

# Mind the (malnutrition) gap: counterfactual decompositions of undernutrition differences in India

3rd LCIRAH Annual Conference

Elisa Cavatorta  
LCIRAH and SOAS

London, 13th June 2012

# Motivations

- The India enigma: despite the rapid economic growth, the prevalence of undernutrition in India remains high
- Nutrition in India seems *disconnected* from economic growth and agricultural growth (Subramanian and Deaton, 2011)
- Different Indian states have performed differently: geographical variation across states (Headley et al., 2011)
  - Some states fairly successful in improving nutrition and experienced rapid agricultural growth (e.g. Tamil Nadu)
  - Some others had little improvement in nutrition in spite of modest agricultural growth (e.g. Bihar)
  - Some states improved nutritional outcomes while having poor agricultural performance (e.g. Uttar Pradesh)
- Unsatisfactory evidence on why the disconnect(s) persists and why improvements in nutrition are uneven

# Aims

- The idea of this paper: to explain the differences in child malnutrition between successful and less successful Indian states using counterfactual decompositions
- An explorative study to shed light on:
  - Which factors explain such disparities in nutritional outcomes across states?
  - To what extent improvements in nutritional outcomes are due to differences in relevant determinants or to differences in the strength of association between those determinants and nutrition?
- We focus on 3 states with different agricultural and nutritional performances: Tamil Nadu, Bihar, and Uttar Pradesh
- Part of a larger research project LANSAs and study a methodology under-explored in agri-health



# Methodology

## What is a counterfactual decomposition?

- Counterfactual: the 'simulated' distribution that would have arisen if some or all the observed determinants of nutrition in one state were distributed as they are in a successful (benchmark) state
- Compare the real distribution with the 'simulated' counterfactuals to gauge the importance of certain factors behind the gaps
- Decomposition: states gaps in nutritional outcomes are due to:
  - (a) Differences in distributions of relevant determinants: hhold income, sanitation, mother's health and education, agriculture (covariate effect)
  - (b) Structural differences in how child nutrition responds to these determinants at given values (coefficient effect)
  - For example, better nutrition because (a) income is more equally distributed or (b) stronger income-nutrition association
- How much the height distribution may improve (shift right) if a relevant factor was distributed as it is in the benchmark state?

## How to create a counterfactual distribution?

- Choose a benchmark state: Tamil Nadu
- Estimate the nutrition distribution conditional on variables of interest: quantile regressions for each state
- Combine the regression coefficients at each percentile with randomly sampled covariates from another states
- This gives the marginal density that would have prevailed if covariates had been distributed as in the benchmark state ( $f^*$ )

$$f(b_B X_B) - f(b_s X_s) = f^*(b_B X_B) - f^*(b_s X_B) + f^*(b_s X_B) - f^*(b_s X_s) \pm \epsilon$$

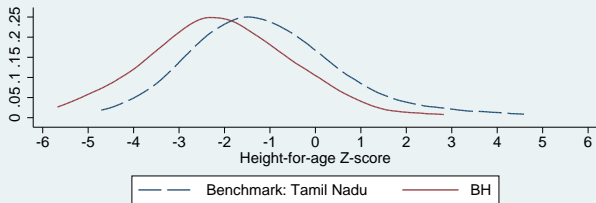
*for state  $s$  and benchmark  $B$*

# Data

- Data from the National Family Health Survey 2005-06
- Advantages:
  - large dataset, representative at national and state level
  - precise anthropometric data
  - comparability with previous studies
- Nutrition measured by stunting (height-for-age z-scores)
  - A measure of chronic malnutrition
  - Z-scores are relative to a healthy population of children (WHO, 2006)

