

# The Effects of Income Fluctuations on Rural Health and Nutrition

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# Research Question

**How do household income fluctuations in Kyrgyzstan affect health and nutrition outcomes, and how do these effects vary by gender and across the life cycle?**

- Primary outcomes: health and nutrition outcomes for young children (age 1–5), older children and adolescents (5–18), and adults (age 18+)
- Secondary outcomes (to analyze mechanisms): consumption, dietary diversity, health expenditures, and fertility decisions

## Preview of the results

Declines in household income:

- Reduce the heights and weights of young children (age 1–5)—particularly girls
- Lower BMI among older children and adolescents (age 5–18)
- Reduce BMI, and incidence of overweight among adults (both youth age 18–35 and those age 35+)

Several findings hint at likely channels explaining findings; declines in household income:

- Reduce food consumption (particularly of healthy foods) and dietary diversity
- Reduce health expenditures
- Lower pregnancy rates and willingness to have additional children

# Motivation

- Understanding the impacts of income fluctuations is critical for protecting vulnerable groups:
  - The poor face a higher arrival rate of negative shocks (Currie and Stabile, 2003)
  - Poor households tend to under-insure against reductions in income (Townsend, 1994, 1995; Jalan and Ravallion, 1999; Dercon, 2002; Yang, 2008)
  - Inability to smooth consumption disproportionately affects women (Dercon and Krishnan, 2000)
- Strong correlations between income and health (Cutler et al., 2006; Adda et al., 2009; Currie, 2009; Banerjee et al., 2010; Bengtsson, 2010; Baird et al., 2011; Ebenstein et al., 2015)
- Causality challenging, motivating consideration of extreme events (droughts, blights, prolonged blackouts, war and armed conflict, recessions, financial crises, etc) or targeted cash transfer programs

# Motivation

- External validity concerns with such studies:
  - Extreme events can have behavioral impacts, such as reduced life satisfaction (Luechinger and Raschky, 2009), increased risk aversion (Cameron and Shah, 2015), and reduced aspirations for the future (Kosec and Mo, 2017), which smaller fluctuations in income do not bring about
  - Findings from cash transfer programs may not generalize to populations not targeted by such programs, or far from the cutoff for getting a program
- Raises the important question: What are the health impacts of more commonly-experienced, modest fluctuations in income?
- Also, we know little about how the impacts of income fluctuations vary by gender and across the life cycle

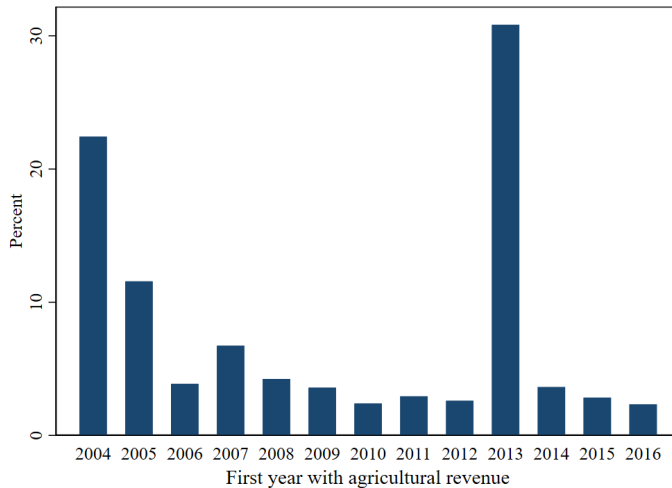
## Study Context: Kyrgyzstan

- Land-locked, mountainous, low-income (until 2014) country
- Agriculture's share in GDP 33% in 2004, but 13% in 2016 (World Bank, 2019)
- Vast majority of agricultural production occurs on small individual farms (FAO, 2015)
- Significant progress over the last two decades on child health and nutrition; e.g., stunting (height-for-age Z-scores, or HAZs, of -2 or less) affected 32.6% of children under age 5 in 1997, but only 12.9% in 2014 (40% decline over 17 years) (World Bank, 2019)
- Incidence of overweight (BMI over 25) among adults has remained consistently high—at 48.1% in 1990 and 50.8% in 2013 (Helble and Francisco, 2017)
- Universal healthcare, but informal payments for some services persist in some places, making access problematic for the poorest (Falkingham et al., 2010)

