Measurement of poverty and inequality using household data

SSER's Research Methodology Workshop on
Using Large-scale Survey Data

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This Lecture

(1) Measuring the welfare level using household data: Income, consumption, socioeconomic indicators; Imputation

(2) Using NSS-type household data: Cluster, strata, weight

(3) Concepts of poverty: Absolute vs. Relative; Country vs. Household (individual)

(4) Poverty line: What is $1/day?; Cost of basic needs vs. Food energy intake; Adjustment for the price level & household demography

(5) Poverty measures: Concept; Unit of aggregation; FGT measures; Clark-Watts measures; Choice of poverty measures and policies

(6) Poverty profile analysis: Decomposability; Bivariate comparison

(7) Introduction to the inequality analysis: Concept

(1) Measuring the welfare level using household data

- **Living standard at the country level**

  Examples: Low GDP per capita; Low average schooling years.

  – **In such countries, it is not possible for everyone to enjoy high living standards. However, even in such countries, it is usually the case that some enjoy high living standards.**

- **Living standard at the individual (household) level**

  Examples: Individuals with low income; Illiterate households.

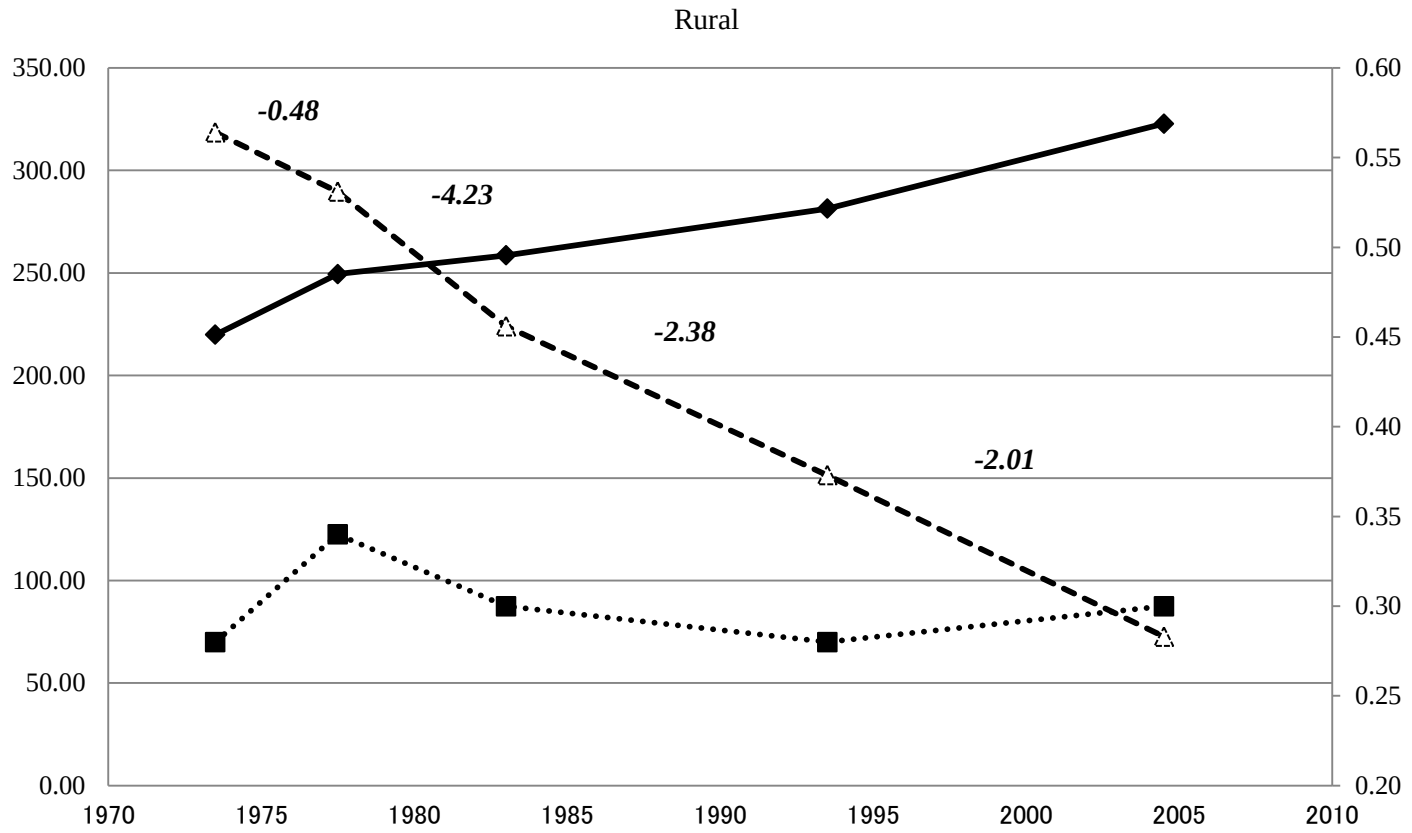
  – **Their living standards are definitely low.**

  – **When we have such data for all, we can aggregate them to have figures at the country level.**

Measures used in analyzing the welfare level using household data

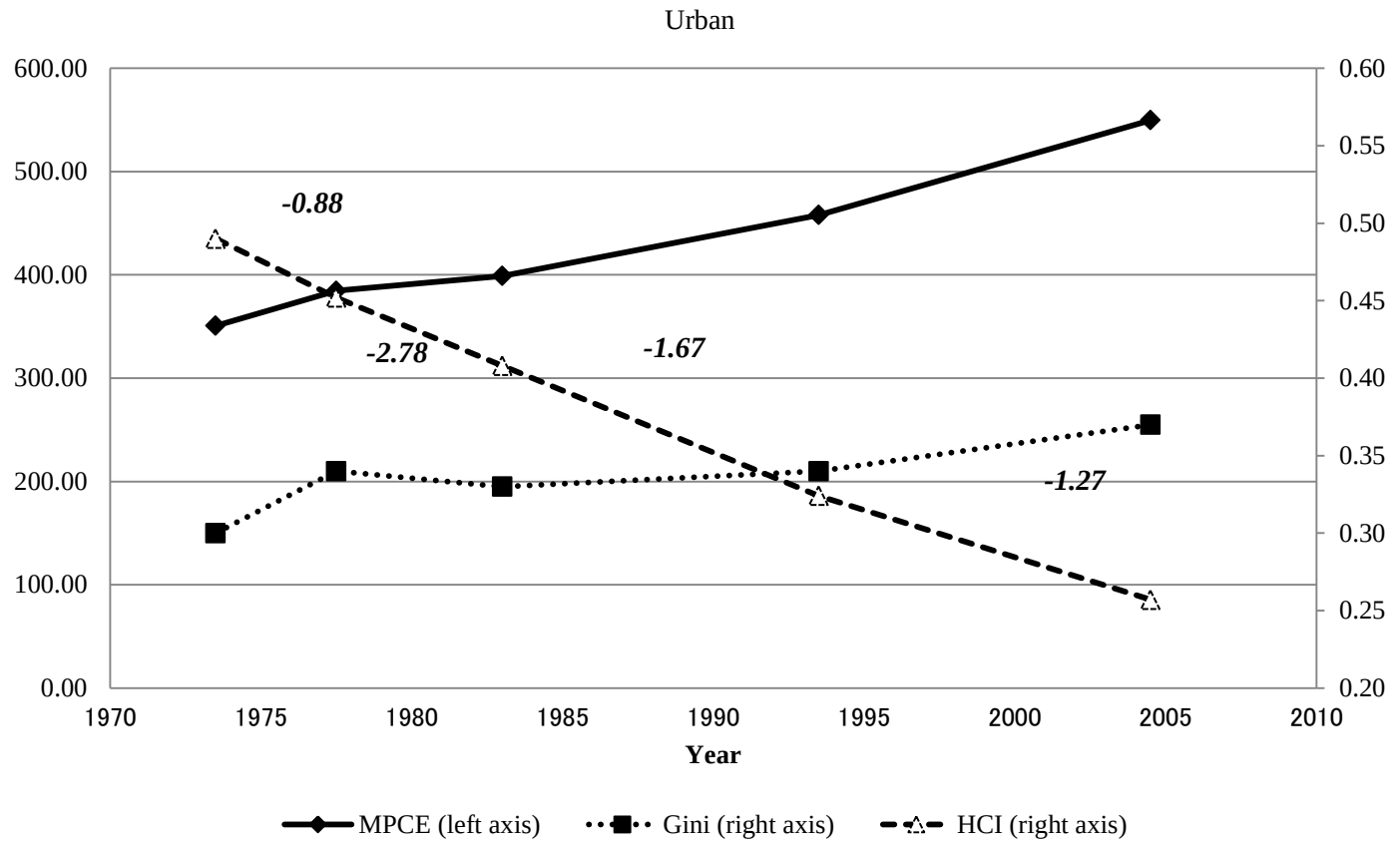
- **Income (Y), consumption (C), education, health, security, empowerment, social participation, security, etc. (z^c): At the household-level, higher the better**
- **Aggregate the whole distribution of these variables:**
  - **Average figures = mean, median, mode**
  - **Dispersion figures = Inequality measures such as Gini coefficient, Theil index, Atkinson measure, etc.**
  - **(Absolute) poverty measures**
- **NSS (consumer expenditure survey) for C (monthly per capita expenditure: MPCE)**

