Catch-up Effects in Health Outcomes - Linear and Quantile Regression Estimates from Four Countries

Subha Mani, Fordham University, University of Pennsylvania and IZA
Jere R. Behrman, University of Pennsylvania
Andreas Georgiadis, University of Oxford
Fan Wang, University of Houston
Young Lives Determinants and Consequences of Child Growth Project Team

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Background

Stunting in early childhood is associated with fewer grades of schooling, lower test scores, smaller stature, and lower earnings

- Stein et. al 2003, 2006, 2008; Alderman et. al 2006; Hoddinott et. al 2008, 2010; Victora et. al 2008; Behrman et. al 2009; Maluccio et. al 2009

However, observed catch-up in stature among children can minimize the permanent deficits of growth faltering

Literature

Partial catch-up exists - between one-third to one-fourth of all early nutritional deficiencies can be reversed

- Hoddinott and Kinsey 2001; Fedorov and Sahn 2005; Alderman, Hoddinott and Kinsey 2006; Mani 2012; Outes and Porter 2013
- Typically captured using a dynamic linear panel data model

Catch-up in HAZ can minimize the long-run detrimental effects of early childhood stunting

Linear and Quantile Regression Models

Dynamic Linear Regression Models

- Limited evidence: Zimbabwe, Russia, Indonesia, Ethiopia
- Captures only average partial effects

Dynamic Quantile Regression Models

- Captures impacts along the entire distribution of health outcomes
- Policy makers are often interested in the distributional effects
- To what extent does history matter for those in the bottom quantiles of the outcome distribution?

Objective

Quantify catch-up potential among children in four countries - Ethiopia, India, Peru and Vietnam

Dynamic linear panel data model

- catch-up coefficient

Dynamic quantile regression model

- Test the assumption of constant catch-up along the entire distribution of outcomes

Use estimation strategies that address endogeneity bias in the lagged dependent variable

Data

Young Lives Study - 2002, 2006, and 2009

Four countries - India, Ethiopia, Peru, Vietnam

Panel study that follows two cohorts of children

- Younger Cohort - children between 6 and 18 months
- Older Cohort - children between 7.5 and 8.5 years

Analysis sample - Younger cohort - three waves of the panel

Attrition rate - 10%

Summary statistics on HAZ

Table: Summary statistics - Pooled sample

Years	% HAZ <-2	Mean	Mean difference
2002	31.18	-1.40	-0.09*** (2006-2002)
		(0.01)	(0.02)
2006	31.09	-1.49	0.26*** (2009-2006)
		(0.01)	(0.17)
2009	22.43	-1.23	0.17*** (2009-2002)
		(0.01)	(0.02)

Summary statistics on HAZ

Table: Summary statistics - Ethiopia

Years	% HAZ <-2	Mean	Mean difference
2002	46.36	-1.81	0.33*** (2006-2002)
		(0.03)	(0.04)
2006	31.19	-1.48	0.25*** (2009-2006)
		(0.02)	(0.03)
2009	21.00	-1.22	0.60*** (2009-2002)
		(0.02)	(0.04)

Summary statistics on HAZ

Table: Summary statistics - India

Years	% HAZ <-2	Mean	Mean difference
2002	30.16	-1.35	-0.30*** (2006-2002)
		(0.03)	(0.04)
2006	35.57	-1.65	0.19*** (2009-2006)
		(0.02)	(0.03)
2009	29.20	-1.45	-0.10*** (2009-2002)
		(0.02)	(0.04)

Summary statistics on HAZ

Table: Summary statistics - Peru

Years	% HAZ <-2	Mean	Mean difference
2002	27.47	-1.32	-0.20*** (2006-2002)
		(0.02)	(0.03)
2006	32.66	-1.53	0.38*** (2009-2006)
		(0.02)	(0.03)
2009	20.05	-1.15	0.18*** (2009-2002)
		(0.02)	(0.03)

