

## CLI BACKGROUND PAPER NO. 12 (Executive Summary)

### Resolving the Paradoxes of Discounting

by Joseph H. Guth\*

How should we take account of the interests of future generations in a clean and healthy environment? Our prevailing framework for making such decisions is cost-benefit analysis. Within this framework, the focal point for valuing the future environment is the mathematical technique of “discounting.” This is the technique used by cost-benefit analysts to value future costs and benefits and then compare them with those that occur in the present.

Controversy continues to rage, however, over how or even whether to use this mathematical tool. Each particular method of using discounting, or not using it, has inconsistencies and can lead to perverse results. Unfortunately, despite extensive study by economists, discounting has been unable to provide a coherent approach to consistently protecting the interests of future generations.

The reasons for this difficulty originate with flaws in the cost-benefit decision-making framework itself. That framework is grounded in a set of underlying assumptions that have become outdated and out of step with the modern realities of environmental degradation. One of these assumptions is that the public welfare is served by economic activity having a net benefit, meaning activity for which the social benefits outweigh the costs, and that we should therefore seek to promote as much economic activity having a net benefit as possible. Another assumption is that the world is essentially an “empty world,” with unlimited capacity for growth in both human economic activity and the environmental damage that the economy does. Thus, our legal and economic systems apply the cost-benefit decision-making framework in an effort to promote as much growth in economic activity as possible on the assumption that both the economic benefits and the accompanying costs, including environmental damage, can grow forever.

We can now see, however, that the world is no longer an empty one. In fact, we can see that many resources that we depend on for survival, such as arable land, fresh water, and stocks of fish in the sea have become finite, even many that are renewable and once seemed inexhaustible. Perhaps even more importantly, the biosphere has a limited capacity to assimilate our environmental damage and still sustain life. Scientists are telling us that by many measures we have overshot the Earth’s ability to provide resources and assimilate our environmental damage. The inevitable result of continuing the course we are on is the destruction of the ecological integrity of the biosphere, which we need to survive.

Discounting and cost benefit analysis lead to anomalous and perverse results when applied to the distant future because the vision of endless growth in economic costs and benefits that underpin their use is being extended to very large future scales of economic growth and environmental damage. But the empty-world assumptions underlying those projections simply do not hold in that imagined future world when the world economy is thousands or even millions of times larger than today’s. Under the ecological circumstances that we now face and can foresee, we must develop a new decision-making framework for protecting the interests of future generations.

To protect the interests of future generations in an ecologically functioning biosphere, we must develop legal structures designed to constrain our cumulative environmental damage to an ecologically sustainable scale. Such new legal structures must reject our current cost-benefit decision-making framework and instead adopt a new framework

---

\* Joseph H. Guth is the Legal Director of the Science & Environmental Health Network (SEHN).

with the goal of preserving an ecologically functioning biosphere. We must prioritize the avoidance of ecological damage because it alone, unlike other forms of costs or benefits, must be capped at ecologically sustainable levels.

These new legal structures would constitute a new overarching legal principle designed to bring our economic activity into alignment with the ecological realities of life on Earth. Developing and then learning to live by such new rules of law is our central obligation to future generations.

For more extended discussion, see unabridged CLI Background Paper No. 12, next in this Appendix A of the CLI Policy Paper.

## CLI BACKGROUND PAPER NO. 12

### Resolving the Paradoxes of Discounting

by Joseph H. Guth\*

Carbon emissions, radioactive waste, and species extinctions affect not just the present but the future as well, sometimes the distant future. As our impact on the Earth mounts, the specter of the future we are creating is looming larger, becoming more insistent. The advent of global warming, especially, impresses upon us that environmental degradation is implicating not only our own welfare but also that of future generations. As we consider taking stronger steps to protect the environment, topics that may seem arcane, such as “cost-benefit analysis” and “discounting,” are being drawn into the public discourse. Discounting, it turns out, holds the key to understanding why our economic and legal systems are having such a difficult time controlling mounting long-term environmental degradation.

The prevailing framework of our legal and economic systems for making decisions that affect the economy and the environment is to compare the costs and benefits of each individual “action” or “project.”<sup>1</sup> Within this framework, the interests of future generations present a special problem because we often experience costs and benefits at different times, enjoying the benefits at one time while bearing the costs at another. The analytical issue in cost-benefit analysis, then, is how to compare costs and benefits that accrue in the future with those that accrue in the present. This comparison is handled through the mathematical technique known as “discounting.”

Controversy continues to rage, however, over how or even whether to use this mathematical tool. While there is some debate over the relative importance of future generations to our own, most analysts agree that all generations should count equally.<sup>2</sup> But as we will see, no particular way of applying discounting will always further that objective. Each particular method of using discounting, or not using it, within the framework of cost-benefit analysis has inconsistencies and can lead to perverse results. As it turns out, the answer to the question of whether discounting benefits the future or the present is: it depends.

The inability of discounting to provide a coherent approach to protecting the interests of future generations originates with flaws in the cost-benefit decision-making framework itself. The choice to base environmental decisions on cost-benefit analysis is grounded in a set of underlying assumptions that have become outdated and out-of-step with the modern realities of environmental degradation. To define our obligations to future generations, we must revisit the assumptions underlying the cost-benefit framework for decision-making at a level that is outside the narrow analytical

---

\* Joseph H. Guth is the Legal Director, Science & Environmental Health Network (SEHN); Ph.D., University of Wisconsin-Madison; J.D., New York University. He gratefully acknowledges the helpful and supportive comments of Carolyn Raffensperger and Tracy Bach, as well as the capable research assistance and comments of Katherine Moll, Vermont Law School '09.