## Height differentials

### Tamil Nadu- Bihar



### Tamil Nadu- Uttar Pradesh

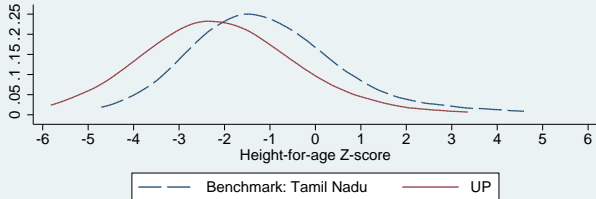


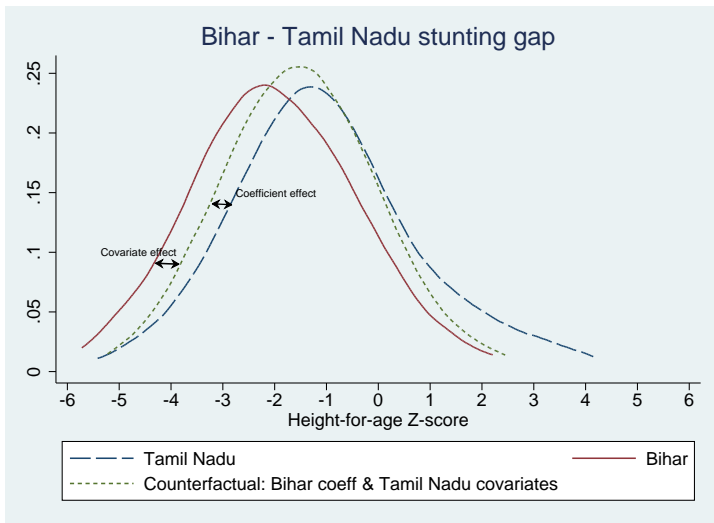


Table: MEDIAN REGRESSIONS OF HEIGHT-FOR-AGE Z-SCORES

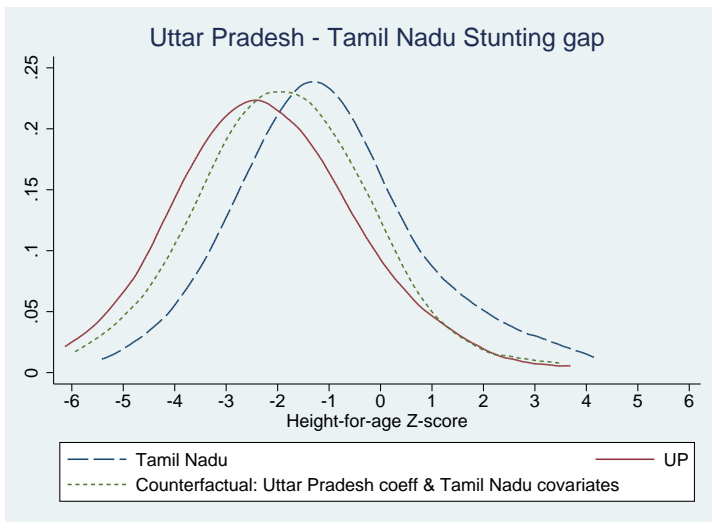
birth order	0.163 (0.104)	0.176** (0.078)	0.139*** (0.050)
female	0.132 (0.083)	-0.162** (0.072)	-0.001 (0.047)
age	-0.082*** (0.012)	-0.100*** (0.009)	-0.133*** (0.006)
age2	0.001*** (0.000)	0.001*** (0.000)	0.002*** (0.000)
vaccination	-0.027 (0.031)	0.004 (0.015)	0.043*** (0.011)
wghbirth	0.425*** (0.079)	0.298** (0.124)	0.225*** (0.083)
mother's age	0.016 (0.010)	0.005 (0.007)	0.020*** (0.005)
mother's HAZ	0.285*** (0.043)	0.301*** (0.041)	0.326*** (0.026)
mother's schooling	0.035*** (0.012)	0.021 (0.013)	0.009 (0.007)
mother's anemic	-0.079 (0.118)	-0.277*** (0.092)	-0.080 (0.062)
wealth hh	0.267*** (0.090)	0.185* (0.095)	0.244*** (0.056)
urban	-0.216 (0.157)	0.085 (0.117)	-0.213** (0.103)
wealth cluster	0.099 (0.144)	0.862*** (0.206)	0.216*** (0.082)
livestock	0.161 (0.116)	-0.012 (0.084)	-0.084 (0.062)
own land	0.181 (0.174)	0.445** (0.194)	0.382** (0.171)
mother in agric	-0.046 (0.136)	-0.222** (0.096)	-0.023 (0.066)
N	1467	1967	5115

Includes open defecation (hhhold and village level), proportion irrigated land, hhhold size and children proportions, father's schooling, twin indicator, birth-month fixed effects

What would have been child stunting in Bihar if all covariates were distributed as in Tamil Nadu?

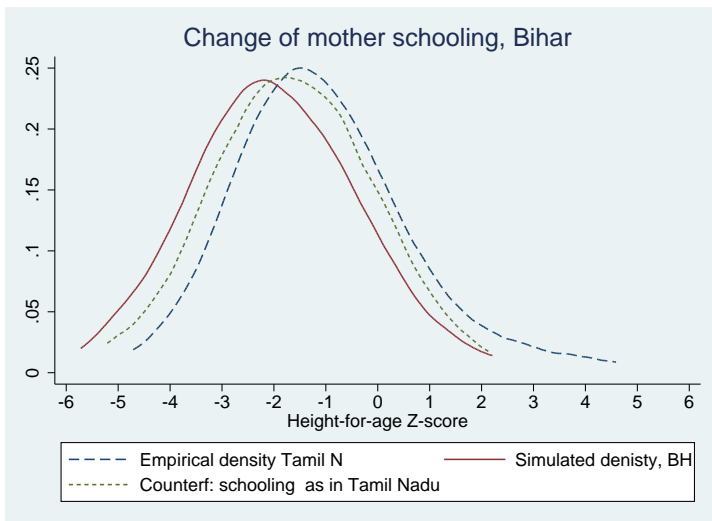


What would have been child stunting in Uttar Pradesh if all covariates were distributed as in Tamil Nadu?

