
Cornell University

# Measuring/Estimating Resilience

Christopher B. Barrett

IFPRI/IPA/Mercy Corps workshop on
Financial Inclusion And Resilience To Climate Variability
Washington, DC
May 29, 2018

# Motivation


**"Resilience" has rapidly become a ubiquitous buzzword, but ill-defined concept within the development and humanitarian communities**

# Motivation

**At the same time, much ambivalence (even cynicism) about the 'rise of resilience'**

1) Seen as too imprecise and malleable a concept/term
2) Not necessarily pro-poor as commonly formulated
3) Often ignores issues of agency/power/rights

If resilience is to prove a useful concept in international development/humanitarian programming, we need a theory-and-evidence-based understanding of what resilience is with respect to human well-being, how to measure/estimate it, and how to effectively promote it so as to sustainably improve living standards.

# Motivation

**To date, the gap b/n practitioner demand and academic supply has been filled w/atheoretical methods or relabeling of familiar variables ('old wine,new bottles').**

**Key questions. Is resilience:**

- A capacity (RHS) versus an outcome (LHS)? If we want to 'build resilience' then it must be an (intermediate?) outcome.
- Return to initial state, or persistence of a normative state? If pro-poor, then must anchor to a normative standard.
- Inverse of vulnerability? Rapid recovery from shock? If normative, then must encompass both stressors and shocks.
- One outcome (and its properties) or a suite of outcomes? Answer turns on question one wants to answer.
- Are all processes stationary? Must explicitly address dynamics.

# A Theory of Development Resilience

PNAS

## Toward a theory of resilience for international development applications

Christopher B. Barrett[a,b,1] and Mark A. Constas[a]

[a]Charles H. Dyson School of Applied Economics and David R. Atkinson Center for a Sustainable Future and [b]Department of Economics Ithaca, NY 14853-7801

Edited by Anthony J. Bebbington, Clark University, Worcester, MA, and approved August 28, 2014 (received for review November 7, 2

We advance a theory of resilience as it applies to the challenges of international development. The conceptualization we advance for

change of a state variable, driving variables, and still persist" (1). Later, Holling distinguished be

Barrett&Constas (*PNAS* 2014) offers a theory of development resilience.

**Subject of interest:** quality of life, ~ Sen's 'capabilities'.
Focus on ***minimizing individual human experience of ill-being***.
Implies:

- focus on individuals' (and groups') *well-being within* a system, not the *state of* a system itself.
- consider the *stochastic dynamics of well-being*
- do <u>not</u> focus on specific sources of risk b/c problem is uninsured exposure to many stressors (*ex ante* risk) and shocks (*ex post*, adverse realizations) to which resilience implies *adaptability while staying/ becoming non-poor*.

# A Theory of Development Resilience

## Stochastic Well-Being Dynamics

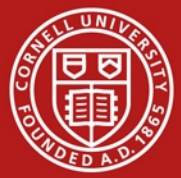
Consider the moment function for conditional well-being:

$$m^k(W_{t+s} \mid W_t, \varepsilon_t)$$

where $m^k$ represents the $k^{\text{th}}$ moment (e.g., mean ($k$=1), variance ($k$ =2) or skewness ($k$ =3)
$W_t$ is well-being at time t
$\varepsilon_t$ is an exogenous disturbance (scalar or vector) at time t

These moment functions describe quite generally, albeit in reduced form, the stochastic conditional dynamics of well-being.

Much like 'poverty' measurement, 'resilience' holds when the time path of conditional probabilities of well-being are sufficiently high by some normative criteria (pov & prob lines).



Cornell University

# Toward Measurement and Evaluation

If agencies program around resilience goals, then we need to be able to measure resilience & evaluate program/project performance. Should use theory to guide measurement.

**Core challenge:** resilience is unobservable, a **latent variable**.

This raises data challenges: need micro-scale panels, ideally high frequency from sentinel sites to capture seasonality and a range of shocks/stressors.

PNAS

## Opinion: Measuring development resilience in the world's poorest countries

**Derek Headey**[a,1] **and Christopher B. Barrett**[b,1]

[a]*Poverty, Health, and Nutrition Division, International Food Policy Research Institute (IFPRI), Washington, DC 20015; and* [b]*Charles H. Dyson School of Applied Economics and Management, Department of Economics, and Atkinson Center for a Sustainable Future, Cornell University, Ithaca, NY 14853*

widespread interest in building "develo
ment resilience," which has quickly becon
a centerpiece of many humanitarian and d
velopment organizations' programming.

