Methods for Assessing Disproportionality

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Presidential Documents

Title 3—

The President

Executive Order 12898 of February 11, 1994

Federal Actions To Address Environmental Justice in Minority Populations and Low-Income Populations

By the authority vested in me as President by the Constitution and the laws of the United States of America, it is hereby ordered as follows:

Section 1–1. *Implementation.*

1–101. *Agency Responsibilities.* To the greatest extent practicable and permitted by law, and consistent with the principles set forth in the report on the National Performance Review, each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States and its territories and possessions, the District of Columbia, the Commonwealth of Puerto Rico, and the Commonwealth of the Mariana Islands.

"identifying and addressing…

disproportionately high and adverse effects…

minority and low-income populations"

How Does EPA Define Environmental Justice?

"Environmental Justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, culture, education, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies."

"Fair Treatment means that no group of people, including racial, ethnic, or socioeconomic groups, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal environmental programs. and policies."

Source: http://www.epa.gov/compliance/resources/faqs/ej/#faq2

Federal Register / Vol. 65, No. 124 / Tuesday, June 27, 2000 / Notices

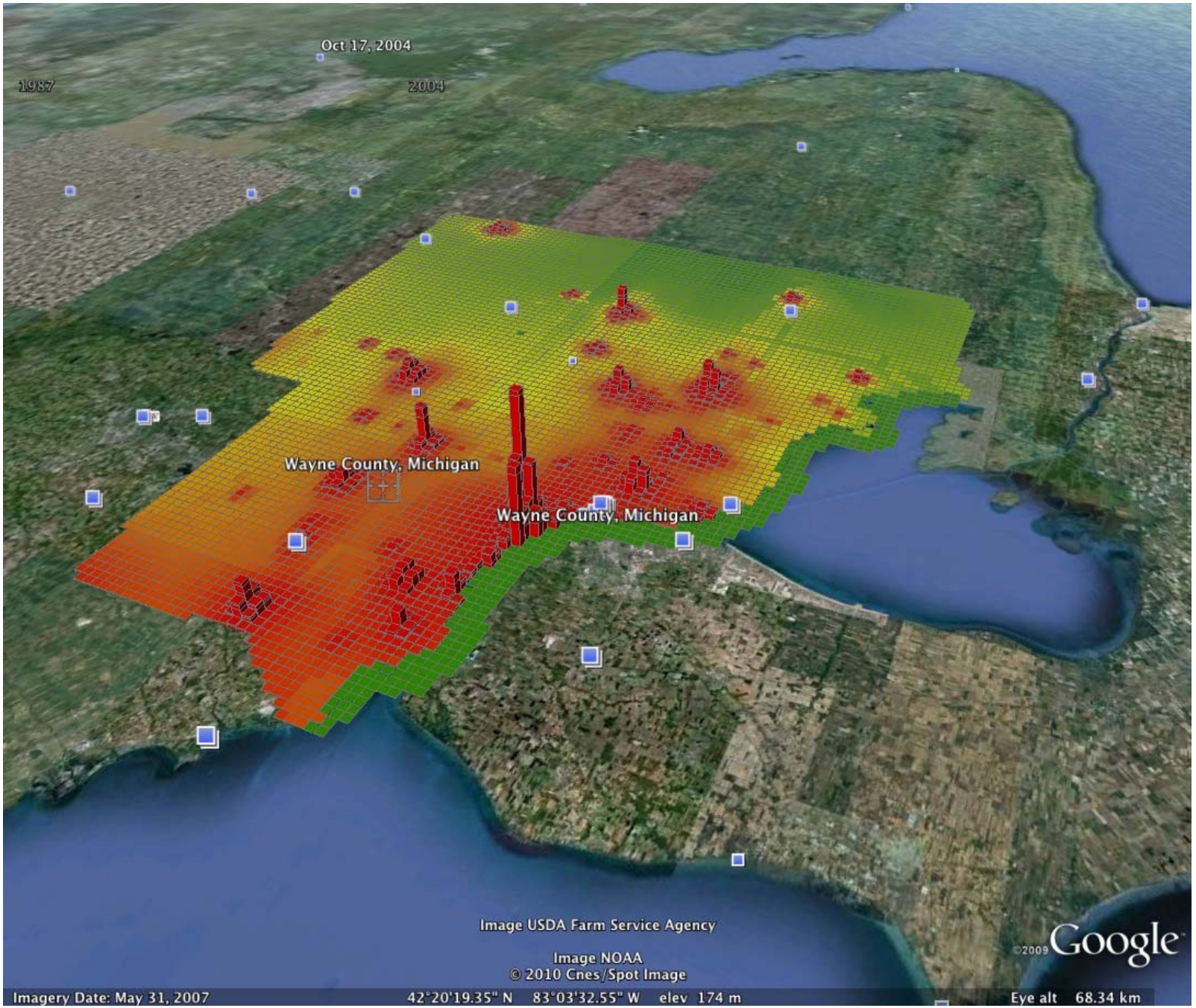
Environmental Protection Agency

Draft Title VI Guidance for EPA Assistance Recipients Administering Environmental Permitting Programs (Draft Recipient Guidance) and Draft Revised Guidance for Investigating Title VI Administrative Complaints Challenging Permits (Draft Revised Investigation Guidance); Notice

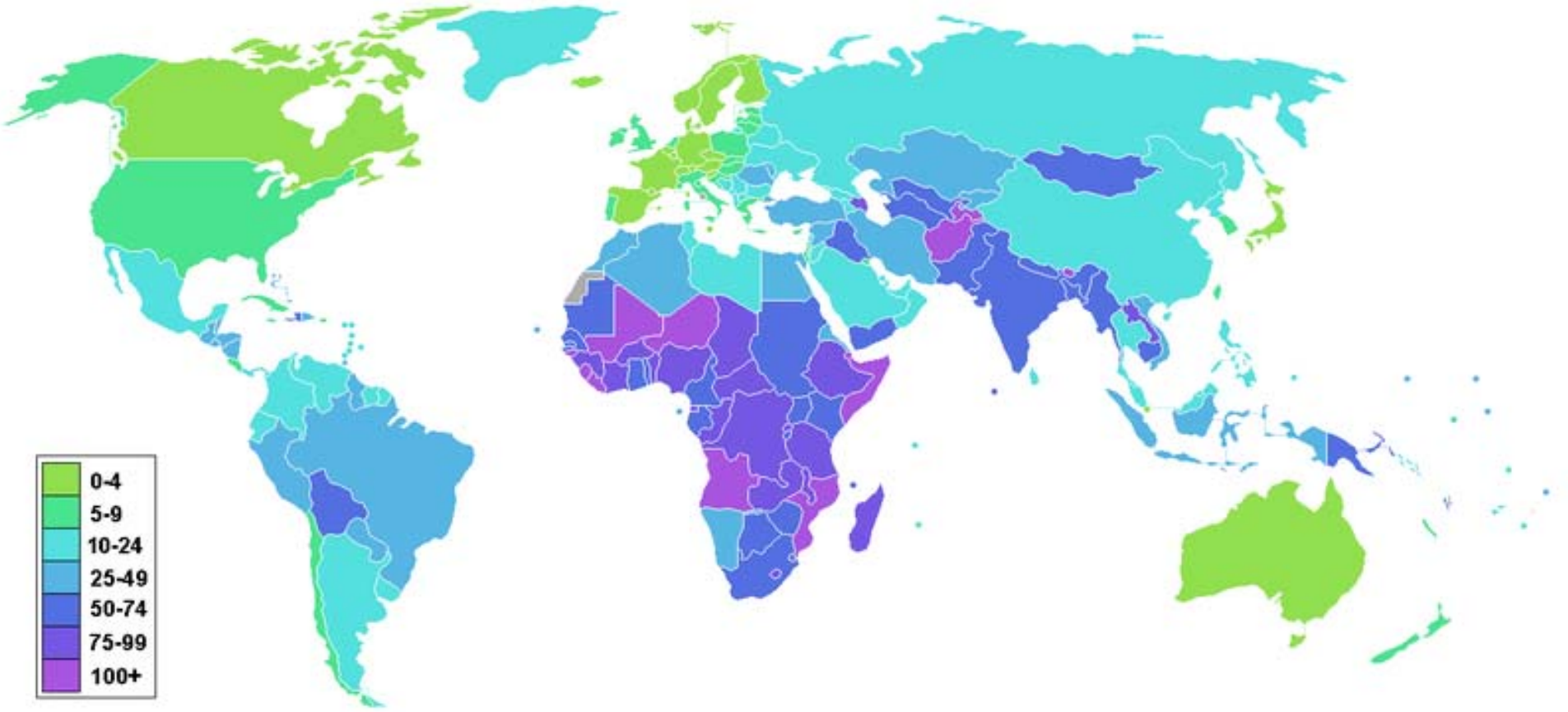
Disparity (Disparate Impact)	A measurement of a degree of difference between population groups for the purpose of making a finding under Title VI. Disparities may be measured in terms of the respective composition (demographics) of the groups, and in terms of the respective potential level of *exposure,* risk or other measure of *adverse impact.*

