

A Pre-Lima Scorecard for Evaluating which Countries Are Doing their Fair Share in Pledged Carbon Cuts¹



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Those worried about the future of the earth's climate are hoping that the climate change convention in Lima, Peru, in December 2014, will yield progress toward specific national commitments to reduce greenhouse-gas (GHG) emissions. The Lima conference will be hosted by the United Nations Framework Convention on Climate Change (UNFCCC) and is a prelude to the make-or-break Paris meeting of the UNFCCC, in December 2015, where a new international agreement is scheduled to be concluded.

The precedent of the Kyoto Protocol, negotiated in 1997, was more discouraging than encouraging. It was an encouraging precedent in that countries were politically able to agree on legally binding quantitative limits to their emissions of greenhouse gases, to be achieved with the aid of international trading and other market mechanisms. But it was discouraging in that China and other big developing countries would not countenance limits to their own emissions, and, largely for that reason, the United States never ratified Kyoto.

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- ¹ A summary of this brief appeared at Project Syndicate, under the title "Emissions Reduction by the Numbers," www.project-syndicate.org/commentary/china-us-carbon-emissions-formula-by-jeffrey-frankel-2014-11. This research builds upon Bosetti and Frankel (2014).
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A rare positive surprise came from Beijing on November 12, 2014, when U.S. President Barack Obama and his host, Chinese President Xi Jinping, announced a bilateral agreement regarding constraints in the coming decade on the GHG emissions of the world's two largest emitters. The best hope at the moment is a looser system in which each country unilaterally offers emissions-reduction targets, actions, or both, such as those that were agreed under the Copenhagen Accord in 2009 and Cancun Agreements³ of 2010. The Copenhagen/Cancun pledges run through 2020; pledges under the Paris agreement are likely to run through 2025 or 2030. It is in this context that the bilateral understanding between China and the United States is so important.

For a system of emission targets⁴ to work, there needs to exist some general notion of what is a fair target for a country to accept, depending on its circumstances. This would allow a scorecard of which countries are doing their fair share and which may not be. The idea is that those who might be less ambitious would then feel the peer pressure (as some countries will from China and the United States with regard to their Paris pledges).

Pinning down the concept of “fairness” would seem to be extraordinarily difficult, especially from the viewpoint of an economist. Perceptions of what are countries’ fair shares of the burden vary widely. India likes to point out, for example, that an average American already emits ten times as much GHGs as an average Indian; from its vantage a fair allocation would be equal emissions per capita. Americans, for their part, think it would be unfair to make U.S. firms pay a high economic cost to reduce emissions, if the energy-intensive industries simply relocated to developing countries that had not constrained the growth in their own emissions.

Each side has a point. Nevertheless, it would not be reasonable to expect rich countries to agree to equal emissions per capita (at least not anytime soon). That would be the equivalent of transferring massive slices of national income from them to poor countries, which is not something they will ever agree to do. Nor, on the other hand, would it be reasonable to ask poor countries to cut emissions the same percentage, relative to current levels, as the rich. This would not allow them the opportunity for economic growth that the rich have already enjoyed as they created the climate change problem.

Everyone should participate in taking on targets. But it is only fair to take into account countries’ individual circumstances, especially their standards of living. Fortunately, it is possible to describe and even to quantify what targets can be considered fair and reasonable. Three principles:

3 <http://cancun.unfccc.int/mitigation>

4 In this brief, “targets” may refer either to absolute, quantitative, economy-wide emissions-reduction targets or to quantitative emissions-reduction targets relative to a baseline. For the purpose of this brief, we do not consider greenhouse-gas emissions-reduction pledges that countries have made under the Copenhagen/Cancun arrangement that include only a description of policies or activities that these countries will undertake.

- *Latecomer Catchup*: It is fair to expect countries that have increased their emissions rapidly to bring them back down, but not practical for them to reverse fully and instantly.
- *Progressivity*: It is fair to expect rich countries to accept bigger cuts than poor countries, measured relative to what their emissions paths would otherwise have been (the so-called “Business as Usual” path, or BAU).
- *Cost*: It is not reasonable to expect any one country or group of countries to agree to cuts that would result in disproportionately large economic costs for them.

