

# ***A Review of *The Climate Casino: Risk, Uncertainty and Economics for a Warming World* by William Nordhaus***

*Robert Repetto*<sup>1</sup>

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For more than three decades William Nordhaus, Sterling Professor of Economics at Yale University, has contributed to a better understanding of climate change issues with three books and dozens of articles. He has consistently taken a judicious, balanced stance, acknowledging the many uncertainties while using the best available research findings, updating his analysis regularly and adopting mid-range estimates for key relationships. This approach has made him influential with policy-makers and an entire generation of climate economists.

His current book, *The Climate Casino*, is written for a general audience and can be readily understood by non-specialists. Extensive documentation and technical matters are consigned to end notes. The book covers the entire range of climate issues: the science, impacts and damages, mitigation possibilities, domestic and international policy options, and politics. Where important controversies exist, Nordhaus fairly explains divergent viewpoints before introducing his own judgment. The book can be strongly recommended to everyone seeking to understand the climate problem and its solution.

The book's main messages are that humans are almost certainly causing climate changes unprecedented during the emergence of civilization, mainly by burning fossil fuels, and that the resultant warming is a major threat to societies and the natural world. Climate dynamics may well involve thresholds and tipping points that, if triggered, could make changes self-reinforcing and irreversible. The only genuine solution is to reduce emissions by changing the practices of billions of people, businesses and governments around the world. This can best be done through market mechanisms, specifically by creating an economic penalty or "price" for carbon emissions, either through a carbon tax or a cap-and-trade regime that limits the use of carbon fuels through tradable permits. Either option would be efficient, but the latter affords greater certainty over future emissions. In adopting targets under either policy, governments should consider both potential damages and the costs of reducing emissions, but should be willing to pay an insurance premium to stay on the safe side. Relative safety may be unattainable unless all countries with significant emissions cooperate to reduce them. If they do, climate change can be limited at a relatively low cost, less than one or two per cent of total income; however, waiting to act would be extremely costly.

These messages will certainly command broad agreement, but some aspects of Nordhaus's analysis warrant particular attention. Though it has taken millennia for the world economy and population to reach its present scale, he confidently

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projects that the economy will double in size in less than thirty years and will be eight times bigger by 2100, with a world population of 10.5 billion and with continuing expansion thereafter. He envisages no ecological or environmental constraints on such growth, not even climate change. To the contrary, he projects that economies will become less dependent on natural resources as people move out of the countryside into cities and other economic sectors expand relative to agriculture and fisheries. Rather than viewing climate change as a “force multiplier” exacerbating a range of other increasing ecological stresses—on water availability and quality, on air quality, on soil productivity and on biological resources—the book portrays it as a modest though increasing charge on an ever-growing production.

This perspective colours the analysis. Exponentially growing output implies more energy use and emissions, making climate change much more difficult and expensive to halt. The rapid rise in world income also strongly affects climate change impacts and potential adaptations. Nordhaus expects that by 2050 today’s poor communities will be much richer, better fed and housed, and will enjoy safe water and sanitation, improved infrastructure and stronger public health systems. There will be significant medical advances, in vaccines, for example. Governments will be better able to afford preventive and remedial investments. They will be much better able to deal with the spread of infectious diseases, weather extremes, and other potential impacts on health and the economy. His growth assumptions make mitigation more expensive and adaptation more manageable.

Also noteworthy is the book’s brave attempt to analyze the climate problem within a benefit-cost framework. Certainly, sensible policy-makers will consider both the damages from climate change and the costs of stopping it, but is it sensible to sweep aside the wide uncertainties that arise at all stages of the analysis and balance both damages and costs on a common monetary scale? Professor Nordhaus does not overemphasize his finding that the “optimal” temperature increase is somewhat higher than the 2 degree centigrade limit adopted at the Copenhagen Conference of the Parties to the United Nations climate treaty; instead, he uses the benefit-cost framework to explore some hypothetical questions and reaches reasonable conclusions. If inefficient regulatory measures are used to control emissions, or if only half of global emissions come under control, then the temperature limit should be higher. If future damages and mitigation costs are not discounted to reflect the opportunity cost of capital or if damages are likely to increase sharply when a temperature threshold is reached, then the limit should be lower.

Several arguments can be made that a benefit-cost framework is not a suitable guide to climate policy.

- Mitigation costs are reversible, but climate change is not. If new information shows that damages have been overestimated, then new coal plants and gas guzzlers can be built, but carbon in the atmosphere and the resultant warming will persist for many centuries.
- Mitigation costs are known, but all the consequences of warming are not. Reducing emissions will raise energy costs; the uncertainty is just the extent. The consequences of climate change are only partially understood. There are the known unknowns, such as the effect of a warmer, more energetic atmosphere on tornados. Then, to borrow Donald Rumsfeld’s famous phrase, there are “the unknown unknowns”—consequences that scientists may not even have anticipated.
- Mitigation costs are bounded, but damages are not. Energy now represents 5 per cent of total output and that percentage is falling. Renewable energy costs are at most double the costs of coal-fired power, and the difference is also falling. So, a limiting upper bound on mitigation costs is 5 per cent of output. By contrast, there is no known upper bound to the potential damages from climate change if allowed to continue unabated.

- Mitigation costs and climate damages are incommensurable. It is reasonable, though difficult, to estimate the monetary cost of a transition to renewable energy, but what is the monetary cost of the earth's sixth mass extinction event? Of millions of people dead, diseased or displaced? Of the loss of historic communities, cities and even nations? As Nordhaus concedes, economists do not have credible answers to these questions.

