# 14.03/003 Micro Theory & Public Policy, Fall 2025

## Lecture 9. Giffen Goods and Subsistence Consumption

David Autor (Prof), MIT Economics and NBER

Salome Aguilar Llanes (TA), Nagisa Tadjfar (TA), Emma Zhu (TA)

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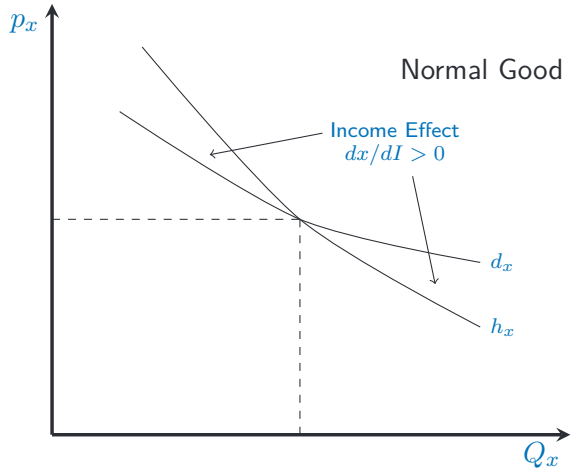
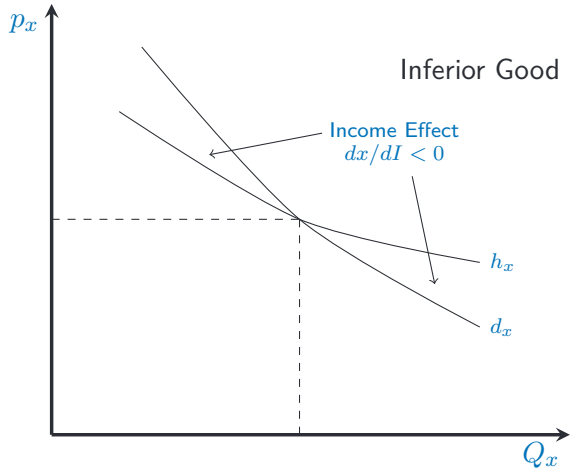
# The missing link between

# Compensated $\longleftrightarrow$ Uncompensated Demand

# Case of a normal good



# Case of an inferior good



# Relationship between compensated and uncompensated demand

Start with the following identity

$$h_x(p_x, p_y, U) = d_x(p_x, p_y, E(p_x, p_y, U))$$

Differentiate this equality

$$\frac{\partial h_x}{\partial p_x} = \frac{\partial d_x}{\partial p_x} + \frac{\partial d_x}{\partial I}\frac{\partial E}{\partial p_x}$$

Rearrange

$$\frac{\partial d_x}{\partial p_x} = \frac{\partial h_x}{\partial p_x} - \frac{\partial d_x}{\partial I}\frac{\partial E}{\partial p_x}$$

But what is $\frac{\partial E}{\partial p_x}$?

# Shephard's Lemma

- Shephard's Lemma relates $d_x$ to the expenditure function.
- This helps to compute the magnitude of the income effect following a price change.
- How does it work?
- Recall the expenditure minimization problem that yields $E(p_x, p_y, \overline{U})$ :

$$\min_{X,Y} p_x X + p_y Y \ s.t. \ U(X,Y) \geq \overline{U}.$$

# Shephard's Lemma continued: Langragian

The Lagrangian for this problem:

$$L = p_x X + p_y Y \ + \gamma(\overline{U} - U(X, Y)).$$

First order conditions:

$$\begin{aligned} \frac{\partial L}{\partial X} &= p_x - \gamma U_x = 0, \\ \frac{\partial L}{\partial y} &= p_y - \gamma U_y = 0, \\ \frac{\partial L}{\partial \gamma} &= \overline{U} - U(X, Y). \end{aligned}$$

$$\gamma = \frac{p_x}{U_x} = \frac{p_y}{U_y}.$$

# Shephard's Lemma continued: Solution

$$\frac{dL(X,Y,\gamma)}{dp_x} = X + \left(p_x\frac{\partial X}{\partial p_x} - \gamma U_x\frac{\partial X}{\partial p_x}\right) + \left(p_y\frac{\partial Y}{\partial p_x} - \gamma U_y\frac{\partial Y}{\partial p_x}\right)$$

Recall the following equations from above:

$$\begin{aligned} p_x &= \gamma U_x \\ p_y &= \gamma U_y. \end{aligned}$$

Substituting in:

$$\begin{aligned} &= X + \left(p_x\frac{\partial X}{\partial p_x} - p_x\frac{\partial X}{\partial p_x}\right) + \left(p_y\frac{\partial Y}{\partial p_x} - p_y\frac{\partial Y}{\partial p_x}\right) \\ &= X + 0 + 0 \\ &= X. \end{aligned}$$

