Nutrition II: Estimating Nutrition Elasticities

14.740x: Foundations of Development Policy

Professor Esther Duflo

Measuring Income Elasticity of Nutrition

Deaton and Dreze, Figure 1

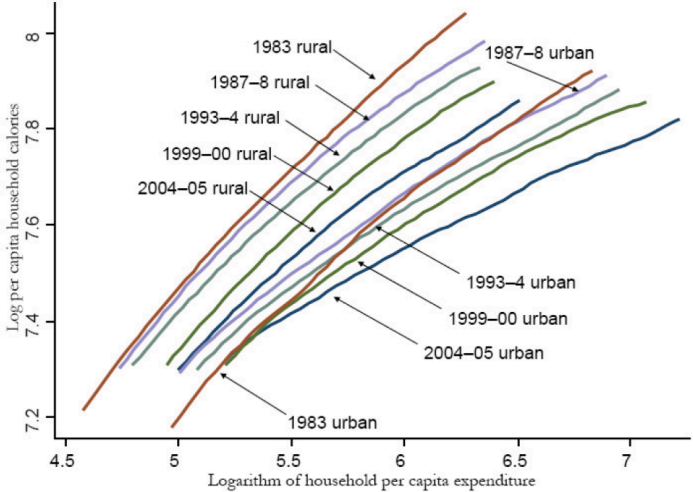


Figure 1: Calorie Engel curves, rural and urban India, 1983 to 2004–05

The causality problem

- Remember what we are trying to do: find out the causal effect of income on calorie purchased.
  - Comparing households does not give us the causal effect of extra income on calorie purchased
  - why? What else may be different?
  - Comparing household over time does not give us the causal effect of extra income on calorie purchased either
  - Why? What else may be different?

The Causality problem in mathematical terms

(Reference: Imbens and Woolridge, 2008).

- Consider a binary treatment W: 1 for treated, 0 for control, and an outcome Y (e.g. the treatment is : received some money, the outcome could be: anemia, or earnings).
- Ex-ante, each individual i has two *potential outcomes*, $Y_i(1)$ if treated, $Y_i(0)$ if non-treated.

$$Y_i = Y_i(1)W_i + Y_i(0)(1 - W_i)$$

- The *treatment effect* for individual i is $Y_i(1) - Y_i(0)$.
- Ex-post, only one of the outcomes is realized: individual is treated or non-treated. Since no individual is observed both in the treated and non-treated state, we will not be able to estimate the treatment effect for each individual. All we can hope to estimate are some statistics concerning the treatment effect for a sample of individuals.

Estimating Average Treatment Effect

Suppose we have a population, with N_1 treated individual, and N_0 non treated individuals. Consider the difference between treated and control population:

$$E[Y_i(1)|W_i = 1] - E[Y_i(0)|W_i = 0]$$

$$= E[Y_i(1)|W_i = 1] - E[Y_i(0)|W_i = 1]$$
$$+E[Y_i(0)|W_i = 1] - E[Y_i(0)|W_i = 0]$$

$$= E[Y_i(1) - Y_i(0)|W_i = 1] + E[Y_i(0)|W_i = 1] - E[Y_i(0)|W_i = 0]$$

First term: ATT. Second term: difference in the underlying characteristics of the treated and non treated population (selection effect).

Selection mechanisms

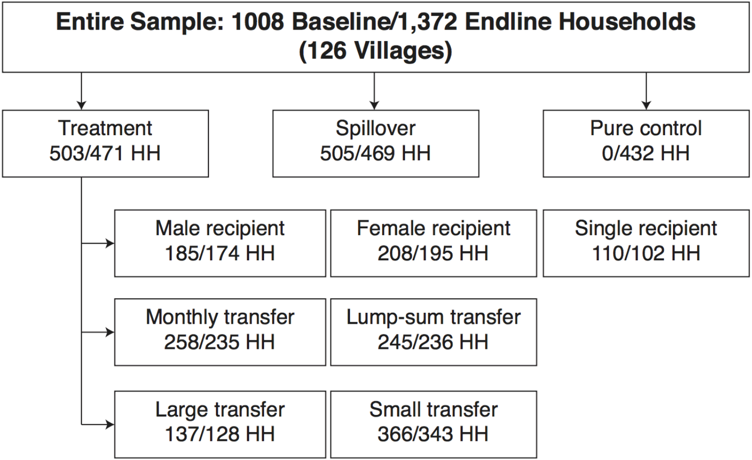
Three cases:

- Random assignment: $E[Y_i(0)|W_i = 1] = E[Y_i(0)|W_i = 0]$ and $E[Y_i(1)|W_i = 1] - E[Y_i(0)|W_i = 0]$ is an unbiased estimate of the effect of the treatment on the treated.
- The probability of assignment does not depend on potential outcomes, but it may be an unknown function of covariates (e.g. people from a given region earn more income).
- The probability of assignment depends on potential outcomes: there is a selection bias of unknown size: This is the case we are in here!

