SAINTS PERSPECTIVES
Things about Climate Change

Why any estimate of the Cost of climate change will be flawed

Temperature fluctuations are unpredictable. Humans are even more so

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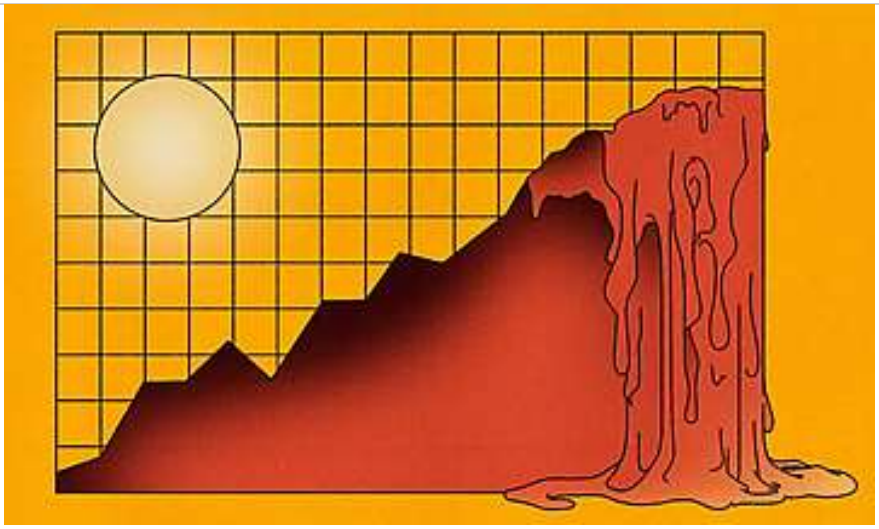

When William Nordhaus, who would later win a Nobel prize in economics, modelled the interaction between the economy and the atmosphere he represented the "damage function"—an estimate of harm done by an extra unit of warming—as a wiggly line. So little was known about the costs of climate change that he called it "terra incognita", unknown land, compared with the "terra infirma", shaky ground, of the costs of preventing it. Eventually, a rough calculation gave him an estimate that 1-2% of global GDP would be lost from a 3°C rise in temperature. This was no more than an "informed hunch", he wrote in 1991.

A new working paper puts the damage far higher. Diego Känzig of Northwestern University and Adrien Bilal of Harvard University use past changes in temperatures caused by volcanic eruptions, as well as El Niño, a years-long increase in heat released by the Pacific Ocean, to model the impact of a warmer planet. Employing long-term data on global economic growth and average annual temperature, they find that an additional 1°C of warming will lead to a 12% fall in GDP. A climate-change scenario with more than 3°C of warming would be, according to their estimates, an equivalent blow to fighting a permanent war.

The damage function is one of the inputs to modelling the “social cost of carbon”, a measure policymakers use to gauge whether investments to reduce climate change are worthwhile. Different methodologies produce wildly different answers. In 2022 America’s Environmental Protection Agency (EPA) proposed revising up its estimate of the social cost of carbon from $51 to $190. Messrs Känzig’s and Bilal’s calculations produce a figure more than five times higher, at $1,056 a ton of carbon-dioxide equivalent. Thus they calculate that it would be worthwhile for America to pursue radical decarbonisation even if no other country joined in.

For all the advances in technical capabilities since 1991, the process of removing the damage function’s wiggles is still a tough one. Economists ideally would observe two identical planets: one warming, the other not. In the absence of another Earth, they must instead find terrestrial counterfactuals. An early approach was to compare hotter countries with colder ones to see how incomes differed. This left some things out, however. Norway is not only richer than Nigeria because of its temperature, and no set of “controls” in a statistical analysis can account for all the differences.

One “top down” strategy preferred today follows a sample of regions over time. This is better, but has its own problems. Both temperature and economic growth are, in the jargon, “non-stationary” and “autocorrelated”. Imagine a drunk walking home. He heads in the right direction but missteps at random, sometimes going too far left and sometimes too far right. At any point, his position will depend not only on the direction in which he is heading but on all such stumbles. Economic growth and temperature are similar: they head in the same direction (up), but in any year their level will depend on past deviations. Trying to find a relationship between the two will almost inevitably lead to a spurious result.

The solution is to look at “temperature shocks”, observing how these correlate with income shocks. The extent to which areas grow more slowly after a hot spell indicates the potential damage from climate change. Using short-term variations in temperature, however, introduces a new problem: adaptation. Farmers would not stop growing wheat and start growing bananas in response to a year of warmth, but they might in response to several decades of it. Using data from small areas also misses the global nature of climate change. If one county faces a drought, it can buy food from elsewhere. If the world as a whole loses farmland, it cannot.

Messrs Känzig and Bilal use the whole world as their panel. Although this approach solves the small-area problem, it also suffers from new ones. Historical variation in global temperature, such as that caused by El Niño, has typically been small—more like a tenth of a degree of warming, rather than the two or three that climate change will probably bring. Using data for the whole planet also cuts the number of observations. The sample used by Messrs Känzig and Bilal starts only in 1960. El Niño has coincided with economic shocks, including the Latin American debt crisis in the 1980s and the Asian financial crisis of the 1990s. Having fewer observations makes it harder to control for such factors, meaning the model may overstate the fall in GDP from climate change.

There is another, "bottom up" approach, employed by the EPA, which uses several different indicators of the damage done from a higher temperature, rather than solely its impact on economic growth. One of the models estimates changes in agricultural yields and mortality, as well as sea-level rises and additional energy demand for cooling. These estimates are then aggregated into a single dollar amount. But the list of the costs of climate change is not exhaustive. Nor can it account for the sum total of the global effects, such as interrupted trade, that a "top down" estimate could at least in theory capture.

Here be dragons

The range of difficulties is telling. Earth's climate is a complex system, in which even basic facts, such as the extra warming produced by a ton of greenhouse gas, are uncertain. There could be tipping points when global warming suddenly accelerates. On top of this, humans are even more complex. **Adaptation** to a warming planet, perhaps via migration or cooling technology, could dramatically reduce the damage. Humanity has managed to carve out a living, of sorts, in both Alaska and the Amazon rainforest. So expect the costs of carbon to stay uncertain. Yet they are no longer quite the terra incognita Mr Nordhaus described. Despite their flaws, the methods agree on one thing: climate change carries far heavier costs than Mr Nordhaus first imagined. ■

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