Summary statistics on HAZ

Table: Summary statistics - Vietnam

Years	% HAZ <-2	Mean	Mean difference
2002	21.44	-1.13	-0.20*** (2006-2002)
		(0.02)	(0.03)
2006	24.60	-1.33	0.23*** (2009-2006)
		(0.02)	(0.03)
2009	19.46	-1.10	0.04 (2009-2002)
		(0.02)	(0.03)

Empirical Specification

Dynamic linear panel data model:

$$HAZ_{it} = \beta_0 + \beta_1 HAZ_{it-1} + \sum_{j=1}^{R} \beta_j^X X_{jit} + \sum_{j=1}^{S} \beta_j^Z Z_{ji} + \epsilon_i + \epsilon_{it}$$

β_1 - catch-up coefficient

demographic and socioeconomic controls - lag age in months, lag age in months*male dummy, asset index, and rural dummy

community level time-varying (limited) controls - Electricity, Hospital, Price of deworming pills, Price of sugar, and Price of oil. All specifications estimated with these limited controls

standard errors clustered at the community level

Dynamic linear panel data model

OLS: omitted variables bias + measurement error bias

FD-OLS: magnifies measurement error bias

Arellano-Bond: addresses both measurement error bias + omitted variables bias, assumes errors in the levels equation to be serially uncorrelated. IVs - two-period lagged HAZ and two-period lagged WAZ

FD-GMM: addresses both measurement error bias + omitted variables bias without relying on the assumption of no serial correlation in the levels residuals. IVs - two-period lagged WAZ, two-period lagged values of all community level time-varying factors

Dynamic linear panel data model

Table: **Catch-up coefficient**

	(1) Ethiopia	(2) India	(3) Peru	(4) Vietnam
FD-OLS	-0.15***	-0.082***	-0.26***	-0.03
	(0.017)	(0.023)	(0.019)	(0.027)
Arellano-Bond	0.018	0.044**	-0.013	0.32***
	(0.02)	(0.022)	(0.032)	(0.08)
FD-GMM	0.05	0.08*	-0.026	0.18***
	(0.05)	(0.05)	(0.06)	(0.06)
Community level time-varying characteristics	Yes	Yes	Yes	Yes
Individual level time-varying characteristics	Yes	Yes	Yes	Yes
First-stage F-statistic FD-GMM	28.43	31.19	18.97	43.39

Empirical Specification

Dynamic quantile regression model:

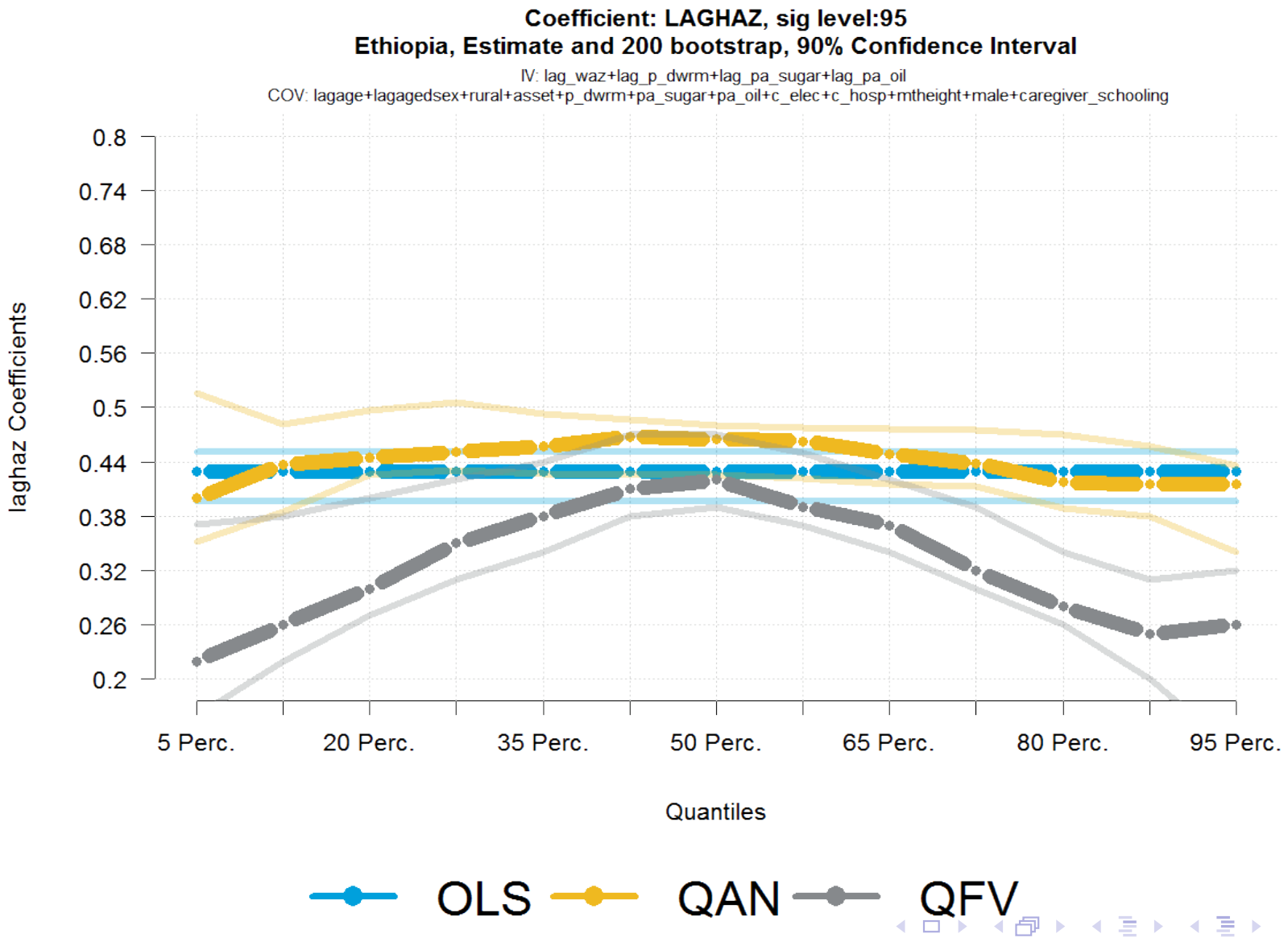
$$Q(\tau)_{HAZ_i t} = \beta_0(\tau) + \beta_1(\tau) HAZ_{it-1} + \sum_{j=1}^{R} \beta_j^X(\tau) X_{jit} + \sum_{j=1}^{S} \beta_j^Z(\tau) Z_{ji} + \epsilon_{it}$$