But whereas a social science theory

# Cissé & Barrett (*JDE* in press) Approach To Development Resilience Estimation

- Application of Barrett-Constas (*PNAS* 2014) probabilistic, cond moments-based estimation of well-being dynamics
- Like poverty estimation, a normative method. Assume:

  (i) Level – Minimum acceptable standard of well-being (outcome) for individual or household.

  (ii) Probability – Minimum acceptable likelihood of meeting level criterion

  Development resilience is sufficient prob. of attaining an adequate standard of living (given shocks and stressors)

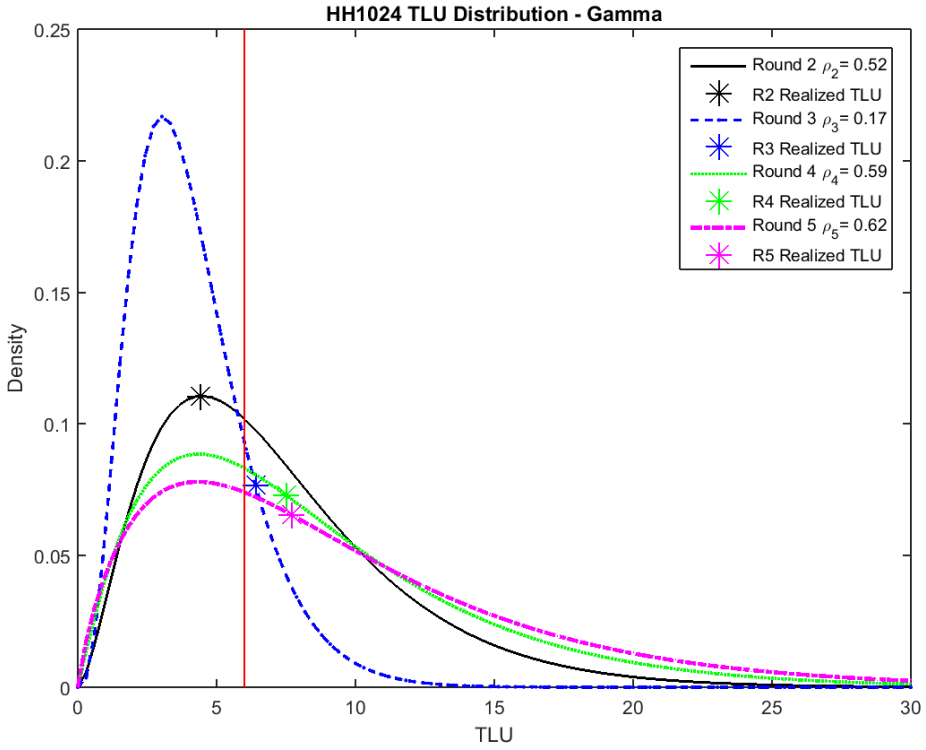
  Aggregable/decomposable, like FGT poverty measures.

# How to Estimate Resilience

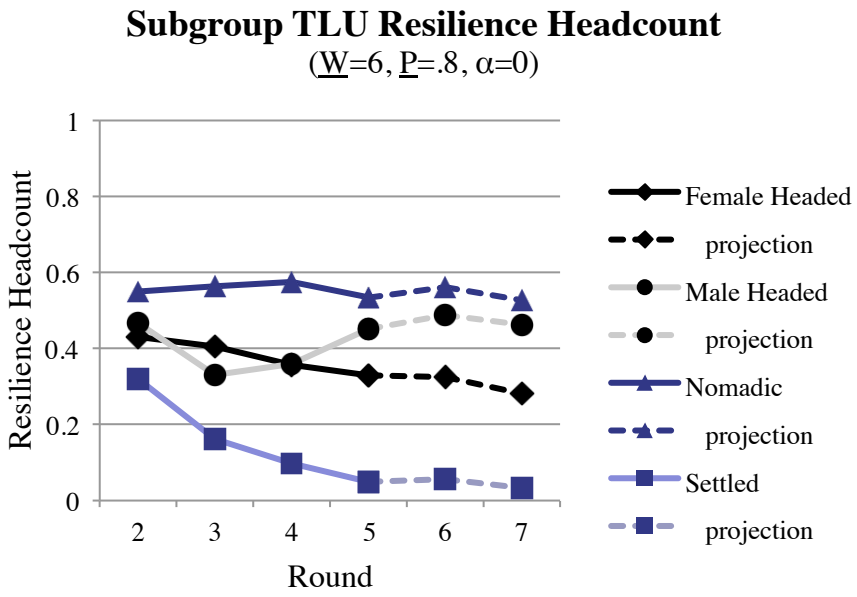
1. Estimate conditional moments of the well-being outcome variable of interest, as a function of variables reflecting
   - (i) Observable exogenous shocks (e.g., drought, cyclone)
   - (ii) conditioners of exposure, recovery (e.g., gender)
   - (iii) interventions (plausibly exog., if evaluating); Interact with shocks if targeted intervention.
   - (iv) polynomial lags of DV and shocks (i.e., nonlinear dynamics and cumulative, delayed response)
2. Use $m^k(\cdot)$ to estimate conditional probability of outcome in sequence of time periods, assuming a dist'n.
3. Based on a normative tolerable likelihood of a tolerable outcome over time, classify individuals as resilient or not where resilience is inverse conditional density.
4. Describe/predict resilience time path for indivs/aggregates

