# 14.73: The Challenge of World Poverty

## Lecture 3: Is There a Nutrition Poverty Trap?

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September 21, 2022

# Today: Is there a nutrition poverty trap?

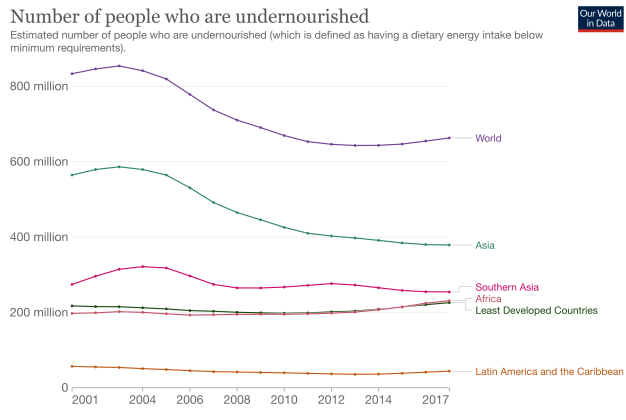
(1) The capacity curve

(2) Do the poor spend everything on food?

(3) Impact of increased income on food expenditures and caloric intake

(4) Impacts of increased caloric intake on productivity/income

# While severe famine may be history, malnutrition is not.



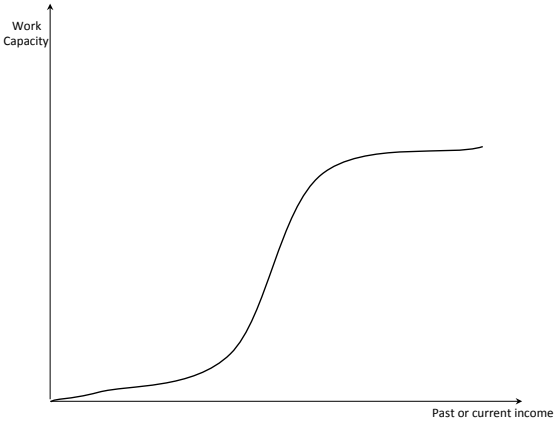

- About 720 to 811 million people were estimated to be under-nourished in 2020 (UN Agency FAO). How is this estimated?
- Symptoms of malnutrition: anemia, low BMI (body mass index), small and thin children.
- Recent increases in food prices made things worse, especially for the poor:
  - The poor spend disproportionate budget share on food.
  - Might this lead to vicious circles?

# The idea of a nutrition-based poverty trap

- What is the story of Pak Solhin in *Poor Economics*?
  - With your wage, you buy food, which gives you strength, which allows you to get wages.
  - Pak Solhin doesn't have well-paid work. Therefore he doesn't make enough money.
  - Because he doesn't have money to buy food, he doesn't eat enough.
  - Because he doesn't eat enough, he is weak and cannot find work.

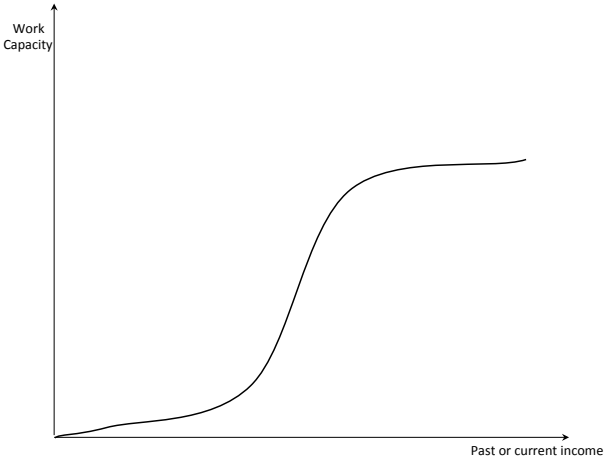
- This creates a relationship between income today, and income tomorrow (or with wage level, and the ability of the poorest people to work).

# What is the capacity curve?



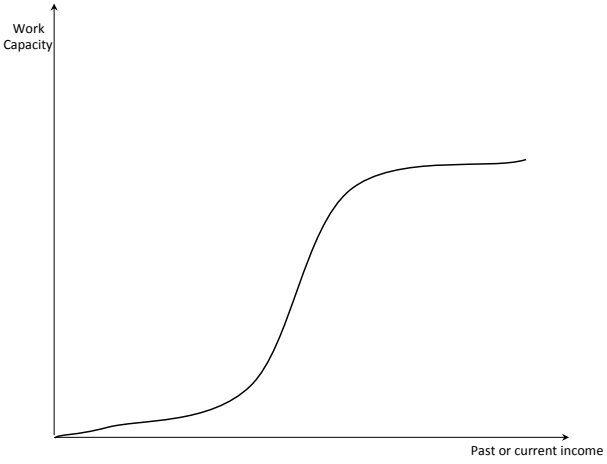

- The capacity curve relates (past or current) income to work capacity (productivity).
- The first few calories are used by your body just to survive: they do not make you strong.
- When you start eating enough to survive, the next calories start giving you strength.
- Pak Solhin (who is very poor) may not have enough to eat to be very productive, but if he could eat more, he would be.

