Person Equivalent Headcount Measures of Poverty

Tony Castleman, James E. Foster, and Stephen C. Smith
George Washington University

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Motivation

- Headcount and Headcount Ratio (number and proportion of people below poverty line) widely used and easily understandable

- But these measures have important limitations:
  - Income changes do not show up unless individuals cross the poverty line (ignore depth of poverty)

  - Incentive to focus on better off among the poor

Motivation (continued)

- Some previously available poverty measures capture depth (and severity), e.g. poverty gap, squared poverty gap
- But not intuitive, harder for policymakers to grasp, or to explain
- This project:
- To create measures that retain the intuitiveness of measures in "people-space" -
- Yet still capture other salient properties – specifically addressing *depth of poverty*

Background: FGT Poverty Measures

Population i = 1...n with incomes $x=(x_i.....x_n)$; poverty line = z

$P_\alpha = \mu(g_1^\alpha, ... g_n^\alpha)$ where $g_i = (z-x_i)/z$ for $x_i < z$, 0 otherwise

P_0 = Headcount ratio H = q/n, q= number below poverty line

P_1 = Poverty gap HA/z, where H = q/n; A is average income shortfall, $A = \mu(z-x_1, ... z-x_q)$

P_2 = Squared poverty gap = $\mu[(z-x_1)^2/z^2, ... , (z-x_n)^2/z^2]$

Some Past Uses of Person-Equivalence

- Full time equivalents in labor economics, e.g. benchmark of 40 hours/week in the US
- Adult-equivalent nutritional needs in intra-household studies
- Adult-equivalent productivity in child labor research (Basu and Pham 1998, Basu 2000)

Person Equivalent Poverty: Initial Numerical Example of the Basic Idea

- Person Equivalence
  - Use the average gap among the poor in an initial period as the benchmark person equivalent for evaluating progress and measuring poverty
- Suppose the average gap is 40¢/day in the initial period
  - If an ultra-poor person moves up from 30¢ to 70¢ per day:
    - We count this as progress Lower by one person equivalent
    - Headcount measures ignore this progress entirely
  - If a slightly poor person moves up from 5¢ below, to something above the line:
    - We count this as a small drop of 1/8 of a person equivalent
    - Headcounts give full weight to this change

Initial Numerical Example, Continued

Person Equivalent Headcount

If the headcount is q = 400 in the second period, but the average gap has fallen to 30¢ per day - so average depth is ¾ of what it was previously - then the **person equivalent headcount** in the second period is $q_e = 300$

Incorporates the poverty-reduction benefit of fall in ave. depth

Person Equivalent Headcount Ratio

If the total population is n = 1200 then the **person equivalent headcount ratio** in the second period is

$H_e = 300/1200 = 0.25$

Transformation to "People Space"

Transform the traditional headcount q and headcount ratio H by 30¢/40¢ to get q_e and H_e for tracking poverty

Person Equivalent Headcount – General Approach

- Measures the poverty gap in "people space" by using the average shortfall of poor persons as the unit of measurement
- $q_e = qA/A_0$ $H_e = q_e/n$
- Average income shortfall among poor (A_0) is the benchmark, and one person-equivalent
- Total poverty gap (qA) expressed in person equivalents
- Note – If average depth falls below benchmark, PE measure is lower than traditional measure; if average depth rises above benchmark, PE will be higher

Population - Numerical Example

1990

- Country X has 500,000 population of whom 100,000 are poor (<$1.25/day)
- Average income shortfall among poor is 50¢/day

2005

- 600,000 population of whom 100,000 are poor
- Average income shortfall among poor is 35¢/day

Changes after 15 years:

- q (number of poor) has remained the same
- q_e has decreased from 100,000 to 70,000
- H (fraction poor) has decreased from .2 to .17
- H_e has decreased from .2 to (approx.) .12

Example (cont.): Impact of One Poor Person's Income Gain on PE Headcount

1990

- Country X has 500,000 population of whom 100,000 are poor (<$1.25/day)
- Average income shortfall among poor is 50¢/day

2005

- 600,000 population of whom 100,000 are poor
- Average income shortfall among poor is 35¢/day

- A person moving from 60¢/day to $1.10/day has no effect on headcount; but decreases p.e. headcount by 1
- A person moving from $1.20/day to $1.30/day decreases headcount by 1; but decreases p.e. headcount by only .10

Benchmarking

- The choice of an appropriate A_0 benchmark is somewhat flexible, depending on purpose
- A_0 can be average income shortfall in a time period, geographic location, or other. We can:
  - Look at a country over time using its own benchmark average income shortfall from a baseline period
  - Compare countries using regional or global average shortfall
  - Compare regions using global average shortfall
  - Track global progress using baseline shortfall
- Values will be proportional and relative magnitudes the same, regardless of benchmark

We Can also Transform other Poverty Measures, P_α , to People Space:

- Where we can write $H_e = P_1/I_0$, where $I_0 = A_0/z$
  (recall H, H_e: *fraction* poor)
- Similarly, $H_{e2} = P_2/I_2^0$, where $I_2^0 = \mu(g_1^2 \ldots g_n^2)$,
  and: $g_i = (z - x_i)/z$
- Analogous with P_2, H_{e2} gives greater weight to individuals who further below the poverty line
- We can also transform multidimensional poverty measures, using average intensity as benchmark

Elasticities

- Growth elasticity of poverty: **$\%\Delta H/\%\Delta GDP$**

- Depth elasticity of poverty reduction: **$\varepsilon = \%\Delta H_e/\%\Delta H$**
  - Addresses question: To what extent is reduction in the headcount ratio leading to reductions in person equivalent headcount ratio (or equivalently the poverty gap)?
  - A measure of inclusiveness of poverty reduction

- Severity elasticity of poverty reduction:

  $\varepsilon_2 = \%\Delta H_{e2}/\%\Delta H$

  To what extent is poverty reduction reaching those in *greater* poverty.

Data

- Uses PovcalNet poverty data from the World Bank
- $1.25/day used for present purposes – corresponds to the data in the accompanying conference paper.
  - Recalculating with $1.90, qualitative results similar
- Countries that have household survey data from both 1992-2000 period and 2005-2010 period.
- Total of 78 countries from six regions
- Consumption data, except LAC data is income data

Global Income Poverty
Traditional & Person Equivalent Headcounts

Year Range		n	q	H	q_e	H_e	%ΔH	%ΔH_e	ε
1992-2000		4,321	1,547	0.36	1,547	0.36	-44.3	-50.4	1.1
2005-2010		5,189	1,035	0.20	922	0.18			

Populations and headcounts in millions of persons

Benchmark is 1992-2000 global average income shortfall: A_0 = 39.5¢/day

Global Income Poverty: P_1 and P_2

Year Range	n	q	H	q_e	H_e	q_{e2}	H_{e2}	%ΔH	%ΔH_e	%ΔH_{e2}	Depth Elasticity	Severity Elasticity
1992-2000	4,321	1,547	.36	1,547	.36	1,547	.36	-44.3	-50.4	-51.8	1.1	1.2
2005-2010	5,189	1,035	.20	922	.18	897	.17					

Populations and headcounts in millions of persons

Benchmark for q_e *is 1992-2000 global average income shortfall:* $A_0 = 39.5¢/day$

