Child Nutrition in India in the Nineties: A Story of Increased Gender Inequality?

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  - We evaluate nutritional status using measures normalized with respect to a reference population (z-scores).
  - Rather than looking at means, we study the whole distribution of nutritional indexes.

Motivation (2)

- Gender inequality is a well-known and still widespread reality in India, particularly in the North, where the cultural, social, and economic role of women in society and/or within the household is weaker (see Basu (1992), Dasgupta (1993), Miller (1981), Murthi, Guio, and Drèze (1995) and countless others...)
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  - village exogamy
- **Are the changes in nutritional status similar for boys and girls, and in different geographical areas?**

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  - Ambiguous relation between son preference and caste/education/income (Das Gupta 87).
  - Decline in fertility may contribute to an increase in son preference if the desired number of sons decreases less quickly than the desired total number of children (Das Gupta and Bhat 95, Basu 99).
  - Anderson (02) constructs a model where economic development, in a caste-based society, leads to an increase in dowries.
  - Goldin (95) and others documents that the role of women as bread earners often decreases in the first stages of development.

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  - Goldin (95) and others documents that the role of women as bread earners often decreases in the first stages of development.
- Overall, theory leads to ambiguous predictions about the relation between economic development and son preference, especially in the short run.

Why it is useful to look at child growth performance?

- Child weight and height performance can be viewed as the output of a “health production function” whose inputs also include elements such as nutritional intakes, exposure to infections, and health care.
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- well documented relationship between child malnutrition and poor adult outcomes.
- When evaluating gender differences, another advantage of nutritional status versus, say, nutrient intakes, morbidity, or health care, is that the former is easily measured, and therefore much less prone to measurement error or reporting bias.

Motivation (3)

- How much of the observed changes can be “explained” by changes in the distribution of household wealth and other observed household characteristics, such as family composition, education, etc.?

Preview of the findings

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- We calculate changes in nutritional status “predicted” by change in the distribution of household wealth (proxied by asset ownership) and of a few other observed household characteristics.

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  - Actual changes are much better than predicted ones for boy weight in rural areas, and much worse for girl height.
  - predicted changes are larger for boys than for girls.

Data

- Two **independent cross-sections** of the Indian National Family and Health Surveys (NFHS): 92/93 (wave I) and 98/99 (wave II), whose major purpose is to collect detailed information on fertility and health issues for ever married women of fertility age. $\approx 90,000$ obs. in each round.

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  - **North**: Delhi, Gujarat, Haryana, Himachal Pradesh, Jammu, Madhya Pradesh, Punjab, Rajasthan and Uttar Pradesh.
  - **East**: Assam, Bihar, Orissa and West Bengal
  - **South**: Andhra Pradesh, Karnataka, Kerala, Maharashtra and Tamil Nadu

Table 1A - Summary statistics - Women

	1992-93 (NFHS-I)		1998-99 (NFHS-II)	
No. of households	88562		92486	
No. of ever married women age 15-49	89777		90303	
No. of ever married age 13-14	271		0	
% living in rural areas (weighted)	73.8		73.8	
Means (Weighted)	**Urban**	**Rural**	**Urban**	**Rural**
Family - Fertility				
Age at first marriage	17.9	16.2	18.2	16.4
Household size	6.73	7.24	6.48	6.93
# children below age 5	0.91	1.14	0.81	1.03
Not usign any contraceptive	51.9	65.0	45.5	58.1
Contraceptive: Female sterilization	28.6	24.9	33.7	31.4
Contraceptive: Pill	1.8	0.9	2.5	1.8
Contraceptive: Condom	5.5	1.2	6.8	1.5
% desiring 3 children or less*	80.3	65.1	85.6	73.1
% desiring 2 children or less*	56.6	34.4	67.4	46.0
Desired % of females*	44.1	40.4	45.2	42.2
North**	41.9	38.0	43.3	39.4
East	43.3	40.4	44.8	42.4
South	46.3	43.5	47.2	45.6

Source: Author's calculations from NFHS-I and II. All means and proportions calculated using sampling weights.

* Calculated including only numeric answers (this excludes responses such as "up to God" etc.). **North: Delhi, Uttar Pradesh, Rajasthan, Punjab, Jammu, Himachal Pradesh, Madhya Pradesh, Gujarat; East: Assam, Bihar, Orissa, West Bengal; South: Andhra Pradesh, Kerala, Karnataka, Maharastra, Tamil Nadu. All statistics are calculated including only women of age 15-49.

Table 1B - Summary statistics - Women

Means (Weighted)	1992-93 (NFHS-I)				1998-99 (NFHS-II)			
	Urban		Rural		Urban		Rural	
Education and Labor Force Participation								
Working	21.1		37.3		24.0		42.0	
North	16.5		29.5		21.2		37.3	
East	16.2		26.7		16.3		27.4	
South	27.5		58.3		29.3		61.2	
Of which, Working for salary	89.1		60.2		89.0		62.6	
North	88.5		43.0		87.2		43.9	
East	88.0		69.7		93.5		79.5	
South	89.8		68.6		89.5		70.4	
	Woman	Partner	Woman	Partner	Woman	Partner	Woman	Partner
% no education	35.6	17.1	71.0	40.5	29.2	13.5	62.4	34.1
North	42.1	18.4	78.4	39.9	33.9	14.0	70.5	32.0
East	37.7	19.9	71.7	43.5	30.3	15.2	64.6	38.9
South	28.5	14.7	59.8	38.7	24.1	12.4	50.0	32.4
% complete secondary or above	10.7	27.0	0.8	8.5	32.8	50.0	7.7	23.2
North**	12.1	28.9	0.7	10.2	34.9	53.9	6.1	27.0
East	11.4	30.1	0.7	8.1	29.1	47.5	5.7	19.5
South	9.1	24.0	1.2	6.5	31.9	47.1	11.4	22.0

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- Generalized increases in women labor market participation.
- Large increases in female literacy rates.

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- weight (given age or height) is deemed to be a better indicator of short-term nutritional status. Height-for-age is better suited to monitor long-term growth performance.
- We adopt the common practice of evaluating nutritional status with respect to reference growth charts, calculating **z-scores:**

$$z_{ig} = \frac{x_{ig} - x_g}{\sigma_g}$$

  - x_{ig} is the weight (height) for a specific child i in group g (defined by sex and either age or height)
  - x_g and σ_g are the mean (or median) and the s.d. of the indicator in reference population.
- z-scores are then easy to interpret if the corresponding nutritional indicator is approximately normally distributed in the reference population.

Reference Growth Charts

– We use the commonly adopted 1977 CDC growth charts for American children as a reference.

Reference Growth Charts

- Motivation
- Preview of the findings
- Data
- Child Nutritional Status
- Methodology
- Results
- “Explaining” the changes
- Conclusions and Future Research

– We use the commonly adopted 1977 CDC growth charts for American children as a reference.
  - Widely used for international comparisons, use recommended by the WHO (Dibley *et al.* 1987a, 1987b).
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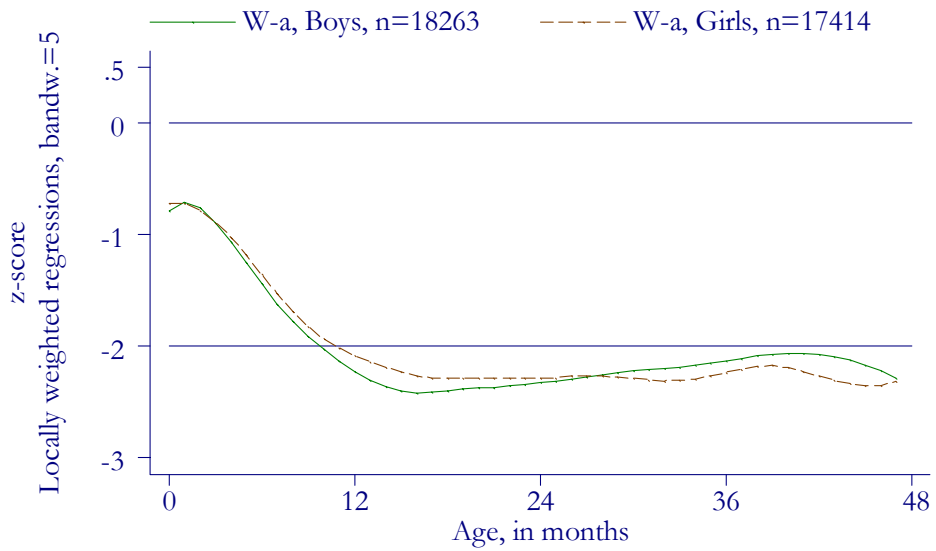
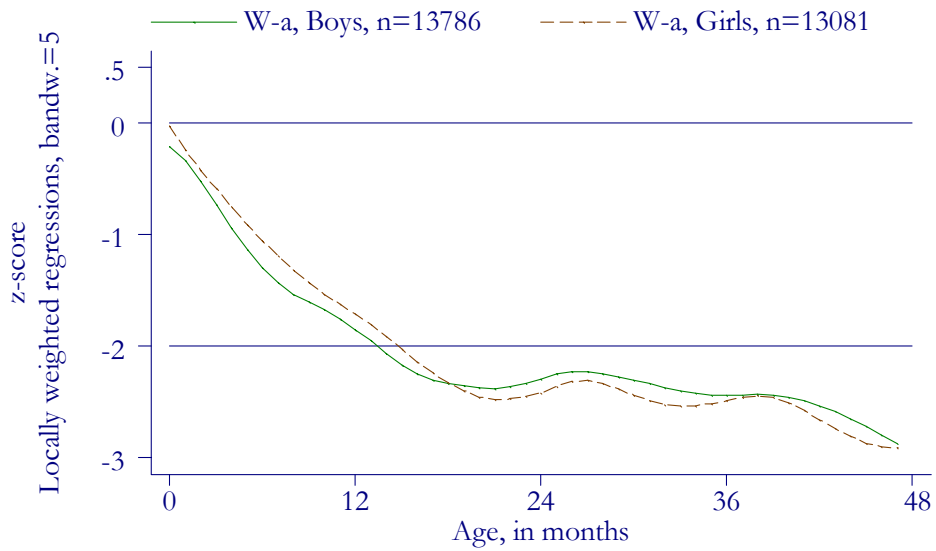
– The choice of a reference should not have important effects on the results, when we look at changes over time.

– The use of z-scores also allows boys vs girls comparisons.

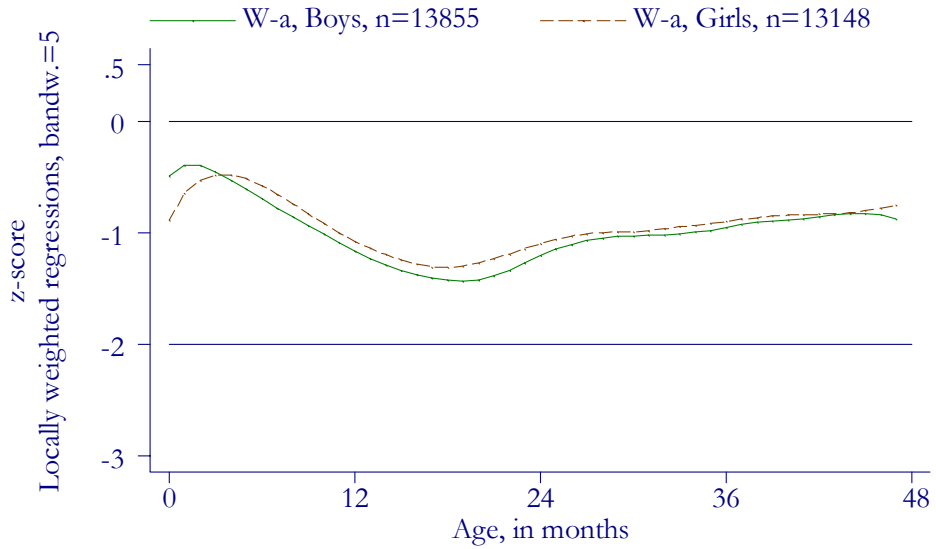
– It also allows us to pool together children of any age.