# Why might the capacity curve have the depicted shape?



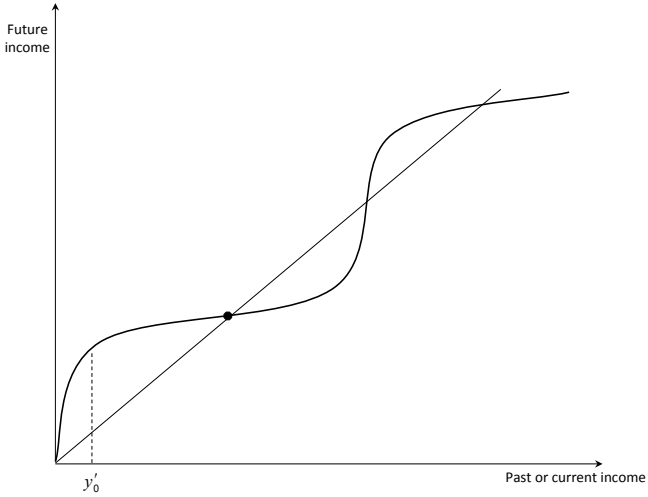

- Work capacity severely impeded at low levels of income
- Additional income makes little difference at low income levels.
- Stark increase of work capacity at intermediate income levels
- Small additional effect of additional income at higher levels

# What other channels may create a similar relationship?



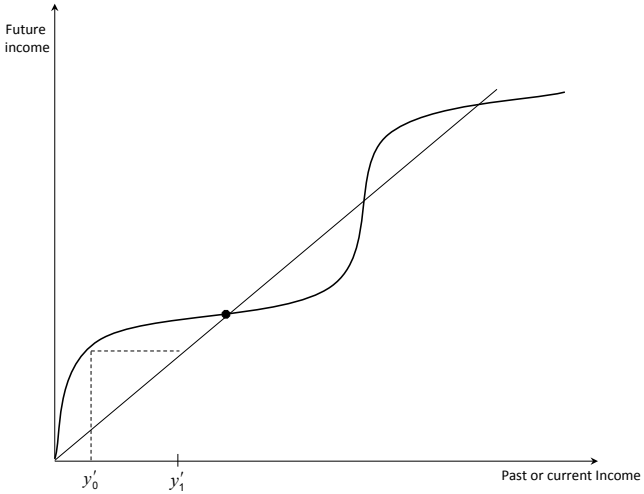

- Many possible channels!
  - Health
  - Education (across generations)
  - Access to credit
  - Savings/investments
  - Access to labor market
  - Stress, depression, sleep deprivation
  - ...
- We will study them one by one throughout this course.

# The dynamics of income over time



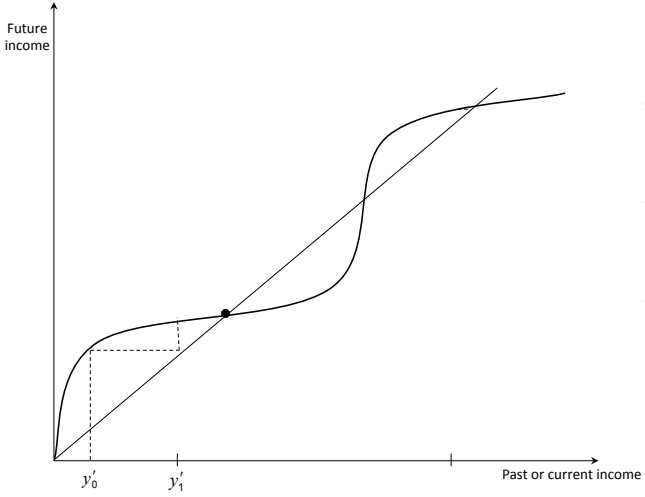

- Change in y-axis! What are we assuming here?
- What is the role of the 45 degree line?
- What are points where the capacity curve intersects with the 45 degree line? We call those steady states.
- Suppose you start at $y_0$. How does your income evolve?