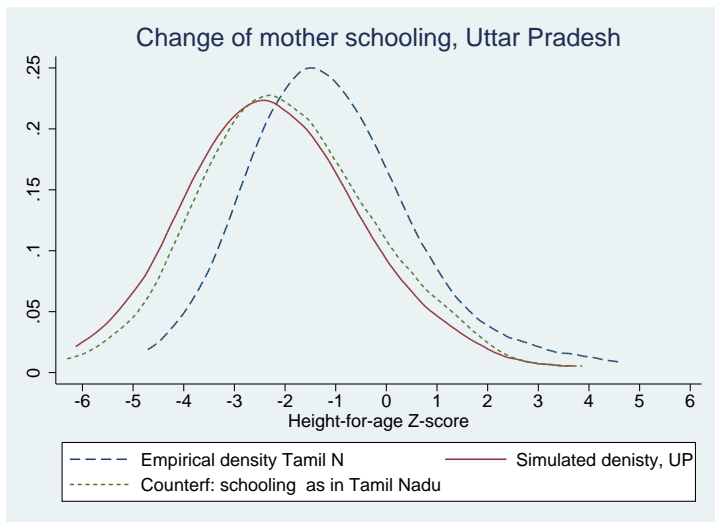


## Looking at single factors

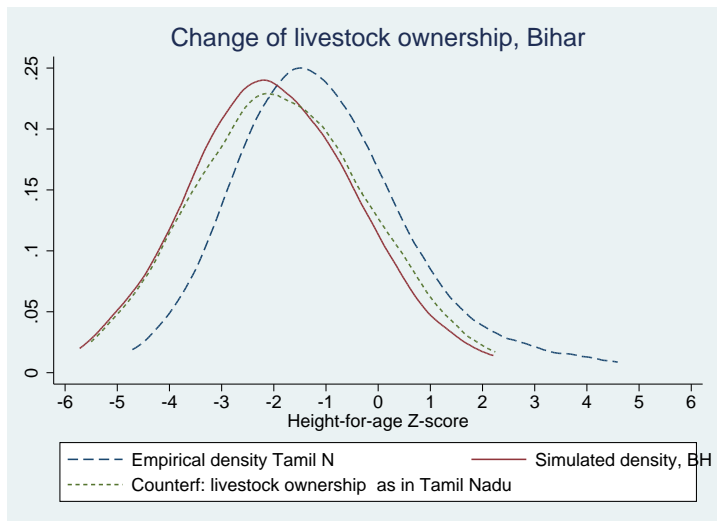
What would have been child stunting in Bihar if mothers' education were distributed as in Tamil Nadu?



What would have been child stunting in Uttar Pradesh if mothers' education were distributed as in Tamil Nadu?



What would have been child stunting in Bihar if livestock ownership was distributed as in Tamil Nadu?



What would have been child stunting in Uttar Pradesh if livestock ownership was distributed as in Tamil Nadu?