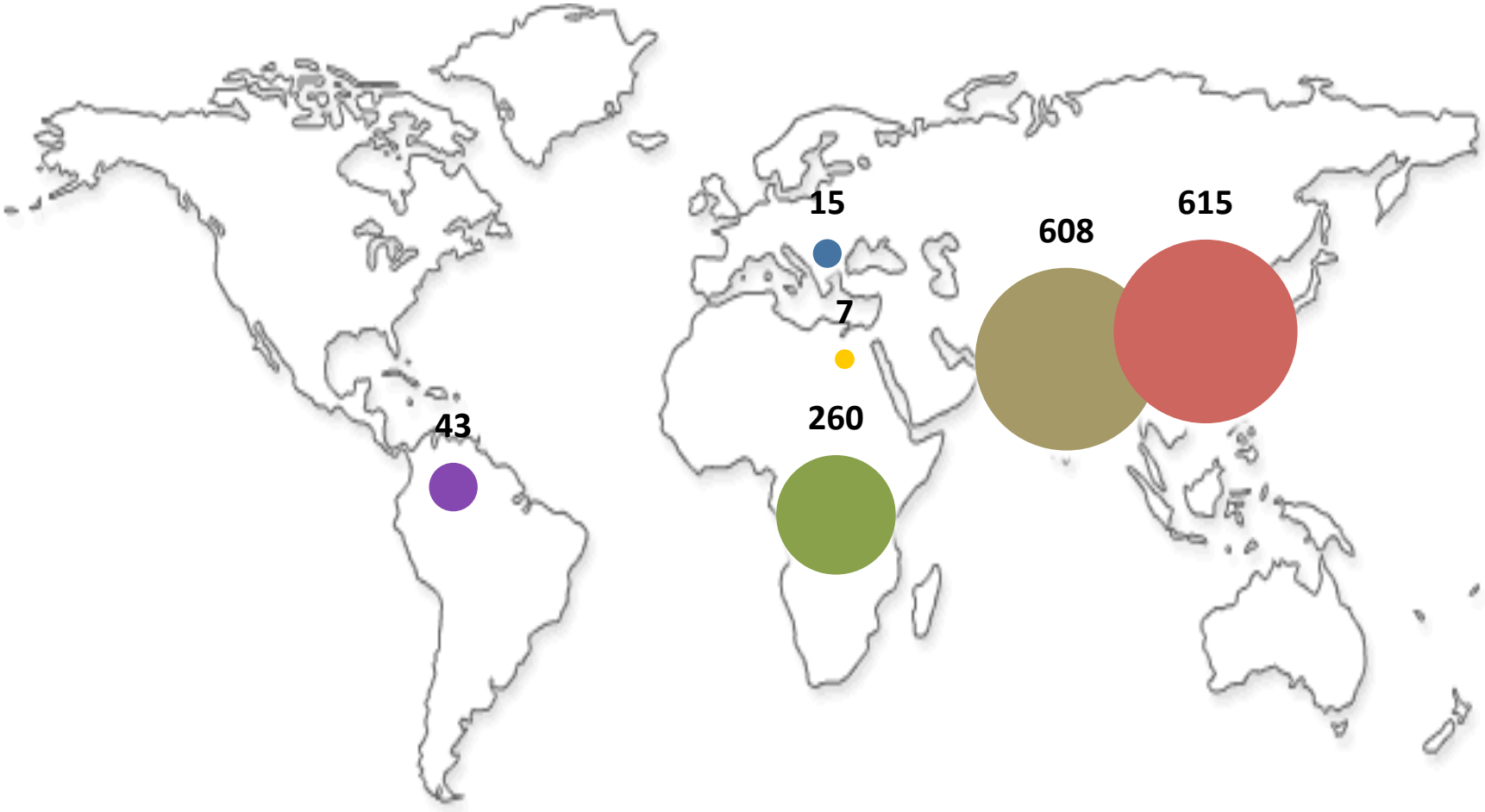
Benchmark for q_{e2} *is 1992-2000 global average squared income shortfall:* $I_0 = 22$ *cents squared per day, an equivalent equally distributed gap of 47¢ per day.*

Additional Interpretation

- Using PEHMP can be interpreted by imagining there is a redistribution of the poor population across sub-groups:
- The higher-intensity subgroup gains Person-Equivalent poor population, and the lower-intensity subgroup loses PE poor population
- Example: Groups are geographic regions (countries)