# Income dynamics: (1) start at current income $y_0'$



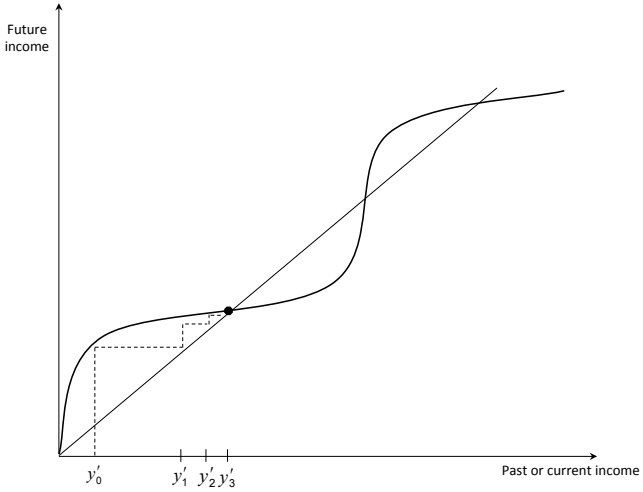

- How does income change over time?
- Find corresponding future income level (on capacity curve).
- Once time passes, future income becomes past or current income.
- Use 45 degree line to determine the new income level ($y_1'$).

# Income dynamics: (2) continue with current income $y_1'$.



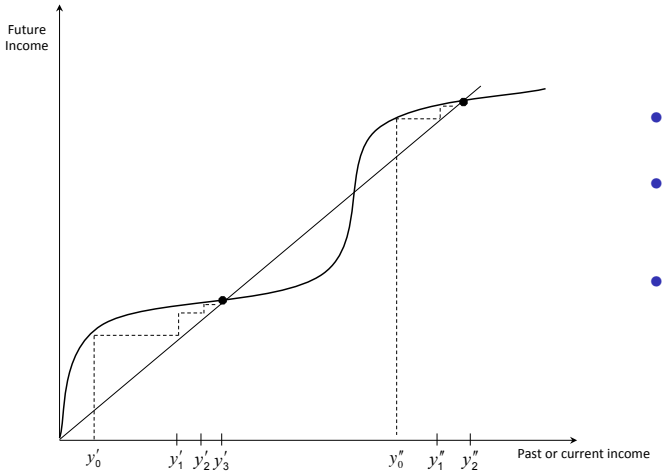

- Find corresponding future income level (on capacity curve).
- Once time passes, future income becomes past or current income.
- Use 45 degree line to determine the new income level ($y_2'$).

# Income dynamics: (3) continue until you reach a steady state



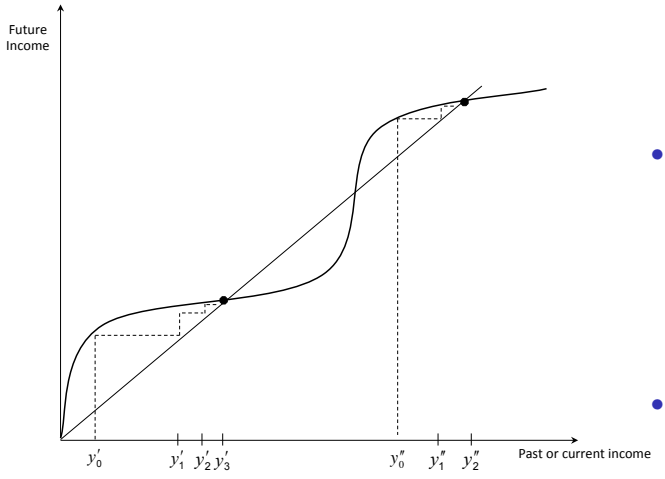

- Continue until you reach point at which capacity curve and 45-degree line intersect (steady state).

# Income dynamics: other starting points



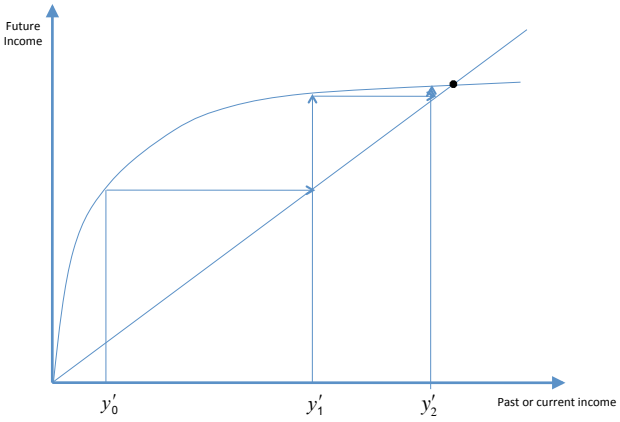

- What happens if you start at of $y_0''$?
- What happens if you start a bit to the right of $y_3'$?
- What determines where people end up in steady state?