Figure 1: Trends in Growth, Inequality, and Poverty



- Original data: *MPCE* (monthly per capita consumption expenditure) in the NSS thick and comparable rounds. Average real MPCE (solid line, in 1993-94 prices), Gini index (dotted line), Poverty headcount index (broken line)
- *Poverty elasticity to growth* (italic) shows "pro-poor" growth in the 1980s while *"anti-poor" or "less pro-poor" growth in the 1990s*

Figure 1: Trends in Growth, Inequality, and Poverty



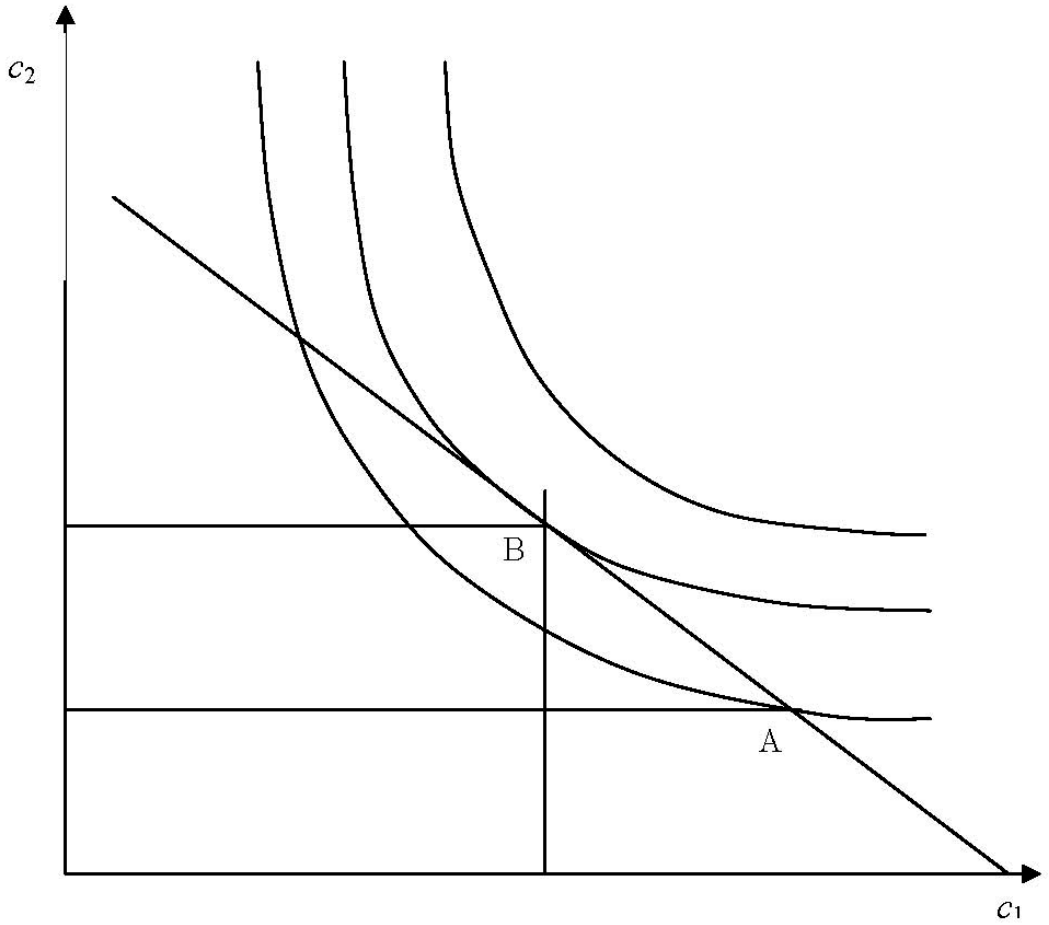
- Similar changes in urban areas
- Poverty headcount index (HCI) in urban areas is lower than that in rural areas. But this is misleading. Poverty gap index (PG) and squared poverty gap index (SPG) in urban areas are higher than those in rural areas! (More extremely-poor people in urban areas)

Correspondence with the Consumer Theory

$$\max_{c} \; U(c_1, c_2, c_3, \ldots, c_k; z^c)$$

$$\text{subject to } p_1c_1 + p_2c_2 + p_3c_3 + \ldots + p_kc_k \leqq y$$

where $U(..)$ is the direct utility function, z^c is a vector of preference shifters, and y is hh disposable income.



Correspondence with the Consumer Theory

- **F.O.C. for the optimization =>**

  Marginal Rate of Substitution = Relative Prices

- **By inserting the optimal consum. quantity into the direct utility function, we can obtain**

$V(p, y, z^c) \equiv U(c_1^*(p, y, z^c), c_2^*(p, y, z^c), c_3^*(p, y, z^c), \ldots, c_k^*(p, y, z^c); z^c)$

Where *V* is the indirect utility function, showing the level of welfare. *V* is monotonically increasing in *y* (V_y>0 for all *y*).

- **This value of *y* corresponds to Y or C in the household welfare analysis. Others are included in z^c.**

Which variable to use?

- Income (Y) or total consumption expenditure (C) is highly correlated with other aspects in human development.
- As a proxy to the multidimensional human development, Y or C is more comparable across regions or across periods than other proxies such as asset or education.
- Measuring the household welfare by Y or C corresponds to the consumer theory in microeconomics.
- Y or C at the individual level (microeconomics) corresponds to Y or C in the national account statistics in macroeconomics.
- Y or C fits rigorous statistical analysis since Y or C is a continuous and cardinal number.

Income (Y) or Expenditure (C)?

- **Identity:**
  - $Y_{it} = C_{it} + S_{it}$
  - **Income may fluctuate due to weather, etc (transient income shocks) => C is better as a proxy to the permanent income than Y.**
  - **It is always better to use the one measured more correctly (measurement error).**
  - **If both are available, use both (robustness check).**
  - **In NSS, consumption in the form of MPCE (monthly per-capita expenditure) is available.**

Calculating income and expenditure from household data

- We want a measure of living standards.

⇒ Cash income or cash expenditure is not appropriate!

- Imputation is required for in-kind transactions using opportunity cost
- This makes Y or C comparable to those in national account statistics (imputation is also adopted in National Accounts)

Example of Imputation

- ✓ **Own-produced and consumed food and fuel (very important for farm households): Its imputed value should be added to Y and C.**
- ✓ **In-kind gift (e.g., Rice) to friends or family not living together: Its imputed value should be added to Y and C.**
- ✓ **In-kind wage (e.g., Rice) paid to permanent workers by farm households: Its imputed value should be subtracted in calculating Y.**
- ✓ **In-kind wage (e.g., Rice) received by workers and consumed by them: Its imputed value should be added to Y and C of the workers.**

"Schedule" in NSS (example from 61st round, 2004-05)

[5] consumption of food, pan, tobacco and intoxicants during the last *30* days ended on .....

code	item	consumption out of home produce		total consumption		source$
		quantity* (0.000)	value (Rs 0.00)	quantity* (0.000)	value (Rs 0.00)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
101	rice – PDS					1
102	rice - other sources					
107	wheat/atta – PDS					1
108	wheat/atta - other sources					
110	Maida					
111	suji, rawa					
112	sewai, noodles					
113	bread: bakery					
115	jowar & products					
116	bajra & products					
160	milk: liquid (litre)					

$*Source code: only purchase -1, only home-grown stock -2, both purchase and home-grown stock -3, only free collection -4, only exchange of goods and services -5, only gifts / charities – 6, others -9*

- ✓ **Point: MPCE is not asked to respondents. Respondents are asked about consumption of individual items (about 500 items! in 61st round)**

How is imputation done in calculating MPCE in NSS?

3.0.6 **Imputation of value**: If an item is purchased and consumed by a household, the value of consumption can be taken as its purchase value. But the value of an item consumed out of commodities received in exchange of goods and services, home-grown/home-produced stock, transfer receipts or free collection requires imputation. The rule for imputation of value of consumption of commodities is given below:

- the value of goods and services received in exchange of goods and services – including those received as perquisites by the members of the household from their employers - will be imputed at the rate of average local retail prices prevailing during the reference period. However, the judgement of the respondent about the price of the goods purchased in exchange is to be taken into account;
- the value of home produce will be imputed at the ex farm or ex factory rate. This should not include any element of distributive service charges;
- the value of consumption out of gifts, loans, free collection, etc. will be imputed at the average local retail prices prevailing during the reference period;
- the value of consumption out of purchase will be the value at which the purchase was made.

