household

- Many farm households face greater income risk than non-farm households:
  - Fluctuations in yields, prices, land rents, input prices (business risk)
  - Rare events such as disease, blight, droughts, flooding (production risk)
  - Changes in government policies
  - Changes in the non-farm economy (e.g. recessions, local labor market conditions)

Lack of Longitudinal Data on U.S. Farm Households

- There is panel data available to measure volatility of non-farm households
  - Panel Study on Income Dynamics (PSID)
  - Current Population Survey (CPS)
- But, a lack of consistent panel data on farm households
  - Agricultural Resource Management Survey is conducted each year (since 1996) and gives data on a variety of farm household characteristics
    - Jointly administered by NASS and ERS
    - Survey is nationally representative, but cross-sectional

Sampling ARMS respondents

- ARMS administered in three phases
  - Phase I: initial screen for eligible farms
  - Phase II: field-level (production practices, resource and input usage)
  - Phase III: farm-level (farm finances, operator/household demographics and finances)
- ARMS has a stratified random sampling design
  - Selection probabilities vary by region and commodity type
  - Larger farms are oversampled in each year
    - More likely to be sampled again over time
  - Population estimates generated with sampling weights

Linking farms through time in ARMS

- NASS identifies farms based on the principal operator
  - Person who makes the managerial decisions on farm
- Each principal operator is given an ID, which does not change over time
  - (POID) Person-operation identification
- For this study, we match on POID and link farm operators (and their operations) over time
  - Unbalanced panel with 27,515 year-pairs
    - No sampling weights used in analysis
  - Because larger farms appear more often in panel, our data is representative of U.S. commercial farms (i.e. Total sales > $350,000)

POIDs that are observed at least twice

	Year 2														
Year 1	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	
1997	-	17	29												379
1998	272	97	151	183											703
1999	178	228	224	282	21										1,113
2000		91	379	339	282	34									1,431
2001			92	34	224	262	213								1,131
2002				241	511	438	384	265							1,839
2003					114	975	654	544	57						2,794
2004						211	117	559	62	557					3,054
2005							378	153	82	66	748				3,605
2006								174	1,146	83	646	668			3,464
2007									187	935	611	543	448		2,724
2008										136	192	719	651	46	3,058
2009											167	1,229	66	-	2,056
2010												164	-	-	164
	450	433	875	1,079	1,152	1,920	1,746	1,695	1,534	1,777	2,364	3,323	1,165	46	27,515

How to Measure Income Volatility?

- Measuring farm household income volatility is difficult because of negative income values.

One measure of income volatility:

- Absolute Coefficient of Variation (ACV)
  - lower limit of 0, unbounded above

$$ACV_{it} = \left| \frac{\sqrt{(\sum y_{it} - y_{i.})^2}}{\bar{y}_{i.}} \right|$$

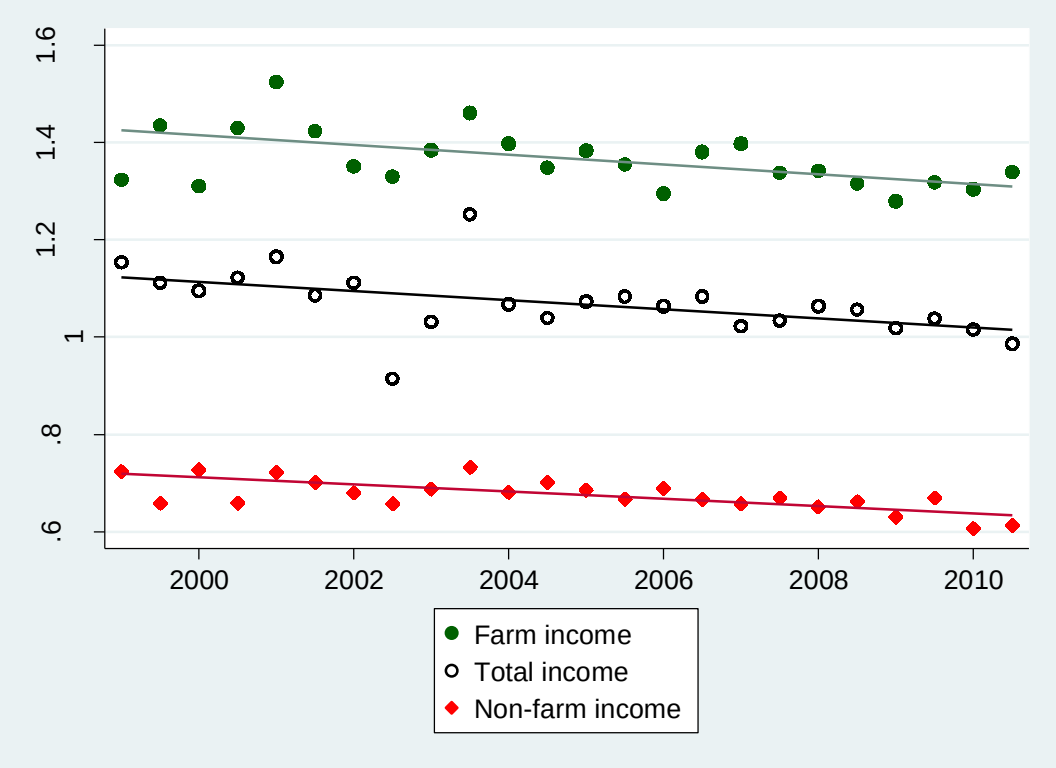
Where $\bar{y}_{i.} = 0.5 * (y_{it} + y_{it-1})$

