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EAAE Masterclass
31 October 2024

Resilience to food and nutrition insecurity

Old wine in new bottles?

Donato Romano
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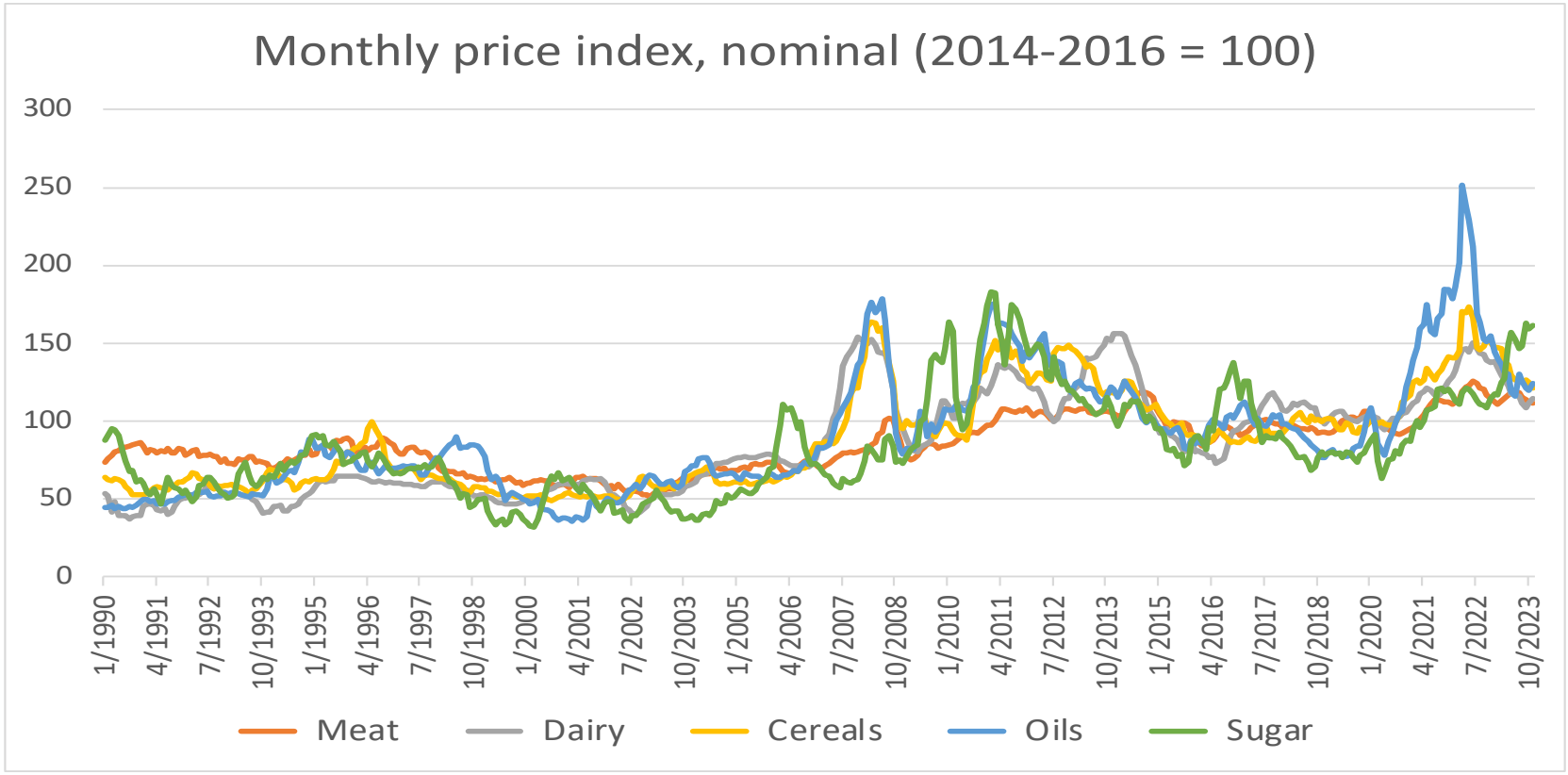
Natural and man-made shocks are on the rise



Source: FAO, 2023

Source: Our World in Data, 2024

Source: Obermeier & Rustad, 2023

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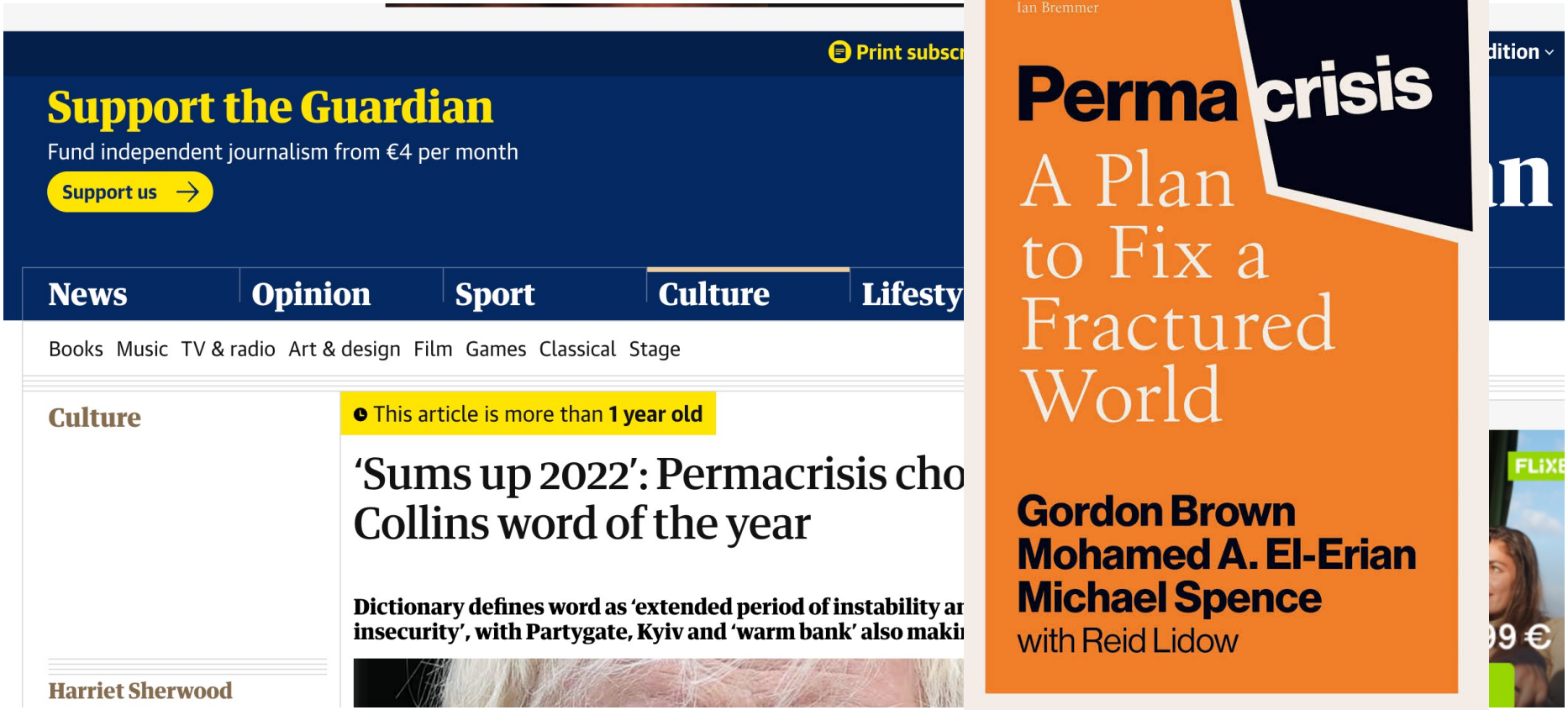
Permacrisis