Measuring the elasticity of calorie consumption using a randomly assigned income treatment

- Income is not randomly assigned: in what way people who have more income are different, which may be related to their nutritional status?
  - Endogeneity
  - Omitted variable
- The solution: randomly assign income!
- GiveDirectly: an NGO that gives cash grants to poor household in Kenya, using mobile phone money that is prevalent in Kenya (MPESA).
- Haushofer and Shapiro conducted a Randomized controlled trial of GiveDirectly

Figure 1: Treatment arms



Notes: Diagram of treatment arms. Numbers designate baseline/endline number of households in each treatment arm. Pure control households were added at endline to allow identification of spillover effects. Male and female recipient was randomized only for households with co-habitating couples. Large transfers were administered by making additional transfers to households that had previously been assigned to treatment.

Data collection

- Detailed data collected on a number of outcomes, including consumption of various items after a few months.
- Randomly assigned transfers of different sizes, give us randomly assigned variation in income
- First step: Simply compare various treatment groups to see if people who got the transfer have more overall consumption and buy more food!

Table 2: Treatment effects: Consumption

	(1) Control mean (SD)	(2) Treatment effect	(3) Spillover effect	(4) Female recipient	(5) Monthly transfer	(6) Large transfer	(7) N
Food total (USD)	104.46	19.60***	−3.48	−2.26	1.76	7.71	1372
	(58.50)	(4.22)	(4.66)	(7.43)	(7.51)	(7.62)	
Food own production (USD)	13.64	2.45**	−2.09*	0.16	3.94**	−0.23	1372
	(14.79)	(0.96)	(1.18)	(1.72)	(1.77)	(1.48)	
Food bought (USD)	90.82	16.98***	−1.39	−3.11	−3.03	7.49	1372
	(52.77)	(3.81)	(4.31)	(6.61)	(6.73)	(6.84)	
Cereals (USD)	22.55	2.24**	0.30	0.24	−1.24	2.45	1372
	(17.18)	(1.14)	(1.58)	(1.87)	(1.87)	(2.08)	
Meat & fish (USD)	12.97	5.10***	−0.35	0.76	−3.12	2.41	1372
	(13.75)	(1.02)	(1.22)	(1.83)	(1.95)	(1.64)	
Fruit & vegetables (USD)	23.50	3.46***	0.20	−0.95	0.13	2.29	1372
	(17.06)	(1.15)	(1.39)	(1.96)	(2.05)	(1.99)	
Dairy (USD)	7.26	1.71***	−0.16	−0.73	0.82	0.49	1372
	(9.43)	(0.64)	(0.74)	(1.10)	(1.09)	(1.09)	
Fats (USD)	6.84	0.80**	0.01	−0.28	−0.27	0.91	1372
	(5.51)	(0.37)	(0.46)	(0.62)	(0.64)	(0.58)	
Sugars (USD)	11.25	1.05**	−0.52	−0.53	0.10	0.41	1372
	(7.18)	(0.48)	(0.56)	(0.81)	(0.84)	(0.78)	
Other food (USD)	42.42	5.98***	−0.36	−1.55	−0.86	3.31	1372
	(28.28)	(1.94)	(2.40)	(3.24)	(3.23)	(3.43)	
Alcohol (USD)	6.38	−0.93	−0.41	1.50	1.00	−1.55	1372
	(16.56)	(1.00)	(1.26)	(1.64)	(1.65)	(1.35)	
Tobacco (USD)	1.52	−0.16	−0.00	0.11	0.43	−0.31	1372
	(4.13)	(0.22)	(0.29)	(0.34)	(0.34)	(0.30)	
Medical expenditure past month (USD)	6.56	2.83***	1.52	2.06	−1.49	−0.35	1372
	(13.17)	(0.98)	(0.93)	(1.86)	(1.87)	(1.73)	
Medical expenditure, children (USD)	3.52	0.66	1.03*	0.63	−0.37	−0.10	1203
	(8.52)	(0.60)	(0.60)	(1.06)	(1.09)	(0.97)	
Education expenditure (USD)	4.71	1.08**	0.32	0.44	−0.10	1.10	1372
	(8.68)	(0.51)	(0.61)	(0.89)	(0.88)	(0.92)	
Social expenditure (USD)	4.36	2.46***	−1.42***	−2.06**	−0.46	0.67	1372
	(5.38)	(0.49)	(0.46)	(0.98)	(1.01)	(0.90)	
Other expenditure (USD)	34.36	10.06***	−3.72	−2.05	−3.56	11.76***	1372
	(24.62)	(1.74)	(2.27)	(3.05)	(3.17)	(3.01)	
Non-durable expenditure (USD)	157.40	36.18***	−7.53	−2.74	−4.40	20.37*	1372
	(82.18)	(5.91)	(7.24)	(10.35)	(10.82)	(10.55)	
Joint test (*p*-value)		0.00***	0.15	0.81	0.39	0.03**	