*That's the envelope theorem at work*

# Intuition for Shephard's Lemma

$$\frac{\partial E(p_x, p_y, U)}{\partial p_x} = h_x(p_x, p_y, U)$$

- To hold utility constant given a small price change in $p_x$ *at the optimally chosen* $x^*$, expenditures must rise by the price change $\times$ the initial level of consumption, $x^*$
- Concretely, if you buy $2$ cups of coffee a day and the price of coffee rises by $\$0.01$ per cup, how much do we need to compensate you to hold utility constant? To a first approximation, $2$ cents
- Shephard's lemma holds only for a small price change. For a meaningful price change, the consumer would re-optimize her bundle to re-equate the MRS with the new price ratio.
- Also see Roy's identity, which will be useful for your p-set

# For self-study: Roy's identity

**We can apply a similar trick to the indirect utility f'n**

1. Differentiating the indirect utility f'n with respect to $p_x$ yields

$$\partial V(p_x, p_y, I)/\partial p_x = -\gamma d_x(p_x, p_y, I)$$

   *What's the intuition?*

2. And recall, the marginal utility of income from the indirect utility function

$$\partial V(p_x, p_y, I)/\partial I = \lambda$$

3. Taking the ratio of these two expressions gives us Roy's identity

$$-\frac{\partial V(p_x, p_y, I)/\partial p_x}{\partial V(p_x, p_y, I)/\partial I} = d_x(p_x, p_y, I)$$

   Roy's Identity is also an application of the *envelope theorem*.

# Back to relationship btwn compensated and uncompensated demand

Start with the following identity

$$h_x(p_x, p_y, U) = d_x(p_x, p_y, E(p_x, p_y, U))$$

Differentiate this equality

$$\frac{\partial h_x}{\partial p_x} = \frac{\partial d_x}{\partial p_x} + \frac{\partial d_x}{\partial I}\frac{\partial E}{\partial p_x}$$

Rearrange

$$\frac{\partial d_x}{\partial p_x} = \frac{\partial h_x}{\partial p_x} - \frac{\partial d_x}{\partial I}\frac{\partial E}{\partial p_x}$$

But what is $\frac{\partial E}{\partial p_x}$? Answer: it's $h_x$

Finally, apply Shephard's Lemma to get the *Slutsky equation*

$$\frac{\partial d_x}{\partial p_x} = \frac{\partial h_x}{\partial p_x} - \frac{\partial d_x}{\partial I}h_x$$

# Slutsky equation

The **uncompensated** demand response to a price change, $\partial d_x/\partial p_x$ is:

$$\begin{aligned}\frac{\partial d_x}{\partial p_x} &= \frac{\partial h_x}{\partial p_x} - \frac{\partial d_x}{\partial I}\frac{\partial E}{\partial p_x} \\ &= \frac{\partial h_x}{\partial p_x} - \frac{\partial d_x}{\partial I}h_x\end{aligned}$$

1. $\partial h_x/\partial p_x$: the **compensated** demand response...
2. *minus* **the income effect** $\frac{\partial d_x}{\partial I}$
3. *times* the effective change in income due to the price change, $\frac{\partial E}{\partial p_x} = h_x$.

# Summary: effect of price increase on Marshallian (uncomp) demand

1. **Normal good**: Substitution effect negative, **income effect negative**

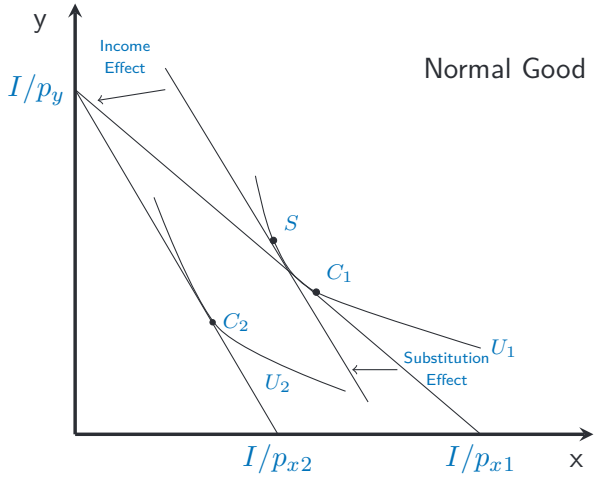
$$\frac{\partial d_x}{\partial p_x} = \underbrace{\frac{\partial h_x}{\partial p_x}}_{\text{Subst effect} < 0} \underbrace{\left[ -\frac{\partial d_x}{\partial I} \times h_x \right]}_{\text{Income effect} < 0} < 0$$