<sup>1</sup> See Joseph H. Guth, *Law for the Ecological Age*, 9 VT. J. ENVTL. L., 431, 450–73 (2008), available at <http://www.vjel.org/index.php> (environmental statutes and common law generally presume economic activity provides net benefit to society, and permit environmental regulation or liability only where government or plaintiffs can prove otherwise); Joseph H. Guth, *Cumulative Impacts—Death-Knell for Cost Benefit Analysis in Environmental Decisions*, BARRY L. REV. (forthcoming 2008) (discussing role of cost-benefit analysis in making decisions that affect the environment); RICHARD L. REVESZ & MICHAEL A. LIVERMORE, *RETAKING RATIONALITY—HOW COST-BENEFIT ANALYSIS CAN BETTER PROTECT THE ENVIRONMENT AND OUR HEALTH*, 10, 12, 14 (Oxford Univ. Press 2008) (cost-benefit analysis ensures that government regulation increases economic efficiency, maximizes the net-benefit of regulation, and helps maximize wealth production by the economy).

<sup>2</sup> David A. Weisbach & Cass R. Sunstein, “Introduction,” *Symposium on Intergenerational Equity and Discounting*, 74 U. CHI. L. REV. 1, 1–2 (2007) (hereinafter “Chicago Symposium”) (noting most analysts agree all generations count equally).

technique of discounting. We must recognize that the new environmental realities we face require a different set of starting assumptions, and then build a new decision-making structure that makes not just discounting but cost-benefit analysis itself all but irrelevant.

## A. Discounting And Cost-Benefit Decision-Making

When performing cost-benefit analyses, most economists hold that we should place less value on benefits that are received in the future rather than in the present and, symmetrically, should prefer to incur costs in the future rather than today. The analytical means for achieving this outcome is to determine mathematically the value to us today of costs and benefits that will occur in the future. The value of future costs and benefits is reduced, or “discounted,” to obtain a “present value” of those future costs or benefits. Discounting is thus a mathematical device for reducing the value of future costs and benefits by a specified annual percentage, which is known as the “discount rate.” For example, employing a discount rate of 3% or 7% reduces the present value of future costs and benefits by 3% or 7% per year, respectively. It is theoretically possible also to employ a discount rate of zero, which would result in valuing present and future costs and benefits equally, or to use a negative discount rate, which would result in valuing future costs and benefits more highly than present ones. (Discount rates are independent of and in addition to inflation, which is accounted for separately and should be ignored in this discussion.)

Economists offer several reasons for the conclusion that future costs and benefits are worth less than those in the present. One is that they believe cost-benefit calculations should reflect the empirical fact that people have what is called a “positive pure time preference,” meaning that people actually say they prefer to receive benefits now rather than receive the same benefits in the future.

The main reasons, however, are grounded in the assumption that the economic growth experienced by Western industrial nations in the last two hundred years or more will continue indefinitely. This assumption has many implications for discounting. For example, as society becomes richer, we experience greater consumption than in the past. If this trend continues, the thinking goes, consumption of particular benefits now would be of greater marginal utility than it would be in the future when we are richer and our consumption is greater. The idea is simply that any particular cost or benefit will constitute a smaller portion of society’s total wealth, and therefore be of less marginal value, in the future than in the present.

Another, more important consequence of the assumption that economic growth will continue is the implication of an opportunity cost associated with spending resources now rather than later. Thus, the thinking goes, if we spend money to obtain particular benefits today, we will have forgone the opportunity to invest the money, let it grow in value, and then in the future have more wealth with which to purchase benefits. In effect, present benefits are thought to cost more than future benefits because when we spend money now to obtain them we lose the opportunity to use that money to obtain growth in wealth.

What about the simple idea of applying a discount rate of zero, so that future costs and benefits are deemed to have the same value as those in the present? Many economists argue that this would lead to numerous “anomalies.” Consider, for example, actions we take today that will permanently affect all future generations, such as causing species losses or perhaps global warming. The total cost of all those future losses, accruing for thousands or millions of years, could be vast. Without discounting those vast future costs, cost-benefit analysis would seem to justify extensive immediate expenditures to avoid them. But some economists view this outcome as clearly unreasonable and as constituting an anomaly, for “not even Greenpeace” would want to incur such large costs today.<sup>3</sup> A second cited anomaly

---

<sup>3</sup> Richard A. Posner, *Efficient Responses To Catastrophic Risk*, 6 CHI. J. INT’L L. 511 (2006).

is that using a discount rate of zero would motivate us always to defer expenses that would create future benefits and therefore cause us to purchase fewer benefits today rather than more. This is because, according to the theory, if we defer an expense, we can invest the resources and then have a larger amount later to create an even larger stream of benefits extending into the future, especially because likely technological improvements will make solution of problems cost less in the future.<sup>4</sup> If future benefits are really worth just as much as today's, the thinking goes, we should wait until our resources grow so we can obtain that larger stream of future benefits. Thus, many economists argue, failing to discount future benefits and costs leads to various perverse results by, at root, failing to account properly for the opportunity cost of the resources being spent (which assumes, of course, that we would actually invest the unspent resources and set them aside for such purposes).<sup>5</sup>

Following these lines of reasoning, many economists conclude that the best option is to use some positive discount rate, though the exact rate to use is a subject of tremendous controversy. A survey in 2001 of 2,160 economists found that they would apply a discount rate to long-term environmental problems, with the most common discount rate chosen in the survey of 2%, a median rate of 3%, and mean of 4%.<sup>6</sup> The U.S. Office of Management and Budget (OMB), in implementing Executive Order 12866, requires that all government agencies discount future costs and benefits in designing significant regulations whenever the law allows.<sup>7</sup> In fact, the OMB recommends that agencies perform two separate analyses of their regulations, one using a 3% discount rate and one employing a 7% discount rate. The 7% rate is the average before-tax rate of return to private capital in the U.S. economy, which the OMB believes approximates the opportunity cost of capital and to be appropriate whenever a regulation displaces the use of capital by the private sector.<sup>8</sup> The 3% rate is the historical real rate of return on long-term government debt, which the OMB believes approximates the social preference for present consumption over future consumption and to be appropriate whenever a regulation primarily affects private consumption (*e.g.*, by affecting the price of consumer products).<sup>9</sup> In some circumstances, the OMB believes a higher rate of 10%<sup>10</sup> or sometimes a rate below 3%<sup>11</sup> could be appropriate and recommends regulatory agencies consider these as well. In a recent example, the U.S. Environmental Protection Agency

---

<sup>4</sup> W. Kip Viscusi, "Rational Discounting For Regulatory Analysis," *Chicago Symposium*, *supra* note 2, at 209, 216–17 (2007) (outlining "anomalies" caused by failure to discount).