# Data

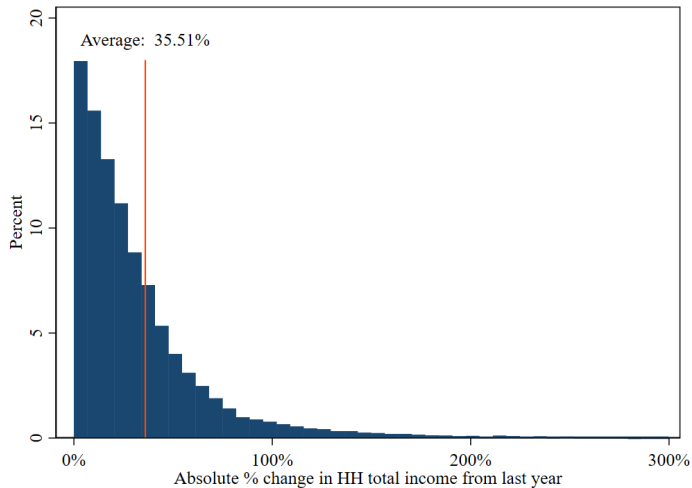
- Kyrgyzstan Integrated Household Survey (KIHS): a rotating panel spanning 2004–2016
- Outcomes:
  - Young children (age 1–5): height, height-for-age Z-score (HAZ), and stunting; weight, weight-for-age Z-score (WAZ), and weight-for-height Z-score (WHZ)
  - Older children (age 5–18): weight, height, BMI
  - Adults (age 18–35 and over 35): weight, BMI, dummy-overweight, dummy-obese
- Total income = non-ag income + agricultural incomes (crop production, livestock sales, meat products, gathering, processed food) - agricultural costs (crop production, livestock)

# Distribution of year of household entry

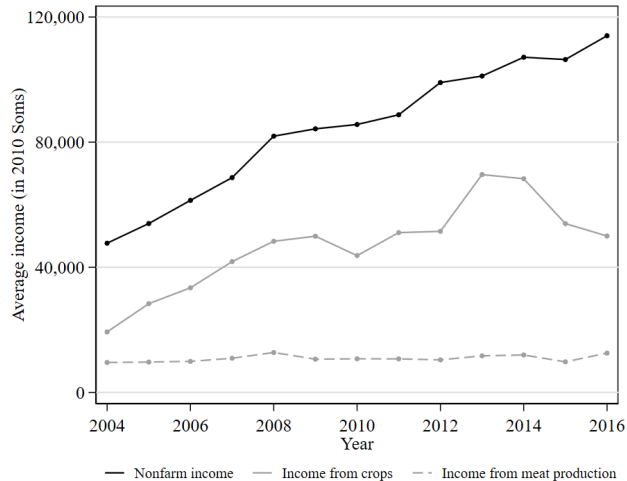




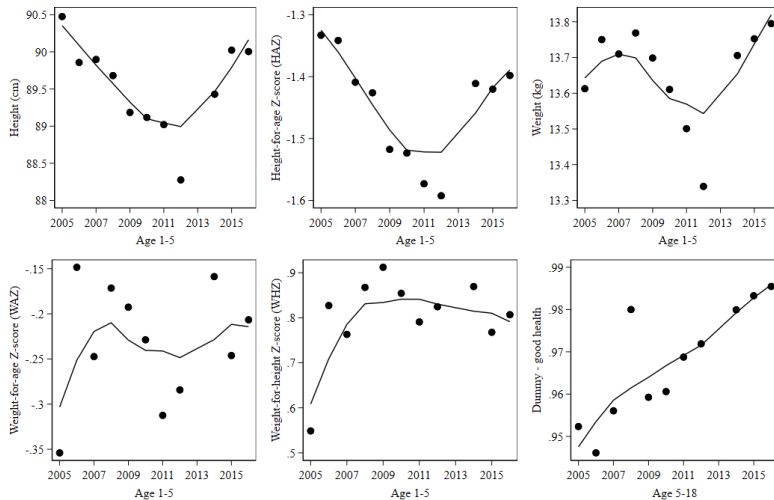
# Distribution of income fluctuations



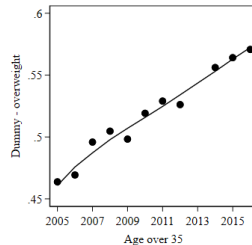
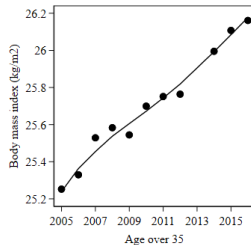
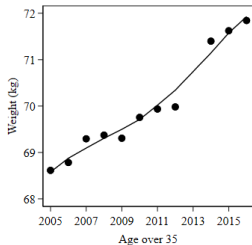
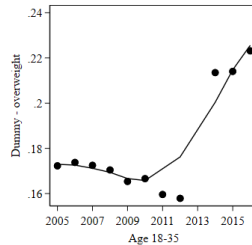
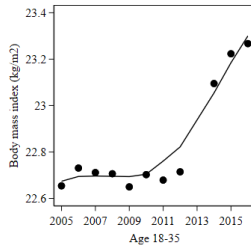
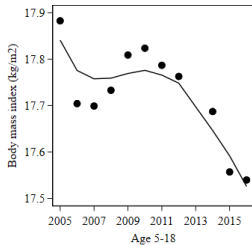
# Trends of top three income/ cost sources