What is the alternative? *The Climate Casino* rejects a target approach, such as the two-degree limit, as neither scientific nor economic, but this risk-management policy approach geared to avoid serious damage was the centrepiece of the United Nations Framework Convention on Climate Change and repeated at the Copenhagen Conference of the Parties.

A related question is whether *The Climate Casino* may be too pessimistic regarding mitigation costs and too optimistic regarding climate change damages. Though citing supporting empirical studies by McKinsey & Co. and others, Nordhaus rejects the view that significant opportunities exist to reduce emissions while saving money. He adopts the conventional economic argument that one does not find \$20 bills on the sidewalk because any such windfalls would already have been harvested.<sup>2</sup> Such "win-win" opportunities do exist. In U.S. states where energy-efficiency providers can enter electricity markets, they are usually lower bidders than new generation. Large savings are possible in emerging market countries, such as China and India, where terribly energy-inefficient buildings are still being built and in countries maintaining significant fossil energy subsidies. The book does concede that households often apply unreasonably high discount rates to potential energy-saving investments, which could justify regulations.

There is also evidence that the cost difference between fossil and renewable energy is smaller than it appears. Previous research by Professor Nordhaus and collaborators found that the damages to health and the environment from coal-fired power plant emissions of sulfur and nitrogen oxides and fine particulates amount on average to 1.8 cents per kilowatt hour, adding more than 25 per cent to average generating costs from such power plants (Mendelsohn, Muller, & Nordhaus, 2011). Counting these costs appreciably lowers the gap and, of course, there are further environmental damages from coal mining and oil and gas extraction that are not yet internalized into market prices.

The analysis behind *The Climate Casino* also excludes the phenomenon of induced technological change, the cost-reducing innovations that arise as new technologies become more widely deployed. "Learning-by-doing" partly explains this phenomenon, as greater familiarity and experimentation with new technologies lead to cost-saving improvements. A further explanation involves the stimulus to innovation that growing markets provide. Historically, America and other countries have undergone several energy transitions of comparable magnitudes over half-century periods: from animal traction to the internal combustion engine; from water power to steam power, and from steam power to electricity. In each transition, costs of the new technologies declined rapidly over time and eventually proved much superior. Although the book acknowledges the rapid decline in the costs of solar energy over past decades, it does not project such declines for renewable energy technologies into the future.

In considering future damages from climate change, *The Climate Casino* pays scant attention to the increasing frequency and intensity of extreme weather-related events, dealing only with hurricanes but excluding floods, heat waves, droughts, fires, pest outbreaks or other extremes. The book's estimates of hurricane damages found that annual damages averaged only 0.05 per cent of the U.S. GDP since 1900 but are rising faster than GDP. The book projects that warming will increase hurricane intensity over this century, raising maximum wind speeds by more than ten per cent and average damages to 0.08 per cent of GDP, about US\$12 billion per year.

<sup>2</sup> While showing houseguests around the Yale campus, my wife found a folded \$20 bill on the sidewalk in front of the Economics Department building on Hillhouse Avenue, where Professor Nordhaus has his office.

That estimate seems overly optimistic. Studies combining Nordhaus's research into the effect of maximum wind speed on damages with estimates of sea-level rise, higher storm surges and increasing value at risk in the coastal zone found much higher expected damages. The main reason is that the small probability of an intense hurricane making landfall is offset by the much higher damages when that happens, creating a very "fat-tailed" damage probability relationship. Results for the Miami-Dade County found that the expected value of hurricane damages will rise from US\$105 billion in 2010 to US\$614 billion in 2030 (Repetto, 2012). Equally dramatic increases were found for other Atlantic coastal cities, including New York and Boston.

*The Climate Casino* suggests that coastal areas could adapt to rising risks by relocating buildings inland as their 50-year average lifetimes expire. By mid-century in Boston, my hometown, rising seas and more intense storms would lead to flooding in the 100-year event that would inundate the entire Back Bay as far as Copley Square, seven blocks inland (Kirshen et al., 2010). How the handsome century-old townhouses of this historic district, the Boston Public Library and the Old South Church, where Benjamin Franklin was baptized, could be relocated and where they might be put is difficult to imagine.

It may turn out that the book's confidence in potential adaptations is overly optimistic. Experience has shown that America and other countries adapt in reaction to disasters, not in anticipation of them. There were clear warnings before 9/11 that terrorists were planning an attack in the United States; there were clear warnings before Hurricane Katrina that the levees could not withstand a direct hit; there were clear warnings before the financial meltdown of growing risks in the financial system, but not much was done to avoid disasters. When risks are increasing, reactive adaptation provides little protection.

While rising incomes and future technologies may facilitate adaptation, some options may no longer be available. For example, *The Climate Crisis* is optimistic that farming can adapt and will actually benefit from moderate climate change, mainly because of the carbon dioxide fertilization effect. But one of the most important modes of agricultural adaptation—irrigation, which enabled food production to increase dramatically during the past century—will no longer be able to expand. Major aquifers around the world have already been depleted through overuse. The best dam storage sites are already occupied and their reservoirs are silting up. Melting glaciers and more winter precipitation falling as rain will reduce potential surface water irrigation over the course of this century. This illustrates how climate change will interact with other resource constraints.

Because of the important issues that it explores and the informative, even-handed way in which it does so, *The Climate Casino* is highly recommended. People of all backgrounds can learn much from the book about one of the most important issues we face, and Professor Nordhaus should be highly commended for writing it.

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