2. **Weakly inferior good**: **Substitution effect negative and dominant**, income effect **positive**

$$\frac{\partial d_x}{\partial p_x} = \underbrace{\frac{\partial h_x}{\partial p_x}}_{\text{Subst effect} < 0} \underbrace{\left[ -\frac{\partial d_x}{\partial I} \times h_x \right]}_{\text{Income effect} > 0} < 0$$

3. **Strongly inferior (Giffen) good**: Substitution effect negative, **income effect positive and dominant**

$$\frac{\partial d_x}{\partial p_x} = \underbrace{\frac{\partial h_x}{\partial p_x}}_{\text{Subst effect} < 0} \underbrace{\left[ -\frac{\partial d_x}{\partial I} \times h_x \right]}_{\text{Income effect} \gg 0} > 0$$


y
Income
Effect
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Normal Good
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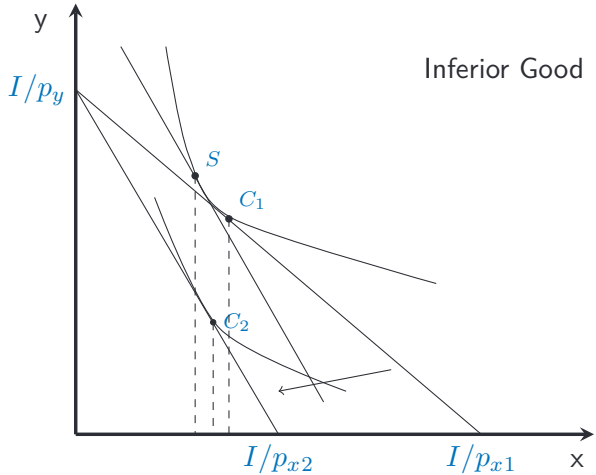
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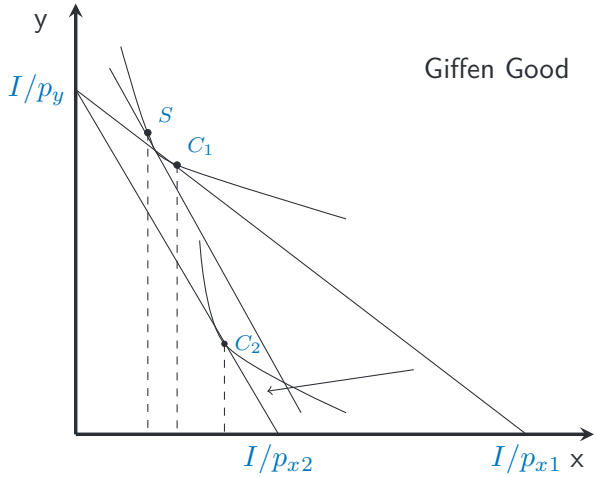
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# The brutal economics of subsistence consumption—Evidence from China

## Jensen and Miller 2008

# Giffen goods and subsistence consumption

- Economists have been looking for evidence of Giffen goods for at least nine decades
- But really, why should we care?

1. Might illustrate the fundamental power of the theory: From five behavior axioms to a strongly counterintuitive behavioral prediction that might just be correct

2. Might illuminate something important about decision-making under extreme poverty

# When would income effects overwhelm substitution effects?

*That is, when does a price rise increase demand?*

- Households are poor enough that they face subsistence nutrition concerns
- Households consume a very simple diet, including a basic (staple) and a fancy good
- The basic good is...
  - ...the cheapest source of calories available
  - ...comprises a large part of the diet/budget
  - ...has no ready substitute