Regional Income Headcounts

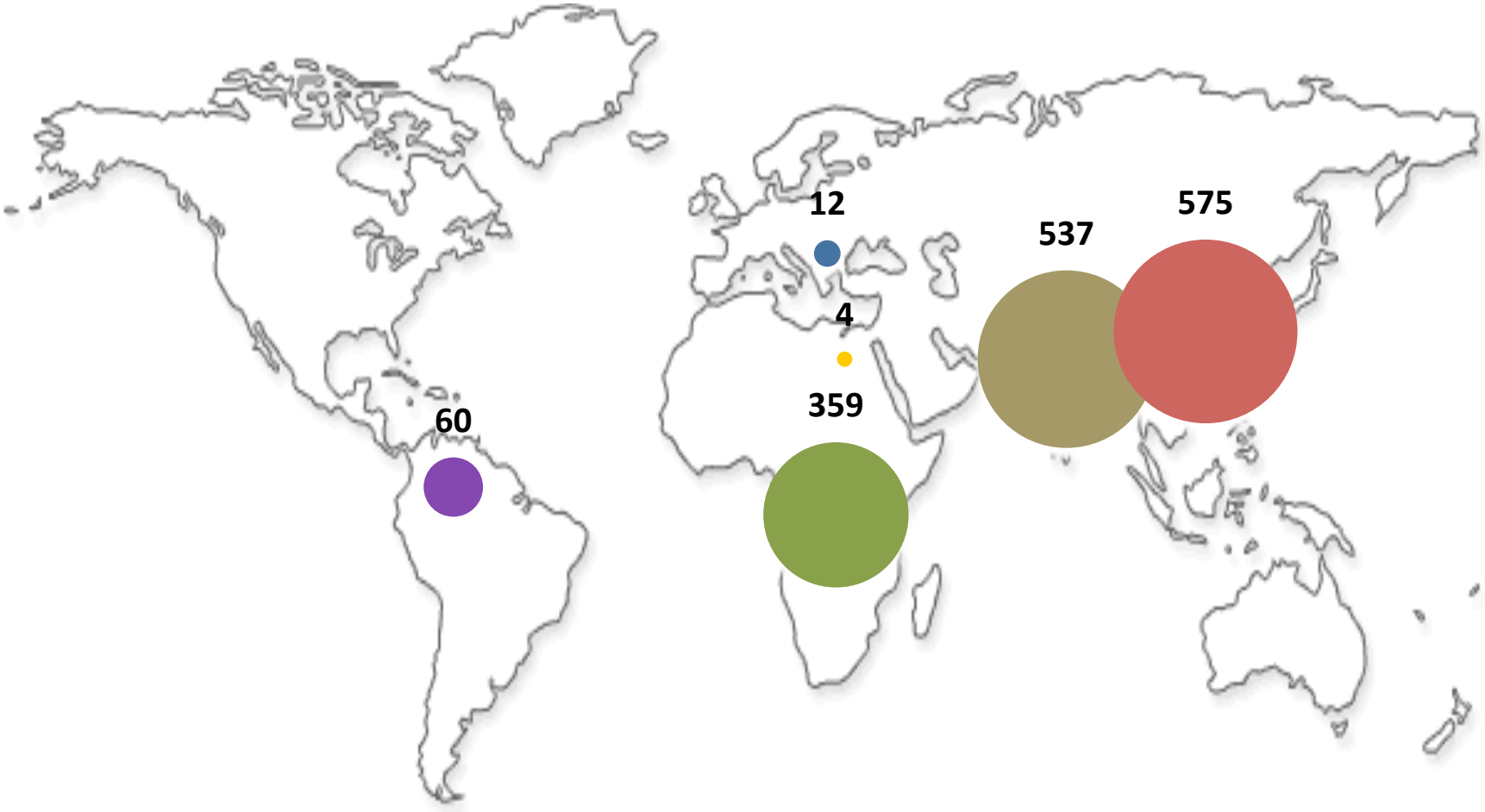
1990's



Headcounts in millions of persons

Regional Income PE Headcounts

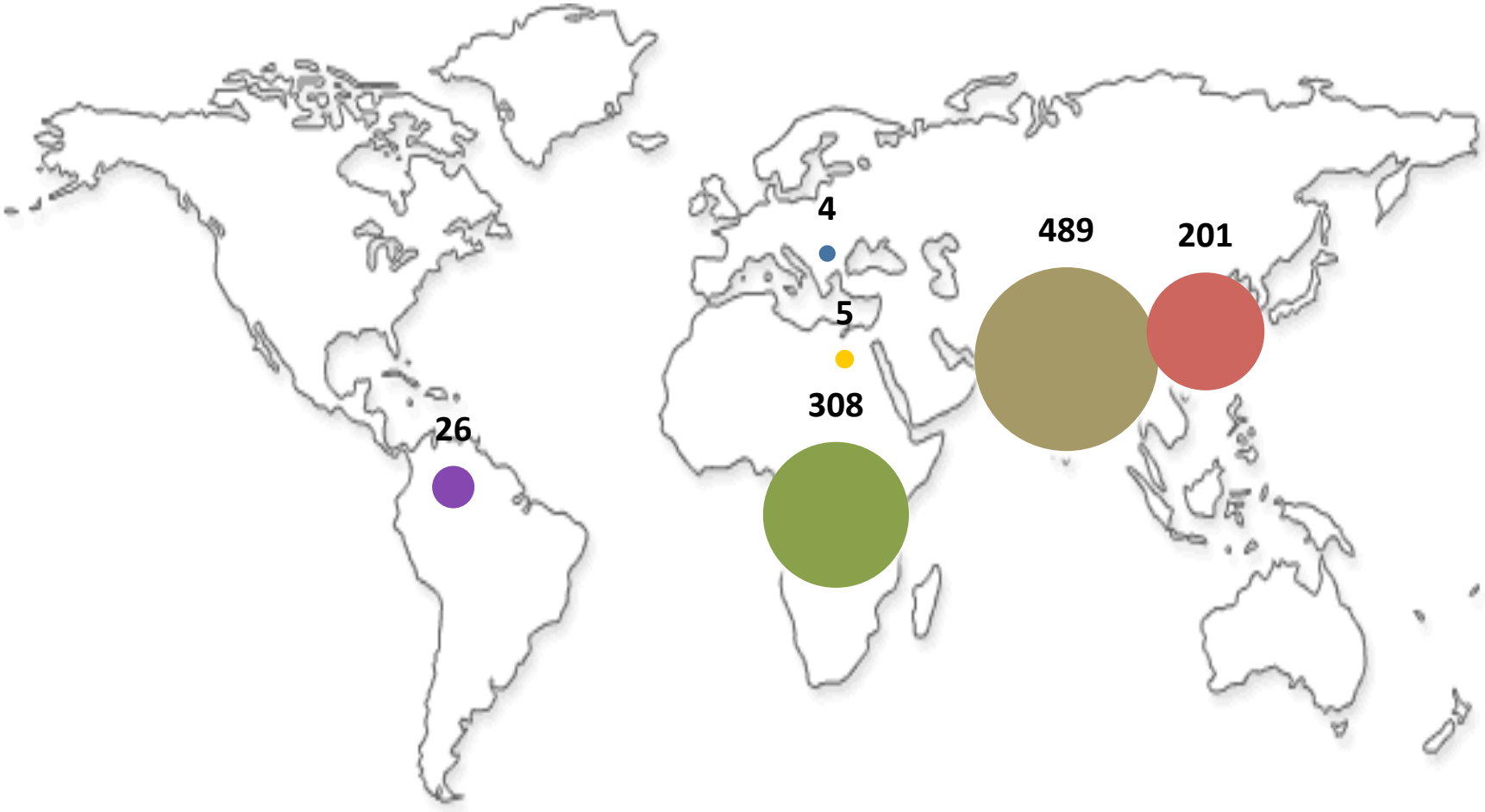
1990's



Headcounts in millions of persons

Regional Income Headcounts

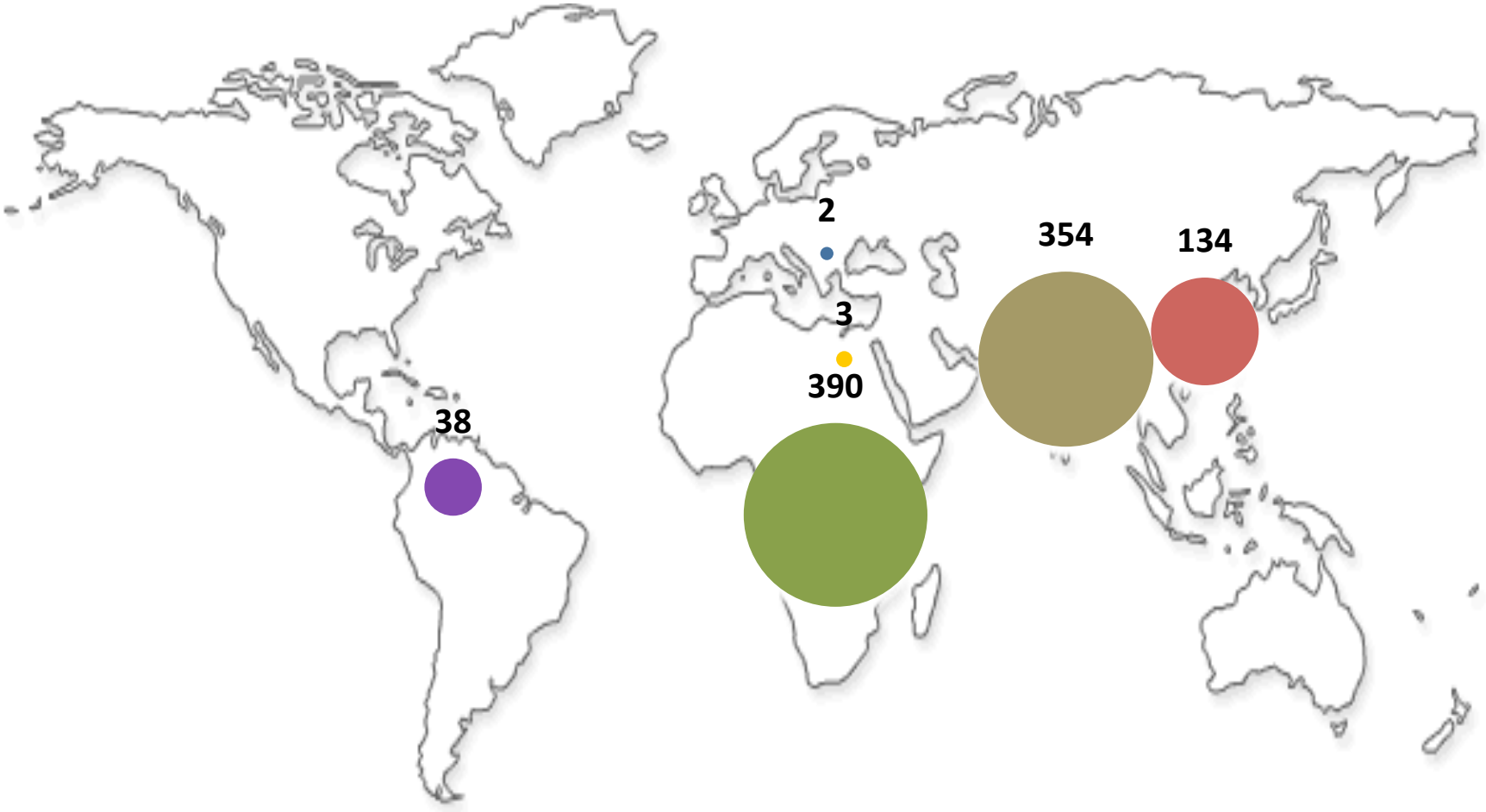
2005-2010



Headcounts in millions of persons

Regional Income PE Headcounts

2005-2010



Headcounts in millions of persons

Global Income Poverty by Region

Region	Year Range	n	q	H	q_e	H_e	%ΔH	%ΔH_e	ε
EAP	1992-97	1,635	615	.38	575	.35	-71%	-79%	1.1
	2008-10	1,842	201	.11	134	.07			
ECA	1993-2000	399	15	.04	12	.03	-74%	-83%	1.1
	2007-10	402	4	.01	2	.01			
LAC	1992-99	457	43	.09	60	.13	-49%	-48%	0.97
	2005-10	535	26	.05	38	.07			
MENA	1994-98	179	7	.04	4	.02	-35%	-25%	0.73
	2005-10	213	5	.02	3	.02			
SA	1993-96	1,210	608	.50	537	.44	-37%	-49%	1.3
	2007-10	1,553	489	.32	354	.23			
SSA	1992-2000	441	260	.59	359	.81	-16%	-23%	1.4
	2005-10	625	308	.49	390	.62			

Population and headcounts in millions of persons

Benchmark is 1992-2000 global average income shortfall: I^0 = 39.5¢ per day

Global Income Poverty by Region