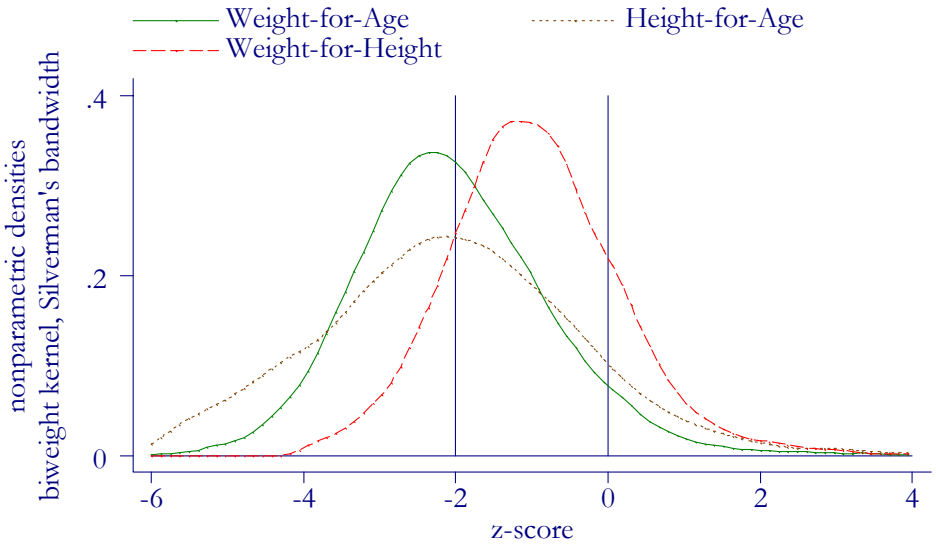
(A) - Weight-for-Age



(B) - Height-for-Age



(C) - Weight-for-Height



(D) - Boys and Girls

NFHS-I, 1992-93

Table 2B - Summary statistics - Children, Anthropometric Indicators - % with z-score below -2**

	1992-93 (NFHS-I)				1998-99 (NFHS-II)			
	Urban		Rural		Urban		Rural	
	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys
Weight-for-age	**44.2 (1.54)**	**44.3 (1.48)**	**52.9 (0.83)**	**55.3 (0.86)**	**40.6 (1.44)**	**39.3 (1.29)**	**51.4 (0.81)**	**47.8 (0.80)**
Obs.	**2871**	**3043**	**7129**	**7349**	**2352**	**2586**	**6605**	**7321**
North	46.1 (2.05)	45.6 (2.02)	52.4 (1.07)	53.8 (1.14)	40.0 (2.00)	37.2 (1.70)	52.1 (1.08)	47.1 (1.13)
Obs.	1465	1648	3695	3808	1118	1282	2975	3349
East	47.0 (4.32)	48.4 (3.42)	56.2 (1.82)	63.6 (1.77)	45.4 (3.58)	45.5 (4.21)	54.7 (1.42)	51.8 (1.25)
Obs.	493	478	1471	1499	263	255	1625	1832
South	41.5 (2.68)	41.2 (2.80)	51.2 (1.84)	49.3 (1.63)	40.7 (2.52)	41.1 (2.25)	48.0 (2.16)	45.5 (2.09)
Obs.	563	526	1124	1226	652	679	857	943
Height-for-age	**40.0 (1.45)**	**40.1 (1.49)**	**48.6 (0.84)**	**49.8 (0.84)**	**38.9 (1.41)**	**35.6 (1.23)**	**50.7 (0.83)**	**48.6 (0.79)**
Obs.	**2871**	**3043**	**7129**	**7349**	**2352**	**2586**	**6605**	**7321**
North	43.9 (1.95)	45.1 (2.03)	50.5 (1.13)	50.0 (1.12)	43.3 (2.02)	39.3 (1.65)	55.4 (1.08)	51.9 (1.08)
Obs.	1465	1648	3695	3808	1118	1282	2975	3349
East	47.7 (4.49)	41.6 (4.02)	50.0 (1.80)	57.6 (1.72)	42.1 (3.76)	38.7 (4.17)	52.6 (1.36)	51.7 (1.30)
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South	32.6 (2.09)	32.3 (2.59)	42.8 (1.76)	39.8 (1.64)	33.0 (2.18)	29.8 (2.09)	40.0 (2.22)	38.3 (1.98)
Obs.	563	526	1124	1226	652	679	857	943
Weight-for-height	**16.9 (1.22)**	**18.6 (0.95)**	**17.7 (0.64)**	**21.7 (0.71)**	**11.5 (0.90)**	**13.6 (0.88)**	**16.9 (0.59)**	**16.6 (0.60)**
Obs.	**2883**	**3053**	**7155**	**7376**	**2370**	**2601**	**6652**	**7355**
North	16.4 (1.50)	18.1 (1.32)	16.6 (0.80)	19.7 (0.92)	8.2 (0.95)	10.6 (1.12)	12.4 (0.73)	11.8 (0.65)
Obs.	1472	1652	3704	3821	1131	1295	3002	3370
East	11.8 (2.42)	19.5 (2.66)	18.7 (1.41)	25.7 (1.62)	15.9 (2.39)	20.7 (3.15)	20.9 (1.10)	21.6 (1.11)
Obs.	493	479	1476	1501	264	256	1629	1833
South	19.7 (2.50)	19.5 (1.69)	19.7 (1.55)	21.9 (1.27)	14.8 (1.71)	16.3 (1.46)	21.9 (1.46)	21.0 (1.63)
Obs.	568	530	1133	1231	656	679	868	950

Source: Author's calculations from NFHS-I and II. All means are calculated using sampling weights. **All results are calculated for children up to 3 years old living in states were height was recorded in NFHS-I. The remaining states are categorized as follows. North: Delhi, Uttar Pradesh, Rajasthan, Punjab, Jammu, Gujarat; East: Assam, Bihar and Orissa; South: Kerala, Karnataka, and Maharastra. The results for all India also include union territories.

Changes over time in the Distribution of z-scores

- For a given gender, estimate $f\left(z \mid 92/93\right)$ and $f\left(z \mid 98/99\right)$ using standard nonparametric kernel density estimators.

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- By construction, a *negative* difference indicates an *improvement*.
- For each pair of cdfs' we perform formal tests for the null hypothesis that the two distribution did not change by using χ^2 tests that take into account the complex survey design (Rao and Scott (1984)).

Gender Differences in the Distribution of z-scores

- In a given wave, estimate $f\left(z \mid boys\right)$ and $f\left(z \mid girls\right)$ using standard nonparametric kernel density estimators.

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- Calculate the Cumulative Distribution Function by numerically integrating the densities.
- Calculate $CDF_{boys}(z) - CDF_{girls}(z)$.
- By construction, a *positive* difference indicates "*female advantage*".
- For each pair of cdfs' we perform formal tests for the null hypothesis that the two gender-specific distributions are equal by using the same χ^2 tests as above.

“Differences-in-Differences”

- To better evaluate the magnitude of the *changes in gender differences* and their statistical significance we estimate “differences-in-differences” of CDFs’, together with 95% bootstrapped confidence bands.

$$\left[CDF_{boys}^{98/99}(z) - CDF_{girls}^{98/99}(z)\right] - \left[CDF_{boys}^{92/93}(z) - CDF_{girls}^{92/93}(z)\right],$$

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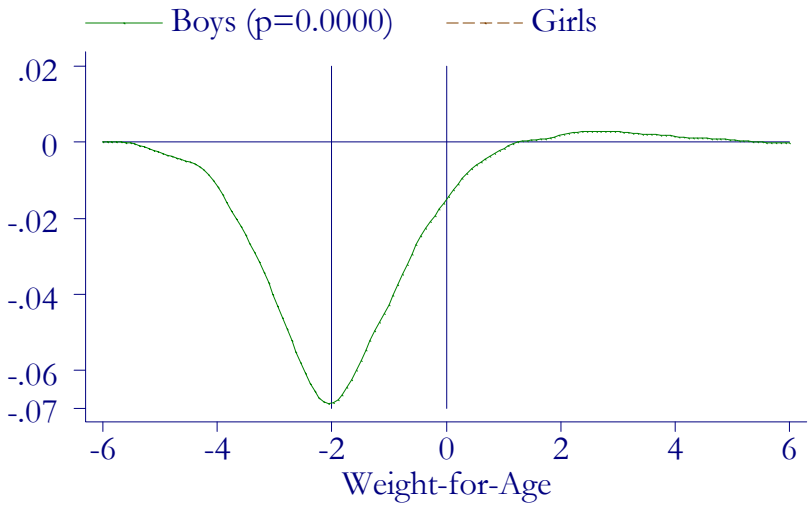
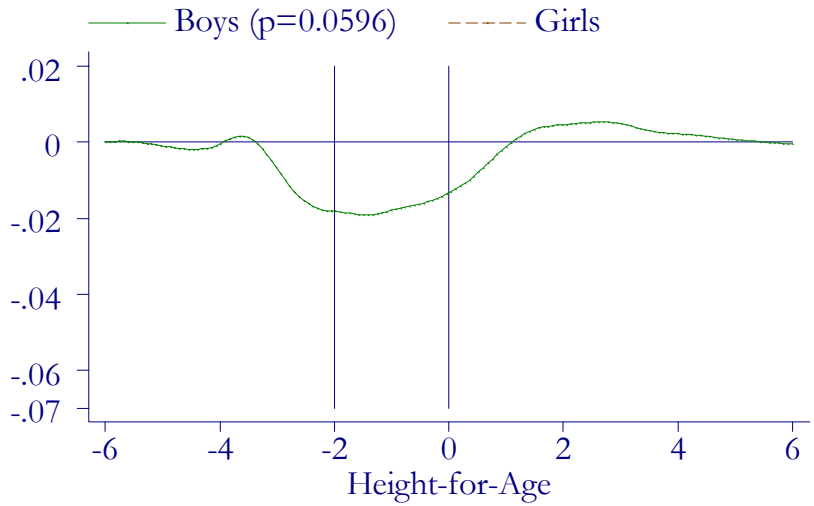
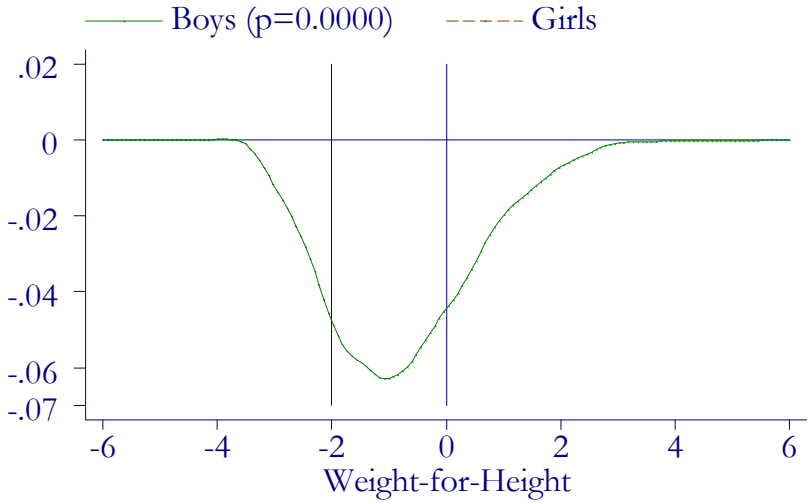
- We use 250 Bootstrap replications, re-sampling clusters independently from each wave, and for brevity we only consider weight and height given age.
- Note that because “relative boy advantage” translates into *negative* values of each difference, an *increase* in boy advantage will be represented by a *negative* difference-in-differences.