# Giffen goods and nutritional subsistence

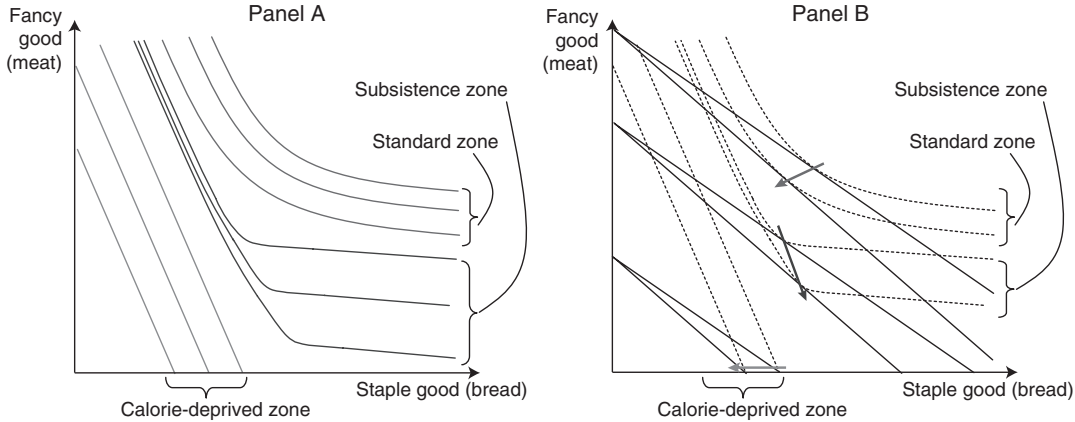
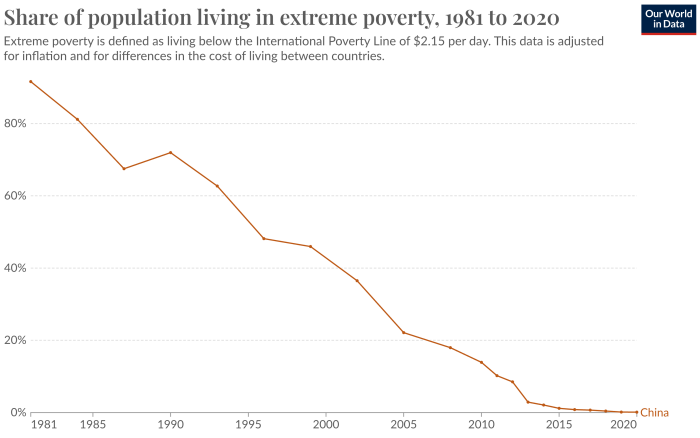



FIGURE 1. ZONES OF CONSUMER PREFERENCES

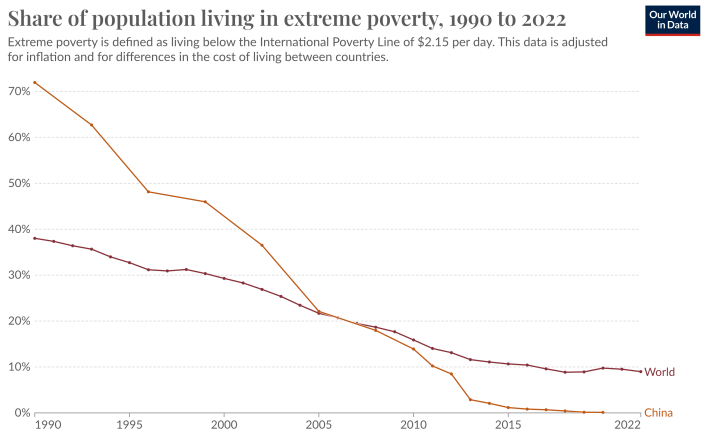
# Incredible progress in poverty reduction in China, 1981–2020




**1. International dollars**: International dollars are a hypothetical currency that is used to make meaningful comparisons of monetary indicators of living standards. Figures expressed in international dollars are adjusted for inflation within countries over time, and for differences in the cost of living between countries. The goal of such adjustments is to provide a unit whose purchasing power is held fixed over time and across countries, such that one international dollar can buy the same quantity and quality of goods and services no matter where or when it is spent. Read more in our article: What are Purchasing Power Parity adjustments and why do we need them?

**2. Per capita**: 'Per capita' here means that each person (including children) is attributed an equal share of the total income received by all members of their household.

# Much of world poverty reduction since 1990 is due to China

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# Understanding subsistence poverty in China in the early 2000s

**In 2000, only 25 years ago, about 45% of Chinese lived in extreme poverty**

- The experimental sample included 644 randomly selected urban poor households in Hunan province (about 1,800 people) in the early 2000s
- Urban poor households had incomes averaging $0.41 to $0.82 per person per day
- At the time of the study, about 90 million Chinese households met this definition of poverty
- The diet among the poor is very simple, consisting mostly of rice, plus some pork and other meat
- Most consumers in the sample obtained 70% of total calories from rice alone