Disparate impact:

A measurement of a degree of difference between population groups for the purpose of making a finding under Title VI…

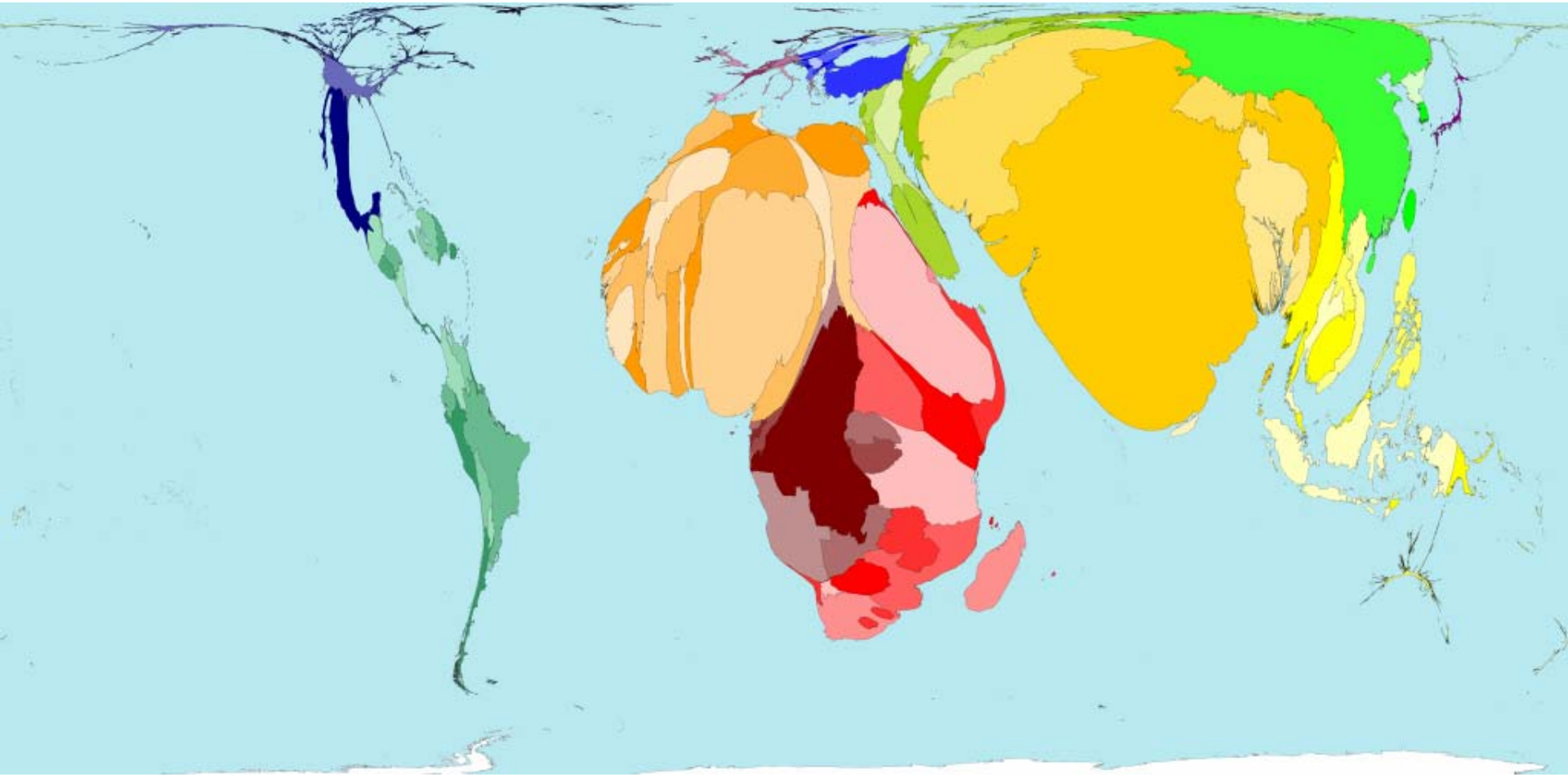

Oct 17, 2004
1987
2004
Wayne County, Michigan
Wayne County, Michigan
Image USDA Farm Service Agency
Image NOAA
© 2010 Cnes/Spot Image
©2009 Google
Imagery Date: May 31, 2007
42°20'19.35" N 83°03'32.55" W elev 174 m
Eye alt 68.34 km

World Map of Infant Mortality Rates (per 1000 births)



Source: CIA Factbook

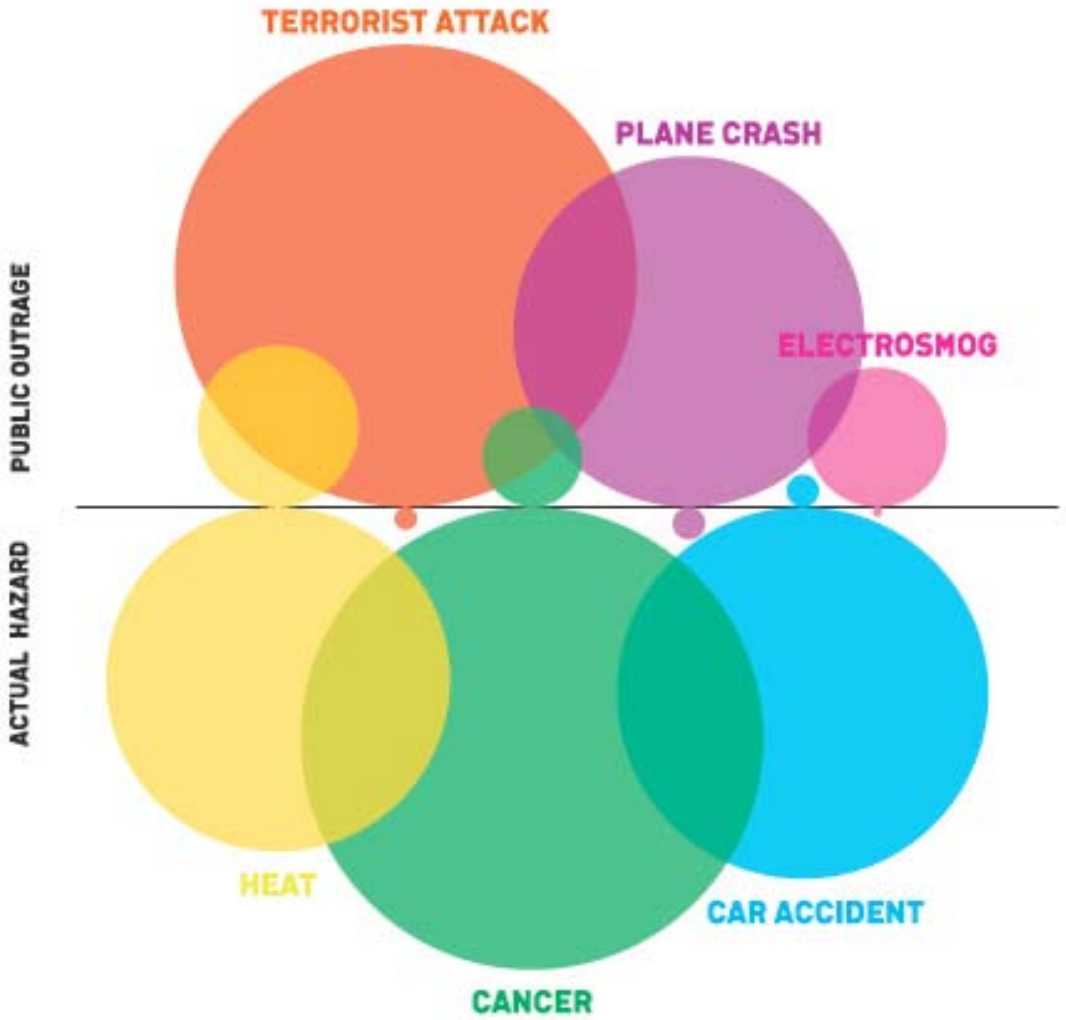
World Map with Territory Size as the Proportion of all Infant Deaths



Source: worldmapper.org

susanna hertrich

reality-checking device
(2008)