# When does a poverty trap emerge?



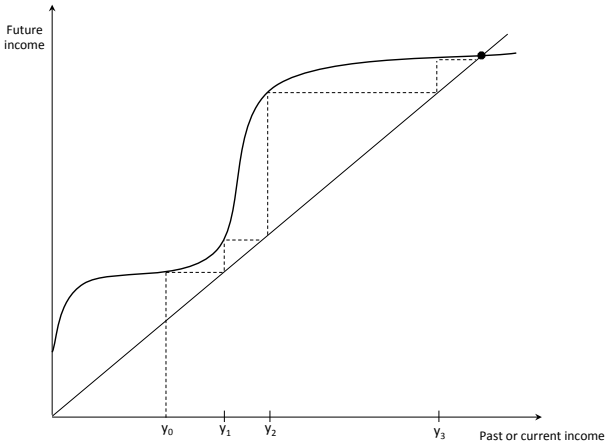

- What characterizes a poverty trap?
  - Multiple steady states
  - Where you start from determines where you end up.
- What does this imply for the shape of the capacity curve?
  - Need an S-shaped capacity curve.
  - Need the capacity curve to intersect the 45-degree line from below.
  - So the capacity curve needs to be steep in some places.
- When does a poverty trap *not* emerge?

# Examples of situation without poverty trap (1)



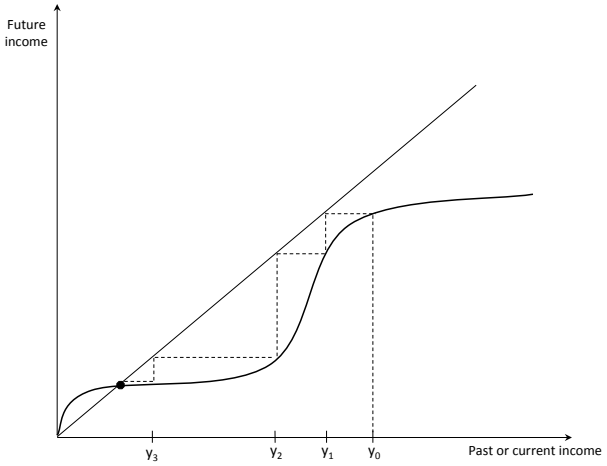

- With a concave relationship between income today and income tomorrow there is no poverty trap.

# Examples of situation without poverty trap (2)



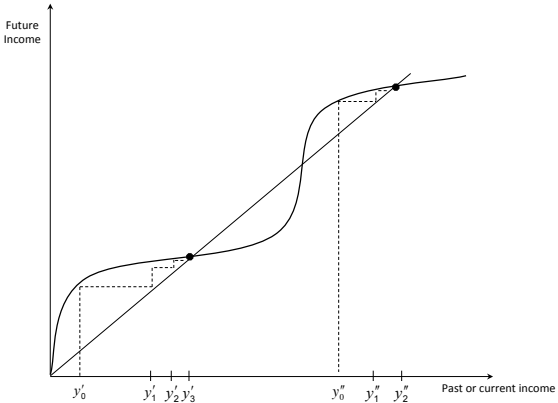

- An S-shaped curve alone is not sufficient!
- If the S-shaped part of the capacity curve is entirely above the 45 degree line, there is no poverty trap either.

# Examples of situation without poverty trap (3)




- An S-shaped curve alone is not sufficient!
- If the S-shaped part of the capacity curve is entirely below the 45 degree line, there is no poverty trap either.

# Summarizing key features of a poverty trap




- Poverty traps are situations with multiple steady state: the capacity curve intersects with the 45 degree line several times.
- A double feedback loop (e.g. poor nutrition lowers income, and low incomes means you cannot buy a lot of food) is *not* sufficient for the existence of a poverty trap.
- The relationship has to be sufficiently strong: this is an error many people (including policymakers) make!

# Policy implications

- Why is it important to know whether there is a poverty trap?
- A poverty trap opens possibility of a "big push": a small action could have big benefits: so it may be the socially optimal thing to do.
- Many food programs are based on this idea.
- On the other hand, if we are in the case without poverty trap, helping the poor in this way will simply be a form of redistribution, but it won't produce durable efficiency gains.
- If there is no nutrition poverty trap, then cash transfers are likely more efficient than food transfer program (which often have a lot of leakage).

# Is there a nutrition poverty trap?

- Idea: Low income → low nutritional intake → low productivity and income.
  - Ideal test: does the capacity curve intersect with the 45 degree line from below?
  - Implication: the capacity curve needs to be steep (somewhere), with a slope above 1.
  - Does an increase in income today result in an income tomorrow even larger than the increase in income today?

- The capacity curve (future income as a function of income today) combines two functions:
  (1) Caloric intake as a function of income
  (2) Income as a function of caloric intake

- We will now study these two relationships one at a time.
  (1) Impact of increased income on caloric intake
  (2) Impact of increased caloric intake on productivity (income)

- Need the combination of (1) and (2) to be large!

# Question 1: Do the poor spend most of their money on food?

- With an S-shaped nutrition-productivity curve, what would we expect the poor to do?
  - Eat as much as they can! The share of food in the budget would be very high for them.
  - If you have some unavoidable expense (e.g. clothes, housing), expenditures on food would first increase more than proportionally, and then less than proportionally. Example:
    - Budget: 20 rupees; spend 5 rupees on clothing/housing, 15 rupees on food.
    - Budget: 30 rupees; spend 5 rupees on clothing/housing, 25 rupees on food.
    - Budget: 45 rupees; spend 10 rupees on clothing/housing, 30 rupees on food; and 5 rupees on other stuff (e.g. movies).