β_1 - catch-up coefficient

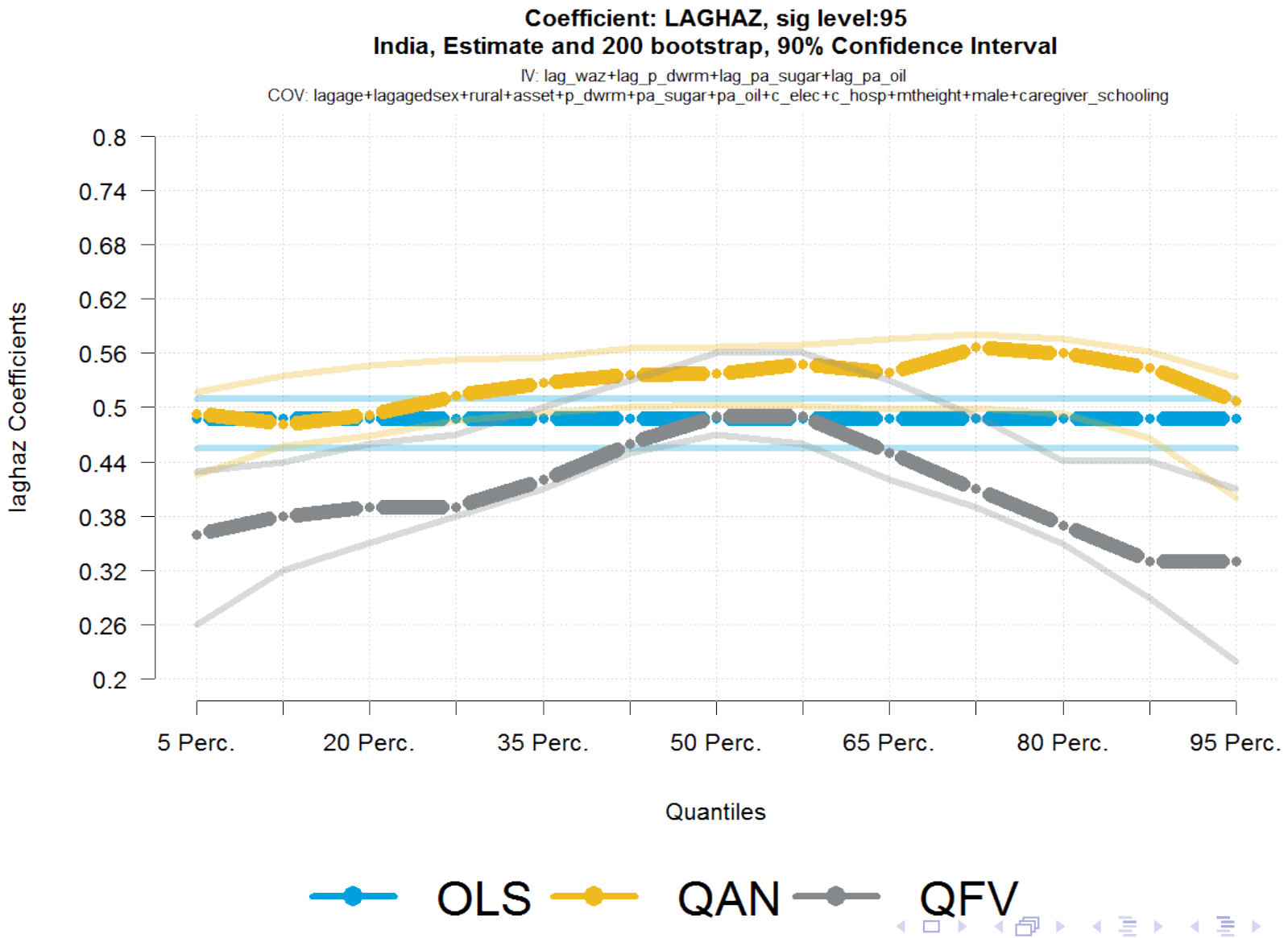
equations are estimated separately for each country

preferred estimates - QRFEIV (Quantile regression fixed-effects instrument variable approach)