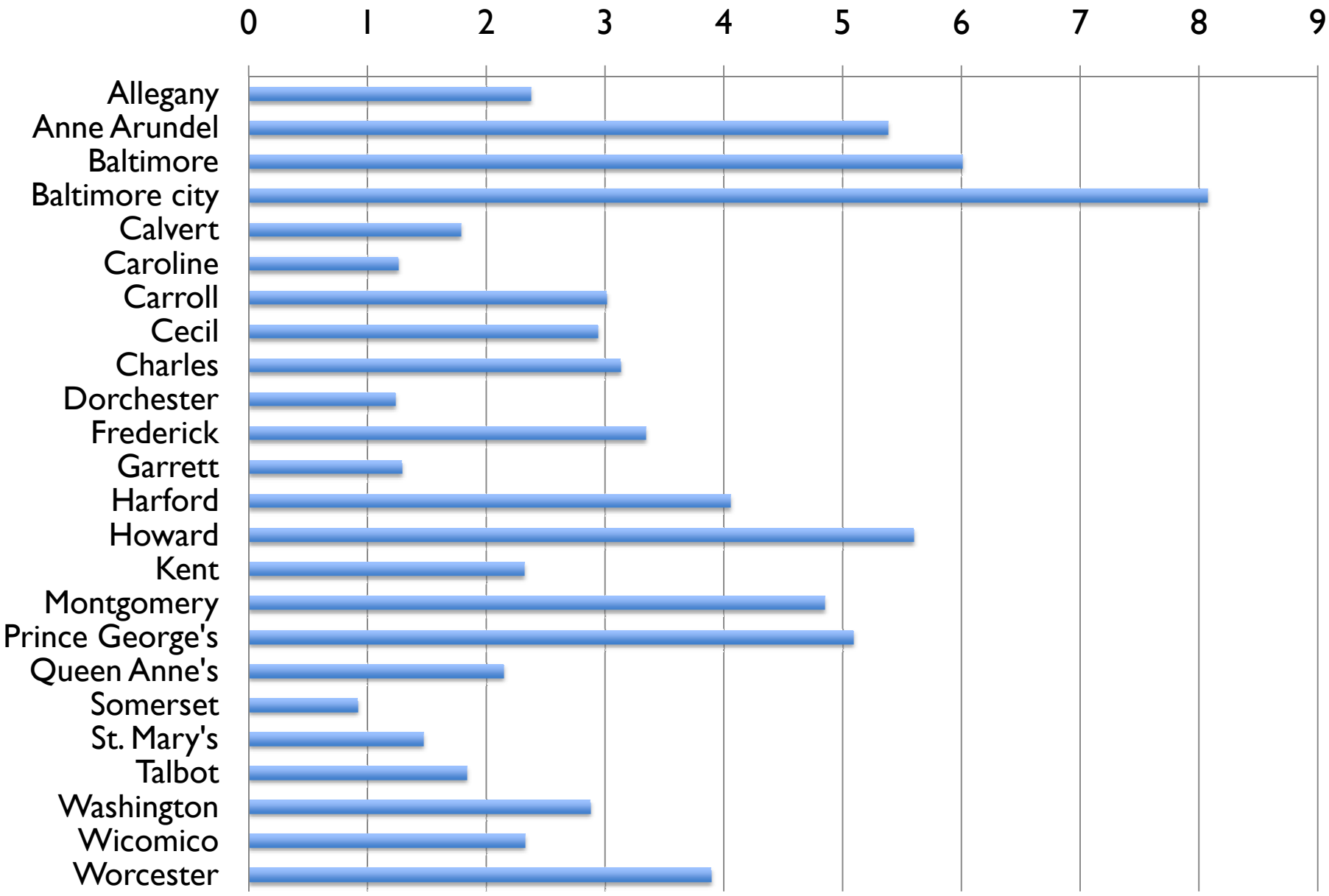


What does ‘proportionate’ mean?

“Even more confounding than how one defines the limits of communities is how one develops a standard methodology for defining the term ‘disproportionate’. When making a reference to an impact as 'disproportionate', the implication is that the impact is being compared to something.”

-Eady, *Just Sustainabilities* (2003) p.173

Risk (Hazard Index) among Maryland Counties



Socioeconomic and Racial Disparities in Cancer Risk from Air Toxics in Maryland

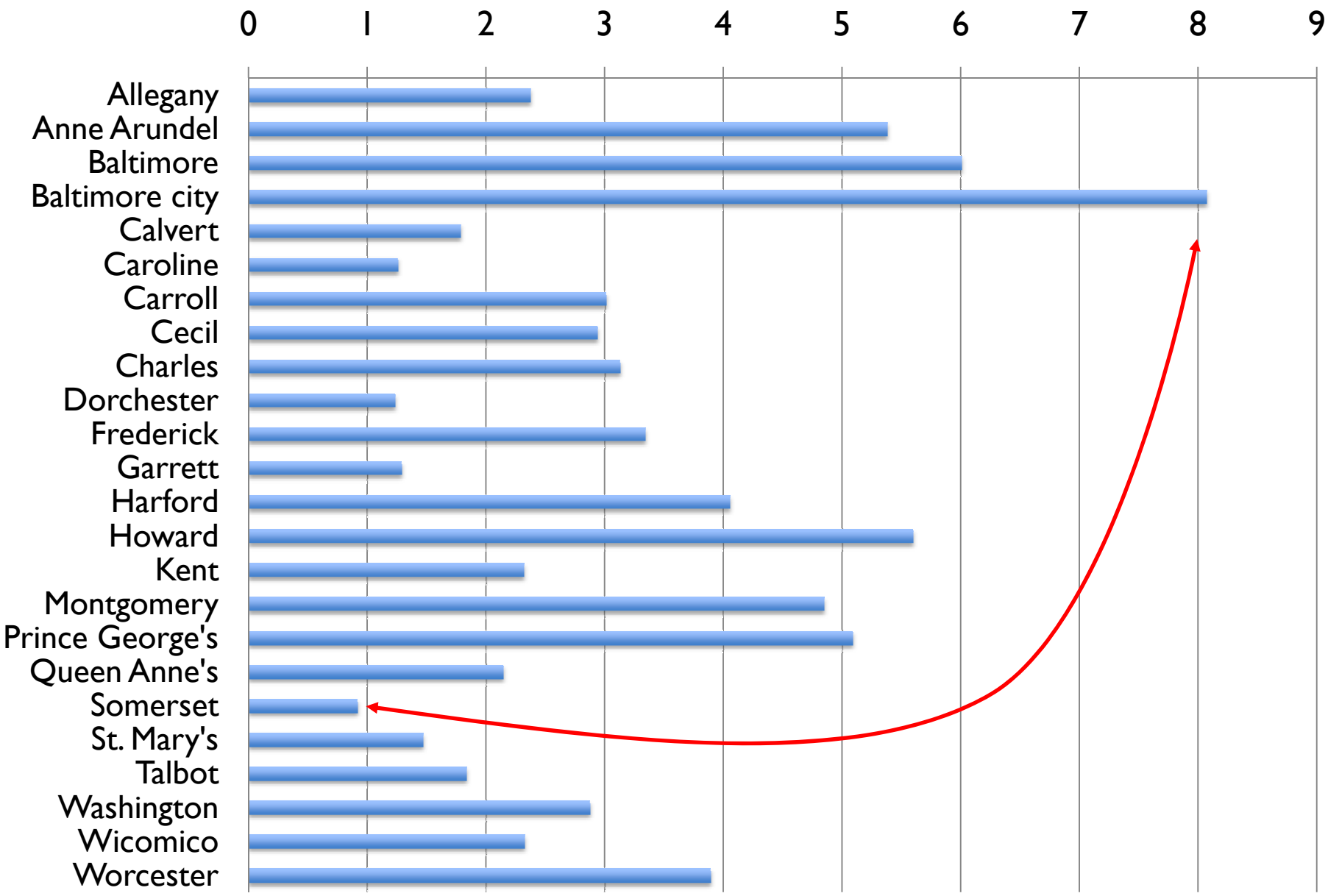
Benjamin J. Apelberg,[1] Timothy J. Buckley,[2] and Ronald H. White[1,3]

Table 3. Percentage of high-risk tracts and RRs by quartile of demographic measure in Maryland, 2000.