Notes: OLS estimates of treatment and spillover effects. Outcome variables are listed on the left. All variables are reported in PPP adjusted USD. Food bought includes all sub-categories except alcohol and tobacco. Education expenditures include tuition and other costs (e.g., uniform, supplies). Social expenditures include charitable donations, dowry, fees paid to village elder or chiefs, religious ceremonies, weddings, funerals and recreation (e.g., books, music). Other expenditures include airtime, travel and transportation, clothing, personal items (e.g., toiletries), household items (e.g., soap, candles), firewood, electricity and water. Non-durable expenditures are the sum of expenditures on food (own production and purchased), alcohol and tobacco, medical, education, social activities and other goods. Variables in PPP adjusted USD are topcoded for the highest 1 percent of observations. For each outcome variable, we report the coefficients of interest and their standard errors in parentheses. Column (1) reports the mean and standard deviation of the control group for a given outcome variable. Column (2) reports the basic treatment effect, i.e. comparing treatment households to control households within villages. Column (3) reports the spillover effect, i.e. the treatment effect on spillover households compared to pure control households. Column (4) reports the relative treatment effect of transferring to the female compared to the male; column (5) the relative effect of monthly compared to lump-sum transfers; and column (6) that of large compared to small transfers. The unit of observation is the household. All columns except the spillover regressions include village-level fixed effects, control for baseline outcomes, and cluster standard errors at the household level (in the spillover column, at the village level). The last row shows joint significance of the coefficients in the corresponding column from SUR estimation. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

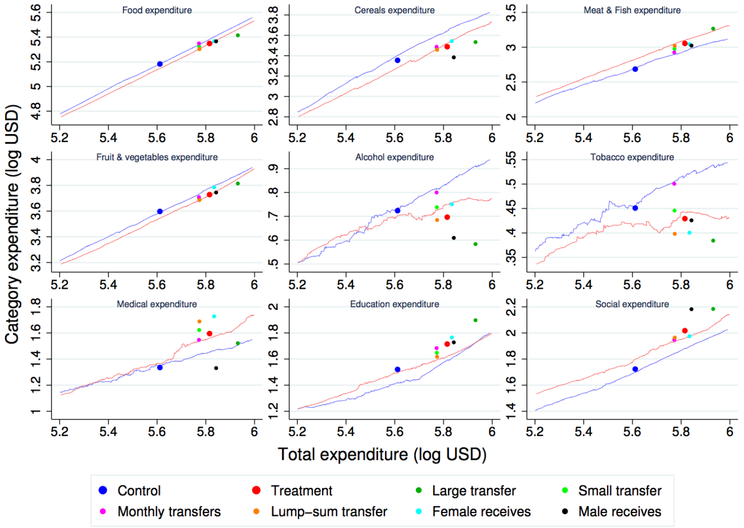
Reading the table

- Column 1: the mean for the control group.
- Column 2: the difference between the treatment group (any transfer) and the control group.
- Below each number: the standard error of the difference.
- The little stars next to the number ?
- Column 4: compare female/male recipients, etc.

Going from the treatment effect to an elasticity

- The transfer is a very temporary income shock: you would not expect households to eat all of it.
- In general we consider *expenditure* elasticity: e.g. the elasticity of food consumption wrt to total expenditure.
- In this case, each transfer size give rise to an increase in expenditure: We can plot on the X axis how much people in each group consume, and on the Y axis how much they spend on food.
- The blue line on the figures is the relationship between total expenditure and food expenditure in the control group (not well identified).

Figure 4: Cross-sectional and experimental Engel curves for different categories of consumption and expenditure



Notes: Cross-sectional and experimental Engel curves for different categories of consumption and expenditure. We plot the log of total monthly nondurable expenditure on the horizontal axis, and the log of monthly expenditure on sub-categories on the vertical axis. Because both axes are on log scales, slopes correspond to elasticities. Total expenditure includes spending on food, education, health care, and social expenses, but not investment in business and agriculture and spending on durables. The red and blue lines represent cross-sectional Engel curves, estimated with local linear regressions of the log of each category's expenditure on the log of total expenditure for the treatment and control groups at endline, respectively. The large red and blue dots represent the experimental Engel curve; the blue dot shows the average total and category expenditure for the control group, and the red dot for the control group. The smaller colored dots represent subgroups of the treatment group (transfers to male vs. female, monthly vs. lump-sum transfers, and large vs. small transfers).