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Why resilience? It is a buzz word

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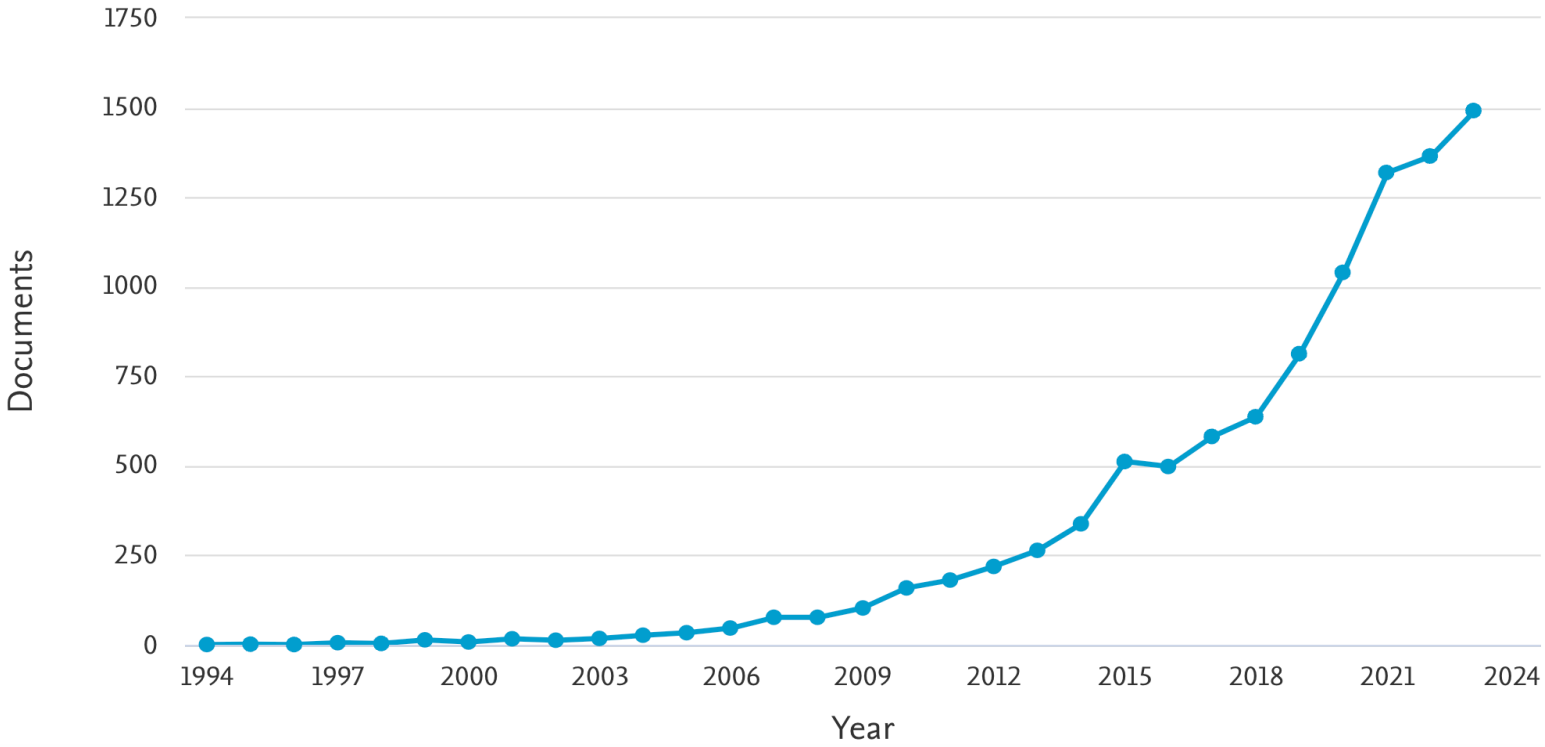

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Why old wine in new bottles?

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A scoping review of th
methods and evidence

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BAE
Bio-based and Applied Economics

OPEN ACCESS

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BAE 10th Anniversary papers

Vulnerability and resilience to food and nutrition insecurity: A review of the literature towards a unified framework

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What resilience?

- considerable debate and ambiguity surrounding the nature of resilience
  - **nature**: is it a state, a capacity, or a condition?
  - **locus**: does it rest in individuals, communities, or institutions?
  - **time frame**: how long for of resilience-relevant responses?
- various typologies of resilience and "shopping lists" of resilience properties abound
- setting the boundaries: **household** resilience to **food and nutrition insecurity** ("development resilience")

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Objectives

1. Critically review the theoretical foundations of the HH resilience concept
2. How this concept can be empirically operationalized in the specific case of HH resilience to FNS

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Outline

- The emergence of resilience concept
  - ecological vs. engineering resilience
  - resilience to food insecurity
- Resilience to food insecurity
  - resilience index measurement analysis (RIMA)
  - conditional moment-based resilience
- Policy implications
- Towards a unifying framework
- Where the frontier is?