These principles are not just abstract ivory-tower proposals. It turns out that the emissions targets that countries have agreed to or voluntarily submitted in the past—at Kyoto and at Cancun—tend statistically to be consistent with a formula that quantifies the three principles. In particular, countries that were richer or that had increased their emissions faster agreed to steeper cuts than others. Among the countries agreeing to targets at Kyoto, every ten percent increase in income per capita corresponded to an agreed emissions reduction of another 1.4 per cent relative to BAU. (See Appendix Figure 1, from Frankel, 2009.) In the initial Cancun targets, every ten percent increase in income corresponded to another cut of 1.6 per cent relative to BAU. (See Appendix Figure 2, from Bosetti and Frankel 2011, 2014.)

The target paths also embodied a “latecomer catch-up factor” that pulled each country back toward what its emissions had been in 1990. If the formula is extended through the remainder of the century with gradually decreasing weight on the past and gradually increasing weight on per capita targets, model estimates show no country suffering a loss of more than 1 per cent of GDP in present discounted value (Bosetti and Frankel 2014).

Such an approach makes it possible to judge who in the current negotiations is now proposing to do their fair share, who is proposing to do more, and who less.⁵ Consider what targets countries have unilaterally pledged as part of the Cancun Agreements.⁶ We use economic/climate models to translate pledges into common terms of emission tons and to estimate BAU (Hof et al., 2013, using the model of the PBL Netherlands Environmental Assessment Agency).

Figure 1 plots countries’ pledged emission cuts against their incomes so that we can judge progressivity. The vertical axis shows cuts in emissions, expressed relative to a particular baseline. The baseline is the simple average of the country’s actual 2005 emissions and the 2020 BAU emission

⁵ Of course the question as to how to share the economic burden of any particular degree of climate change mitigation is completely different from the question as to how environmentally ambitious the global emissions path should be.

⁶ As suggested in footnote 4, some countries have expressed their numerical targets in terms of tons of carbon dioxide equivalent, some relative to emissions in particular years, and some relative to their GDPs.

level. This baseline makes some allowance for the reality of rapid growth, particularly in developing countries, while pulling everyone partway back in the direction of 2005 levels. A statistical estimate of the “latecomer catchup factor” embodied in the targets is .51, highly significant and remarkably close to .50 (see regression in Appendix Table 1). This justifies the use of the simple average in constructing the baseline.

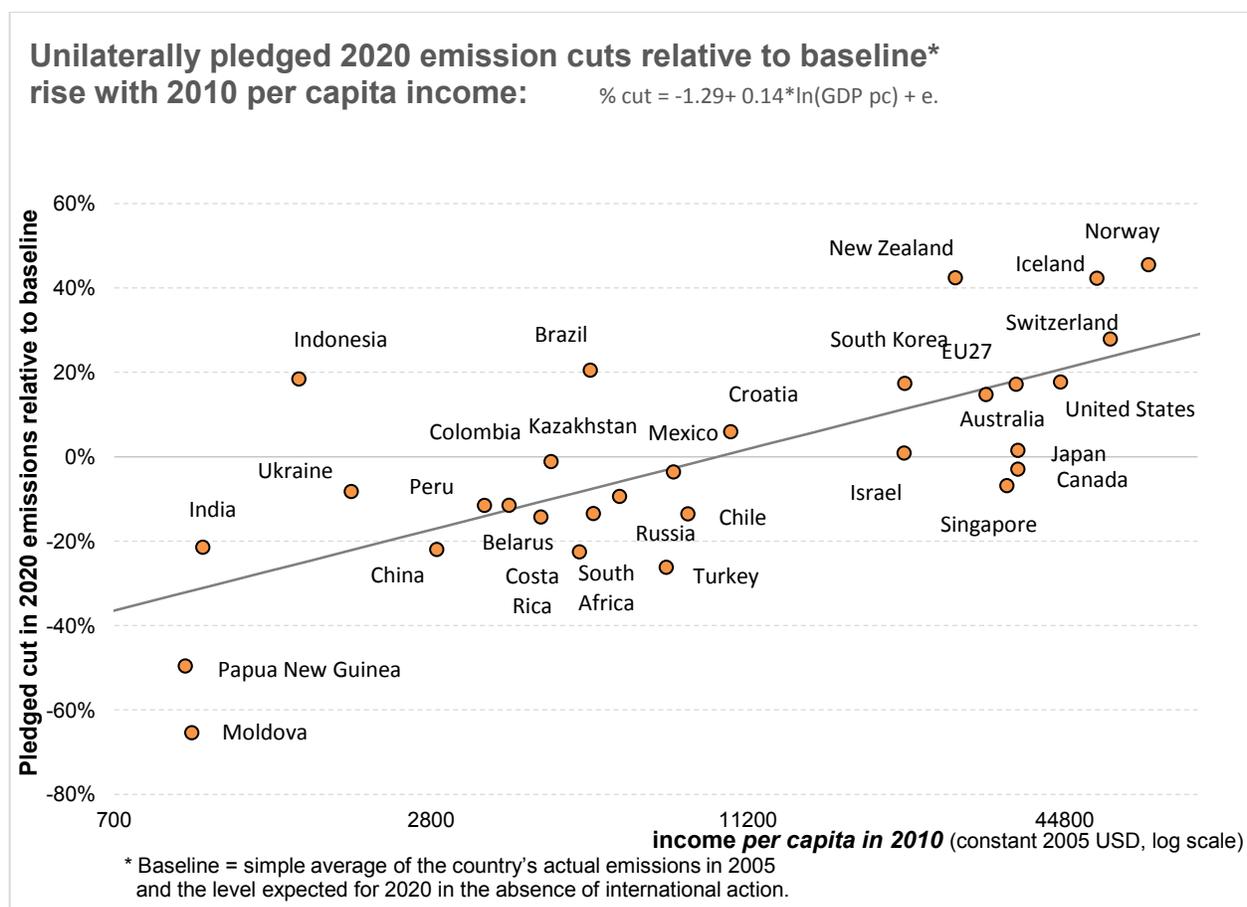
According to our statistical estimates, the 2020 targets implicitly have a base year of 2005 rather than 1990 as at Kyoto. Many countries now have chosen explicitly to express their targets as percentage cuts from their 2005 levels. But even for the set of pledging countries overall, the 2005 number shows up as highly significant in an unconstrained regression, and the 1990 number is no longer at all significant. Evidently too much time has passed since 1990, and it is no longer treated as part of the relevant baseline. (See column 3 in the regression estimates in Appendix Table 1.)