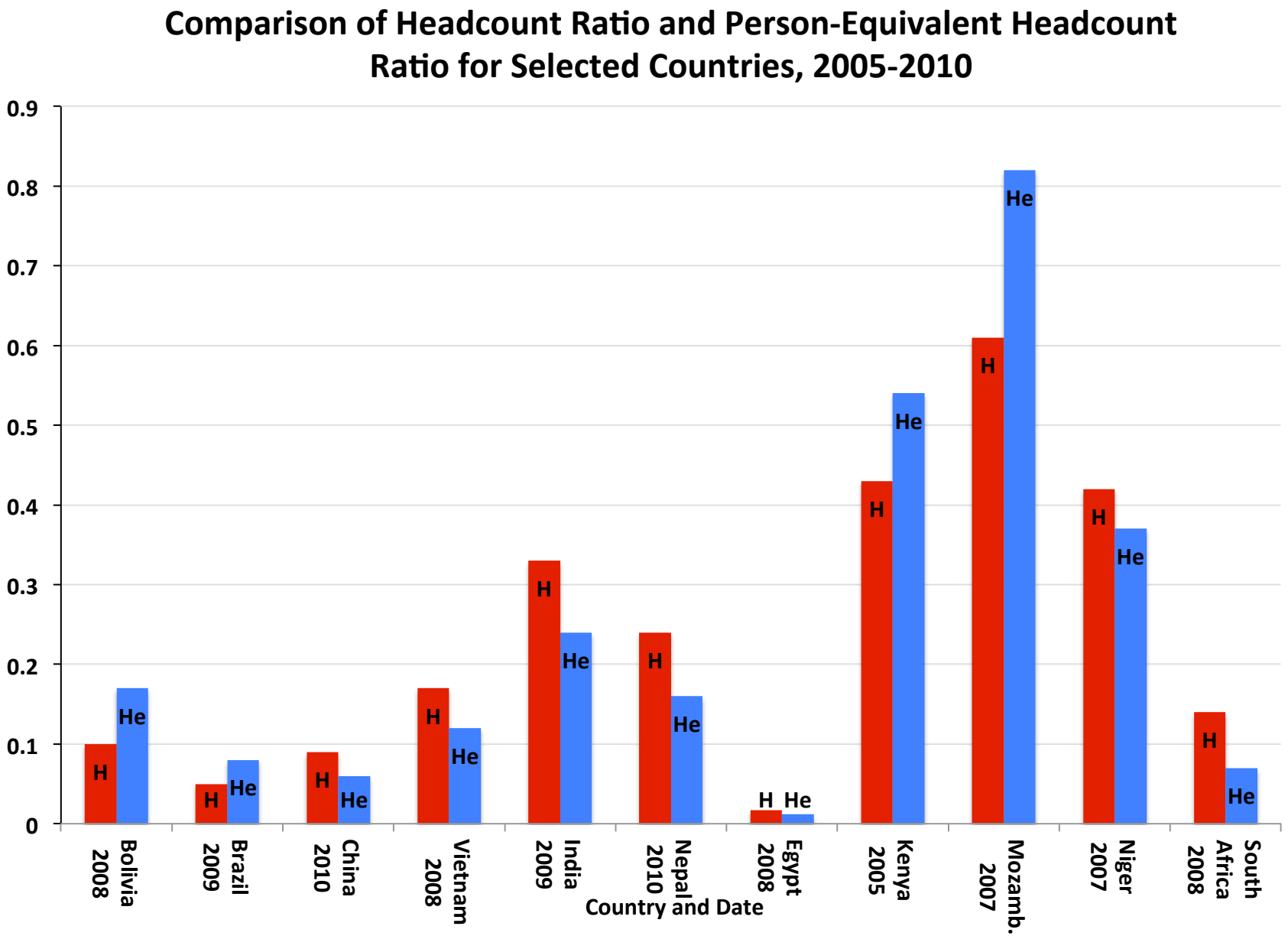
(Supplementing Previous Table with H_{e2} Measures)

Region	Year Range	n	q	H	q_e	H_e	q_{e2}	H_{e2}	%ΔH	%ΔH_e	%ΔH_{e2}	Depth Elasticity	Severity Elasticity
EAP	1992-97	1,635	615	.38	575	.35	524	.32	-71%	-79%	-84%	1.1	1.2
	2008-10	1,842	201	.11	134	.07	94.4	.05					
ECA	1993-2000	399	15	.04	12	.03	11	.03	-74%	-83%	-80%	1.1	1.1
	2007-10	402	4	.01	2	.01	2.3	.01					
LAC	1992-99	457	43	.09	60	.13	90	.20	-49%	-48%	-46%	0.97	0.93
	2005-10	535	26	.05	38	.07	59	.11					
MENA	1994-98	179	7	.04	4	.022	2.8	.016	-35%	-.25%	-5%	0.73	.14
	2005-10	213	5	.02	3	.016	3.2	.015					
SA	1993-96	1,210	608	.50	537	.44	464	.38	-37%	-49%	-55%	1.3	1.5
	2007-10	1,553	489	.32	354	.23	268	.17					
SSA	1992-2000	441	260	.59	359	.81	456	1.0	-16%	-23%	-27%	1.4	1.7
	2005-10	625	308	.49	390	.62	471	.75					

Populations and headcounts in millions of persons

Benchmark* for q_e *is 1992-2000 global average income shortfall: A_0 = 39.5¢/day

Benchmark* for q_{e2} *is 1992-2000 global average squared income shortfall: I_0 = 22 cents squared per day, an equivalent equally distributed gap of 47¢ per day.