<sup>5</sup> Cass R. Sunstein & Arden Rowell, "On Discounting Regulatory Benefits: Risk, Money and Intergenerational Equity," *Chicago Symposium*, *supra* note 2, at 171, 175–78 (2007) (outlining objections to failure to discount); Douglas A. Kysar, "Discounting . . . on Stilts," *id.* at 118, 122–24 (criticizing as unlikely the assumption that we would ever actually make and set aside for future use the investments in man-made capital that discounters make to justify depletion of natural capital).

<sup>6</sup> See Geoffrey Heal, "Discounting: A Review of the Basic Economics," *Chicago Symposium*, *supra* note 2, at 59, 72 (2007) (discussing 2001 survey of economists reported in Martin L. Weitzman, *Gamma Discounting*, 91 AM. ECON. REV. 260, 266–69 [2001]).

<sup>7</sup> The Office of Management and Budget, *Regulatory Analysis*, OMB CIRCULAR A-4, at p. 32 (Sept. 17, 2003), available at <http://www.whitehouse.gov/omb/circulars/a004/a-4.pdf> (hereinafter "OMB, 'Regulatory Analysis'"). See also John D. Graham, "Valuing the Future: OMB's Refined Position," *Chicago Symposium*, *supra* note 2, at 51, 51–57 (2007) (discussing OMB, "Regulatory Analysis," various discount rates and when they should be used). Extensive ongoing evaluation of regulations under Exec. Order No. 12,866 by the Office of Information and Regulatory Affairs (OIRA), an office within OMB, both before they are promulgated and after they issue is reflected in OMB's Annual Reports to Congress on the Costs and Benefits of Federal Regulations (*compiled at* <http://www.whitehouse.gov/omb/legislative/index.html>). See also REVESZ & LIVERMORE, *supra* note 1, at 21–45, 151–69 (providing history of Executive Order 12866 and of OIRA and OMB influence over administrative agencies, especially including the EPA).

<sup>8</sup> OMB, "Regulatory Analysis," *supra* note 7, at 33.

<sup>9</sup> *Id.*

<sup>10</sup> *Id.* at 34.

<sup>11</sup> *Id.* at 36.

(EPA) calculated the costs and benefits of a Clean Air Act regulation using both a 3% and 7% discount rate.<sup>12</sup> Analysts who have examined agency compliance with the OMB guidelines on discounting find that recent agency cost-benefit analyses frequently employ discounting, though in varying, sometimes inconsistent ways.<sup>13</sup>

The outcome of cost-benefit-driven decisions is highly dependent on the exact discount rate chosen. For example, a 2006 report from the British Treasury, *The Stern Review on the Economics of Climate Change*, found that global warming would impose large costs on the future, warranting substantial immediate preventive action.<sup>13</sup> This conclusion differed dramatically from that of other economists who have found that global warming justifies only modest action now. The difference was driven by Sir Stern's choice of a very low positive discount rate (less than 1%) rather than the higher rate used by other economists.<sup>14</sup> Thus it is that recommendations by economists on critical issues such as whether society should take immediate action on climate change to protect the Earth can turn on their choice of a discount rate!

Though many economists seem to agree that we should use positive discount rates, the use of any positive discount rate over long time periods can produce its own set of anomalies. Some writers have referred to use of discounting as “shrinking the future,” for discounting at any positive rate inevitably makes any effect of our actions on the distant future, even very large impacts, seem insignificant compared to effects in the present.<sup>15</sup> For example, discounting at a rate of 5% per year reduces any future value by a factor of 131 in 100 years and by a factor of over 39 billion in 500 years.<sup>16</sup> Thus, a dollar's worth of benefits today can be made to appear to be worth more than millions or even billions of dollars of damage in the future. Saving one life today can be made to seem to be worth more than the discounted value of saving billions of people in the future.<sup>17</sup> The entire global economy of the several centuries in the future can be discounted to just two dollars per person today.<sup>18</sup> Or, as we have seen, the future devastation of global warming can appear to be worth taking little action to avert today.

Projecting streams of costs and benefits into the future also brings into sharp relief the distributional questions of who gets the benefits and who bears the costs. Numerous difficult conflicts of interest exist not just between current and future generations but also between rich and poor societies and the rich and poor members of particular societies. These divisions become more or less acute depending on the growth path that the economy takes, and the choice of a discount rate for particular costs and benefits can influence the shape of this path.<sup>19</sup>

<sup>12</sup> Clean Air Interstate Rule, Environmental Protection Agency, 70 FED. REG. 25162 (May 12, 2005).

<sup>13</sup> Viscusi, *supra* note 4, at 224–26 (analyzing use of discounting by regulatory agencies).

<sup>14</sup> For discussion disapproving the near-zero discount rate used in Stern Review and analysis of alternative approaches, see WILLIAM A. NORDHAUS, QUESTION OF BALANCE—WEIGHING THE OPTIONS ON GLOBAL WARMING POLICY 9–11, 59–62, 165–191 (2008) (proofs available at [http://nordhaus.econ.yale.edu/Balance\\_2nd\\_proofs.pdf](http://nordhaus.econ.yale.edu/Balance_2nd_proofs.pdf)).

<sup>15</sup> See FRANK ACKERMAN & LISA HEINZERLING, PRICELESS—ON KNOWING THE PRICE OF EVERYTHING AND THE VALUE OF NOTHING 179–203 (2004).

<sup>16</sup> Tyler Cowen, “Caring About the Distant Future: Why It Matters and What It Means,” *Chicago Symposium*, *supra* note 2, at 5, 8 (2007).

<sup>17</sup> Sunstein & Rowell, *supra* note 5, at 176 (quoting Frank Ackerman & Lisa Heinzerling, *Pricing the Priceless*, 150 U. PA. L. REV. 1553, 1571 (2002)).