The horizontal axis in Figure 1 is the country’s income per capita in 2010 (on a log scale). The slope of the line corresponds remarkably well to earlier estimates on Kyoto data: each 10.0 per cent increase in income is associated with a 1.4 percent more ambitious cut, on average. The line generally fits the points, reflecting the fact that the relationship is highly significant statistically. The fit provides encouragement that countries are again implicitly operating according to notions of fairness similar to what we have hypothesized.⁷

Consider some examples. The relatively small cuts in India’s target for 2020 are appropriate given its low income per capita. Indonesia’s targets are apparently the most ambitious, controlling for its circumstances. Norway is offering the biggest cuts of all. This can partly be explained by its high income, but it is doing a bit more than its share, even considering its income.

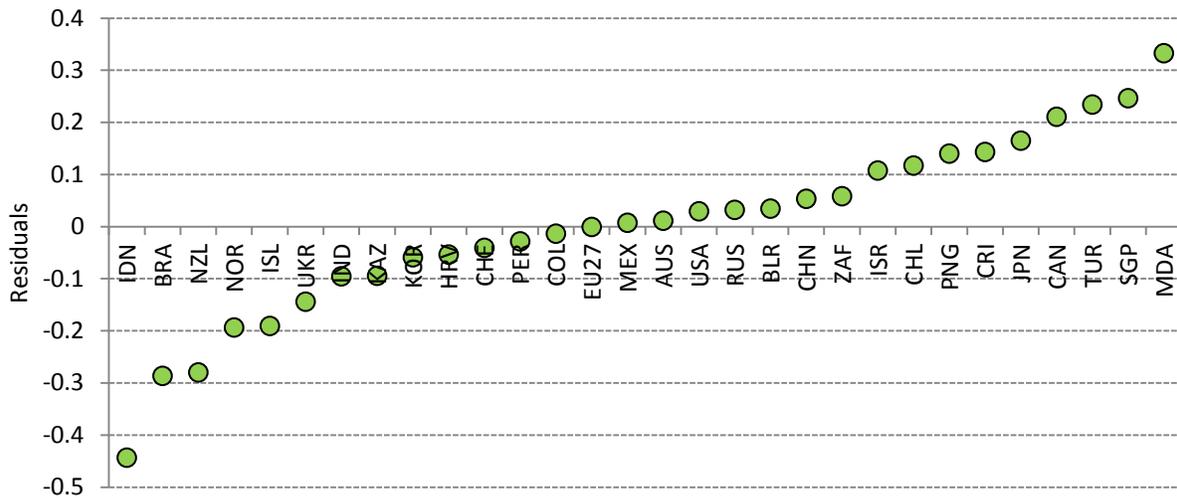
⁷ The estimated regression equation (model number 2 in Appendix Table 1) giving the pledged 2020 Cancun emission cuts expressed relative to our defined baseline is: $-1.29 + 0.14 \cdot \ln(2010 \text{ GDP pc})$; “ln” refers to natural logarithm.

