

NATURE & TECHNOLOGY

Climate Change and GDP: Is 55 Degrees America's Economic Breaking Point?

A new study predicts some countries might receive an economic boost from climate change—but the U.S. isn't one of them.

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Scientists have predicted that climate change will lead to longer wildfire seasons, increasingly destructive storms, higher rates of disease, and—yes—[more frequent scuffles](#) on the baseball diamond.

Now, researchers say there's another climate crisis on the horizon: a downturn in the United States economy.

According to [a study](#) published last month in *Nature*, warmer temperatures have historically improved economic productivity—but only up to a point. In an analysis of climate and economic data from 166 countries, researchers from Stanford University and the University of California–Berkeley found that, once a country's average temperature eclipses 13 degrees Celsius—or 55.4 degrees Fahrenheit—its economic growth takes a nosedive.

When considering all countries together, the study projects that warmer temperatures will drag down the global economy by 23 percent.

That's no problem for cold-weather nations like Sweden, where annual temperatures are currently well below the 55.4-degree tipping point. In fact, the study predicts that, if global warming continues at its current pace, Sweden's per-capita GDP in 2100 would be 210 percent higher than in a world without climate change. Other projected “winners” include Canada (+247 percent), Russia (+419 percent), and Iceland (+513 percent).

But the outlook is less cheery for the U.S., where temperatures are already approaching the economic drop zone. By 2100, continued global warming is expected to depress per-capita GDP in the U.S. by 36 percent, compared to baseline growth. The prognosis is yet bleaker in the global south, where hot-weather countries like Nigeria (-91 percent), Pakistan (-93 percent), and Venezuela (-91 percent) would likely experience the most severe slowdowns, causing the global north-south income gap to widen.

The bottom line: When considering all countries together, the study projects that warmer temperatures will drag down the global economy by 23 percent. That figure dwarfs previous estimates of climate change's economic effects, but lead author Marshall Burke, an assistant professor of Earth system science at Stanford University, sees a silver lining. "The optimistic view is that the benefits of mitigating climate change are actually much bigger than we thought," he says. "If we're able to reduce greenhouse gas emissions, we could see huge economic benefits."

In fact, the costs of climate change—and the potential benefits of taking action—might actually be higher than the study suggests. For one, the economic modeling doesn't account for how downturns in the U.S., China, and other major countries might ripple through the rest of the global economy. Although per-capita GDP in cold-weather nations has historically risen as temperatures approach 55 degrees, it's possible those trends won't hold up in a globalized economy where falling stock prices in New York City can spark financial frenzy across the globe. (Sorry, Sweden.)

Also, because it uses historical data to predict future outcomes, the study doesn't fully account for the likelihood that the impacts of a warming planet will grow worse over time. Despite decades of rising sea levels, for example, cities like New Orleans and Miami have yet to be claimed by the sea. But if water levels continue rising at the current rate, scientists predict that could change before the end of the century, creating an economic catastrophe not fully reflected even in the new projections.

On a brighter note, Burke says the worst outcomes outlined in the study could be avoided if countries act swiftly to curb carbon emissions. A hopeless proposition, given political gridlock in the U.S.? Maybe not entirely. Despite the intransigence of Congress's climate change deniers, there actually has been some modest climate progress in recent years. California has implemented a cap-and-trade carbon-pricing scheme, the U.S. and China have agreed to restrict greenhouse gas emissions over the next decade, and a legitimate contender for the Democratic Party's presidential nomination, Vermont Senator Bernie Sanders, has called for a federal carbon tax on polluters.

This summer, the Pope threw his support behind climate action, inspiring some cautious optimism that the United Nations' climate change conference—usually a hot-air summit—might actually yield results in Paris next month. One of the conference's top goals is to develop a binding emissions-reduction plan that would limit global warming to two degrees C by century's end—an increase much smaller than the 4.3 degrees C global temperature boost predicted by the study if climate change goes unchecked.

As the U.N. climate conference nears, Burke and his team are turning their focus to a question that will likely loom large over those discussions: If climate change has a global economic cost, and if that cost increases in proportion with carbon emissions, what is the true cost of each additional unit of carbon released into the atmosphere?

Last month, German Chancellor Angela Merkel and French President François Hollande joined other world leaders in calling for a global price on carbon emissions—but determining where exactly to set that price is a tricky economic endeavor, even before considering political constraints. In 2013, a committee of U.S. government scientists and economists placed the cost of carbon at \$37 per ton, but many researchers believe it's much higher. A Stanford University study in January, for example, estimated a carbon cost of \$220 per ton.

Why the huge discrepancy? At least in part, it's a function of inherent uncertainty in economic modeling. When calculating the cost of carbon, estimates rely on big assumptions about how carbon emissions will impact climate change—and even bigger assumptions about how climate change will impact various sectors of the economy. Even small tweaks to those assumptions can lead to massive gulfs in the bottom line.

Burke and his team want to sidestep some of the micro-level uncertainty by studying the cost-of-carbon question from a macroeconomic perspective. Instead of trying to calculate the cost of climate change in dozens of different economic sectors—and then adding them all up—the researchers intend to stick with the aggregate national-level approach they deployed in the study released last month.

“It doesn't capture the same nuance, but we are able to say, ‘OK, once all these factors have washed out and interacted, what's the net impact?’” Burke says. “We like that approach.”