PP253/ARE253 Alain de Janvry & Elisabeth Sadoulet
Fall 2003

Positive analysis: Indicators and determinants

Objectives of this class:
(1) Acquire the tools necessary to prepare a country poverty assessment for the World Bank or to assist a country in developing a PRSP (Poverty Reduction Strategy Paper) for debt reduction.
(2) Construct and measure an indicator of standard of living that is both rigorous and simple to use by policy-makers. Use this indicator to compare poverty between groups, countries and regions, over time, and before and after a policy change.
Technical issues: (1) How to measure welfare?
(2) How to separate poor from non-poor: choice of a poverty line?
(3) How to aggregate into a poverty indicator?

1. Measuring welfare: Choice of individual welfare measure *y* (Ravallion, EJ 1996)

- *What data (y) to use to measure welfare? Income vs expenditure:*
  Total consumption expenditure per household during the period.
  Advantage over income: easier to measure; more stable due to smoothing and closer to permanent income.
  Limitations:
  Generally not available for individuals.
  Large measurement errors.
  Varies with tastes: difficult to use for inter-personal comparisons.

- *Need adjust y for*
  - Changes in prices for comparisons over time: what deflators to calculate real expenditures?
  - Spatial price differences for regional/country comparisons: PPP-adjusted *e* across countries; CPI-adjusted across regions or urban/rural
  - Need include all commodities consumed, both bought and home produced: valued at what price?
  - Need account in *y* for the imputed value of public goods and services received (e.g., free or subsidized health care, school lunches, public education). (e.g., Ghana: poverty fell according to WB Poverty Assessment; poverty rose according to NGO. Decline in access to public goods not measured by income poverty in WB report.)

- *Household vs individual*
  - Calculate per capita consumption.
  - Adult equivalence scales, to take into account differences in demographic composition for comparison across households.

  Example: age-adjusted family size $n^* = \sum_k w_k n_k$, $w_k = 1$ male adults, $w_k < 1$ other members,

  where n_k and w_k are number of members and weight of demographic category k.
  These weights are established by regression of consumption on demographic structure of the household

  - Need allow for the existence of economies of scale in consumption in calculating per capita welfare due to household-level public goods (housing, durables, heating, electricity) versus private goods (food, child education).

  Total household income (consumption): $Y = C_f + p_{0h}\overline{C}_h$

  Per capita income (or consumption): $y^* = \frac{C_f}{n} + p_{0h}\frac{\overline{C}_h}{n^\beta}$

  $\overline{C}_h$ = fixed (short run) quantity of housing consumed (quasi-public good)
  C_f = consumption of food (private good),
  p_{0h} = initial prices of housing (food price as numeraire).

n = number of household members
β = degree of "privateness" of the good: $\beta = 0$, pure public good, $\beta = 1$, pure private good.

2. Measuring poverty

2.1. Poverty line

- Absolute poverty line: Calorie-based procedure

Absolute or extreme poverty or indigence: z_{abs} = cost of recommended minimum food caloric intake.
"Normal" poverty line: z = income level necessary to consume the recommended minimum food caloric intake (Figure 1)

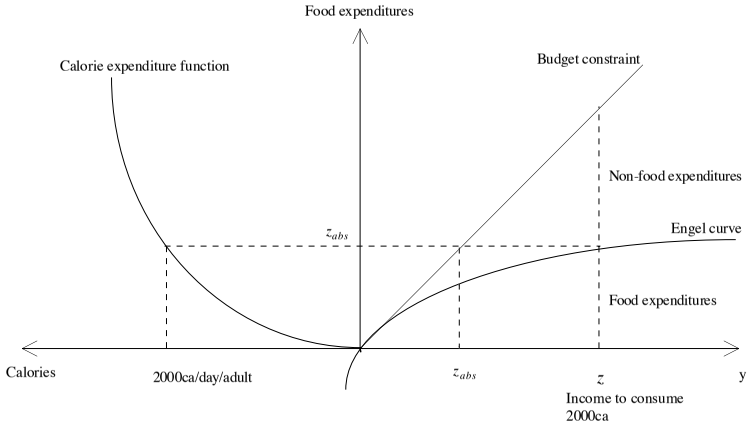


Figure 1. Nutrition-based poverty line

- *Relative poverty line (a measure of inequality)*
  Fixed % of population declared poor.
  Poverty relative to mean income: $z = k\bar{y}$, constant percentage of mean expenditure or income $\bar{y}$.
  e.g., Atkinson for Europe, $k = 0.5$; hardcore poverty, $k = 0.33$.