"Schedule" in NSS (example from 61st round, 2004-05)

[13] summary of consumer expenditure						
srl. no.	item	reference			value (Rs 0.00) of consumption	
		block	item	column	**during last 30 days**	
(1)	(2)	(3)	(4)	(5)	(7)	
1.	cereals	5	129	6		
2.	cereal substitute	5	139	6		
3.	pulses & products	5	159	6		
4.	milk & milk products	5	169	6		
5	edible oil	5	179	6		
31.	education	9	409	3		
32.	medical (institutional)	9	419	3		
33.	durable goods	11	659	7		00
34.	**total monthly expenditure [sub-total (27-33)]**					
35.	household size	3	1	×		
36.	**monthly per capita expenditure (Rs 0.00) [srl. no. 34 ÷ srl. no. 35]**					

✓ **Point: MPCE is not asked to respondents. MPCE is calculated by NSS investigators.**

(2) Using NSS-type household data

- ✓ India's most celebrated micro data = NSS
- ✓ More generally, LSMS (Living Standards Measurement Survey) type data (cf. Grosh and Glewwe 2000).
  - ➢ World Bank assisted-project to improve household surveys in developing countries, since 1979
  - ➢ Comprehensive household survey including human development indicators as well, usually supplemented by community and market surveys
  - ➢ Nationally representative sample
  - ➢ Some have panel (same households surveyed in consecutive years) dimensions
  - ➢ Micro data open to researchers
- ✓ LDCs' other household data open to researchers: Thai SES, Philippine FIES, Indian NSS, etc. : Data structure similar to LSMS

Sampling in NSS-type household data

- **Random sampling:**
  - ✓ To draw nationally representative data
  - ✓ To have group-wise information on living standards
  - ✓ To maximize the precision of data
  - ✓ To minimize the survey cost
- **As the solution to these conflicting requirements, clustering, stratification, and weighting (multiplier) are introduced**
  - ✓ You will find something like “stratified two-stage sampling”.

Clustering, stratification, and weighting in NSS-type household data

- **Clustering & stratification:**
  - ✓ **The groups about which representative information is required are fixed as strata (e.g., urban vs. rural; NSS regions etc.)**
  - ✓ **Sample households are randomly drawn from randomly chosen clusters (primary sampling unit: PSU, usually a village in rural areas and a ward in urban areas). The sample PSUs may be randomly chosen from the next level which is also randomly chosen (3-stage sampling)**
- **Weighting (multiplier):**
  - ✓ **The sampling probability is set higher for categories whose population number is expected to small**
  - ✓ **For example, the sampling probability is higher for wealthy villages and households than no-wealthy villages and households.**

Implications of weighted, stratified, multi-stage random sampling

- **Descriptive analysis:**
  - ✓ In calculating the mean, you need to use correct weights
  - ✓ In conducting statistical tests on the means, you should adjust standard errors for stratification and clustering
- **Mean calculation example:**
  - ✓ The economy consists of two villages: the rich village with 10 households and the poor village with 20 households
  - ✓ You did a random sampling of one household each from each village and you obtained the following data.
  - ✓ Calculate the mean household expenditure and the mean per-capita expenditure

Sample ID	Household expenditure (incl. imputed portion) in $	House-hold size	Per-capita expenditure	Sampling probability (hh)	Inflation factor (hh)
1	1,600	4	400	0.1	10
2	1,200	6	200	0.05	20

Answer to the previous slide's example:

- **Mean household expenditure:**
  - ✓ **Simple mean without weighting = (1600+1200)/2 = 1400**
  - ✓ **Appropriately weighted mean [the inverse of the sampling probability as weights] = (1600*10+1200*20)/(10+30) = 1333**

  *** Unweighting overestimate the national average by 5%**
- **Mean per-capita expenditure:**
  - ✓ **Simple mean without weighting = (400+200)/2 = 300**
  - ✓ **Using the inverse of the sampling probability (hh) as weights, the weighted mean becomes = (400*10+200*20)/(10+30) = 267**

  Is this average a useful concept? No. When we analyze the per-capita expenditure, we are interested in the well-beings of individuals, not households. Therefore, we need to use the inverse of the sampling probability defined at the individual level as weights.
  - ✓ **Appropriately weighted mean = (400*40+200*120)/(40+120) = 250**

  *** Unweighting overestimate the national average by 20%!**
  - ✓ **Another way of understanding that the mean at 250$ is appropriate: In this economy, the estimated national consumption is 1600*10+1200*20= $40,000. The estimated population of this economy is 4*10+6*20=160 persons. Therefore, the estimated per-capita consumption is $250, which is exactly what we obtain using the appropriate weighting.**

Implications of weighted, stratified, multi-stage random sampling (cont'd)

- **Adjustment of standard errors (SE) for stratification and clustering:**
  - ✓ **Formula: See Deaton (1997). STATA command: use *svyset***
  - ✓ **Stratification: adjusted SE is usually slightly smaller than non-adjusted SE because stratums are more distinct each other**
  - ✓ **Clustering: adjusted SE is usually very larger than non-adjusted SE because each households in a cluster are more homogeneous, resulting in less information in variation than it seems from the number of households in the cluster.**

  See Table 1.5 of Deaton (1997) for the example of bias.

Implications of weighted, stratified, multi-stage random sampling (cont'd)

- **Microeconometric analysis (regression analysis) for testing economic models:**
  - ✓ **Weighting to reflect the difference in sampling probability is not required (you can do as a robustness check)**
  - ✓ **Standard errors of regression coefficients need to be adjusted for stratification and clustering. Especially, not-adjusting for clustering will over-estimate the precision of regression coefficients**
  - ✓ **Heteroskedasticity is also a problem in usual microeconometric analysis.**

  => In STATA, use the option for SE ", *cluster*(PSU)". This corrects for the clustering and also yields White's heteroskedasticity-consistent SE.

(3) Concepts of Poverty

- **Relative Poverty: Groups or individuals whose living standards are lower than those of other groups or individuals**
  - **Is it desirable and possible to eradicate this type of poverty in a capitalist society?**
  - **The relative poverty analysis is very similar to the analysis of economic inequality.**
- **Absolute Poverty: Groups or individuals whose living standards are lower than the minimum living standards in the absolute sense.**
  - **It is possible (in theory) to eradicate this type of poverty even in a capitalist society.**
  - **MDGs show that its eradication is also desirable.**
  - **The absolute poverty analysis is different from the analysis of economic inequality.**

Income Poverty Approach: Advantages

- **Income (Y) or total consumption expenditure (C) is highly correlated with other aspects in multidimensional poverty.**
- **As a proxy to the multidimensional poverty, Y or C is more comparable across regions or across periods than other proxies such as asset or education.**
- **Measuring poverty by Y or C corresponds to the consumer theory in microeconomics and the national account statistics in macroeconomics.**
- **Y or C fits rigorous statistical analysis since Y or C is a continuous and cardinal number.**

 # For this purpose, both Y and C should include imputed values of in-kind transactions.

(4) Poverty Line
What is the $1/day Poverty Line?

Millennium Development Goal #1, Target 1:
Halve, between 1990 and 2015, the proportion of people whose income is less than $1 a day

Two popular measures of poverty:

(1) Headcount ratio: % of the poor (those whose income/consumption is below the poverty line) to the total population

(2) Poverty gap ratio: % of the income deficiency of the poor to the total money required to guarantee the poverty line income to the total population

Poverty measures based on the poverty line of $1/day

Source: World Bank, *World Development Report 2008*, pp.336-337.

	Survey year	Headcount ratio (%)	Poverty gap ratio (%)
Bangladesh	**2000**	**41.3**	**10.3**
India	**2004-05**	**34.3**	**7.9**
Nepal	**2003-04**	**24.1**	**5.4**
Pakistan	**2002**	**17.0**	**3.1**
Sri Lanka	**2002**	**5.6**	**0.8**

Often heard question:

The poverty line of $1 a day per person should be about Rs. 8,100/month per household of 6 members in India (1 $/day * 30 days/month * 45 Rs./$ * 6 members/hh) in 2004-05. Nobody in my village in India earns such big money!

=> Headcount ratio of 34% for India seems something wrong!?

Well, there are two technical things you have to remember: (1) Imputation of in-kind transactions (already described) and (2) Adjustment for the difference in price levels using Purchasing Power Parity

Adjustment for price levels

The welfare level in terms of income/consumption should be compared with the poverty line of $1/day per person.

