UNIVERSITÀ DEGLI STUDI FIRENZE

DISEI
Dipartimento di scienze per l'economia e l'impresa

Testing for Household Resilience to Food Insecurity

Evidence from Nicaragua

Federico Ciani
Donato Romano

3rd AIEAA Conference - Alghero, 25-27 June 2014

Objectives

- **General:**
  - develop a methodology to quantitatively assess resilience to food insecurity

- **Specific:**
  - resilience index estimation
  - resilience index validation
  - resilience and impact evaluation

Resilience

- **Development Resilience**
  - the ***likelihood*** over time of a person, household or other unit **not being poor** in the face of various **stressors** and in the wake of myriad **shocks**. If and only if that ***likelihood is and remains high***, then the unit is resilient (Barrett and Constas, 2012).

- **Resilience to Food Insecurity**
  - the the ***ability*** of a household to ***keep with*** **a certain level of well-being** (i.e. being food secure) by withstanding **shocks** and **stresses**, and reorganize while undergoing change so as to still retain essentially the same function, structure, and identity (Ciani and Romano, 2013).

Resilience

- **Components**
  - **Outcome**: a measure of well-being (not being poor, being food secure)
  - **Dynamics**: the likelihood over time is and remains high, ability to keep with a certain level of well-being
  - **Disturbances**: stressors and shocks

* **Livelihood strategies**: options available to the HH

➔ functionings

➔ response diversity (**heterogeneity**)

Resilience vs. vulnerability

- Well-being (e.g. being food secure): ex-post measure
- Vulnerability: ex-ante description of the process outcome

		Expected future food security status	
		Food secure	*Food insecure*
Present food security status	*Food secure*	Food secure	Potentially food insecure
	Food insecure	Potentially food secure	Chronically food insecure
		Non-Vulnerable	***Vulnerable***

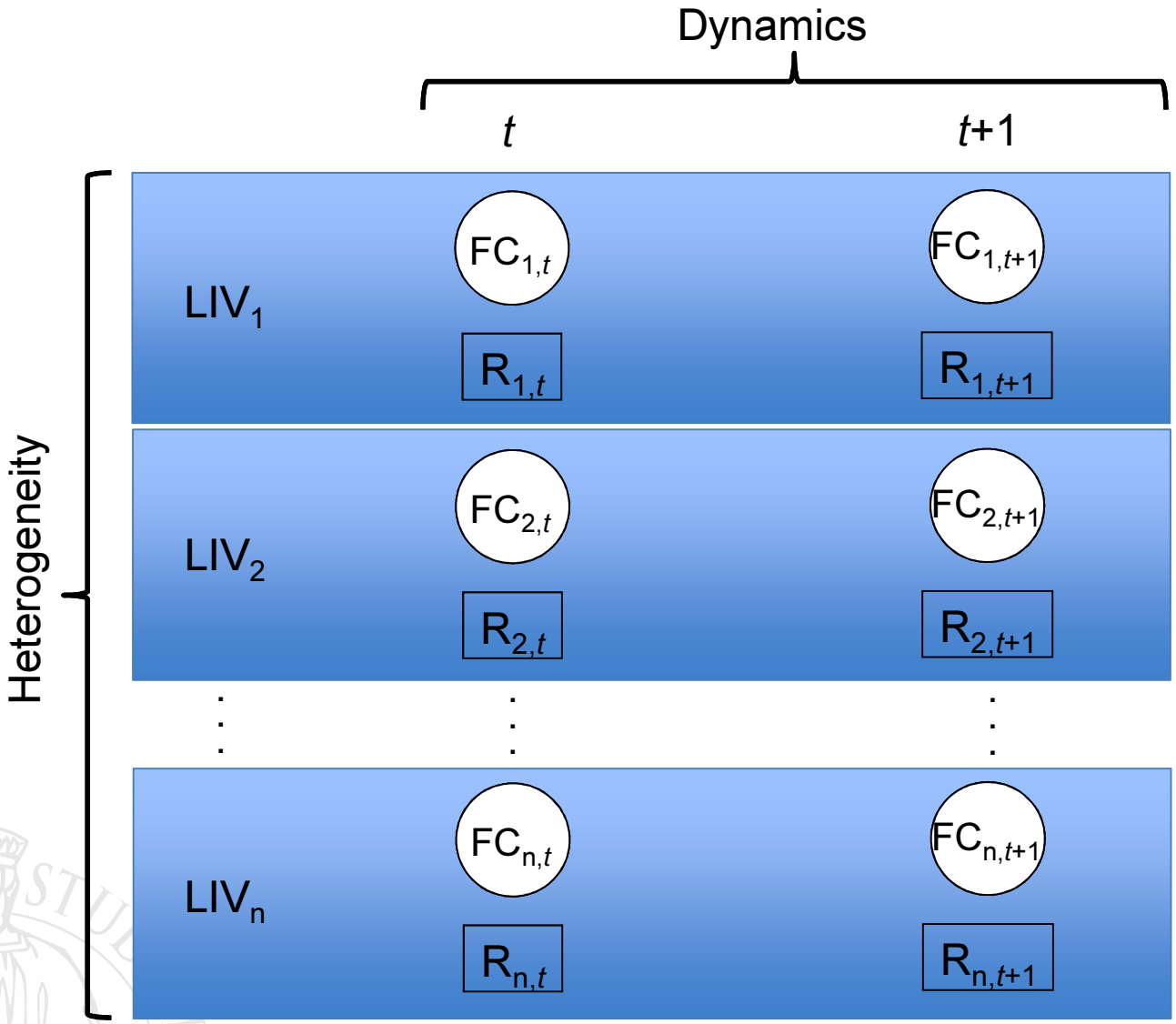
Resilience vs. vulnerability

- vulnerability
  - output-based: asset-income-wellbeing (Dercon, 2001)
  - *V = f* (*exposure to risk*, *resilience*)
    - risks faced by the HH
    - option available to the HH
    - ability to handle risks