# Trends of outcomes



# Trends of outcomes (con't)



# Empirical Strategy

- Use predicted total income as a Bartik instrument for total income (Bartik, 1991), computed as follows:

$$A_{j,k,t} = \sum_{r=1}^6 (\text{revenue}_{j,r,t=0} \times (1 + g_{j,k,r,t})) - \sum_{c=1}^2 (\text{cost}_{j,c,t=0} \times (1 + g_{j,k,c,t}))$$

- $j$ : HH,  $k$ : oblast  $\times$  area type (rural/urban),  $t$ : year,  $r$ : revenue source,  $c$ : cost source
- $g_{j,k,r,t}$  ( $g_{j,k,c,t}$ ): average growth rate of revenue (cost) source in oblast  $\times$  area type between initial year and year  $t$

## First and second stage equations

$$\log(H_{jkt}) = \theta_0 + \theta_1 \log(A_{jkt}) + \theta_2 \mathbf{X}_{j,k,t=0} + \theta_3 \mathbf{Y}_{ijkt} + \delta_k + \sigma_t + v_{ijkt} \quad (1)$$

$$O_{ijkt} = \pi_0 + \pi_1 \log(H_{jkt}) + \pi_2 \mathbf{X}_{j,k,t=0} + \pi_3 \mathbf{Y}_{ijkt} + \gamma_k + \eta_t + u_{ijkt} \quad (2)$$

- Basic controls: year FE, oblast FE, rural dummy, logged initial values of each income/cost component, and logged initial year total income, each also interacted with a time trend; male dummy, quadratic in age
- Full controls: Basic plus: land size, head's education category, married head, male head, head's age and squared age, dummies for HH size, # distinct goods grown/raised by HH; relation to head dummies (adults: education category, married dummy)

Table 1: First stage results

Universe:	(1) 1-5 years	(2)	(3) 5-18 years	(4)	(5) 18-35 years	(6)	(7) Over 35 years	(8)
<i>Control set</i>								
Basic control set:	X		X		X		X	
Full control set:		X		X		X		X
$\ln(\text{predicted income, } t-1)$	0.733*** (0.036)	0.678*** (0.036)	0.670*** (0.029)	0.628*** (0.029)	0.701*** (0.027)	0.648*** (0.027)	0.682*** (0.022)	0.619*** (0.022)
$R^2$	0.634	0.651	0.619	0.630	0.630	0.643	0.643	0.657
First stage F-stat	408.5	363.8	520.5	477.2	651.9	569.3	942.7	809.9
N	10,041	10,041	38,008	38,008	25,414	25,414	49,820	49,820

Notes: Standard errors are in parentheses and clustered at the household level. \*\*\* indicates  $p < 0.01$ ; \*\* indicates  $p < 0.05$ ; and \* indicates  $p < 0.10$ .

Table 2: Effects of income fluctuations on height, HAZ, and stunting of children age 1-5 OLS

	(1)	(2)	(3)	(4)	(5)	(6)
	Height (cm)		HAZ		Dummy – stunting	
Basic control set:	X		X		X	
Full control set:		X		X		X
<i>Panel A: IV estimates using income from last year</i>						
Income, $t - 1$ (logged)	0.515 (0.342)	0.650* (0.374)	0.151 (0.094)	0.187* (0.104)	-0.032 (0.035)	-0.030 (0.039)
$R^2$	0.820	0.821	0.029	0.036	0.027	0.031
First stage F-stat	408.5	363.8	408.5	363.8	408.5	363.8
N	10,041	10,041	10,041	10,041	10,041	10,041
<i>Panel B: IV estimates using income from two years ago</i>						
Income, $t - 2$ (logged)	0.600 (0.376)	0.819** (0.412)	0.191* (0.104)	0.252** (0.114)	-0.056 (0.040)	-0.061 (0.043)
$R^2$	0.826	0.827	0.033	0.039	0.031	0.035
First stage F-stat	321	277.7	321	277.7	321	277.7
N	7,191	7,191	7,191	7,191	7,191	7,191

Notes: Standard errors are in parentheses and clustered at the household level. \*\*\* indicates  $p < 0.01$ ; \*\* indicates  $p < 0.05$ ; and \* indicates  $p < 0.10$ .



