14.74 Foundations of Development Policy
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Lecture 4: Income and Nutrition: Interrelationship

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Is there a nutrition based poverty trap:

We have seen in the last lecture that in order to have a proverty trap, the capacity curve which

links today's income to tomorrow income must intersect the 45 degree line from below:

The capacity curve links productivity to income: productivity $= \phi(\text{income}) = f(g(\text{income}))$

where:

- nutrition=g(income)

- productivity=f(nutrition)

A poverty trap will emerge if $f'g' > 1$. Let's denote income by y and do some algebra:

$$f'g' = gf' * \frac{g'}{g} = \frac{f'}{f}g * \frac{g'}{g}y * \frac{f}{y} \tag{1}$$

The expressions $\frac{f'}{f}g$ and $\frac{g'}{g}y$ are called"elasticities".

Definition of an elasticity of Y with respect to E. When E changes by 1%, Y changes by η %.

$$\eta = \frac{\frac{\partial C}{\partial E}}{\frac{C}{E}}$$

Elasticity is an important concept because it is unit-free: you do not need to know in what unit

expenditures and calories are measured. It is much easier to make comparisons across countries

and samples.

On the 45 degree line, $f = y$. Expression 1 tells us that there can be a nutrition-based poverty

trap *only* if the product of the elasticities of the income-nutrition and nutrition-productivity

relationships is greater than 1. It gives us a clear empirical fact to look for. n

1 The relationship between income and nutrition

We seek to estimate the elasticity of calories (or other nutrients) consumed with respect to total resources available.

Several things to keep in mind:

1.

2.

3.

1.1 Endogeneneity Issues

We know that calories (or other nutrients) consumed may lead to more resources (through the effect of nutrition on productivity). When we observe the relationship between nutrition and resources, we may be picking this up as well.

For now, we will ignore this issue (because the literature has not dealt with it) but we should keep it in the back of our mind

1.2 Functional Form Issues

We know that the elasticity is unlikely to be the same everywhere: in fact, this is the basis for the poverty trap.

We want to estimate:

$$\ln(\text{Calories per capita}) = g(\ln(\text{Expenditures per capita})) + \epsilon$$

$$y = g(x) + \epsilon$$

And we want to be agnostic on the shape of $g(.)$

Two questions:

- Why do we run the relationship in logs?

- Once we have estimated this function $g(.)$, where can we read the elasticity? (hint: think of a log-log regression)

To estimate this relationship, we use a *non-parametric method*: we are looking for the $g(.)$ that follows as closely as possible true shape of the function, while not being driven by the cloud of point: there is a trade off between bias and variance.

Three possible methods:

- Approximate the $g()$ with a series of polynomial, and run a familiar linear regression.

- Chose a grid of point for x $(x_1, x_2, ...)$ and at each of point x_k, compute a weighted average of y, giving more weight to the points that are closer to x_k: kernel regression.

- Same method, but at each point x_k, run a weighed regression, and take the predicted value: local linear regression $y = \alpha x + \epsilon$. Advantages of this methods:

  - It is not biased at the edges

  - Since we run a regression, we can immediately read the local elasticity at x_k: it is α!

1.3 Measurement issues

- Measurement of the calories

  - Can we observe the calories directly?

  - How can we infer them?

  - When we infer them from expenditures, what problem to do we into?

- First issue: quality.

Expenditure = number of calories*price of calorie

log(food expenditure) = log(number of calories) + log(price of calories)

Imagine running the regression:

$$\log(\text{food expenditure per capita}) = g(\log(\text{Expenditures per capita})) + \epsilon$$

This can be rewritten:

$$\log(\text{Calories per capita}) + \log(\text{Price per calorie}) = g(\log(\text{Expenditures per capita})) + \epsilon$$

There is a positive correlation between the price of calories and the expenditures per capita. In what direction does that bias α?

• Second issue: Waste, food given away to people, meals received elsewhere.

We need to correct for this by calculating the expenses on items in a very detailed way.

1.4 The nutrition-income relationship in India

Deaton and Subramanian: Maharastra, India

- The relationship between expenditure and calories

  - Figure 2: More expenditures → better nutrition.

  - Figure 3: Elasticity: derivative of the curve in figure 2. It is declining with expenditures (the curve is concave), but not very fast.

- The relationship between quality and expenditures

  - An indicator of quality: price paid per calorie.

  - Figure 4: Log of price per calorie increases with expenditures.

  - Figure 5: Elasticity is fairly constant with expenditures.

• Parametric results

$$\ln(\text{Calories per capita}) = \alpha \ln(\text{Expenditures per capita})) + X\beta + \epsilon$$

What do they find for α?

Dreze and Deaton: The evolution of the income-calories relationship in India over time.

See the pictures.

- What do you observe?

- How can we explain that?

1.5   Conclusion

There is a fairly sizeable relationship between income and nutrition (an elasticity of about 0.3). However, the relationship is nowhere close to 1, even for the poorest.

In a sense, it is surprisingly large, because the price of the cheapest calories is very low in India. The cheapest meals are not expensive. One could think that the poorest household would eat as much calories as they need, and then as they become richer, acquire better quantity.

It could be :

- beginitemize

- because the relationship is over-estimated:

    - Reverse causality

    - Omitted varibles

- because even the very poorest want to eat something which taste nice

- or because the effect of calories on productivity is low: calories are a luxury.

2   The relationship between nutrition and productivity

Is there evidence that this relationship is very steep?

- There is experimental evidence that better-fed workers are more productive at physical tasks. Experiment in Indonesia provided iron supplement to randomly selected household (reference in the reading list). Compared to other households, they were stronger, less likely to be anemic, less likely to be sick, worked longer hours, and earned more.

- However the elasticity of the productivity-nutrition relationship appears to be below 1, unless all the extra money is spent on specific nutrients: A study of the relationship between farm productivity and calorie consumption in Burkina Faso (Strauss 1986) finds an elasticity of 0.34, 0.49 for the poorest.

3   Conclusion: Should we abandon DasGupta and Ray?

- This exercise has shown us that this very clever and appealing model is not a literal description of the reality: the relationship between calories and nutrition is not steep enough to generate a poverty trap by itself: the product of the two elasticities is around 0.09, which is far from one!!

- However, the model forces us to think about how the nexus between human capital and income can lead to a vicious circle: this circle may be found in contexts other than the health and productivity nexus.

- Examples:

  - Child development: iron; worms; Iodine supplementation of pregnant women: small improvement in nutrition can have large long term consequences for the entire life via the education channel, or via irreversible losses (IQ, physical fitness) of poor nutrition in utero or early childhood: the elasticity of life-time earning with respect to improvement during childhood may be much larger than one. For example, Miguel and Kremer (2003) find that a school based deworming program that cost $0.49 would increase life time earning of affected children by $30: the elasticity is much greated by one.

  - Schooling investment

  - Investment in businesses with fixed cost. Suppose you need 100 dollars to buy your first bag of widgets: if there is no credit market, small changes in your baseline level of wealth will have large impact on productivity: poverty trap can emerge.