=> Difference in price levels between the US and India should be adjusted. How much does it cost to purchase the typical consumption items in the US and in India? Instead of the market exchange rate, we should use Purchasing Power Parity (PPP) exchange rate.

=> "$1 a day per person" (loose definition) = "$1/day per person in 1985 PPP dollars" = "$1.08/day per person in 1993 PPP dollars" = "$1.25/day per person in 2005 PPP dollars"(precise definition often used until around 2010)

- **In India, 2004-05, 1 PPP$ = 0.331 $ (*the price level in the US are about 3 times the price level in India*)**

 # The 2005 PPPs dollars are available from the World Bank web in "World Development Indicators & Global Development Finance"

Correct understanding of the $1/day Poverty Line

"$1/day per person in 1985 PPP$" is roughly Rs. 2,800/month per household of 6 members in 2004-05, including the value of in-kind receipts (food from own field, in-kind wages, etc.).

=> Headcount ratio of 34% for India makes more sense.

 # International poverty line of $1/day may not be relevant for India. Planning Commission (now Niti Aayog) sets Indian poverty line for NSS analysis

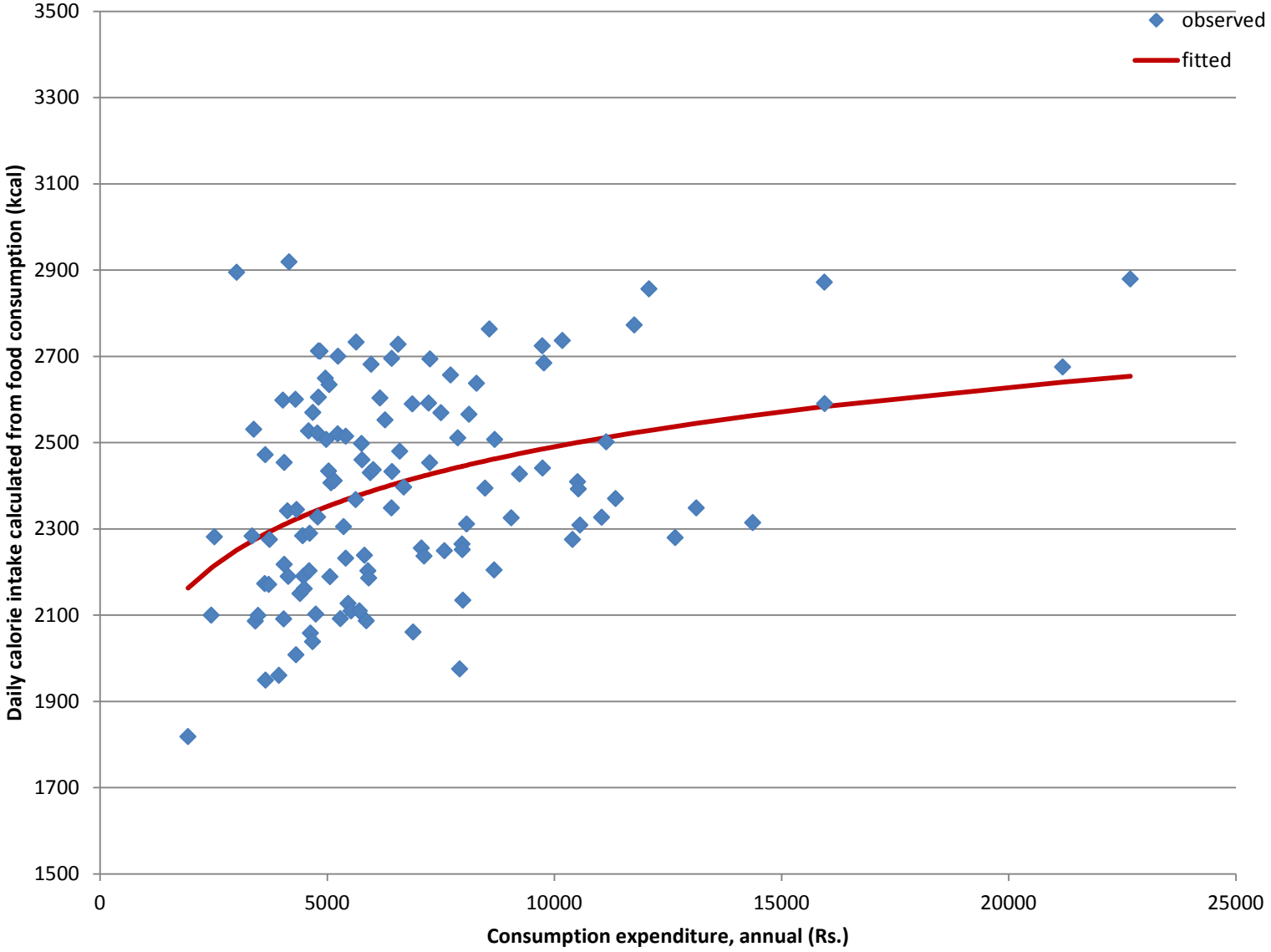
Several Alternatives for Poverty Line

- **Relative poverty line (OECD countries): The poverty line is often set at half of the median income**
  - ✓ **Lorenz-curve-preserving growth (all income multiplied by some constant) does not affect poverty!**
- **Absolute poverty line for LDCs: The money required for the minimum living standards, defined in the absolute terms.**
  - ✓ **Examples = PPP$1/day, Country-specific poverty lines.**
  - ✓ **Lorenz-curve-preserving growth always decreases poverty!**
- **For robustness check, better to use several poverty lines**

Identifying the Country-specific Poverty Line

- **Cost-of-basic-needs approach:**
  - **Household expenditure survey data => Identify the consumption basket comprising the basic minimum needs.**
  - **Using the same household data, calculate the amount of money required to purchase this basket. This is the poverty line.**
- **Food-energy-intake method):**
  - **Determine the minimum daily calorie intake required for an adult (FAO standard).**
  - **Household expenditure survey data => Estimate the total consumption expenditure that is associated with the minimum daily calorie intake on average.**
  - **cf. Marshallian demand functions and Engel's curve.**

The Food-Energy-Intake Method applied to my village survey data



Pros and Cons of Each Method

- **Cost-of-basic-needs approach)**:
  - **Easy to understand. We can have additional information on "minimum basic needs"**
  - **"Minimum basic needs" are always arbitrary**
- **Food-energy-intake method)**:
  - **No arbitrariness regarding the required calorie given the type of reference adult (age, work intensity, etc.).**
  - **The choice of other commodities is the liberty of consumers**
  - **Econometric procedure may affect the poverty line.**
  - **The choice of the reference adult to determine the required calorie is arbitrary.**

Poverty Lines for Different Regions, Different Periods

- **The standard: Fix the poverty line in the reference year for the reference region. Deflate it for a different year or for a different region, using the consumer price indices.**
  - **You can calculate the poverty line for each region and each period, applying the cost-of-basic-needs approach or the food-energy-intake method every time (non-standard way). Why we should not do this?**
  - **The non-standard way mixes up the impact of economic changes and preference changes. More meaningful comparison across regions or across periods should consider only the impact of economic changes.**

Adjustment for the Household Demography

NSS standard: MPCE (dividing the total expenditure by the number of household members)

As a welfare analysis, is it good enough to use per-capita expenditure?

- **It ignores economies of scale in consumption.**
- **It ignores the heterogeneous consumption needs, by age and gender.**
- **It ignores the intrahousehold inequality in resource allocation.**

Adjustment for the Household Demography: Scale Economy

- **Per-capita assumption: a person in a single person household with 365 PPP$ per year is equally poor as a person in a two person household with 730 PPP$.**
- **Use the *size elasticity* parameter θ ($0 \leqq \theta \leqq 1$) and define N^{θ} as the equivalence scale of a *N* person household.**
  - **See Lanjouw and Ravallion (1995) for the theoretical background.**
  - **θ could be estimated from hh data. Using Pakistan PIHS data, Lanjouw and Ravallion estimated θ at around 0.6 (θ=1 was rejected at the 1% level).**
  - **OECD's equivalence scale: θ=0.5, implying that a person in a single person household with 365 PPP$ per year is equally poor as a person in a four person household with 730 PPP$.**

Adjustment for the Household Demography: Heterogeneous Consumption Needs

- **Per-capita assumption: a four person household (4 adults) with 1460 PPP$ per year is equally poor as a four person household (two infants and two adults) with 1460 PPP$.**
- **Minimum calorie needs are heterogeneous by age and gender => Total food needs are also heterogeneous => Define the *adult equivalence unit* with normalization 1 for adult male.**
  - **In the above example, if the adult equivalence unit for an infant is 0.5, then the consumption level of the 2-2 household is 33% higher than that of the 4 adult household.**
- **A combination model: Apply size elasticity parameter θ to the sum of adult equivalence unit. In practice, either will make a big difference but the combination is often redundant (see Lanjouw and Ravallion 1995)**