**Table 3:** Effects of income fluctuations on height, HAZ, and stunting of children age 1-5, by gender

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Height (cm)			HAZ			Dummy – stunting		
	All	Girls	Boys	All	Girls	Boys	All	Girls	Boys
<i>Panel A: IV estimates using income from last year</i>									
Income, $t - 1$ (logged)	0.650*	1.092**	0.353	0.187*	0.280**	0.143	-0.030	-0.113**	0.033
	(0.374)	(0.522)	(0.495)	(0.104)	(0.142)	(0.139)	(0.039)	(0.053)	(0.053)
$R^2$	0.821	0.822	0.823	0.036	0.037	0.050	0.031	0.035	0.032
First stage F-stat	363.8	196.3	249.8	363.8	196.3	249.8	363.8	196.3	249.8
N	10,041	4,857	5,184	10,041	4,857	5,184	10,041	4,857	5,184
<i>Panel B: IV estimates using income from two years ago</i>									
Income, $t - 2$ (logged)	0.819**	1.144**	0.586	0.252**	0.304*	0.217	-0.061	-0.123*	-0.015
	(0.412)	(0.581)	(0.537)	(0.114)	(0.158)	(0.152)	(0.043)	(0.063)	(0.057)
$R^2$	0.827	0.823	0.835	0.039	0.042	0.060	0.035	0.037	0.049
First stage F-stat	277.7	162.2	192.7	277.7	162.2	192.7	277.7	162.2	192.7
N	7,191	3,486	3,705	7,191	3,486	3,705	7,191	3,486	3,705

Notes: Standard errors are in parentheses and clustered at the household level. \*\*\* indicates  $p < 0.01$ ; \*\* indicates  $p < 0.05$ ; and \* indicates  $p < 0.10$ .

Table 4: Effects of income fluctuations on weight, WAZ, and WHZ of children age 1-5 OLS

	(1)	(2)	(3)	(4)	(5)	(6)
	Weight (kg)		WAZ		WHZ	
Basic control set:	X		X		X	
Full control set:		X		X		X
<i>Panel A: IV estimates using income from last year</i>						
Income, $t - 1$ (logged)	0.362*** (0.118)	0.411*** (0.129)	0.207*** (0.067)	0.234*** (0.073)	0.174** (0.086)	0.184* (0.095)
$R^2$	0.710	0.712	0.118	0.123	0.064	0.067
First stage F-stat	408.5	363.8	408.5	363.8	408.5	363.8
N	10,041	10,041	10,041	10,041	10,041	10,041
<i>Panel B: IV estimates using income from two years ago</i>						
Income, $t - 2$ (logged)	0.383*** (0.133)	0.426*** (0.145)	0.219*** (0.075)	0.244*** (0.082)	0.169* (0.101)	0.156 (0.110)
$R^2$	0.719	0.721	0.121	0.127	0.063	0.069
First stage F-stat	321	277.7	321	277.7	321	277.7
N	7,191	7,191	7,191	7,191	7,191	7,191

Notes: Standard errors are in parentheses and clustered at the household level. \*\*\* indicates  $p < 0.01$ ; \*\* indicates  $p < 0.05$ ; and \* indicates  $p < 0.10$ .

**Table 5:** Effects of income fluctuations on weight, WAZ, and WHZ of children age 1-5, by gender

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	
	Weight (kg)		WAZ		WHZ					
	All	Girls	Boys	All	Girls	Boys	All	Girls	Boys	
<i>Panel A: IV estimates using income from last year</i>										
Income, $t - 1$ (logged)	0.411*** (0.129)	0.482*** (0.172)	0.357** (0.176)	0.234*** (0.073)	0.278*** (0.097)	0.210** (0.100)	0.184* (0.095)	0.156 (0.124)	0.198 (0.128)	
$R^2$	0.712	0.712	0.714	0.123	0.184	0.100	0.067	0.096	0.064	
First stage F-stat	363.8	196.3	249.8	363.8	196.3	249.8	363.8	196.3	249.8	
N	10,041	4,857	5,184	10,041	4,857	5,184	10,041	4,857	5,184	
<i>Panel B: IV estimates using income from two years ago</i>										
Income, $t - 2$ (logged)	0.426*** (0.145)	0.432** (0.185)	0.431** (0.203)	0.244*** (0.082)	0.245** (0.103)	0.251** (0.115)	0.156 (0.110)	0.093 (0.144)	0.210 (0.151)	
$R^2$	0.721	0.720	0.725	0.127	0.199	0.103	0.069	0.099	0.071	
First stage F-stat	277.7	162.2	192.7	277.7	162.2	192.7	277.7	162.2	192.7	
N	7,191	3,486	3,705	7,191	3,486	3,705	7,191	3,486	3,705	

Notes: Standard errors are in parentheses and clustered at the household level. \*\*\* indicates  $p < 0.01$ ; \*\* indicates  $p < 0.05$ ; and \* indicates  $p < 0.10$ .

**Table 6:** Effects of income fluctuations on anthropometric outcomes of older children (age 5-18) OLS

	(1) Weight	(2) Height	(3) BMI
<i>Panel A: IV estimates using income from last year</i>			
Income, $t - 1$ (logged)	0.257 (0.339)	0.330 (0.258)	0.173* (0.094)
$R^2$	0.926	0.897	0.541
First stage F-stat	477.2	477.2	
N	38,008	38,008	38,008
<i>Panel B: IV estimates using income from two years ago</i>			
Income, $t - 2$ (logged)	0.418 (0.382)	0.429 (0.283)	0.190* (0.107)
$R^2$	0.932	0.902	0.554
First stage F-stat	369.5	369.5	
N	28,165	28,165	28,165

*Notes:* Standard errors are in parentheses and clustered at the household level. \*\*\* indicates  $p < 0.01$ ; \*\* indicates  $p < 0.05$ ; and \* indicates  $p < 0.10$ .