# Poor households in Hunan province get most calories from rice

| | HUNAN | |
|---|---|---|
| | Consumption (g) | Calorie Share |
| Rice | 330 | 0.64 |
| | [125.4] | [0.17] |
| Wheat | 42 | 0.08 |
| | [60.2] | [0.12] |
| Other Cereals | 1.5 | 0.00 |
| | [21.3] | [0.022] |
| Vegetables and fruit | 341 | 0.05 |
| | [194.6] | [0.044] |
| Meat (incl. eggs) | 47 | 0.07 |
| | [68.6] | [0.11] |
| Pulses | 62 | 0.02 |
| | [102.3] | [0.043] |
| Dairy | 1 | 0.00 |
| | [7.4] | [0.0031] |
| Fats | 26 | 0.13 |
| | [20.4] | [0.095] |
| Calories | 1805 | -- |
| | [591.7] | |
| Observations | 644 | 644 |

Notes: Standard deviations in brackets. All consumption figures are in grams per capita. Calorie share is the percent of total calories attributable to the particular food category.

# Does subsidizing $p_r$ cause HH's to eat less rice?

1. Households randomly assigned to a control group *or* one of three treatment groups
2. HH's in the treatment group were given printed vouchers entitling them to price reductions of 0.10, 0.20 or 0.30 yuan off the price of each 500g (1 jin) of rice, the staple good. This is a price subsidy
3. Treated households received vouchers for 5 months. Vouchers distributed at the beginning of each month, valid till the end of the experiment
4. The vouchers were for **large** quantities, amounting to 750g (1.6Lb) per person per day for each month of treatment. Households unlikely to use their full quotas
5. As far as the household is concerned, voucher is equivalent to a price reduction in the staple good with no quantity constraint
6. ***How should a subsidy that reduces households' cost of purchasing rice affect their demand for rice?***

# Experimental estimates of rice subsidy: Effect of $\Delta p_r$ on $\Delta Q_r$

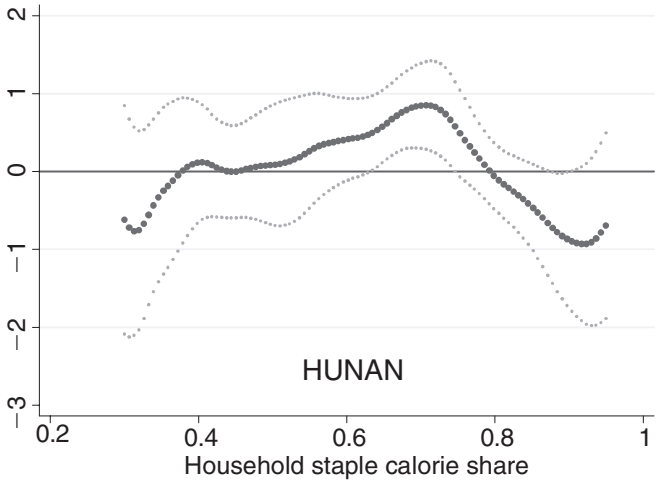
Dependent variable: %$\Delta$Rice consumption

ISCS = Share of Household's Calories from Rice ("Initial Staple Calorie Share")

| | Full sample (1) | Full sample (2) | ISCS ≤0.80 (3) | ISCS ≤0.80 (4) | ISCS >0.80 (5) | ISCS >0.80 (6) | ISCS 0.60–0.80 (7) |
|---|---|---|---|---|---|---|---|
| %ΔPrice(rice) | 0.224 | 0.235* | 0.451*** | 0.466*** | −0.61** | −0.585** | 0.640*** |
| | (0.149) | (0.140) | (0.170) | (0.159) | (0.296) | (0.262) | (0.192) |
| %Δ Earned | | 0.043*** | | 0.047*** | | 0.024 | 0.030 |
| | | (0.014) | | (0.016) | | (0.023) | (0.019) |
| %ΔUnearned | | −0.044* | | −0.038 | | −0.058 | −0.053* |
| | | (0.025) | | (0.030) | | (0.049) | (0.030) |
| %ΔPeople | | 0.89*** | | 0.83*** | | 1.16*** | 0.79*** |
| | | (0.08) | | (0.09) | | (0.15) | (0.14) |
| Constant | | 4.1*** | | 5.7*** | | −1.8 | 0.8 |
| | | (1.0) | | (1.1) | | (1.7) | (1.3) |
| Observations | 1,258 | 1,258 | 997 | 997 | 261 | 261 | 513 |
| $R^2$ | 0.08 | 0.19 | 0.09 | 0.20 | 0.15 | 0.33 | 0.24 |

# Household demand for rice in Hunan province: $\partial Q_r / \partial p_r$

*Notice 'Giffen region' $\approx (0.40, 0.75)$ where demand is upward sloping*




**Poorest households on left, poor household in middle, non-poor households on right**