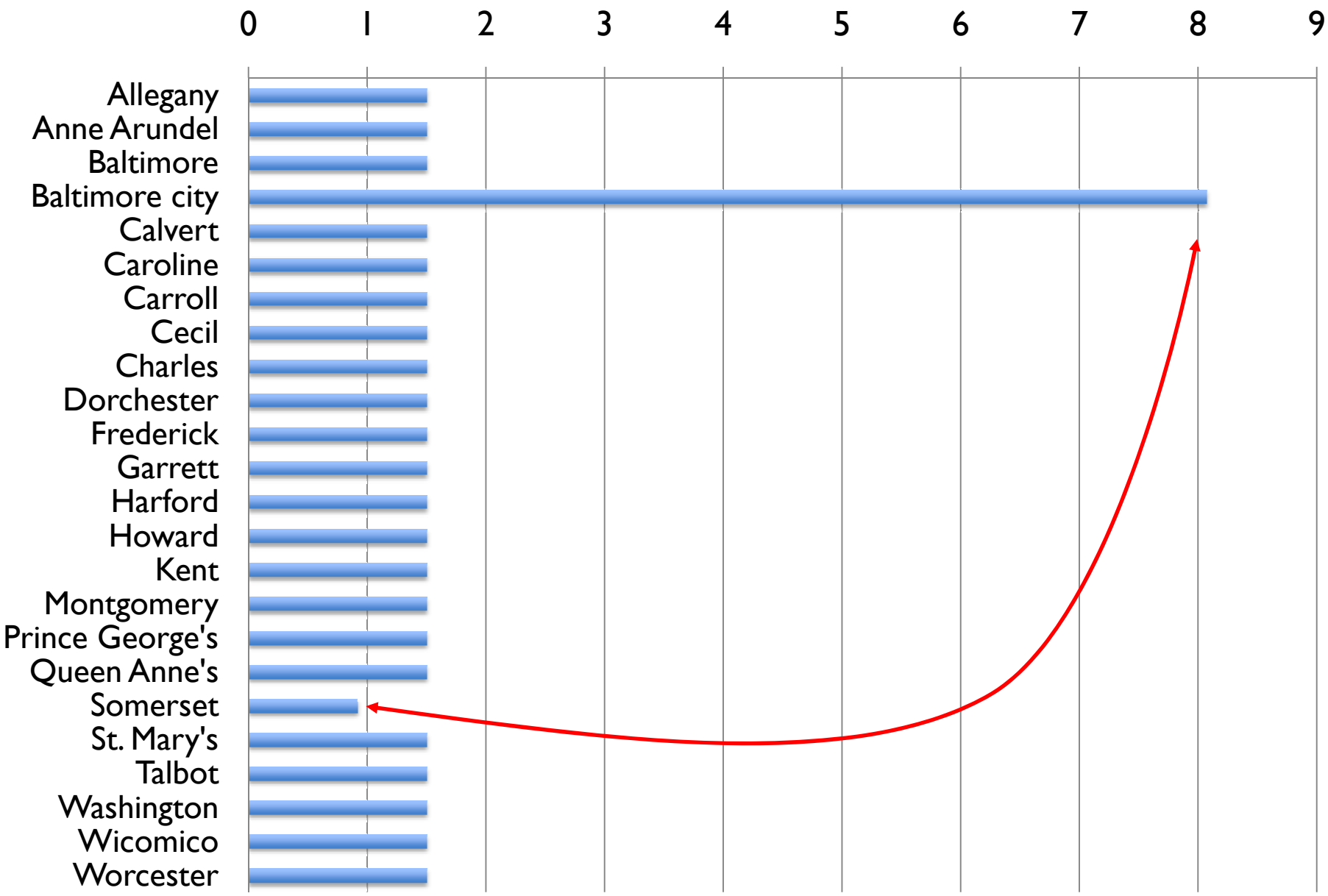
Census tract measure	Percent high risk[a]	RR (95% CI)
Median household income		
Quartile 1	33	100 (14–715)
Quartile 2	5.6	17 (2.3–127)
Quartile 3	1.0	3.0 (0.3–29)
Quartile 4	0.3	—

els. For example, census tracts in the lowest quartile of median household income were 100 times more likely to be high risk than were those in the highest quartile (95% CI, 14–715). Furthermore, an increasing trend in

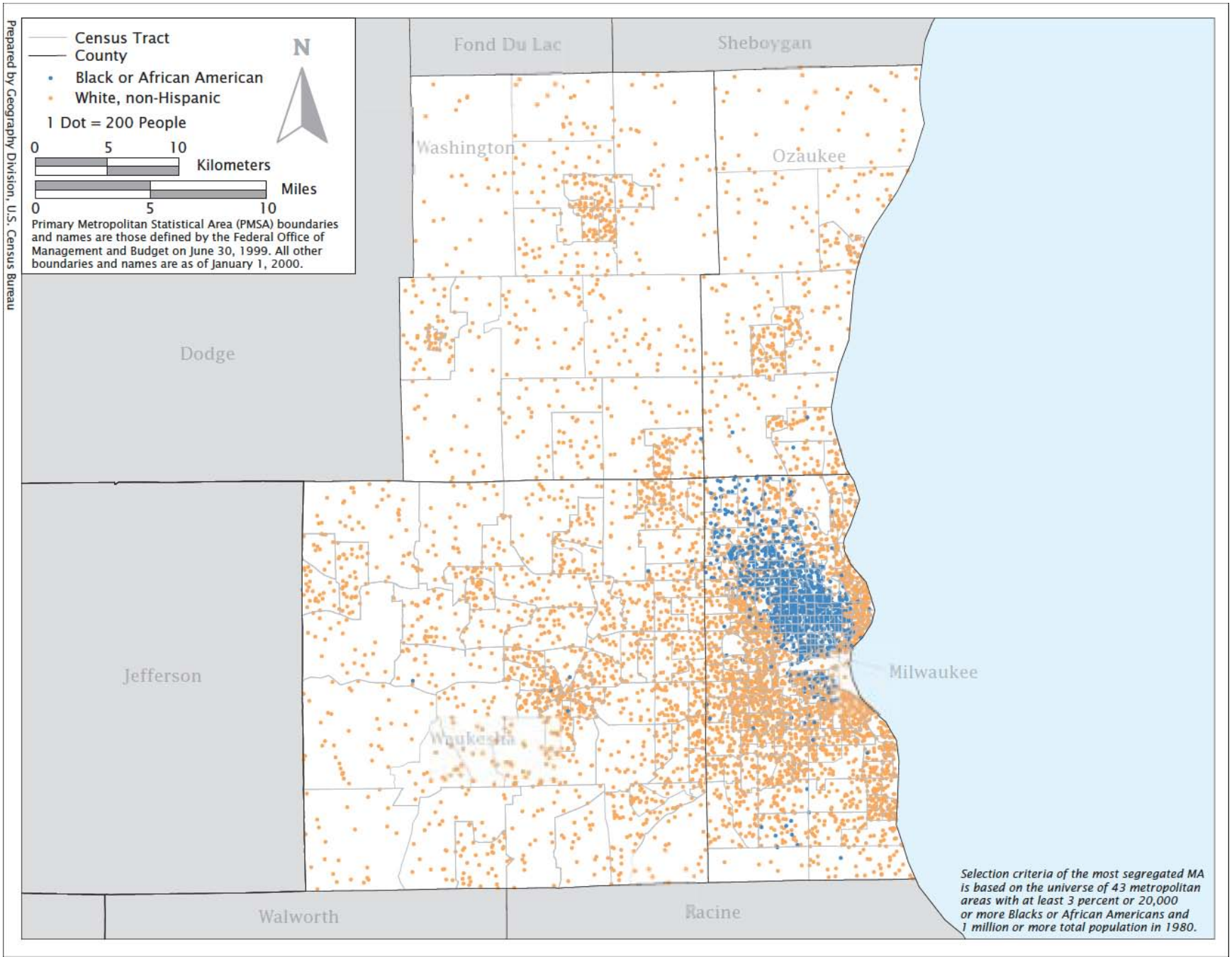
Risk (Hazard Index) among Maryland Counties