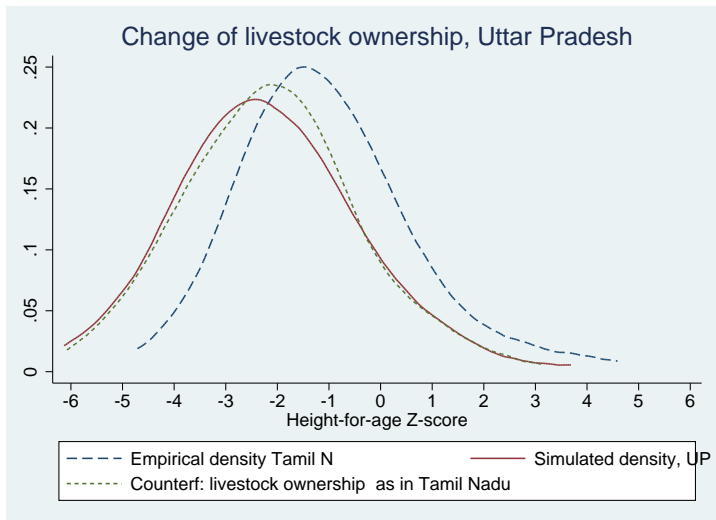


Table: Single covariate contribution

q	gap	partial effect	%gap	% covariate	q	gap	partial effect	%gap	% covariate
<b>BIRAH</b>					<b>UTTAR PRADESH</b>				
<b>Wealth</b>									
25	0.95	0.25	26.32	48.19	25	1.07	0.09	8.67	24.57
50	0.89	0.27	30.89	54.19	50	0.94	0.14	15.25	42.59
75	0.91	0.26	28.59	61.68	75	0.94	0.04	4.45	12.32
stunting	0.540	0.460				0.550	0.530		
<b>Mother education</b>									
25	0.95	0.35	37.55	68.75	25	1.07	0.24	22.47	63.67
50	0.89	0.50	56.45	99.02	50	0.94	0.19	20.96	58.55
75	0.91	0.38	42.31	91.28	75	0.94	0.26	27.92	77.37
stunting	0.540	0.410				0.550	0.510		
<b>Mother height</b>									
25	0.95	0.10	11.34	20.75	25	1.070	0.03	3.64	10.31
50	0.89	0.15	17.00	29.82	50	0.940	0.06	6.77	18.91
75	0.91	0.22	24.34	52.51	75	0.940	0.04	4.77	13.24
stunting	0.540	0.490				0.550	0.540		
<b>Livestock</b>									
25	0.95	0.05	5.44	9.96	25	1.07	0.10	9.64	27.33
50	0.89	0.27	31.10	54.55	50	0.94	0.15	16.07	44.89
75	0.91	0.26	28.81	62.15	75	0.94	-0.03	-3.27	-9.06
stunting	0.540	0.460				0.550	0.540		



## Conclusions and next steps

- Relative contributions of covariates and coefficients in explaining nutritional gaps vary across states
- Covariate and coefficient effects have different impact along the height distribution: can help targeting
- Wealth and mothers' education explain the largest part of HAZ distribution disparities: in Bihar, mothers' schooling alone predicts 13 percentage point decrease in stunting rate
- Livestock ownership stands out as important among agricultural livelihood variables
- Refine the technique to achieve more precise results
- Explore other datasets with more extensive agricultural variables

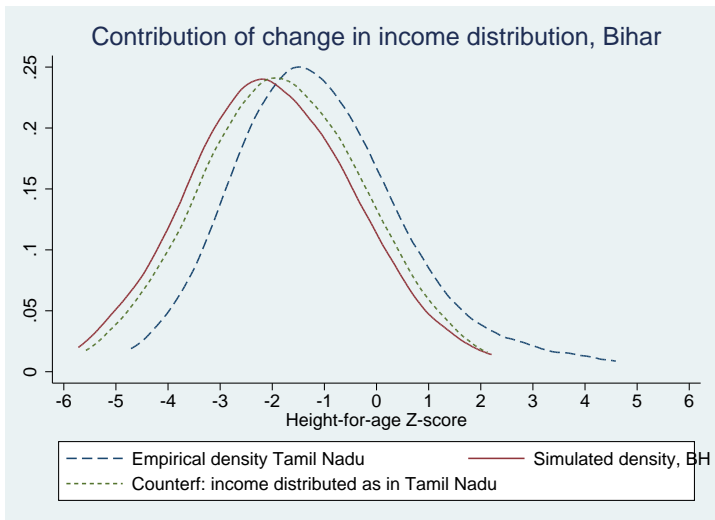
Thank you for listening!

Table: Stunting gap decomposition

quantile	Total gap	observed returns		observed characteristics		residuals	
		HAZ (sd)	%	HAZ (sd)	%	HAZ (sd)	%
<b>BIHAR</b>							
10	1.130	0.230	20.323	0.641	56.733	0.259	22.943
25	0.950	0.345	36.279	0.519	54.631	0.086	9.090
50	0.900	0.379	42.070	0.507	56.380	0.014	1.549
75	0.910	0.495	54.433	0.422	46.357	-0.007	-0.790
90	1.140	1.016	89.146	0.314	27.522	-0.190	-16.668
<b>UTTAR PRADESH</b>							
10	1.180	0.759	64.309	0.359	30.429	0.062	5.262
25	1.070	0.770	71.920	0.378	35.294	-0.077	-7.214
50	0.940	0.743	79.065	0.337	35.810	-0.140	-14.875
75	0.930	0.695	74.712	0.339	36.483	-0.104	-11.195
90	0.990	1.200	121.220	0.051	5.166	-0.261	-26.386

## Looking at single factors

What would have been child stunting in Bihar if income were distributed as in Tamil Nadu?



## Looking at single factors

What would have been child stunting in Uttar Pradesh if income were distributed as in Tamil Nadu?

Contribution of change in income distribution, Uttar Pradesh