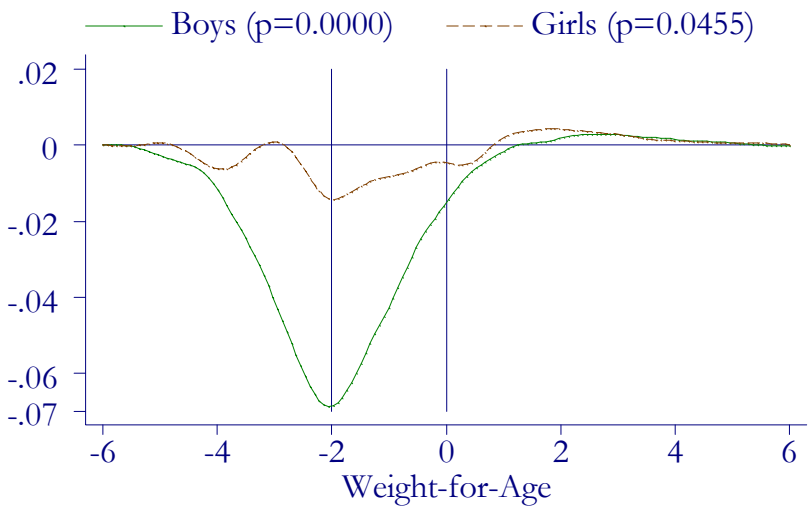


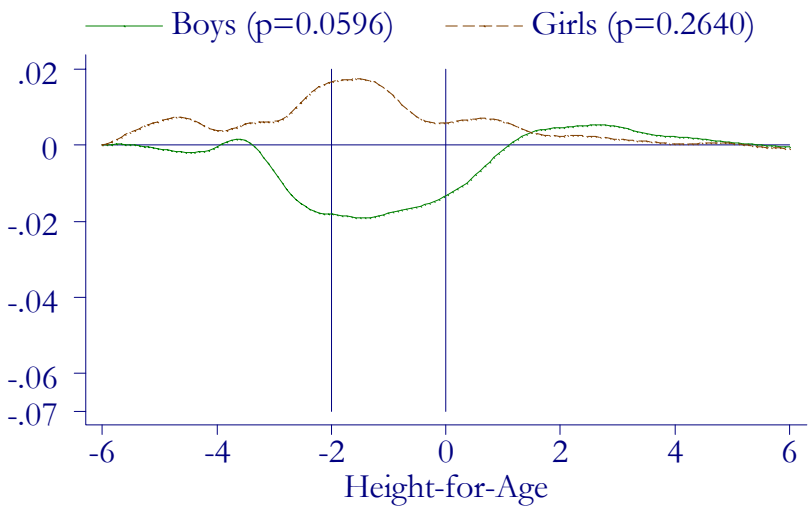


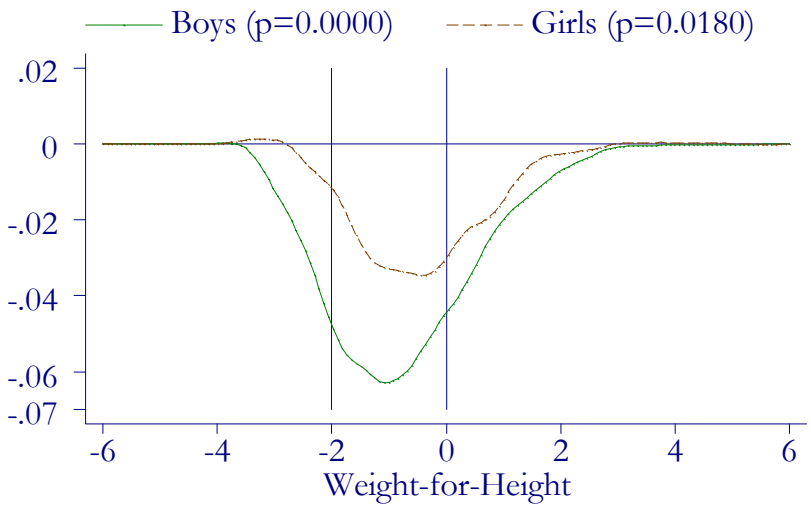


age 0-35 months, exclude AP/HP/MP/TN/WB

CDF(1998-99)-CDF(1992-93)- RURAL

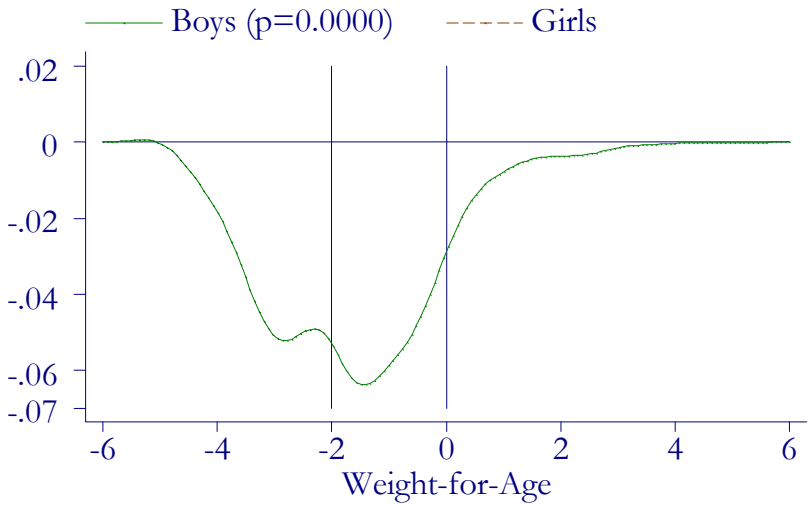


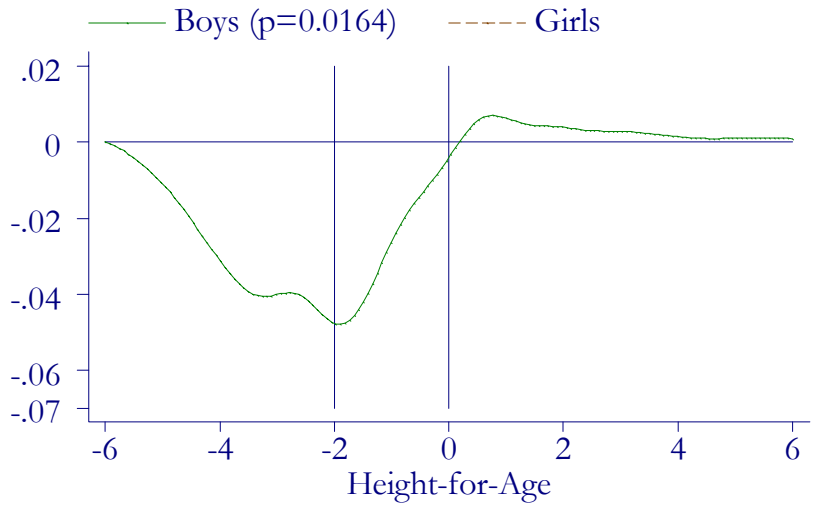


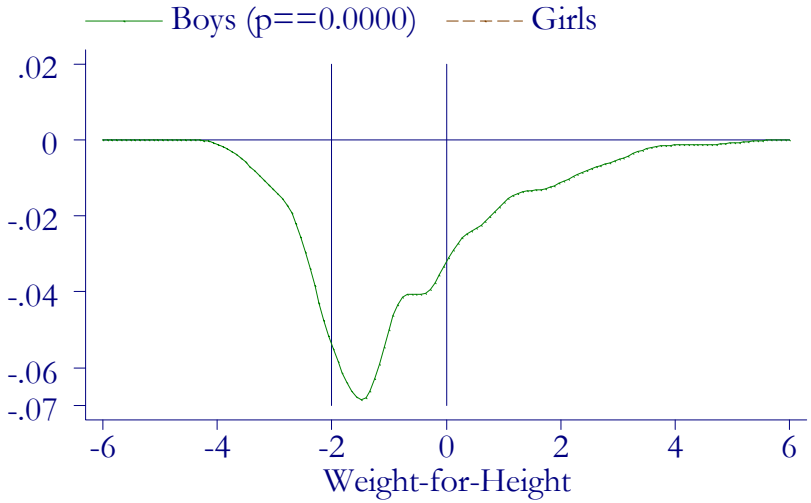


age 0-35 months, exclude AP/HP/MP/TN/WB

CDF(1998-99)-CDF(1992-93)- RURAL

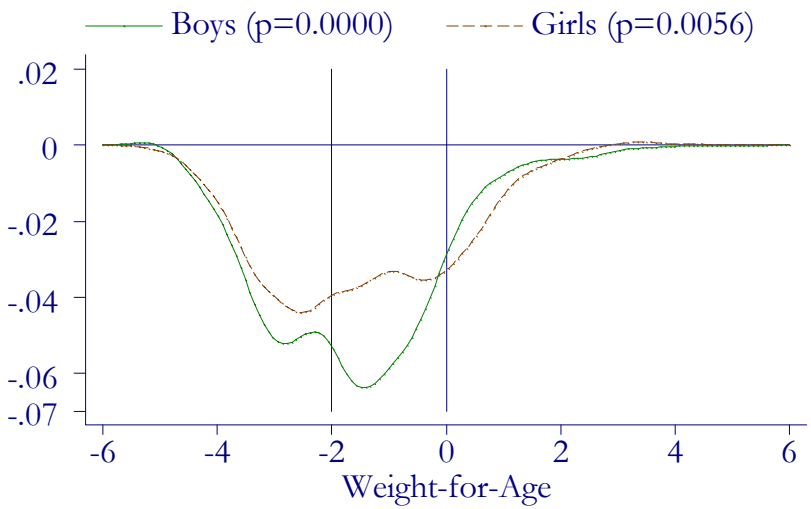


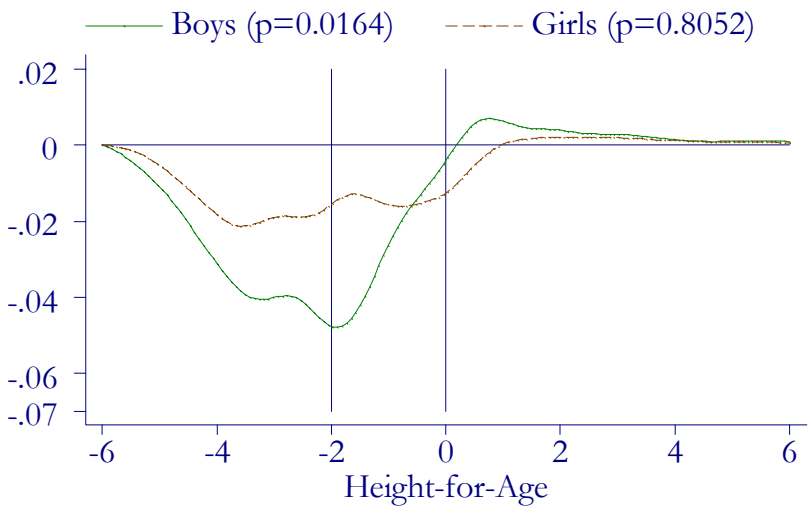


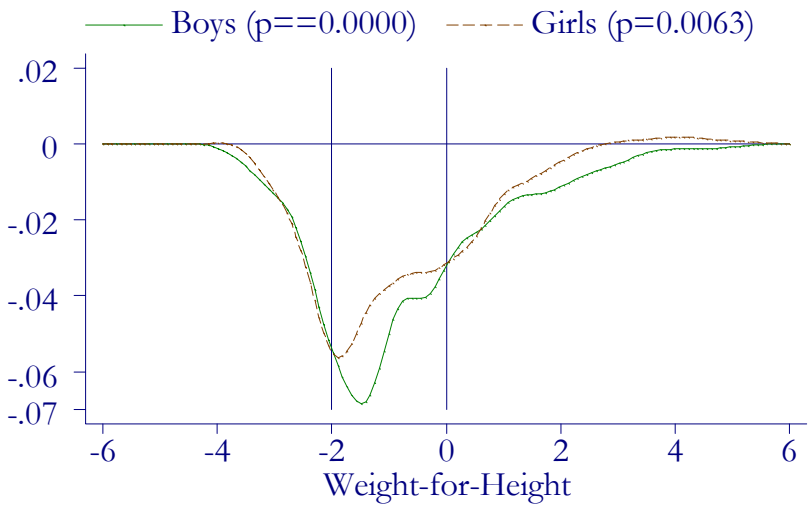


age 0-35 months, exclude AP/HP/MP/TN/WB

CDF(1998-99)-CDF(1992-93)- URBAN

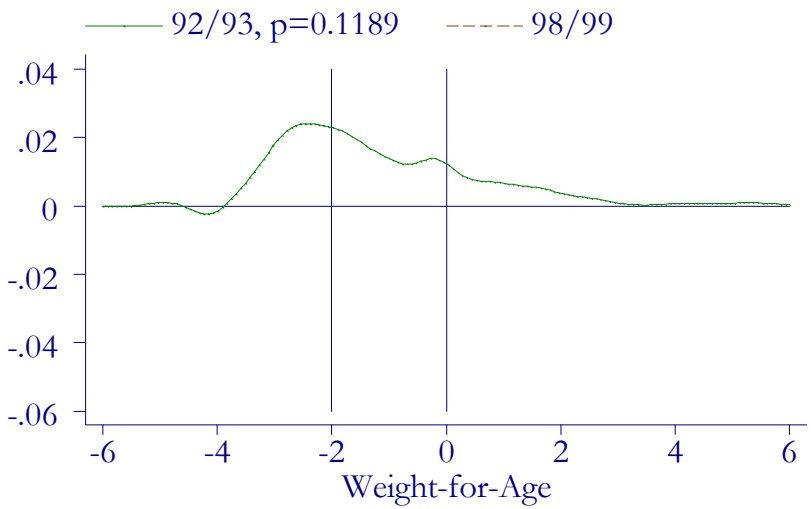


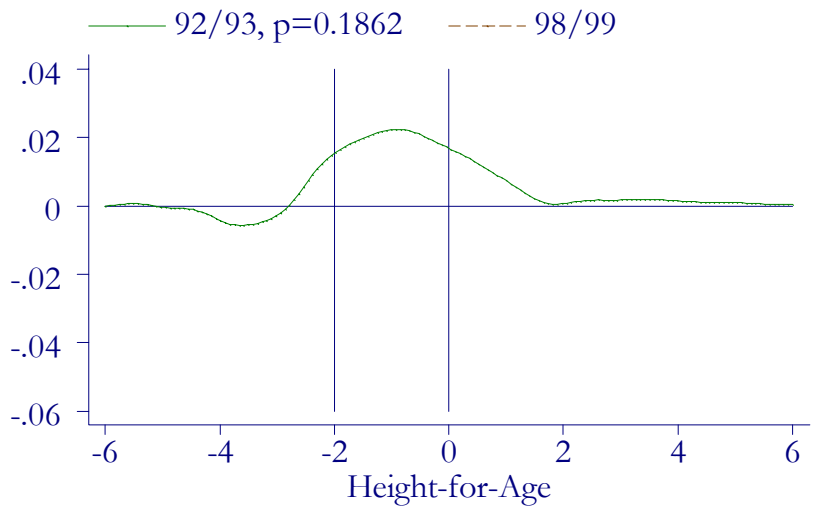