<sup>18</sup> See Paul R. Portney & John P. Weyant, *Introduction*, in DISCOUNTING AND INTERGENERATIONAL EQUITY 1, 5 (Paul R. Portney & John P. Weyant, eds., 1999) (hereinafter “DISCOUNTING AND INTERGENERATIONAL EQUITY”).

<sup>19</sup> See Matthew D. Adler, “Economic Growth and the Interests of Future (and Past and Present) Generations: A Comment on Tyler Cowen,” *Chicago Symposium*, *supra* note 2, at 41, 41–49 (2007) (analyzing different kinds of economic growth on the welfare of society).

These issues give many economists pause. As the organizers of a discounting workshop involving twenty leading economists put it:

[I]t is impossible to read these papers without getting a sense of the unease even the best minds in the profession feel about discounting, due to the technical complexity of the issues and their ethical ramifications. This unease is expressed most directly by [Nobel Prize winner] Robert Solow. In his foreword, he writes, “Maybe the idea of a unitary decision maker—like an optimizing individual or a wise or impartial advisor—is not very helpful when it comes to choice of policies that will have distant future effects about which one can now know hardly anything.”<sup>20</sup>

Nevertheless, economists and lawyers continue to struggle to find ways to manage the various paradoxes, inconsistencies, and troubling results that spring from relying on discounting to evaluate our impacts on the future. For example, debate continues to rage over the “correct” discount rate, and the range of options only grows as the economists struggle. Besides all the rates discussed already, suggestions have emerged that the empirical evidence supports use of different discount rates for projects involving different time frames, ranging from 15 percent (5 years) to 5 percent (30 to 50 years) down to 2 percent (100 years).<sup>21</sup> Some have suggested “hyperbolic discounting” in which the discount rate is not constant but varies over the time period involved<sup>22</sup> while others insist the same discount rate should be applied to all generations.<sup>23</sup> Negative discount rates have been suggested for some circumstances.<sup>24</sup> One prominent commentator argues that because the evidence from our political system shows that Americans place little value on future generations, they should not be considered at all and the discount rate for long time periods should effectively be infinite.<sup>25</sup>

Economists also struggle over the discounting of future human lives and health when they can be protected by environmental health regulations. Those who object to this sort of discounting argue that lives in the future are worth just as much as lives today, and so should not be discounted. After all, they point out, people cannot be put in a bank where they would somehow “grow” like money can.<sup>26</sup> Others object that the evidence does not show that people discount future lives and health in the same way they do money and other forms of consumption, and especially not across generations and into the future.<sup>27</sup> Yet those who support discounting future lives and health are not convinced, and argue that what is being discounted is not really lives and health but the underlying expenses needed to save them, so that a failure to discount the benefits of lives and health, while discounting the money spent to obtain those benefits, leads to various paradoxes as well.<sup>28</sup> The OMB insists that future human health-related benefits and costs should be discounted

---

<sup>20</sup> Portney & Weyant, *supra* note 18 (introducing volume collecting workshop papers). *See id.* at 6–7 (discussing discomfort many economists feel with distributional implications of different forms of discounting).

<sup>21</sup> Heal, *supra* note 6, at 68–69.

<sup>22</sup> Maureen Cropper & David Laibson, *The Implications of Hyperbolic Discounting for Project Evaluation*, in DISCOUNTING AND INTERGENERATIONAL EQUITY, *supra* note 18, at 163, 163–72.

<sup>23</sup> Viscusi, *supra* note 4, at 209–46.

<sup>24</sup> Partha Dasgupta, Karl-Goran Maler & Barrett, Scott, *Intergenerational Equity, Social Discount Rates, and Global Warming*, in DISCOUNTING AND INTERGENERATIONAL EQUITY, *supra* note 18, at 51, 51–77.

<sup>25</sup> Richard A. Posner, “Agencies Should Ignore Distant Future Generations,” *Chicago Symposium*, *supra* note 2, at 139, 139–40.

<sup>26</sup> ACKERMAN & HEINZERLING, *supra* note 15, at 191.

<sup>27</sup> THOMAS O. MCGARRITY, SIDNEY SHAPIRO & DAVID BOLLIER, SOPHISTICATED SABOTAGE—THE INTELLECTUAL GAMES USED TO SUBVERT RESPONSIBLE REGULATION 183–89 (2004), quoting Lisa Heinzerling, *Discounting Our Future*, 34 LAND & WATER L. REV. 39 (1999); Kysar, *supra* note 5, at 121–22; Richard L. Revesz, *Environmental Regulation, Cost-Benefit Analysis, and the Discounting of Human Lives*, 99 COLUM. L. REV. 941, 1015 (1999).

<sup>28</sup> Sunstein & Rowell, *supra* note 5, at 174–78.

in designing government regulations. This is, according to the OMB, because people prefer health gains now to identical gains in the future and because discounting the money spent for health gains but not the health gains themselves would have the perverse result of leading us to perpetually defer the expenses, invest the money, and have more to spend on obtaining greater health gains later.<sup>29</sup>

We have seen that discounting minimizes the apparent importance of serious future environmental degradation, even when it threatens the planet and ultimately human survival. Patches for this inconvenience, too, have been proposed, including the suggestion that discounting be somehow adjusted or eliminated where the impacts are “catastrophic” and “irreversible,” with various examples including global warming, species loss, uranium leaks out of containment ponds, ozone depletion, or hazardous waste leaching into ground water.<sup>30</sup> But exactly which environmental impacts should be designated for such exceptional treatment and how to make decisions in those cases remain to be developed.