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The emergence of resilience concept

Ecological vs. engineering resilience (Holling, 1996)

- **engineering resilience:** a system's ability to return to the steady state after a perturbation
  - efficiency, constancy and predictability
  - the concept that engineers look at to optimize their designs ("fail-safe" designs) → **make things work**
- **ecological resilience:** the magnitude of disturbance that a system can absorb before it redefines its structure/functions
  - disruptions to the stable steady state
  - instabilities can flip a system into another behaviour regime (i.e., into another stability domain), threshold effects and non-linearity → **things can break down and shift their behavior**

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The emergence of resilience concept

What about "economic" resilience? Traditionally,

- economists tend to consider conditions close to a single stable state
  - convex production and utility sets
  - multiple equilibria reduced by means of agents' expectations and predetermined normative and social institutions
- objective function (outcome of interest)
  - economic objectives more like engineering objectives (make things work): efficiency of functions vs. existence of functions
  - max GPP vs. max NPP
  - social science: anthropocentric viewpoint → **normative content**

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The emergence of resilience concept

What about "economic" resilience? More recently,

- not only a single stable state
  - multi-stable states due to path-dependency (Arthur, 1987)
  - production non-convexities (IRS) (David, 1985)
- objective function (outcome of interest)
  - not only maximization of expected result (income, return, consumption), but
  - also maximization of flexibility to cope with, and adapt to, unexpected change

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The emergence of resilience concept

Resilience to food insecurity

"The ability to prevent disasters and crises as well as to anticipate, absorb, accommodate or recover from them in a timely, efficient and sustainable manner. This includes protecting, restoring and improving food and agricultural systems under threats that impact food and nutrition security, agriculture, and food safety/public health" (FAO in emergencies)

- two key questions:
  - how to measure a construct that is unobservable?
  - what are the sources of resilience within a system?
- several **ad hoc approaches**, no clear **theoretical underpinnings**

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Resilience to food insecurity

Several ad hoc approaches (Barrett et al., 2021; Montalbano & Romano, 2022)

1. Resilience as **capacity** (Alinovi et al., 2008; FAO, 2016; d'Errico et al., 2018; Smith & Frankenberger, 2018)
2. Resilience as **return to equilibrium** (Pimm, 1984; Knippenberg et al., 2019)
3. Resilience as **transformability** (Walker et al., 2004; Reyers et al., 2018)
4. Resilience as **a normative condition** (Barrett & Constas, 2014; Cissé & Barrett, 2018)

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Resilience Index Measurement Analysis - II

Analytical framework (FAO, 2016; d'Errico et al., 2018)

- Resilience index estimation
  - Factor analysis: from observed variables to "pillars"
    - Access to Basic Services (ABS)
    - Assets (AST)
    - Social Safety Nets (SSN)
    - Adaptive Capacity (AC)
  - Multiple Indicators Multiple Causes (MIMIC)
    - R → FCS, Food Exp: outcomes (indicators of R), endogenous
    - ABS, AST, AC, SSN → R: resilience structure, exogenous

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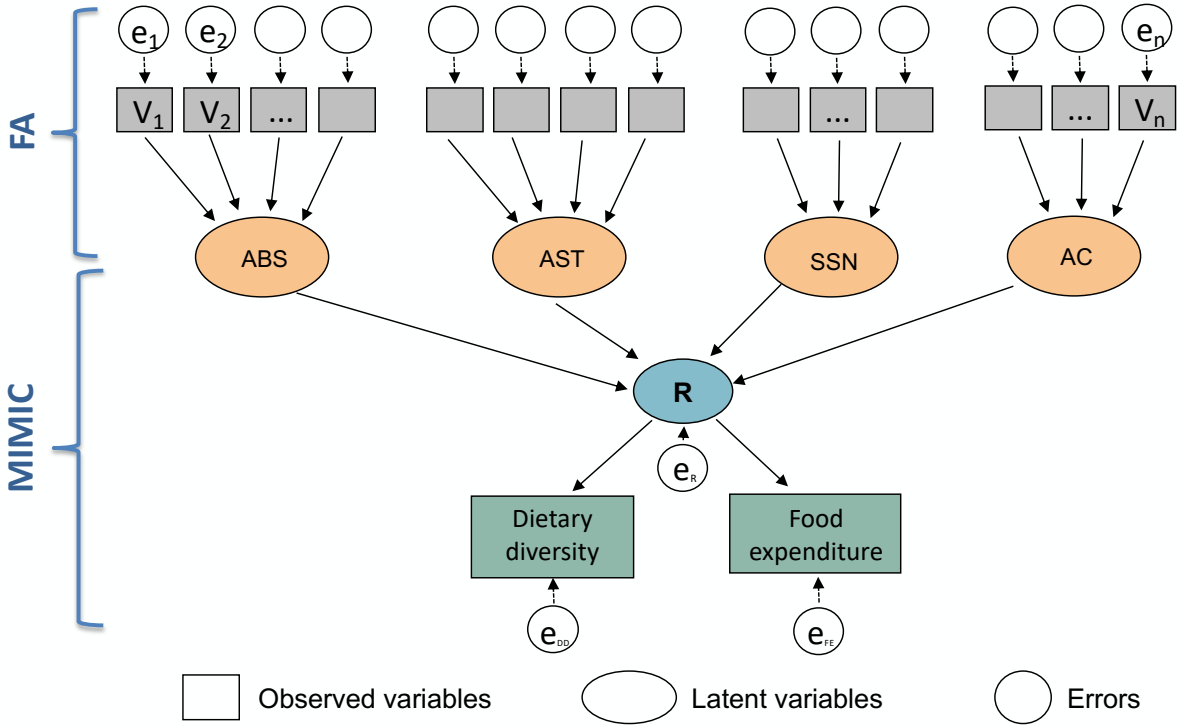
Resilience Index Measurement Analysis - II

Analytical framework (FAO, 2016; d'Errico et al., 2018)



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Resilience Index Measurement Analysis - II Assessment

- Theoretical issues
  - not rooted in a robust theoretical framework
  - not really dynamic, not stochastic
  - not an outcome
- Measurement issues
  - unclear RCI meaning: not anchored to any scale
  - RCI values change as new rounds are included in the sample

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Resilience Index Measurement Analysis - II Assessment

- Positive aspects
  - relatively easy to apply: e-RIMA https://www.fao.org/agrifood-economics/areas-of-work/rima/shiny/en/
  - pattern of determinants
  - future evolution prediction (though not dynamic)

Food Security (2018) 10:1033–1054
https://doi.org/10.1007/s12571-018-0820-5

ORIGINAL PAPER

CrossMark

Household resilience to food insecurity: evidence from Tanzania and Uganda

Marco d'Errico[1] · Donato Romano[2] · Rebecca Pietrelli[1]

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Development resilience (Barrett & Constas, 2014)

Development resilience is the capacity over time of a person, household or other aggregate unit to **avoid poverty** in the face of various **stressors** and in the wake of myriad **shocks**. If and only if that **capacity** is and remains **high over time**, then the unit is resilient

- Focus: human wellbeing (*resilience for what*)
- Scale: individuals, but easily aggregable (*resilience of what*)
- Risks: stressors, shocks (*resilience to what*)