Calculating an elasticity

- How do we compute the slope of the implied curve?
- It is simply the ratio of the increase in food expenditure we read on the Y axis to the ratio in overall expenditure we see on the X axis.
- Or alternatively the ratio between the proportional increase in food expenditure (or any other you are interested) in table 2 to the ratio in total non durable expenditure (also in table 2)

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	(52.77)	(3.81)	(4.31)	(6.61)	(6.73)	(6.84)	
Cereals (USD)	22.55	2.24**	0.30	0.24	−1.24	2.45	1372
	(17.18)	(1.14)	(1.58)	(1.87)	(1.87)	(2.08)	
Meat & fish (USD)	12.97	5.10***	−0.35	0.76	−3.12	2.41	1372
	(13.75)	(1.02)	(1.22)	(1.83)	(1.95)	(1.64)	
Fruit & vegetables (USD)	23.50	3.46***	0.20	−0.95	0.13	2.29	1372
	(17.06)	(1.15)	(1.39)	(1.96)	(2.05)	(1.99)	
Dairy (USD)	7.26	1.71***	−0.16	−0.73	0.82	0.49	1372
	(9.43)	(0.64)	(0.74)	(1.10)	(1.09)	(1.09)	
Fats (USD)	6.84	0.80**	0.01	−0.28	−0.27	0.91	1372
	(5.51)	(0.37)	(0.46)	(0.62)	(0.64)	(0.58)	
Sugars (USD)	11.25	1.05**	−0.52	−0.53	0.10	0.41	1372
	(7.18)	(0.48)	(0.56)	(0.81)	(0.84)	(0.78)	
Other food (USD)	42.42	5.98***	−0.36	−1.55	−0.86	3.31	1372
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Tobacco (USD)	1.52	−0.16	−0.00	0.11	0.43	−0.31	1372
	(4.13)	(0.22)	(0.29)	(0.34)	(0.34)	(0.30)	
Medical expenditure past month (USD)	6.56	2.83***	1.52	2.06	−1.49	−0.35	1372
	(13.17)	(0.98)	(0.93)	(1.86)	(1.87)	(1.73)	
Medical expenditure, children (USD)	3.52	0.66	1.03*	0.63	−0.37	−0.10	1203
	(8.52)	(0.60)	(0.60)	(1.06)	(1.09)	(0.97)	
Education expenditure (USD)	4.71	1.08**	0.32	0.44	−0.10	1.10	1372
	(8.68)	(0.51)	(0.61)	(0.89)	(0.88)	(0.92)	
Social expenditure (USD)	4.36	2.46***	−1.42***	−2.06**	−0.46	0.67	1372
	(5.38)	(0.49)	(0.46)	(0.98)	(1.01)	(0.90)	
Other expenditure (USD)	34.36	10.06***	−3.72	−2.05	−3.56	11.76***	1372
	(24.62)	(1.74)	(2.27)	(3.05)	(3.17)	(3.01)	
Non-durable expenditure (USD)	157.40	36.18***	−7.53	−2.74	−4.40	20.37*	1372
	(82.18)	(5.91)	(7.24)	(10.35)	(10.82)	(10.55)	
Joint test (*p*-value)		0.00***	0.15	0.81	0.39	0.03**	

Notes: OLS estimates of treatment and spillover effects. Outcome variables are listed on the left. All variables are reported in PPP adjusted USD. Food bought includes all sub-categories except alcohol and tobacco. Education expenditures include tuition and other costs (e.g., uniform, supplies). Social expenditures include charitable donations, dowry, fees paid to village elder or chiefs, religious ceremonies, weddings, funerals and recreation (e.g., books, music). Other expenditures include airtime, travel and transportation, clothing, personal items (e.g., toiletries), household items (e.g., soap, candles), firewood, electricity and water. Non-durable expenditures are the sum of expenditures on food (own production and purchased), alcohol and tobacco, medical, education, social activities and other goods. Variables in PPP adjusted USD are topcoded for the highest 1 percent of observations. For each outcome variable, we report the coefficients of interest and their standard errors in parentheses. Column (1) reports the mean and standard deviation of the control group for a given outcome variable. Column (2) reports the basic treatment effect, i.e. comparing treatment households to control households within villages. Column (3) reports the spillover effect, i.e. the treatment effect on spillover households compared to pure control households. Column (4) reports the relative treatment effect of transferring to the female compared to the male; column (5) the relative effect of monthly compared to lump-sum transfers; and column (6) that of large compared to small transfers. The unit of observation is the household. All columns except the spillover regressions include village-level fixed effects, control for baseline outcomes, and cluster standard errors at the household level (in the spillover column, at the village level). The last row shows joint significance of the coefficients in the corresponding column from SUR estimation. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Calculating an elasticity

- How do we compute the slope of the implied curve?
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- Or alternatively the ratio between the proportional increase in food expenditure (or any other you are interested) in table 2 to the ratio in total non durable expenditure (also in table 2)

$$\frac{\frac{104}{19}}{\frac{157}{36}} = \frac{18}{22} = 0.8$$

Table 3: Elasticity of different expenditure categories with respect to total expenditure