Surveying this dismal landscape, some analysts have challenged the enterprise of relying on discounting to account for our obligations to future generations. For example, Professor Richard Revesz argues that discounting across multiple generations is unethical for it unavoidably privileges the current generation; whatever reasons a person might use to make cost-benefit tradeoffs in his or her own lifetime do not apply across generations and so cannot justify discounting across generations.<sup>31</sup> Professor Revesz urges that determining our responsibilities to future generations must move from debates over discounting to other kinds of explicitly ethical debates, including frank consideration of distributional issues in the present and the future and prevention of catastrophic environmental harms and destruction of unique natural resources.<sup>32</sup> Similarly, noting that “absurdities” can be constructed either by discounting or not discounting<sup>33</sup> and that neither will always benefit future generations, Professor Cass Sunstein and Arden Rowell urge:

It follows that the moral obligations of current generations should be uncoupled from the question of discounting, because neither discounting nor refusing to discount is an effective way of ensuring that those obligations are fulfilled. The moral issues should be investigated directly, and they should be disentangled from the practice of discounting.<sup>34</sup>

This is a step in the right direction. But the question remains: why is it that discounting in cost-benefit analysis is unable to produce any coherent approach to the protection of future generations (whatever particular ethical stance we take on that question)? What is the reason for the “absurdities” and “paradoxes” that so trouble economists and lawyers alike? Until we understand this, we will remain unable to develop any coherent alternative structure for making decisions that affect future generations, and will continue struggling with exceptions, patches, and fixes for cost-benefit analysis. I believe the answer is clear. When a theoretical construct leads to excessive complexity and paradoxical conclusions, we should look to the assumptions lying at the foundation of that construct. The baffling debates over discounting remind one of nothing so much as the intricate Ptolemaic system of epicycles that was necessary to explain observed planetary motions while retaining Aristotle’s conclusion that the Earth is at the center of the solar system. Surely an enduring lesson

<sup>29</sup> OMB, “Regulatory Analysis,” *supra* note 7, at 34.

<sup>30</sup> ACKERMAN & HEINZERLING, *supra* note 15, at 185–86; Sunstein & Rowell, *supra* note 5, at 189, 204–05, n.77; Posner, *supra* note 3, at 511.

<sup>31</sup> ACKERMAN & HEINZERLING, *supra* note 15, at 187.

<sup>32</sup> Revesz, *supra* note 27, at 1015–18.

<sup>33</sup> Weisbach & Sunstein, *supra* note 2, at 1–2 (noting that “absurdities” are created by both discounting and not discounting).

<sup>34</sup> Sunstein & Rowell, *supra* note 5, at 199. *See also* Kysar, *supra* note 5, at 120 (expressing hope that after publication of papers from 2006 Symposium those interested in long-term policymaking will be able to put discounting aside and “focus instead on the more important task of conceiving and realizing equitable relations between human generations”).

of the history of the human search for truth is that if ever more detailed analysis governed by a set of starting assumptions leads only to paradoxes and confusion, then those starting assumptions are certain to be wrong. Resolution of the paradoxes of discounting requires stepping back, out to the level of thought at which starting assumptions are made. Just as Copernicus reexamined the Aristotelian starting assumptions to solve the mystery of planetary motions, we must reexamine the assumptions that underlie the legal and economic theories that lead us to cost-benefit analysis and discounting.<sup>35</sup>

## **B. The Endless-Growth Assumptions Underlying Cost-Benefit Decision-Making**

Former World Bank economist Herman Daly has described what he calls the “pre-analytic vision,” the set of starting assumptions, that mainstream economics is built upon.<sup>36</sup> According to this vision, our economic and legal systems assume that the human economy will grow forever, and indeed our society’s overriding macroeconomic goal is to ensure permanent economic growth. No limit is envisioned to the total size of the economy or the scale of the use of material and ecological resources. While some resources are obviously limited, it is thought that we can overcome such limits by substituting either other natural resources or human capital and technology for all forms of natural capital, including both resources (like oil and fisheries) and pollution sinks (like air and water). Even valuable resources and pollution sinks may be exhausted, for as they become scarce and therefore expensive, we will be motivated to find substitutes which, it is assumed, we will always be able to do. Though the market may contain no prices for many natural resources that are in fact of great value (clean air, wildlife, wetlands) and therefore can lead only to their exhaustion, these market flaws are not thought to be serious enough to disrupt the overarching vision. Environmental assets like clean air and water are viewed as “amenities” that we can obtain whenever we feel we can afford them. Thus, this economic vision presumes, all the various portions of the biosphere can and should be liquidated whenever the market justifies it.

Thus, the market contains no means for preventing the exhaustion of valuable resources, and the law governing this market contains no general principle of ecological preservation. They are structured around the assumption that there is nothing that we must have, nothing we can’t learn to live without, nothing we can’t replace with human-made capital. In short, we are without market or legal constraints on the total scale of ecological damage because our starting assumption is that we don’t need them.

One can see how adopting this pre-analytic vision leads to an exclusive reliance on cost-benefit analysis to guide decision-making. For if the human economy (including both costs and benefits) can grow forever, and if there is no reason to value any particular element of the natural world other than for its worth in an unfettered market, then it would stand to reason that all we need to do to promote human welfare is ensure that each activity has a net benefit, and develop as much such activity as possible. Preservation of any portion of the environment can be viewed as an “investment” that must compete with investment in other elements of the human economy. Every portion of the Earth, and even the entire Earth, can be viewed as no more important than a fungible part of the larger human economy that steadily becomes, as the economy grows forever, an ever smaller fraction of that economy until, in the distant future, it seems to disappear all together. And as we pursue endless growth in economic activity having a net benefit, we need not be too concerned with the cumulative costs, including cumulative ecological damage, for according to this vision each increment of damage must be worth the accompanying benefits. We can choose to obtain environmental “amenities” whenever we decide we can afford them, if not now then later when we are richer and can trade for them with our other

---

<sup>35</sup> Economist Herman Daly has noted the resemblance between ad hoc elements of current neoclassical economic theories and the system of epicycles once needed to explain astronomical observations. See HERMAN E. DALY, *BEYOND GROWTH* 34 (1996).

<sup>36</sup> For a detailed presentation and critique of these assumptions of mainstream, neoclassical economics, see *id.* See also HERMAN E. DALY & JOSHUA FARLEY, *ECOLOGICAL ECONOMICS* 15, 35, 223–44 (2004).

forms accumulated capital. Those sensitive souls who mourn the losses must simply have insufficient appreciation for the greater gains we surely are obtaining.

