Weather shocks and child health: Evidence from the Life in Kyrgyzstan Study

work in progress

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Fourth Annual "Life in Kyrgyzstan" Conference

17-18 October 2018, Bishkek

@LiK_Study

Research questions

- What are the determinants of child health?
- How does child health respond to exogenous shocks such as cold, heat, drought and flood?
- What role does nutrition play?

Existing literature I

Weather shocks and child health

- Drought (Kubik & Maurel 2016, Hoddinott & Kinsey 2001);
- Famine (Aswaf 2016);
- Harsh winters (Groppo & Kraehnert 2016);
- Flood (Foster 1995).

Existing literature III

Cross-sectional studies

- Maternal education and time, parental health, intrahousehold allocation, forced marriage;
- Household income and expenditures, public health services, food prices and local infrastructure;
- Early childhood interventions, complementary feeding, conditional cash transfer programmes;
- References: Becker et al. (2017), Alderman & Headey (2017), Leroy et al. (2009), Kamiya (2011), Sahn (1994), Duflo (2003), Rosenzweig & Schultz (1982), Glick & Sahn (1998), Alderman et al. (2003), Thomas et al. (1996), Thomas & Strauss (1992), Nores & Barnett (2010), Imdad et al. (2011).

Existing literature II

Panel studies

- Maternal education, parental height, alcohol use;
- Household expenditures and income, paternal employment status;
- Prenatal nutrition;
- Local infrastructure, gender preference for children;
- References: Kosec & Holtemeier (2018), Palloni (2017), Mani (2014), Fedorov & Sahn (2005), Jensen & Richter (2001).

Contributions

1

Our study contributes to the literature on the impact of weather shocks on child health.

2

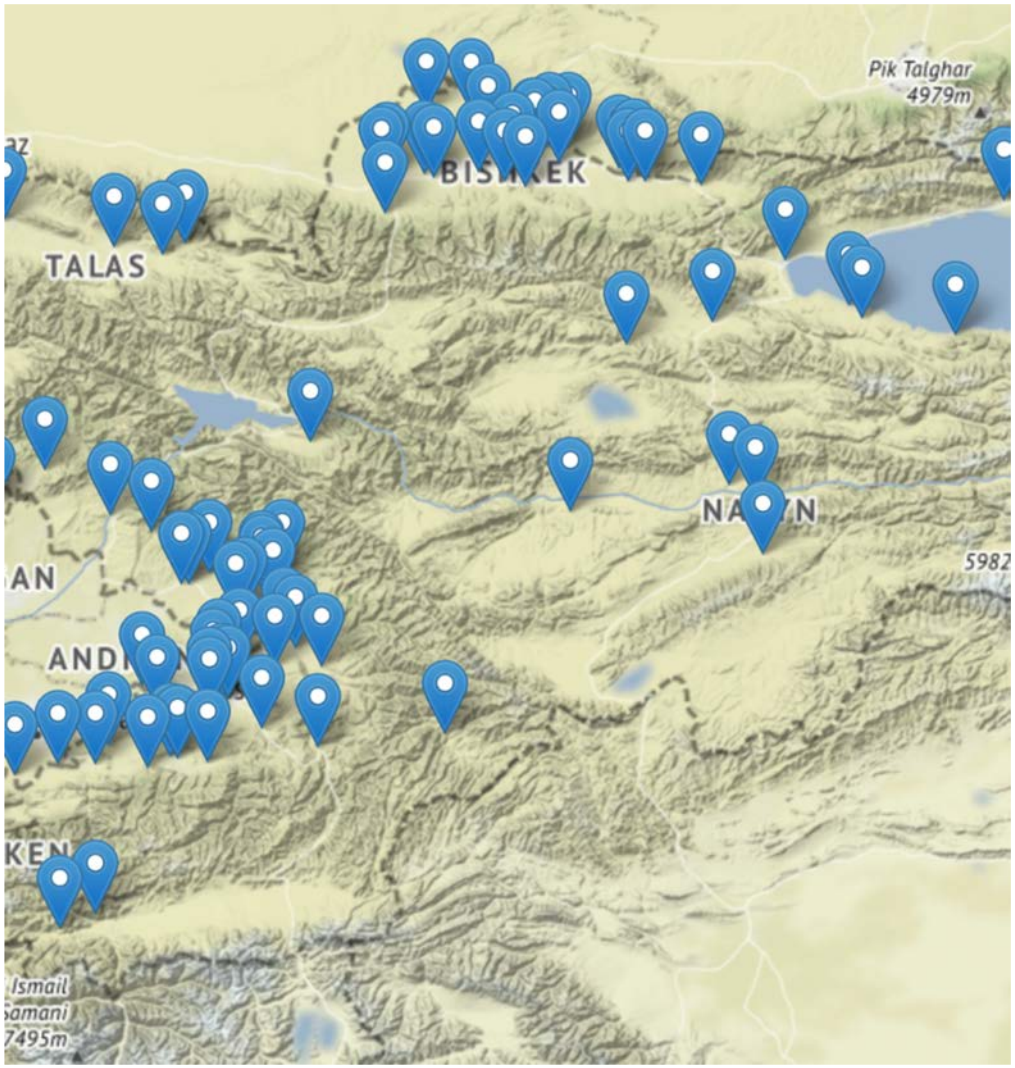
Especially in a fragile context and in a rarely studied region.

3

Because of the panel data, we are able to identify long-term impacts and control for unobservable characteristics fixed in time.

Life in Kyrgyzstan study (2010-2016)

- Nationally representative data from 3,000 households and 90 urban and rural communities (Brück et al. 2014);
- Panel data with low attrition;
- In our analysis, we follow 2,178 children under age of 5 from 1,294 two-parent households;
- The data were collected at the end of each year (October-December).

