

A gift that keeps on giving: The contributions of Martin Weitzman to environmental economics

Robert Stavins 09 September 2019

Environmental economist Martin Weitzman passed away in August. This short intellectual biography and personal remembrance, by his long-time co-host of the Harvard Seminar on Environmental Economics and Policy, outlines how his contributions have advanced the thinking of environmental economists and policymakers on many fundamental issues, including policy instrument choice, discounting, species diversity, and environmental catastrophes. Across the board, the example of his rigorous and often ingenious work set high standards for theorising in environmental economics and thereby served to elevate the entire field.

Martin Weitzman was a treasure – a gift that kept on giving to the research and policy worlds – for Harvard, for economists around the world, and for the global intellectual community. His work as an economic theorist who addressed a broad set of problems, and as an environmental economist who during the past decade focused on climate change, was unparalleled, and formed the basis for theoretical and empirical work carried out by legions of economists and other scholars around the world. His contributions to environmental economics in particular were unprecedented, and helped to shape the field for nearly five decades.

If economic theory is about stripping a problem down to its absolute essentials, and deriving meaningful insights from those essentials, then Weitzman was a master. Over and over again, Marty Weitzman demonstrated how careful and rigorous analysis of artfully constructed theoretical models can provide valuable and often surprising insights into difficult economic problems with real implications for the design of public policies.

Marty's contributions have advanced the thinking of environmental economists and policymakers on policy instrument choice, discounting, species diversity, environmental catastrophes, and other fundamental issues. Across the board, the example of his rigorous and often ingenious work set high standards for theorising in environmental economics and thereby served to elevate the entire field.

Brief intellectual biography

Born in New York City in 1942, Marty received his BA degree in mathematics and physics from Swarthmore College in 1963, and one year later, received an MS degree in statistics

and operations research from Stanford University. In 1967, just three years after his Stanford degree, he was awarded a PhD degree in economics from the Massachusetts Institute of Technology (MIT), where his dissertation committee chair was Bob Solow. From 1967 to 1972, he taught in the Department of Economics at Yale University, then moved to MIT, where he taught in the Department of Economics until 1989, when he moved to Harvard University. He was a Professor of Economics at Harvard until 2018, when he became a Research Professor of Economics.

Economic planning

At the start of his research career, Weitzman studied centrally planned economies in a field that has all but disappeared from academic economics – comparative economic systems. It was during this early period of his career that Marty's papers with titles such as "Soviet Postwar Economic Growth and Capital Labor Substitution" (1970b) and "Iterative Multi-Level Planning with Production Targets" (1970a) appeared.

A remarkable product of his interest in how to manage a centrally planned economy efficiently was Marty's classic paper on "Prices vs. Quantities" (1974). He began this work to address the question of whether prices or production quotas would lead to more efficient outcomes in a centrally planned economy (under conditions of uncertainty), but the paper and the subsequent literature evolved to address the question of whether a price instrument or a quantity instrument will be more efficient for environmental regulation.

Although Marty began his first forays into research and writing on environmental and natural resource problems in the 1970s (some of it developing Marxian views of common property problems), it was not until the 1990s that he turned with such passion and energy to this realm, and produced one important work after another that virtually span the field. That outpouring coincided with the beginning of my collaboration with Marty, co-hosting the Harvard Seminar on Environmental Economics and Policy (more on this below).

Along the way, Weitzman carried out important research in macroeconomics and unemployment theory. One product of this – along with dozens of journal articles (inevitably in the top periodicals) – was his best-selling 1984 book, – which was eventually translated into seven languages. In this brief (167-page) book, Marty laid out his proposal for how the US economy could be protected from the dual threats of unemployment and inflation with a remarkably simple idea (a hallmark of many of his contributions) – namely, that instead of companies paying workers in manufacturing a fixed wage, they be paid through something akin to profit sharing, in particular by paying workers a significant share of company revenue.

In short, this would provide incentives for companies to continue adding workers as long as, through their work, they added to company revenues. This "novel, seemingly workable plan for equipping the economy to resist the instabilities" that had plagued it for more than a decade (Passell 1984) was labelled in the headline of a lead *New York*

Times 1985 editorial, “the best idea since Keynes”.