Table 7: Effects of income fluctuations on anthropometric outcomes of youths age 18-35 OLS

	(1) Height	(2) Weight	(3) BMI	(4) Dummy – overweight	(5) Dummy – obese
<i>Panel A: IV estimates using income from last year</i>					
Income, $t - 1$ (logged)	-0.696 (0.482)	0.603 (0.558)	0.429** (0.190)	0.067*** (0.025)	-0.004 (0.009)
$R^2$	0.421	0.314	0.153	0.096	0.025
First stage F-stat	569.3	569.3	569.3	569.3	569.3
N	25,414	25,414	25,414	25,414	25,414
<i>Panel B: IV estimates using income from two years ago</i>					
Income, $t - 2$ (logged)	-0.810 (0.535)	0.226 (0.620)	0.317 (0.212)	0.049* (0.028)	-0.005 (0.010)
$R^2$	0.424	0.318	0.162	0.106	0.028
First stage F-stat	497.7	497.7	497.7	497.7	497.7
N	18,612	18,612	18,612	18,612	18,612

Notes: Standard errors are in parentheses and clustered at the household level. \*\*\* indicates  $p < 0.01$ ; \*\* indicates  $p < 0.05$ ; and \* indicates  $p < 0.10$ .

Table 8: Effects of income fluctuations on anthropometric outcomes of adults age over 35 OLS

	(1) Height	(2) Weight	(3) BMI	(4) Dummy – overweight	(5) Dummy – obese
<i>Panel A: IV estimates using income from last year</i>					
Income, $t - 1$ (logged)	0.528 (0.453)	2.845*** (0.703)	0.911*** (0.248)	0.141*** (0.031)	0.024 (0.021)
$R^2$	0.403	0.143	0.068	0.044	0.041
First stage F-stat	809.9	809.9	809.9	809.9	809.9
N	49,820	49,820	49,820	49,820	49,820
<i>Panel B: IV estimates using income from two years ago</i>					
Income, $t - 2$ (logged)	0.600 (0.498)	2.778*** (0.750)	0.872*** (0.268)	0.132*** (0.033)	0.020 (0.023)
$R^2$	0.403	0.146	0.071	0.046	0.043
First stage F-stat	677.6	677.6	677.6	677.6	677.6
N	37,252	37,252	37,252	37,252	37,252

Notes: Standard errors are in parentheses and clustered at the household level. \*\*\* indicates  $p < 0.01$ ; \*\* indicates  $p < 0.05$ ; and \* indicates  $p < 0.10$ .

Table 9: Effects of income fluctuations on food consumption (indicators, extensive margin)

Outcome (1)	IV estimates using income from <i>this</i> year					IV estimates using income from <i>last</i> year				
	Income (2)	S.E. (3)	R <sup>2</sup> (4)	F-statistic (5)	N (6)	Income (7)	S.E. (8)	R <sup>2</sup> (9)	F-statistic (10)	N (11)
Cereals	0.001	(0.002)	0.006	986.5	33,901	-0.002	(0.002)	0.006	920.3	27,687
Eggs	0.013	(0.021)	0.154	986.5	33,901	-0.009	(0.022)	0.146	920.3	27,687
Fruits	0.128***	(0.019)	0.150	986.5	33,901	0.126***	(0.021)	0.158	920.3	27,687
Meat & poultry	-0.033**	(0.016)	0.436	986.5	33,901	-0.044**	(0.017)	0.453	920.3	27,687
Pulses/legumes/nuts	0.013	(0.013)	0.092	986.5	33,901	0.013	(0.015)	0.099	920.3	27,687
Roots & tubers	0.152***	(0.017)	0.279	986.5	33,901	0.125***	(0.017)	0.292	920.3	27,687
Fresh vegetables	0.058***	(0.011)	0.027	986.5	33,901	0.026**	(0.012)	0.033	920.3	27,687
Fish & seafood	0.013**	(0.005)	0.050	986.5	33,901	0.010*	(0.006)	0.052	920.3	27,687
Oils	0.008	(0.009)	0.025	986.5	33,901	-0.002	(0.009)	0.028	920.3	27,687
Sugar	0.032***	(0.009)	0.038	986.5	33,901	0.024***	(0.009)	0.037	920.3	27,687
Dairy products	0.155***	(0.025)	0.100	986.5	33,901	0.144***	(0.026)	0.095	920.3	27,687
Cheese products	0.210***	(0.022)	0.165	986.5	33,901	0.200***	(0.024)	0.163	920.3	27,687
Milk products	0.131***	(0.025)	0.060	986.5	33,901	0.120***	(0.027)	0.059	920.3	27,687

Notes: Standard errors are in parentheses and clustered at the household level. \*\*\* indicates  $p < 0.01$ ; \*\* indicates  $p < 0.05$ ; and \* indicates  $p < 0.10$ .