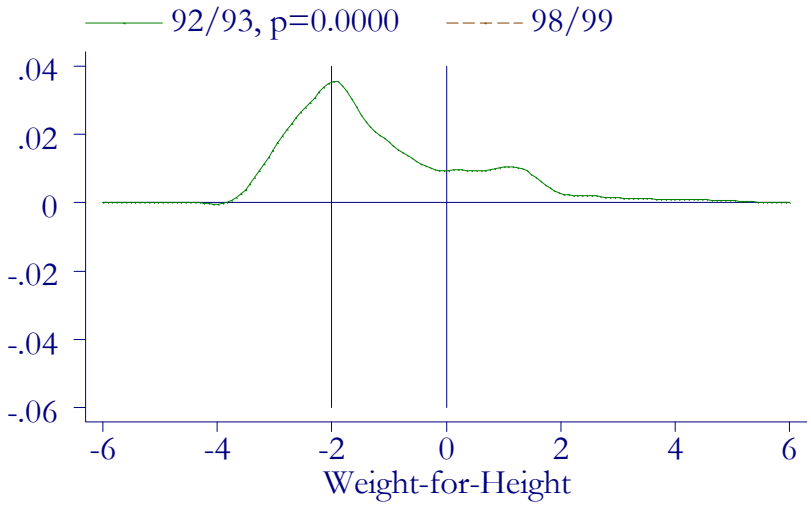


age 0-35 months, exclude AP/HP/MP/TN/WB

CDF(1998-99)-CDF(1992-93)- URBAN

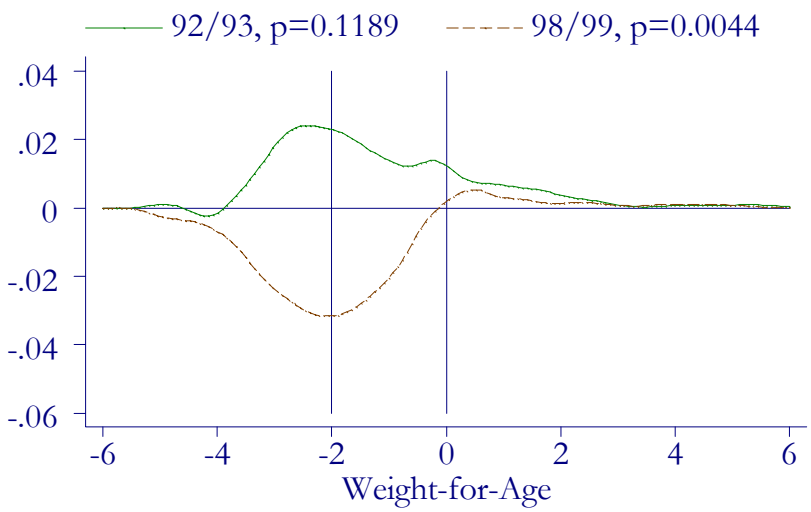


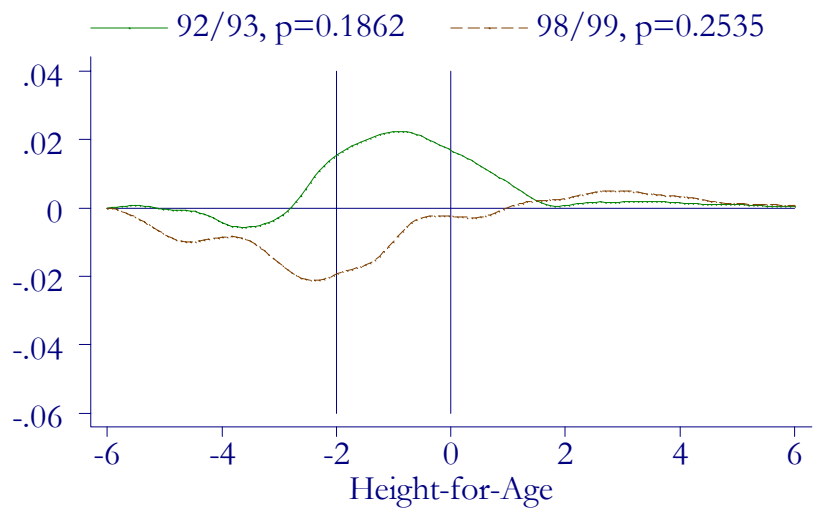


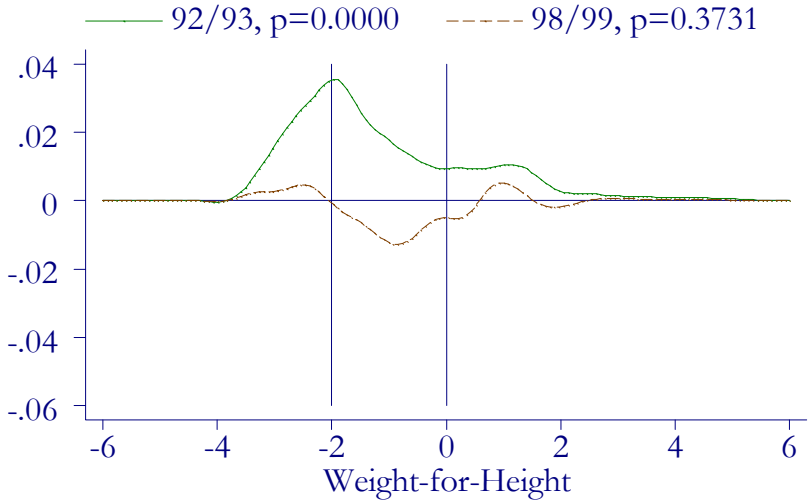


age 0-35 months, exclude AP/HP/MP/TN/WB

Differences CDF(boys)-CDF(girls), RURAL

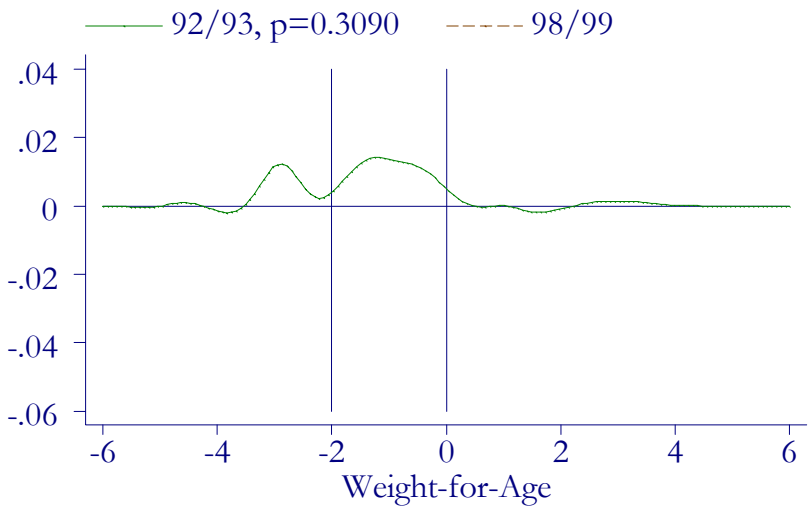


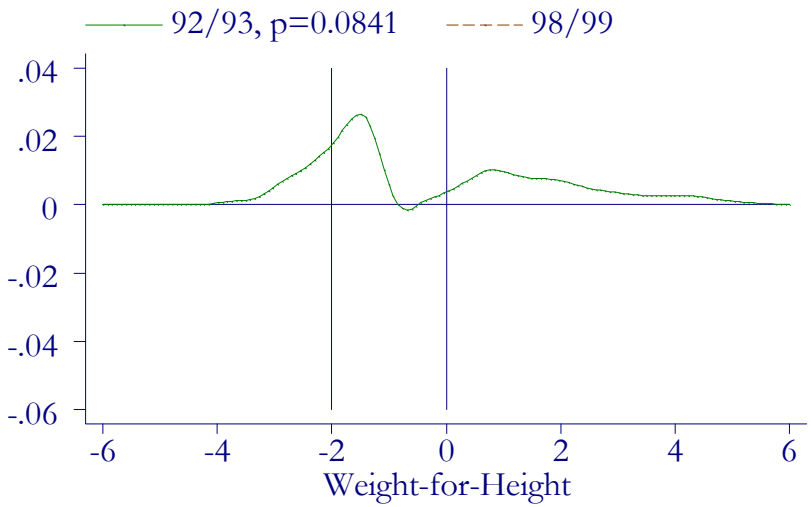




age 0-35 months, exclude AP/HP/MP/TN/WB

Differences CDF(boys)-CDF(girls), RURAL





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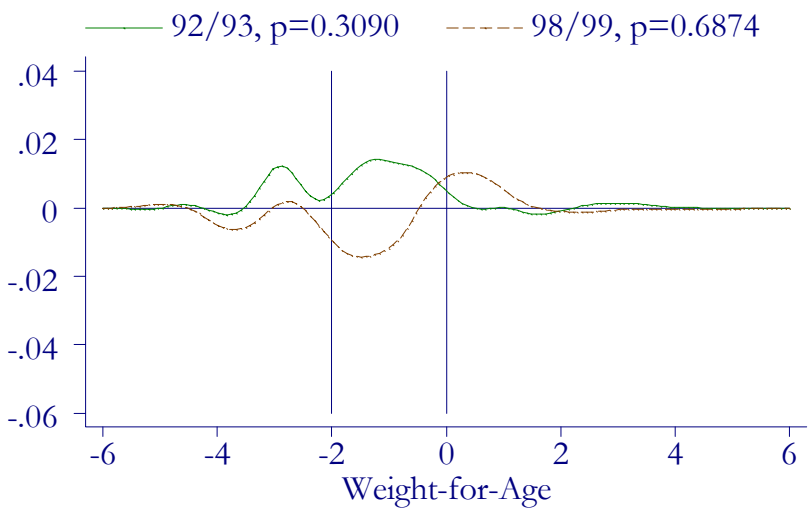
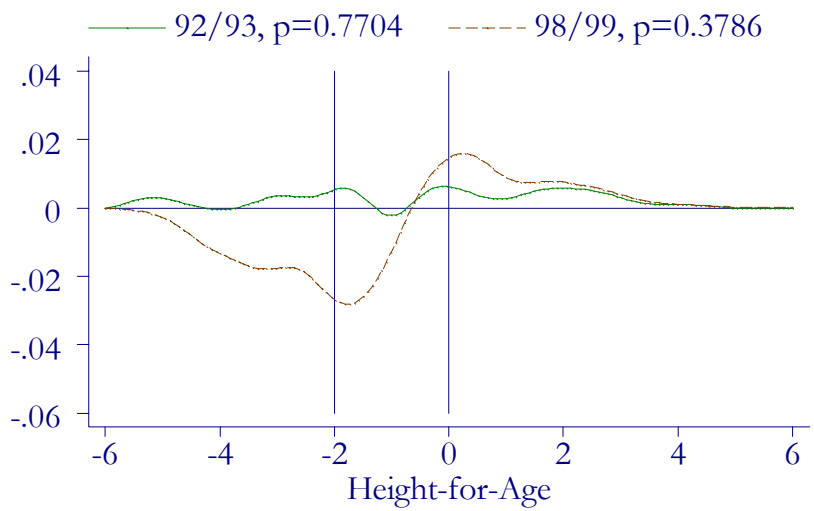
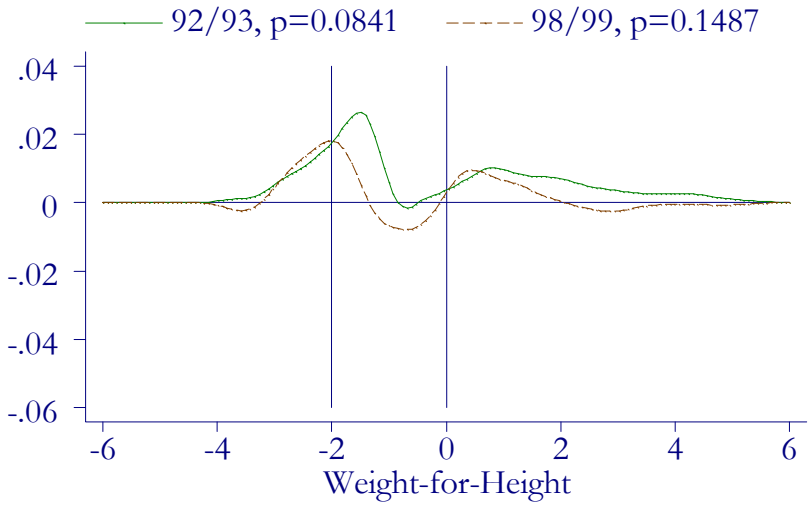
Differences CDF(boys)-CDF(girls), URBAN