- Time path (*dynamics*)
- Normative foundation: more is better (*policy orientation*)

*** stochastic dynamics of human wellbeing, development goal**

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Development resilience (Barrett & Constas, 2014)

- Devt resilience ↔ stochastic poverty traps
  - **state variables**: e.g. some wellbeing indicator(s), W_t
  - **law of motion**: stochastic (affected by exogenous events, ε_t), potentially highly nonlinear dynamics
  - **equilibrium**: multiple attractors defining stable states within distinct regimes
  - **thresholds**: tipping points that lead to discernible shifts in behavior and performance
- stochastic wellbeing dynamics described by the **moment function for conditional wellbeing**

$$m^k = \left(W_{t+s} \middle| W_t, \varepsilon_t\right)$$

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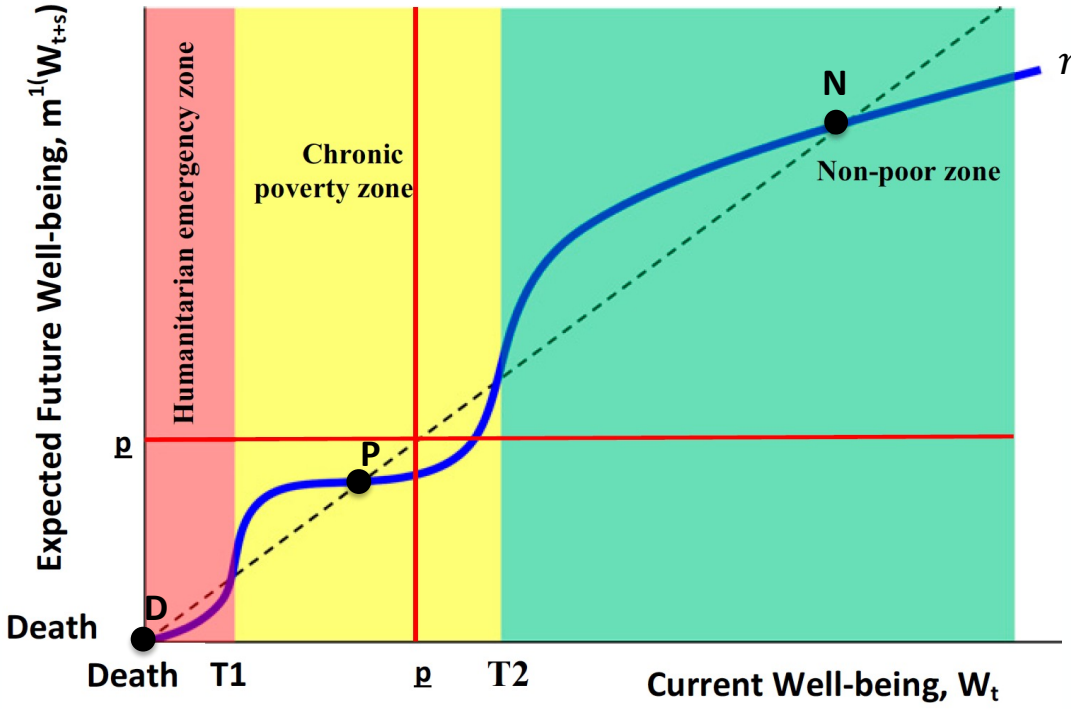
Development resilience (Barrett & Constas, 2014)

Non-linear expected wellbeing dynamics with multiple stable states: conditional expectation function



$$m^1 = \left(W_{t+s} \middle| W_t, \varepsilon_t\right)$$

- Three basins of attraction: *HEZ*, *CPZ*, *NPZ*
- Two thresholds: T1, T2
- Three stable states: death (D), poor standard of living (P), non-poor standard of living (N)
- Ordering: $NPZ \succ CPZ \succ HEZ \rightarrow$ guard against downward/leftward slides
- Chronically poor:

$$m^1 = \left(W_\infty \middle| W_t \in \{CPZ, HEZ\}, \varepsilon_t\right) < \underline{p}$$

- Exact m^1 shape could differ, but at least two equilibria: death (D) and one living equilibrium (P or N)

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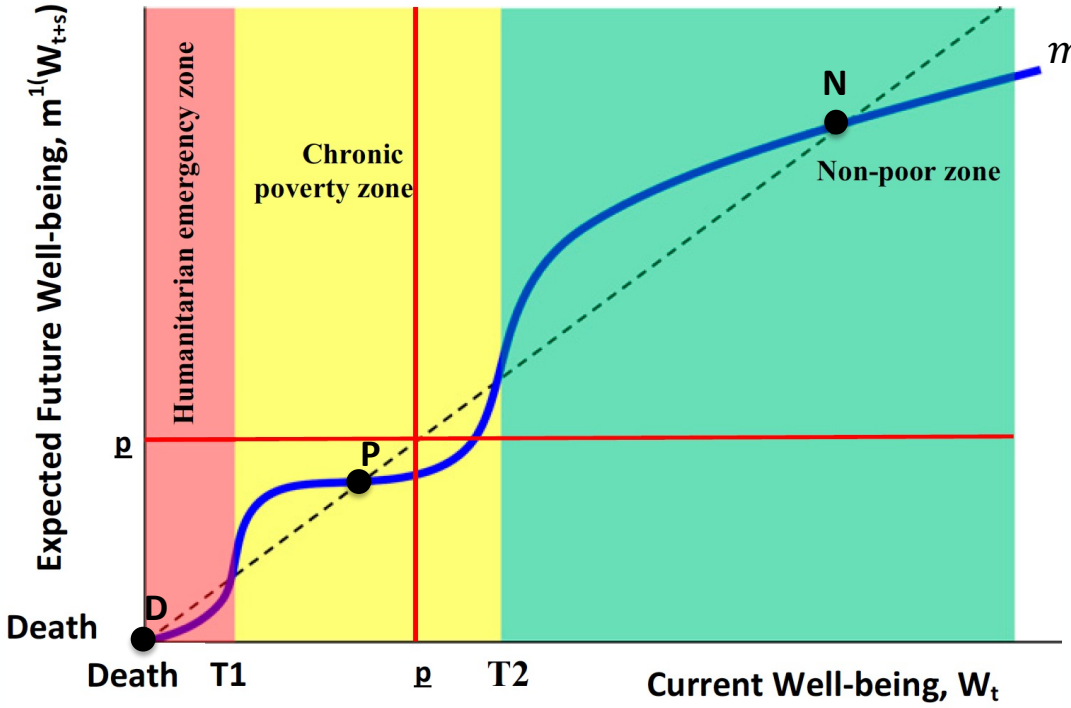
Development resilience (Barrett & Constas, 2014)