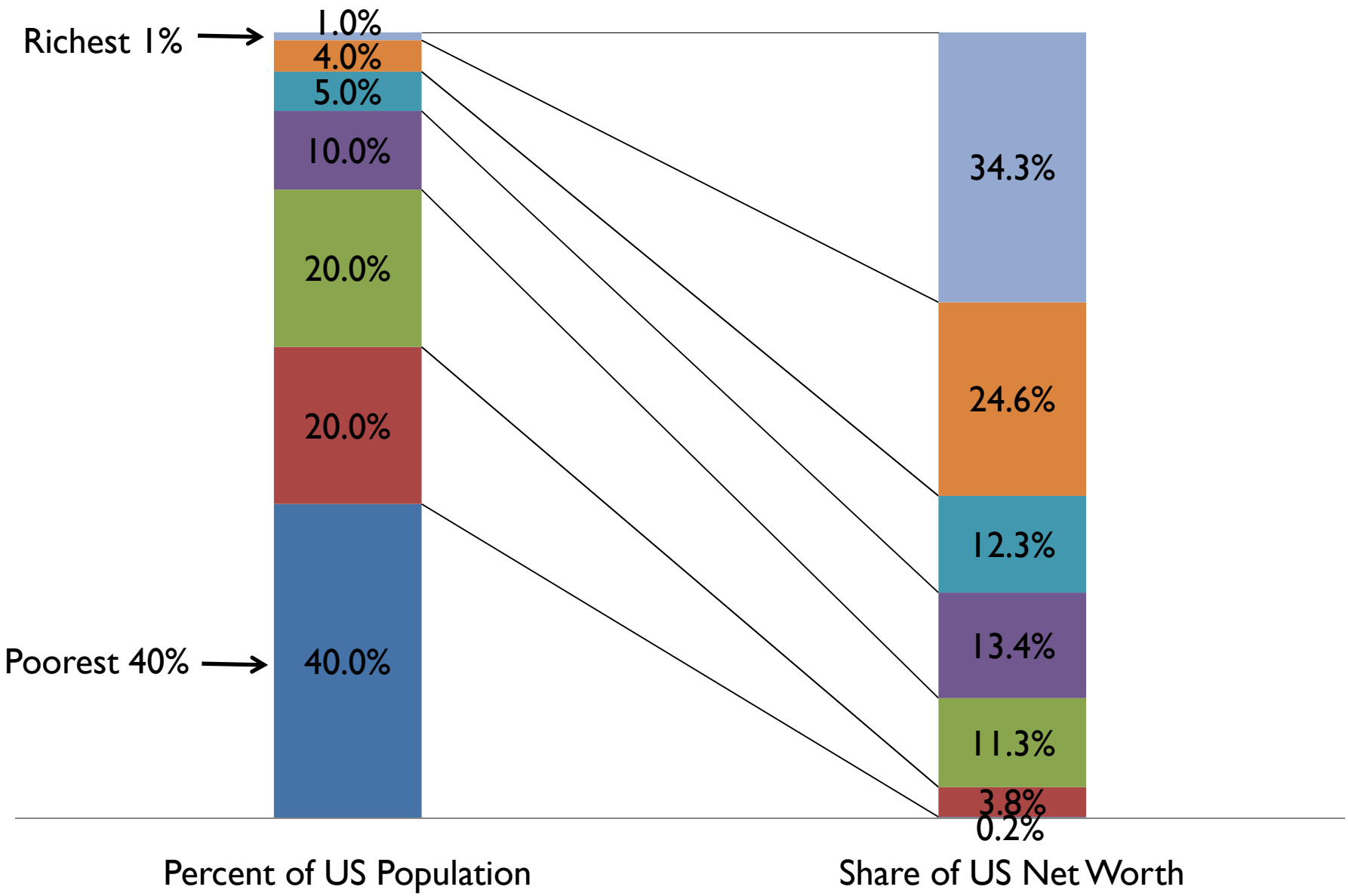
Risk (Hazard Index) among Maryland Counties



Most Segregated Large US Metropolitan Area for African Americans, 2000 (Milwaukee, WI)



Wealth Inequality as Disproportionality



Source: Wolff (2007)

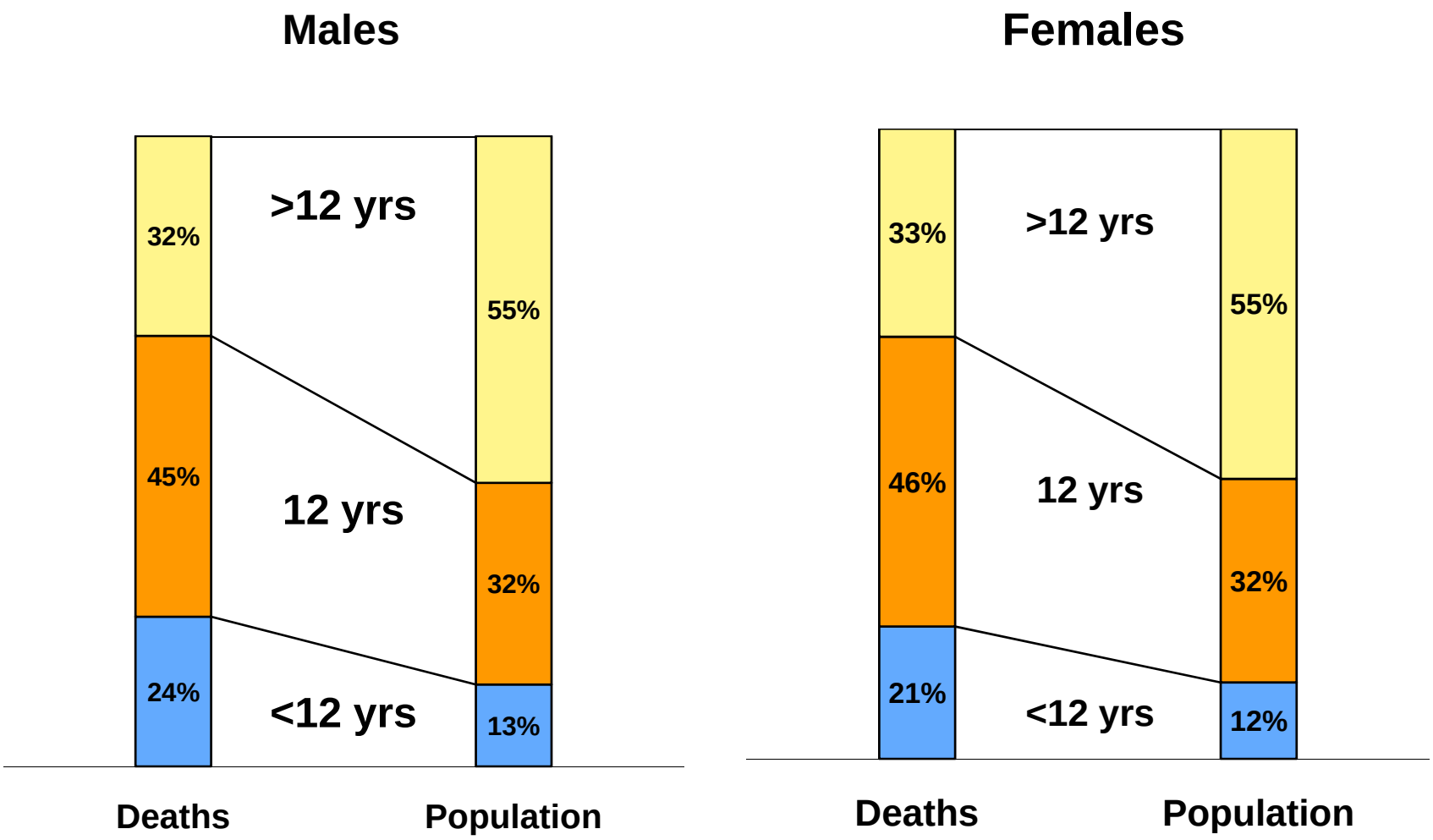
Disproportionality in other domains

- Demography/Sociology: Residential Segregation
  - Measurement of the differential distribution of people across spatial units (e.g., neighborhoods)
  - Examples include: Dissimilarity Index, Exposure Index, Centralization Index, Concentration, Clustering, Spatial Proximity Index, etc…

- Economics: Income Inequality
  - Measurement of the disproportionate concentration of income across individuals or groups
  - Examples include: Gini coefficient, Theil index, Mean Log Deviation, Coefficient of Variation, Atkinson Index, Variance of Logarithms, Concentration Index, and so on…

Health Inequality as Disproportionality

Shares of All Deaths and Population, by Gender and Education, 2000



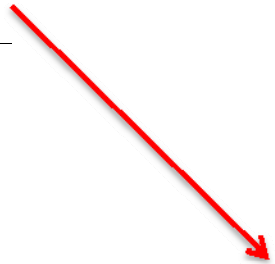
Source: NCHS (2002)

Disproportionality as a comparison of ‘shares’

Area	Population	Share of Population (%)	Exposure Index	Contribution to Exposure	Share of Exposure (%)
Tract A	25	8.5	1.3	0.1	3.1
Tract B	50	16.9	1.5	0.3	7.2
Tract C	50	16.9	2.0	0.3	9.5
…					
Tract X	100	33.9	6.3	2.1	60.1
Tract Y	50	16.9	2.3	0.4	11.0
Tract Z	20	6.8	4.8	0.3	9.2
All tracts	295	100.0	3.6	3.6	100.0

Disproportionality is a function of population size and exposure ratio

Area	Share of Population (%)	Exposure Index	Exposure Ratio
Tract A	8.5	1.3	0.37
Tract B	16.9	1.5	0.42
Tract C	16.9	2.0	0.56
…			
Tract X	33.9	6.3	1.77
Tract Y	16.9	2.3	0.65
Tract Z	6.8	4.8	1.35
All tracts	100.0	3.6	



Ratio of each tract's exposure compared to the population average for all tracts

E.g., 4.8/3.6 = 1.35

Empirics of World Income Inequality[1]