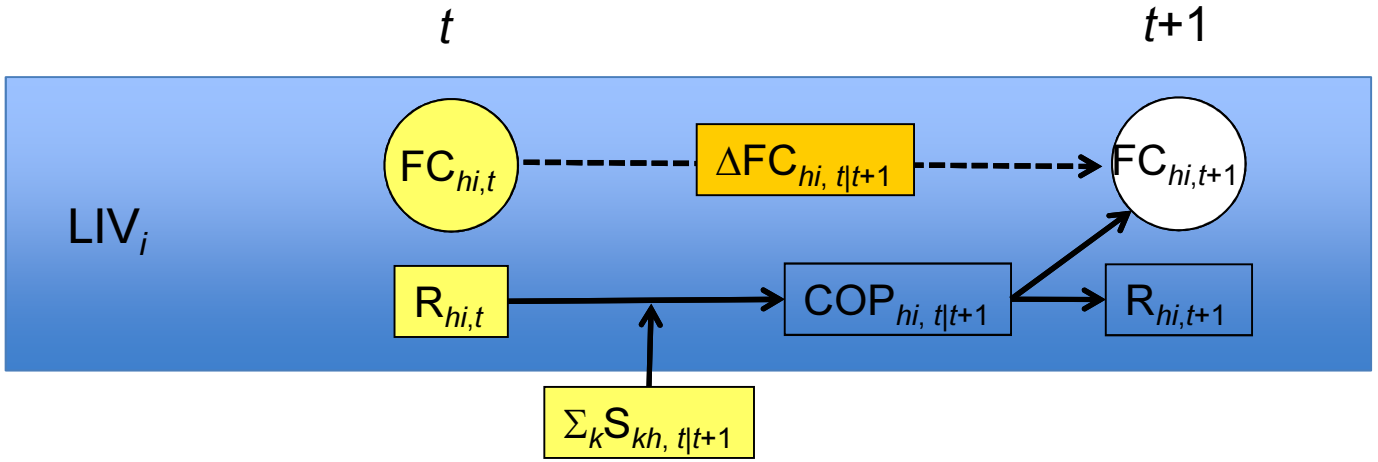
- resilience
  - ex-ante (reduction and mitigation) vs. ex-post (coping)
  - short-term (coping) vs. longer-term (adaptation, reorganization)

  $\Rightarrow$ We focus only on resilience

Estimation strategy (I)



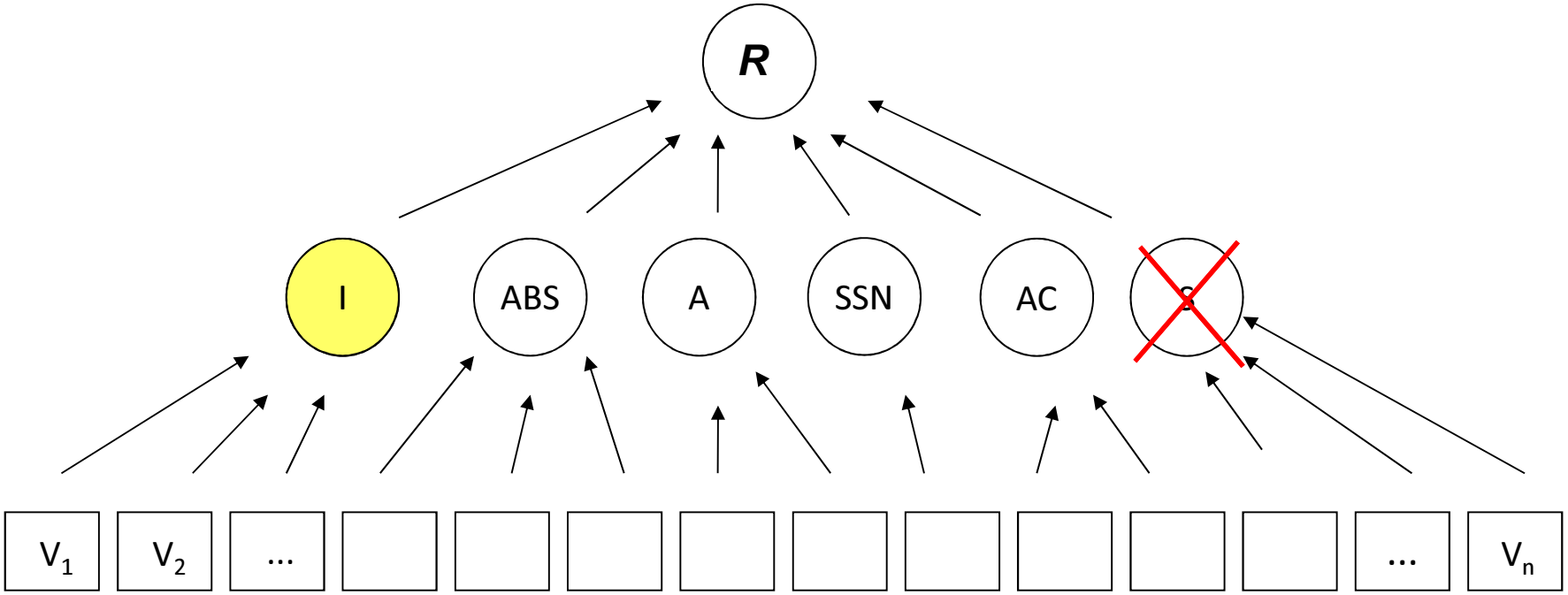
Estimation strategy (II)



?