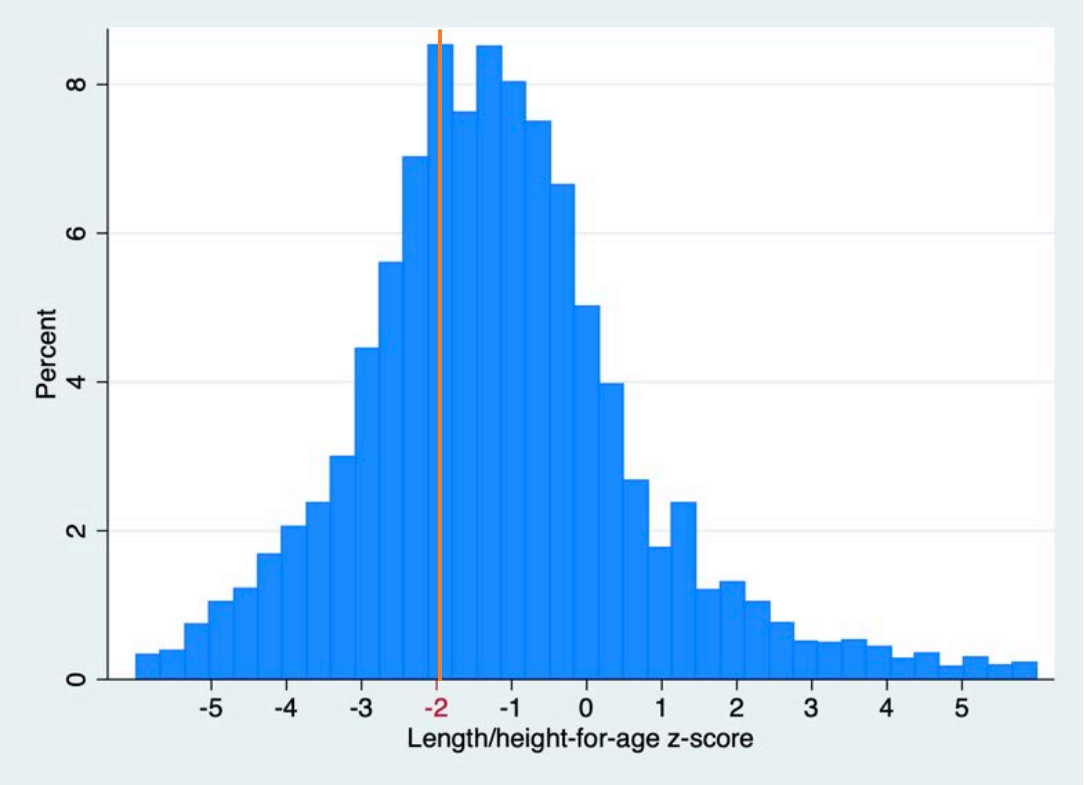


Stunting

- We use an indicator HAZ (height-for-age z-score) for boys and girls aged 0-60 months.
- Height measures long-term growth performance more specifically than weight, which may vary on a daily/weekly basis.
- Height is relatively easy to measure during autumn-winter seasons (when data were collected), so we expect low measurement error.

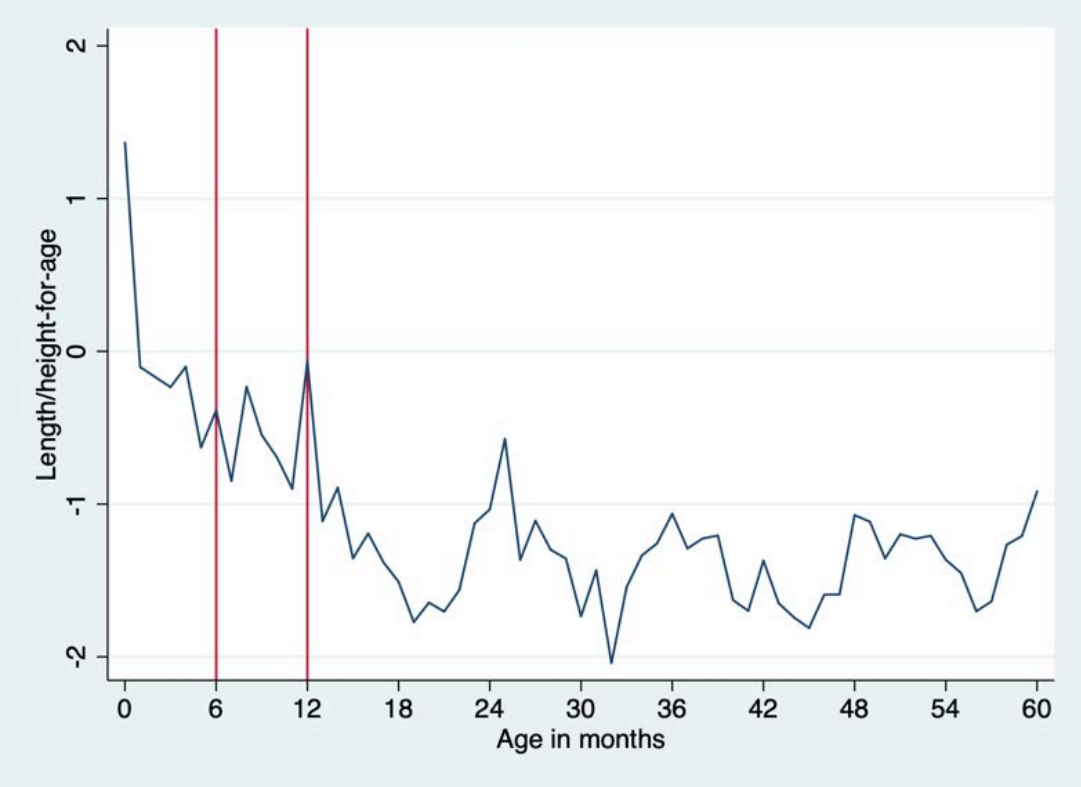
Stunting: distributions of z-scores

- We compare height-for-age z-scores in Kyrgyzstan with ”healthy” reference population (WHO);
- Part of the distribution which lies to the left of “-2” SDs is defined as stunted.