Comparison of Headcount Ratio and Person-Equivalent Headcount Ratio for Selected Countries, 2005-2010
0.9
0.8
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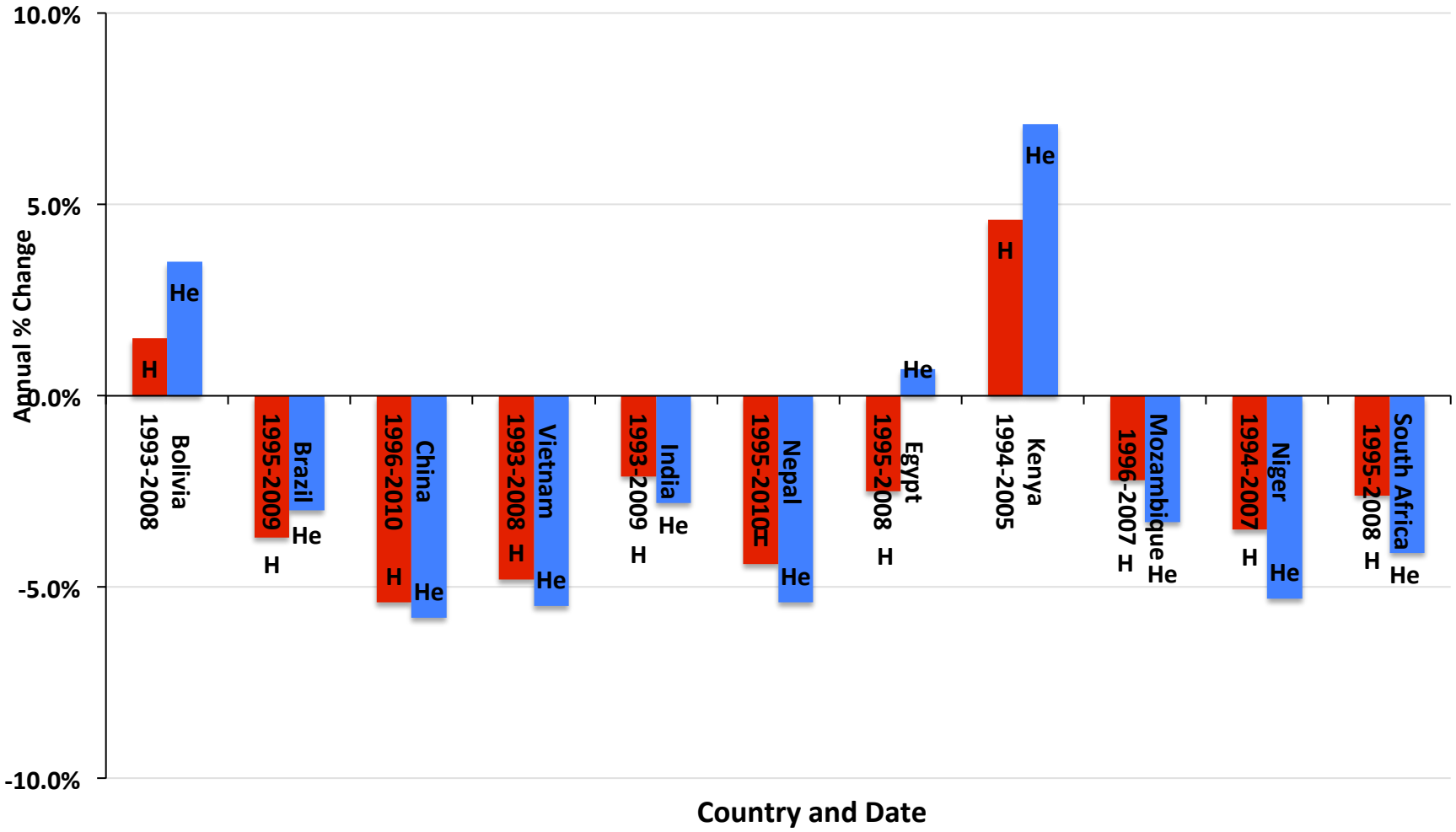
Brazil 2009
China 2010
Vietnam 2008
India 2009
Nepal 2010
Egypt 2008
Kenya 2005
Mozamb. 2007
Niger 2007
South Africa 2008
Country and Date


Comparison of Annual Percentage Change in Headcount Ratio and Person Equivalent Headcount Ratio for Selected Countries
10.0%
5.0%
0.0%
-5.0%
-10.0%
Annual % Change
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1993-2008
Bolivia
1995-2009
Brazil
1996-2010
China
1993-2008
Vietnam
1993-2009
India
1995-2010
Nepal
1995-2008
Egypt
1994-2005
Kenya
1996-2007
Mozambique
1994-2007
Niger
1995-2008
South Africa
Country and Date

Regional Income Poverty by Country

Sub-Saharan Africa

Country	Year	n	q	H	q_e	H_e
Burkina	2009	15	6.7	.44	5.5	.37
Burundi	2006	8	6.5	.81	7.3	.91
Cameroon	2007	19	5.2	.28	3.5	.18
Cent Afr Rep	2008	4	2.6	.63	3.3	.78
Ethiopia	2010	18	6.4	.35	5.8	.32
Ghana	2005	87	34	.39	23	.26
Guinea	2007	21	6.1	.29	5.3	.25
Kenya	2005	10	4.0	.39	3.3	.33
Madagascar	2010	36	16	.43	15	.42
Malawi	2010	21	18	.88	26	1.2
Mali	2010	15	10.8	.72	12.9	.86

Population and headcounts in millions of persons

Benchmark is 2001-2010 Sub-Saharan average income shortfall: A = 50.0¢ per day

Regional Income Poverty by Country

Sub-Saharan Africa

Country	Year	n	q	H	q_e	H_e
Mauritania	2008	3.4	.80	.23	.58	.17
Mozambique	2007	23	14	.61	15	.65
Niger	2007	14	6.0	.42	4.2	.29
Nigeria	2009	155	96	.62	107	.67
Rwanda	2010	11	6.8	.63	7.2	.66
Senegal	2005	11	3.8	.34	3.0	.27
South Africa	2008	50	6.8	.14	2.8	.06
Swaziland	2009	1.2	.46	.40	.45	.38
Tanzania	2007	41	28	.68	29	.70
Uganda	2009	33	12	.38	10	.30
Zambia	2010	13	9.8	.74	14	1.0

Population and headcounts in millions of persons

Benchmark is 2001-2010 Sub-Saharan average income shortfall: A = 50.0¢ per day

Poverty in Niger Using Country Benchmark

Year		n	q	H	q_e	H_e	%ΔH	%ΔH_e	ε
1994		8.9	6.9	.78	6.9	.78	-3.5%	-5.3%	1.5
2007		14.2	6.0	.42	3.4	.24			

Populations and headcounts in millions of persons
Benchmark is Niger's 1994 average income shortfall: A = 61.7¢ per day
Percentage changes are annualized

Recent Application:

Trends in PE poverty measures reported in the World Bank and IMF's *Global Monitoring Report, 2015*

Examples:

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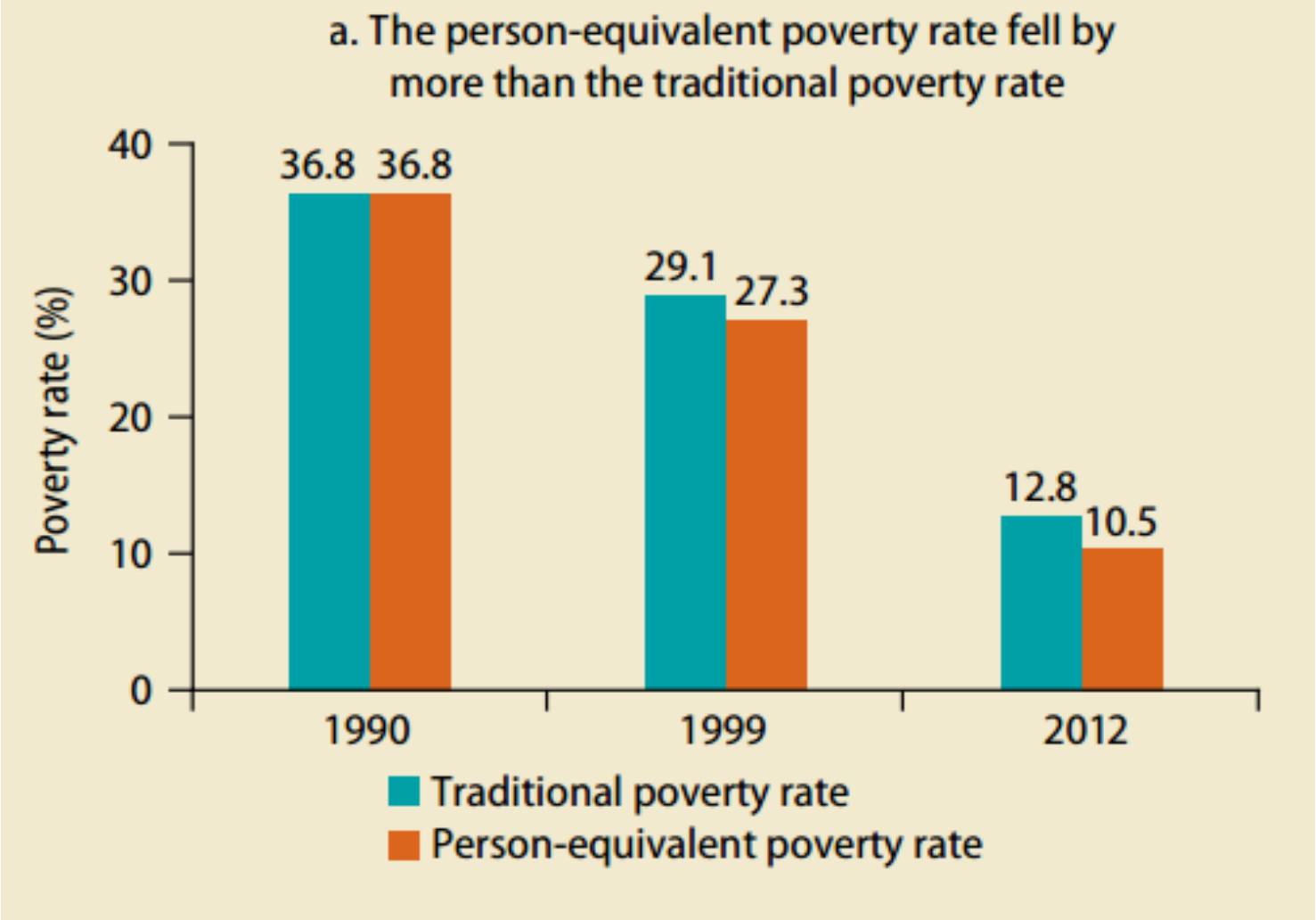

Sources: World Bank calculations, PovcalNet 2015.

Note: Estimates based on the $1.90 poverty line and 2011 PPP prices.

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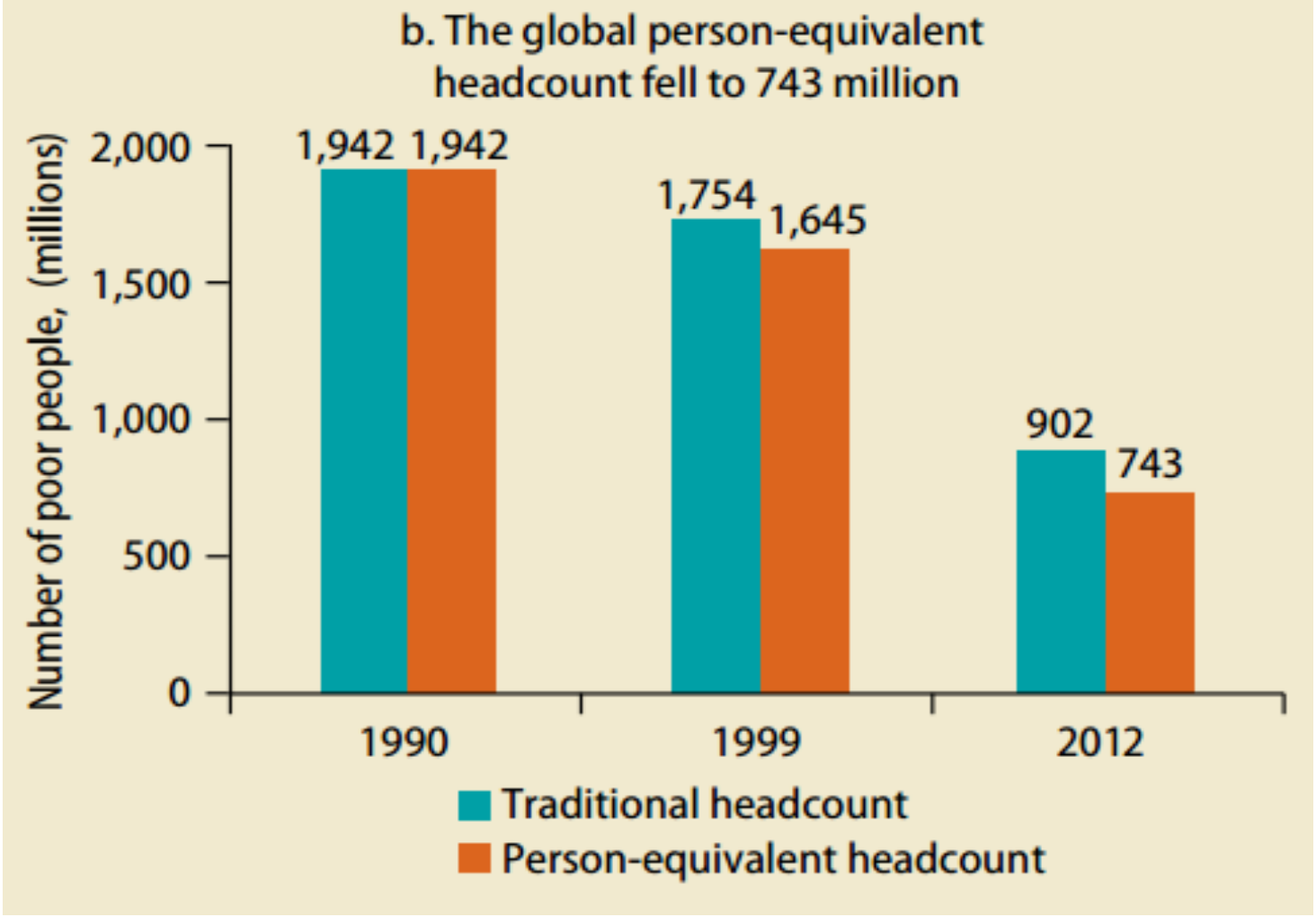

