

Martin Weitzman: A Gift That Keeps on Giving

Robert N. Stavins, Gernot Wagner

THIS SPECIAL ISSUE IS A REMINDER that the world lost a truly remarkable scholar when Martin Weitzman sadly passed away in 2019. Across five decades, he explored policy options for the most challenging issues—from unemployment and inflation in the 1970s to climate change in the twenty-first century. In this article, we provide a brief biography and personal remembrance of Weitzman and describe how his contributions advanced the thinking of environmental economists,¹ and the thoughts and actions of policy makers on many fundamental issues. We conclude with a brief description of the articles that follow in this issue.

Weitzman was a treasure—a gift that kept on giving to the research and policy worlds—for Harvard University, 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 for over a 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. Weitzman's contributions to environmental economics in particular were unprecedented, helped to shape the field for nearly five decades, and as the papers in this volume show undoubtedly set the direction for many more years to come.

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, he demonstrated how careful and rigorous analysis of artfully constructed

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1. We focus exclusively on Weitzman's contributions to environmental and resource economics, which define the scope of this journal. We thereby omit his significant contributions to several other areas, including economic planning, optimal search and technological growth, and the share economy. We treat those areas in Stavins and Wagner (2022).

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theoretical models can provide valuable and often surprising insights into difficult economic problems with real implications for the design of public policies. At a symposium held at Harvard University in October 2018, to mark Weitzman's retirement and celebrate his contributions, "Frontiers in Environmental Economics and Policy: A Symposium in Honor of Martin L. Weitzman," he explained, "I'm drawn to things that are conceptually unclear, where it's not clear how to make your way through this maze." His writings were works of art as well as science, weaving Greek mythology and everyday anecdotes into his expositions like few others.

As a teacher and colleague, he left a memorable impression on many, both with his ideas and his approach to tackling some of the most important economic problems of his lifetime. He was fond of saying that the best tools of his trade were a No. 2 pencil, a yellow legal pad, and a hard, wooden chair. Across the board, the example of his rigorous and often ingenious work set high standards for theorizing in environmental economics and thereby served to elevate the entire field.

1. BIOGRAPHY

Meyer Levinger was born in New York City on April 1, 1942, to Joseph and Helen Levinger.² His mother died of tuberculosis in the boy's infancy, and his father was apparently unable to care for him after returning from military service in the Second World War. Meyer was placed in foster care and was eventually adopted by Samuel and Fannie Weitzman, elementary school teachers on the Lower East Side of Manhattan, who raised him in the planned community of Levittown, New York, renaming him Martin Lawrence Weitzman.

Despite this rather challenging start, Weitzman emerged early as a brilliant student and was valedictorian at his high school. He received his BA in Mathematics and Physics from Swarthmore College in 1963, where the *Phoenix*, the student newspaper, characterized him as discussing mathematics and politics "with the intonations of a Brooklyn garage mechanic."

Just one year after graduating from Swarthmore, Weitzman received an MS degree in Statistics and Operations Research from Stanford University and three years later earned a PhD in Economics from the Massachusetts Institute of Technology (MIT), where his dissertation committee chair was Robert Solow. From 1967 to 1972, he taught in the Department of Economics at Yale University, then moved back 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 an emeritus and research professor of economics.

He taught courses at all levels at Harvard, ranging from introductory courses for first-year students in Harvard College to seminars for PhD students. He cohosted (with

2. This biographical sketch draws, in part, on Hagerty (2019), Roberts (2019), Smith (2019), and Hart et al. (2021).

Stavins) the Harvard Seminar in Environmental Economics and Policy for 26 years, across 52 semesters involving more than 400 seminars, each with a distinct paper and presentation by a leading scholar from across the United States and around the world. Stavins found that “Weitzman’s questions and comments were often as insightful as the speaker’s presentation” (Stavins 2019b).