Policy instrument choice: Prices versus quantities

For environmental economists, Marty’s most prominent contribution is probably his classic 1974 article, “Prices vs. Quantities”, which developed the simultaneously simple and powerful insight that – under conditions of uncertainty – the expected relative efficiency of policy instruments based on prices (such as a pollution tax) versus those based on quantities (such as a cap-and-trade system) depends on the relative slopes of the expected marginal benefit and marginal cost functions.

That work remains one of the most frequently cited articles in all of environmental economics. It stimulated a massive literature, a fact that prompted Richard Newell (Resources for the Future) to characterise the work as a “gift that keeps on giving” at a symposium we held at Harvard in October 2018 to mark Marty’s retirement and celebrate his contributions”. Even now, Marty’s 1974 paper is at the core of analysis of carbon taxes versus carbon cap-and-trade systems to address climate change (Karp and Traeger 2018, Mideksa and Weitzman 2019, Stavins 2019).

Biodiversity

In the early 1990s, Weitzman responded to what he sensed might be the unwillingness – or the inability – of ecologists to rank ecologies in terms of their relative biodiversity, by producing a series of brilliant treatments of how these comparisons can be made quantitatively and rigorously: “On Diversity” (1992), “What to Preserve: An Application of Diversity Theory to Crane Conservation” (1993), “Patterns of Behavior in Biodiversity Preservation” (Metrick and Weitzman 1996), and “The Noah’s Ark Problem” (1998a). At the Harvard symposium, Charlie Kolstad (Stanford University) cited this body of work for its “significance and importance”.

Discounting

It was also in the 1990s that Marty became interested in a central issue of the economic analysis of climate change policies, namely long-term discounting. Given the long time horizons of the climate change problem, analysis of the expected net present value of alternative policies can be dominated by the choice of discount rate, which – with conventional exponential discounting – will greatly diminish the relative quantitative importance of phenomena that are decades or longer in the future.

Through careful theoretical analysis, Marty concluded that rather than a constant discount rate being employed, a rate that itself is diminishing over time is appropriate, so that benefits and costs in the near future would be subject to a typical rate, while benefits and costs further in the future would be subject to a much lower rate.

This important and influential work appeared in a series of articles, including: “On the

Environmental Discount Rate' (1994), "Why the Far-Distant Future Should be Discounted at its Lowest Possible Rate" (1998b), and "Gamma Discounting" (2001a). At the Harvard symposium, Larry Goulder (Stanford University) emphasised that this work is important "because it affects decisions as to how much we should invest in infrastructure, in mitigation, and in other realms".

Green national accounting

A topic that has pervaded decades of analysis and commentary in the environmental sphere is the reality that conventional measures of economic growth, such as gross domestic product, are not measures of welfare, since they do not account for externalities (among other non-market economic phenomena). In 1999, the National Research Council published *Nature's Numbers: Expanding the National Economic Accounts to Include the Environment*, produced by a committee chaired by Bill Nordhaus and including Marty Weitzman (Nordhaus and Kokkelenberg 1999). That was linked with several contributions that Weitzman subsequently made to the scholarly literature, including: "Does NNP Growth Indicate Welfare Improvement" (Asheim and Weitzman 2001) and "A Contribution to the Theory of Welfare Accounting" (2001b).

At the Harvard symposium, Bill Nordhaus emphasized Marty's contributions in this realm, and launched his keynote presentation, "The Intellectual Footprint of Martin Weitzman in Environmental Economics", by stating that Marty "has changed the way we think about economics and the environment". He concluded that "those who claim that environmental regulations hurt growth are completely wrong, because they are using the wrong yardstick. Pollution should be in our measures of national output, but with a negative sign, and if we use green national output as our standard, then environmental and safety regulations have increased true economic growth substantially in recent years... For this important insight we applaud Martin Weitzman, a radically innovative spirit in economics".

Fisheries

Some will be surprised to learn that a theorist such as Marty Weitzman was as immersed as he was in concerns about the real world of natural resource management and environmental protection. One example comes from his research and outreach in the realm of fisheries management. His modelling of Icelandic commercial fisheries affected thinking and discussion around the world regarding the use of taxes and quotas to regulate open-access fisheries.

