

# Commentary: Underestimating the impact of climate change on our effectiveness, economy



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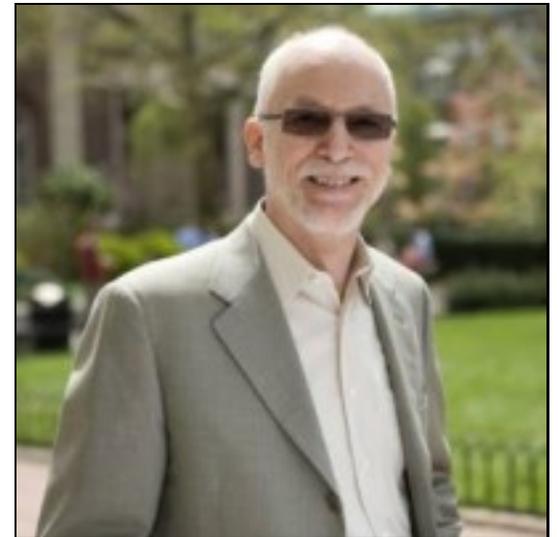
## A changing climate threatens our productivity and effectiveness and, unchecked, could lead to an endless recession.

By Geoffrey Heal, Jisung Park

In a bid to cement his legacy as a champion of the environment, President Obama's administration recently unveiled regulations aimed at tackling climate change by fostering our use of clean, renewable energy. While we applaud the federal government for taking a stand on one of the most important issues of our time, we believe the most pressing issue of climate change is economic.

An emerging body of research suggests that rising temperatures are eating into our productivity right now, in part due to the fact that human beings haven't evolved to operate well at climatic extremes. If we continue to move at our present pace, the possible future economic impact is equivalent to an endless Great Recession.

Quite simply, the hotter we are, the less effective we are at any task we tackle. A fact first noted by the British navy when at war in the tropics, this has now been documented many times in the lab. These findings should not be surprising: anyone who has watched construction workers toil in midday heat or attended a class in a freezing lecture hall can intuit the link between thermal stress and human performance.



What has been less understood is just how significant the impact of extreme temperatures on productivity can be. Emerging work suggests that it may be substantial. A 2012 study covering all General Motors plants in the U.S. found that output dropped by 8 percent during weeks in which temperatures exceeded 90°F for six days.

This is perhaps the most surprising of the plant-level studies, as most would expect a high-tech industry like auto manufacturing to be immune to the weather. Another study, in India, found that plant-level productivity among Indian manufacturers declined by roughly 3 percent per degree Celsius (1.8°F) above twenty-five degrees C (77°F).

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These findings also hold for entire economic sectors including agriculture, transportation and tourism. In the Caribbean and Central America, industrial output drops by 2.5 percent per degree Celsius increase in summer temperature, controlling for the impact of storms and other correlated weather events.

In our own research, we complemented these small-scale studies with cross-country research, and confirmed worldwide that temperature increases in hot and poor countries lead to a sharp drop in productivity, on the order of 3-4 percent per degree Celsius (or 2.5-3 percent per degree Fahrenheit).



If the more extreme predictions turn out to be accurate, temperatures could rise by as much as 6 degrees centigrade by the end of this century, leading to a huge drop in productivity in hot regions, nearly 20 percent.

A drop in productivity of only 4.3 percent, corresponding to a temperature increase of 2°C or less, would lead to a drop in output on the same scale as the massive recession of 2007 – 2009.

The direct economic impact of these productivity losses pales in comparison to the overall price tag of a business-as-usual approach to climate change.

The most significant of those costs are likely to derive from extreme weather events, like the drought in California, now stretching into its fourth year, which cost the state \$2 billion in 2014 alone. Just as importantly, many of the most significant costs — like mass extinctions and wholesale destruction of entire ecosystems — can't be monetized.

Even limiting ourselves to the ledger of strictly economic costs and benefits, however, the absence of these productivity losses from our present models indicates that we are likely gravely underestimating the final costs of climate change.

Fortunately, we can begin to prevent these productivity losses by making sure that the hotter parts of the world are provided with adequate carbon-free electricity for air conditioning.

Using carbon-free electricity is exactly where the Obama administration's proposal propels us and the return on investment could be significant in economic and human terms. Of course, none of these things will be easy, or cheap, but it is clearer than ever that the highest cost is the cost of doing nothing.

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