- heterogeneity
- dynamics

Estimation strategy (III)

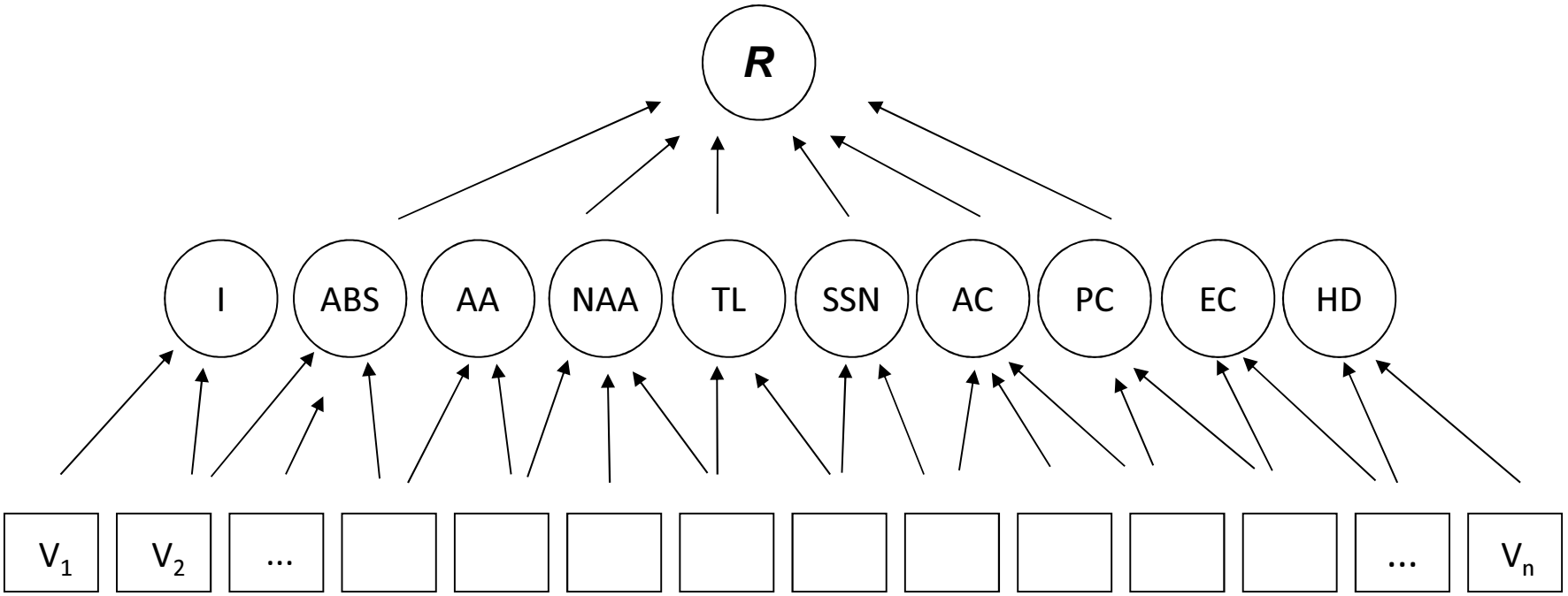


Alinovi *et al.*, 2008

Observed variables (onsets)

Unobserved (latent) variables

Estimation strategy (III)



Observed variables (onsets)

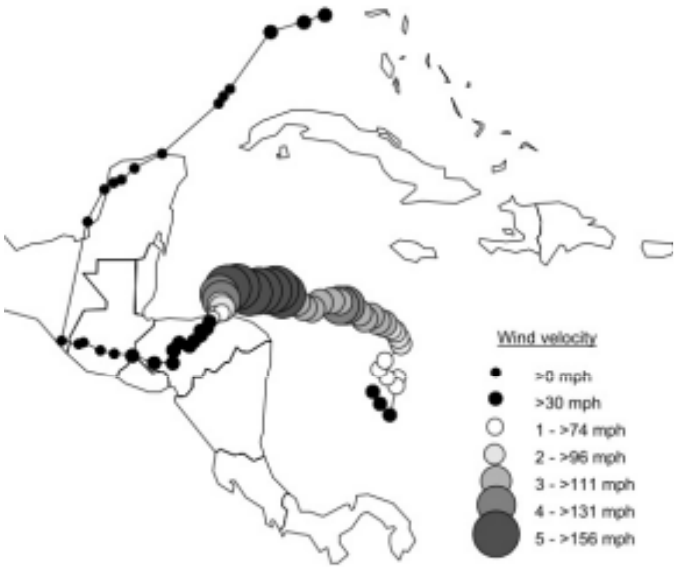
Unobserved (latent) variables

Estimation strategy (IV)

Income	Access to Basic Services	Agr. Assets	Non Agric. Assets	HH. Tech. Level	Social Safety Nets (1)	Social Safety Nets (2)	Adaptive Capacity	Physical Connectivity	Economic Connectivity	HH Demographics
per capita income	distance to school	land	durables	prod. capital	institutional transfers	private transfers	n employed	access to the household (kind of road)	market reliance for food	dependency ratio
	safe water	capital	house				n sectors of employment	tv	access to credit	
	distance to water	livestock					education hh head	ownership of private transportation mean	financial assets	
	distance to health facility						max education in hh			
	safe sewage						empl. ratio			
	electricity						health insurance			

The case study: Nicaragua and Mitch

- one of the poorest countries in LAC (low income and low HDI)
- poverty HCR from 50.3% in 1993 to 48.3% in 2005, higher among women and in rural areas
- > 1 mln undernourished (19% total population)
- 26th October - 4th November 1998: Nicaragua hit by hurricane Mitch
- Central and Northern regions (Leon and Chinandega departments)
- Mitch classified as a 5th degree on the Saffir-Simpson scale
- 3,800 casualties; 7,000 missing; 700,000 homeless
- agriculture: losses ranging from 7% to more than 60%