Lanjouw and Ravallion (1995)

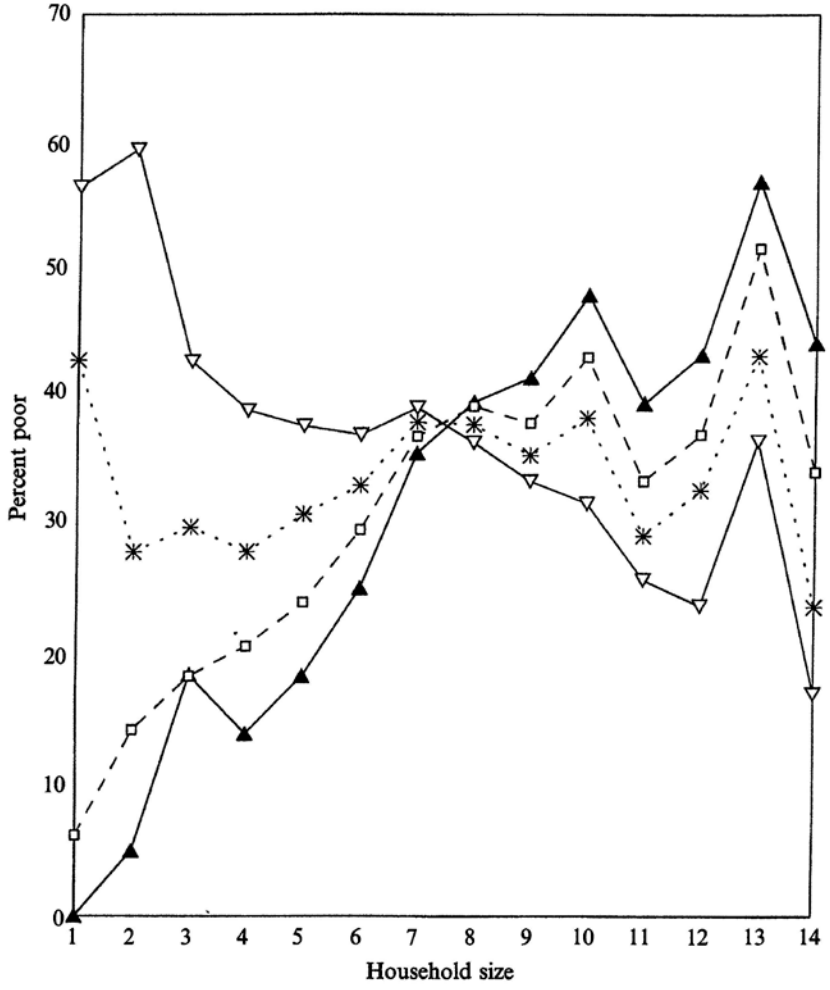


Fig. 2. Poverty and household size (head-count index). Size elasticity: ▽, 0·4; ✳, 0·6; □, 0·8; ▲, 1.

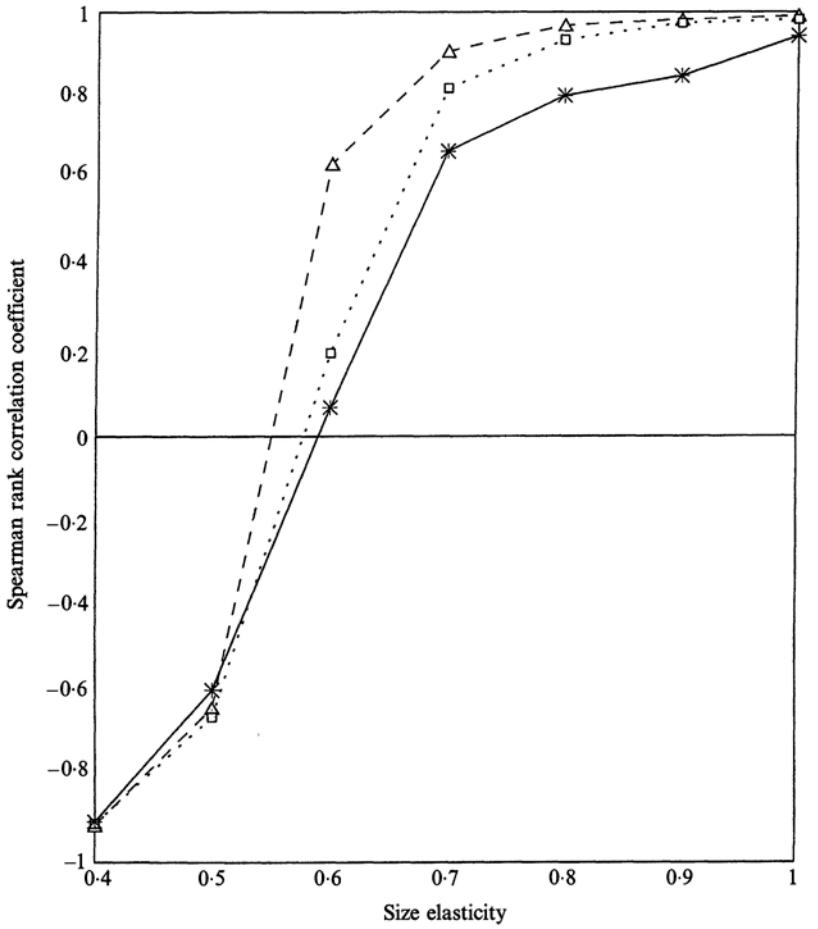


Fig. 4. Rank correlations between poverty and household size. Poverty measure: ✳, head-count index; □, poverty gap; △, squared poverty gap.

Adjustment for the Household Demography: Intrahousehold Inequality

- **Per-capita assumption: a four person hh with the same total consumption and the same demographic composition, but one with an altruistic head who allocates the total consumption according to needs of all members and another with an selfish head who satisfies his own needs only are equivalent in poverty measurement!**
- **Ideally, each individual's welfare should be evaluated based on his/her own consumption (private [rivalrous] consumption goods + household public consumption goods)**
- **Haddad and Kanbur (1990): Collected individual food intake data (Philippines) and compare poverty measures based on the usual process (total food consumption/total food requirement: Φ_2) and those based on actual individual food consumption (Φ). => The usual process underestimates inequality and poverty substantially! (But rankings were robust.)**

Table 4

P_α Poverty Measures for Selected Subgroups Using ϕ, ϕ_1, and ϕ_2

Group	N	$P_0(\phi)$	$P_1(\phi)$	$P_2(\phi)$	$P_0(\phi_1)$	$P_1(\phi_1)$	$P_2(\phi_1)$	$P_0(\phi_2)$	$P_1(\phi_2)$	$P_2(\phi_2)$
All	2,880	0·70243	0·18640	0·06759	0·76875	0·15201	0·04093	0·75764	0·14355	0·03756
Corn	1,565	0·69521	0·18144	0·06483	0·75463	0·14661	0·03925	0·73738	0·13897	0·03632
Sugar	1,028	0·70055	0·18592	0·06811	0·77634	0·15042	0·04029	0·77172	0·14125	0·03647
No crop	233	0·75966	0·22203	0·08369	0·82833	0·19571	0·05516	0·82833	0.18494	0·05097
Owner	695	0·68345	0·17584	0·06342	0·74964	0·14021	0·03716	0·74964	0·13459	0.03495
Mix	516	0·67636	0·17171	0·05930	0·70543	0·13731	0·03354	0·72093	0·13092	0·03137
Tenant	758	0·68865	0·17792	0·06445	0·76253	0·14202	0·03822	0·74802	0·13265	0·03441
Labourer	580	0·74310	0·20589	0·07605	0·83276	0·17269	0·04884	0·78276	0·16133	0·04424
Other ten	331	0·74320	0·21676	0·08159	0·80967	0·18633	0·05270	0·80967	0·17582	0·04822
Corn own	341	0·68622	0·18359	0·06663	0·73607	0·14803	0·03970	0·73607	0·14226	0·03797
Corn mix	310	0·71613	0·18241	0·06382	0·70968	0·15507	0·03895	0·70968	0·14857	0·03646
Corn share	549	0·68852	0·17219	0·06080	0·76138	0·13601	0·03740	0·74499	0·12825	0·03452
Corn lab	267	0·69288	0·18820	0·06766	0·81273	0·15036	0·04007	0·74532	0·14009	0·03578
Sug own	354	0·68079	0·16837	0·06034	0·76271	0·13269	0·03472	0·76271	0·12720	0·03204
Sug mix	206	0·61650	0·15562	0·05250	0·69903	0·11059	0·02541	0·73786	0·10435	0·02370
Sug rent	209	0·68900	0·19298	0·07404	0·76555	0·15781	0·04037	0·75598	0·14421	0·03412
Sug lab	313	0·78594	0·22099	0·08320	0·84984	0·19174	0·05632	0·81470	0·17946	0·05146
Other occ	233	0·75966	0·22203	0·08369	0·82833	0·19571	0·05516	0·82833	0·18494	0·05097
Corn othrnt	98	0·70408	0·20423	0·07661	0·76531	0·16404	0·04685	0·76531	0·15414	0·04168
Male	1,484	0·72372	0·19017	0·06863	0·77089	0·15058	0·04016	0·76146	0·14262	0·03691
Female	1,396	0·67980	0·18240	0·06648	0·76648	0·15353	0·04175	0·75358	0·14453	0·03826
Adult*	1,191	0·48615	0·10074	0·03259	0·75231	0·14757	0·03957	0·74139	0·13920	0·03633
Non-adult	1,689	0·85494	0·24681	0·09226	0·78034	0·15515	0·04189	0·76909	0·14661	0·03843

* Non-adults are defined as individuals less than or equal to nineteen years of age in accordance with definitions employed by the National Nutrition Council of the Philippines for calorie requirements (NNC, 1976).