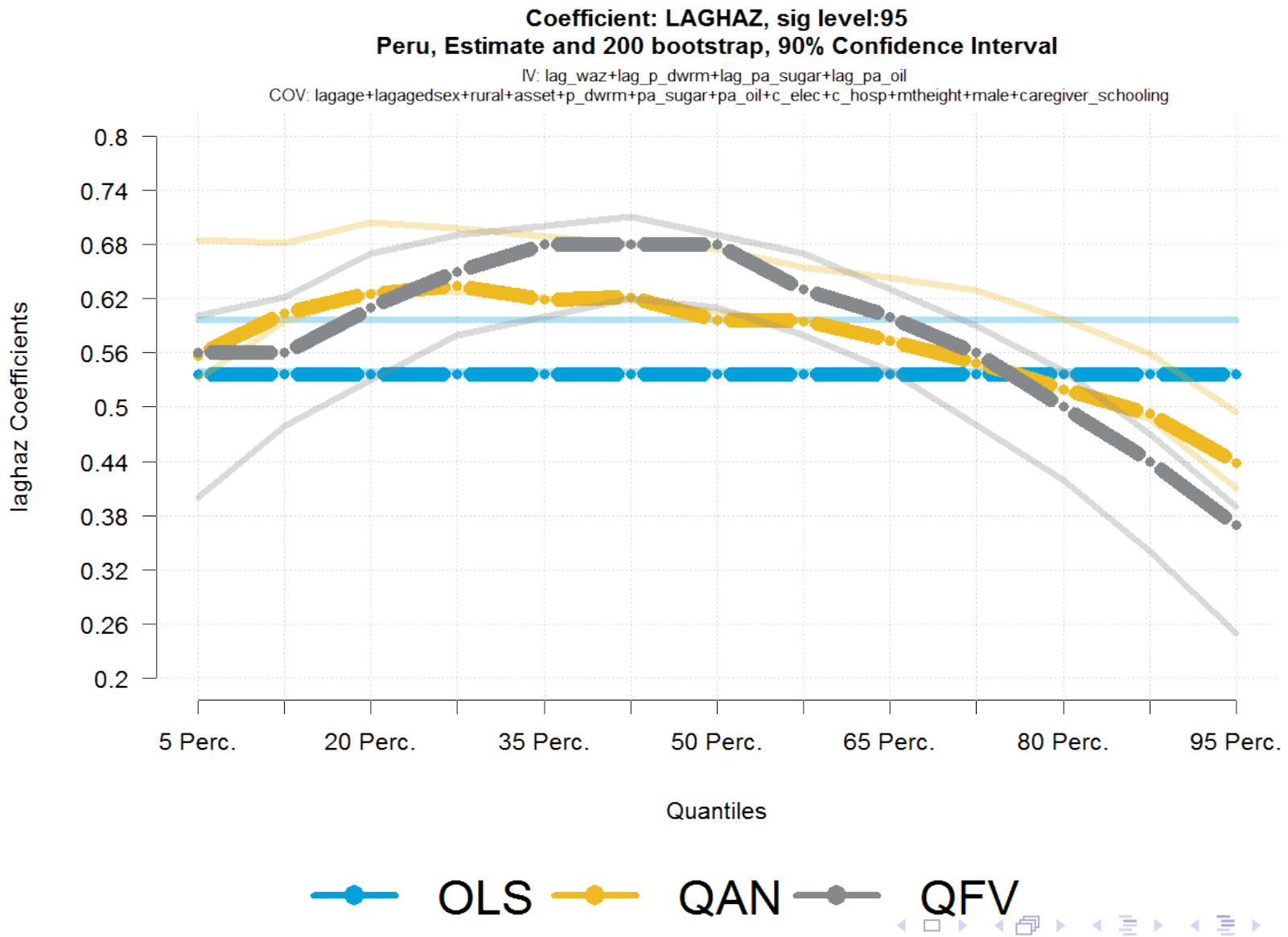
Ethiopia, Lag HAZ Coefficient, 13 Quantiles