	Entire sample			Monthly vs. lump-sum transfers			Female vs. male recipient			Large vs. small transfer		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	OLS	IV	Hausman p-value	Monthly transfers	Lump-sum transfers	Difference p-value	Female recipient	Male recipient	Difference p-value	Large transfers	Small transfers	Difference p-value
Food total	1.00***	0.83***	0.05**	1.19***	0.69***	0.08*	0.88***	0.77***	0.62	0.68***	1.04***	0.10
	(0.02)	(0.08)		(0.20)	(0.20)		(0.14)	(0.12)		(0.12)	(0.16)	
Food own production (USD)	0.92***	1.10***	0.53	2.64**	0.38	0.10*	1.11**	1.29***	0.81	0.63*	1.72**	0.21
	(0.09)	(0.31)		(1.17)	(0.64)		(0.54)	(0.43)		(0.35)	(0.74)	
Food bought (USD)	1.03***	0.87***	0.18	1.03***	0.84***	0.57	0.90***	0.76***	0.58	0.76***	1.03***	0.30
	(0.04)	(0.10)		(0.22)	(0.21)		(0.17)	(0.14)		(0.12)	(0.21)	
Cereals (USD)	1.20***	0.75**	0.29	0.98	0.63	0.77	1.43***	−0.25	0.05*	0.64*	0.89	0.77
	(0.09)	(0.33)		(0.83)	(0.68)		(0.54)	(0.62)		(0.35)	(0.70)	
Meat & fish (USD)	1.17***	2.07***	0.01**	1.61*	2.52***	0.48	2.04***	1.35***	0.40	2.02***	2.14***	0.90
	(0.09)	(0.37)		(0.89)	(0.77)		(0.58)	(0.44)		(0.39)	(0.79)	
Fruit & vegetables (USD)	0.95***	0.76***	0.30	1.11**	0.49	0.35	1.10***	0.58*	0.29	0.74***	0.78*	0.93
	(0.06)	(0.19)		(0.45)	(0.43)		(0.30)	(0.31)		(0.22)	(0.40)	
Dairy (USD)	1.44***	1.41***	0.95	3.03**	0.97	0.21	1.65**	1.71***	0.95	0.45	2.70**	0.09*
	(0.11)	(0.45)		(1.28)	(0.88)		(0.77)	(0.63)		(0.59)	(1.09)	
Fats (USD)	0.89***	0.62***	0.32	0.49	0.61	0.89	0.79**	0.68**	0.85	0.76***	0.43	0.59
	(0.07)	(0.24)		(0.56)	(0.48)		(0.38)	(0.33)		(0.25)	(0.51)	
Sugars (USD)	0.89***	0.68***	0.46	1.14**	0.55	0.45	0.60	0.75**	0.79	0.43	1.00*	0.39
	(0.08)	(0.25)		(0.56)	(0.47)		(0.38)	(0.34)		(0.30)	(0.52)	
Other food (USD)	1.14***	0.80***	0.16	1.06***	0.66*	0.52	0.98***	0.57**	0.32	0.69***	0.95***	0.54
	(0.06)	(0.18)		(0.40)	(0.38)		(0.28)	(0.26)		(0.18)	(0.36)	
Alcohol (USD)	0.53***	−0.13	0.36	0.98	−0.59	0.43	0.27	−0.61	0.54	−0.57	0.47	0.46
	(0.13)	(0.56)		(1.46)	(1.14)		(0.98)	(0.83)		(0.59)	(1.16)	
Tobacco (USD)	0.24**	−0.19	0.35	0.07	−0.10	0.89	−0.61	−0.19	0.66	−0.49	0.19	0.46
	(0.09)	(0.36)		(0.85)	(0.70)		(0.66)	(0.53)		(0.41)	(0.74)	
Medical expenditure past month (USD)	0.36***	1.47**	0.12	1.27	2.61*	0.54	3.16**	−0.99	0.01**	0.35	2.96*	0.15
	(0.13)	(0.58)		(1.42)	(1.37)		(1.29)	(0.97)		(0.67)	(1.57)	
Medical expenditure, children (USD)	0.18	0.86*	0.38	0.38	1.86	0.41	1.93**	−0.95	0.05*	0.17	1.89	0.25
	(0.12)	(0.47)		(1.12)	(1.14)		(0.97)	(0.95)		(0.54)	(1.27)	
Education expenditure (USD)	0.75***	0.84**	0.88	1.22	0.55	0.62	1.12*	0.42	0.45	0.88**	0.78	0.92
	(0.10)	(0.37)		(0.93)	(0.77)		(0.63)	(0.52)		(0.42)	(0.80)	
Social expenditure (USD)	0.74***	1.60***	0.02**	1.48*	1.61**	0.91	0.71	2.44***	0.06*	1.71***	1.45**	0.78
	(0.07)	(0.35)		(0.87)	(0.71)		(0.57)	(0.65)		(0.42)	(0.73)	

Notes: Elasticity of different expenditure and consumption categories with respect to total expenditure, for different subsets of the treatment group. Column (1) presents cross-sectional OLS estimates in the control group; column (2) presents IV estimates across both treatment and control groups when total expenditure is instrumented with treatment. Column (3) shows the p-value of the Hausman test comparing OLS and IV specifications. Columns (4) and (5) present IV estimates for the effect of monthly and lump-sum transfers, respectively; column (6) shows the p-value of the difference. Analogously for the remaining columns.