Non-linear expected wellbeing dynamics with multiple stable states: conditional expectation function



$$m^1 = \left(W_{t+s} \middle| W_t, \varepsilon_t\right)$$

Humanitarian and dev't objectives reconciliation

- emergency: move people out of the HEZ to save lives
- development: move to the NPZ and stay there
- **asymmetry**: guard against downward/ leftward slides vs. enable upward/ rightward adjustments
- ordering:

  Devt resilience > Hum resilience

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Misconception #1 - Resilience vs. stability

- Stability: maintenance of an equilibrium
- Resilience: disequilibria are ubiquitous → changes are inevitable → **adaptability to change**
- The existence of a stable equilibrium is
  - **not sufficient** condition for development resilience: e.g. P is a stable but miserable equilibrium within CPZ
  - **not necessary** condition for development resilience: escaping from a miserable state necessarily entails instability, i.e. disruption is desirable in order to climb out of poverty

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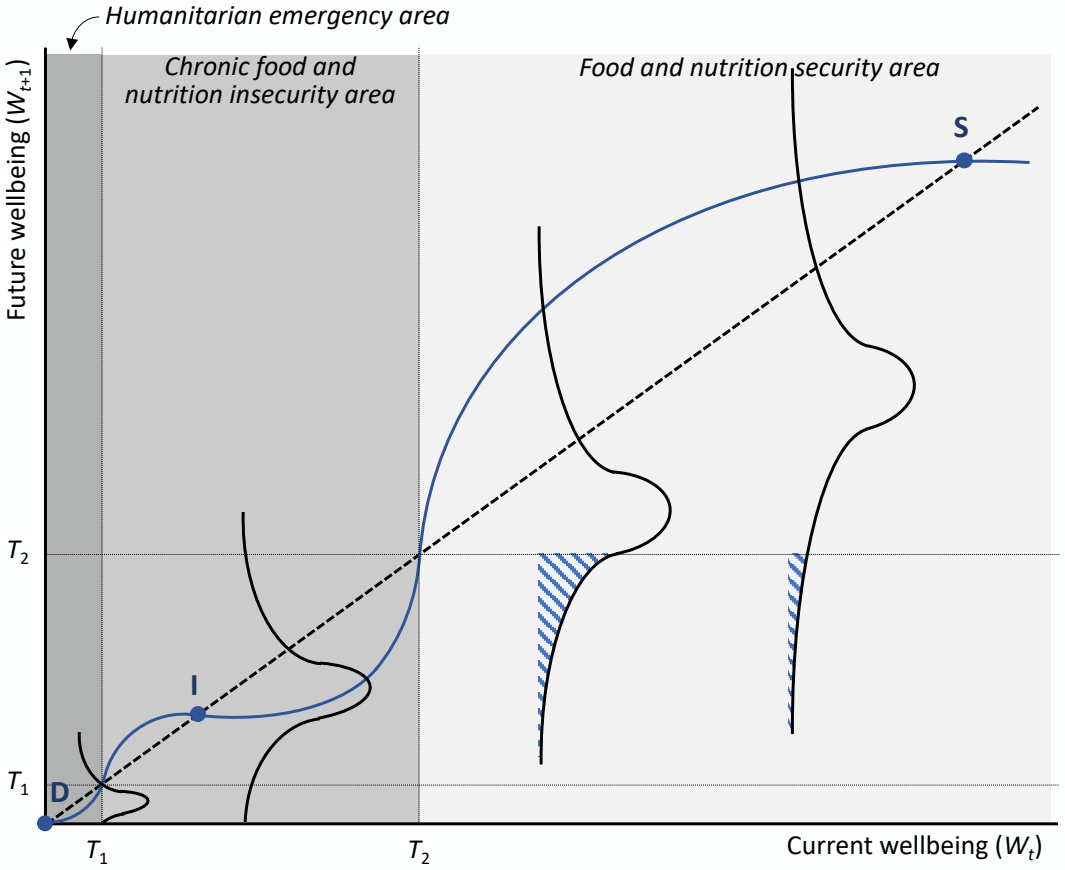
Misconception #2 - Resilience vs. vulnerability



Conditional transition distribution functions associated with $m^k = \left(W_{t+s} \middle| W_t, \varepsilon_t\right)$

- even a seemingly short-lived shock that does not change the basic parameters of the underlying well-being dynamics can persistently alter outcomes
  - if realizations beneath T1 $\Longrightarrow$ the agent will slide to death
  - if realizations above T2 $\Longrightarrow$ the agent will move towards the non-poor equilibrium
- probabilities of falling into worsened states are nonzero and may change over time → non-poor HH with high m^2 may be **both vulnerable and resilient**

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Development resilience (Barrett & Constas, 2014)

Three-step approach

1. conditional **mean**:

$$\hat{\mu}_{1it} = \hat{E}\left[W_{it} \middle| W_{i,t-1}, \mathbf{X_{it}}\right] = g_M\left(W_{i,t-1}, \mathbf{X_{it}}, \hat{\beta}_M\right) + \widehat{\boldsymbol{\delta}}_{\mathbf{M}}\mathbf{X_{it}}$$

2. conditional **variance**:

$$\hat{\mu}_{2it} = \hat{\sigma}^2_{it} = g_V\left(W_{i,t-1}, \mathbf{X_{it}}, \hat{\beta}_V\right) + \widehat{\boldsymbol{\delta}}_{\mathbf{V}}\mathbf{X_{it}}$$

3. resilience **score**, i.e. probability of having a level of wellbeing above a normative threshold $\underline{W}$:

$$\hat{\rho}_{is} \equiv P\left(W_{is} > \underline{W} \middle| W_{i,s-1}, \mathbf{X_{is}}\right)$$
$$= \overline{F}_{W\,is}\left(\underline{W}, \hat{\mu}_{1it}\left(W_{i,s-1}, \mathbf{X_{is}}\right); \underline{W}, \hat{\mu}_{2it}\left(W_{i,s-1}, \mathbf{X_{is}}\right)\right)$$

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Development resilience modelling (Cissé & Barrett, 2018)

Use of estimated model for interventions

- resilience building
- predictions
- targeting

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Development resilience modelling (Cissé & Barrett, 2018)

