CORRESPONDENCE

China's uncertain CO_2 emissions

To the Editor — By compiling the emission inventories of China's 30 provinces (excluding Tibet, Hong Kong, Macao and Taiwan) and the nation as a whole in 2010, Guan and his co-workers reported an 18% difference in estimates of China's CO_2 emissions[1]. Although several possible reasons have been suggested[2], the researchers were unable to resolve the source of the discrepancy and could not identify which value was the most accurate[3]. Such discrepancies are apparent not only in energy consumption but also in other economic and environmental datasets, such as gross domestic product (GDP). Throughout the past decades, the data in China's statistical yearbooks never equal the sum of the numbers shown in the provincial statistical yearbooks. For example, just in the first half of 2012 the gap in GDP between the country data announced by the National Statistic Bureau (NSB) and the aggregation of its 31 provinces (excluding Hong Kong, Macao and Taiwan) is about RMB3,000 billion, about 14% of the national total[4], whereas the difference in CO_2 emissions in 2010 reported by Guan *et al.*[1] is about 18% compared with the national figure. In both cases the sum of the provinces is greater than the national total.

To understand the possible reasons for the reported inconsistencies, we must take into account the differences between the national and local statistical systems. All the indicators are counted both at national and provincial level and it is the job of NSB to validate the provincial data and announce the national data after removing duplicate entries. Since 2000, international organizations such as the World Bank, as well as domestic institutes have admitted that the national-level statistical data should be adapted when we study the whole of China due to this duplicate counting at the local level. Researchers should not drop hints to favour the 'bigger' number of China's carbon dioxide emissions or just focus on describing the global impacts resulting from the discrepancies; we have to show objective caution regarding such uncertainty, especially with respect to CO_2 emissions. ❐

References

1. Guan, D. *et al. Nature Clim. Change* **2,** 672–675 (2012).
2. Cyranoski, D. *Nature* (13 June 2012); available via http://go.nature.com/4Z9FMs
3. Marland, G. *Nature Clim. Change* **2,** 645–646 (2012).
4. National Bureau of Statistics of China. China Statistical Database. Accessed 25 August 2012 (NBS, 2012) ; available at http://219.235.129.58/welcome.do.

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CORRESPONDENCE:

Asymmetric effects of economic growth and decline on CO_2 emissions

To the Editor — Estimating the trajectory of CO_2 emissions, an important part of planning for climate change mitigation and adaptation, depends in part on understanding how these emissions are influenced by the economy. Although researchers have developed sophisticated models of the connections between the economy and CO_2 emissions, prominently used modelling approaches implicitly assume that the effect on emissions of declining GDP per capita is symmetrical with the effect of growth in GDP per capita[1,2]. Here, analysing available data from 1960 to 2008 (see Methods), I find that in years where GDP per capita shrinks, CO_2 emissions per capita do not decline in equal proportion to the amount by which they increase with economic growth. One important implication of this finding is that CO_2 emissions depend not only on the size of the economy, but also on the pattern of growth and decline that led to that size.

I estimated two separate models of CO_2 emissions (from fossil-fuel combustion and cement manufacturing) per capita using first-differenced (that is, change from year to year) variables. I estimated different slopes for when the change in GDP per capita was positive (economic growth) and when it was negative (economic decline). All variables were converted to natural logarithmic form before first-differencing, making these elasticity models. The use of first-differenced data controls for factors that vary across nations but do not change over the period of observation, such as many aspects of physical geography.

The coefficients for both models are presented in Table 1 (full results are presented in Supplementary Table S1). In Model 1 no control variables were included. This model indicates that for each 1% of growth in GDP per capita, CO_2 emissions per capita grew by 0.733%, whereas for each 1% decline in GDP per capita, CO_2 emissions per capita declined only by 0.430%. Both of these coefficients are significantly different from 0 and from each other. In Model 2, the percentage of the population living in urban areas and the percentage of GDP from the manufacturing sector were included as control variables. This model has lower data coverage than Model 1 (154 versus 160 nations, and 4,134 versus 5,630 nation-year observations) owing to missing data on the control variables. The coefficients, at 0.752 for growth and 0.346 for decline, are similar to those from Model 1 and, as in Model 1, are both significantly different from 0 and significantly different from each other. I also examined models, not presented here, with other control variables (international trade as a percentage of GDP, foreign direct investment as a percentage of GDP and the age-dependency ratio) that have been examined in other studies of CO_2 emissions[1–3]. These variables did not, however, have significant effects in the models I estimated. Therefore, I omitted these additional control variables in this analysis so as to improve statistical efficiency and the parsimony of the models.