Dataset

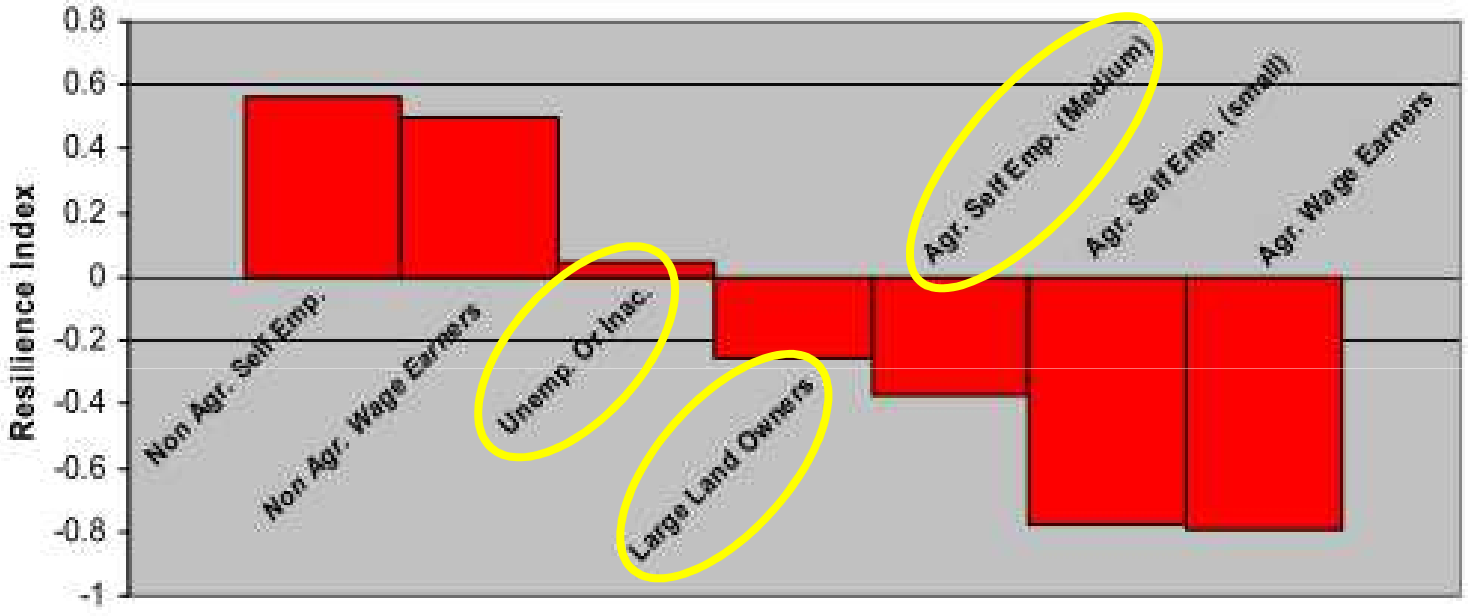
- 1998 and 2001 *Encuesta Nacional de Hogares sobre Medición de Niveles de Vida* (EMNV) → nationally repres.
- 3,078 HHs interviewed both in 1998 and in 2001 → panel
- 1999: follow-up survey in Mitch affected areas
- 422 Mitch affected HHs in 1998, 1999 and in 2001

Department	Total HHs	Mitch Affected HHs	Department HHs to total HHs (%)	Affected HHs to total Department HHs (%)
Nueva Segovia	137	7	4.45	5.11
Jinotega	159	12	5.17	7.55
Madriz	134	24	4.35	17.91
Estelì	153	59	4.97	38.56
Chinandega	225	64	7.31	28.44
Léon	248	105	8.06	42.34
Matagalpa	219	47	7.12	21.46
Boaco	137	37	4.45	27.01
Managua	403	0	13.09	0.00
Masaya	238	24	7.73	10.08
Chontales	142	0	4.61	0.00
Granada	151	0	4.91	0.00
Carazo	164	0	5.33	0.00
Rivas	151	7	4.91	4.64
Rio San Juan	84	0	2.73	0.00
RAAN	142	20	4.61	14.08
RAAS	191	16	6.21	8.38
Tot	**3,078**	**422**	**100.00**	**13.71**

'General' Resilience Index

- First attempt: measurement of a single resilience index for the whole population
- **Livelihood Classification**
- Cluster Analysis→ Euclidean Distance + Ward's Linkage
- **Resilience Measurement**
- Two stage factor analysis
- Polychoric variance covariance matrixes
- Bartlett's method
- Factorial scores of the first factor are considered as the resilience index

'General' Resilience Index



- unreliable results: AGR vs Non-AGR livelihood strategies

  ⇒ **assuming the same process of resilience-building holds for all livelihood groups untenable**

'Agriculture-specific' Resilience Index

- Sample selection criterion: AGR income share > 25% TOT

Livelihood Strategies

- Cluster analysis on:
  - sector of employment of the HH's head
  - job position of the HH's head
  - HH's income shares
  - number of HH's income sources
  - agricultural production assets
  - market reliance (share of food self-consumption)

'Agriculture-specific' Resilience Index

- Livelihood Groups
  - agricultural wage earners: low share of income from agriculture (76%). One third of hh heads agricultural unsk. wage worker. Most part of households net food buyer. 40% hh of them live urban areas. Diversification between agricultural and not agricultural activities;
  - minifundia owners: avg land endowment 2 ha. One half of these hh is net food buyer. More than 84% of income from agriculture;
  - small-medium farms: avg area 16 ha. Much more capital intensive than minifundia. Difference depending on the overall organization of production and livelihoods. Low share of non-agricultural income (5%). Growing role of livestock farming;
  - large owners: 187 ha land on avg. Remarkable endowments of capital, extra hh labour and livestock. One half of total income is from livestock.