Use of estimated model for interventions

- resilience building:
  - if an element of the $\mathbf{X}$ vector is plausibly exogenous, one can identify associated changes in the estimated probabilities, as reflected in the $\boldsymbol{\delta}_{\mathbf{R}}$ vector, as causal and rigorously evaluate claims of "resilience building" using established inferential methods → assess the **impact** of specific characteristics or programs today on the HH's development resilience at time t:

given $\quad \hat{\rho}_{it} = g_R\left(W_{i,t-1}, \mathbf{X_{it}}, \beta_R\right) + \boldsymbol{\delta}_{\mathbf{R}}\mathbf{X_{it}} + u_{Rit}$

compute $\quad \partial\hat{\rho}_{it}/\partial X_{it}$

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Development resilience modelling (Cissé & Barrett, 2018)

Use of estimated model for interventions

- predictions:
  - improved prediction if there are predictable intertemporal patterns such as arise from path dynamics in the underlying well-being variable, e.g. simulate resilience **responses to shocks** by including various simulated shocks in $\ddot{\mathbf{X}}$ by computing $\hat{\rho}_{i,t+1}$ recursively and by updating any elements of $\mathbf{X}_{it}$:

$$\hat{\rho}_{i,t+1} \equiv P\left(W_{i,t+1} > \underline{W} \middle| W_{it}, \mathbf{X}_{\boldsymbol{i,t+1}}\right) = \overline{F}_{W_{i,t+1}}\left(\underline{W}; \hat{\mu}_{1i,t+1}, \hat{\mu}_{2i,t+1}\right)$$

where:
$$\hat{\mu}_{1i,t+1} = g_M\left(W_{i,t}, \ddot{\mathbf{X}}_{\boldsymbol{i,t+1}}, \hat{\beta}_M\right) + \widehat{\boldsymbol{\delta}}_{\mathbf{M}}\ddot{\mathbf{X}}_{\boldsymbol{i,t+1}}$$
$$\hat{\mu}_{2i,t+1} = g_V\left(W_{i,t}, \ddot{\mathbf{X}}_{\boldsymbol{i,t+1}}, \hat{\beta}_V\right) + \widehat{\boldsymbol{\delta}}_{\mathbf{V}}\ddot{\mathbf{X}}_{\boldsymbol{i,t+1}}$$

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Development resilience modelling (Cissé & Barrett, 2018)

Use of estimated model for interventions

- targeting:
  - which of the current period covariates (individual, geographical, or other characteristics included in $\mathbf{X}$) are most strongly and statistically significantly correlated with the resilience forward-looking measure, $\hat{\rho}_{it+s}$: **proxy means test**
  - an agency can choose which sort of targeting errors it favors – e.g. errors of **exclusion** or of **inclusion** – by adjusting $\underline{W}$

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Development resilience Assessment

- Positive aspects
  - theory
    - well rooted in a robust theoretical framework
    - truly dynamic and stochastic
    - it is an outcome
    - anchored to a normative scale
    - integration of humanitarian-development objectives
  - empirical viewpoint
    - easy to interpret measure: it is a score
    - decomposability / aggregation at various scales

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Development resilience Assessment

- Negative aspects
  - empirical viewpoint
    - highly data demanding (good quality, high frequency microdata)
    - poor out-of-the sample predictions

Journal of Development Economics 157 (2022) 102873

Contents lists available at ScienceDirect

Journal of Development Economics

journal homepage: www.elsevier.com/locate/devec

Regular Article

Caveat utilitor: A comparative assessment of resilience measurement approaches

Joanna Upton [a], Susana Constenla-Villoslada [b], Christopher B. Barrett [a,*]

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Policy implications

Objective

- minimize the likelihood of people falling into either of the less desirable zones (HEZ, CPZ)
- three possible options for disruptive interventions
  a) shift people's current status
  b) alter the conditional transition distributions
  c) change the underlying system structure

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Policy implications

a) Shift people's current status, i.e. increase W_t:

- cash transfers, education, health care, or other means that increase the recipient's capabilities
- best intervention when:
  - HEZ and CPZ domains are small, so that modest transfers can achieve dramatic results
  - the probability of $W_{t+s} < T_2$ is low for those in the NPZ, so that it is less the structure of the system than the initial conditions of the currently poor that gives rise to persistent poverty

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Policy implications

b) Alter the conditional transition distributions, by reducing risk exposure, i.e. truncate ε_t from below:

- introduction of drought- or disease-resistant seeds or animal breeds, transferring risk (e.g. employment guarantee scheme or insurance programs designed as adverse state-conditional transfers) → social protection/assistance
- best intervention when:
  - HEZ and CPZ domains are not small
  - the probability of $W_{t+s} < T_2$ is not low for those in the NPZ

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Policy implications

c) Change the underlying system structure to induce behavioral change and thereby change the functions $m^k = (W_{t+s}|W_t, \varepsilon_t)$:

- changes in cultural, economic, or sociopolitical institutions, introduction of new technologies, creation of new markets → (identify causal relationships to) increase human agency , e.g. making possible to shift to an improved livelihood
- best intervention when:
  - HEZ and CPZ domains are not small
  - the probability of $W_{t+s} < T_2$ is not low for those in the NPZ

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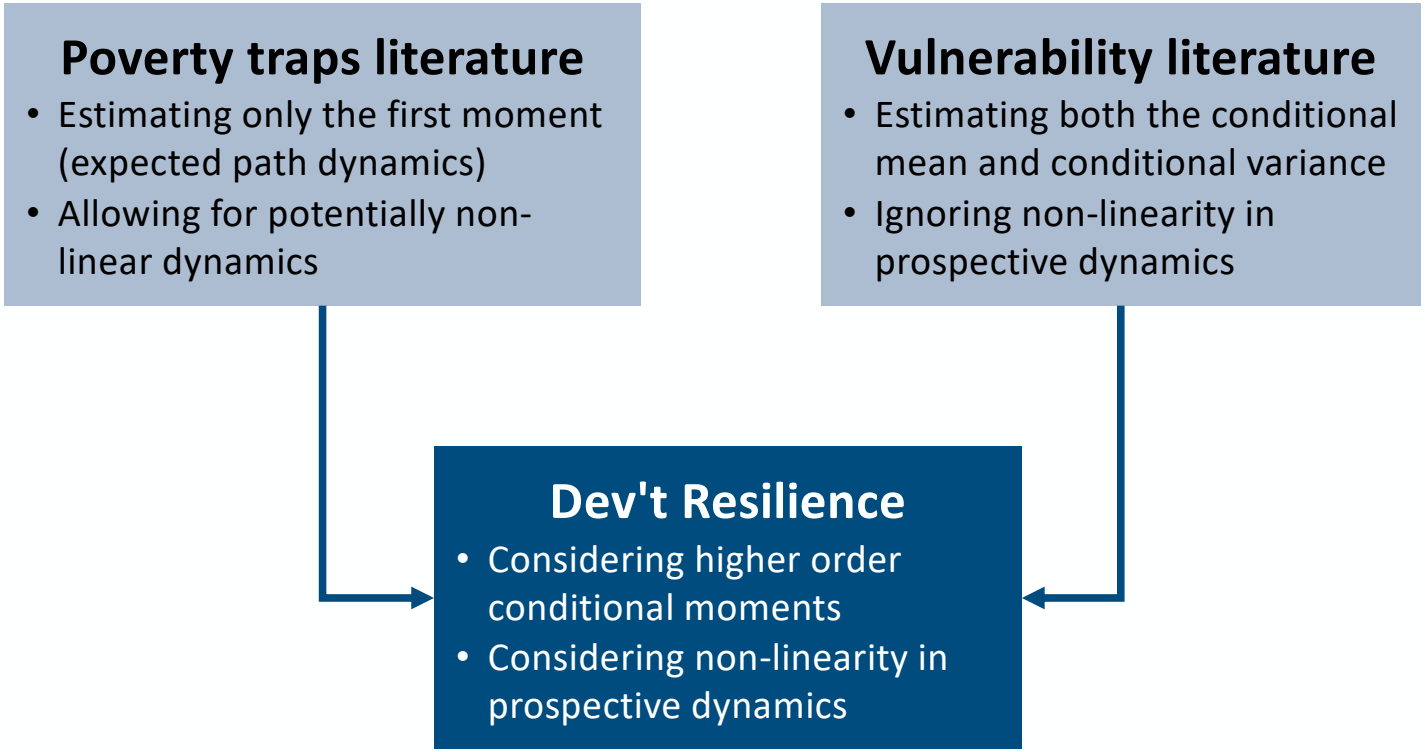
Towards a unifying framework: theory