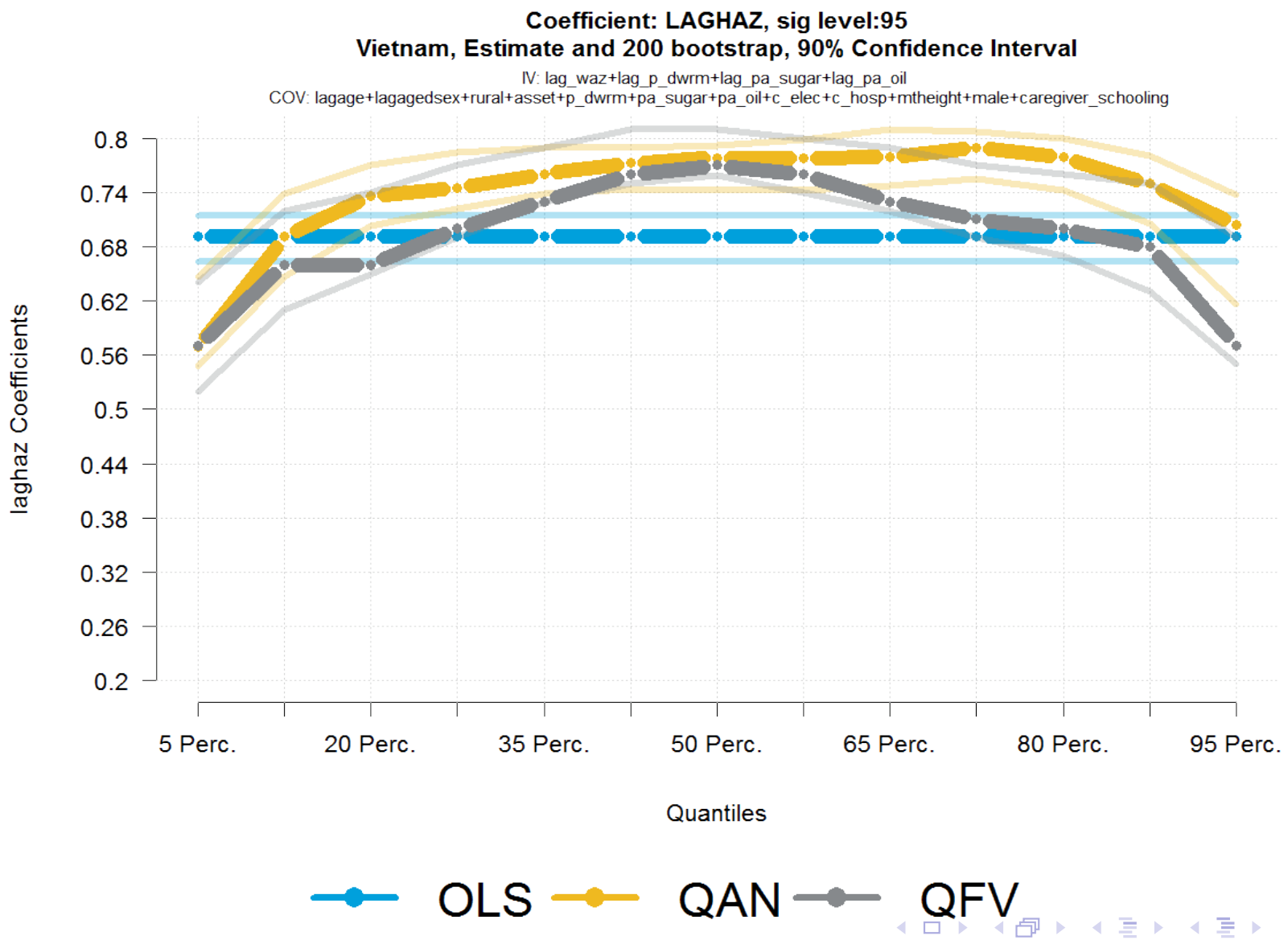
India, Lag HAZ Coefficient, 13 Quantiles



Peru, Lag HAZ Coefficient, 13 Quantiles



Vietnam, Lag HAZ Coefficient, 13 Quantiles



Lag HAZ coefficient from Dynamic QR IV FE (5 Quantiles)

	10%	25%	50%	75%	90%
Ethiopia	0.26	0.38	0.4	0.36	0.27
95% CI	(0.24,0.39)	(0.34,0.46)	(0.38,0.46)	(0.33,0.42)	(0.21,0.33)
India	0.41	0.41	0.48	0.49	0.37
95% CI	(0.33,0.46)	(0.41,0.51)	(0.46,0.54)	(0.42,0.54)	(0.3,0.46)
Peru	0.58	0.66	0.66	0.59	0.43
95% CI	(0.5,0.63)	(0.6,0.71)	(0.61,0.69)	(0.5,0.62)	(0.34,0.46)
Vietnam	0.64	0.71	0.75	0.75	0.66
95% CI	(0.59,0.71)	(0.7,0.78)	(0.75,0.81)	(0.72,0.79)	(0.63,0.75)

- Inverted U-shape catch-up process along the distribution of outcomes
- Reject the null of constant catch-up
- History matters, but one can reject the null of perfect path dependence among children in the bottom quantiles of the outcome distribution

Robustness

No selective attrition

Results are robust to the choice of controls

Discussion

Dynamic linear panel data models:

- Catch-up effect: between 0 and one-fourth
- Ethiopia: 0.05 (full); India: 0.08 (partial); Peru: -0.02 (full); Vietnam: 0.18 (partial)

Dynamic quantile regression models:

- Inverted U-shape catch-up process along the distribution of outcomes
- Reject the null of constant catch-up
- Catch-up is greatest among those at the bottom quantile
- History matters, but only a little for those at the bottom most quantile of the outcome distribution

Thank You!