

Perfect temperature for economic success – 13C

Research linking economic performance to average temperature shows 'stark repercussions' of failing to tackle climate change

Damian Carrington

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The perfect average temperature for national economic success is 13C (55.4F), academics have discovered.

But the fundamental link they have revealed between a country's economy and its temperature has led them to warn that the costs of unchecked climate change will be many times worse than previously thought.

The new analysis has "stark repercussions", according to one independent expert, and indicates that all economic activity in all kinds of countries is affected. It estimates that the average citizen's income in 2100 will be a quarter lower if global warming is not tackled and that global inequality will widen much further.

Underlying the link is the impact that rising temperatures have on people's ability to work, their health and even their ability to think, as well as harm to crops and machinery. Today, the US, Japan and China have average annual temperatures close to the sweet spot of 13C, meaning that further warming will begin to harm their economies.

But Brazil, India, Indonesia and Nigeria are already much warmer, meaning the impact of climate change on their economic growth will be even greater. The UK and Germany are currently cooler than 13C, meaning their economies may improve a little as temperatures rise, before starting to decline.

"We are already experiencing the economic impacts of climate change - heatwaves, for example, are increasing health costs and employee absenteeism, as well as reducing crop yields," said Thomas Sterner, at the University of Gothenburg in Sweden, who was not involved in the research.

"The conclusion [of the new research] that temperature-associated costs will be higher than previously calculated will cause a stir, and should have stark repercussions for policy. My feeling is that we are only beginning to understand just how much damage a changed climate can wreak."

The new analysis, published in the journal *Nature* on Wednesday, began by examining the economic performance of countries between 1960 and 2010. When a country's average temperature was above 13C, they found that national economies performed worse in warmer years than in cooler years. Below 13C, the reverse was the case.

“This relationship we have uncovered is almost like a law,” said Solomon Hsiang, at the University of California, Berkeley, a member of the research team. “Over the last 50 years, this relationship between how temperature fluctuates and how economies perform hasn't changed a bit.”

The researchers checked the results had not been skewed by factors like changes in oil price or the arrival of new technologies and then applied the findings to standard models of future economic development. They found that unrestricted global warming would cut expected incomes in 2100 by between 15% and 75%, many times higher than previous estimates. In the analysis, 77% of nations were worse off than they would be in 2100 if climate change is not tackled.

Furthermore, if projected economic growth is sluggish, nearly half the world's nations would be poorer in 2100 than they are today. “The effect of climate change is to massively increase global income inequality,” said Hsiang. The analysis shows the poorest 40% of nations would see their expected incomes plummet, while the richest 40% would experience much smaller falls.

“Very slowly, economies start performing worse and worse [as temperature rises], but over time those little differences add up, so by 2100 there is a huge wedge between where we could be and where we find ourselves,” said Hsiang.

High temperatures are known to harm crop productivity, but they also harm people's ability to work. “People are known to be very sensitive to temperature,” said Hsiang. “So as a country warms up, millions of people start to experience warmer temperatures and their productivity starts to decline.”

The impact of heat on manual workers is more obvious but Hsiang says it can affect white collar workers too: “There is a lot of interesting work showing that cognitive errors, or other types of mistakes, increase as workers are subjected to higher temperatures. So in places where increasingly we are relying on people to sit and think to be productive, that could be costly.”

Another impact of rising temperatures is on health, with heart and pulmonary diseases rising as well as malaria and dengue fever. Air conditioning can cool people, but is expensive and means that money is not being used elsewhere in the economy, Hsiang said

“When we hear of a few degrees of temperature change, it doesn't sounds like a lot, but when you look in detail at what will happen on the ground, you are looking at a completely different planet,” said Hsiang.

“So it shouldn't be too surprising that it is going to reshape the global economy in ways that

are going to be quite traumatic. We can then ask whether or not we want to subject future generations to that turmoil and change, or if we want to invest what seems like a relatively small amount of today to avoid that scenario.”

Climate economist Lord Nicholas Stern, at the London School of Economics, said: “This paper recognises that climate change could have impacts that increase very steeply with rising global average temperature. This is an advance on other previous studies [which have] made severe underestimates of the economic effects of unmanaged climate change.”

But he said even the new estimate could be unduly lower, because many possible and severe disruptions suggested by scientific evidence had not been included.

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