- *International comparisons (World Bank: World Development Indicators):*
  z = 1 PPP-adjusted$/day per capita (also 2$).
  PPP income = income/PPP exchange rate
  PPP exchange rate = number of LCU to buy the same amount of quality adjusted goods and services as 1$ in the United States.

- *Locally defined poverty line, based on lifestyle* (used in most individual country analyses): minimum income needed to "make it".

Important: Use a consistent z in making comparisons. Use more than one definition of poverty line and look at consistency in orderings.

2.2. Describing poverty: Poverty profile (Figure 2) and correlates of poverty

Poverty profile

Define: q = number of individuals below poverty line
z = poverty line
n = population size
y_i = income (or consumption expenditure) of individual with income rank i.

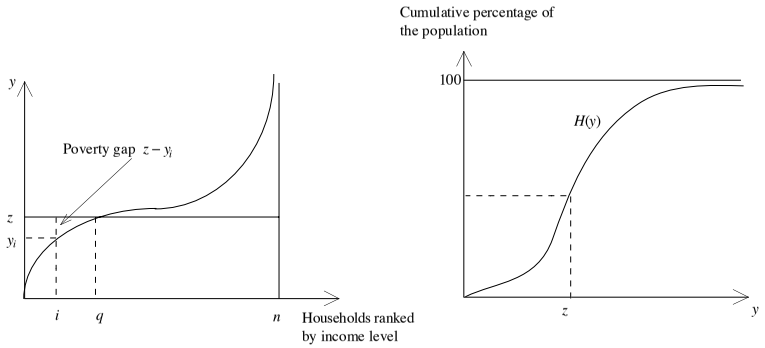


Figure 2. Poverty profile and poverty incidence curve

Correlates of poverty: no pretense of causality

Correlates can be endogenous variables: activity (choice of crops, type of employment), dependency ratio, location and neighborhood effects (e.g., what other households in the same social network do), ethnicity, gender, use of credit, etc.

2.3. Most commonly used indicators of poverty

All based on the distribution of income (y) truncated at z.
General desirable properties of a welfare index:
- Monotonocity (Sen). A decrease in y of a poor person should increase the index.
- Transfer (Sen). An y transfer from a poorer poor to a richer poor should increase the index.
- Transfer sensitivity. The rise in the index declines as the y transfer from poor to rich is taken from a richer poor.

Specific desirable properties of a poverty index:
- Population symmetry. If two identical populations are pooled, the index should not change.
- Proportion of poor. If the share of poor increases, the index should increase.
- Focus (Sen). The index is independent of the y level of people above z.
- Decomposability. If the poverty of a subgroup increases, the index increases.

- **Members of the P_α class** (Foster-Geer-Thorbecke (FGT) index)

  i) General index: $P_\alpha = \frac{1}{n}\sum_{i=1}^{q}\left(\frac{z-y_i}{z}\right)^\alpha = \int_0^z \left(\frac{z-y}{z}\right)^\alpha f(y)dy$.

  ii) If $\alpha = 0$, $P_0 = \frac{q}{n}$: headcount ratio or incidence of poverty: % of poor in the population.

  (P_0 does not satisfy the monotonicity and transfers axioms. Yet, it is the most widely used poverty index.)

  iii) If $\alpha = 1$, $P_1 = \frac{1}{n}\sum_{i=1}^{q}\left(\frac{z-y_i}{z}\right) = \frac{q}{n}\left(\frac{z-\bar{y}_p}{z}\right) = P_0 I$: poverty gap index or depth of poverty, where

  $\bar{y}_p = \frac{1}{q}\sum_{1}^{q} y_i$, average income of the poor,

  $I = \frac{z-\bar{y}_p}{z}$, average income gap ratio,

  $\sum_{1}^{q}(z-y_i)$ = total income deficit of the poor = cost to eliminate poverty with perfect targeting,

  nz = cost of eliminating poverty without targeting.

