Data: good data on farm productivity, land characteristics etc... Results: Table 1 and Figure 2.

Implied elasticities:
- Calories: 0.33 (0.11)
- Labor: 0.60 (0.18)
- Hired labor: 0.13 (0.15)
- Capital: 0.03 (0.10)
- Land: 0.26 (0.10)

The highest output is obtained at 5,200 calories, and it flattens after 4,500 calories. At an intake of 1,500 calories, the calories elasticity is 0.75...

Problem: i and ε are endogenous.

Instruments: number of adults, prices of foodstuff, assets, price of output. None of these instruments is perfect.

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**ESTIMATING THE RELATIONSHIP BETWEEN NUTRITION AND ELASTICITY**

Classic study: Strauss (1986)

Farmers in Sierra-Leone: semi-arid area, strenuous physical activity.

Seeks to estimate the relationship:

\[ y = f(\varepsilon; i; \epsilon; X) \]

- \( y \): Farm production
- \( \varepsilon \): Efficiency value of labor, \( i \): number of hours worked, \( \epsilon \): nutrition obtained, \( k \): capital (land, animals, etc...), \( X \): land characteristics
- \( f(\varepsilon; i; \epsilon; X) \): Cobb-Douglas, \( \varepsilon(\varepsilon) \): quadratic specification.

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**THE IMPACT EVALUATION QUESTION**

Does a policy intervention (or an NGO program) caused a change in the outcomes of individuals exposed to the policy relative to what they would have experienced otherwise?

**Potential outcome**

Let us call \( Y^P \) the health of an individual if he was exposed, and \( Y^N \) the health of the same individual if he was not exposed.

\[ E[Y^P|\text{PROGRAM}]-E[Y^N|\text{NO PROGRAM}]=E[Y^P|\text{V}]-E[Y^N|\text{V}] \]
\[ E[Y|X = x] - E[Y|X = x] = E[Y|X \neq x] - E[Y|X = x] \]

Slide 5

The first term is what we try to isolate (effect of treatment on the treated), the second is the selection bias.

When we compare people affected by a policy and people who were not affected, we confound the real effect of the program and the intrinsic difference between people who were affected and people who were not affected.

How to eliminate the selection bias?

- Natural or randomized experiment: \( E[Y^{NT}|X] - E[Y^{NT}|X] \) (Miguel and Kremer, Karlan)
- Controlling for observables. Assume that you know \( X \) such that \( E[Y|X = x] = E[Y|X = x] \). Regression (Deaton-Subramanian, Shaban, Banerjee-Duflo, Udry)
- Matching
- Policy changes: simple differences (Spohr)
- Policy changes: differences in differences - (Duflo, Banerjee-Gertler-Ghatak, Besley-Burgess, Burgess-Pande)
- Discontinuity in policy rules - Example Angrist-Lavy
- Instrumental variables: Duflo (2001), Duflo-Udry

Slide 6

Experimental evidence: Food supplement

Example: 302 Rubber tree tapers in Indonesia where assigned to a control or a treatment group, and individuals in the treatment group received iron supplement.

- It did reduce anemia level in the treatment group.
- Wages increased in the treatment group.
- Iron supplement should have no effect on earnings other than those coming from improvement in health ⇒ We can infer that all the effect of the iron supplement is due to the effect it had on health ⇒ The fact that earnings improved is a sign that health is important for earnings.
- HOW important? To calculate an elasticity, could use assignment to iron supplement group as an instrument for hemoglobin level.

Miguel-Kremer: Impact of Deworming

- One in four people worthwhile affected by worms. Treatment is either one or two pills per year. Worms affect anemia, energy level.
- Program took place in 75 rural Kenyan primary schools.
- Program design: Randomization at the school level
- 3 groups (26 schools each) treated in 98, 99, 2001.
- In 1998, group 1 schools are treatment schools, in 1999, group 1 and 2 schools are treatment schools.
- Treatment schools treated for geohelminth and those with high schistosomiasis (75%) treated for it.
- Children above 13 were not treated.
- Beginning January 1999, need parental consent
- Baseline (table 1): little difference between groups
- Treatment rates (table 3): Compliance not very high in 1999.
RESULTS: HEALTH OUTCOMES

- Group 1 children less affected than Group 2 children
- They have better health outcomes
- Need to take into account externalities (worms travel)
- Table 6: Children who are untreated in group 1 are doing better than children who are untreated in group 2.
- Note: this is a non-random subset, however the bias would probably go the other way.
- Externalities across schools: table 7

RESULTS: SCHOOL PARTICIPATION

- Participation collected with random visits (about 3.8 per year and school).
- Table 9: regression results.
- Using treatment as instrument for illness, illness decreases school attendance by 16.9 percentage point (on a basis of about 80%).
- Not an elasticity, but a large number.

CONCLUSION

Quantitative evidence on adult health-income relationship does not suggest a poverty trap would emerge in the Das Gupta-Ray model.

However, children health may be a conduit (larger effects on one side, effect on the income-health side will be shown later).