Table 10: Effects of income fluctuations on food consumption (logged qty, intensive margin)

Outcome (1)	IV estimates using income from <i>this</i> year					IV estimates using income from <i>last</i> year				
	Income (2)	S.E. (3)	R <sup>2</sup> (4)	F-statistic (5)	N (6)	Income (7)	S.E. (8)	R <sup>2</sup> (9)	F-statistic (10)	N (11)
Cereals	0.067***	(0.019)	0.265	971.4	36,908	0.003	(0.020)	0.258	875.6	30,107
Eggs	0.072	(0.047)	0.289	784.8	30,126	0.033	(0.050)	0.272	711.9	24,519
Fruits	0.447***	(0.044)	0.170	869.3	33,147	0.378***	(0.047)	0.174	791.1	27,078
Meat & poultry	0.041	(0.052)	0.495	719.9	27,232	-0.009	(0.057)	0.507	654.3	22,425
Pulses/legumes/nuts	-0.020	(0.065)	0.109	516.6	16,579	0.022	(0.067)	0.105	504.3	14,001
Roots & tubers	0.306***	(0.032)	0.610	961.5	36,546	0.266***	(0.032)	0.608	865.5	29,786
Fresh vegetables	0.170***	(0.030)	0.345	974.1	36,932	0.128***	(0.032)	0.340	875.4	30,121
Fish & seafood	0.053	(0.098)	0.170	299.7	10,969	-0.020	(0.104)	0.171	296.6	8,904
Oils	-0.010	(0.020)	0.266	972.2	36,884	-0.025	(0.022)	0.254	873.6	30,085
Sugar	0.224***	(0.030)	0.318	972.8	36,884	0.360***	(0.034)	0.272	875.5	30,079
Dairy products	0.316***	(0.059)	0.204	974.9	35,728	0.280***	(0.063)	0.195	878.5	29,139
Cheese products	0.535***	(0.058)	0.221	717	26,767	0.431***	(0.061)	0.215	667.4	21,938
Milk products	0.255***	(0.050)	0.239	992.1	33,900	0.219***	(0.054)	0.227	900.7	27,625

Notes: Standard errors are in parentheses and clustered at the household level. \*\*\* indicates  $p < 0.01$ ; \*\* indicates  $p < 0.05$ ; and \* indicates  $p < 0.10$ .



Table 11: Effects of income fluctuations on household dietary diversity scores

	(1) HDDS	(2) Healthy HDDS
<i>Panel A: IV estimates using income from this year</i>		
Income, $t$ (logged)	0.316*** (0.058)	0.138*** (0.029)
$R^2$	0.424	0.356
First stage F-stat	986.5	986.5
N	33,901	33,901
<i>Panel B: IV estimates using income from last year</i>		
Income, $t - 1$ (logged)	0.279*** (0.061)	0.131*** (0.031)
$R^2$	0.426	0.356
First stage F-stat	920.3	920.3
N	27,687	27,687

Notes: Standard errors are in parentheses and clustered at the household level.

\*\*\* indicates  $p < 0.01$ ; \*\* indicates  $p < 0.05$ ; and \* indicates  $p < 0.10$ .

Table 12: Effects of income fluctuations on household health expenditure

	(1) outpatient expenditures	(2) inpatient expenditures
<i>Panel A: IV estimates using income from this year</i>		
Income, $t$ (logged)	1.134*** (0.376)	0.455 (0.283)
$R^2$	0.139	0.067
First stage F-stat	970.9	970.9
N	36,849	36,849
<i>Panel B: IV estimates using income from last year</i>		
Income, $t - 1$ (logged)	1.722*** (0.405)	0.639** (0.300)
$R^2$	0.140	0.066
First stage F-stat	874.3	874.3
N	30,082	30,082

Notes: Standard errors are in parentheses and clustered at the household level.

\*\*\* indicates  $p < 0.01$ ; \*\* indicates  $p < 0.05$ ; and \* indicates  $p < 0.10$ .



Table 13: Effects of income fluctuations on fertility decisions

	(1) Dummy – practices contraception	(2) Dummy – pregnant	(3) Dummy — wants additional children
<i>Panel A: IV estimates using income from this year</i>			
Income, $t - 1$ (logged)	-0.036 (0.031)	0.023* (0.013)	0.090*** (0.025)
$R^2$	0.151	0.117	0.483
First stage F-stat	623.6	660.9	672.5
N	16,704	17,873	20,053
<i>Panel B: IV estimates using income from last year</i>			
Income, $t - 2$ (logged)	-0.055 (0.035)	0.040** (0.016)	0.078*** (0.028)
$R^2$	0.162	0.116	0.493
First stage F-stat	484.3	519.9	541.5
N	12,279	13,144	14,751

Notes: Standard errors are in parentheses and clustered at the household level. \*\*\* indicates  $p < 0.01$ ; \*\* indicates  $p < 0.05$ ; and \* indicates  $p < 0.10$ .