  $P_1 = \frac{\sum_{1}^{q}(z-y_i)}{nz} = \frac{\text{Targeted welfare budget}}{\text{Untargeted welfare budget}}$. Hence $1 - P_1$ = Gain from targeting.

  (P_1 does not satisfy the transfer axiom.)

  iv) If $\alpha = 2$, $P_2 = \frac{1}{n}\sum_{1}^{q}\left(\frac{z-y_i}{z}\right)^2$: severity of poverty index.

  (P_2 satisfies the monotonicity and transfers axioms. But interpretation problematic: $\$^2$?. Use only to characterize change.)

  v) If $\alpha = \infty$, P_∞ = Rawls poverty index.

  Policy question: how to target a given welfare budget B to minimize P_0, P_1, and P_2?
  For P_0: start spending B on the least poor first.
  For P_1: no rule.
  For P_2: start spending B on the poorest first.

- **Average exit time from poverty** (Morduch). How many years t does it take for a poor person with income y_i to reach the poverty line z if income grows at the annual rate g? In continuous time, $y_i e^{gt} = z$, or in discrete time, $y_i(1+g)^t = z$. Hence, exit time out of poverty is:

  $t = \frac{\ln z - \ln y_i}{g}$.

  For the whole population of poor, the average exit time is:

  $T_g = \frac{1}{N}\sum_{i=1}^{N} t_i = \frac{1}{N}\sum_{i=1}^{q}\frac{\ln z - \ln y_i}{g}$.

  This index is:
  Decomposable into population-weighted subsets of the population of poor;
  Sensitive to redistribution among the poor;
  In meaningful units (as opposed to P_2), namely years.

2.4. Robustness of a poverty profile over a range of z: Stochastic dominance

Compare two poverty profiles: A and B
Let: $f(y)$ frequency distribution of income
$H(z)$ poverty incidence curve = cumulative percentage of population that earns z or less.
$D(z)$ poverty deficit curve = cumulative poverty deficit up to z.
$S(z)$ poverty severity curve = cumulative poverty deficit square up to z.

1. If there is first-order dominance of distribution A over B , i.e. CDF $H_A(z)$ is always above $H_B(z)$, we can conclude that:

$P_0^A > P_0^B$ at all values of z
$P_1^A > P_1^B$ at all values of z
$P_2^A > P_2^B$ at all values of z

2. If there is second-order dominance of distribution A over B, i.e., D_A is always above D_B, it implies greater poverty deficit ($P_1^A > P_1^B$) and greater severity of poverty ($P_2^A > P_2^B$) but not greater headcount ratio (P_0) between A and B. Second order stochastic dominance and generalized Lorenz dominance are the same.

3. If there is third order dominance of distribution A over B, i.e., S_A is always above S_B, it implies greater severity of poverty ($P_2^A > P_2^B$) but not necessarily a greater headcount ratio (P_0) nor greater poverty deficit (P_1) between A and B.

Note: We may have lower and upper limits for the poverty line. In which case, all is needed is that the curves do not cross over the range to assert a robust ranking to the choice of poverty line.

3. Decomposition of poverty indices

- **Decomposition of P_α by population groups** (decomposability axiom)

Let $j = 1, ..., k$ exclusive population groups with index P_j^α

$$P^\alpha = \sum_{j=1}^{k} \frac{n_j}{n} \frac{1}{n_j} \sum_{i \in k} \left(\frac{z - y_i}{z} \right)^\alpha = \sum_{j=1}^{k} m_j P_j^\alpha, \quad \text{where } m_j = \frac{n_j}{n}, \text{ population share of group } j.$$

Percentage contribution of group j to the total poverty index = $100 * \frac{m_j P_j^\alpha}{P^\alpha}$.

- **Decomposition of the change in the aggregate poverty index P_α between two periods (0, t) into change due to size of group and change due to intra-group poverty, with k groups:**

$$\Delta P^\alpha = P_t^\alpha - P_0^\alpha = \sum_{j=1}^{k} \Delta\left(m_j P_j^\alpha\right) = \sum_{j=1}^{k} m_{j0} \Delta P_j^\alpha + \sum_{j=1}^{k} P_{j0}^\alpha \Delta m_j + \sum_{j=1}^{k} \Delta P_j^\alpha \Delta m_j$$

where:

First term = change in poverty internal to each group,
Second term = change in relative size of each group,
Third term = cross effect.

