14.771 Development Economics: Microeconomic issues and Policy Models
Fall 2008

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Basic problem: lack of information about who is really poor.

- This is a problem everywhere. See US PF literature.
- But the problem is particularly severe in developing countries: we don’t even observe income!

Two approaches:

- Broad subsidies (e.g., food subsidies)
- Try to do targeted transfers anyway
Poverty metrics

- Standard decomposable metric developed by Foster, Greer, and Thorbecke (1984):
  - Define $z$ as the poverty line.
  - Then for $\alpha \geq 0$ define
    \[ P_\alpha = \int_0^z \left( \frac{z - y}{z} \right)^\alpha f(y) \, dy \]

- Special cases:
  - $P_0 = \int_0^z f(y) \, dy$ is the "headcount" ratio, i.e., number of poor people
  - $P_1 = \int_0^z \left( \frac{z - y}{z} \right) f(y) \, dy$ is the "poverty gap", i.e., the amount of money required to bring all poor people up to the poverty line.
  - $\alpha > 1$ puts more weight on the poverty of very poor.

- Key property is decomposability. Assume $i$ subgroups with population shares $\lambda_i$. Then
  \[ P_\alpha = \sum_i \lambda_i P_{i,\alpha} \]
Thinking about transfers

- Assume for the moment we cannot directly identify poor households (i.e., no targeting)
- Besley and Kanbur (1988): How do we evaluate subsidies in terms of poverty reductions?
  - Infra-marginal subsidies
    - To everyone
    - With geographical targeting
  - Marginal subsidies (i.e., price changes)
    - To everyone
    - When there are both producers and consumers
Notation

- Since we’re talking about subsidies we sometimes need two price vectors:
  - $p$ is the undistorted world price vector
  - $q$ is the price vector faced by households

- Indirect utility function: $V(q, y)$

- Define equivalent income as income at world price vector, i.e.

$$y_E(p, q, y),$$

defined by

$$V(p, y_E) = V(q, y)$$
Infra-marginal subsidies

- Typically happen in the form of ration shops, where each household entitled to buy \( x \) kg of subsidized food
- Can be thought of as lump-sum transfer of size \( m \), where \( m \) is monetary equivalent of subsidy at \( p \) prices
- Impact on poverty:

\[
P_\alpha = \int_0^z \left[ \frac{z_E - y_E (p, p, y + m)}{z_E} \right]^{\alpha} f (y) \, dy
\]

- Taking derivatives with respect to \( m \):

\[
\frac{\partial P_\alpha}{\partial m} = \frac{\alpha}{z_E} \int_0^z \left[ \frac{z_E - y_E (p, p, y + m)}{z_E} \right]^{\alpha-1} \left( -\frac{\partial y_E}{\partial m} \right) f (y) \, dy
\]

\[
= -\frac{\alpha}{z_E} P_{\alpha-1}
\]

- So if we care about poverty gap (\( \alpha = 1 \)), then impact of inframarginal subsidy is proportional to the headcount ratio.
Geographical targeting

- Geographical targeting is much easier than individual targeting, since we can use representative household surveys to figure out the geographical distribution of poverty.
- This allows us to improve substantially on lump-sum transfers.
- Suppose there are $i$ regions, population shares represented by $\lambda_i$.
- Increasing budget to region $i$ by $b_i$ gives each person in region $i$ a transfer of $\frac{b_i}{\lambda_i}$.
- Using the logic from before,

$$\frac{\partial P_\alpha}{\partial b_i} = -\frac{\alpha}{z_E} P_{i,\alpha-1}$$

- So, if objective is to minimize national $P_\alpha$, give infra-marginal subsidies at the margin to regions with highest $P_{\alpha-1}$. I.e., to reduce poverty gap, put ration shops in areas with high poverty rates, since that is where money most efficiently reaches the poor.
Geographical targeting

- How is geographical targeting done in practice?
- Idea:
  - Representative household survey has data on consumption, for small number of people
  - Census has data on every individual (age, education, etc), but doesn’t measure consumption
  - So project consumption on census characteristics in household survey, and use census to extrapolate out of sample
  - Standard errors need to be corrected for spatial autocorrelation

- Big savings in cost:
  - In Cambodia, geographic targeting at province level reduces cost of given poverty reduction by 45%; targeting at commune level reduces cost of given poverty reduction by 69%! (Elbers et al 2007)
Price subsidies at the margin

- Price subsidies also affect consumer choices.

Notation:
- Post-tax prices: \( q_i = p_i + t_i \)
- Effect on poverty of change in subsidy \( t_i \):
  \[
  \frac{\partial P_\alpha}{\partial t_i} = \frac{\alpha}{z_E} \int_0^z \left[ \frac{z_E - y_E(p, q, y)}{z_E} \right]^{\alpha-1} \left( - \frac{\partial y_E}{\partial q_i} \right) f(y) \, dy
  \]
- Consumer demand \( x_i(q, y) \). Define
  \[
  \bar{x}_i = \int_0^\infty x_i f(y) \, dy \quad \text{(mean consumption of } i)\]
  \[
  \bar{x}_i^p = \frac{\int_0^z x_i f(y) \, dy}{\int_0^z f(y) \, dy} \quad \text{(mean consumption of } i \text{ by poor)}
  \]
- Government budget constraint:
  \[
  \int_0^\infty \left[ \sum_k t_k x_k(q, y) \right] f(y) \, dy = B
  \]
Effect of a revenue-neutral change in taxes

- Consider taxes on two commodities, \( t_1 \) and \( t_2 \).

