

3. REGULATION:

Study shows how a global CO2 regime might prod laggard nations to reduce emissions

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It's frustrating when someone else gets a free ride off of your hard work, but when it comes to curbing greenhouse gas emissions, researchers may have found a way to make sure everyone pulls his fair weight.

Countries that go through all the trouble of scrubbing flue gases, buying carbon offsets and building wind farms may find it difficult to contend with nations that continue to spew greenhouse gases into the atmosphere from power and industrial plants. Though the whole world benefits from the reduced overall pollution, some nations worry that in a global climate change mitigation strategy, they would bear an undue burden in reducing their emissions while others do nothing.

It's a vexing problem that has derailed many international climate negotiations. In fact, one of the main criticisms of the Kyoto Protocol -- an international agreement to reduce greenhouse gas emissions by 5 percent between 2008 and 2012 -- was that it excluded large developing economies like China and India from emissions targets. And among the 37 countries included, there was no way to make sure everyone played by the rules.

At the Potsdam Institute for Climate Impact Research in Germany, researchers have come up with a way to give countries incentives to adhere to their commitments for emissions reductions by using a branch of mathematics known as game theory. By including certain provisions in an agreement, noncompliant actors -- or "free riders" -- might be deterred. The findings were published this summer in the journal *Proceedings of the National Academy of Sciences*.

Game theory, which has been used to model everything from bluffing in poker to nuclear war scenarios, is a way to simplify a situation involving decisions from two or more parties into a game. Based on how certain outcomes or payoffs are weighted, you can actually calculate the best decisions and predict how other players will react.

Jobst Heitzig, a researcher at the institute and lead author of the paper, explained the premise this way: "Let's say we have a world of two countries or two regions. Let's say both regions reduce their emissions by a large amount. But if one reduces their emissions, but the other doesn't reduce its emissions, then the other country [that didn't make any cuts still] benefits."

A game with 192 players

Of course, the real world doesn't have just two countries, so Heitzig scaled his model for 192 countries, or players. "Many studies then applied this model and then came to very pessimistic results," said Heitzig. "Traditional game theory says that cooperation is highly unlikely with a large number of players."

According to Heitzig, the problem with many of the previous climate games is that they make two fundamental assumptions that are not necessarily true: They assume that you can only accept or reject a reduction target, and they assume that you must adhere to this decision forever.

"You have more than only two options. You can not only cooperate or defect, but you can control your emissions output as a continuous quantity," said Heitzig, explaining that emissions targets can be moved up or down on a sliding scale as an incentive or disincentive.

He also pointed out that an emissions treaty can be renegotiated after a set amount of time, say a four- or five-year period. "In the climate context, it means it makes a big difference if every country makes a big decision and sticks to it for a hundred years or if every country selects their emissions levels again and again. When you're able to react to each other, you can punish other people for their actions."

With these new rules, the research team crunched the numbers again to see if it would affect how the players behave. "It turns out, with this combination, it's possible to come up with a strategy that keeps other countries in check," said Heitzig. "It basically says that if you're a free rider for the last four years, my strategy is that in the next

period, I emit even more and set lower [tougher] targets for you."

Say, for example, Spain, France and Germany have all agreed to lower emissions or offset them by 5 percent in five years. At the end of the five-year period, suppose Spain and France have hit their targets but Germany has done nothing. Then for the next period, Germany would be required to lower its emissions by 10 percent, while France and Spain each only have to hit a 2.5 percent reduction target.

If Germany decides it still doesn't want to do anything this time around, Spain and France could impose trade restrictions, sanctions or tariffs on German goods until it complies. However, if everyone holds up his end of the bargain this time, the load is then balanced for the third period and byones are byones.

This behavior is known as a "redistribution of liabilities," and it creates incentives for countries to monitor each other, since they all have an interest in lowering emissions but also want to make sure everyone chips in, said Heitzig.

So what does this mean for the global poker table? Heitzig cautioned against using his model to develop policy right away, since it still makes some big assumptions. He said his climate game is predicated on a global emissions trading market in place and on the idea that all countries would benefit and profit from reducing their emissions and slowing climate change. In the real world, countries like Canada and Russia may actually see economic benefits from a warming climate in the short term, according to Heitzig.

Helping the players enforce the rules

Scott Barrett, the Lenfest-Earth Institute professor of natural resource economics at the Columbia University School of International and Public Affairs and Earth Institute, agreed that it's too soon to write legislation based on these models. "In terms of what game theory suggests, I wouldn't say there's any kind of consensus on how to move forward," he said. However, "there's a pretty strong consensus on the nature of the problem."

"It's this top-down logic, which is absolutely the wrong way to think about the problem [of climate change]," said Barrett, referring to treaties like the Kyoto Protocol, which he described as a "badly conceived agreement."

Regulations imposed from the international level on down are bound to fail because they don't address the nuances of what drives the players' climate mitigation, according to Barrett. "You have to grapple with these incentive problems," he said. "There are ways we can do better: In my opinion, what you need to do is break up the problem into smaller pieces. Kyoto treats everything as a unified problem."

The better approach, according to Barrett, is to track the various greenhouse gases individually and to divide the world into regions or sectors in addressing their emissions impacts. To make sure countries follow the rules, countries can hold onto the threat of sanctions. "If you design the treaty in the right way, you would be subject to the trade restrictions," said Barrett. "If the design of the agreement is very good, you basically don't have to deal with enforcement."

"I think the key thing is that climate change is many things, but it is a profound challenge for collective action. Every country is responsible for global emissions," said Barrett. "We could do better, but to do better, you've got to rethink how you negotiate. It's not the process, it's the approach." In other words, when it comes to climate change, it's not whether you win or lose, it's how you play the game.

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