- In the example, a 50% increase in income (from 20 to 30 rupees) leads to a 66% increase in food expenditures (from 15 to 25 rupees).
  - Diving the two is called an *elasticity*: by what percentage does food expenditure increase as income increases by one percent?
  - If there is a nutrition poverty trap, this elasticity should be very high for the poor.

# Do the poor spend most of their money on food?

**Table 3: How the poor spend their money**

| | As a Share of Total Consumption | | | | | | % HHs with any Festival |
|---|---|---|---|---|---|---|---|
| | Food | Alcohol/ Tobacco | Education | Health | Entertainment | Festivals | Expenditure |
| **Living on less than $1 a day** | | | | | | | |
| **Rural** | | | | | | | |
| Cote d'Ivoire | 64.4% | 2.7% | 5.8% | 2.2% | 0.0% | 1.3% | 59.9% |
| Guatemala | 65.9% | 0.4% | 0.1% | 0.3% | | 0.1% | 7.7% |
| India - Udaipur | 56.0% | 5.0% | 1.6% | 5.1% | 0.0% | 14.1% | 99.4% |
| India - UP/Bihar | 80.1% | 3.1% | 0.3% | 5.2% | 0.1% | 2.2% | |
| Indonesia | 66.1% | 6.0% | 6.3% | 1.3% | 0.0% | 2.2% | 80.3% |
| Mexico | 49.6% | 8.1% | 6.9% | 0.0% | 0.7% | 0.0% | 2.7% |
| Nicaragua | 57.3% | 0.1% | 2.3% | 4.1% | 0.0% | 0.0% | 1.8% |
| Pakistan | 67.3% | 3.1% | 3.4% | 3.4% | 0.3% | 2.4% | 64.8% |
| Panama | 67.8% | | 2.5% | 4.0% | 0.6% | 0.0% | 0.0% |
| Papua New Guinea | 78.2% | 4.1% | 1.8% | 0.3% | 0.2% | 1.5% | 21.7% |
| Peru | 71.8% | 1.0% | 1.9% | 0.4% | 0.0% | | |
| South Africa | 71.5% | 2.5% | 0.8% | 0.0% | 0.1% | 3.2% | 90.3% |
| Timor Leste | 76.5% | 0.0% | 0.8% | 0.9% | 0.0% | 0.0% | 49.0% |

Figure: Food expenditures among the poor based on World Bank LMIS (Banerjee and Duflo 2008)

# Do the poor spend most of their money on food?

- Food budget shares among the poor are around 60 to 70 percent, with quite a bit of variation across places, suggesting that people are making some choices.
- What could people do to increase their caloric intake? Two potential margins:
  - Spend larger share of their income on food (e.g. less on alcohol, tobacco, festivals, etc.)
  - Eat different kinds of food (i.e. relatively more nutritious food for given expenses)

# Do people eat more calories as they become richer?

- How can we test whether caloric intake is increases rapidly with income for the very poor?
  (1) Compare people with different incomes (cross-section)
  (2) Study impacts of food subsidies
  (3) Study impacts of cash transfers

# Is caloric intake is increasing very rapidly with income for the very poor?

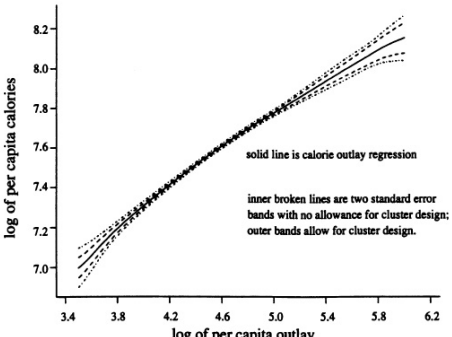



FIG. 2.—Regression function for log calories and log per capita expenditure, Maharashtra, India, 1983.

Figure: Deaton and Subramanian (1996)

- Log of calorie consumption plotted against the log of total household expenses per capita (outlay). This is called an *Engel Curve*.
- Slope is about 0.35: when total expenditures per capita increase by 1%, consumption of calories increase by 0.35% This is an *elasticity*.
- Estimation allows for non-linear shape of this curve. But it looks linear! Even for the poorest, elasticity is only about 0.35.
- Income elasticity of *overall* food expenditure is 0.7. What does this imply?