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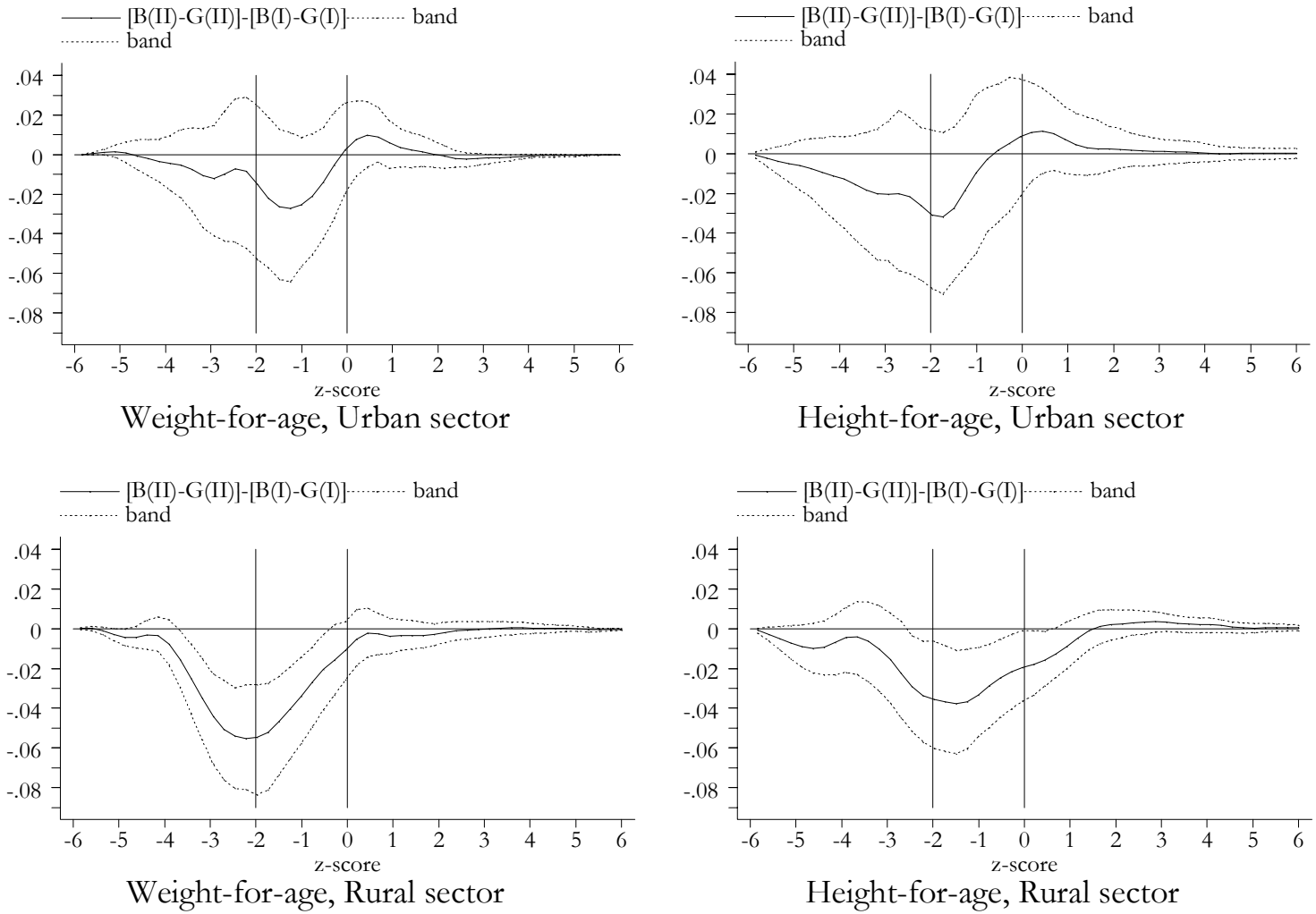
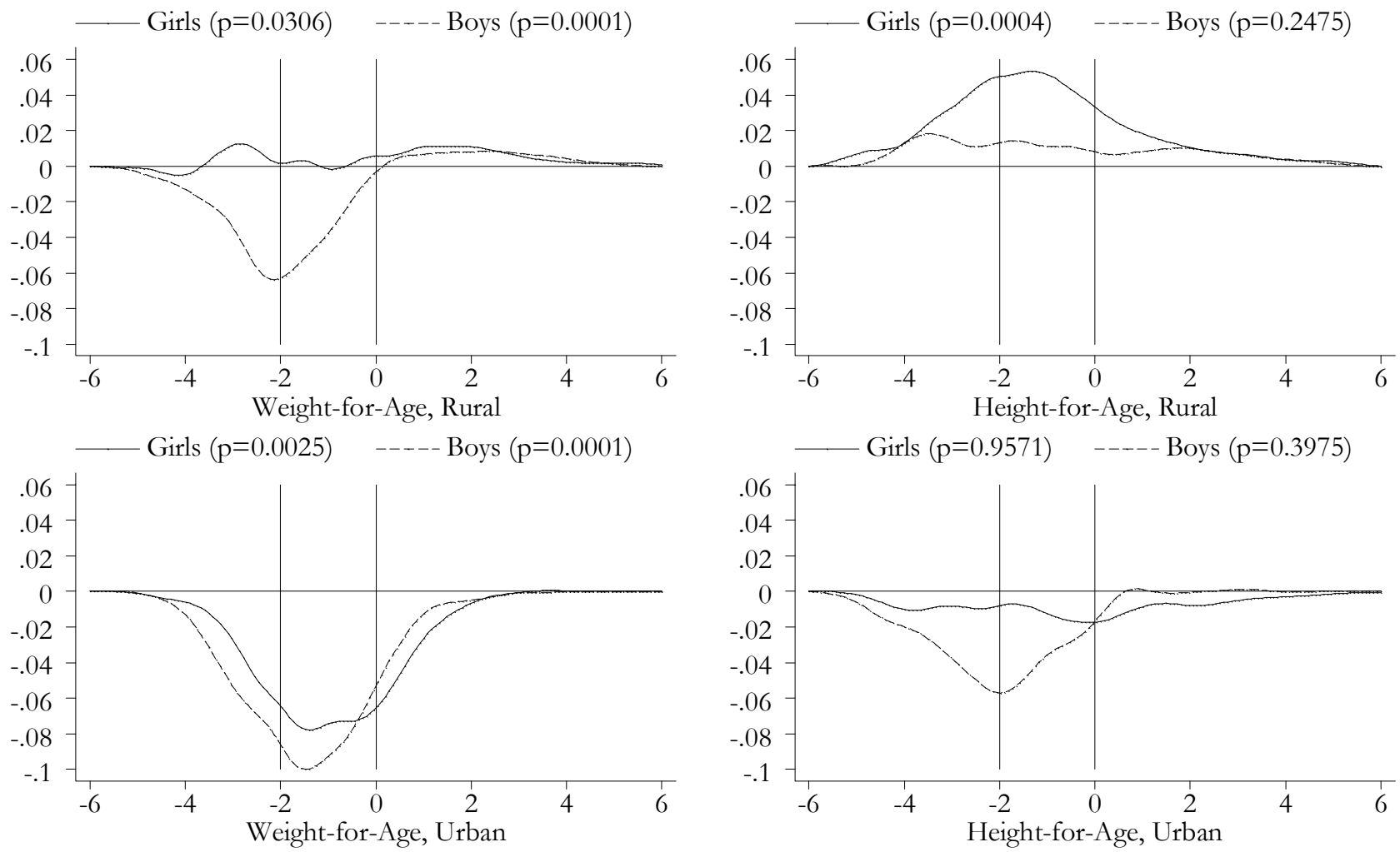


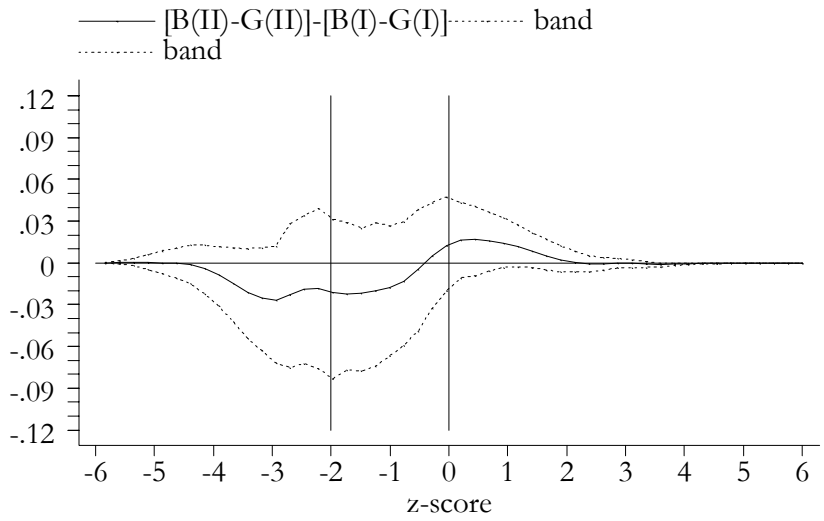
Figure 3 – All India. Change over time of the pointwise gender difference in distributions Children below age 3 – All states in NFHS-I Phase II

By construction, **negative differences-in-differences (dd) indicate an in(de)crease in boy ad(disad)vantage**. The dotted lines represent 95% confidence bands, calculated, at each point over the grid, as the 2.5 and 97.5 percentile of the distribution of estimated dd over 250 bootstrap replications, each done by resampling clusters separately from each survey.