'Agriculture-specific' Resilience Index

Variables	Total HHs	s.d.	Wage earners	Minifundia	Medium size own.	Large owners
number of hh	1,237	-	373	479	342	43
Sector of Employment						
hh head in agriculture	0.702	0.420	0.493	0.770	0.822	0.884
hh head in secondary sector	0.037	0.175	0.056	0.029	0.023	0.047
hh head in commerce	0.045	0.153	0.113	0.019	0.009	0.000
hh head not working	0.114	0.301	0.188	0.090	0.082	0.000
hh head inactive	0.065	0.218	0.088	0.065	0.041	0.047
Job Classification						
hh head peon	0.170	0.385	0.314	0.148	0.064	0.023
Income Shares						
sh. of income from agriculture	0.822	0.220	0.763	0.844	0.850	0.894
sh. of income from agricultural wages	0.290	0.371	0.580	0.220	0.094	0.045
sh. of income from crop	0.290	0.347	0.056	0.424	0.355	0.348
sh. of income from livestock	0.227	0.303	0.119	0.180	0.384	0.501
sh. of income from land rent	0.029	0.153	0.016	0.041	0.030	0.000
sh. of income from non agr. activities	0.085	0.158	0.124	0.074	0.055	0.086
Income Sources						
number of sector of employment	1.213	0.517	1.260	1.182	1.208	1.163
sh. of working members not in agriculture	0.084	0.137	0.151	0.056	0.057	0.035
sh. of members in agriculture	0.322	0.236	0.240	0.344	0.373	0.397
sh. of members peones	0.180	0.215	0.168	0.184	0.188	0.195
sh. of members unemployed or inactive	0.593	0.242	0.609	0.600	0.569	0.567
Agricultural Assets						
livestock (TLU)	2.678	10.161	0.006	0.911	4.883	28.636
agricultural capital	3,729	22,694	2	335	7462	46,252
land (ha)	12	49	0	2	16	187
extra hh labour (C$)	6,580	49,961	1	968	5,030	145,964
Market Reliance						
share of self-consumption	0.274	0.266	0.033	0.445	0.305	0.178
net food buyer	0.583	0.499	0.997	0.501	0.307	0.070

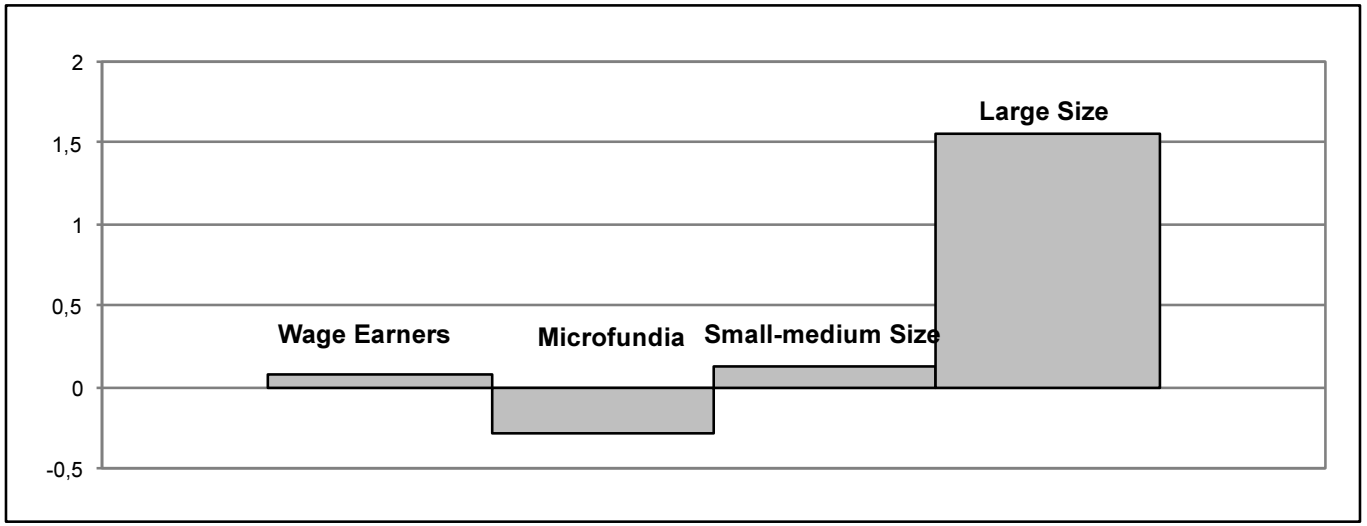
'Agriculture-specific' Resilience Index

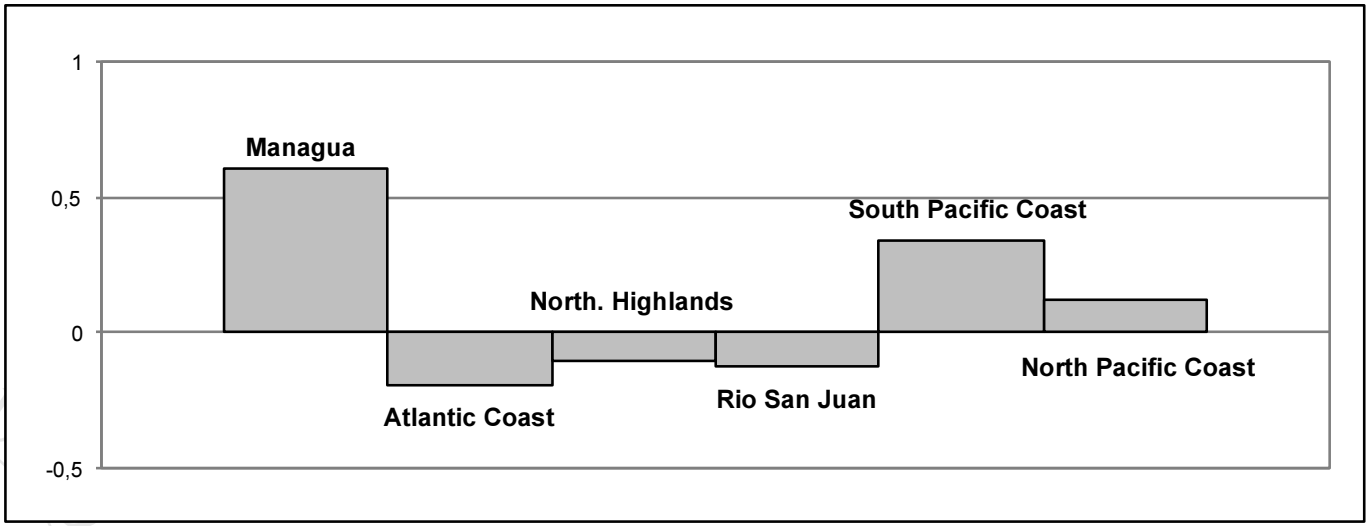
Income	Access to Basic Services	Agr. Assets	Non Agric. Assets	HH. Tech. Level	Social Safety Nets (1)	Social Safety Nets (2)	Adaptive Capacity	Physical Connectivity	Economic Connectivity	HH Demographics
per capita income	distance to school	land	durables	prod. capital	institutional transfers	private transfers	n employed	access to the household (kind of road)	market reliance for food	dependency ratio
	safe water	capital	house				n sectors of employment	tv	access to credit	
	distance to water	livestock					education hh head	ownership of private transportation mean	financial assets	
	distance to health facility						max education in hh			
	safe sewage						empl. ratio			
	electricity						health insurance			