Figure 1: Pledged cuts are again larger for higher-income countries



The three countries to fall short by the widest margin in these calculations are Moldova, Singapore, and Turkey. (Figure 2 shows the residuals from Figure 1, that is, the target level of emissions minus what they should be, according to the equation.) One might have thought it impossible to compare the contributions of three countries that are in such very different positions: High-income Singapore is committing to a target that is at least a 7% cut with respect to its 2020 BAU, but is still 23% above its 2005 level. (It has offered steeper cuts contingent on a legally binding global agreement.) Turkey is not committing to any cutting as of yet. Moldova is in effect asking credit for “hot air” (that is, it wants a target above its current emissions path—as estimated by Hof, et al (2013)—which has been depressed by bad economic performance).

Figure 2: Moldova’s target for 2020 appears the least ambitious and Indonesia the most, adjusted for their economic circumstances



Of greatest interest: China and the United States both show cuts in 2020 that are only slightly smaller than what the equation says they should be. The targets that these two largest emitters are proposing *do* constitute approximately their “fair share” of the global total.

So there is good news in this scorecard:

- I. it is possible to quantify fairness;
- II. the emission targets that have been offered by most countries going into Lima correspond relatively well to the “fairness” relationship; and
- III. this judgment includes China and the U.S., without whose serious participation little progress is possible.

Two big questions remain. First, can these countries deliver on their pledges? Second, what are the targets to be for 2030 and beyond (that is, the targets to be submitted for inclusion in the 2015 Paris agreement)? The sort of statistical analysis described here may offer a basis for countries to judge what each other is offering. Now that all three of the biggest emitters—China, the US, and the EU—have announced post-2020 Paris targets, the formula could be recalibrated for the coming round. These three key data points are enough to identify the equation’s parameters for 2025 or 2030, which in turn could help other countries decide what future targets are appropriate for them. Thus this statistical yardstick for judging fairness can continue to serve as a powerful tool for establishing what share of the burden is appropriate for each country to take on.