(Barrett & Constas, 2014 ; Montalbano & Romano, 2022)



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Towards a unifying framework: measurement

FNS measurement axioms (Upton et al., 2016)

- **Scale**: possibility aggregation across / decomposition between subpopulations
- **Time**: ability to estimate the time series of resilience score per each period, *s*, beyond *t*
- **Access**: condition the moments of the food security distribution on any of a host of economic, physical, and social factors
- **Outcome**: conditional probability of satisfying a normative wellbeing (e.g. FCS, HDDS, MUAC, etc.)

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Towards a unifying framework: measurement

Approaches	FNS measurement axioms			
	Scale	Time	Access	Outcome
Vulnerability				
Expected poverty	Yes	No	Yes	No
Low expected utility	Yes	Yes	Yes	No
Threat to future poverty	No	Yes	Yes	Yes
Resilience				
Capacity	No	No	Yes	Yes
Return to equilibrium	No	Yes	Yes	No
Normative condition	Yes	Yes	Yes	Yes

Source: Montalbano & Romano (2022)

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Where the frontier is?

- Improving **predictive capacity**: Existing resilience measures "are all, at best, imperfect, and at worst, deeply flawed"
  - type of data/surveys
  - testing whether alternative/integrative approaches (e.g. ML) would do better

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Joanna Upton [a], Susana Constenla-Villoslada [b], Christopher B. Barrett [a,*]

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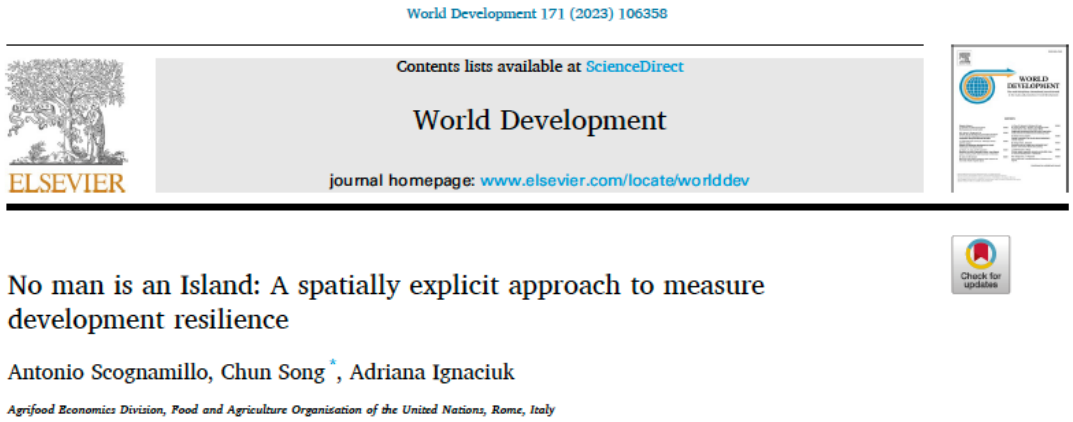
Where the frontier is?

- **Meso** (i.e. community-level) **determinants**
  - explicit modelling of the spatial structure underlying human system interactions and locational effects
  - policy implications:
    - improved targeting accuracy for devt-hum interventions
    - community-based interventions must complement HH-level interventions



World Development 171 (2023) 106358

Contents lists available at ScienceDirect

World Development

journal homepage: www.elsevier.com/locate/worlddev

No man is an Island: A spatially explicit approach to measure development resilience

Antonio Scognamillo, Chun Song *, Adriana Ignaciuk

Agrifood Economics Division, Food and Agriculture Organisation of the United Nations, Rome, Italy

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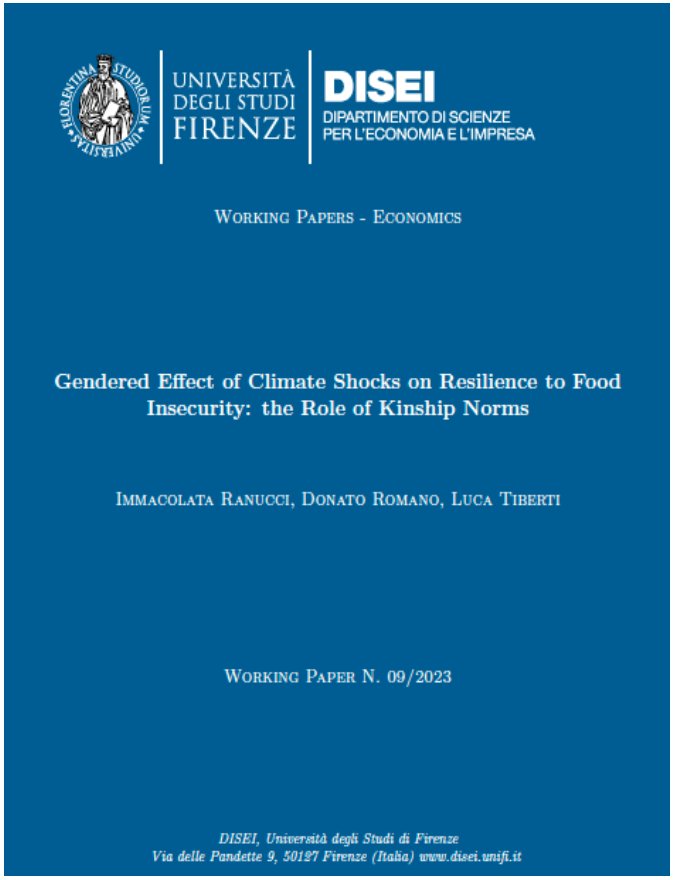
Where the frontier is?