Glenn Firebaugh
Pennsylania State University

American Journal of Sociology
Volume 104 Number 6 (May 1999): 1597–1630

MEASURES OF MULTIGROUP SEGREGATION

*Sean F. Reardon**
*Glenn Firebaugh**

Sociological Methodology
2002; Volume 32: 33-67

A general expression for inequality indexes (I) is

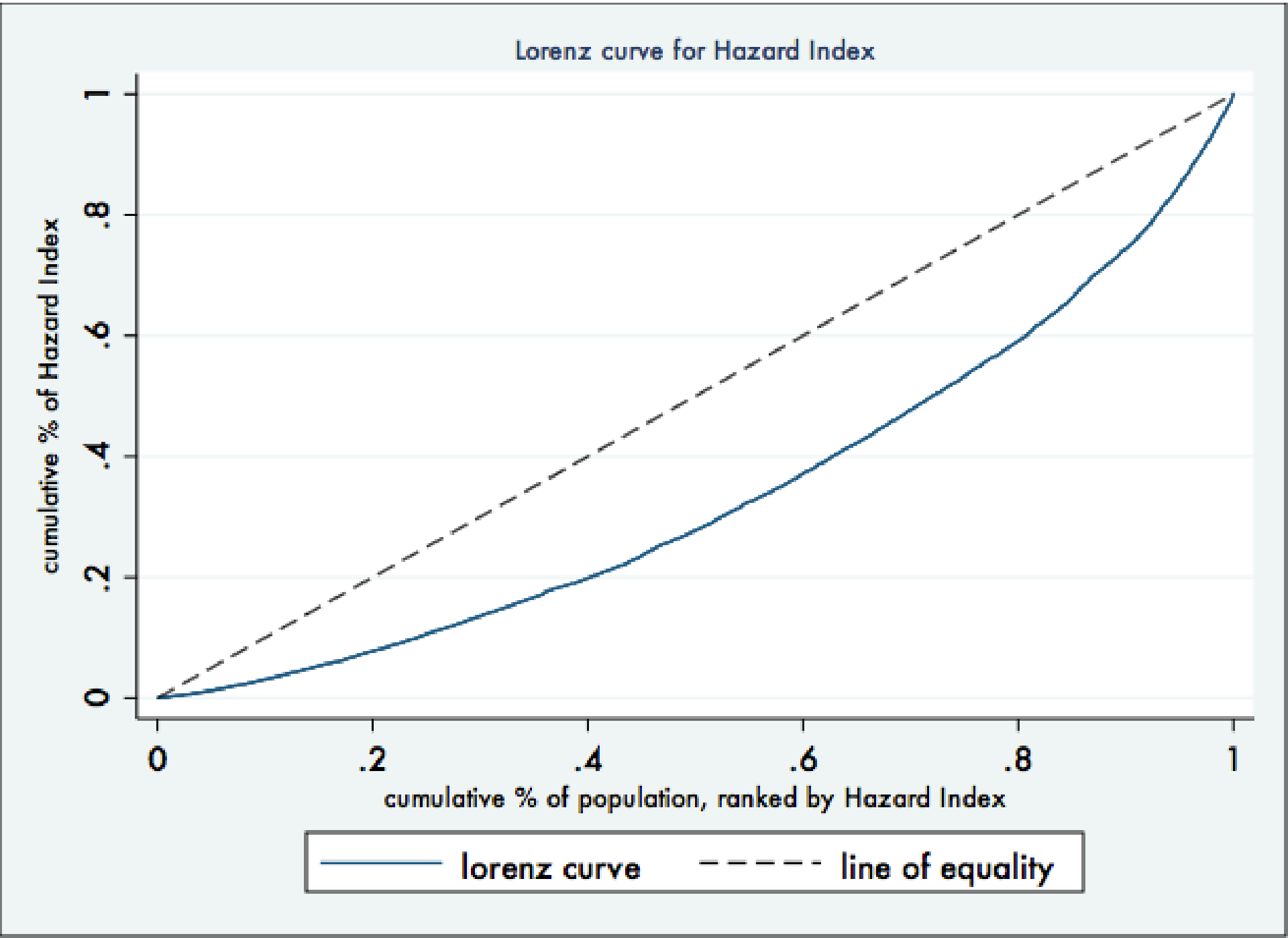
$$I = \sum_j p_j f(r_j), \tag{2}$$

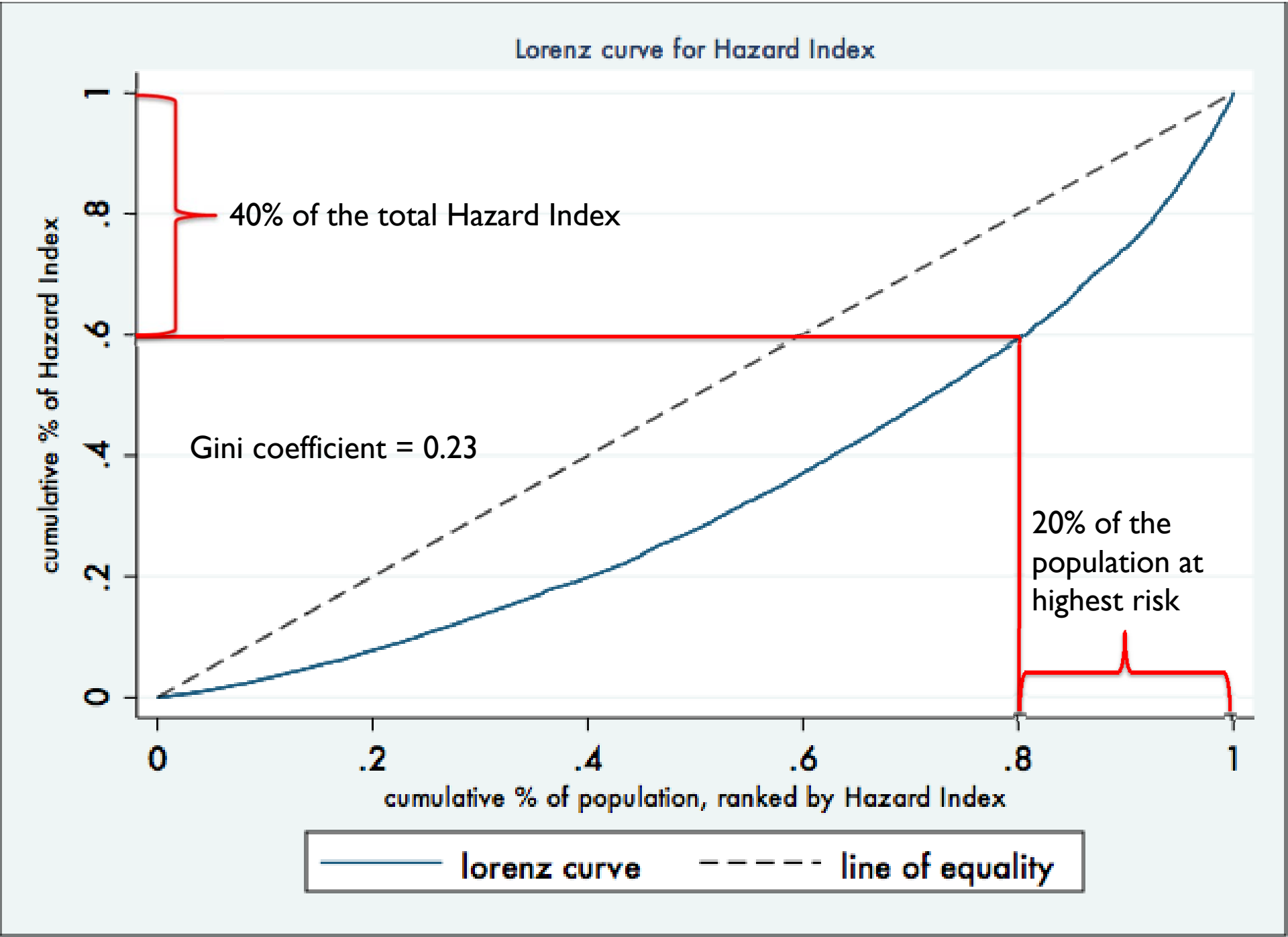
Population share

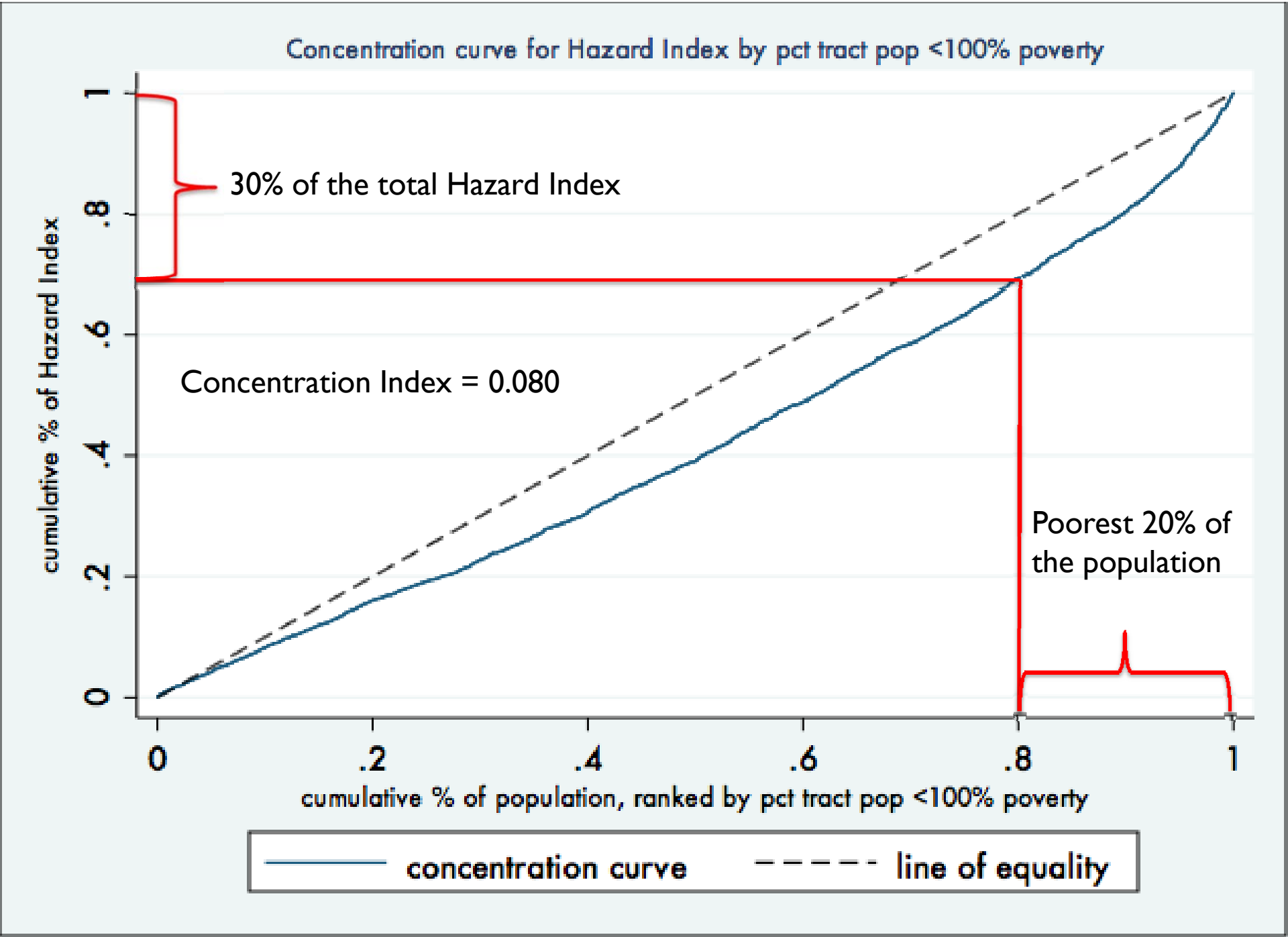
Exposure ratio

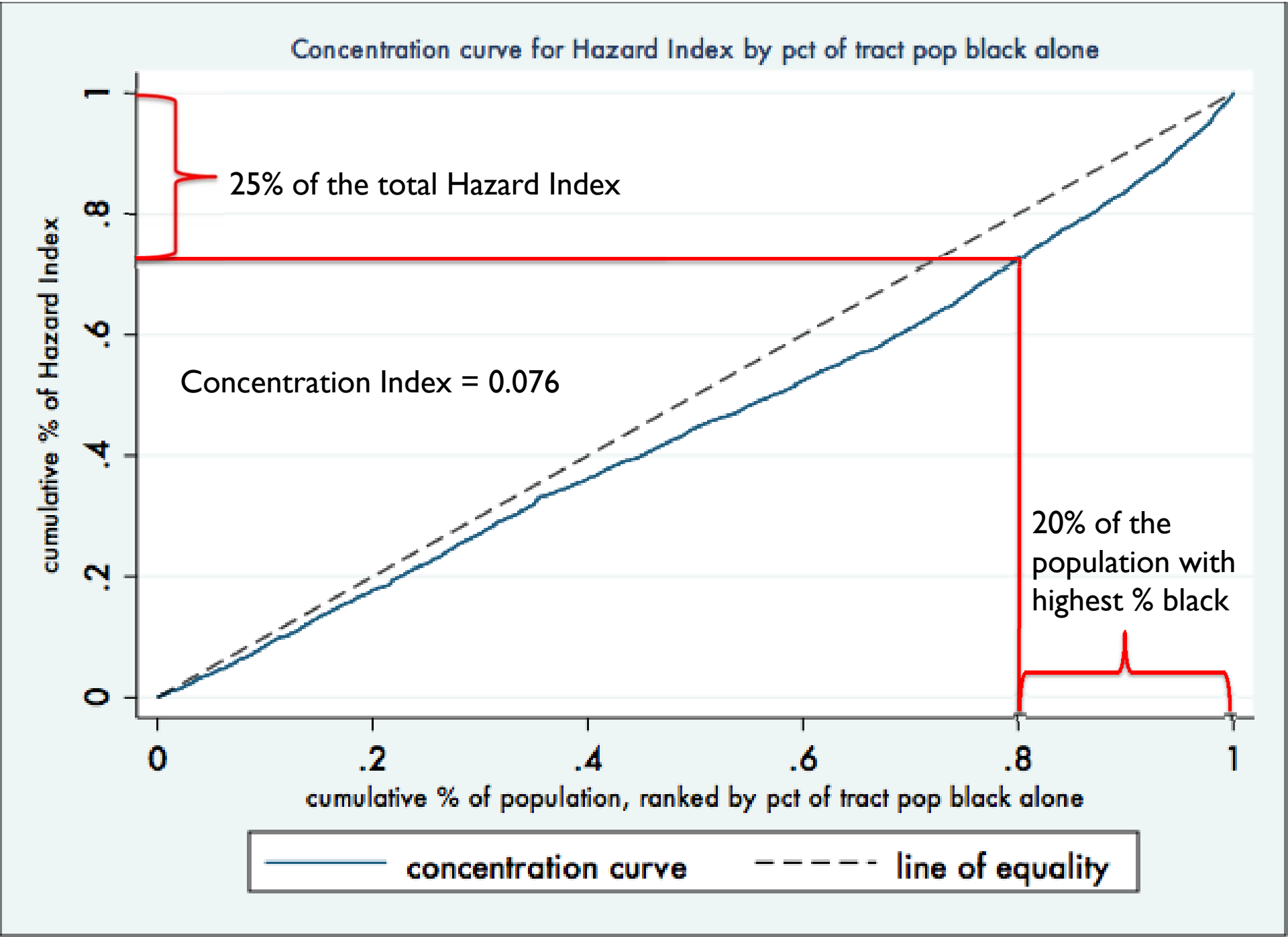
used. It follows from equation (2) that *inequality indexes differ only because they employ different functions of the income ratios.* Those functions are as follows for four popular indexes (V^2, Theil, VarLog, and Gini, respectively):

$$\begin{aligned} v_j &= f(r_j) = (r_j - 1)^2, \\ t_j &= f(r_j) = r_j \log(r_j), \\ l_j &= f(r_j) = \{\log(r_j) - E[\log(r_j)]\}^2, \\ g_j &= f(r_j) = r_j(q_j - Q_j), \end{aligned} \tag{3}$$


Lorenz curve for Hazard Index
cumulative % of Hazard Index
0
.2
.4
.6
.8
1
0
.2
.4
.6
.8
1
cumulative % of population, ranked by Hazard Index
lorenz curve
line of equality


Lorenz curve for Hazard Index
40% of the total Hazard Index
Gini coefficient = 0.23
20% of the population at highest risk
cumulative % of Hazard Index
0
.2
.4
.6
.8
1
cumulative % of population, ranked by Hazard Index
lorenz curve
line of equality


Concentration curve for Hazard Index by pct tract pop <100% poverty
30% of the total Hazard Index
Concentration Index = 0.080
Poorest 20% of the population
cumulative % of Hazard Index
0
.2
.4
.6
.8
1
cumulative % of population, ranked by pct tract pop <100% poverty
concentration curve
line of equality