Resilience Dimension	Factor Loadings
Income	0.197
Access to Basic Services	0.488
Agricultural Assets	0.622
Non-agricultural Assets	0.518
HH Production technological level	0.545
Public transfers	0.112
Private transfers	0.104
Adaptive capacity	0.526
Physical connectivity	0.705
Economic Connectivity	0.385
HH demographics	0.240

- all signs of loadings are positive
- variable selection → large share of variance explained by the first factor

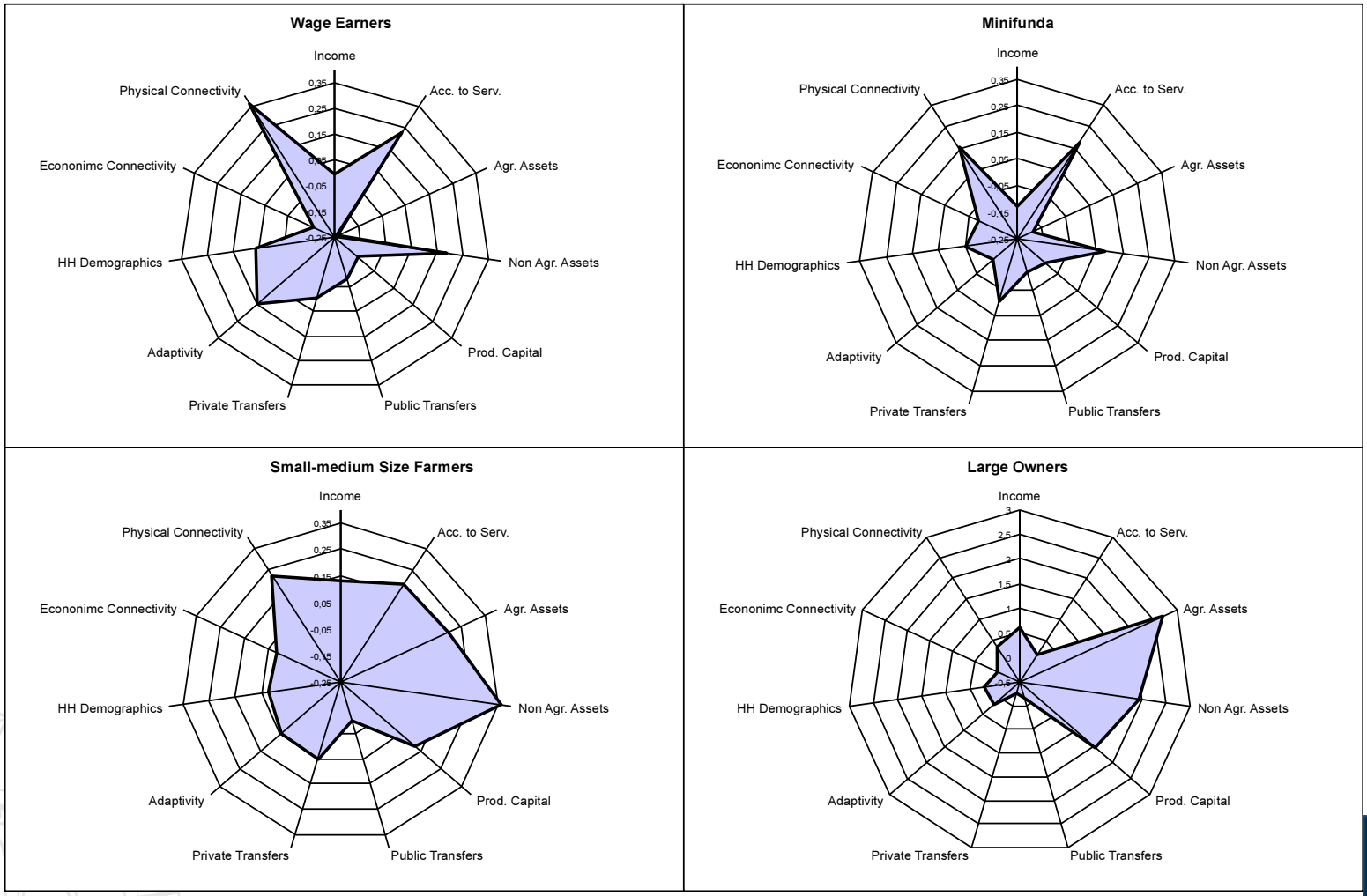
'Agriculture-specific' Resilience Index





'Agriculture-specific' Resilience Index

- Resilience determinants per livelihood groups



Resilience Index Validation

- is R a good predictor of HHs' future level of food security?
- outcome variable: level of food security
  - ➢ daily caloric intake: unreliable data
  - ➢ food expenditure per adult equivalent
- Sample: 1,221 agricultural HHs (228 HHs Mitch-affected)