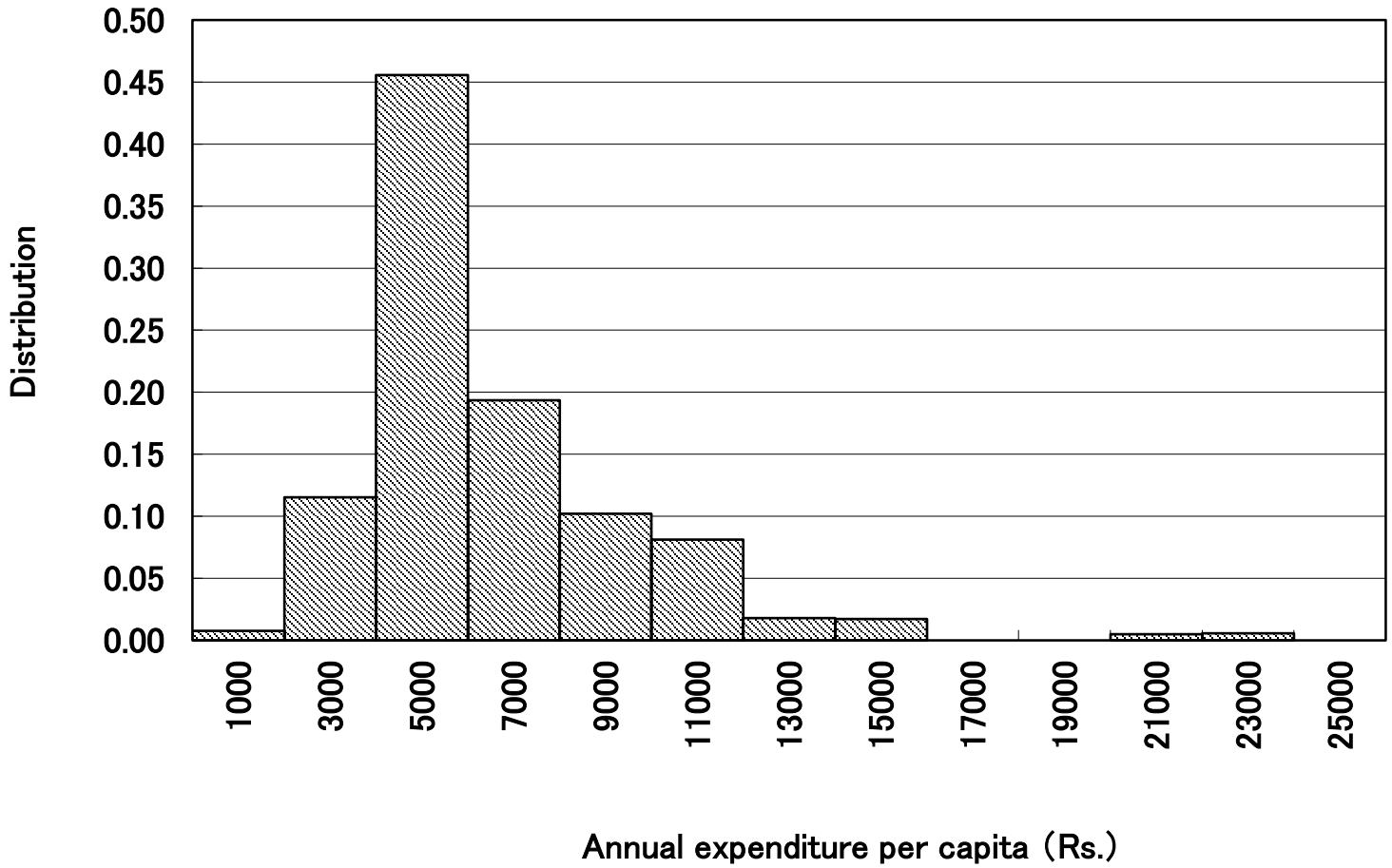
(5) Poverty Measures

The concept of poverty measures:

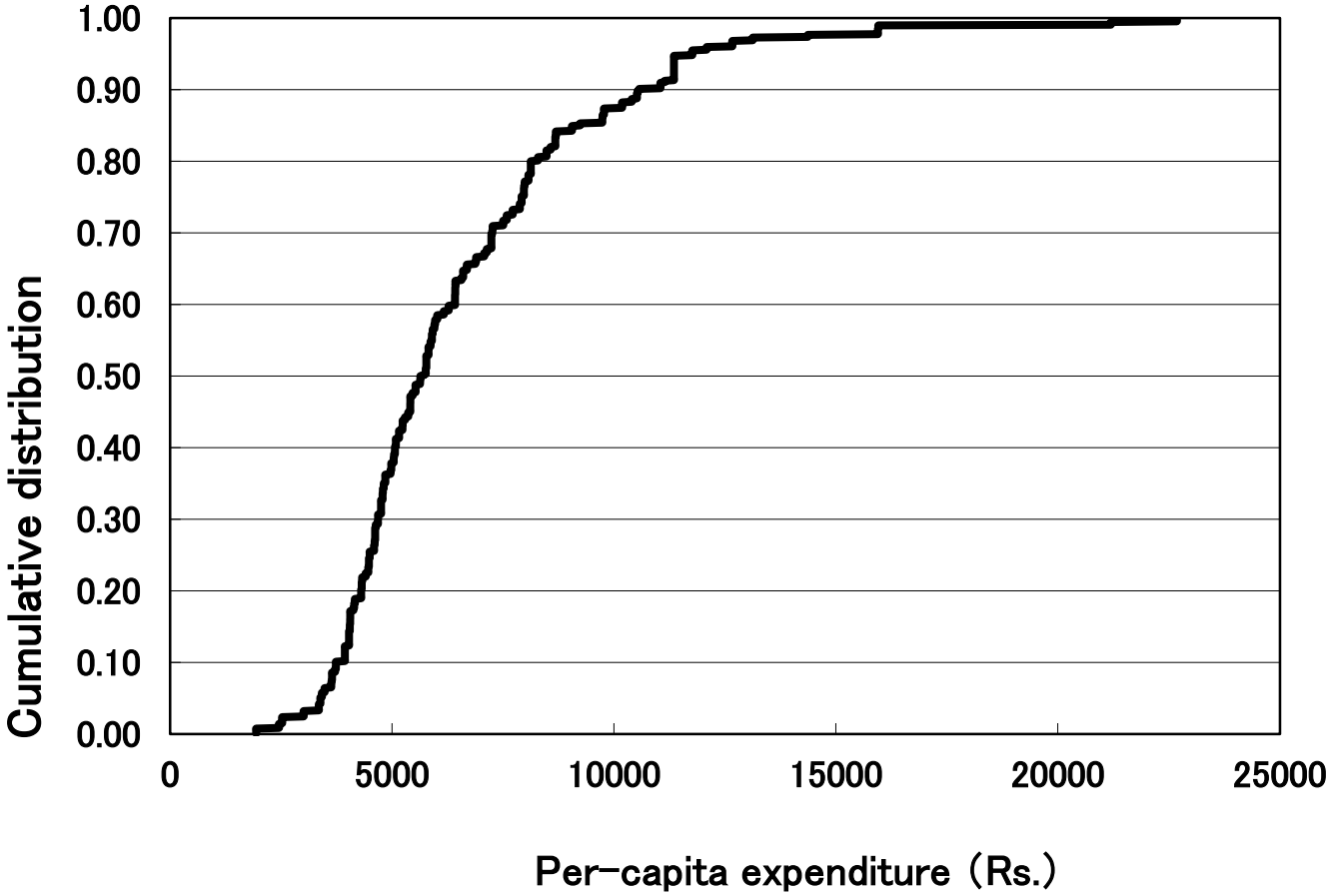
- **Household data: Each individual *i* is assigned a micro-level poverty gap: 1-c_i/z, where c_i is real consumption per capita (or divided by the relevant household size) and *z* is the poverty line corresponding to the assumption of household size.**
- **A poverty measure aggregates 1-c_i/z for *i* belonging to a group of interest.**
- **Axiomatic approach to poverty measurement (cf. Foster and Sen (1997): A poverty measure should satisfy Focus axiom, Monotonicity axiom, Transfer axiom, Transfer sensitivity axiom, etc.**
- **Unit of aggregation: Individuals with equal weights**