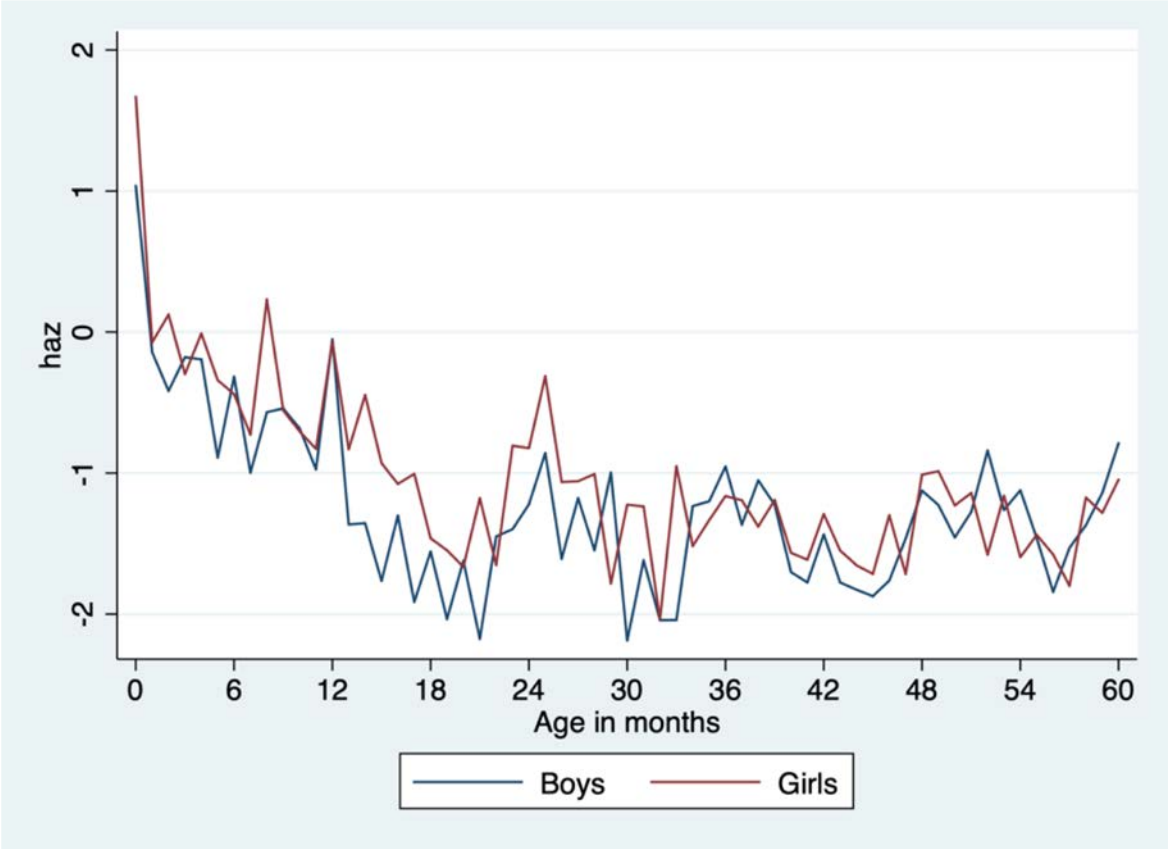
HAZ growth chart

- There is a steep decline in the first months after birth;
- Existing literature suggests that the decline usually starts after breastfeeding period (from 6 or 12 months on);
- In our sample, more than 90% of children are breastfed for 6 months or longer;
- So what does explain this immediate decline?