# Examples from northern Kenya pastoralists

## HH-period-specific CPDs:




## Population-level measures:




Source: Cissé & Barrett *JDE* in press

# Extensions to Food Security

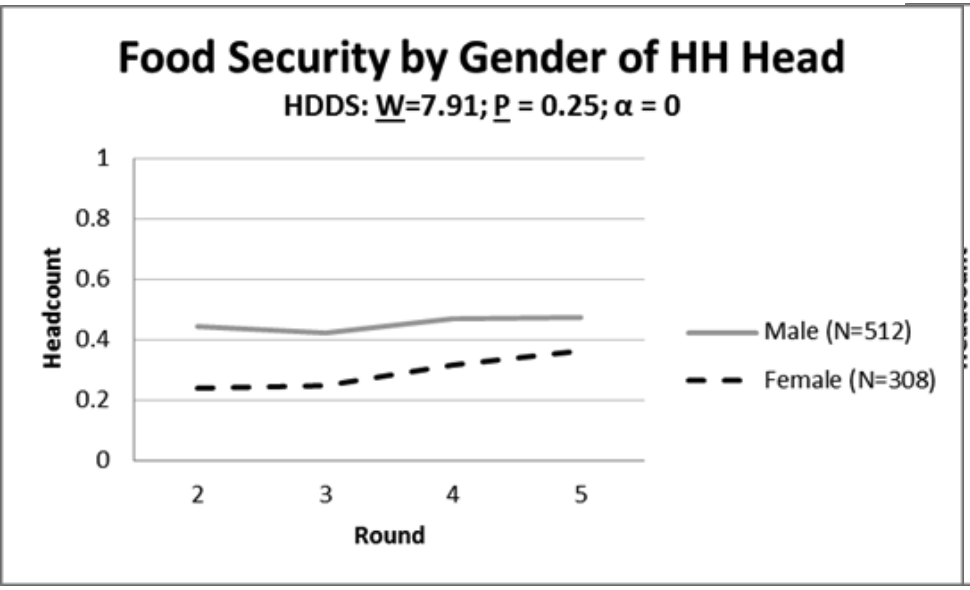
Can use same methods with food intake indicators as DVs. Satisfies axioms from 1996 World Food Summit definition of food security.