Poverty Measures: Understanding aggregation

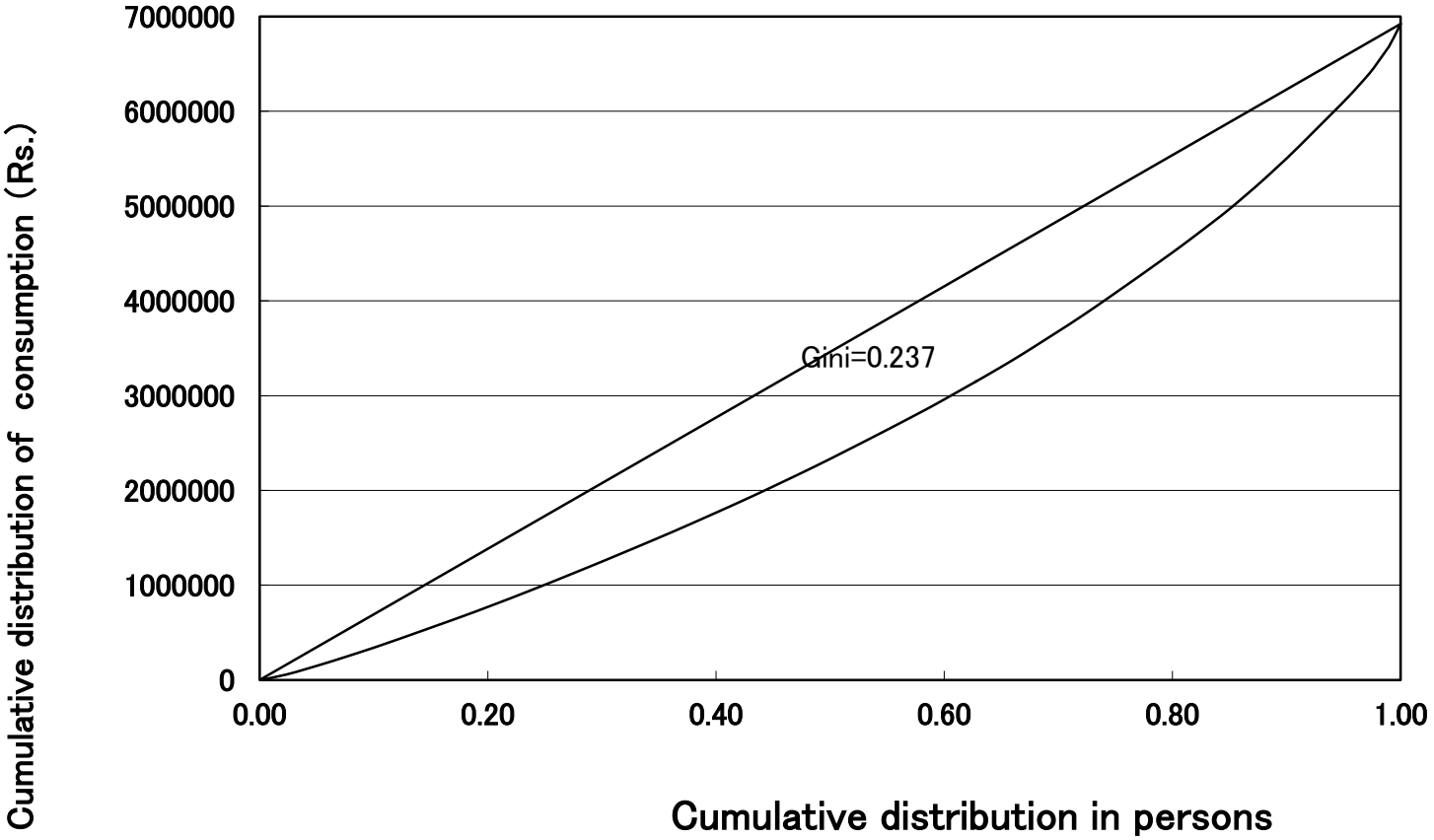
(a) Histogram



(b) Cumulative Distribution Figure of per-capita consumption



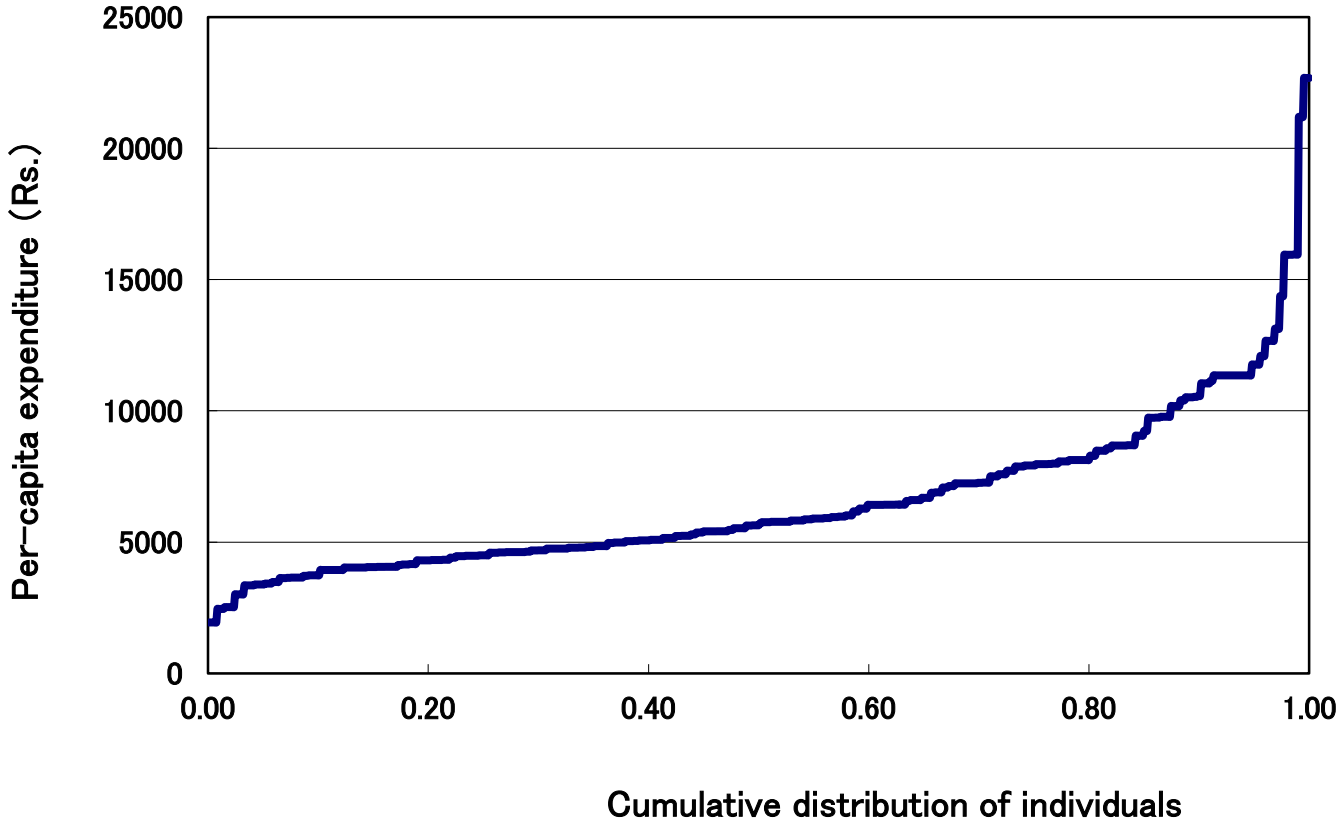
(d) Generalized Lorenz Curve of per-capita consumption