Crop Farms Have Higher Household Income Volatility

Farm income	All farms	Livestock	Crop
Median	$48,057	$35,598	$71,223
Median absolute change between years	$86,462	$63,765	$123,903
Share negative in at least one year	0.46	0.49	0.44
Share negative in both years	0.14	0.15	0.11
Mean ACV	1.35	1.37	1.35
Off-farm income			
Median	$33,037	$31,261	$34,647
Median absolute change between years	$16,793	$15,149	$18,341
Mean ACV	0.67	0.67	0.67
Total household income			
Median	$98,893	$83,742	$125,176
Median absolute change between years	$100,925	$77,470	$138,021
Share negative in at least one year	0.26	0.25	0.28
Share negative in both years	0.04	0.03	0.04
Mean ACV	1.06	1.03	1.10

Source: 1996-2014 ARMS panel

Farm household income, farm income, and off-farm income volatility have declined



Regression Analysis

What factors are associated with farm household income volatility?

- Estimation Equation:

$$y_{it} = \alpha + \boldsymbol{X_1'\beta} + \boldsymbol{X_2}'\boldsymbol{\gamma} + Year_t + State_i + \epsilon_{it}$$

- $\boldsymbol{X_1}$ – *farm, operator, and household characteristics*
- $\boldsymbol{X_2}$ – *unbalanced panel data controls*
  - *E*.g., the number of times a farm appears in the dataset and the distance between observations

Regression results (selected variables)

	Dependent variable: Ln(ACV)		
	Total Household Income	**Farm Income**	**Off-farm Income**
Mid-year	-0.016***	-0.009**	-0.016***
Year span	0.025***	0.033***	0.053***
Farm Type: Cattle and livestock	-0.105***	-0.056*	-0.074***
Assets $750K-1.5M	0.215***	0.068**	0.082***
Assets $1.5M-3.0M	0.352***	0.118***	0.184***
Assets $3.0M+	0.466***	0.110***	0.322***
Operator Education: High school	-0.122***	-0.079**	-0.216***
Operator Education: Some college	-0.126***	-0.053	-0.265***
Operator Education: College or more	-0.217***	-0.114***	-0.317***
Primary occupation: farmer	0.498***	-0.039	0.459***
Operator Age: 65+	-0.040*	0.100***	-0.200***
Operator Married: Both years	-0.269***	-0.055	-0.388***
Unemployment Rate	0.010**	0.002	0.002

Note: State-clustered standard errors (*** p<0.01, ** p<0.05, * p<0.1)

Findings

- Farm households have volatile income
  - Fluctuations in farm income is primary driver of volatility
  - Off-farm income less volatile
- Regression results show a secular decrease in household, farm, and off-farm income volatility
  - Larger farms (assets) and crop farms have more volatile income
  - More educated operators and older operators have lower income volatility (household, farm and off-farm)
  - Married operators have lower household and off-farm income volatility
  - Local labor market conditions affect ability to smooth household income volatility

Thank you!

Questions?

My contact info:

christopher.burns@ers.usda.gov

+01 202 694 5329