		2001		
		Food Poor	**Non Food Poor**	**Total**
1998	**Food Poor**	296 (24.24%)	203 (16.63%)	499 (40.87%)
	Non Food Poor	187 (15.32%)	535 (43.82%)	722 (59.13%)
	Total	483 (39.56%)	738 (60.44%)	1,221 (100.00%)

- Food poverty dynamics
  - ➢ slight decline of food poverty (203 in 2001 vs. 187 in 1998)
  - ➢ high dynamics:
    - stability: food poor 59%, non food poor 74%
    - transition: food poor 41%, non food poor 26%

Resilience Index Validation

$\Delta FCpc_{h,t|t+}$ rate of growth of food expenditure between 1998 and 2001

$R_{h,t}$ household h's resilience at time t

X_h and Z_{ht} are time invariant and time varying household characteristics, respectively

LIV_{ht} livelihood strategy adopted by household h at time t

$S(i)_{h,t|t-1}$ vector of shocks occurred between t and t + 1,

ε_{ht} stochastic error term

Variable	Kind of Variable	Mean	Standard Deviation
log Food expenditure 1998	continuous	7.742	0.67
Food poor 1998	binary	0.396	0.489
Food poor 2001	binary	0.409	0.492
Into food poverty	binary	0.153	0.360
Out of food poverty	binary	0.166	0.372
Shocks			
Natural shocks	binary	0.513	0.554
Anthropic shocks	binary	0.559	0.604
Hurricane Mitch	binary	0.211	0.408
Region of Residence			
Region: Managua	binary	0.025	0.157
Region: Atlántico	binary	0.146	0.353
Region: Northern Highlands	binary	0.39	0.488
Region: Rio San Juan	binary	0.139	0.346
Region: South Pacific Coast	binary	0.159	0.366
Region: North Pacific Coast	binary	0.141	0.348

Variable	Kind of Variable	Mean	Standard Deviation
Area of Residence			
Urban	binary	1.793	0.405
Livelihood Group			
Large owners	binary	0.297	0.457
Wage earners	binary	0.393	0.489
Minifundia owners	binary	0.275	0.447
Small-middle size farm owners	binary	0.034	0.182
Resilience			
Resilience index		0	1.005
Resilience: 4th quart.	binary	0.25	0.433
Resilience: 3rd quart.	binary	0.25	0.433
Resilience: 2nd quart.	binary	0.25	0.433
Resilience: 1st quart.	binary	0.251	0.434
HH Head Characteristics			
HH head is white	binary	0.144	0.351
HH head is male	binary	0.174	0.38

Resilience Index Validation

- BP test→ heteroskedasticity
- Ward's Linkage method→groups aggregated at an earlier stage of the regression tree have a lower within group variance
- Large number of binary variables
- Alternative estimation strategy
  - estimation of the fitted error term of the OLS regression
  - specification of a functional form of ε_i (s.d.) or of ε_i^2 (variance)→ e.g. the regression of ε_i on all the dependent variables
  - the fitted value of the regression (v_i or s_i) used as weights in the weighted least squares (WLS) or variance-WLS regression

Resilience Index Validation

Dep. Var.: Diff. Log. Food Exp.						
Variable	**WLS**			**VWLS**		
	Coeff.	**S.E.**		**Coeff.**	**S.E.**	
log Food expenditure 1998	-0.127	0.016	***	-0.123	0.011	***
Shocks						
Natural shocks	-0.030	0.021		-0.025	0.014	*
Anthropic shocks	-0.032	0.020		-0.034	0.013	**
Hurricane Mitch	-0.060	0.034	*	-0.066	0.023	**
Region of Residence						
Region: Managua	-0.016	0.071		0.007	0.049	
Region: North. Highlands	-0.039	0.032		-0.031	0.021	*
Region: Rio San Juan	0.028	0.039		0.030	0.026	
Region: South Pacific Coast	0.017	0.040		0.019	0.026	
Region: North Pacific Coast	0.014	0.040		0.016	0.027	
Area of Residence						
Urban	0.031	0.029		0.043	0.019	
Livelihood Group						
Wage earners	-0.127	0.060	**	-0.124	0.060	***
Minifundia owners	-0.119	0.059	**	-0.124	0.059	***
Small-middle size farm owners	-0.109	0.059	*	-0.112	0.059	***
Resilience Quartile						
Resilience: 3rd quart.	-0.102	0.032	***	-0.104	0.022	***
Resilience: 2nd quart.	-0.126	0.033	***	-0.127	0.022	***
Resilience: 1st quart.	-0.243	0.034	***	-0.234	0.023	***
Interact. Term Mitch*Food Exp.						
Interaction: 3rd quart.*Mitch	0.172	0.074		0.112	0.045	*
Interaction: 2nd quart.*Mitch	-0.031	0.067		-0.016	0.044	
Interaction: 1st quart.*Mitch	0.172	0.074	**	0.186	0.048	***
HH Head Characteristics						
HH head is white	-0.006	0.030	*	-0.003	0.020	*
HH head is male	0.050	0.027	*	0.056	0.021	***
Constant	1.506	0.153	**	1.446	0.113	**
obs. 1,221	**Adj. Rq.**=0.095			**GoF=** 2439.04		
	F-Stat= 5.78	**Prob>F=**0.000		**Prob>Chi2** 0.000		
				M. Chi2=247.72	**Prob>Chi2** 0.000	