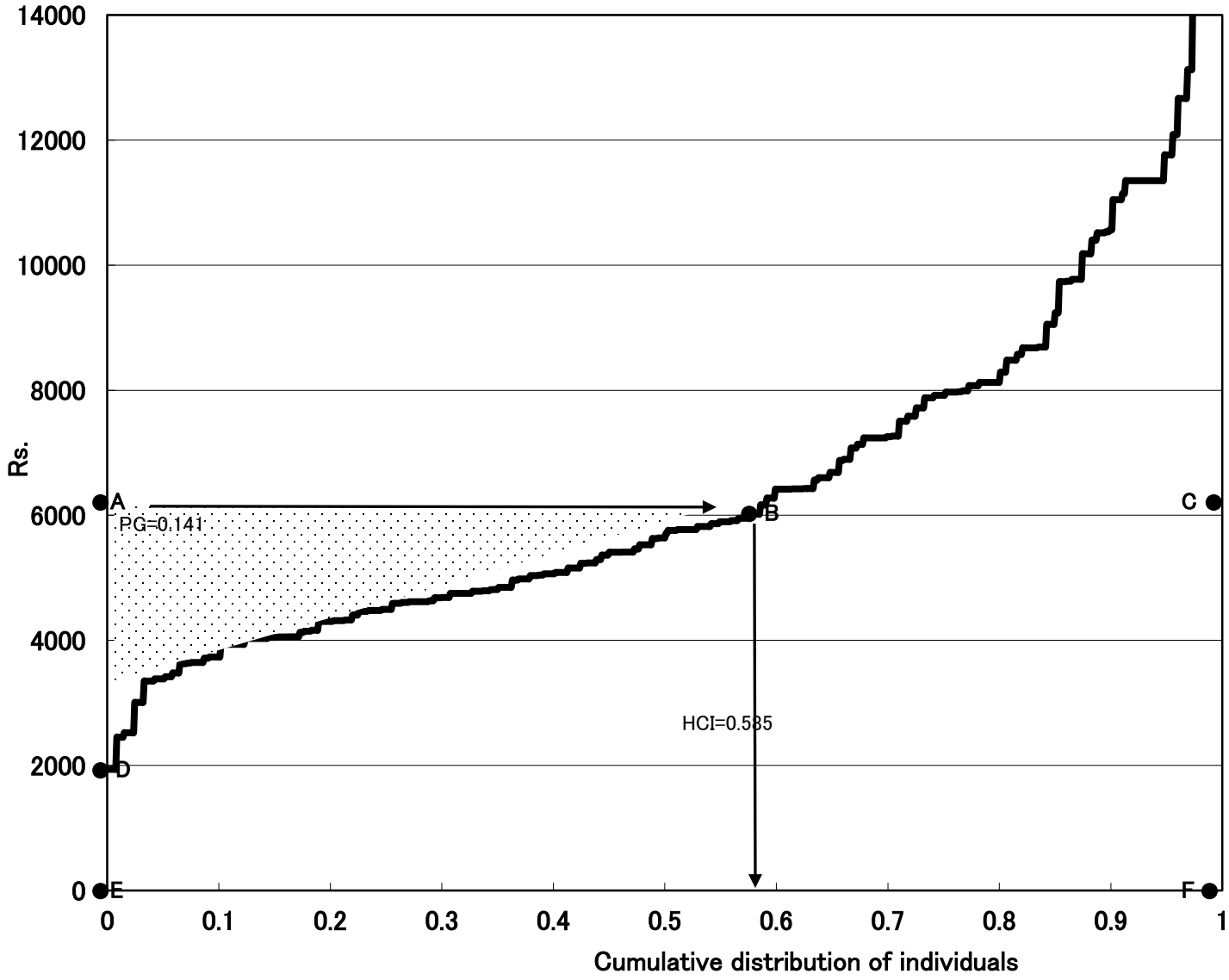
Poverty Measures: Three FGT Measures

- **Head Count Index**：**Ratio of the poor population to the total population.**
  - **Problem: The monotonicity axiom is not satisfied when the poor becomes poorer.**
- **Poverty Gap Index PG**：**The sum of the poverty gap divided by the total population. Poverty ratio in terms of money.**
  - **Problem: The transfer axiom is not satisfied when the transfer occurs from the very poor to the moderately poor and the moderately poor did not cross the poverty line after the transfer.**
- **Squared Poverty Gap Index SPG**： **The sum of the poverty gap squared divided by the total population.**

c) Cumulative Distribution Figure, X-Y axis changed



HCI and PG shown on the (reversed) Cumulative Distribution Figure



Three Poverty Measures as the Family of Generalized FGT Poverty Measures

- SPG = The FGT poverty measure in the narrow sense. FGT: Foster, Greer, and Thorbecke (*Econometrica*, 1984)
- Generalized FGT poverty measures

$$P(\alpha) = \Sigma_{i=Poor}(1-c_i/z)^{\alpha}/n$$

Where n is total population, $\alpha \geqq 0$.

- HCI: α=0, PG: α=1, SPG: α=2
- Monotonicity axiom satisfied when α>0; Transfer axiom satisfied when >1; Transfer sensitivity axiom satisfied when α>2.

Example of STATA Command for Household-level Data

```
gen wratio = MPCE/pove_line
gen povd = 1*(wratio<1)
gen povgap = povd*(1-wratio)
gen povg2 = povgap^2

# The following is the case where the sum of popwt
    is equal to the national population

gen popwt=hhd_size*MLTPL
sum MPCE povd povgap povg2 [w=popwt]
sum MPCE povd povgap povg2 [w=popwt] if ZZ==k
```

Other poverty measures

- **Sen's poverty index: $P = H[I+(1-I)G]$, where H=HCI, I=PG/(zq), q is the number of the poor, and G is Gini index among the poor.**
- **Clark-Watts poverty measures:**

$$P(\beta) = \Sigma_{i=Poor}(1-(c_i/z)^{\beta})/\beta/n$$

Where n is total population, $\beta \leqq 1$.

PG when $\beta=1$

This is a good measure that corresponds to a well-behaved utility function under risk (constant relative risk aversion: CRRA). For example, when $\beta=0$, the poverty measure corresponds to the log utility fn.

Choice of poverty measures and policies

- **"Poverty Reduction Policy" => Outcome measured by a poverty measure? => The choice of the measure potentially brings potential bias!**
  - **HCI does not take into account the negative change of income for the poor => The most efficient policy to reduce HCI is to help those just below the poverty line!**
- **Each of poverty measure has different characteristics: It is important to implement a robustness check with different measures and different poverty lines.**

(6) Poverty Profile Analysis

Basics of poverty profile analysis:

- **Which group (region, class, occupation, gender, etc.) is poorer than other groups?**
- **Useful for targeting a poverty reduction policy.**
- ***Decomposability*: Generalized FGT measures and Clark-Watts measures can be expressed as**

$$P = \frac{1}{n}\sum_i p\left(1 - \frac{c_i}{z}\right),$$

where *p*(.) is an individual-level poverty score function, which transforms the micro-level poverty gap by some rule.

- **In other words, Generalized FGT measures and Clark-Watts measures are the population average of the poverty score function.**

Poverty Profile Analysis: How-to implement

$$P = \frac{1}{n}\sum_i p\left(1-\frac{c_i}{z}\right) = \sum_j \frac{n_j}{n}\frac{1}{n_j}\sum_{i\in j} p\left(1-\frac{c_i}{z}\right) = \sum_j \frac{n_j}{n}P_j,$$

- Divide the total population into exclusive groups.
- Calculate FGT poverty measure for each group.
- Prepare a cross table for each group axis.
  - Run statistical tests for the equality of poverty measure across groups
  - Decompose the total poverty into those attributable to each group (a group's contribution to the total poverty increases if P_j increases or n_j increases)

(7) Introduction to Inequality Analysis: Concept

Relative inequality to measure the spread of whole distribution of well-beings

(1) Axioms to be satisfied by standard measures of inequality:

- **Anonymity or symmetry**
- **Mean independence or income homogeneity**
- **Population independence**
- **Pigou-Dalton transfer principle**

(2) Frequently-used measures satisfying these:

- **Gini coefficient**
- **Coefficient of variation**
- **Theil index**
- **Generalized entropy index**
- **Atkinson measure**
- **Log variance (a non-normalized Atkinson measure when the inequality aversion parameter is 1)**

(3) All these are calculated using unit data, similar to the poverty analysis

(More on the next lecture)

Summary of this lecture

(1) Measuring the welfare level using household data: Use total consumption expenditure including the imputed values of in-kind transactions

(2) Using NSS-type household data: In calculating means, use correct weights; in calculating standard errors, adjust for clustering

(3) Concepts of poverty: Use absolute poverty at the household (individual) level defined on Y or C including imputed values

(4) Poverty line: Adjust for the price level & household demography

(5) Poverty measures: Do not rely only on HCI. Use SPG, PG, Clark-Watts, etc.

(6) Poverty profile analysis: Prepare cross tables based on the decomposability property of FGT (CW) measures

(7) Introduction to inequality analysis: Using unit data, inequality measures calculated

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