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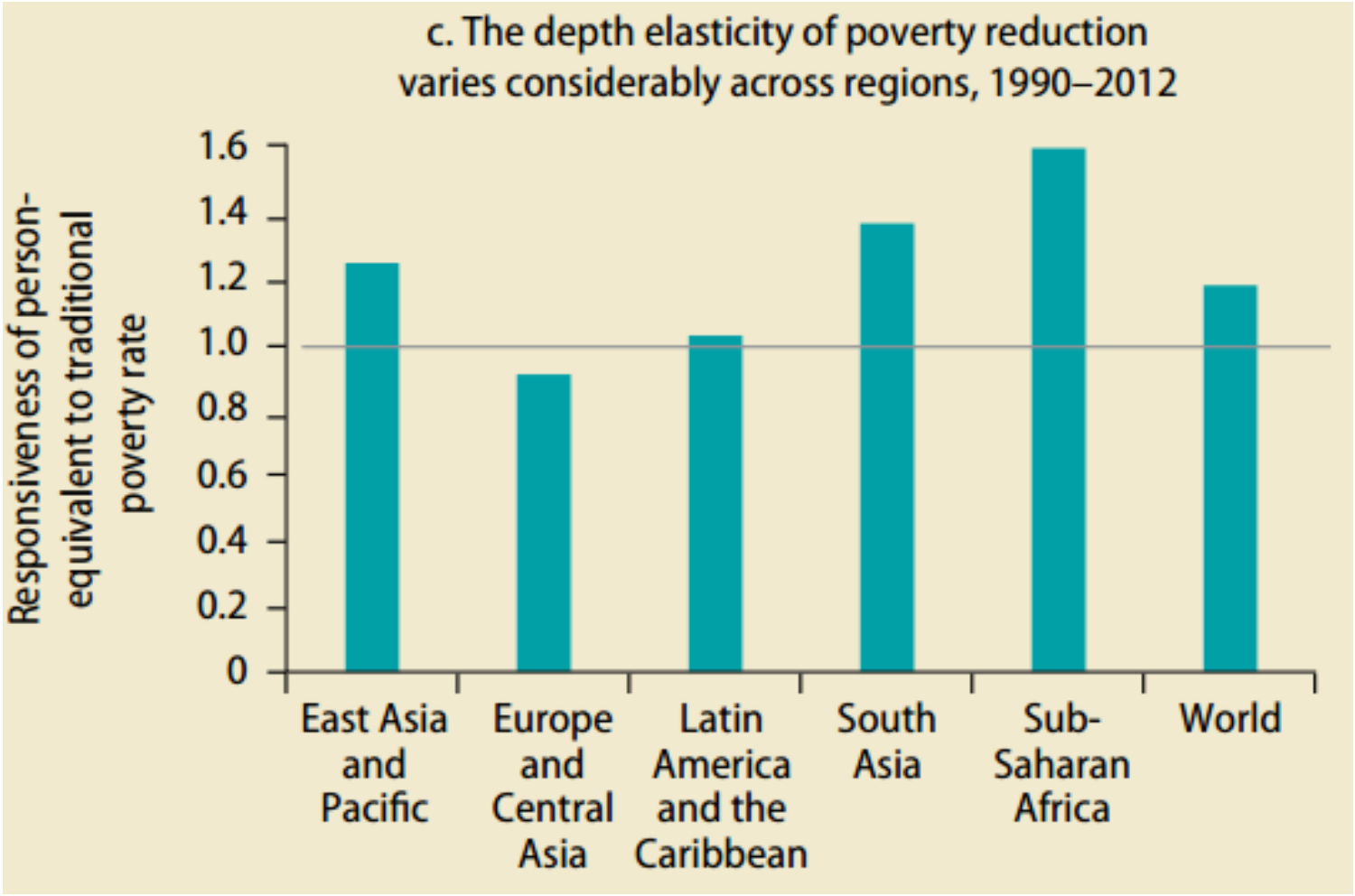

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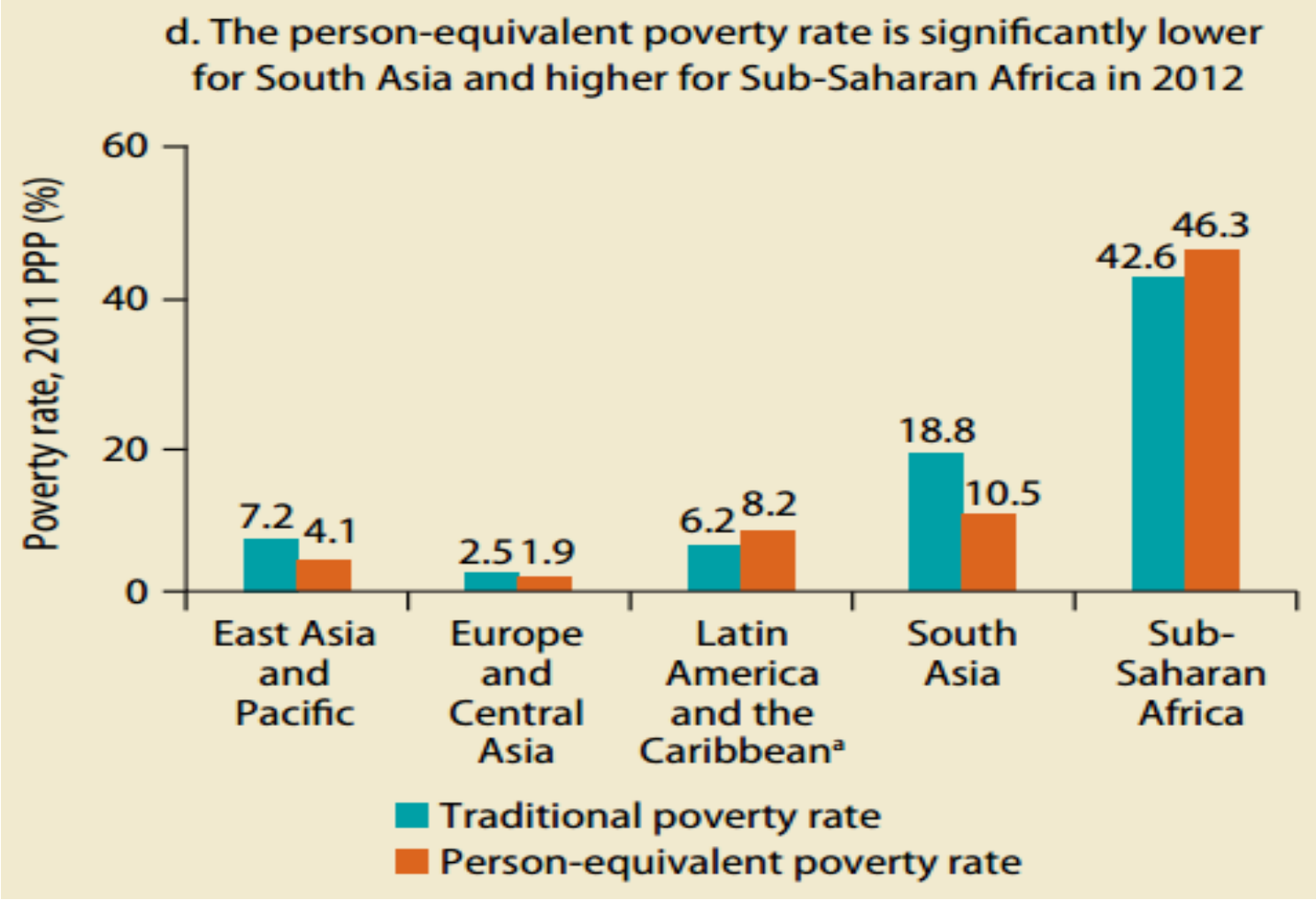