As Maureen Cropper (University of Maryland) said at the Harvard symposium, "this is another example of the use of a simple model and treatment of uncertainty that really did start a conversation among fisheries economists". This application of Weitzman's previously developed theory of instrument choice was documented in his 2002 paper "Landing Fees vs Harvest Quotas with Uncertain Fish Stocks".

Fat tails

In recent years, Marty made prominent and important contributions to thinking about long-term climate change policy with his development of a theory of how positive biophysical feedback loops could lead to uncertainty about the damages of climate change that is best characterized by a probability distribution of damages with fat tails, such as a Pareto distribution, rather than a conventional Gaussian (normal) distribution. The result is greater weight being given to catastrophic (but relatively small probability) outcomes.

Speaking at the Harvard symposium, [Bob Pindyck](#) of MIT pointed to Weitzman's prescient 2007 paper, "Subjective Expectations and Asset-Return Puzzles" as having had a profound influence on Marty's subsequent modelling of catastrophic climate change. A small subset of the papers Marty published on this topic include: "On Modeling and Interpreting the Economics of Catastrophic Climate Change" (2009), "Fat-Tailed Uncertainty in the Economics of Climate Change" (2011), and "Fat Tails and the Social Cost of Carbon" (2014b).

Domestic and international climate change policy

Marty Weitzman always searched for topics for his research that were not only interesting, but also relevant and important for real-world applications. His recent work exploring alternative policy instruments to address climate change and his critical examinations of the form of international climate agreements provide telling examples of this. It was in this regard that [Jim Stock](#) (Harvard University) credited Weitzman for the "tremendous influence" his ideas have had on the formulation of public policy around the world.

Just a few of the many papers that could be cited in this context are: "Can Negotiating a Uniform Carbon Price help to Internalize the Global Warming Externality" (2014a), "A Voting Architecture for the Governance of Free-Driver Externalities, with Application to Geoengineering" (2015), and "On a World Climate Assembly and the Social Cost of Carbon" (2017). Also, of course, Marty and his former student, [Gernot Wagner](#), wrote a lucid and compelling book, *Climate Shock: The Economic Consequences of a Hotter Planet* (2015).

Theoretical foundations for empirical analyses

It should be emphasised that Marty Weitzman's theoretical work was not only important for other theorists, but also for empirical economists. In many of the realms described above, his insights were fundamental as the foundation for sound empirical analysis. As [Michael Greenstone](#) (University of Chicago) noted at the Harvard symposium, Marty's work "takes something you are kind of confused about, and then after you read it, you can't understand how in the world you were confused beforehand. It just clarifies things in a way that is really beautiful."

A remarkable scholar

Marty Weitzman was thus a real treasure – a “gift that kept on giving” – for both the research and policy worlds. His work as a theorist on environment broadly and on climate change in particular was unparalleled, and formed the basis of much theoretical and empirical research carried out by others over several decades. His work – from examining price versus quantity instruments in the early 1970s through his examinations in the last few years of the implications of fat tails in the probability distribution of possible climate damages – has changed the way economists and others think about the environment and policies to protect it.

His contributions were well recognised. He was elected a Fellow of the Econometric Society in 1976; a Fellow of the American Academy of Arts and Sciences in 1986; three times won the annual award for “Publication of Enduring Quality” from the Association of Environmental and Resource Economists; received the 20th Anniversary Prize from Fondazione Eni Enrico Mattei, the Leontief Prize, and the Eric Kempe Prize in 2011; and the John Kenneth Galbraith Award in 2013.

My greatest personal remembrance will be that I learned an immense amount from Marty by co-hosting with him for 26 years the Harvard Seminar on Environmental Economics and Policy. That’s 52 semesters involving more than 400 seminars, each with a distinct paper and presentation by a leading scholar from across the US and around the world. I found that Marty’s questions and comments were often as insightful as the speaker’s presentation.

Of course, we did not always agree. I remember our spirited discussions contrasting Marty’s strong view of the superiority of carbon taxes and my view of the relative symmetry of price and quantity instruments for climate change. Also we had some long discussions about the 2015 Paris Agreement on climate change, which Marty saw (accurately) for what it lacks, and I saw for its improvements over the international policy architecture that had preceded it. We disagreed, but were never disagreeable (and I never succeeded in changing his mind!). All in all, for three decades, I consistently learned from this remarkable scholar. He truly was a gift that kept on giving.

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