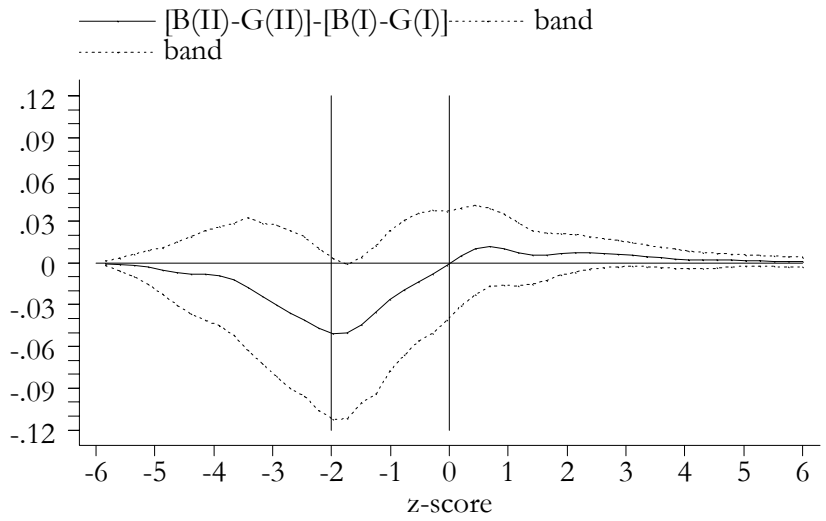


Age 0-35 months, Guj/Har/Jam/Pun/Raj/UP/Del

Differences CDF(1998-99)-CDF(1992-93) - North



Weight-for-age, Urban sector



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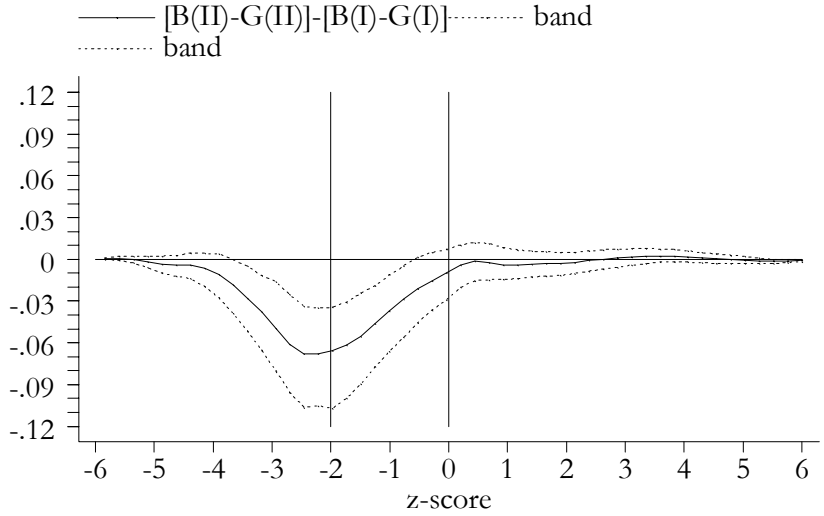
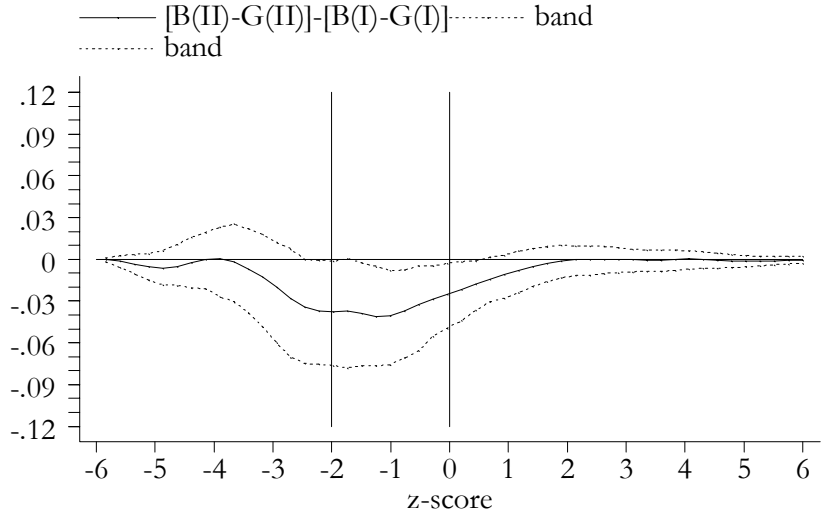


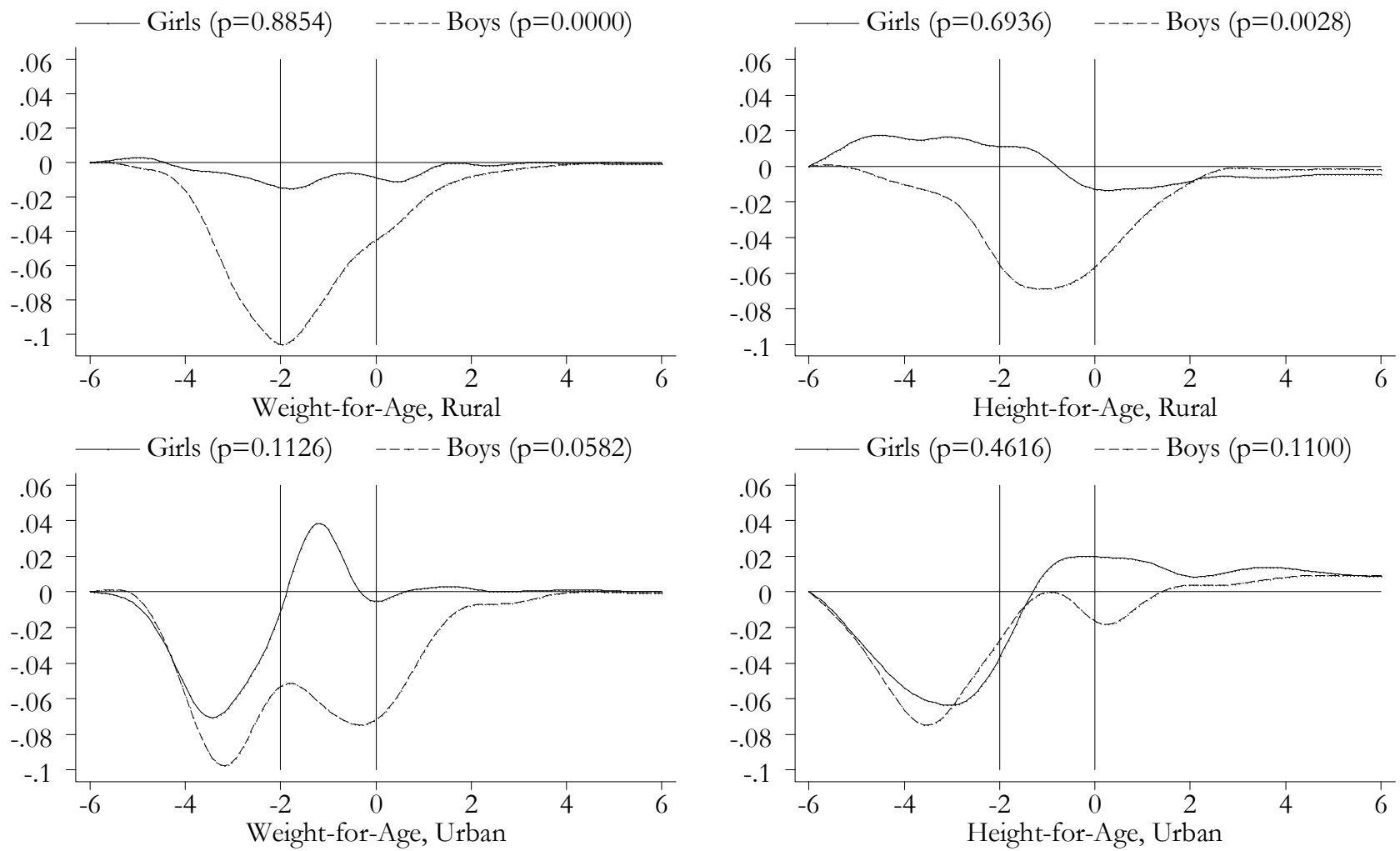
Weight-for-age, Rural sector



Height-for-age, Rural sector

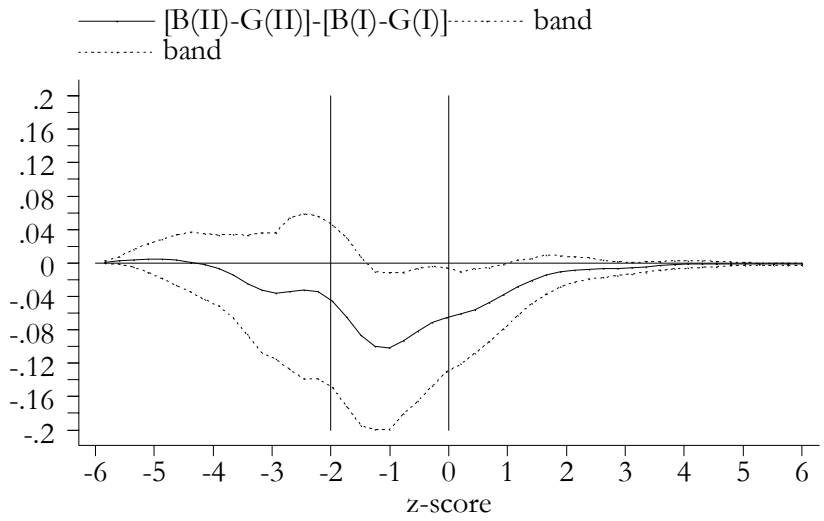
Figure 6a – Differences-in-Differences, North

Gujarat, Haryana, Jammu, Punjab, Rajasthan, Uttar Pradesh, and New Delhi.

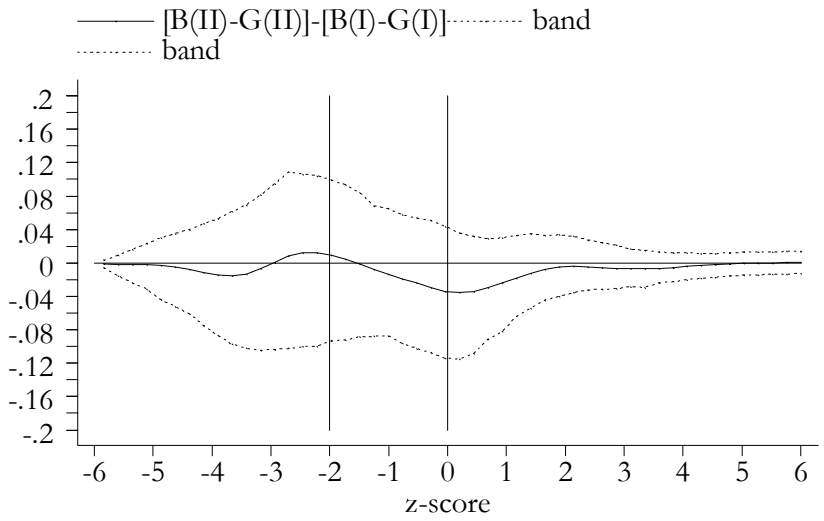


Age 0-35 months, Assam/Bihar/Orissa

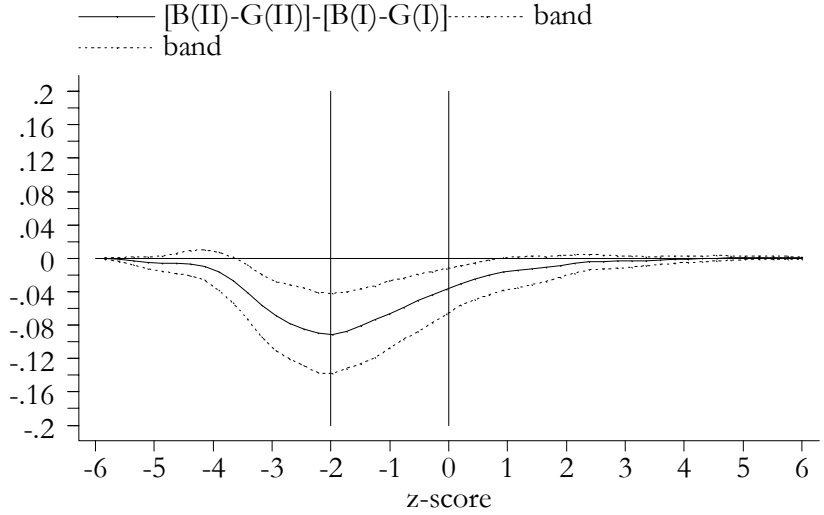
Differences CDF(1998-99)-CDF(1992-93) - East