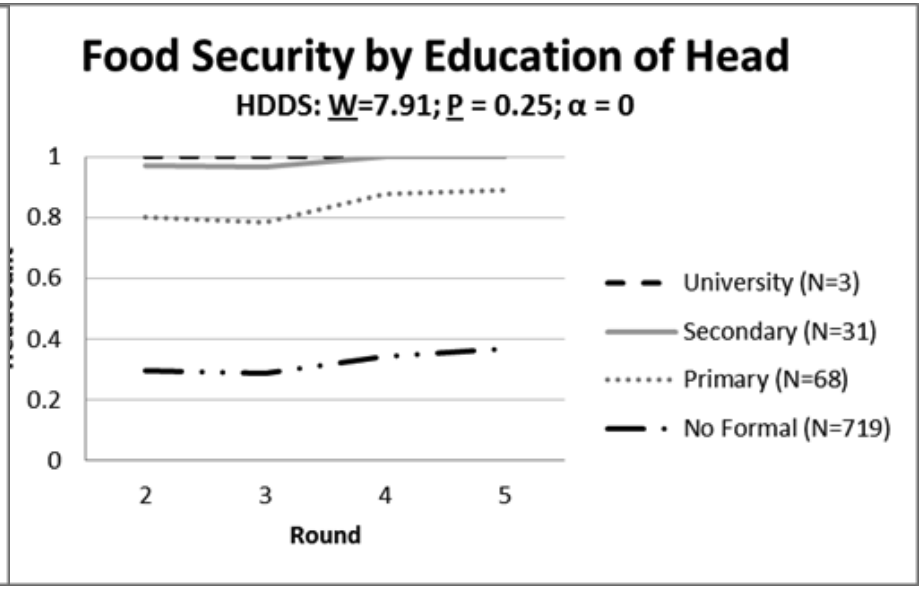
AGRICULTURAL ECONOMICS

Agricultural Economics 47 (2016) supplement 135–147

Food security as resilience: reconciling definition and measurement

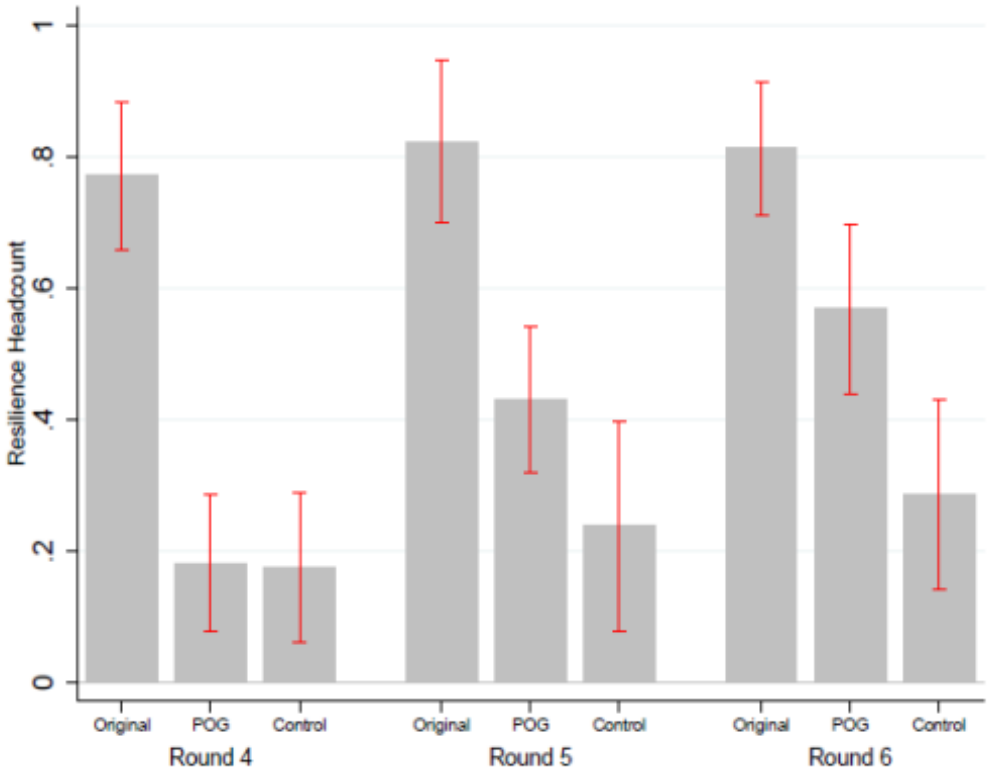
Joanna B. Upton, Jennifer Denno Cissé, Christopher B. Barrett*