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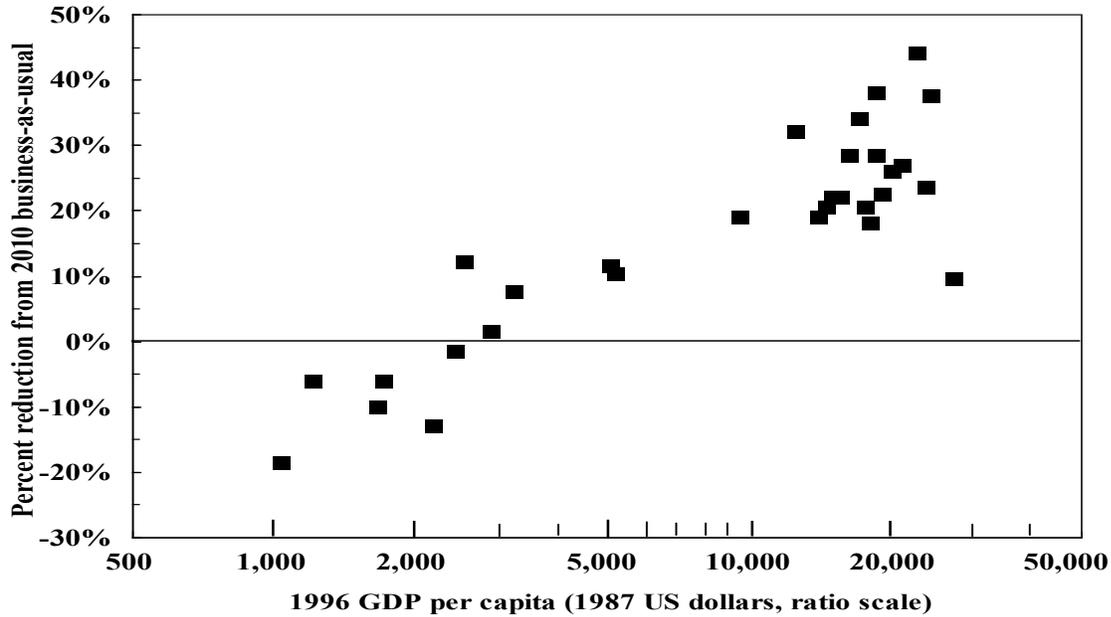
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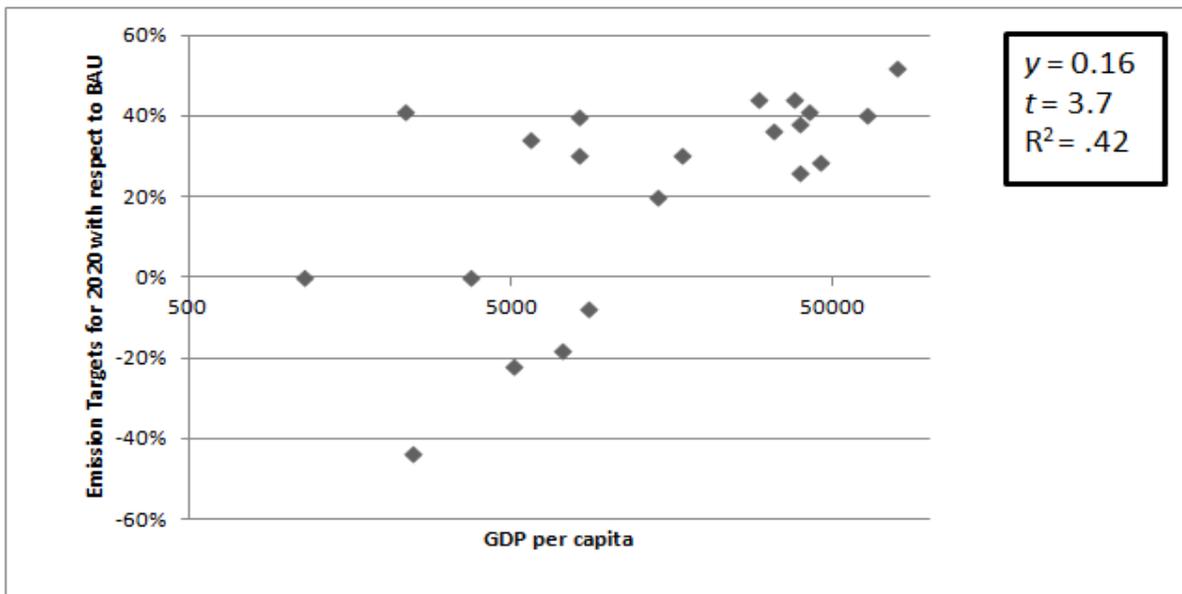
Appendix Figure 1: Progressivity in Kyoto targets for 2010



Source: Frankel (2009), Figure 1.

Based on data from the World Bank, the U.S. Energy Information Administration, and national communications to the UNFCCC

Appendix Figure 2: Estimated progressivity in Cancun targets (including former Soviet countries)



Source: Bosetti and Frankel (2014, Figure 1a).

Based on estimates of BAU from WITCH model. (On the WITCH model, see Bosetti, et al., 2006, 2009.)

Appendix Table 1: Regression estimates

Emissions targets \equiv ln (unilaterally pledged 2020 level) - ln (2020 BAU)			
EXPLANATORY VARIABLES:	(1)	(2)	(3)
ln(GDP per capita 2010)	-0.154*** (0.039)	-0.141*** (0.025)	-0.137*** (0.027)
ln (Emissions 2005) - ln (BAU2020)		0.515*** (0.0827)	0.502*** (0.087)
ln (Emissions 1990) - ln (BAU2020)			-0.045 (0.084)
Constant	1.317*** (0.358)	1.294*** (0.233)	1.259*** (0.246)
30 observations			
R-squared	0.354	0.735	0.738

*** p<0.01 (Standard errors in parentheses.)

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