## Conclusion

Declines in household income:

- Reduce the heights and weights of young children (age 1–5)—particularly girls
- Lower BMI among older children and adolescents (age 5–18)
- Reduce BMI, and incidence of overweight among adults (both youth age 18–35 and those age 35+)

Several findings hint at likely channels explaining findings; declines in household income:

- Reduce food consumption (particularly of healthy foods) and dietary diversity
- Reduce health expenditures
- Lower pregnancy rates and willingness to have additional children

## References

- Adda, J., J. Banks, and H.-M. Von Gaudecker (2009). The impact of income shocks on health: evidence from cohort data. *Journal of the European Economic Association* 7(6), 1361–1399.
- Baird, S., J. Friedman, and N. Schady (2011). Aggregate income shocks and infant mortality in the developing world. *Review of Economics and Statistics* 93(3), 847–856.
- Banerjee, A., E. Duflo, G. Postel-Vinay, and T. Watts (2010). Long-run health impacts of income shocks: Wine and phylloxera in nineteenth-century france. *The Review of Economics and Statistics* 92(4), 714–728.
- Bartik, T. J. (1991). Who benefits from state and local economic development policies?
- Bengtsson, N. (2010). How responsive is body weight to transitory income changes? evidence from rural tanzania. *Journal of Development Economics* 92(1), 53–61.
- Cameron, L. and M. Shah (2015). Risk-taking behavior in the wake of natural disasters. *Journal of Human Resources* 50(2), 484–515.
- Currie, J. (2009). Healthy, wealthy, and wise: Socioeconomic status, poor health in childhood, and human capital development. *Journal of Economic Literature* 47(1), 87–122.

- Currie, J. and M. Stabile (2003). Socioeconomic status and child health: Why is the relationship stronger for older children? *American Economic Review* 93(5), 1813–1823.
- Cutler, D., A. Deaton, and A. Lleras-Muney (2006). The determinants of mortality. *Journal of economic perspectives* 20(3), 97–120.
- Dercon, S. (2002). Income risk, coping strategies, and safety nets. *The World Bank Research Observer* 17(2), 141–166.
- Dercon, S. and P. Krishnan (2000). In sickness and in health: Risk sharing within households in rural ethiopia. *Journal of Political Economy* 108(4), 688–727.
- Ebenstein, A., M. Fan, M. Greenstone, G. He, P. Yin, and M. Zhou (2015). Growth, pollution, and life expectancy: China from 1991-2012. *American Economic Review* 105(5), 226–31.
- Falkingham, J., B. Akkazieva, and A. Baschieri (2010). Trends in out-of-pocket payments for health care in kyrgyzstan, 2001–2007. *Health policy and planning* 25(5), 427–436.
- FAO (2015). Food and Agriculture Organization of the United Nations Country Programming Framework in the Kyrgyz Republic, <http://www.fao.org/3/a-au213e.pdf>.
- Helble, M. and K. Francisco (2017). The imminent obesity crisis in asia and the pacific: First cost estimates.

- Jalan, J. and M. Ravallion (1999). Are the poor less well insured? Evidence on vulnerability to income risk in rural China. *Journal of Development Economics* 58(1), 61–81.
- Kosec, K. and C. H. Mo (2017). Aspirations and the role of social protection: Evidence from a natural disaster in rural Pakistan. *World Development* 97, 49–66.
- Luechinger, S. and P. A. Raschky (2009). Valuing flood disasters using the life satisfaction approach. *Journal of Public Economics* 93(3-4), 620–633.
- Townsend, R. M. (1994). Risk and insurance in village India. *Econometrica: Journal of the Econometric Society*, 539–591.
- Townsend, R. M. (1995). Consumption insurance: An evaluation of risk-bearing systems in low-income economies. *Journal of Economic Perspectives* 9(3), 83–102.
- World Bank (2019). World Development Indicators, <https://data.worldbank.org>.
- Yang, D. (2008). International migration, remittances and household investment: Evidence from Philippine migrants' exchange rate shocks. *The Economic Journal* 118(528), 591–630.

**Table A1:** Effects of income fluctuations on height, HAZ, and stunting of children age 1-5[Back to IV](#)

	(1)	(2)	(3)	(4)	(5)	(6)
	Height (cm)		HAZ		Dummy – stunting	
Basic control set:	X		X		X	
Full control set:		X		X		X
<i>Panel A: OLS estimates using income from last year</i>						
Income, $t - 1$ (logged)	0.514*** (0.116)	0.587*** (0.118)	0.149*** (0.032)	0.168*** (0.033)	-0.066*** (0.013)	-0.070*** (0.013)
$R^2$	0.820	0.821	0.029	0.036	0.028	0.032
N	10,041	10,041	10,041	10,041	10,041	10,041
<i>Panel B: OLS estimates using income from two years ago</i>						
Income, $t - 2$ (logged)	0.541*** (0.141)	0.628*** (0.144)	0.145*** (0.040)	0.167*** (0.041)	-0.061*** (0.015)	-0.062*** (0.015)
$R^2$	0.826	0.827	0.033	0.040	0.031	0.035
N	7,191	7,191	7,191	7,191	7,191	7,191

Notes: Standard errors are in parentheses and clustered at the household level. \*\*\* indicates  $p < 0.01$ ; \*\* indicates  $p < 0.05$ ; and \* indicates  $p < 0.10$ .