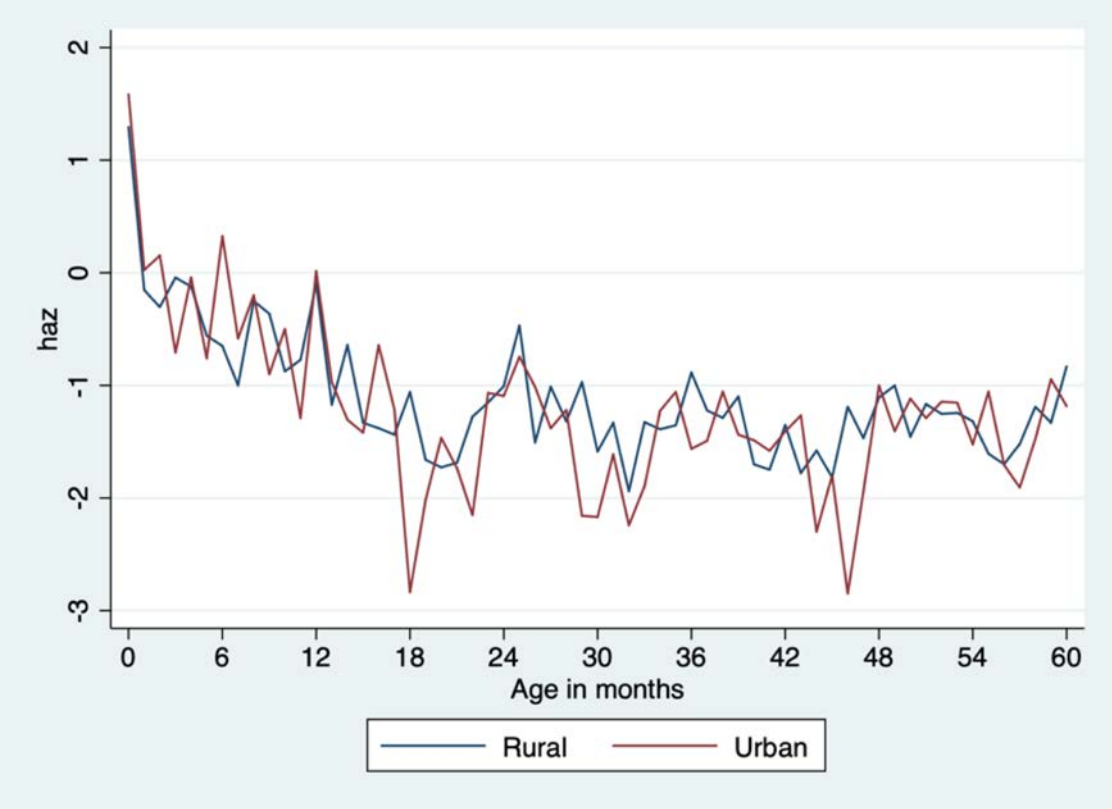
Girls vs. boys

	Girls	Boys
Moderately stunted (<-2SD)	30% (830)	34% (964)
Severely stunted (<-3SD)	12% (339)	15% (426)



Rural vs. urban

	Rural	Urban
Moderately stunted (<-2SD)	32% (1,252)	32% (542)
Severely stunted (<-3SD)	14% (552)	13% (213)



Weather/climate data

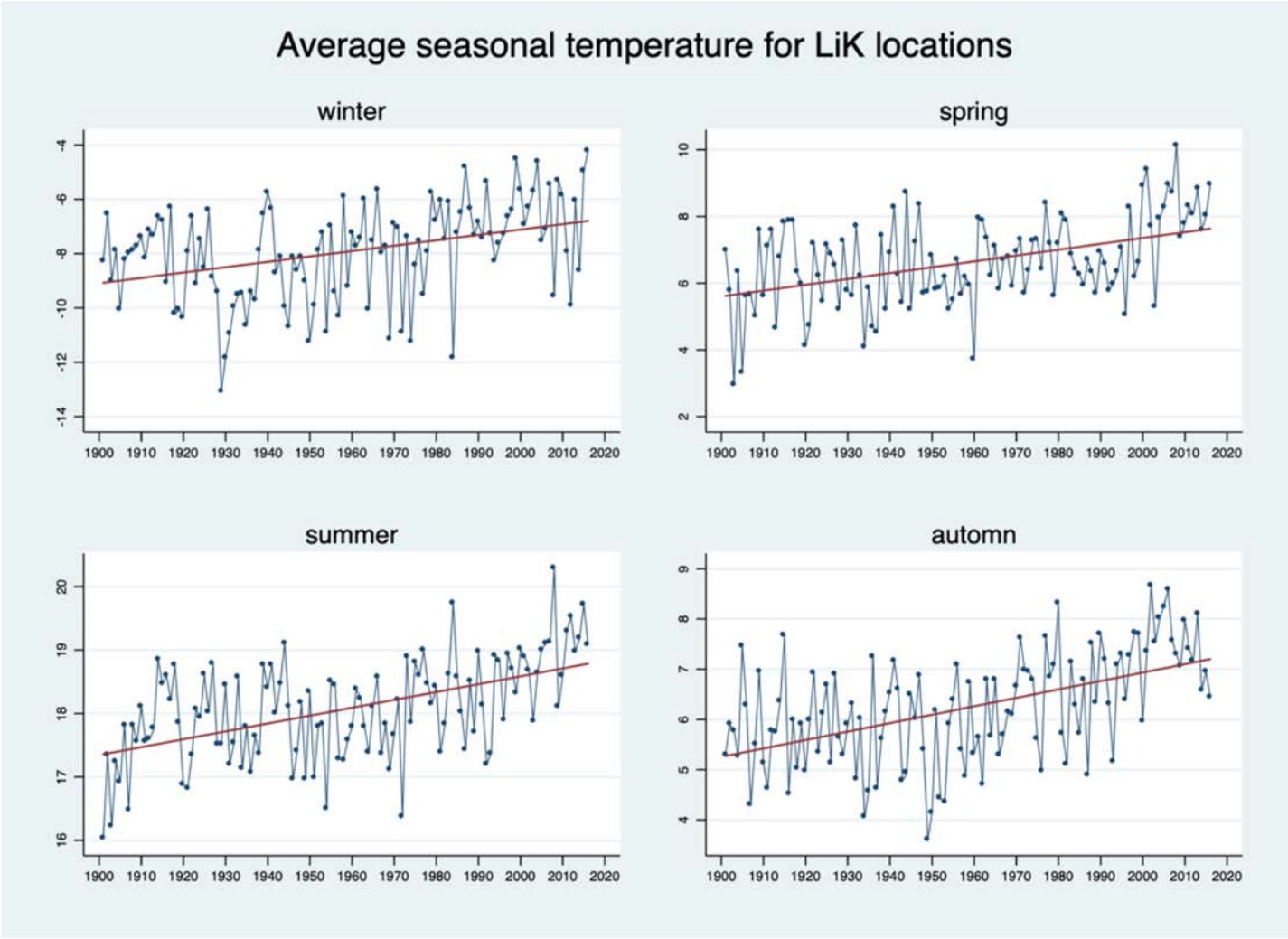
- CRUTS dataset 4.0 from University of East Anglia, covering years 1901-2016;
- Contains monthly data on temperature and precipitation with 0.5 km grid (from stations extrapolated in the neighboring locations, taking into account altitude);
- We merge these data with latitude and longitude coordinates of LiK (90 coordinates/PSUs);
- Some papers claim that the last 30 years of data are more precise but we currently use all data (esp. to calculate cumulative shocks).