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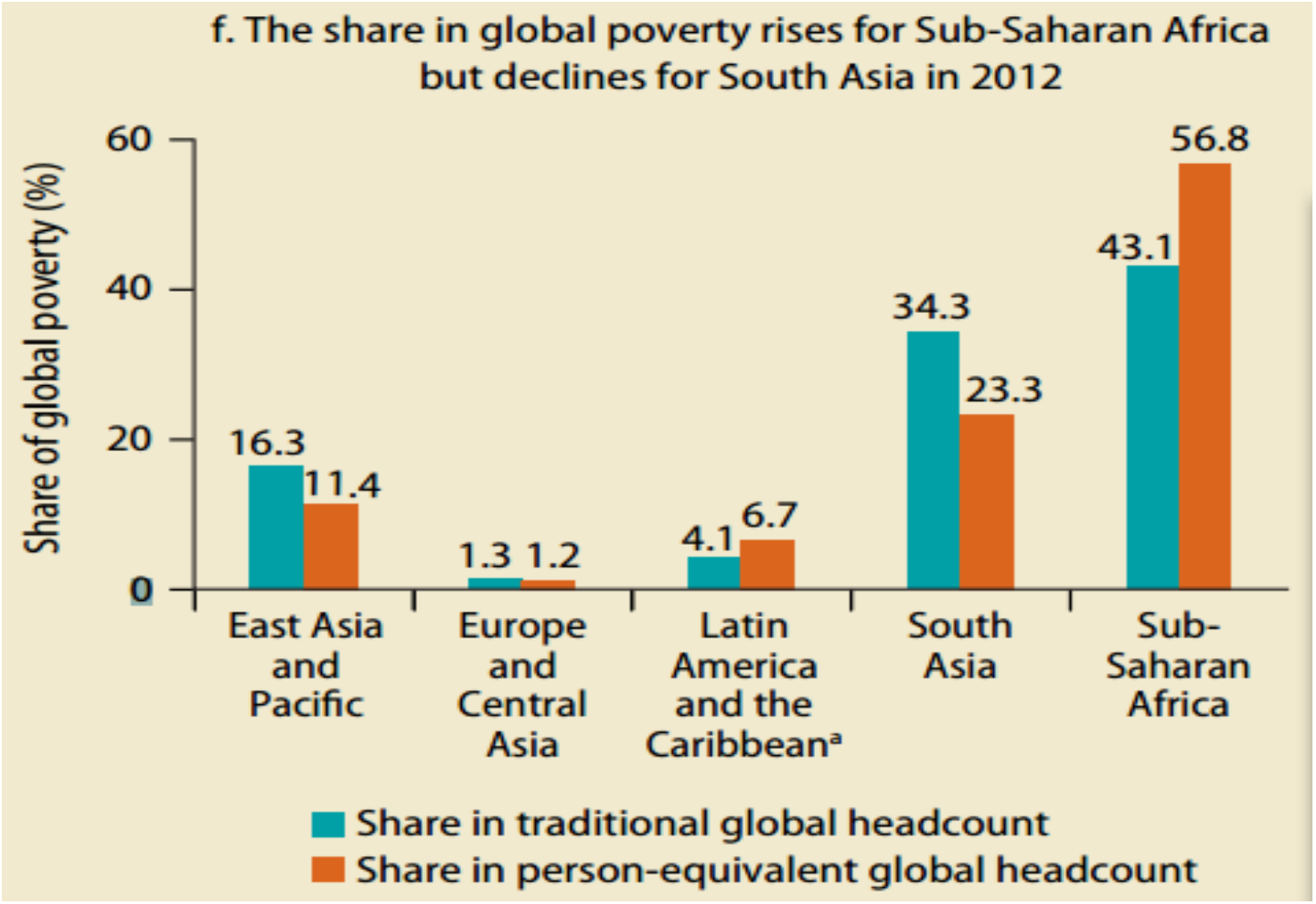

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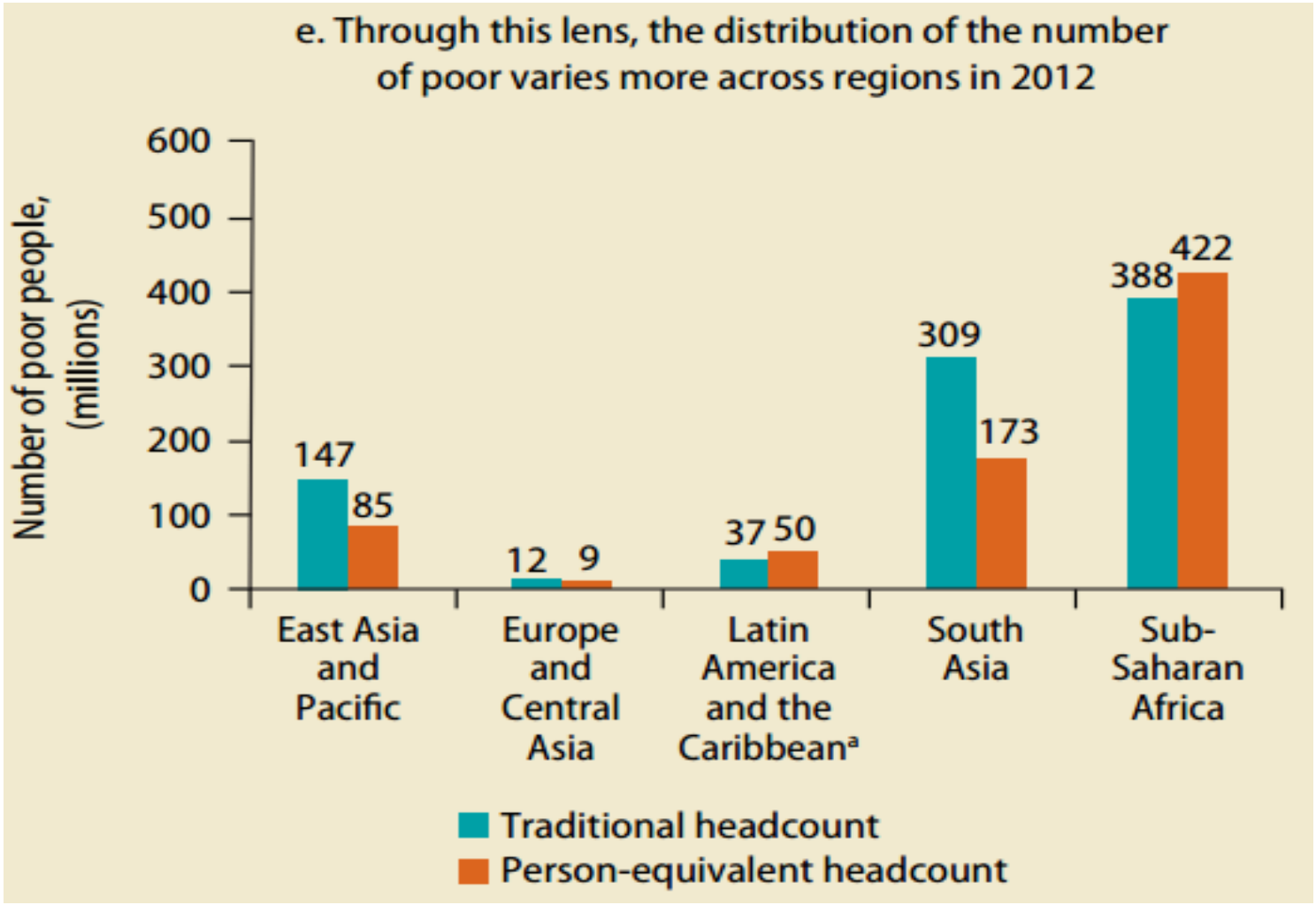

Sources: World Bank calculations, PovcalNet 2015.

Note: Estimates based on the $1.90 poverty line and 2011 PPP prices.

Conclusions

- Measure combines intuitiveness and "people space" of headcounts with capturing depth of poverty, and having desirable properties such as monotonicity.

- Including PE measures to track poverty at global, national or program levels can help incentivize reaching the poorest.

- Method can be applied to other indicators
  - For cardinal variables, same method as income poverty
  - For ordinal variables, use average intensity, e.g. MPI

- Country data from IZA Paper: http://ftp.iza.org/dp9402.pdf
- Forthcoming chapter in *Inequality and Growth: Patterns and Policy* (2016), K. Basu and J. Stiglitz, eds.