From Food expenditure elasticity to calories elasticity?

- Is Food expenditure what we would like to see?
- No: what matters is calories.
- What happens as you become richer?
- You will start spending more on tastier food: the price per calorie increases at the same time as the number of calories, so the food expenditure elasticity is an upwards biased estimate of what we care about
- Unfortunately they don't have price paid per calorie here. In other data set, the food expenditure elasticity is about half calories, and half price per calories. Here we have some inkling that there is some substitution going on. Where?

The elasticity of productivity with respect to nutrition

- Ideal experiment?
- Fewer good randomized evaluations than you might expect!
- Example: Wolgemuth et al, Kenyan road workers
- Randomly create two group of workers.
  - Group I gets a bowl of poridge worth 200 kilo-calories, 7g of proteins, and 1.36mg Iron
  - Group II gets a bowl of poridge worth 1000 kcal, 18.5 g proteins, 2.18mg iron

Results

- Increase in total calorie consumption: 69 kcal in group I, 549 in group 2
- Baseline consumption
  - group I: 1715 kcal (1407 for females and 2028 for males) -quite low (less than RDA)
  - group 1: 1705 kcal (1274 for females and 2137 for males)
- Change in calorie consumption in percentage: roughly 28% overall, 23% for males
- Baseline productivity for males: 0.873 cubic meters per man hour.
- Increase in group I compared to group II: 12.5%
- Elasticity: $\frac{12.5}{23}$=0.54

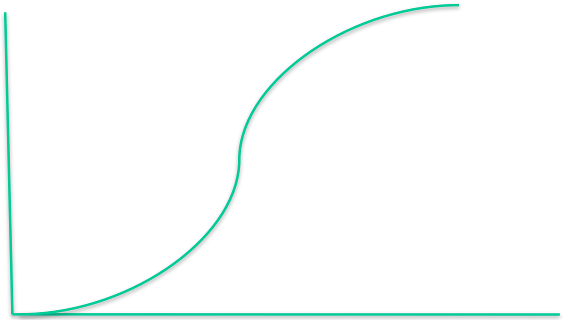
Conclusion so far....

- Even after controlling for endogeneity we find a pretty robust response of food expenditure to total expenditure.
- But the headline number is below one (0.83 is the upper bound)
- As people become richer, they don't increase calorie consumption proportionally
- This in itself is not a very good sign for the nutrition based capacity curve, because if the returns to investing in nutrition were so high, you might expect people to try to spend more and more on food as they can.
- This will tend to make the capacity cure more shallow.
- There is an effect of nutrition on productivity, but even for undernourished workers working in very physical job, it is only 0.54.
- 0.54*0.83=0.45 , which is less than 1!!
- It seems it will be hard to generate a nutrition based poverty trap based just on this phenomenon.

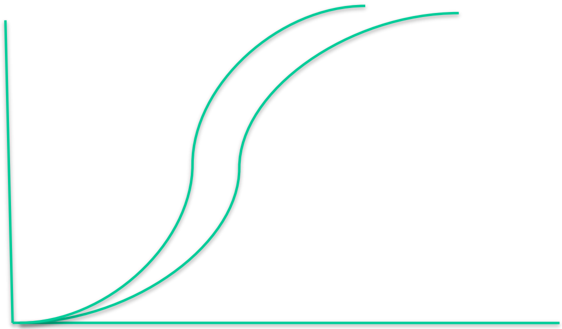
Child nutrition

- Child nutrition may be a mechanism through which such a productivity trap emerges.
- This is because a one time investment potentially has long term impacts: can generate much larger returns in terms of life time income.

Capacity curve with different nutrition histories



Capacity curve with different nutrition histories



Example: The Long Term effect of Deworming

- Why deworming ?
- The program was started in 1999.
- A first study was undertaken in the short run (before the control group was treated) to look at the effect of the program on school participation, anemia, etc. A second study was undertaken in the longer run : 7,530 of children who were in schools at the time of the deworming program were followed at home, in 2003-2005 and 2007-2009.