- **Decomposition of change in P_α between two periods (0, t) into change due to average income growth and change due to income redistribution.**

Let P_α be written as a function $P\left(\frac{z}{\mu}, f\right)$, where f is the distribution of income per capita.

A discrete change between two periods (0, 1) is written:

$$\Delta P = P\left(\frac{z}{\mu_1}, f_1\right) - P\left(\frac{z}{\mu_0}, f_0\right)$$
$$\equiv \frac{1}{2}\left[P\left(\frac{z}{\mu_1}, f_1\right) - P\left(\frac{z}{\mu_0}, f_1\right) + P\left(\frac{z}{\mu_1}, f_0\right) - P\left(\frac{z}{\mu_0}, f_0\right) \right]$$
$$+ \frac{1}{2}\left[P\left(\frac{z}{\mu_0}, f_1\right) - P\left(\frac{z}{\mu_0}, f_0\right) + P\left(\frac{z}{\mu_1}, f_1\right) - P\left(\frac{z}{\mu_1}, f_0\right) \right]$$

where the first term measures the change in P due to change in mean income with no change in distribution, and the second term measures the effect of a change in distribution without change in mean income.

How this is done in practice:

Income data series at time 0: (μ_0, f_0)
Income data series at time 0 multiplied by μ_1/μ_0: (μ_1, f_0)
Income data series at time 1 multiplied by μ_0/μ_1: (μ_0, f_1)
Income data series at time 1: (μ_1, f_1)

In practice, one often sees ΔP be approximated by a change in average income, $P\left(\frac{z}{\mu_1}, f_0\right) - P\left(\frac{z}{\mu_0}, f_0\right)$, a change in distribution, $P\left(\frac{z}{\mu_0}, f_1\right) - P\left(\frac{z}{\mu_0}, f_0\right)$, both computed from the same reference year 0, and a residual that cannot be interpreted (Grootaert).

4. Determinants of poverty: causal analysis

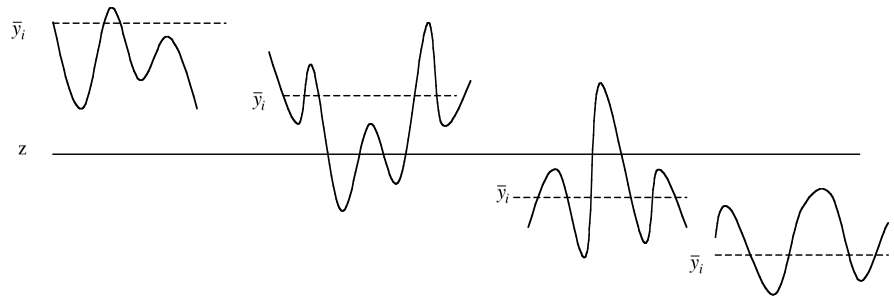
Poverty regressions: Probit on poverty (Y/N), Tobit on P_1 and P2.

Determinants = exogenous variables: household characteristics, asset endowments, context (local opportunities, exogenous neighborhood effects (characteristics of others in the same social network)). Context variables can be constructed using GIS information (distance to market, topography, distance to others, etc.).

5. Dynamics of poverty and vulnerability: Transient and chronic poverty

1. ΔP_0 does not tell us how many people escaped from poverty or became poor during the period. For example, we could have $\Delta P_0 = 0$, and yet many may have entered/left poverty during the period. We observe that there is high mobility in and out of poverty.

2. *Need distinguish between categories of poor on the basis of the dynamics of poverty:*
   i) Never poor: on average above z, and never in poverty.
   ii) Transient poor/Temporarily poor: on average above z, but sometimes in poverty.
   iii) Chronic poor: on average below the poverty line, but sometimes out of poverty.
   iv) Persistent poor: always in poverty.