Table A2: Effects of income fluctuations on weight, WAZ, and WHZ of children age 1-5

[Back to IV](#)

	(1)	(2)	(3)	(4)	(5)	(6)
	Weight (kg)		WAZ		WHZ	
Basic control set:	X		X		X	
Full control set:		X		X		X
<i>Panel A: OLS estimates using income from last year</i>						
Income, $t - 1$ (logged)	0.151*** (0.039)	0.156*** (0.039)	0.094*** (0.023)	0.098*** (0.022)	0.016 (0.029)	0.006 (0.029)
$R^2$	0.712	0.714	0.121	0.128	0.068	0.072
N	10,041	10,041	10,041	10,041	10,041	10,041
<i>Panel B: OLS estimates using income from two years ago</i>						
Income, $t - 2$ (logged)	0.168*** (0.045)	0.168*** (0.045)	0.093*** (0.026)	0.094*** (0.026)	0.015 (0.033)	-0.002 (0.033)
$R^2$	0.720	0.722	0.126	0.133	0.067	0.073
N	7,191	7,191	7,191	7,191	7,191	7,191

Notes: Standard errors are in parentheses and clustered at the household level. \*\*\* indicates  $p < 0.01$ ; \*\* indicates  $p < 0.05$ ; and \* indicates  $p < 0.10$ .

**Table A3:** OLS results: income fluctuations and anthropometric outcomes of older children (age 5-18) [Back to IV](#)

	(1) Weight	(2) Height	(3) BMI
<i>Panel A: OLS estimates using income from last year</i>			
Income, $t - 1$ (logged)	0.339*** (0.100)	0.398*** (0.081)	0.110*** (0.029)
$R^2$	0.926	0.897	0.541
N	38,008	38,008	38,008
<i>Panel B: OLS estimates using income from two years ago</i>			
Income, $t - 2$ (logged)	0.397*** (0.109)	0.424*** (0.087)	0.111*** (0.031)
$R^2$	0.932	0.902	0.554
N	28,165	28,165	28,165

Notes: Standard errors are in parentheses and clustered at the household level. \*\*\* indicates  $p < 0.01$ ; \*\* indicates  $p < 0.05$ ; and \* indicates  $p < 0.10$ .

Table A4: Effects of income fluctuations on anthropometric outcomes of youths age 18-35

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	(1) Height	(2) Weight	(3) BMI	(4) Dummy – overweight	(5) Dummy – obese
<i>Panel A: OLS estimates using income from last year</i>					
Income, $t - 1$ (logged)	0.243* (0.148)	0.500*** (0.180)	0.116** (0.058)	0.011 (0.008)	0.001 (0.003)
$R^2$	0.423	0.314	0.155	0.099	0.025
N	25,414	25,414	25,414	25,414	25,414
<i>Panel B: OLS estimates using income from two years ago</i>					
Income, $t - 2$ (logged)	0.158 (0.168)	0.501** (0.206)	0.137** (0.066)	0.017** (0.009)	0.003 (0.003)
$R^2$	0.427	0.318	0.163	0.107	0.028
N	18,612	18,612	18,612	18,612	18,612

Notes: Standard errors are in parentheses and clustered at the household level. \*\*\*

indicates  $p < 0.01$ , \*\* indicates  $p < 0.05$ , and \* indicates  $p < 0.10$ .

**Table A5:** Effects of income fluctuations on anthropometric outcomes of adults age over 35[Back to IV](#)

	(1) Height	(2) Weight	(3) BMI	(4) Dummy – overweight	(5) Dummy – obese
<i>Panel A: OLS estimates using income from last year</i>					
Income, $t - 1$ (logged)	0.523*** (0.120)	1.587*** (0.201)	0.420*** (0.069)	0.050*** (0.009)	0.015*** (0.006)
$R^2$	0.403	0.145	0.071	0.050	0.041
N	49,820	49,820	49,820	49,820	49,820
<i>Panel B: OLS estimates using income from two years ago</i>					
Income, $t - 2$ (logged)	0.517*** (0.133)	1.621*** (0.222)	0.432*** (0.076)	0.051*** (0.009)	0.015** (0.006)
$R^2$	0.404	0.148	0.073	0.051	0.043
N	37,252	37,252	37,252	37,252	37,252