# Example from Zambia project by Heifer Int'l

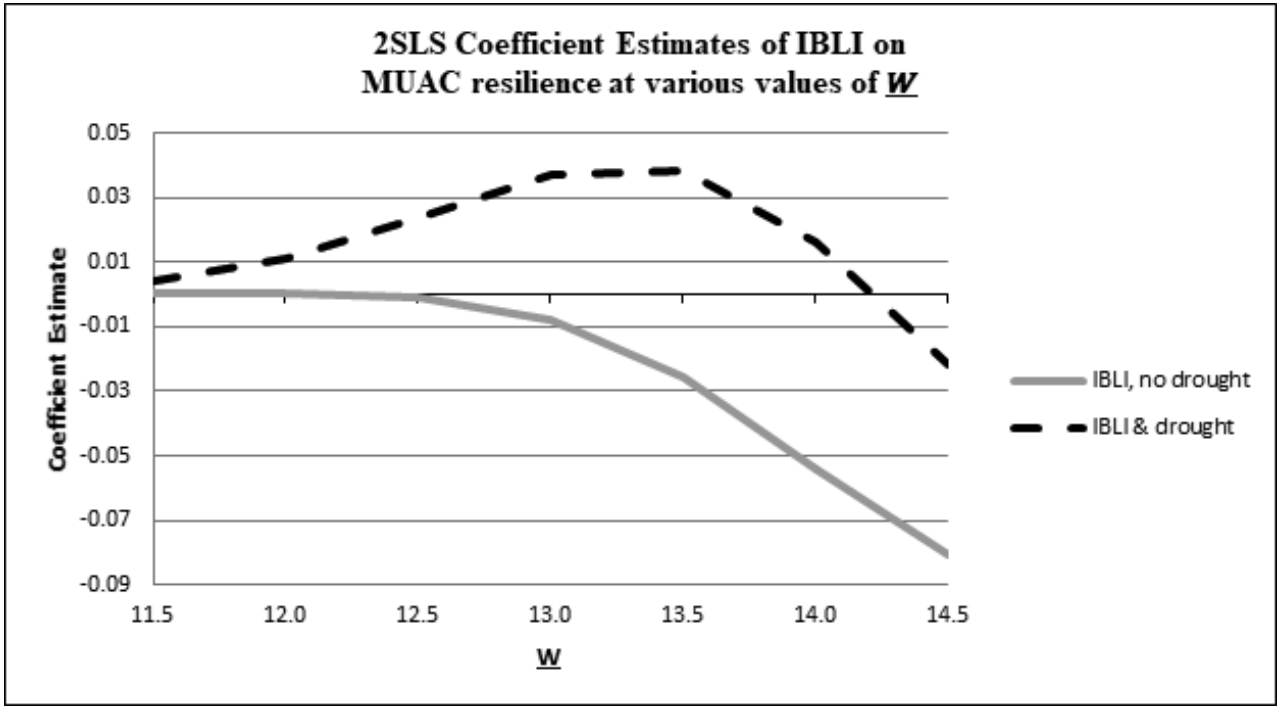
Figure 5: Headcount Resilient Rate (Gamma, $\bar{A} = 308$, $R = 0.5$ and $k = 3$)




Training and asset transfers significantly increase conditional mean and reduce conditional variance of household wealth over time. Total B/C ~ 7 [2.5,8.7] across hh wealth deciles

Source: Phadera, Michelson, Winter-Nelson & Goldsmith (2018)

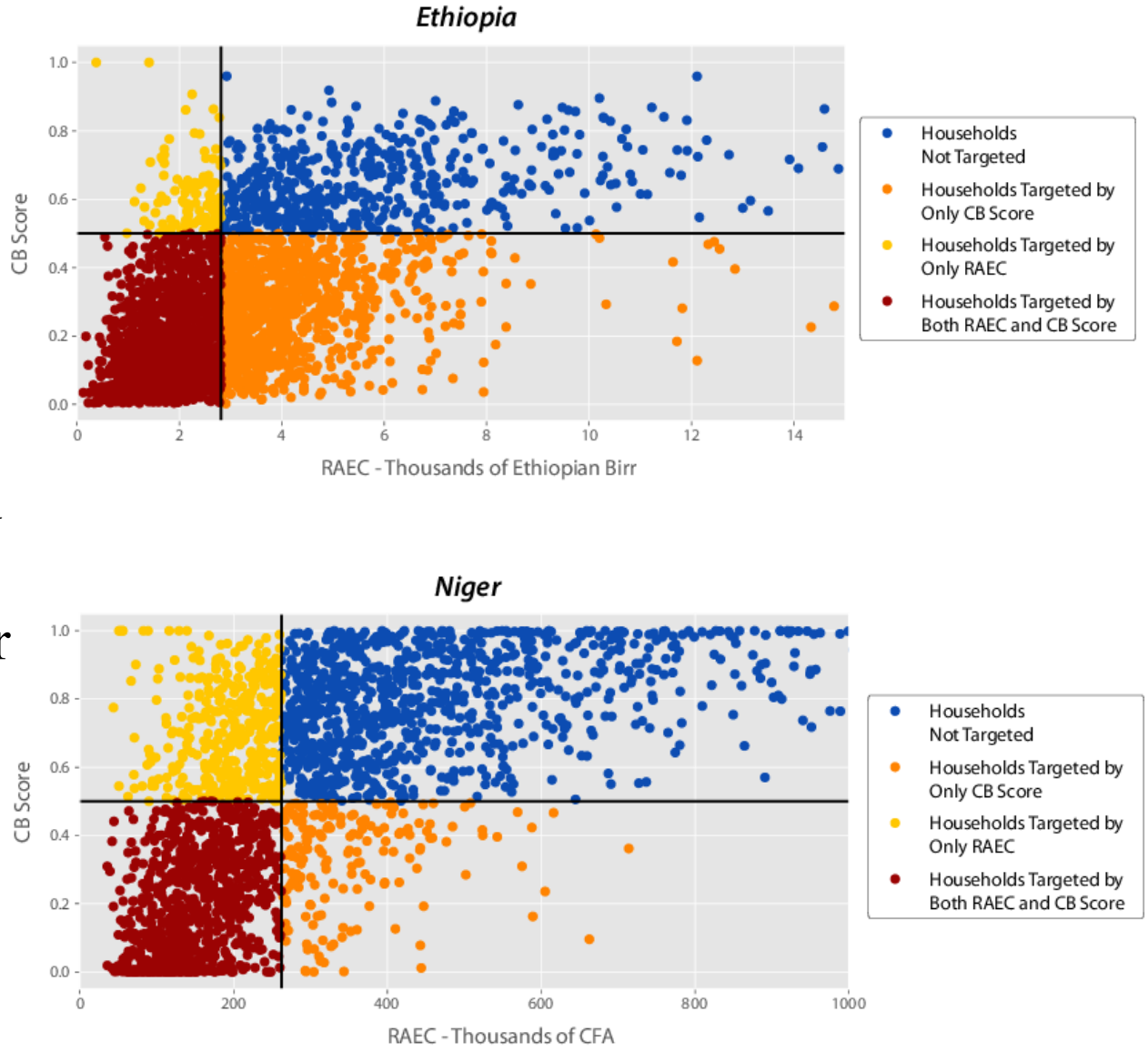
# Example from Kenya: Index-based livestock insurance increases resilience in child anthropometric terms over most values