# As people get richer, they also buy more expensive calories.

TABLE 1

EXPENDITURE PATTERNS, CALORIE CONSUMPTION, AND PRICES PER CALORIE, RURAL MAHARASHTRA, 1983

| | Expenditure Shares (%) | | | Calorie Shares (%) | | | Price per Calorie (Rupees per 1,000 Calories) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Mean (1) | Bottom 10% (2) | Top 10% (3) | Mean (4) | Bottom 10% (5) | Top 10% (6) | Mean (7) | Bottom 10% (8) | Top 10% (9) |
| **A. Food Groups** | | | | | | | | | |
| Cereals | 40.7 | 46.0 | 31.0 | 70.8 | 77.3 | 57.3 | .64 | .51 | .79 |
| Pulses | 8.9 | 10.2 | 7.8 | 6.6 | 6.2 | 7.2 | 1.51 | 1.44 | 1.60 |
| Dairy | 8.1 | 4.9 | 11.8 | 2.8 | 1.3 | 4.9 | 3.69 | 3.59 | 3.92 |
| Oils and fats | 9.0 | 9.2 | 9.2 | 5.9 | 4.8 | 7.6 | 1.74 | 1.67 | 1.81 |
| Meat | 5.1 | 3.4 | 6.4 | .7 | .4 | 1.0 | 11.7 | 11.0 | 12.2 |
| Fruits and vegetables | 10.5 | 8.5 | 12.0 | 3.5 | 2.3 | 5.4 | 3.90 | 3.83 | 3.85 |
| Sugar | 6.5 | 7.4 | 5.9 | 7.2 | 7.0 | 8.0 | 1.01 | .94 | 1.09 |
| Other food | 11.3 | 10.4 | 16.1 | 2.5 | 0.8 | 8.6 | 17.4 | 16.8 | 15.9 |
| **B. Cereals** | | | | | | | | | |
| Rice | 11.6 | 9.0 | 10.9 | 15.2 | 10.1 | 16.5 | .95 | .89 | 1.02 |
| Wheat | 5.6 | 3.8 | 7.9 | 8.5 | 4.7 | 14.4 | .79 | .73 | .82 |
| Jowar | 18.2 | 27.4 | 9.3 | 37.8 | 52.9 | 21.6 | .50 | .43 | .55 |
| Bajra | 3.0 | 2.7 | 1.3 | 6.6 | 4.9 | 3.2 | .48 | .48 | .50 |
| Other coarse cereal | 1.2 | 2.8 | .3 | 2.2 | 4.5 | .6 | .66 | .58 | .99 |
| Cereal substitutes | 1.1 | .5 | 1.3 | .6 | .2 | .8 | 2.23 | 2.22 | 2.22 |
| Total food (or total calories) | 67.4 | 73.4 | 54.1 | 2,120<br>2,098 | 1,385<br>1,429 | 3,382<br>3,167 | 1.14 | .88 | 1.50 |

NOTE.—Mean refers to mean over the whole sample, bottom 10% to mean over households in the bottom decile of per capita household expenditure, and top 10% to mean over households in the top decile of per capita household expenditure. The figures in the last row of panel B are unadjusted and adjusted total calories, respectively, where the adjustment corrects for meals given to others or not received from others; see the text for a full description. Shares of calories and of expenditures are calculated on an individual household basis and are averaged over all appropriate households. Calorie prices are averages over consuming households.

Figure: Deaton and Subramanian (1996)

- Expenditure shares and prices per calorie for the poor vs. the rich.
- Meat, fruits, and dairy instead of cereals
- Rice instead of coarse cereals
- Suggests people don't maximize caloric intake.

# Impacts of food subsidies (Jensen and Miller 2008)

- Jensen and Miller (2008) study this issue in a different way: they search for a *Giffen good*, a good whose consumption *increases* when the price increases (or equivalently, consumption of the good decreases as the price decreases).

- Why are Giffen goods surprising? We usually expect demand curves to slope down!

- Two effect when the price of a good decreases:
  - **Substitution effect:** you want to consume more of this good because it has become less expensive than other goods (the good is a better deal).
  - **Income effect:** you can now afford more overall (you have more available income) since your expenditure on the good has gone down due to the price decrease
    - Normal goods have positive income effects (you consume more as income goes up);
    - Inferior goods have negative income effects (you consume less as income goes up).

- Giffen goods are inferior goods with an income effect that is so strong that it dominates the substitution effect!

# Jensen and Miller (2008): in search of a Giffen good

- First finding: in Chinese cities where the price of rice is higher, people consume more rice.
  - Why is this result not conclusive? It mixes up changes in demand and supply.

- RCT can help isolate people's demand response!
  - Among a sample of households in Hunan, randomly choose a subsample of them.
  - Distribute vouchers for reduced price of rice in Hunan to the random subsample, for more than month's supply.
  - Make sure that households do not exchange or trade them (otherwise it would be a pure income transfer, there would be no substitution).
  - After 6 month, ask households detailed questions about their consumption of rice, wheat, and other stuff.

# Jensen and Miller (2008): Results

- When the price of rice decreases by 10 percent, rice consumption *decreases* by 2.5% (elasticity: -0.25)
  - Jensen and Miller found a Giffen good!
- Households consume more of other goods:
  - Households with the subsidy report increased consumption of seafood (and maybe meat).
  - Decrease in expenditures on rice due to the subsidy allows people to spend more on seafood.
- Note: they also do this experiment in a different province (Gansu) with a different good (wheat) and find that wheat is not a Giffen good.