Randomization Design

In the original program, the decision was taken to randomize at the *school level*. Schools were assigned into three groups:

- Group 1 Deworming program received in 1998-2003
- Group 2 Deworming program received in 1999-2003
- Group 3 Deworming program recevied in 2001-2003

Thinking carefully about Design

- Why not randomize *within* school instead? (treat some kids and not some other)
- Externalities—Worms are contagious: if some children are treated, they are less likely to be sick, so even their friends are also less likely to be sick. What does it do to our treatment effect if we randomize within school?
- What would be the best way to *test* whether there are such externalities within schools in practice?
- When we randomize at the school level, rather than at the individual level, we need to take it into account when figuring what is the noise of the estimation Why?
- Clustering: we adjust the standard errors (using the "cluster" command in stata, e.g. cluster(schoolid)).

TABLE V

JANUARY TO MARCH 1999, HEALTH AND HEALTH BEHAVIOR DIFFERENCES BETWEEN GROUP 1 (1998 TREATMENT) AND GROUP 2 (1998 COMPARISON) SCHOOLS[a]

	Group 1	Group 2	Group 1 – Group 2
Panel A: Helminth Infection Rates			
Any moderate-heavy infection, January–March 1998	0.38	–	–
Any moderate-heavy infection, 1999	0.27	0.52	−0.25*** (0.06)
Hookworm moderate-heavy infection, 1999	0.06	0.22	−0.16*** (0.03)
Roundworm moderate-heavy infection, 1999	0.09	0.24	−0.15*** (0.04)
Schistosomiasis moderate-heavy infection, 1999	0.08	0.18	−0.10* (0.06)
Whipworm moderate-heavy infection, 1999	0.13	0.17	−0.04 (0.05)
Panel B: Other Nutritional and Health Outcomes			
Sick in past week (self-reported), 1999	0.41	0.45	−0.04** (0.02)
Sick often (self-reported), 1999	0.12	0.15	−0.03** (0.01)
Height-for-age Z-score, 1999 (low scores denote undernutrition)	−1.13	−1.22	0.09* (0.05)
Weight-for-age Z-score, 1999 (low scores denote undernutrition)	−1.25	−1.25	−0.00 (0.04)
Hemoglobin concentration (g/L), 1999	124.8	123.2	1.6 (1.4)
Proportion anemic (Hb < 100g/L), 1999	0.02	0.04	−0.02** (0.01)
Panel C: Worm Prevention Behaviors			
Clean (observed by field worker), 1999	0.59	0.60	−0.01 (0.02)
Wears shoes (observed by field worker), 1999	0.24	0.26	−0.02 (0.03)
Days contact with fresh water in past week (self-reported), 1999	2.4	2.2	0.2 (0.3)

Treatment Effect on infection, an standard err

T stat=.....

TABLE VI

DEWORMING HEALTH EXTERNALITIES WITHIN SCHOOLS, JANUARY TO MARCH 1999[a]

	Group 1, Treated in 1998	Group 1, Untreated in 1998	Group 2, Treated in 1999	Group 2, Untreated in 1999	(Group 1, Treated 1998) – (Group 2, Treated 1999)	(Group 1, Untreated 1998) – (Group 2, Untreated 1999)
Panel A: Selection into Treatment						
Any moderate-heavy infection, 1998	0.39	0.44	–	–	–	–
Proportion of 1998 parasitological sample tracked to 1999 sample[b]	0.36	0.36	–	–	–	–
Access to latrine at home, 1998	0.84	0.80	0.81	0.86	0.03 (0.04)	−0.06 (0.05)
Grade progression (= Grade − (Age − 6)), 1998	−2.0	−1.8	−1.8	−1.8	−0.2** (0.1)	−0.0 (0.2)
Weight-for-age (Z-score), 1998 (low scores denote undernutrition)	−1.58	−1.52	−1.57	−1.46	−0.01 (0.06)	−0.06 (0.11)
Malaria/fever in past week (self-reported), 1998	0.37	0.41	0.40	0.39	−0.03 (0.04)	−0.01 (0.06)
Clean (observed by field worker), 1998	0.53	0.59	0.60	0.66	−0.07 (0.05)	−0.07 (0.10)
Panel B: Health Outcomes						
Girls <13 years, and all boys						
Any moderate-heavy infection, 1999	0.24	0.34	0.51	0.55	−0.27*** (0.06)	−0.21** (0.10)
Hookworm moderate-heavy infection, 1999	0.04	0.11	0.22	0.20	−0.19*** (0.03)	−0.09* (0.05)
Roundworm moderate-heavy infection, 1999	0.08	0.12	0.22	0.30	−0.14*** (0.04)	−0.18** (0.07)
Schistosomiasis moderate-heavy infection, 1999	0.09	0.08	0.20	0.13	−0.11* (0.06)	−0.05 (0.06)
Whipworm moderate-heavy infection, 1999	0.12	0.16	0.16	0.20	−0.04 (0.16)	−0.05 (0.09)

Externalities within school
Even untreated children benefit

The results

- Short run: Large effects on school participation (mainly due to reduce absence: presumably because kids are sick less often).
- Long run: See in figure 3, table 3
- What are the results highlights?