His research contributions were well recognized. He was elected a fellow of the Econometric Society in 1976; named 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; and received the Twentieth Anniversary Prize from Fondazione Eni Enrico Mattei, the Leontief Prize, and the Eric Kempe Award in 2011.

Weitzman was a stimulating teacher and colleague with a refreshingly contrarian attitude. He was always willing to talk at length with colleagues and particularly students. The range of his attainments took one by surprise. He was knowledgeable about many areas, including history, literature, and politics, and did not advertise, for example, that he was fluent, mostly self-taught, in Russian. But in the last few months of his life, Marty began to feel that his mental acuity was deserting him. It seems likely that this situation, which he could not bear easily, caused him to take his own life on August 27, 2019.

2. CONTRIBUTIONS TO ENVIRONMENTAL AND RESOURCE ECONOMICS

Martin Weitzman began his research career in a field that has since all but disappeared—comparative economic systems—studying centrally planned economies. In the 1990s, however, he turned with passion and energy almost exclusively to environmental and natural resource problems.

2.1. 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 nonmarket economic phenomena). Weitzman’s first foray into the topic was one of the most significant contributions to this literature. In Weitzman (1976), he developed an idealized measure of economic output net of all depreciation, including natural resources, and of environmental costs. Twenty years later, this work was validated by a major report from the National Research Council (Nordhaus and Kokkelenberg 1999). Two decades after that, at the 2018 Harvard symposium, Nordhaus emphasized Weitzman’s contributions in this realm and launched his keynote by stating that Weitzman “has changed the way we think about economics and the environment.” Nordhaus concluded that “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” (Nordhaus 2018).

2.2. Policy Instrument Choice—Prices versus Quantities

It may be difficult to identify Weitzman’s single greatest contribution to environmental economics, but his classic 1974 article, “Prices vs. Quantities,” would be at or near the top of any such list. In it, Weitzman developed the simple yet 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 to characterize it as a “gift that keeps on giving” at the Harvard symposium. Even now, the 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 2019a).

2.3. 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 showing how these comparisons can be made theoretically and quantitatively (Weitzman 1992, 1993, 1998a; Metrick and Weitzman 1996). In doing so, Weitzman taught himself and then applied set theory in ways so novel that he essentially invented the economics of species conservation.

2.4. Discounting

It was also in the 1990s that Weitzman 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 constant exponential discounting, will greatly diminish the relative quantitative importance of phenomena that are decades or longer in the future.

Through careful theoretical analysis, he concluded that rather than a constant discount rate being employed, a rate that itself is diminishing over time is appropriate. This important and influential work appeared in a series of articles (Weitzman 1994, 1998b, 2001). The last of these presented the results of a survey he sent to all members of the American Economic Association, leading to his analysis demonstrating how disagreement around the “correct” discount rate in itself points to a declining discount rate over time.

2.5. Fisheries

Some will be surprised to learn that a theorist such as 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. In part an outgrowth of his theoretical instrument choice work, Weitzman's modeling of Icelandic commercial fisheries affected thinking and discussion around the world regarding the use of taxes and quotas to regulate open-access fisheries (Weitzman 2002). 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."

2.6. Fat Tails

In recent years, Weitzman made prominent and important contributions to thinking about long-term climate change policy with his development of what he memorably termed the "dismal theorem." In typical Weitzman fashion, he taught himself Bayesian statistics, "unlearning" frequentist statistics, as he described it; he also approached the topic from the ground up, reading assessment reports from the Intergovernmental Panel on Climate Change (IPCC) cover to cover to understand climate science as thoroughly as possible.

He quickly focused on the all-important climate sensitivity parameter, which links concentrations of carbon dioxide in the atmosphere to global average temperatures. The climate sensitivity distribution has been deeply uncertain for decades. Weitzman argued that the IPCC cut off its right tail too quickly (Wagner 2019) and concluded that even without relying on "fat tails" per se and instead looking at "heavy-tailed" distributions, relatively low-probability, high-consequence outcomes may dwarf everything else. He described this as the "dismal theorem," because it emphasizes how much potential climate catastrophes do—or, at least, should—matter. A small subset of the papers include Weitzman (2009, 2011) and (2014b). It was this work that piqued his interest in domestic and international climate change policy debates.