# Jensen and Miller (2008): Implications for nutrition policy

- Many countries use food price subsidies to encourage greater nutrition (e.g. national subsidy for rice in rice-consuming regions).
- What do the Jensen and Miller (2008) results suggest for such policies?
  - If households consume less rice and more shrimps, but shrimps are not very nutritious per dollar spent, the effect on calorie consumption of subsidizing rice may not be large, and it may even be negative. This is what Jensen and Miller (2008) find in Hunan.
  - And this is true not only for calories but also other nutrients.
- What does this tell us about the effect of income on calorie consumption in this population? It must be negative!

# (How) can we reconcile this result with the Engel curves we saw for India?

- Above, we were comparing different households, not the same households as we give them more money.
- This may lead us to over-estimate the impact of well-being on calorie consumption:
  - Those who eat more may be more productive and have more money (reverse causality)
  - Those who have more income may be have different tastes, and would may be eat more even if they were poorer (for example, people who smoke may both eat less and earn less).
- Solution: RCT evidence of (unconditional) cash transfers (GiveDirectly)!
- *Note:* Of course, the settings (India vs. China) are also very different, and even within China, Jensen and Miller (2008) did not find evidence of Giffen goods in Gansu.

# Haushofer and Shapiro (2016): RCT with GiveDirectly!

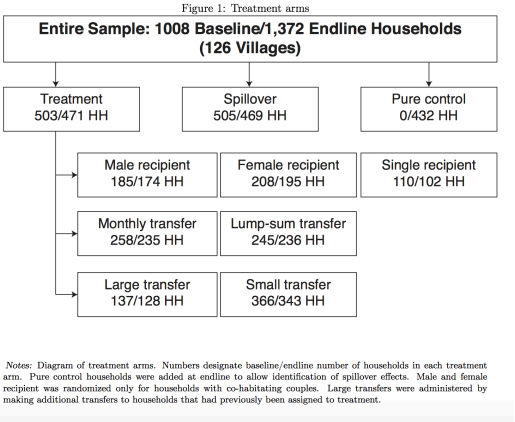



Figure: RCT Design of Haushofer and Shapiro (2016)

- RCT with poor households in Kenya
- Some people are randomized to receive cash transfers, others form the control group.
- Other variation:
  - Who receives the transfer
  - Monthly vs. lump-sum
  - Small vs. large transfer
- *Note:* GiveDirectly did not enough resources available to give everyone cash.

# 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.

# Treatment effects on monthly consumption

| | (1) Control mean (std. dev.) | (2) Treatment effect | (3) Female recipient | (4) Monthly transfer | (5) Large transfer | (6) $N$ |
|---|---|---|---|---|---|---|
| Food total (US$) | 104.46 | 19.46*** | −1.81 | 1.79 | 8.28 | 940 |
| | (58.50) | (4.19) | (7.37) | (7.42) | (7.59) | |
| Cereals (US$) | 22.55 | 2.23** | 0.37 | −1.06 | 2.68 | 940 |
| | (17.18) | (1.13) | (1.87) | (1.86) | (2.07) | |
| Meat & fish (US$) | 12.97 | 5.05*** | 0.87 | −2.93 | 2.52 | 940 |
| | (13.75) | (1.01) | (1.82) | (1.92) | (1.63) | |
| Alcohol (US$) | 6.38 | −0.93 | 1.56 | 1.03 | −1.42 | 940 |
| | (16.56) | (0.99) | (1.62) | (1.64) | (1.33) | |
| Tobacco (US$) | 1.52 | −0.15 | 0.12 | 0.42 | −0.29 | 940 |
| | (4.13) | (0.22) | (0.34) | (0.33) | (0.30) | |
| Social expenditure (US$) | 4.36 | 2.43*** | −2.06** | −0.52 | 0.62 | 940 |
| | (5.38) | (0.48) | (0.97) | (0.99) | (0.90) | |
| Medical expenditure past month (US$) | 6.78 | 2.58*** | 2.06 | −1.34 | −0.29 | 940 |
| | (13.53) | (0.99) | (1.86) | (1.86) | (1.74) | |
| Education expenditure (US$) | 4.71 | 1.08** | 0.48 | −0.02 | 1.15 | 940 |
| | (8.68) | (0.51) | (0.88) | (0.87) | (0.91) | |
| Non-durable expenditure (US$) | 157.61 | 35.66*** | −2.00 | −4.20 | 21.25** | 940 |
| | (82.18) | (5.85) | (10.28) | (10.71) | (10.49) | |
| Joint test ($p$-value) | | .00*** | .47 | .13 | .01*** | |

Figure: Haushofer & Shapiro (2016): results

- Reading the table:
  - Column 1: mean of control group
  - Column 2: difference between treatment (any transfer) and control group
  - Columns 3 to 5: additional effects of other treatment variation
  - Below each number: the standard error of the difference
  - The little stars next to the number?
- **Key result:** transfer increases total food expenditures by $19.46, or 18.6% relative to the control group.
- Overall expenditures increased by 22.6% (35.66/157.61)

# Going from the treatment effect to an elasticity

- The transfer is a temporary income shock!
  - We do not expect households to eat all of it at once.
  - In general we consider expenditure elasticity: e.g. the elasticity of food consumption wrt to total expenditure.