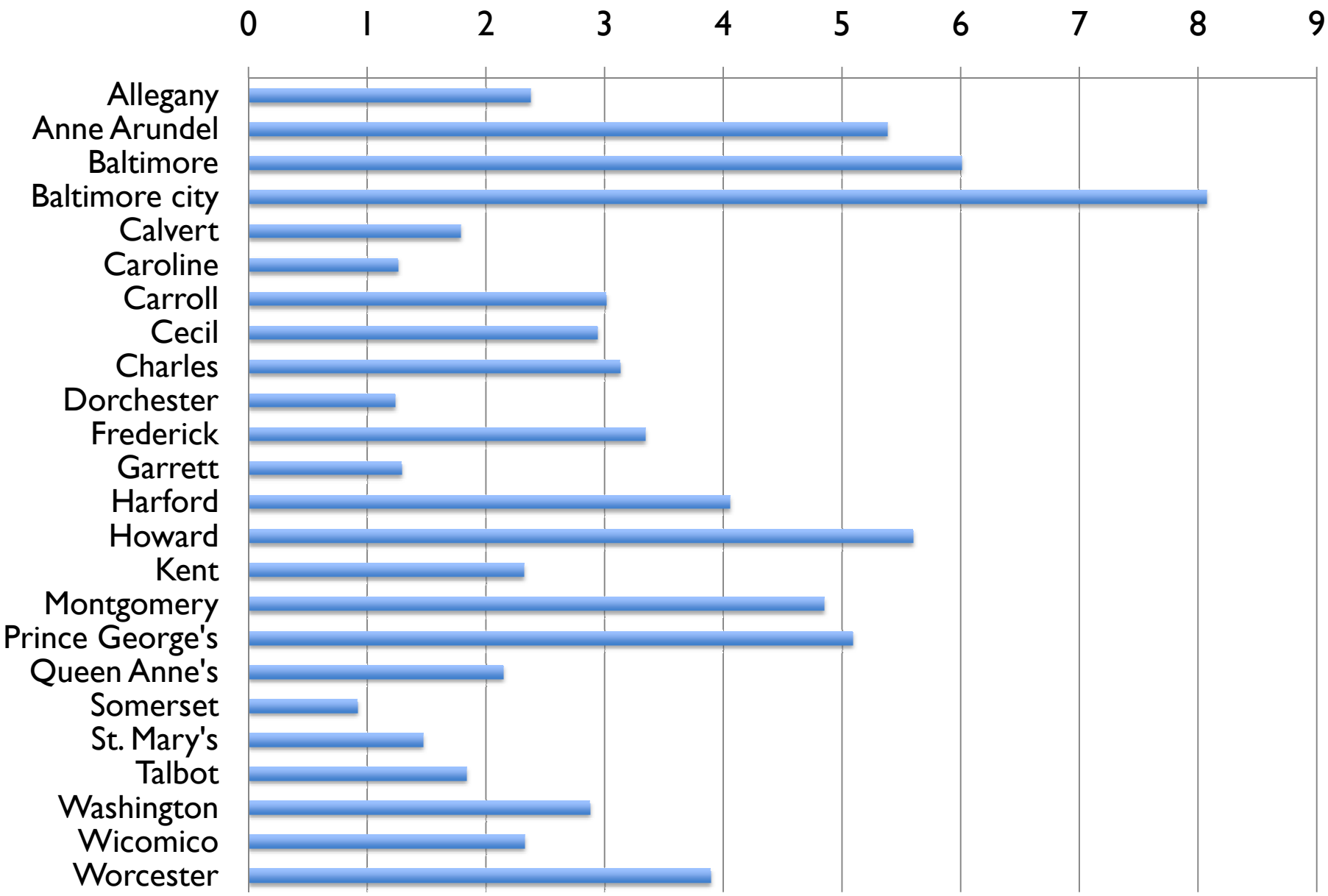

Concentration curve for Hazard Index by pct of tract pop black alone
25% of the total Hazard Index
Concentration Index = 0.076
20% of the population with highest % black
cumulative % of Hazard Index
0
.2
.4
.6
.8
1
cumulative % of population, ranked by pct of tract pop black alone
concentration curve
line of equality

What does ‘proportionality’ look like?

‘Proportionality’ may imply increasing exposure for some groups

		Community with ‘High Disproportionality’		Community with ‘Exact Proportionality’	
Area	Share of Population (%)	Exposure Index	Exposure Ratio	Exposure Index	Exposure Ratio
Tract A	8.5	1.3	0.37	3.6	1.0
Tract B	16.9	1.5	0.42	3.6	1.0
Tract C	16.9	2.0	0.56	3.6	1.0
…					
Tract X	33.9	6.3	1.77	3.6	1.0
Tract Y	16.9	2.3	0.65	3.6	1.0
Tract Z	6.8	4.8	1.35	3.6	1.0
All tracts	100.0	3.6		3.6	

Risk (Hazard Index) among Maryland Counties



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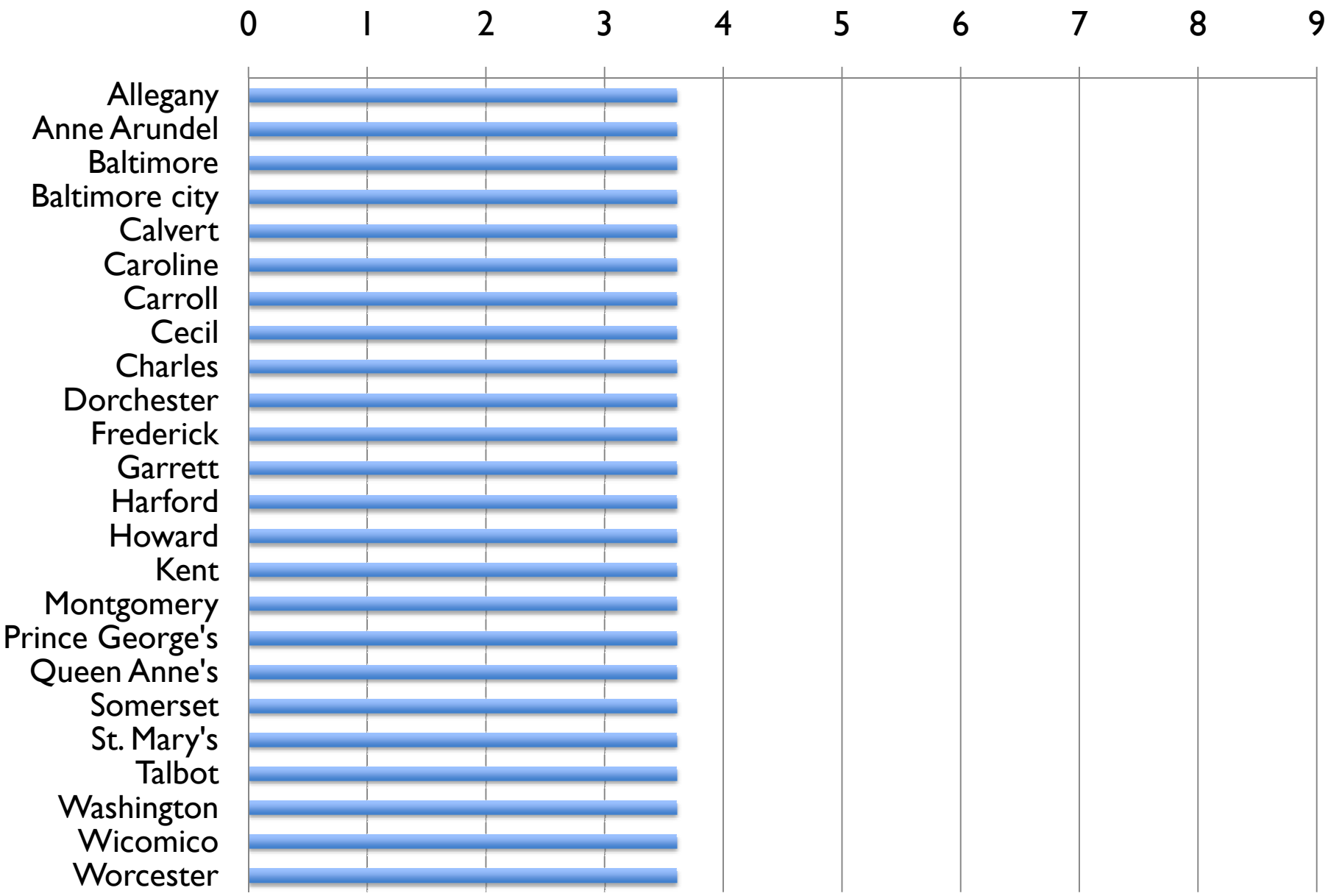

Conclusions

- Disproportionate impacts may be measured in many ways, but summary measures are probably necessary

- Many measures of disproportionality already exist in the fields of economics and demography, and could easily be applied to environmental measures of risk/exposure

- Achieving “proportionality” for existing measures implies possibly increasing risks for some individuals/areas that are currently at low risk/exposure in order to achieve equality

Thank you!

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