Never poor	**Transient poor**	**Chronic poor**	**Persistent poor**
Chronic = 0	Chronic = 0	Chronic C > 0	Chronic C > 0
Transient = 0	Transient T > 0	Transient T > 0	Transient T > 0

3. Indicators of intertemporal poverty: observations over T periods

3.1. For an individual i

Poverty indicator for individual i at time t = P_{it}^{α}. For example: $P_{it}^{2} = \left(\frac{z - y_{it}}{z}\right)^{2}$

Intertemporal total poverty indicator during period (1,T) for individual i is defined as the sum of P_{it}^{α} over time: $P_i = \sum_{t=1}^{T} P_{it}^{\alpha}$.

Chronic poverty indicator for individual i during period (1,T) is defined as the poverty indicator if all y_{it} were equal to their average $\bar{y}_i = \frac{1}{T}\sum_{t=1}^{T} y_{it}$:

$$C_i = \left(\frac{z - \bar{y}_i}{z}\right)^{2}.$$

Transitory poverty indicator for individual i during period (1,T) is defined as the difference between total and chronic poverty:

$$T_i = P_i - C_i.$$

3.2. For the whole population with N individuals

Interpemporal total, chronic, and transitory poverty for the population are:

$$P = \frac{1}{N}\sum_{i=1}^{N} P_i, \quad C = \frac{1}{N}\sum_{i=1}^{N} C_i, \quad T = P - C$$

Note 1: Measurement errors increase chronic poverty.
Note 2: Time between surveys decreases transitory and chronic poverty.

Example (Jalan and Ravallion, JDS 2000): South-West rural China, 1985-90. % of households:

Never poor:	41%
Transient poor:	36%
Chronic poor:	18%
Persistent poor:	5%

4. Explaining chronic and transient poverty:

Tobit for chronic poverty: $\Pr(C_i > 0)$
Tobit for transient poverty: $\Pr(T_i > 0)$.

5. Types of economic shocks:

Shocks to income: illness, unemployment.
Shocks to assets: disease animals, landslide hurricane, expropriation.
Shocks to context: prices (coffee), economic crisis (transition, debt crisis, devaluation).

Idiosyncratic shocks (illness).
Covariate shocks (drought, recession, policy changes, political cycles (role of credibility and commitment devices), economic transition). Idiosyncratic shocks can be insured locally (e.g., through mutual insurance) but not covariate shocks.

6. Responses to shocks

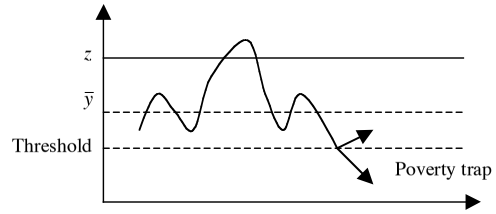
Ex-ante: risk management (choice of activities, change in context (migration, lobbying)). Risk management decreases the variance of income, but generally also decreases the expected level of income.

Ex-post: risk coping (loans, sale of liquid assets, public assistance (safety nets, transfers), mutual insurance)

Vulnerability to shocks: irreversibilities (sale of productive assets, kids out of school, infant malnutrition, homelessness)

7. Are there poverty traps?

Introduce concept of an income threshold for irreversibility. Below threshold, household becomes captive of poverty (vicious circle of poverty).



7. Determinants of transient and chronic poverty

Chronic poverty (level of income): assets, context, household characteristics.
Transient poverty (risk coping ability): liquid assets, access to credit, social capital for mutual insurance.
Hence, different policy instruments are needed to reduce chronic and transient poverty.

8. Indicator of vulnerability to poverty: ex-ante probability of falling into poverty

Vulnerable if: Pr(Poor next period) > 50%
Explain vulnerability: Causal analysis of vulnerability indicator.

6. Dynamics of poverty: duration models

Use panel data over several years (e.g., Poland, 1993-96) (Okrasa, 1999).
Hazard rate entry = Pr of falling into poverty at time *t* after *t* years not in poverty
Hazard rate exit = Pr of rising out of poverty at time *t* after *t* years in poverty.
Survival function out of poverty = Pr of household remaining out of poverty after *t* years not in poverty
Survival function in poverty = Pr of household remaining in poverty after *t* years in poverty.
Hazard function = f(

Household characteristics (age of head, education, type of household, gender, marital status)
Location (rural, large town)
Sector of employment (public, private)
Socio-economic status (employees, farmers, self-employed, welfare recipients, pensioners)
Financial assets (savings account) and transfers (private, public)
Year poverty spell began
Social benefits: family allowances, unemployment benefits, other.