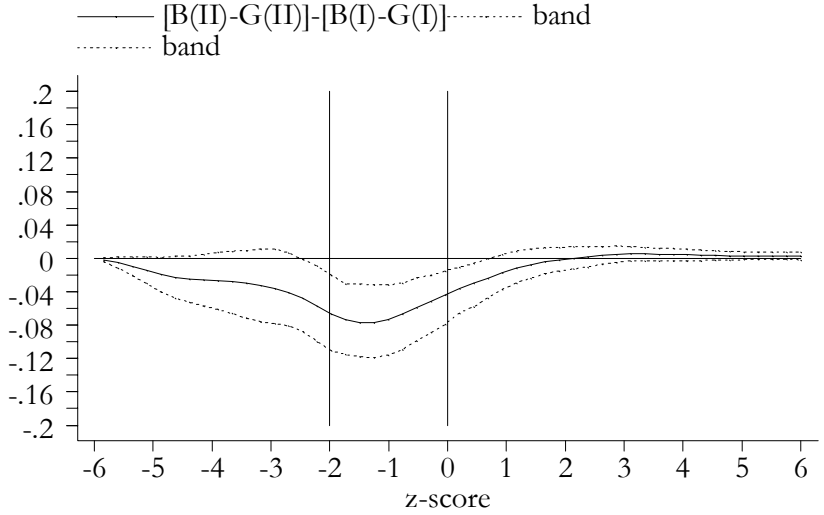
Weight-for-age, Urban sector



Height-for-age, Urban sector



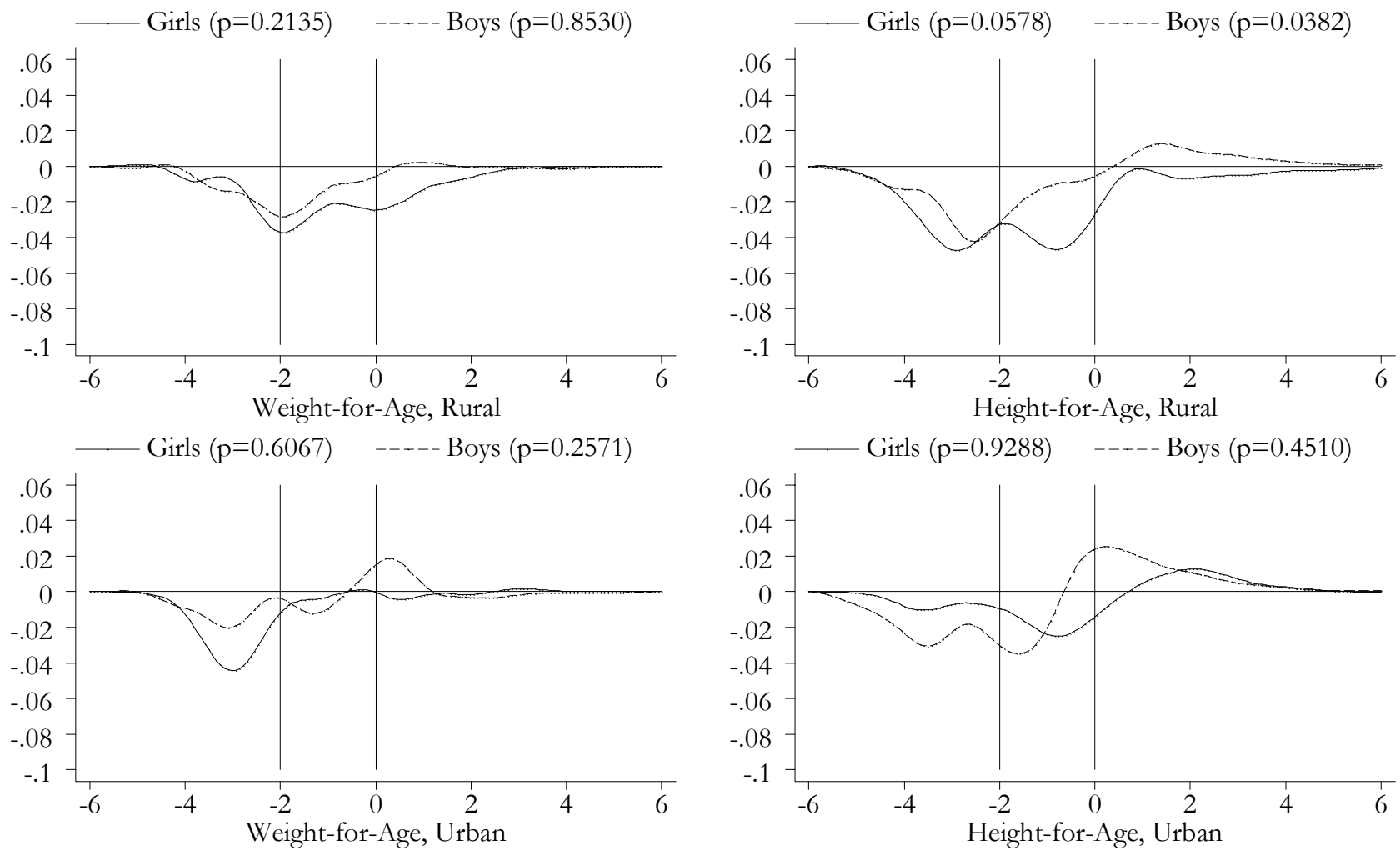
Weight-for-age, Rural sector



Height-for-age, Rural sector

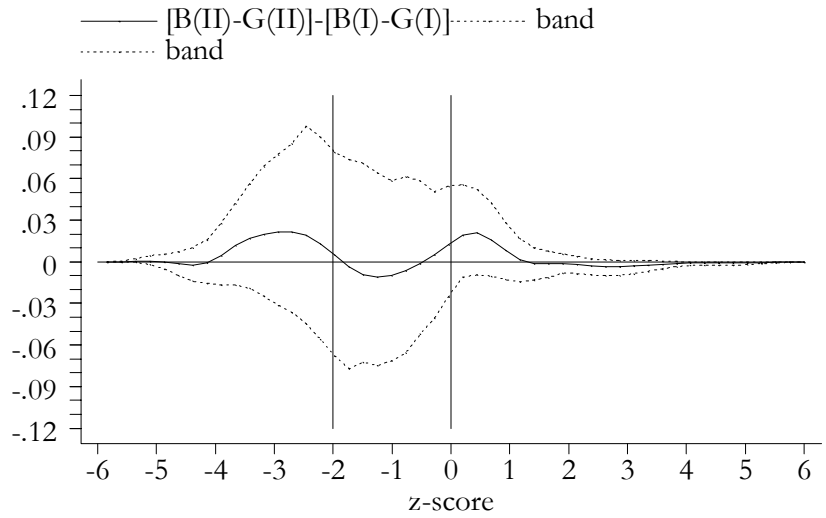
Figure 6b – Differences-in-Differences, East

Assam, Bihar, and Orissa.

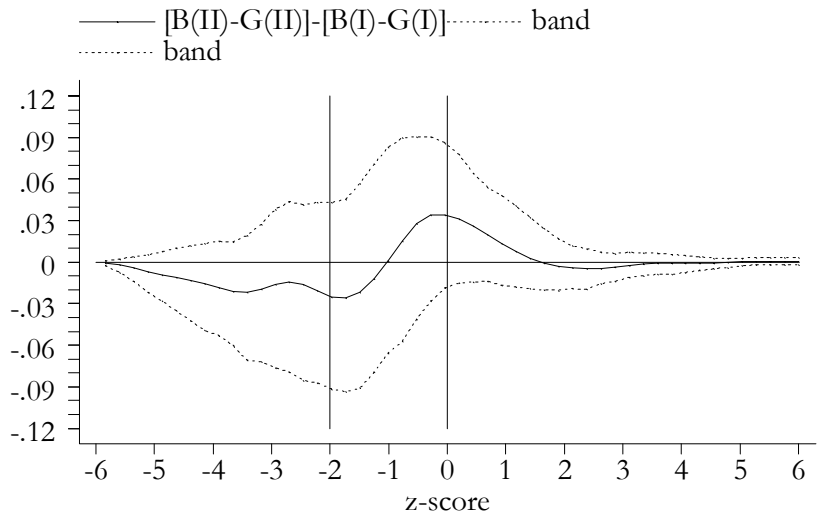


Age 0-35 months, Kerala/Karnataka

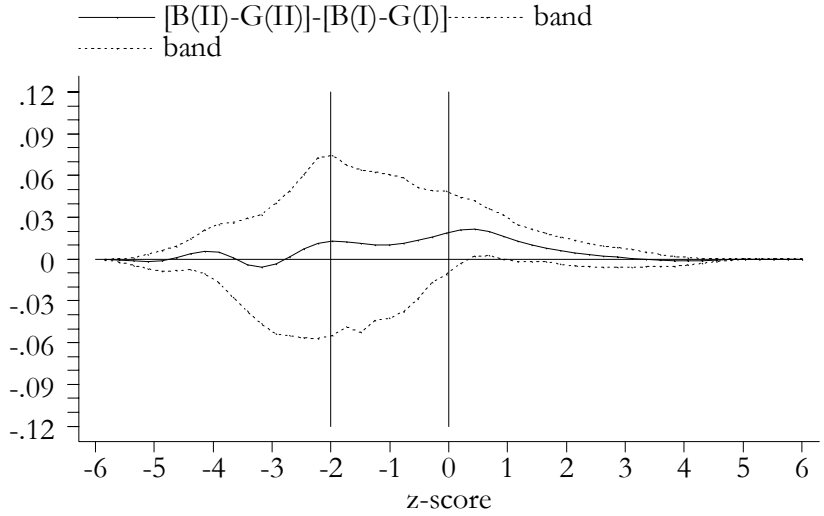
Differences CDF(1998-99)-CDF(1992-93) - South



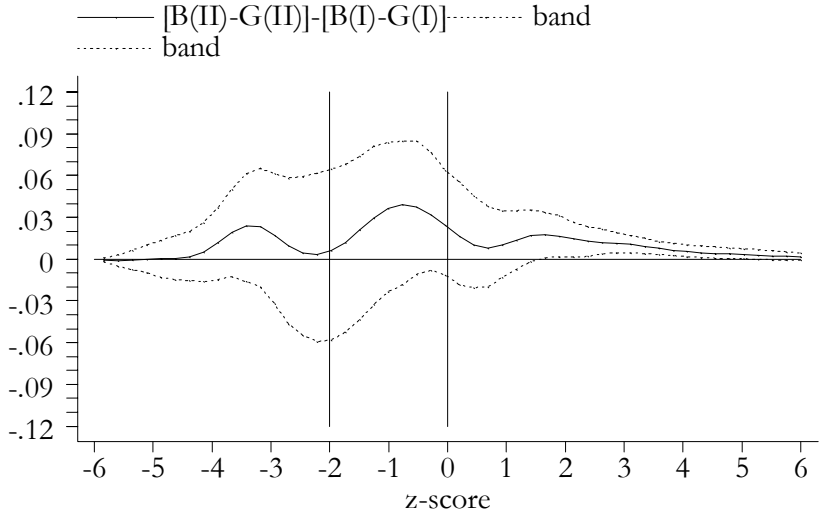
Weight-for-age, Urban sector



Height-for-age, Urban sector



Weight-for-age, Rural sector



Height-for-age, Rural sector

Figure 6c – Differences-in-Differences, South.

Kerala, Karnataka, and Maharashtra.

Summary of results

- Motivation
- Preview of the findings
- Data
- Child Nutritional Status
- Methodology
- Results
- “Explaining” the changes
- Conclusions and Future Research

– important movements in the distribution of weight and height for age z-scores during the short period of time between the two waves of the NFHS.

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– Only in Southern regions, and in urban areas elsewhere, we find that improvements in the nutritional status of children up to 3 years old have been significant for both boys and girls.

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– in rural areas of Northern and Eastern states boys’ nutrition appear to have improved much more than girls’.

– Only in Southern regions, and in urban areas elsewhere, we find that improvements in the nutritional status of children up to 3 years old have been significant for both boys and girls.

– It is somehow disturbing that areas where son preference has historically been found to be stronger—and in a period of rapid growth—appear to be moving towards a situation of *more* pronounced gender inequality in child nutritional status.

“Explaining” the changes

How much of the observed changes can be explained by changes in the distribution of selected household characteristics?

- We use the approach in DiNardo, Fortin and Lemieux (1996) to ‘decompose’ the change in the distribution $f(z)$ of an anthropometric index z using the following thought experiment:
  - keeping the distribution of z-scores *conditional* on a list of covariates equal to the one observed in 1992-93, how should the *marginal* distribution of z-scores have changed if the distribution of the covariates were those observed in 1998-99?

“Explaining” the changes

How much of the observed changes can be explained by changes in the distribution of selected household characteristics?

- We use the approach in DiNardo, Fortin and Lemieux (1996) to ‘decompose’ the change in the distribution $f(z)$ of an anthropometric index z using the following thought experiment:
  - keeping the distribution of z-scores *conditional* on a list of covariates equal to the one observed in 1992-93, how should the *marginal* distribution of z-scores have changed if the distribution of the covariates were those observed in 1998-99?
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- **Caveat:** the results *should not* be interpreted in a *causal* sense, as virtually all covariates would be endogenous in a regression context.
- **Included covariates:** A proxy for wealth (an asset index constructed using principal components), parental education, child age, number of older siblings living at home, household size, main source of drinking water, availability of electricity or sanitation facilities in the house.