2.7. Domestic and International Climate Change Policy

Weitzman's recent work exploring alternative policy instruments to address climate change and his critical examinations of the form of international climate agreements provide examples of continuous search for topics that were not only interesting but also relevant and important for real-world applications. Just two of the many papers that could be cited in this context include Weitzman (2014a) and (2017). During this time, Weitzman approached Wagner, his former student, to coauthor what would become a series of popular writings in major periodicals, as well as a complete book (Wagner and Weitzman 2015). The book combined ideas around "fat tails," climate risks, uncertainties, and solar geoengineering and recognized that reducing consumption of fossil fuels would be one of the most difficult challenges modern civilization has ever faced but, at

the same time, warned against complacency. Weitzman also ventured into solar geoengineering, inventing the term “free driver,” in contrast to the well-known economic concept of the “free rider,” in Wagner and Weitzman (2012) and formalizing the argument in Weitzman (2015).

3. PREVIEW OF THE SPECIAL ISSUE

The set of articles that follow in this issue are not simply related—closely or remotely—to Weitzman’s work but, rather, in nearly all cases stem quite directly from it. For example, the article by Dallas Burtraw, Charles Holt, Karen Palmer, and William Shobe starts from the important refinement by Roberts and Spence (1976) of Weitzman’s (1974) relative-slopes rule to recognize that the most efficient policy might be neither a pure (and simple) price instrument nor quantity instrument but, rather, a hybrid of the two. The authors develop an implementable instrument wherein an auction for allowances in a cap-and-trade system yields not only a price but also a quantity. Picking up on a key focus of Weitzman’s work on discounting—uncertainty regarding future economic growth—Richard G. Newell, William A. Pizer, and Brian Charles Prest develop a rule for identifying an appropriate discount rate to use in estimating a key climate policy metric, namely, the social cost of carbon.

David Anthoff and Richard S. J. Tol carry out an empirical test of Weitzman’s dismal theorem, using three prominent integrated assessment models (IAMs) that have been used to estimate the social cost of carbon. In doing so, they find that only one of the three IAMs affirms the dismal theorem, but their meta-analysis provides “qualified support.” And Christopher Costello and Matthew Kotchen directly apply Weitzman’s (1974) rule to assessing the relative efficiency of price and quantity instruments in a very different context—private provision of public goods. They find that prices are more efficient than quantities and not only with cost uncertainty (as in Weitzman’s analysis of government policies) but with benefit uncertainty as well.

Joseph E. Aldy and Sarah Armitage use Weitzman’s (1974) relative slopes rule to compare price and quantity instruments, but in addition to abatement cost uncertainty, they add firm-specific uncertainty regarding future allowance prices under a quantity instrument. The result strongly favors the price instrument option. Frances C. Moore, Arianna Stokes, Marc Conte, and Xiaoli Dong build upon Metrick and Weitzman (1996) by examining how climate change is likely to lead to greater threats to biodiversity and thereby to increases in species listing (and consequent spending) under the US Endangered Species Act. Like the 1996 work, a very significant bias emerges for vertebrate species.

4. CONCLUSION

As this special issue illustrates, Martin Weitzman’s theoretical work was important not only for other theorists but also for empirical economists. In many of the realms

we describe above, his insights were fundamental as the foundation for sound empirical analysis. Michael Greenstone noted at the Harvard symposium that Weitzman'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."

Weitzman was thus a real treasure—a "gift that keeps 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 it 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. Shortly after Marty's death, Bill Nordhaus said, "Marty Weitzman was the pre-eminent environmental economist of the modern era, which is to say of all time" (Roberts 2019).

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