Same year shocks

- Average monthly temperature and total precipitation the same year as the survey (2010-2016);
- We average these data by season for each LiK location.

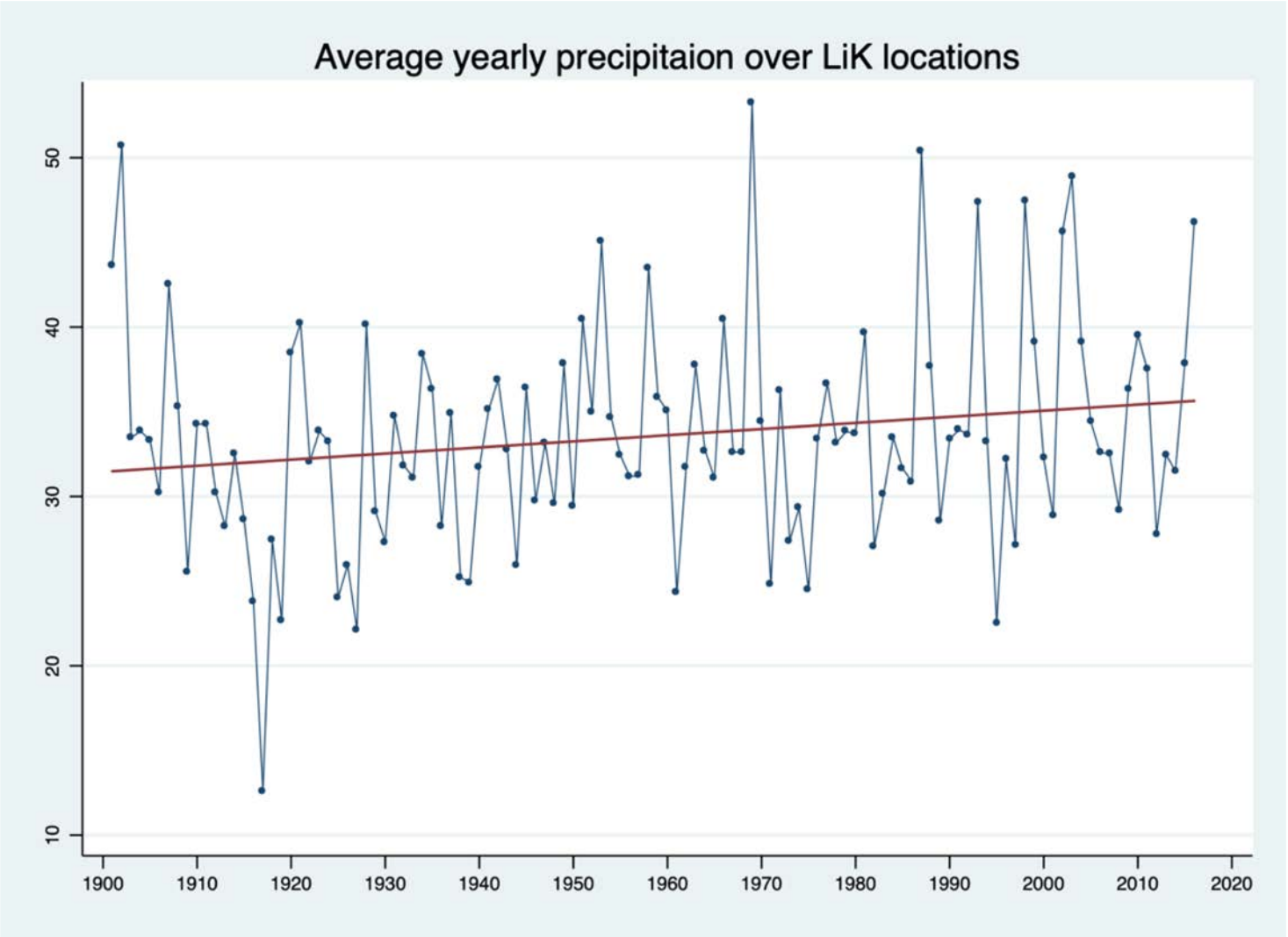
Temperature rises

- There has a been an increase in temperature by XX C°



Precipitation slightly increases

(particularly in the North of the country)



Temperature

- Child fixed effects regression;
- Interview date dummies, age and age-squared are included but not reported.

Control variables	Height-for-age z score
Avg spring temperature	0.040
	(0.116)
Avg summer temperature	0.022
	(0.153)
Avg autumn temperature	-0.524***
	(0.090)
Avg winter temperature	0.050*
	(0.030)
Household size	0.052
	(0.033)
Ln of size of land	-0.003
	(0.012)
Mother's age, years	0.010
	(0.012)
Dummy - if father is a labour migrant	-0.038
	(0.141)
Dummy - bottom quintile	0.108
	(0.084)
Regional CPI	0.036***
	(0.012)
Observations	5,370
R-squared	0.225
Number of ids	2,742

Precipitation

- Child fixed effects regression;
- Interview date dummies, age and age-squared are included but not reported.