- Budget balance implies

\[
\frac{dt_1}{dt_2} = \int_0^\infty \frac{ \left( \sum_k t_k \frac{\partial x_k}{\partial t_2} + x_2 \right) f(y) dy}{\int_0^\infty \left( \sum_k t_k \frac{\partial x_k}{\partial t_1} + x_1 \right) f(y) dy}
\]

- Effect of budget-neutral increase in \( t_1 \) is:

\[
\frac{\partial P_\alpha}{\partial t_1} = \frac{\alpha}{z_E} \int_0^z \left( \frac{z_E - y_E}{z_E} \right)^{\alpha-1} \left( - \frac{\partial y_E}{\partial q_1} - \frac{\partial y_E}{\partial q_2} \frac{dt_2}{dt_1} \right) f(y) dy
\]

- To gain intuition, need to understand how equivalent income affected by subsidies, i.e., \( \frac{\partial y_E}{\partial q_i} \).
Effect of a revenue-neutral change in taxes

- Simple case: suppose we start from case of no subsidies, so $t_k = 0 \ \forall k$. Then (recalling 14.121)

$$\frac{\partial y_E}{\partial q_i} \bigg|_{p=q} = -x_i (q, y)$$

$$\frac{\partial P_\alpha}{\partial t_1} = \frac{\alpha}{z_E} \int_0^z \left( \frac{z_E - y_E}{z_E} \right)^{\alpha-1} \left( -\frac{\partial y_E}{\partial q_1} - \frac{\partial y_E}{\partial q_2} \frac{dt_2}{dt_1} \right) f(y) \ dy$$

$$= \frac{\alpha}{z_E} \int_0^z \left( \frac{z_E - y_E}{z_E} \right)^{\alpha-1} \left( x_1 + x_2 \frac{dt_2}{dt_1} \right) f(y) \ dy$$

$$= \frac{\alpha}{z_E} \int_0^z \left( \frac{z_E - y_E}{z_E} \right)^{\alpha-1} \left( x_1 - x_2 \frac{\bar{x}_1}{\bar{x}_2} \right) f(y) \ dy$$

$$= \frac{\alpha}{z_E \bar{x}_1} \int_0^z \left( \frac{z_E - y_E}{z_E} \right)^{\alpha-1} \left( \frac{x_1}{\bar{x}_1} - \frac{x_2}{\bar{x}_2} \right) f(y) \ dy$$

- Reduction in $P$ depends on relative consumption of $x_1$ and $x_2$ by poor
Effect of a revenue-neutral change in taxes

- Special case of $\alpha = 1$ (poverty gap).
- Define $H$ as headcount ratio (fraction poor). Then:

$$\frac{\partial P_\alpha}{\partial t_1} = \frac{\alpha}{zE \bar{x}_1} \int_0^z \left( \frac{x_1}{\bar{x}_1} - \frac{x_2}{\bar{x}_2} \right) f(y) \, dy$$

$$= \frac{\alpha}{zE \bar{x}_1} H \left( \frac{\bar{x}_1^P}{\bar{x}_1} - \frac{\bar{x}_2^P}{\bar{x}_2} \right)$$

- Very intuitive: subsidize the commodity where share of commodity consumed by the poor is highest, if goal is to reduce $P_1$.
- More generalized versions have similar intuitions with appropriate weights.
- If initial taxes not equal to 0, also need to incorporate effect of tax change on other revenues
Infra-marginal vs. marginal subsidies

- Assume positive Engel curves on all goods, so expenditure on all goods increases with income.
  - Then infra-marginal subsidies are always better than marginal subsidies.
  - Intuition: for marginal subsidies, effect on poverty only from share of expenditure from the poor, $\bar{x}_1^P$
Producers and consumers

- Assume income generated by profit function
  \[ y = \Pi [q, k] \]
  where \( k \) are endowments like land.

- For producers,
  \[
  \frac{\partial y_E}{\partial q_i} \bigg|_{p=q} = - [x_i(q, y) - r_i(q, k)]
  \]
  where \( r \) is production of commodity. (envelope theorem).

- Define \( n = r - x \).

- Then effect of price change is
  \[
  \frac{\partial P_\alpha}{\partial t} \bigg|_{p=q} = \lambda_1 \frac{\alpha}{Z_E} \int_0^z \left[ \frac{z_E - y_E}{Z_E} \right]^{\alpha-1} x f_1(y) \, dy + \\
  \lambda_2 \frac{\alpha}{Z_E} \int_0^z \left[ \frac{z_E - y_E}{Z_E} \right]^{\alpha-1} n f_2(y) \, dy
  \]
If $\alpha = 1$, this simplifies to

$$\frac{\partial P_\alpha}{\partial t} \bigg|_{p=q} = \frac{\alpha}{z_E} \left( \lambda_1 H_1 x_1^P + \lambda_2 H_2 n_2^P \right)$$

This is intuitive: effect on poverty depends on mean net consumption among consumers and mean net consumption among producers.
Summary so far

- Inframarginal subsidies tend to be better than price subsidies, unless there are inferior goods that you can subsidize.