Now this set of assumptions seemed reasonable, no doubt, a century or two ago as our current legal and economic structures were being put in place, when the human enterprise was but a fraction of what it is today. In that “empty” world, with comparatively few people living low-impact lives surrounded by seemingly boundless resources and pollution sinks, it might very well have seemed that costs and benefits could grow without restraint. For that is the path our society embarked upon in its pursuit of industrial progress. What is happening in today’s discounting debates is that the vision of endless growth in economic costs and benefits is being extended from the empty world that gave it birth far out in time and to very large scales of economic growth. And there are paradoxes abound.

When the troubling implications of large-scale future ecological degradation arise in the discounting literature, authors often revert to reminders of the endless-growth assumptions upon which the cost-benefit decision-making enterprise rests, for the commitment of modern economic thought to those assumptions is profound. For example, John Graham, the leader of the OMB’s approach to regulatory analysis during much of the last decade, recently has written that U.S. regulatory analysts should always assume that they are evaluating small projects with no economy-wide implications:

That is because (a) the U.S. economy is only one part of a huge and growing world economy, and (b) a single regulation is rarely expected to have a discernible impact on the overall growth path of the U.S. economy. Even in the case of policies to address global climate change, we should not assume that general equilibrium approaches to analysis [of the entire economy] will be required. The U.S. economy, for example, is far less sensitive to changes in energy prices than it was thirty or fifty years ago. Moreover, climate change policies that have a significant impact on the overall U.S. economy are not likely to be politically feasible.<sup>37</sup>

Professor Cass Sunstein and Arden Rowell, who we have seen are troubled enough by the discounting debates to suggest that our moral obligations to future generations should be “uncoupled” from questions of discounting, nevertheless are unable to offer a real alternative because they can’t help reverting to endless-growth assumptions:

Some people believe that current generations are obliged not to make the environment worse than it is today. On this view, current generations are environmental trustees. As such, they must follow a kind of environmental nondegradation principle. But there is a problem with this position, which is its selective focus on environmental quality. Suppose that the current generation sacrifices a remote island, but that as a direct result of that action, it is able to confer significant economic, medical, and other benefits on posterity, giving them healthier, longer, and better lives. Is it so clear that the sacrifice is morally unacceptable?<sup>38</sup>

Though these same writers support the notion of preserving the environment when “irreversible” environmental change is implicated, they caution against taking this idea too far, again unable to escape endless-growth assumptions:

But environmental protection can burden the future too, especially if it is extremely costly, and there is no abstract reason to believe that preserving a particular environmental amenity (a forest, a lake) is

---

<sup>37</sup> Graham, *supra* note 7, at 54–55 (citations omitted).

<sup>38</sup> Sunstein & Rowell, *supra* note 5, at 200.

always better for posterity than other investments that do not involve the environment in particular (expenditures on basic research, reductions in national debt).<sup>39</sup>

Similarly, Professor Revesz, who as we have seen suggested a set of ethical principles to inform our obligations to future generations in place of debates over discounting, cannot disengage from endless-growth assumptions when it comes to the global environment. When considering the idea of sustainable development and environmental preservation, he seems compelled to consider hypotheticals involving environmental impacts in isolation, and concludes that “it does not make sense to undertake environmental expenditures for the benefit of future generations if the investment can yield higher benefits elsewhere.”<sup>40</sup> The best he can offer, on the environment at least, is that we might “seek to prevent catastrophic harms and the destruction of unique natural resources,” though defining those, he admits, may be “hard.”<sup>41</sup>

### C. The Source of the Discounting Paradoxes

We need to reexamine our assumptions about the human need for functioning ecological systems. If we are to live long and well on the Earth, we should ground these assumptions not in abstract economic theories, but in biology, in a scientific understanding of the human dependence on the biosphere, and in the reports of scientists on what is actually happening to the Earth in our time.<sup>42</sup> As the summary of the United Nations 2005 Millennium Ecosystem Assessment Synthesis begins: “Everyone in the world depends completely on Earth’s ecosystems and the services they provide, such as food, water, disease management, climate regulation, spiritual fulfillment, and aesthetic enjoyment.”<sup>43</sup>

Earth’s biosphere seems almost magically suited to human beings and, indeed, it is, for we evolved through eons of intimate immersion within it. The air we breathe, the land we live on, the water we drink, the food we eat are all elements of a functioning biosphere that is itself the product of evolution, that was not always present on the Earth, and that we have no reason to believe must always be here. Deep in the past, the Earth, like the other planets we can see, was completely uninhabitable by us, and so it can become again. We cannot live without the functioning biosphere now sustaining us on the Earth, and so it is worth everything we have to preserve it.

As we look around us now, this biosphere suddenly appears as no more than a thin film on the surface of the Earth. Many resources that we depend on for survival, such as arable land, fresh water, and stocks of fish in the sea have become finite, even many that are renewable and once seemed inexhaustible. Perhaps even more importantly, the biosphere has a limited capacity to assimilate our environmental damage and still sustain life. It has a finite physical size, containing only so much air, water, and land for all of life to share. This means that environmental damage becomes concentrated as it accumulates within the biosphere’s finite physical volume. Moreover, because the various constituents of the biosphere, both living and nonliving, are so deeply interdependent, the various forms of damage interact, each compounding the effects of the others. Finally, the time scale on which life evolves is immense, so that depletion of species and ecosystems is essentially permanent for us. As a result, our ecological damage is cumulative, not just in space but also in time, as the generations pass.

---

<sup>39</sup> *Id.* at 205.

<sup>40</sup> Revesz, *supra* note 27, at 1015.

<sup>41</sup> *Id.*

<sup>42</sup> The following passages are adapted from Joseph H. Guth, *Law for the Ecological Age*, *supra* note 1.

<sup>43</sup> UNITED NATIONS MILLENNIUM ECOSYSTEM ASSESSMENT 2005, ECOSYSTEMS AND HUMAN WELL-BEING: SYNTHESIS I (2005). The Millennium Ecosystem Assessment was an evaluation of the world’s ecosystems and human well-being carried out between 2001 and 2005 under the auspices of the United Nations by over 2,000 people including 1,360 experts from 95 nations (*id.* at ii–ix). The reports are available at <http://www.millenniumassessment.org/en/index.aspx>.