Control variables	Height-for-age z score
Total spring precipitation	0.006***
	(0.001)
Total summer precipitation	-0.009***
	(0.003)
Total autumn precipitation	0.003***
	(0.001)
Total winter precipitation	-0.007***
	(0.002)
Household size	0.057*
	(0.033)
Ln of size of land	-0.010
	(0.012)
Mother's age, years	0.011
	(0.012)
Dummy - if father is a labour migrant	-0.038
	(0.140)
Dummy - bottom quintile	0.118
	(0.084)
Regional CPI	0.036***
	(0.011)
Observations	5,402
R-squared	0.225
Number of ids	2,762

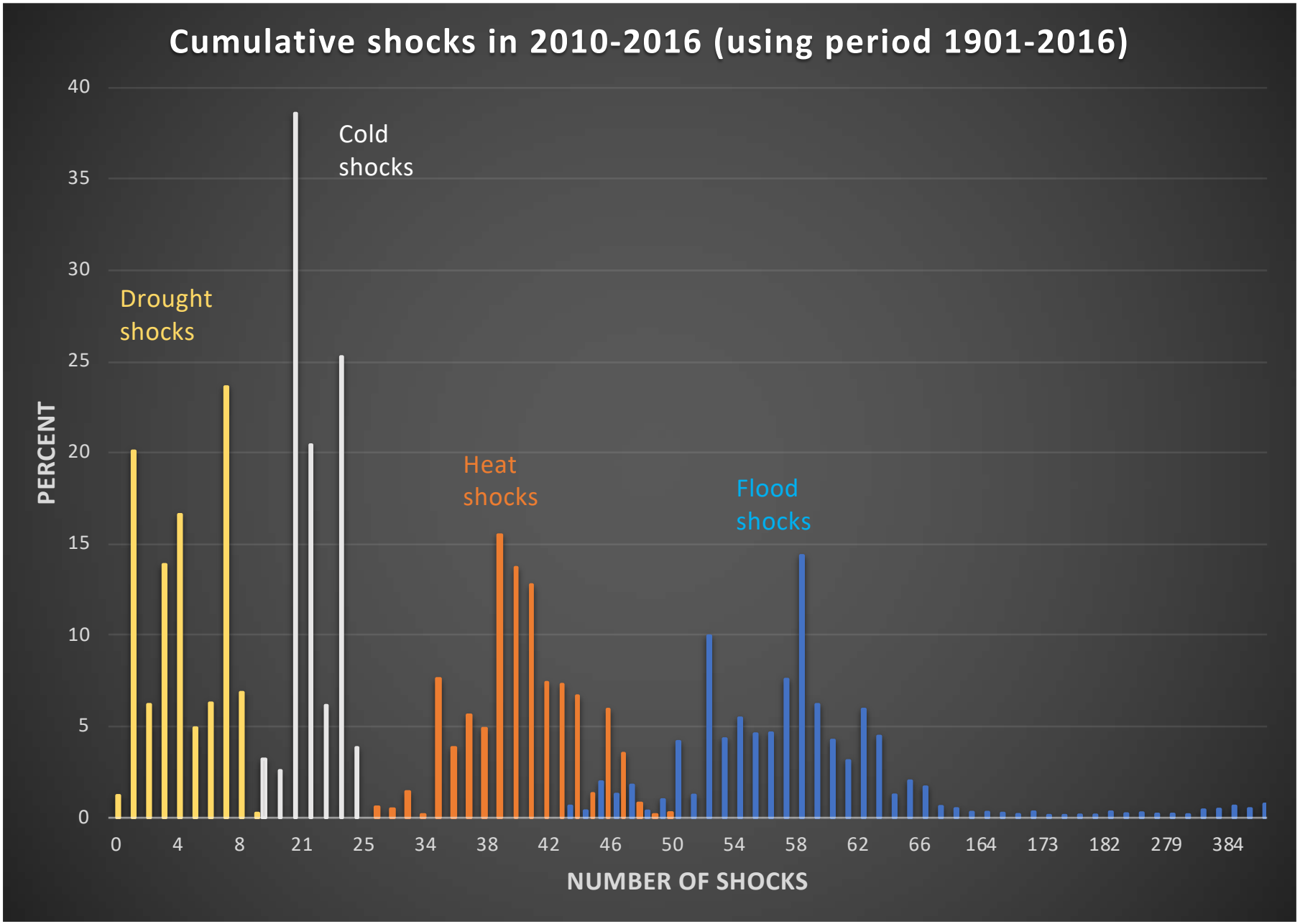
Cumulative shocks (anomalies)

- Defined as community-level cumulative events between 1901 and 2016,

which are:

- two standard deviations above (for heat) or below (for cold) the historical mean temperature, and
- two standard deviations above (for floods) or below (for droughts) the historical mean precipitation

for the corresponding community.


