

## Problems with burden-sharing proposal among one billion high emitters

Chakravarty et al. (1) have proposed an original burden-sharing scheme for global CO<sub>2</sub> emission reduction efforts whose underlying theme of “Eat the Rich” (or as it turns out, rather, the middle-class) might resonate well in current times of economic crises. The core methodological elements of Chakravarty et al.’s proposal include the construction of a current global income distribution curve, which is assumed to remain constant over time. The authors then boldly assume a constant elasticity of CO<sub>2</sub> emissions with respect to income, irrespective of country, development status, or time to determine each country’s share of “high emitters.”

All above assumptions are at odds with economic theory and empirical data. First, one of the most robust empirical and theoretical “stylized facts” in the economic growth literature is the so-called Kuznets curve: Nobel laureate Simon Kuznets (2) observed an inverted U-shaped pattern of changing income inequality in the process of economic development: inequality initially rises, passes through a maximum, and declines thereafter. Second, the assumed constant elasticity of CO<sub>2</sub> emissions with respect to income is entirely at odds with empirical observations both from macro-economic statistics (data available from the authors) and panel household data (Table 1) that consider both direct and indirect emissions for urban vs. rural dwellers for different income

classes. The emission elasticities are highly variable across countries, spatial location, income groups, and over time and also cover a much broader range than reported by Chakravarty et al.

Finally, the results obtained appear quite implausible. The authors have refrained from reporting their income- and emission-grouping results for the base year, so the reader can only judge the plausibility of the scenario results for 2030, in which India is projected to have 2 million high emitters, compared to 354 million in China. The 2 million for India are in stark contrast to observations by social scientists, who speak of “Belindia” (3), referring to the roughly 10 million current Indian inhabitants (approximately the size of Belgium) who enjoy Western European middle-class lifestyles. In a thought experiment we propose a much simpler indicator of middle-class, high carbon-emission lifestyles: private car ownership. Using a business-as-usual scenario, the World Business Council of Sustainable Development (4) projects 1.3 billion cars in the year 2030 (the same number as the “high emitters” used in Chakravarty et al.’s burden-sharing scheme), and yet the regional distribution of the two indicators of high-emission lifestyle are drastically different (Table 2), suggesting that the 2030 scenario for India based on Chakravarty et al.’s methodology is implausibly low.

We conclude with the observation that whatever burden-sharing scheme is proposed as input to the climate negotiations, the scheme needs to be simple, based on established theories and empirical observations, as well as include some element of historical responsibility for concentration increase in order to be perceived as equitable from the perspective of developing countries. Even if highly original, Chakravarty et al.’s proposal fails on all of the above accounts.

**Table 1. Average direct and indirect primary energy use, emissions, and income elasticities for rural and urban expenditure quintile groups in India in 2000**

Expenditure quintile	GJ/capita			Tons/capita			Total expenditure	Income elasticity estimates from regressions				
	Direct energy*	Direct energy <sup>†</sup>	Total fossil energy <sup>‡</sup>	Direct CO <sub>2</sub> emissions*	Direct CO <sub>2</sub> emissions <sup>†</sup>	Total CO <sub>2</sub> emissions <sup>‡</sup>	1999–2000 Rupees/capita	Total fossil energy	Direct energy*	Direct energy <sup>†</sup>	Total CO <sub>2</sub> emissions*	Total CO <sub>2</sub> emissions <sup>‡</sup>
<b>Rural</b>												
Q1	0.69	3.42	3.58	0.01	0.31	0.64	2,953	0.88	0.76	0.49	1.08	0.89
Q2	1.01	4.16	4.69	0.02	0.36	0.79	4,066	0.75	0.98	0.83	1.01	0.95
Q3	1.39	5.06	5.66	0.03	0.43	0.94	5,042	0.80	1.69	0.72	1.86	1.34
Q4	1.97	6.12	6.96	0.04	0.50	1.11	6,370	0.87	1.54	0.78	1.60	1.24
Q5	3.97	8.23	11.12	0.11	0.57	1.48	10,693	0.91	1.14	0.50	1.14	0.90
<b>Urban</b>												
Q1	2.23	3.89	5.62	0.07	0.25	0.69	4,075	1.01	1.62	0.72	1.81	1.44
Q2	3.81	5.21	8.30	0.12	0.27	0.89	6,020	0.94	1.54	0.64	1.67	1.28
Q3	5.46	6.40	10.93	0.17	0.27	1.07	8,040	0.86	1.15	0.69	1.11	1.00
Q4	7.45	7.98	14.32	0.23	0.29	1.31	11,111	0.84	0.98	0.81	0.85	0.82
Q5	17.95	18.21	29.68	0.55	0.58	2.62	22,294	0.88	0.79	0.76	0.78	0.77

Source, ref. 5. Household expenditure data sourced from NSSO Round 55 Household Consumer Expenditure Survey for 1999–2000, Ministry of Statistics and Programme Implementation, Government of India. Energy Intensities estimated using the 1998–1999 Input–Output matrix for India and various National Energy Statistics according to the methodology and sources described in ref. 5. Carbon emissions factors sourced from OECD/IEA (2008) CO<sub>2</sub> Emissions from Fuel Combustion, IEA, Paris. Exchange rates for conversion from Indian Rupees to PPP \$ sourced from Alan Heston, Robert Summers and Bettina Aten (2006) Penn World Table Version 6.2, University of Pennsylvania.

\*Fossil.

<sup>†</sup>Fossil and biomass.

<sup>‡</sup>Direct and indirect.

**Table 2. Two indicators of middle class, high-emission lifestyles: car ownership projected by WBCSD (4) vs. high income/high emission population projection (1) for 2030 and comparison with base year values so published**

Region	Light duty vehicles		Population under emissions cap		Relative allocation
	2000	2030	2003	2030	2030
OECD North America	250	349		316	0.90
OECD Europe	201	268		175	0.65
OECD Pacific	86	111		113	1.02
FSU	25	76		85	1.12
Eastern Europe	20	36		60	1.67
China	17	127		354	2.78
Other Asia	19	75		52	0.70
India	10	56		2	0.04
Middle East	7	23		64	2.84
Latin America	32	106		56	0.53
Africa	16	62		27	0.43
World total	683	1,289	n.a.	1,304	1.01
Absolute					
UNFCC Annex-1	583	839		749	0.89
China	17	127		354	2.78
India	10	56		2	0.04
ROW	74	266		199	0.75
World	683	1,289	n.a.	1,304	1.01
Percent					
UNFCC Annex-1	85	65		57	0.88
China	2	10		27	2.75
India	1	4		0	
ROW	11	21		15	0.75
World	100	100	n.a.	100	1.00

n.a., not available. All values are in millions. Light duty vehicles data are from ref. 4, population under emissions cap data are from ref. 1, relative allocation ref. 1 projection divided by ref. 4 projection.

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