- **Institutional mediators** of resilience
  - influence of kinship norms on gender-specific food resilience
    - FLM-HHs in MM communities show greater dietary diversity resilience
    - in the case of drought, they are less resilient to food insecurity → different reallocations of men's and women's work hours when hit by a drought btw MM and non-MM communities
  - policy implications:
    - need to consider socioeconomic, cultural, and ecological interactions → interventions enhancing women's agricultural resilience and a broader range of outside options



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Where the frontier is?

- **Impact assessment** of resilience-building interventions
  - asset transfers
    - the program increased HH resilience (on avg +44%)
    - added value of the resilience estimation compared with a conventional impact assessment: many HHs classified as non-poor are unlikely to remain non-poor over time

Journal of Development Economics 138 (2019) 205–227

Contents lists available at ScienceDirect

Journal of Development Economics

journal homepage: www.elsevier.com/locate/devec

Do asset transfers build household resilience?

Lokendra Phadera [a,b,*], Hope Michelson [a], Alex Winter-Nelson [a], Peter Goldsmith [a]

[a] Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign, United States
[b] World Bank, United States

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Where the frontier is?

- **Impact assessment** of resilience-building interventions
  - cash transfers
    - regular cash transfers strengthen poor HHs' ability to mitigate the welfare effects of drought shocks
    - mechanisms: savings, asset accumulation, income smoothing in agriculture and off-farm activities

Journal of Environmental Economics and Management 116 (2022) 102744

Contents lists available at ScienceDirect

Journal of Environmental Economics and Management

journal homepage: www.elsevier.com/locate/jeem

Cash transfers, climatic shocks and resilience in the Sahel

Patrick Premand [a], Quentin Stoeffler [b,*]

[a] The World Bank, 1818 H Street, NW Washington, DC, 20433, USA
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Where the frontier is?

- **Impact assessment** of resilience-building interventions
  - social protection interventions
    - positive impact, but need of significant transfers over multiple years
    - mechanisms: driven by different factors → optimizing intervention designs for improving ST welfare impacts may not necessarily improve HHs' resilience, and vice versa

Food Policy 112 (2022) 102367

Contents lists available at ScienceDirect

Food Policy

journal homepage: www.elsevier.com/locate/foodpol

Social protection and resilience: The case of the productive safety net program in Ethiopia

Kibrom A. Abay [a,*], Mehari H. Abay [b], Guush Berhane [c], Jordan Chamberlin [d]

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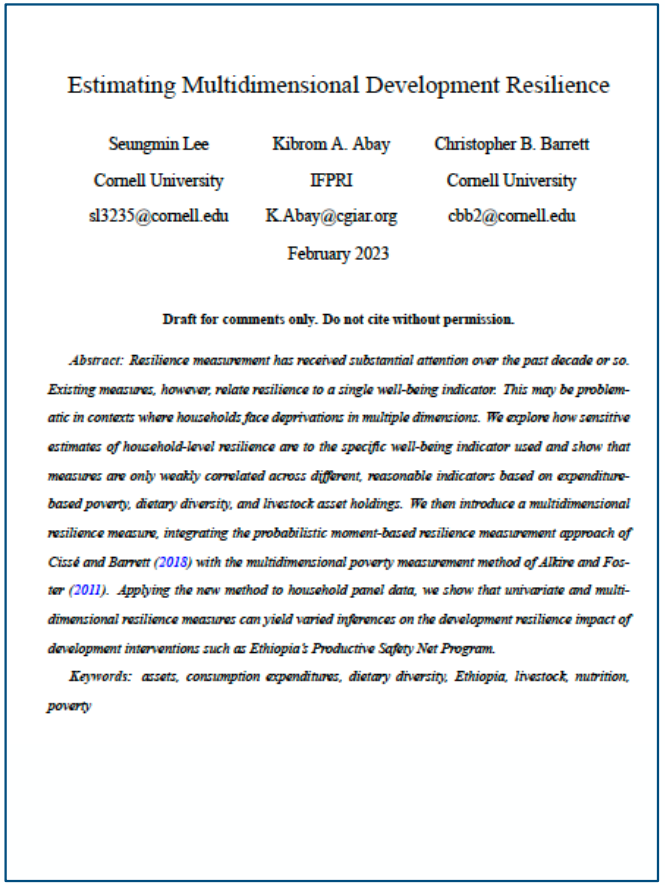
Where the frontier is?

- **Different outcomes**
  - how sensitive estimates of HH resilience are to the specific wellbeing indicator
  - measures are only weakly correlated across different indicators (e.g. poverty, dietary diversity, livestock asset holding)
  - univariate and multidimensional resilience measures can yield varied inferences on the development resilience impact of development interventions



Estimating Multidimensional Development Resilience

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Abstract: Resilience measurement has received substantial attention over the past decade or so. Existing measures, however, relate resilience to a single well-being indicator. This may be problematic in contexts where households face deprivations in multiple dimensions. We explore how sensitive estimates of household-level resilience are to the specific well-being indicator used and show that measures are only weakly correlated across different, reasonable indicators based on expenditure-based poverty, dietary diversity, and livestock asset holdings. We then introduce a multidimensional resilience measure, integrating the probabilistic moment-based resilience measurement approach of Cissé and Barrett (2018) with the multidimensional poverty measurement method of Alkire and Foster (2011). Applying the new method to household panel data, we show that univariate and multidimensional resilience measures can yield varied inferences on the development resilience impact of development interventions such as Ethiopia's Productive Safety Net Program.

Keywords: assets, consumption expenditures, dietary diversity, Ethiopia, livestock, nutrition, poverty

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Concluding remarks

- Old wine in new bottles? Resilience is a truly new construct vis-à-vis already existing ones in economics
- Need to clearly identify the research questions to identify the outcome of interest and the possible drivers
- Specifically, at HH level
  - important progress from the theoretical viewpoint: dev't resilience
    - unifying framework
    - only measure meeting the FNS measurement axioms
  - still problematic from the empirical viewpoint
    - data needs, survey design
  - fast-evolving field of research: there is still a lot to be done

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Thanks a lot for your attention

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