Why?

- Higher share goes to the poor
- Don’t hurt producers
- Can do even better with geographic targeting
- Also: dead-weight loss from distorted prices

But inframarginal subsidies are much harder to implement (e.g., corruption, operating shops, etc)

And, even they are not perfect, because large amounts of transfers still go to non-poor.

Can we do better with more directly targeted transfers?
Targeting

Targeting options if income is not observable:

- Proxy-means tests
- Self-targeting
- Community-based targeting
Proxy-Means Tests

- Similar idea to poverty mapping, but at individual level. This is the main way individual targeting is done in most developing countries. (E.g, Progresa).

- Concept: consumption surveys are expensive, and non-verifiable, so you can’t use them to target directly.

- Instead: do a survey where you collect data on assets (land, house, motorcycle, etc)
  - Assets capture permanent component of income
  - And they are hard to falsify on a survey

- Use survey data to estimate relationship between consumption and assets, and used predicted consumption for targeting.

- Problems
  - $R^2$ much less than 1, so you don’t get poverty exactly right
  - Corruption among surveyors
  - Costly: need to do a census
Self-Targeting

- Nichols and Zeckhauser (1982): "Ordeals" can be used to target the poor
  - Suppose you need to wait in long line to get unemployment benefits
  - Unemployed have low opportunity cost of time, so they are more likely to wait in line
  - Waiting in line therefore serves as a screening device
Self-Targeting In Practice

  - Subsidized rice (no self targeting)
  - Public employment scheme (self targeting)

![Rice Diagram](image1)

![Employment Diagram](image2)

Community-Based

- Allow local community to identify poor households
- Idea: local community has much more information than central government
  - This is the premise behind informal insurance, microfinance, etc.
- Problem:
  - If you are using this information to target beneficiaries, this information may not get revealed. Instead, elites may capture the project.
  - Potential tradeoff: better local information vs. more elite capture
- Some existing evidence that communities do know more (Alderman, Galasso and Ravallion)
Current research on targeting

- Alatas, Banerjee, Hanna, Olken, and Tobias (in the field next month!)
- Randomized experiment will compare three targeting methods:
  - Proxy-means test
  - Community ranking
  - Hybrid: community ranking, followed by proxy-means test on bottom 50%.
- Will test corruption in PMT, elite capture of community, and whether hybrid reduces elite capture of ranking process
- To evaluate, we will first conduct household survey to get consumption data, as well as data on family links to village elites and subjective rankings of poverty of other household members
- Stay tuned.
Adding it all up

- Olken (2007) analysis of targeted subsidized rice program in Indonesia
  - In theory, proxy-means test to determine eligibility. Eligible households receive 20kg of subsidized rice per month. Subsidy value about $4/month, or 9% of HH expenditures for median eligible household.
  - In reality, local officials ignored official criteria and chose beneficiaries.
  - In addition, there was substantial corruption – at least 18% of rice went missing.

- To add this up, calculate social welfare under alternative scenarios:
  - CRRA utility function $u = \frac{c^{1-\rho}}{1-\rho}$
  - Assume all stolen rice goes to richest household in village.
  - Program financed through consumption tax (VAT). Use alternate estimates for marginal cost of public funds (typical developed country estimate: approx 1.3), which measures deadweight loss of taxation
  - Normalize social welfare so that complete waste (throw the money in the ocean) = 0% and perfect targeting of transfer = 100%.
Adding it all up

- Local reallocation improved welfare, but corruption may have made program not worthwhile
- Most of the potential gains from redistribution not captured by either PMT or local targeting

### Comparing Costs and Benefits

<table>
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<th>Allocations:</th>
<th>Utilitarian, CRRA utility $\rho=1$ (% of welfare maximizing utility)</th>
<th>Utilitarian, CRRA utility $\rho=2$ (% of welfare maximizing utility)</th>
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<td>Actual allocation, no corruption</td>
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<td>Welfare maximizing</td>
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Figure by MIT OpenCourseWare.
Concluding thoughts

- Common theme for taxation and redistribution: lack of information
  - True everywhere, but particularly true in developing countries
  - As a result, tax and redistribution policies look very different

- More broadly, PF and development is a very open area, so lots of room for potential research
Roy’s identity details

- Recall

\[ V(p, y_E) = V(q, y) \]

- Implicit function theorem implies

\[ \frac{\partial y_E}{\partial q_i} = \frac{\partial V(q, y)}{\partial q_i} \]

\[ \frac{\partial V(p, y_E)}{\partial y_E} \]

- Roy’s identity implies

\[ \frac{\partial y_E}{\partial q_i} = -\frac{\partial V(q, y)}{\partial y} x_i(q, y) \]

\[ \frac{\partial V(p, y_E)}{\partial y_E} \]