The Earth and its interdependent ecosystems can assimilate on a permanent basis only a maximum rate of ecological damage without becoming biotically impoverished, with a decreased ability to sustain life itself, including us. Once we overshoot this assimilative capacity, we must inexorably diminish and eventually devastate the biosphere.

Has our cumulative rate of environmental damage already surpassed the Earth's ecologically sustainable assimilative limits? The reports of scientists are clear. In 2005, a study compiled by over 2,000 scientists from 95 countries concluded that 60% of global ecosystem services were being degraded or used unsustainably, including fresh water, capture fisheries, air and water purification, and the regulation of regional and local climate, natural hazards, and pests. In its most recent report, involving over 400 scientists and policy-makers, the United Nations Environment Programme (UNEP) concluded that current environmental trends threaten human development and imperil our overall well-being, including climate change, indoor and outdoor pollution, land degradation, decreasing supplies of fresh water, reduction of fish stocks, and accelerating species extinction rates.<sup>44</sup> Human activities are now crossing thresholds of sudden irreversible changes, causing collapse of fisheries, dead zones in the sea, regional climate change, and loss of species, and it is difficult to know exactly where other thresholds lie or when they will come upon us.<sup>45</sup> By some detailed estimates, humanity reached and surpassed the Earth's sustainable biocapacity in the 1980's and is continuing to grow beyond it.<sup>46</sup> UNEP also concluded that humanity is overusing the ecological resources of the Earth and that this overshoot is degrading many elements of the environment.<sup>47</sup> Similar extensive degradation of ecosystems across the United States has been documented as well.<sup>48</sup>

We should harbor no doubts that we can outgrow the limits of the Earth. History already shows us this. Scientists have shown that many past civilizations have used their resources unwisely, outgrown them, and collapsed.<sup>49</sup> This continues today as communities deplete the resources upon which they have long depended and then decline or move away, having overused their means of survival and being unable to somehow invent a new one. The notion that we can always adapt, always substitute technology or new resources for those that we deplete, always move on, that there is no part of the Earth that we truly need, is hubris. This idea does not derive from science or history. It is a fantasy of the economist's imagination, made necessary by the hopes for endless growth of costs and benefits.<sup>50</sup> It is a thin reed upon which to hang the fate of humanity.

As a matter of simple logic, it must be true that as environmental damage grows forever in a finite biosphere, it must inevitably reach and then surpass the rate of ecological damage that the Earth can assimilate indefinitely. Since we cannot live for long once we exceed this scale of ecological degradation, we must regard the cumulative cost of such

---

<sup>44</sup> United Nations Environment Programme, Fourth Global Environment Outlook: Environment for Development (GEO-4), at 6 (2007), available at <http://www.unep.org/geo> (hereinafter "GEO-4").

<sup>45</sup> *Id.* at 362–63.

<sup>46</sup> WORLD WILDLIFE FUND, LIVING PLANET REPORT 2006, available at [http://www.panda.org/news\\_facts/publications/living\\_planet\\_report/index.cfm](http://www.panda.org/news_facts/publications/living_planet_report/index.cfm).

<sup>47</sup> GEO-4, *supra* note 44, at 202, Box 6.1 ("Increasing Demand, Diminishing Global Natural Resources"), available at <http://www.unep.org/geo>.

<sup>48</sup> REED, F. NOSS, EDWARD T. LAROE III & J. MICHAEL SCOTT, ENDANGERED ECOSYSTEMS OF THE UNITED STATES: A PRELIMINARY ASSESSMENT OF LOSS AND DEGRADATION (National Biological Service, U.S. Dept. of the Interior, 1995) (unpaginated report), available at <http://biology.usgs.gov/pubs/ecosys.htm>.

<sup>49</sup> *See generally*, JARED DIAMOND, COLLAPSE: HOW SOCIETIES CHOOSE TO FAIL OR SUCCEED 18–19 (2005).

<sup>50</sup> Some progressive economists have strongly criticized the endless-growth assumptions that the economy can grow forever and that man-made capital is infinitely substitutable for natural capital, and argued that we must have policy interventions if we are to ensure that we pass a legacy of natural capital on to future generations. *See, e.g.*, DALY, *supra* note 35; DALY & FARLEY, *supra* note 36, at 15, 35, 223–44; Kysar, *supra* note 5, at 126–28.

degradation as immeasurable. Under conditions of ecological overshoot, cost-benefit analysis can no longer be used to justify individual increments of environmental damage. Each incremental impact, if taken alone, might cause little or even no harm at all in an empty world. But under conditions of overshoot each increment of damage contributes to an immeasurable, indeed infinite, loss. The cumulative loss, once infinite, cannot be meaningfully allocated among the various increments of damage. Once we are degrading the environment at an unsustainable rate, attempting to justify increments of damage using cost-benefit principles is profoundly misguided and represents a denial of the biological realities of life on Earth.

Thus we see the source of the paradoxes and anomalies that result from extending endless-growth assumptions into the distant future and to very large scales of economic growth. In several centuries or more, the endlessly growing economy of the discounting hypotheticals would be thousands or even millions of times larger than today's. Under our current market structure, with no additional legal intervention designed to preserve the environment, the human footprint of such a future economy would be vastly larger than today's, assuredly beyond the Earth's ecologically sustainable limits. The biosphere does not grow along with the economy in its ability to accommodate this footprint. It does not steadily grow new lakes, forests and species to endlessly satisfy our growing use of the Earth. Though discounting may make a sacrificed forest or lake seem mathematically to shrink to nothing in the distant future, the physical reality of the loss remains unchanged forever. Though a few elements of the biosphere may seem like amenities that we can recover if we desire, such as air free of short-lived pollutants, most elements even if renewable can be permanently depleted. For the most part, in the future we will not be able to decide to reconstitute the soils, productive oceans, lakes, forests, and species that we thought we were too poor to save in the past, for once sacrificed they will be irretrievably lost forever. In such a future world, the various empty world assumptions (that all our projects are small and do not affect the world as a whole, that we can sacrifice every lake, forest, and other element of the environment for some other gain, that we should not make environmental investments because other investments would produce more value) would stand revealed as utterly senseless.<sup>51</sup>