Resilience Index Validation

Dep. Var.: Food Poor 2001			
Variables	**Coefficient (dx/dy)**	**Robust S.E.**	
Food poor 1998	0.287	0.031	***
Shocks			
Natural shocks	-0.007	0.033	
Anthropic shocks	0.029	0.031	
Hurricane Mitch	-0.003	0.041	
Region of Residence			
Region: Managua	0.006	0.107	
Region: North. Highlands	0.196	0.050	***
Region: Rio San Juan	-0.132	0.052	**
Region: South Pacific Coast	0.003	0.062	
Region: North Pacific Coast	-0.032	0.061	
Area of Residence			
Urban	0.061	0.044	
Livelihood Group			
Wage earners	0.169	0.124	
Minifundia owners	0.245	0.117	**
Small-middle size farm owners	0.146	0.124	
Resilience Quartile			
Resilience: 3rd quart.	0.146	0.049	***
Resilience: 2nd quart.	0.191	0.049	***
Resilience: 1st quart.	0.302	0.050	***
HH Head Characteristics			
HH head is white	0.137	0.045	***
HH head is male	-0.008	0.040	
obs. 1,211			
Wald Chi2=222.51	**Prob>chi2=**0.000	**Pseudo R2=**0.179	

*, **, ***: significant at the 10, 5 and 1 per cent respectively.

Vulnerability:

- likelihood of being poor in 2001
- logit specification

- poverty trap: being poor in 1998 increases 28.7% the probability of being poor in 2001
- resilience: the lower R in 1998 the higher the probability of being poor in 2001

Resilience Index Validation

Transition in and out of poverty

Dep. Var.: Into Food Poverty			
Variables	**Coefficient (dx/dy)**	**S.E. (Robust)**	
Shocks			
Natural shocks	-0.027	0.033	
Anthropic shocks	0.031	0.030	
Hurricane Mitch	0.005	0.043	
Region of Residence			
Region: Managua	-0.070	0.097	
Region: North. Highlands	0.144	0.058	**
Region: Rio San Juan	-0.113	0.047	**
Region: South Pacific Coast	0.014	0.069	
Region: North Pacific Coast	-0.089	0.054	*
Area of Residence			
Urban	0.092	0.051	*
Livelihood Group			
Wage earners	0.021	0.104	*
Minifundia owners	0.156	0.117	
Small-middle size farm owners	0.002	0.101	
Resilience Quartile			
Resilience: 3rd quart.	0.151	0.055	***
Resilience: 2nd quart.	0.185	0.061	***
Resilience: 1st quart.	0.264	0.070	***
HH Head Characteristics			
HH head is white	0.077	0.049	
HH head is male	0.023	0.048	
obs. 722			
Wald Chi2=109.95 **Prob>chi2=**0.000 **Pseudo R2=**0.153			

Dep. Var.: Out of Food Poverty			
Variables	**Coefficient (dx/dy)**	**S.E. (Robust)**	
Shocks			
Natural shocks	-0.028	0.053	
Anthrophic shocks	-0.025	0.048	
Hurricane Mitch	0.031	0.060	
Region of Residence			
Region: Managua	-0.267	0.127	**
Region: North. Highlands	-0.171	0.066	**
Region: Rio San Juan	0.141	0.091	
Region: South Pacific Coast	0.026	0.085	
Region: North Pacific Coast	-0.059	0.086	
Area of Residence			
Urban	-0.001	0.0660	
Livelihood Group			
Wage earners	-0.355	0.124	***
Minifundia owners	-0.366	0.148	**
Small-middle size farm owners	-0.313	0.113	***
Resilience Quartile			
Resilience: 3rd quart.	-0.076	0.074	
Resilience: 2nd quart.	-0.130	0.070	**
Resilience: 1st quart.	-0.250	0.066	***
HH Head Features			
HH head is white	-0.212	0.060	***
HH head is male	0.041	0.058	
obs. 499			
Wald Chi2=53.72 **Prob>chi2=**0.000 **Pseudo R2=**0.084			

Resilience and Impact Evaluation

- evaluation of the impact of post-Mitch rehabilitation and relief measures on households' resilience
- problem of counterfactual → selection bias
- PSM to identify a suitable counterfactual
- sub-sample of only 278 agricultural HHs affected by Mitch → caution!

Interventions	Households	%
assistance to agricultural firm	18	3.03
technical assistance	30	7.11
transfer	311	52.27
assets	77	12.94
infrastructure	190	31.92
in kind	297	49.92
support to production	283	47.56

Dep. Var.: Asset Program			
Variables	**Coeff.**	**Robust S.E.**	
Urban	0.55053	0.298065	*
Region: North. Highlands	0.36215	0.404741	
Region: Rio San Juan	0.19024	0.531679	
Region: South Pacific Coast	-0.01015	0.528455	
Region: North Pacific Coast	0.86634	0.397004	**
Agricultural Damage	0.16504	0.228697	
House Damage	-0.14592	0.192801	
Resilience 1998	-0.04477	0.143523	
Constant	-2.64285	0.621601	***
obs. 278			
Wald Chi2=22.47	**Prob>chi2** 0.002	**Pseudo R2=**0.083	

Conclusions

1. Resilience index estimation
   - refinement of Alinovi et al. methodology
     - dropping shocks as determinants of resilience
     - including economic, physical and social connectivity
     - including some household characteristics
   - reliable results from resilience profiling
     - minifundistas and agricultural wage workers as least resilient groups
     - access to land and other agricultural assets crucial for food security

2. Resilience index validation
   - consistently the most robust predictor of household food security irrespective of the adopted specification
     - level of food security at time t+1
     - probability of escaping food poverty between t and t + 1
     - probability of falling into food poverty at time t+1

Conclusions

- households' resilience reconstitution is an overriding goal of policy interventions
  - positive impact of assets reconstitution programs on households' resilience
  - coupling of standard policy evaluation techniques with resilience analysis
- resilience-based interventions are primarily eligible for:
  - non-emergency, business-as-usual contexts
  - after crisis, rehabilitation phase
  - protracted crises contexts
- further research question
  - inclusion of stresses
  - coupling qualitative and quantitative analyses
  - up-scaling resilience assessment at a more aggregated level (e.g. community)

Thank you for your attention

donato.romano@unifi.it