Cumulative shocks in 2010-2016 (using period 1901-2016)
PERCENT
40
35
30
25
20
15
10
5
0
Drought shocks
Cold shocks
Heat shocks
Flood shocks
0
4
8
21
25
34
38
42
46
50
54
58
62
66
164
173
182
279
384
NUMBER OF SHOCKS

Cumulative shocks

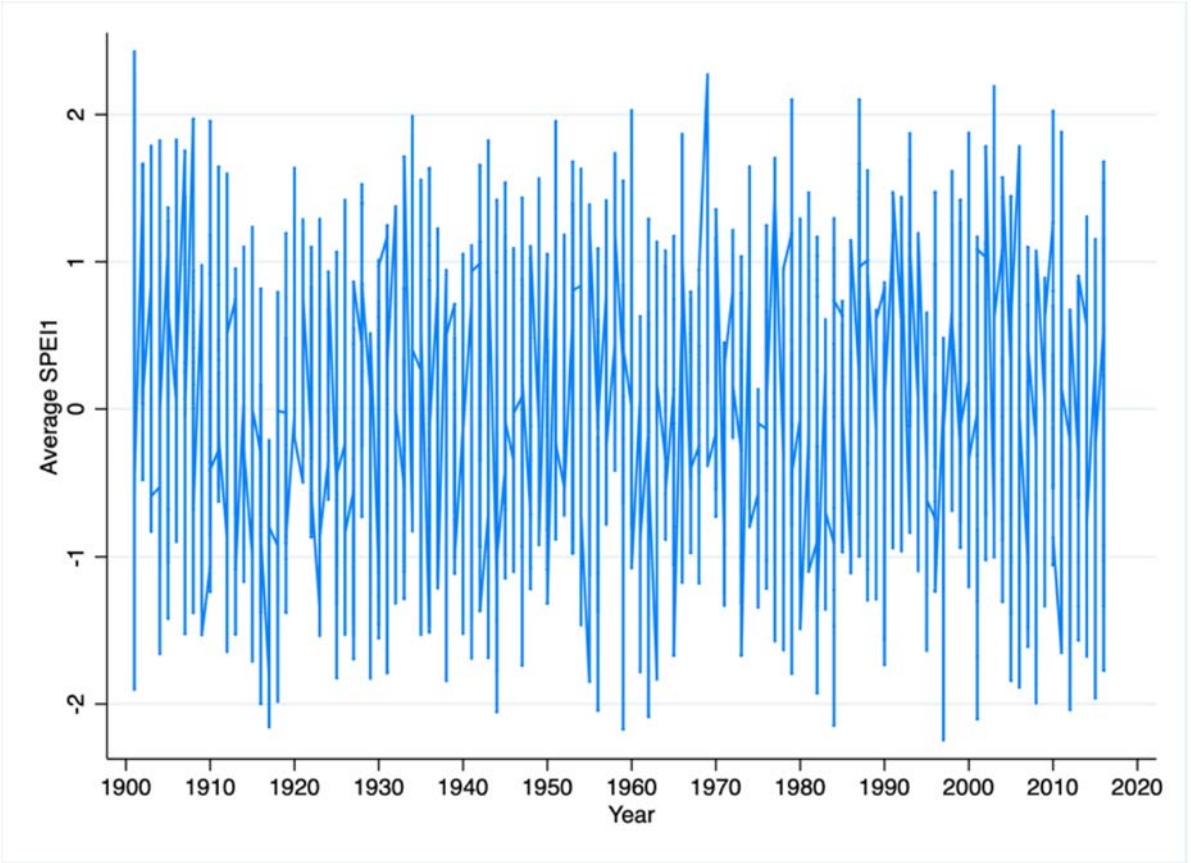
- Child fixed effects regression;
- Interview date dummies, age and age-squared are included but not reported.

Control variables	Height-for-age z score			
Cold	0.088			
	(0.284)			
Heat		-0.122*		
		(0.064)		
Drought			2.063***	
			(0.703)	
Flood				0.086***
				(0.033)
Household size	0.055	0.056*	0.052	0.050
	(0.033)	(0.033)	(0.033)	(0.033)
Ln of size of land	-0.016	-0.014	-0.016	-0.016
	(0.012)	(0.012)	(0.012)	(0.012)
Mother's age, years	0.015	0.016	0.010	0.013
	(0.012)	(0.012)	(0.012)	(0.012)
Dummy - if father is a labour migrant	-0.037	-0.035	-0.035	-0.037
	(0.142)	(0.142)	(0.142)	(0.142)
Dummy - bottom quintile	0.105	0.117	0.099	0.105
	(0.085)	(0.085)	(0.084)	(0.085)
Regional CPI	0.038***	0.044***	0.034***	0.040***
	(0.011)	(0.011)	(0.011)	(0.011)
Observations	5,370	5,370	5,370	5,370
R-squared	0.211	0.212	0.214	0.213
Number of ids	2,742	2,742	2,742	2,742

SPEI index

- Precipitation and temperature both contribute to the extreme weather events;
- Standard precipitation-evapotranspiration index, which captures both temperature and precipitation (Vicente-Serrano et al. 2010);
- Effective in measuring the risks of droughts;
- Increased evaporation -> reduced soil moisture (especially in summer) -> amplifying risk of drought;
- Could be measured as monthly average (spei1) or cumulative (3, 6, 12, 24 etc. scale);
- Index ranges from -5 (high degree of drought) to +5 (high degree of moisture).

- Monthly SPEI 1 index for the period 1901-2016;
- Average over LiK locations;
- The number of “negative events” (SPEI<0) has been increasing for the past 20 years;
- Research suggests that Kyrgyzstan will experience more risks of drought in the future due to climate change.



SPEI

- Average annual SPEI index;
- SPEI 3, SPEI 6 and SPEI 12 accumulate previous periods of 3, 6 and 12 months -> cumulative index;
- Child fixed effects regression;
- Interview date dummies, age and age-squared are included but not reported.