Source: Cissé & Ikegami (2017)

# Targeting

Given stochasticity, most recent outcome is not strongly correlated with probability of a good outcome. So which measure works better for targeting interventions?




Source: Kimetrica (2017)

# Targeting

C-B method can be useful for targeting interventions. Relative to standard PMT/IT, can adjust *Pr(W)* to vary T1/2 errors based on one's strategy/resources.

**Estimates of Targeting Accuracy: Livestock Holdings**

| P | Correctly Not Targeted | Correctly Targeted | TI Error | TII Error | Sum of Errors |
|---|---|---|---|---|---|
| 0.45 | 0.539 | 0.342 | 0.059 | 0.059 | 0.119 |
| 0.5 | 0.519 | 0.358 | 0.079 | 0.044 | 0.123 |
| 0.55 | 0.505 | 0.363 | 0.093 | 0.038 | 0.132 |
| 0.6 | 0.485 | 0.368 | 0.113 | 0.034 | 0.147 |
| 0.8 | 0.384 | 0.386 | 0.214 | 0.015 | 0.229 |
| Standard | 0.526 | 0.352 | 0.072 | 0.049 | 0.122 |

Source: Cissé & Barrett (*JDE* in press)

Source: Upton, Cissé & Barrett (*Ag Econ* 2016)

**Estimates of Targeting Accuracy - HDDS**

| P | Correctly Not Targeted | Correctly Targeted | TI Error | TII Error | Sum of Errors |
|---|---|---|---|---|---|
| 0.15 | 0.266 | 0.503 | 0.088 | 0.143 | 0.231 |
| 0.20 | 0.198 | 0.566 | 0.156 | 0.080 | 0.236 |
| 0.25 | 0.122 | 0.609 | 0.231 | 0.037 | 0.268 |
| 0.30 | 0.056 | 0.644 | 0.298 | 0.002 | 0.300 |
| Standard | 0.209 | 0.536 | 0.145 | 0.110 | 0.255 |

# Summary

Resilience is a popular buzzword now. But little precision in its use, theoretically or methodologically. Makes learning about 'building resilience' difficult-to-impossible.

Methods are now becoming available to enable rigorous, precise use of the concept to identify how best to avoid and escape chronic ill-being. Initial results promising for descriptive/predictive purposes as well as impact evaluation.

Much to do in all areas … a massive research agenda, especially as agencies begin using resilience as a programming principle.

**But we must start with a firm theoretical foundation.**

**Thank you for your time and interest**