- How do we find the expenditure elasticity?
  - Calculate the ratio between the proportional increase in food expenditure (or any other you are interested) to the ratio in total (non-durable) expenditure.
  - Food expenditures increased by 18.6% (19.46/104.46) while overall expenditures increased by 22.6% (35.66/157.61).
  - The ratio of the two increases is about 0.8!

- Is the impact on food expenditure what you would like to see?
  - No, we would like to see calories!
  - Almas et al. (2019) use food prices and estimates of calories to find an elasticity of 0.6.

# Impact of income on caloric intake: summary

- Most studies find a pretty robust response of food expenditure to total expenditure. But the headline number is fairly clearly below one (0.6 is perhaps the best estimate).
- As people become richer, they don't increase calorie consumption proportionally, in part because they substitute to other types of food.
- This will tend to make the capacity cure more shallow.
- We need to see a very strong slope of the relationship between nutrition and productivity to generate a poverty trap from the basic adult capacity curve mechanism.

# Does eating more make people more productive?

- Why are poor households not eating more and not seizing every available opportunity to eat more?
- Maybe they don't need to eat as much anymore?
  - Over time, in India, need for calories have gone down: less "backbreaking work", fewer illnesses.
- And maybe the resulting productivity effects are not that large?
  - Want: estimates of impact of calories on productivity. Few studies exist!
  - Strauss (1986) studies impact of calories on productivity in Sierra Leone (not an experiment, but Strauss used the fact that people eat less when the price of food goes up).

# Does eating more make people more productive? (Strauss 1986)

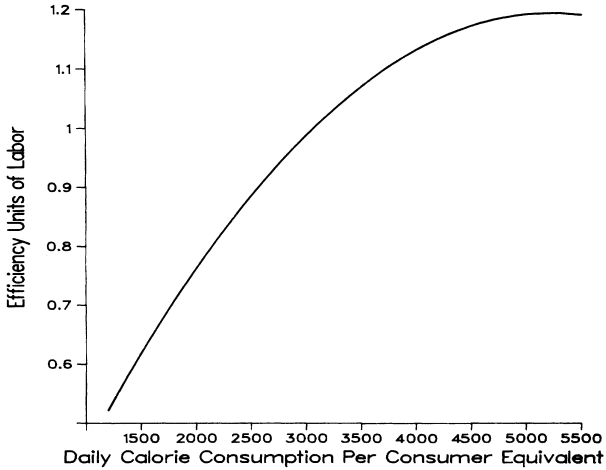



Figure: Productivity as function of nutrition (Strauss 1986)

- Calories makes people more productive, but it looks like an inverted L-shape curve.
- Implied elasticity is highest for the poorest.
- When their calorie consumption increase by 1%, their productivity increase by 0.4%, and after that it goes down.

# Overall summary

- Increasing income does increase caloric intake but the elasticity is clearly below 1.
  - Deaton & Subramanian (1996) estimate income elasticity of caloric intake of 0.35.
  - Jensen & Miller (2008) even find negative income effects!
  - Haushofer & Shapiro (2016) evidence suggests an elasticity of around 0.6.

- Similarly, eating more does seem to increase productivity but the impacts are modest.
  - Strauss (1986) finds elasticity of 0.4 (or less).
  - Experiment by Wolgemuth (1982) with Kenyan road workers finds elasticity of 0.54.
  - More recent RCT finds no effect of increasing caloric intake on productivity in flower plant in Ethiopia (Park and Kim 2022).

- So the impact of increased income on productivity is at most 0.54 * 0.6 = 0.324!
  - This is clearly below 1! And increased productivity might not even lead to larger wages.
  - Overall, this evidence suggest that a nutrition-based poverty trap is unlikely.
  - So policies that insist that the big problem is not eating enough calories are likely misguided.

# But this is not the end of the story!

- There could be longer-run effects, e.g. from improved micronutrients. (e.g. iron).
- In addition, child nutrition (and more broadly, child health) could be a mechanism through which such a trap could merge.
- Idea: a short-run (or even one-time) investment might have long-run effects: this can lead to large returns in terms of life-time income.
- E.g. better nutrition in-utero or during childhood might make you a stronger/smarter/healthier → steep capacity curve.
- Stay tuned for next week's lecture!