Estimation

- Motivation
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- The actual density of the anthropometric index z evaluated at $\bar{z}$, in wave t ($t = I, II$) can be written as:

$$\begin{aligned} f(\bar{z} \mid t) &= f(\bar{z} \mid t_{\mathbf{x}} = t, t_{z|\mathbf{x}} = t) \\ &= \int f(\bar{z} \mid \mathbf{x}, t_{z|\mathbf{x}} = t) f(\mathbf{x} \mid t_{\mathbf{x}} = t) d\mathbf{x} \end{aligned}$$

  - $t_{z|\mathbf{x}}$ indicates the wave that identifies $f(z \mid \mathbf{x})$
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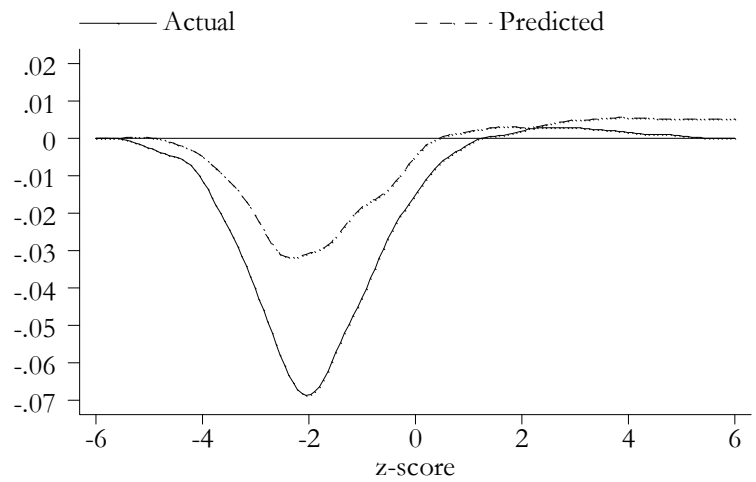
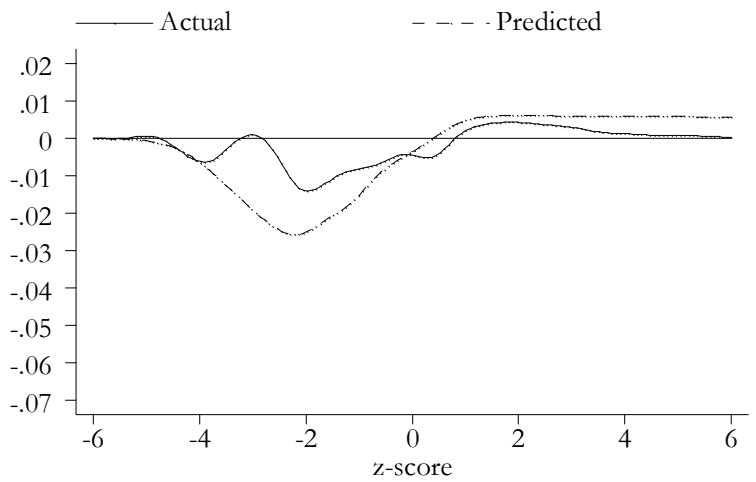
- The counterfactual density can be usefully rewritten as:

$$f(\bar{z} \mid t = I) E\left[\frac{P(t_{\mathbf{x}} = II \mid \mathbf{x}) P(t_{\mathbf{x}} = I)}{P(t_{\mathbf{x}} = I \mid \mathbf{x}) P(t_{\mathbf{x}} = II)} \middle| \bar{z}, t = I \right]$$

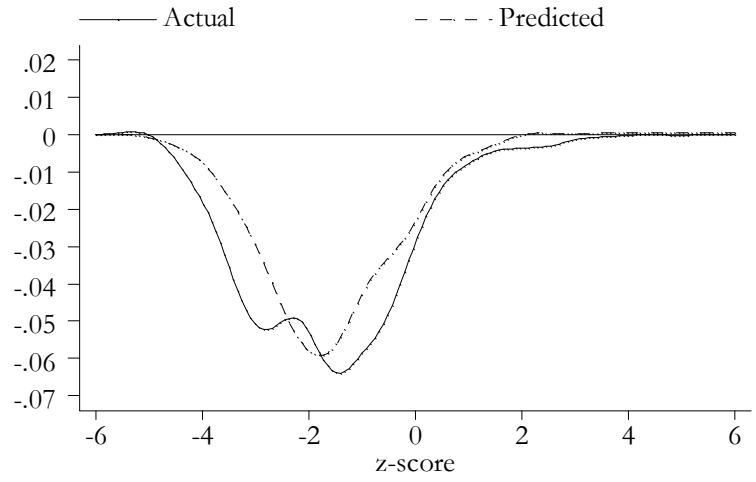
- Estimation is done non-parametrically.



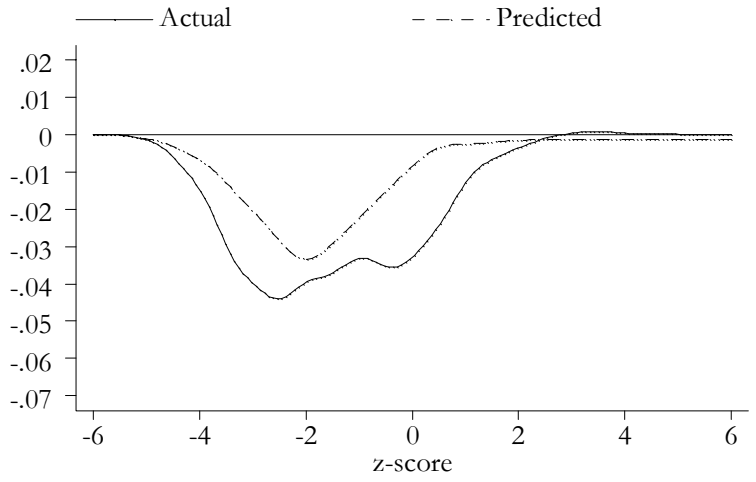
Rural, Boys



Rural, Girls



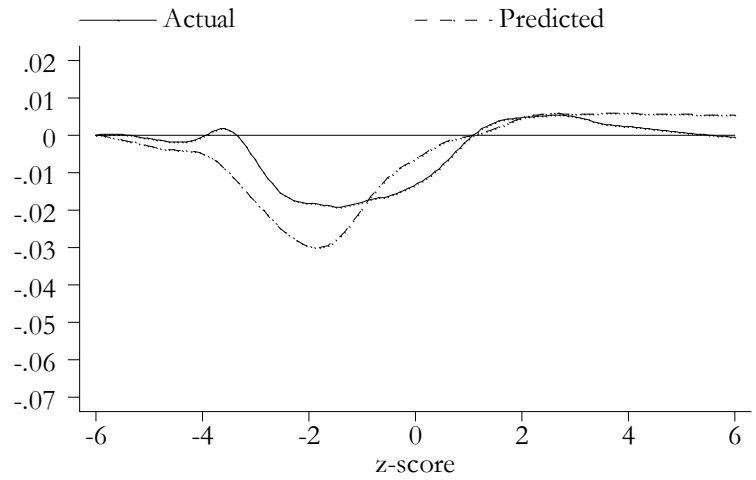
Urban, Boys



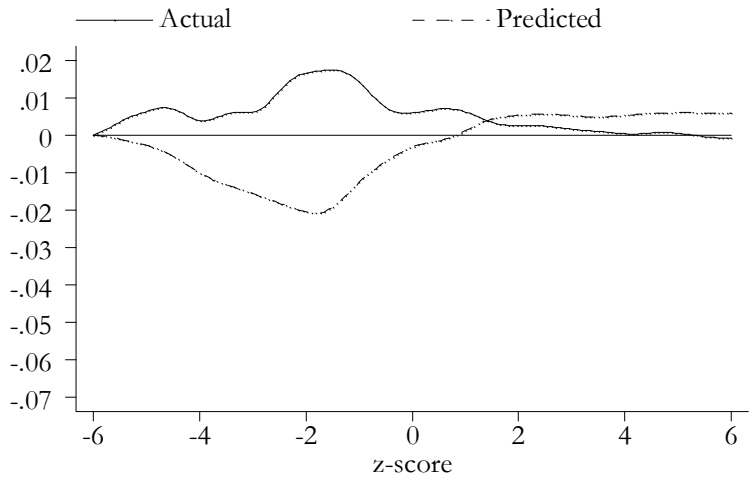
Urban, Girls

Weight-for-age, All India

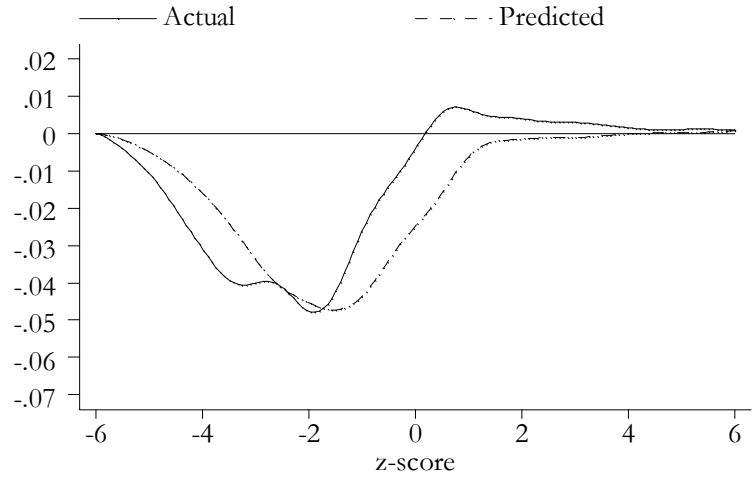
Counterfactuals estimated using a semi-parametric procedure as in DiNardo, Fortin, Lemieux (1996)



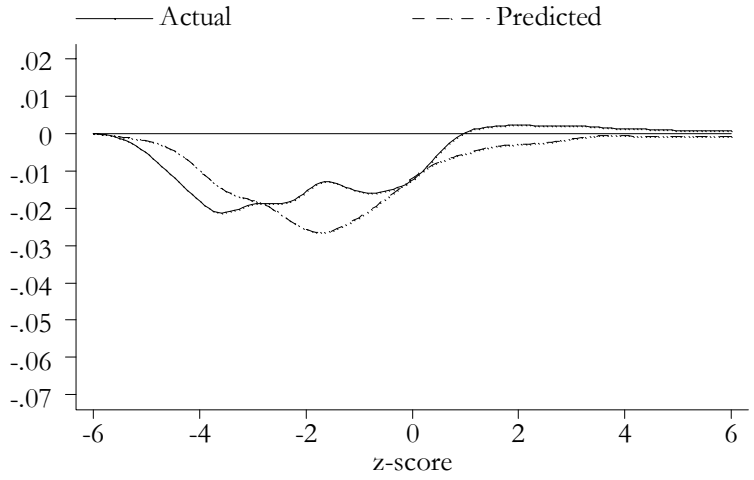
Rural, Boys



Rural, Girls



Urban, Boys



Urban, Girls

Height-for-age, All India

Counterfactuals estimated using a semi-parametric procedure as in DiNardo, Fortin, Lemieux (1996)

Conclusions and Future Research

- we find that child nutrition improved substantially, but we also find that gender differences in nutritional status increased as well, with nutritional status improving substantially more for boys than for girls

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Conclusions and Future Research

- we find that child nutrition improved substantially, but we also find that gender differences in nutritional status increased as well, with nutritional status improving substantially more for boys than for girls
- Consistently with a large literature that show the existence of a steep North-South gradient in gender inequality in India, we find that changes in nutritional status appear to be much more similar between genders in the South
- we attempt to identify how much of these changes can be explained by changes in household wealth and some other observable household characteristics.
  - Actual changes appear to be relatively close to predicted ones in urban areas.
  - In the rural sector we observe that actual changes in weight are much larger than predicted ones for boys, while they are much worse than the predicted ones for girl height.
  - The predicted changes are generally larger for boys than for girls.

Future Research

- (At least) two important questions left unexplained

Future Research

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Future Research

– (At least) two important questions left unexplained

  - Why these differences between genders?
  - Why the discrepancies between weight and height?