Control variables	Height-for-age z score			
SPEI1	0.165*			
	(0.088)			
SPEI3		0.144***		
		(0.054)		
SPEI6			0.153***	
			(0.044)	
SPEI12				0.167***
				(0.040)
Household size	0.058*	0.060*	0.060*	0.063*
	(0.033)	(0.033)	(0.033)	(0.033)
Ln of size of land	-0.017	-0.016	-0.017	-0.015
	(0.012)	(0.012)	(0.012)	(0.012)
Mother's age, years	0.014	0.014	0.013	0.013
	(0.012)	(0.012)	(0.012)	(0.012)
Dummy - if father is a labour migrant	-0.041	-0.044	-0.049	-0.048
	(0.142)	(0.142)	(0.142)	(0.142)
Dummy - bottom quintile	0.096	0.095	0.097	0.099
	(0.085)	(0.085)	(0.084)	(0.084)
Regional CPI	0.045***	0.047***	0.047***	0.048***
	(0.011)	(0.011)	(0.011)	(0.011)
Observations	5,370	5,370	5,370	5,370
R-squared	0.212	0.213	0.215	0.216
Number of IDs	2,742	2,742	2,742	2,742

Is nutrition a mechanism?

- Existing research stresses the importance of consumption of healthy food in the first years of life after a child is introduced to solid foods;
- We construct general household dietary diversity index and healthy household dietary diversity index;
- Based on survey questions:
  - In the last 12 months, how much money (on average) did your household spend on the following food items?
  - How much of a particular food item did your household consume from own production in the last 12 months?

Household dietary diversity index

General HDDI

- Cereals
- Roots and tubers
- Vegetables
- Fruits
- Meat
- Eggs
- Fish
- Milk and milk products
- Cheese
- Oil
- Butter
- Sugar/honey

Healthy HDDI

- Vegetables
- Fruits
- Meat
- Eggs
- Fish

Dietary diversity and same year temperature

- Poisson household fixed effects regression;
- Interview date dummies are included but not reported.

	(1)	(2)	(3)	(4)
Control variables	**HDDI**	**HHDDI**	**HDDI**	**HHDDI**
Min spring temperature	0.026***	0.037***		
	(0.007)	(0.011)		
Min summer temperature	-0.030	-0.048		
	(0.021)	(0.032)		
Min autumn temperature	0.010	0.013		
	(0.016)	(0.023)		
Min winter temperature	0.012*	0.016		
	(0.007)	(0.010)		
Avg spring temperature			0.027	0.048
			(0.025)	(0.037)
Avg summer temperature			-0.049	-0.071
			(0.036)	(0.053)
Avg autumn temperature			0.026	0.038
			(0.019)	(0.029)
Avg winter temperature			0.025***	0.035***
			(0.007)	(0.010)
bottom quintile dummy	-0.041*	-0.078**	-0.043**	-0.082**
	(0.022)	(0.033)	(0.022)	(0.033)
Regional CPI	0.001	0.001	0.001	0.001
	(0.001)	(0.002)	(0.001)	(0.002)
Observations	4,584	4,551	4,584	4,551
Number of ids	1,671	1,667	1,671	1,667

Dietary diversity and same year precipitation

- Poisson household fixed effects regression;
- Interview date dummies are included but not reported.

	(1)	(2)	(3)	(4)
Control variables	**HDDI**	**healthy HDDI**	**HDDI**	**healthy HDDI**
Total spring precipitation	-0.000	-0.000		
	(0.000)	(0.000)		
Total summer precipitation	0.002***	0.004***		
	(0.001)	(0.001)		
Total autumn precipitation	0.000	-0.000		
	(0.000)	(0.000)		
Total winter precipitation	-0.000	-0.000		
	(0.000)	(0.001)		
Avg spring precipitation			-0.000	-0.001
			(0.001)	(0.001)
Avg summer precipitation			0.007***	0.012***
			(0.002)	(0.003)
Avg autumn precipitation			0.001	-0.000
			(0.001)	(0.001)
Avg winter precipitation			0.000	-0.001
			(0.001)	(0.002)
Dummy - bottom quintile	-0.043**	-0.083**	-0.041*	-0.080**
	(0.022)	(0.033)	(0.022)	(0.033)
Regional CPI	-0.003**	-0.005***	-0.003**	-0.004**
	(0.001)	(0.002)	(0.001)	(0.002)
Observations	4,614	4,581	4,584	4,551
Number of ids	1,684	1,680	1,671	1,667

Dietary diversity and child health

- 2SLS child fixed effects regressions;
- Instruments: same year temperature and precipitation;
- Interview date dummies are included but not reported.

	(1)	(2)
Control variables	**Height-for-age z score**	
Household dietary diversity index	-0.037	
	(0.055)	
Healthy household dietary diversity index		-0.103
		(0.085)
Age in months	-0.099***	-0.097***
	(0.009)	(0.009)
Age in months squared	0.001***	0.001***
	(0.000)	(0.000)
Household size	0.052	0.058*
	(0.033)	(0.034)
Ln of size of land	-0.014	-0.014
	(0.012)	(0.012)
Mother's age, years	0.014	0.013
	(0.012)	(0.012)
Dummy - if father is a labour migrant	-0.030	-0.041
	(0.142)	(0.143)
Dummy - bottom quintile	0.108	0.094
	(0.087)	(0.089)
Regional CPI	0.033***	0.030**
	(0.012)	(0.012)
Observations	5,334	5,305
Number of idpp	2,738	2,738

Conclusions

- While cross-sectional studies find impact of parental characteristics on child growth (maternal education, parental height), we do not find them using pooled cross-sectional data.
- We do not find strong impacts of household income variables on stunting, either (in contrast to previous research).
- Weather-related shocks are important in explaining high stunting rates and nutrition choices in Kyrgyzstan.
- It is difficult to measure the nutrition of children with household nutrition variables -> more precise variables are needed.

With many thanks

- to my coauthor Anastasia Aladysheva
- to our many LiK collaborators

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