The resolution to the paradoxes of discounting, then, is this: while each small part of the ecologically functioning biosphere may seem dispensable for some finite gain, the entire biosphere, though finite and composed only of these small parts, is nevertheless indispensable. We can sacrifice any of the individual parts, but we cannot sacrifice the whole. An increment of environmental damage that seems affordable now cannot be projected at that value (or at a discounted lesser value!) into a distant future where the total cost of the cumulative increments of damage will have become infinite. An economy that sells off bits and pieces of the Earth without means for recognizing they are parts of an invaluable whole cannot be projected into a future where that economy is assumed to grow forever. While in an empty world individual portions of the biosphere might be viewed as fungible, ever-shrinking fractions of the ever-growing human economy, this assumption cannot be extended to the Earth as a whole.

#### **D. Toward A New Pre-Analytic Vision and Environmental Decision-Making Structure**

Because it is based on an outdated pre-analytic vision, our cost-benefit structure for making environmental decisions must be discarded. No rate of discounting, whether positive, negative, zero or variable, can mold that structure into a form that can manage large-scale ecological degradation. Regardless of how discounting is employed, that structure remains saddled always with the paradox inherent in attributing definite and finite values to individual increments of environmental damage, and then projecting endless growth of such damage onto a finite biosphere.

---

<sup>51</sup> See Kysar, *supra* note 5, at 129 (arguing that the assumption that all our projects are small can lead to an intolerable result if applied individually to a series of small projects across the economy, noting that global fisheries depletion is the result of cumulative "local" fisheries collapses).

Instead, we must form a new pre-analytic vision comprising a new set of starting assumptions. We must accept the message from the scientific community about the full world that has come upon us: the growing cumulative impact of the human footprint is threatening the ecological integrity of the biosphere that we need to survive and prosper.

The law must incorporate this reality into a new framework for making environmental decisions. As its most essential feature, a new framework should adopt the goal of maintaining an ecologically functioning biosphere by restraining the cumulative impact of our environmental damage to an ecologically sustainable scale.

To be sure, we cannot live without having some impact on the environment and we should permit our economy to continue to develop and improve human welfare. But we need the law to prevent the developing economy from undermining the ecological systems that the public welfare depends so profoundly upon.<sup>52</sup> Such a legal structure would build on the instincts of many cost-benefit analysts to exempt “catastrophic” and “irreversible” environmental problems from discounting, but it would recognize that the ecological threat we face results from myriad small impacts and not just a handful of special cases.

This reorientation would constitute a dramatic evolution of the law. And yet, legal structures capable of restraining cumulative environmental impacts do exist, and in fact have long existed in American law. The lesson from these examples is that the law should establish a standard of environmental or human health necessary for the long-term public welfare, and then defend that standard from being invaded by the accumulation of small impacts.<sup>53</sup>

Examples of this legal approach can be found in old common law rules grounded in the ancient principle of “do no harm” under which the law was able to protect such interests as the public’s right to navigable waters from being interfered with by industrial discharges from numerous sources.<sup>54</sup> Examples can also be found in the modern federal environmental statutes under the Clean Air Act’s National Ambient Air Quality Standards, the Clean Water Act’s Water Quality Standards, the Endangered Species Act and the Clean Air Act’s cap-and-trade system for sulfur dioxide.<sup>55</sup>

Legal writers have begun to extend these legal structures to ecological degradation writ large, including proposals for new principles of tort law designed to preserve ecological integrity, for constitutional environmental rights for future generations, and for capping and allocating the global human footprint.<sup>56</sup> Legal elements commonly found in these proposals include definitions of a standard of environmental or human health that the law should protect, legal barriers to all acts that contribute to invasion of such a standard, placing the burden of proof on those whose actions threaten the environment, recognizing broad standing to enforce such rules of law and a focus on motivating development of less-damaging alternatives. Under such new decision-making structures, cost-benefit analysis and even discounting might continue to help us choose among less damaging alternatives, but they would no longer be used to justify incremental contributions to ecological degradation.

---

<sup>52</sup> Daly, *supra* note 35, at 31–60 (distinguishing “development” (defined as improvement in quality of products but within a fixed ecological impact) from economic “growth” [defined as quantitative increase in total scale of throughput]).

<sup>53</sup> See Guth, *Cumulative Impacts – Death-Knell for Cost Benefit Analysis in Environmental Decisions*, *supra* note 1 (discussing legal structures that can prevent cumulative impacts).

<sup>54</sup> See *id.* (discussing old common law cases controlling cumulative impacts).

<sup>55</sup> See *id.* (discussing setting of standards and control of cumulative impacts by certain provisions of federal environmental laws).

<sup>56</sup> See *id.* (discussing proposals by legal writers for legal strategies for controlling scale of ecological damage and creating environmental rights in future generations); Guth, *Law for the Ecological Age*, *supra*, note 1 at 494–511 (proposing tort of ecological degradation); World Wildlife Fund, Zoological Society of London and Global Footprint Network, *Living Planet Report 2006* at 25 (proposing capping and allocating human footprint), available at [http://www.panda.org/news\\_facts/publications/living\\_planet\\_report/living\\_planet\\_index/index.cfm](http://www.panda.org/news_facts/publications/living_planet_report/living_planet_index/index.cfm).

---

We live in a transitional time. We are struggling to control mounting environmental degradation and threats to future generations using a legal system that is ill suited to the task because it is built on a pre-analytic vision that is no longer valid. The paradoxes of discounting are telling us that this is so. The resolution of these paradoxes is also telling us what we must do. For both our own welfare and that of future generations, we must build a new environmental law specifically designed to maintain the ecological integrity of the biosphere against the onslaught of cumulative impacts.