Results: Hazard function
Effects of household-risk factors on poverty mobility (entry and exit)

Poland, 1993-96		Probability of exit from poverty	
		High	**Low**
Probability of entry into poverty	**High**	**High poverty mobility** Single Married w/out children Has savings account Participate to transfer network	**High poverty persistence** Low education Married with many children Disabled Employed in public sector Welfare recipient
	Low	**Low poverty persistence** University degree Single Employees Self-employed Pensioners	**Low poverty mobility** Widowed Divorced Indebted Farmers

7. Other issues

Economic mobility (transition matrices): long term change in poverty status, for example across income quintiles:
% who remain in same income category.
% who move up or down by one or more quintiles.
Inter-generational transmission of poverty: inheritance of poverty (low education, ill-health, lack of social capital) = inter-generational poverty trap.
Intra-household poverty (role of gender): large component of total poverty.

8. The geography of poverty: construction of poverty maps: Two approaches

8.1. Combine household survey data with small area data (parsimonious approach)

Step1: Use household survey data to explain the incidence of poverty (P_0) in each small area (a), P_{0a}, covered by the survey as a function of the average area characteristics (X_a) that explain poverty and that are available for every small area in the country:

$$P_{0a} = f(X_a)$$

Step 2: Use this relation to predict P_{0a} for all small areas in the country for which there is information on the X_a variables (e.g., municipal or locality data).

Step 3: Map the predicted $\hat{P}_{0a}$ for each small area using GIS.

8.2. Combine household survey data with household-level population census data (WB approach; P&J Lanjouw)

Step 1: Use household suevey data (e.g., LSMS) to explain the probability of being in poverty at the individual (*i*) level:

Prob(P_i = 1 if poor, 0 if non-poor) = f(X_i)

X_i are individual-level determinants of poverty that are available both in the household survey (intensive data) and in the census data (extensive data), e.g., individual and household characteristics, activities, context). These variables can be endogenous since they are used for predictive purposes.

Step 2: Use the population census information on every individual in the country to predict this individual's probability of being in poverty using the *f*(.) function estimated with the household survey:

$$P_i = \hat{f}(X_i)$$

Average the poverty predictions over individuals in "small areas" (e.g., census tract, municipality) to reduce the variance. This gives poverty predictions $\hat{P}_k$ for groups k (e.g., of no less than 5,000 individuals to have reasonable accuracy). Calculate Var($\hat{P}_k$) to place confidence intervals.

Step 3: Map the predicted $\hat{P}_k$ for each small area using GIS.

9. The growth-poverty relation: controversy on the elasticity (E) of income of poor with respect to aggregate income

9.1. "Growth is good": E = 1

Dollar and Kray (WB, 2001), Roemer and Gugerty (HIID), Economist (March 27, 2000).
Income gains from growth are shared equally whatever the source of growth
Policy implication: accelerate growth
Instruments: ↑ openness, ↓ government expenditures, ↓ inflation.

9.2. E depends on quality of growth

⇒ Squire and Walton (WDR 1990): labor-intensive growth, targeted transfers, safety nets.
⇒ Vinod Thomas (WB. Economist October 7, 2000): E depends on: level and distribution in access to education, health, good governance (corruption, rule of law, political freedoms), environmental quality.
⇒ Lundborg and Squire (WB): Increasing openness increases income of the richest 60% but decreases income of the poorest 40%.
⇒ de Janvry and Sadoulet (RIW, 2000): E in Latin America depends on:
⇒ Initial inequality in the distribution of income: low E if high inequality.
⇒ Initial level of poverty: low E if high initial; level
⇒ Level of secondary education: low E if low level of education
⇒ Stage of economic cycle: low E under ISI, large negative E during recession, high E in post-debt crisis growth.
⇒ Composition of growth: E large if service sector growth (labor intensive).
⇒ Inequality: ratchet effect: increases during recession, but does not fall with growth.