Figure 3:
Panel A: The distribution of log labor earnings in the last month,
leworming treatment versus control (among those with positive labor earnings)

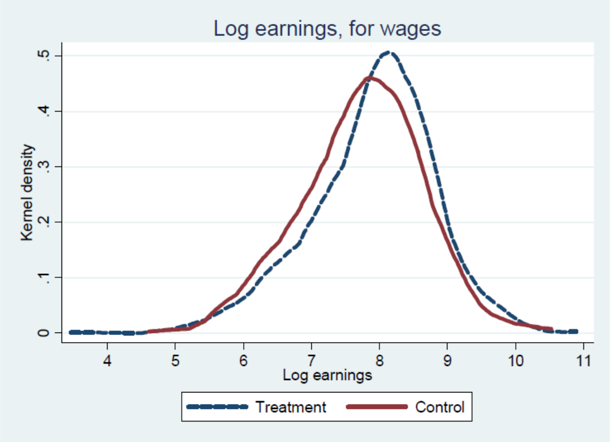


Table 3: Deworming impacts on labor earnings (2007-2009)

	Dependent variable:					
	Ln(Total labor earnings, past month)			Total labor earnings, past month (in Kenya Shillings)		
	(1)	(2)	(3)	(4)	(5)	(6)
Deworming Treatment indicator	0.191**	0.181**	0.242***	578**	576*	696*
	(0.078)	(0.077)	(0.092)	(292)	(306)	(418)
Deworming Treatment pupils within 6 km (in '000s), demeaned			0.183			345
			(0.167)			(734)
Total pupils within 6 km (in '000s), demeaned			-0.085			-124
			(0.126)			(571)
Additional controls	No	Yes	Yes	No	Yes	Yes
R^2	0.060	0.169	0.175	0.056	0.115	0.117
Observations	710	710	710	710	710	710
Mean (s.d.) in the control group	7.81	7.81	7.81	3,531	3,531	3,531
	(0.86)	(0.86)	(0.86)	(3,611)	(3,611)	(3,611)

Table 11: Returns to child deworming investments

Panel A: Benefits (per pupil in the treatment group)	
Total lifetime earnings (over 40 years, no time discount), excluding externalities	\$1,123
Lifetime earnings from wage productivity gains (over 40 years, no time discount), excluding externalities	\$700
Panel B: Costs (per pupil in the treatment group)	
Deworming pill and delivery (2.41 additional years in treatment schools)	\$0.65
Child opportunity cost of attending more school (as described in the text)	\$23.29
Additional teacher wages (due to school participation increases)	\$5.17
Deadweight loss of taxation (from raising revenue for teacher salaries)	\$1.16
Panel C: Benefit-cost ratio	
Total lifetime earnings / All costs	37.1
Lifetime earnings from wage productivity gains / All costs	23.1
Panel D: Internal rate of return (per annum)	
Total lifetime earnings and all costs	21.1%
Lifetime earnings from wage productivity gains and all costs	17.2%

Cost effectiveness analysis

- Benefit:
- Costs:
  -
  -
  -
  -

Bottom line: benefits/cost ratio: 23!

Conclusion

- School based deworming is extremely cheap and easy to do. In places where it worms are a problem (which can be measured with a survey) it is recommended policy (by WHO). This shows that a "small" program can have very large impact (there are very few things we know if that can increase wages by 20% every year!!!
- This also suggests a large elasticity of life time earnings with respect to better nutrition in childhood.
- However one surprising thing is that parents are not doing it themselves. In fact, when cost-sharing was introduced in the schools in treatment 1, take up fell to almost zero.
- Why coud that be?

Conclusion

- Where does this leave us in terms of thinking about poverty trap?
- If there is a cheap investment with a very high return (like deworming), then it is very hard to think that it could be the source of a poverty trap, in a mechanical sense: we need another ingredient (such as lack of information, low valuation of children's earnings, etc.)

References

- Deaton, A., and Dreze, J. (2009). Food and nutrition in India: facts and interpretations. *Economic and political weekly*, 42-65.
- Imbens, G. M., and Wooldridge, J. M. (2008). Recent developments in the econometrics of program evaluation. National Bureau of Economic Research.
- Haushofer, J., and Shapiro, J. (2013). Household response to income changes: Evidence from an unconditional cash transfer program in Kenya. Massachusetts Institute of Technology.
- Wolgemuth, Latham and Chesher: "Worker productivity and the nutritional status of Kenyan road construction laborers" Am J Clin Nutr July 1982 vol. 36 no. 1 68-78

References

- Miguel and Kremer "Worms" Quarterly Journal of economics
- Baird, Sarah, Kremer, Michael, Jessica Leino, Edward Miguel, and Alix Peterson Zwane. "Worms at work" Working paper, harvard.