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## Time in Cost-Benefit Analysis

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# Time in Cost-Benefit Analysis

Arden Rowell\*

*Agencies are accustomed to considering questions of discounting—the process that makes monetary amounts comparable through time. But valuing the future is a distinctive enterprise for reasons that go beyond discounting. This Article explores two basic features of time that create challenges for intertemporal decision making: (1) time’s physical asymmetry, which makes relationships between the present and the future necessarily nonreciprocal, and (2) the subjective experience of time as continuously flowing, which creates definitional challenges in categorizing segments of time as “the future.” Although these features of time may affect any decision procedure, they have particular and concrete implications for the quantitative form of cost-benefit analysis on which American regulatory agencies routinely rely. First, because temporal asymmetry makes present/future relationships nonreciprocal, and because cost-benefit analysis lacks any intrinsic tool for managing distribution, there is a heightened need for supplemental distributional tools when cost-benefit analysis is performed intertemporally. Second, cost-benefit analysis relies upon quantification of the monetized value of future regulatory impacts—a process that depends on identifying the time at which those impacts accrue. Yet time flow creates systematic line-drawing challenges for decision makers who must distinguish between present and future events. To manage these, regulators should at least extend their analyses to the temporal break-even point, or the point in time where aggregate benefits of the rule equal aggregate costs. When decision makers compare future costs and benefits to current impacts, or even to foreign or other impacts, they should be wary of making cross comparisons that do not account for the distinctive qualities of future valuation.*

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## INTRODUCTION

Discounting, or the process of making monetary amounts comparable in time by accounting for the time value of money, is a key aspect of intertemporal valuation in cost-benefit analysis. Discounting policy is important both because of the enormity of its potential impact on final policy decisions,<sup>1</sup> and because it forms a core process allowing quantitative cost-benefit analyses to compare apples to apples, when those apples accrue at different points in time.<sup>2</sup> Discounting has rightfully received significant attention in legal, economic, political, psychological, and philosophical literatures.<sup>3</sup> In response, agencies and the Office of Management and Budget (OMB) have developed sophisticated (albeit still controversial) methods for discounting future costs and benefits.<sup>4</sup>

I have described my own views on agency discounting practice<sup>5</sup> and on the relationship between discounting and intergenerational equity<sup>6</sup> elsewhere. In this Article, I explore the possibility that valuing the future is a distinctive enterprise for reasons that go beyond discounting, and which relate to the basic physical and social qualities of time itself.

These qualities distinguish future valuations from, for example, foreign valuations—an analogy that is periodically invoked to analyze intergenerational questions.<sup>7</sup> One implication of the arguments in this Article is that the analogy

1. See, e.g., David A. Weisbach & Cass R. Sunstein, *Climate Change and Discounting the Future: A Guide for the Perplexed*, 27 YALE L. & POL'Y REV. 433, 440 (2009) (arguing that the most important disagreements about how aggressively to respond to the threat of climate change turn on discounting policy).

2. See Arden Rowell, *The Cost of Time: Haphazard Discounting and the Undervaluation of Regulatory Benefits*, 85 NOTRE DAME L. REV. 1505, 1516–18 (2010) (arguing that failing to discount future impacts in a monetized cost-benefit analysis misleadingly converts some—but not all—of the money in the analysis into “money lite,” defeating the purpose of the analysis).

3. For multiple perspectives on the legal implications of discounting debates, see Symposium, *Intergenerational Equity and Discounting*, 74 U. CHI. L. REV. 1 (2007).

4. See OFFICE OF MGMT. & BUDGET, EXEC. OFFICE OF THE PRESIDENT, CIRCULAR A-4, at 3 (2003) [hereinafter CIRCULAR A-4], available at [http://www.whitehouse.gov/omb/circulars\\_a004\\_a-4](http://www.whitehouse.gov/omb/circulars_a004_a-4).

5. See Rowell, *supra* note 2 (reviewing the interaction between agency discounting and valuation practices).

6. See Cass R. Sunstein & Arden Rowell, *On Discounting Regulatory Benefits: Risk, Money, and Intergenerational Equity*, 74 U. CHI. L. REV. 171 (2007) (arguing that discounting should be disentangled from the question of intergenerational equity).

7. See, e.g., Eric A. Posner, *Agencies Should Ignore Distant-Future Generations*, 74 U. CHI. L. REV. 139, 140–42 (2007) (analogizing investment in distant-future benefits to the provision of foreign aid); Richard Revesz, *Environmental Regulation, Cost-Benefit Analysis, and the Discounting of Human Lives*, 99

between foreign and future valuations breaks down along at least two parameters, along which temporal distance is importantly different than spatial distance.

The first of these distinctive parameters follows from the physical law of entropy, which makes time unidirectional. This unidirectionality means that there can never be reciprocal relationships across generations as there can be across countries, or within contemporaneous domestic populations. Intertemporal relationships thus violate one of the foundational observations underlying the Coase theorem: that of reciprocal risk.<sup>8</sup>

The systematic lack of intertemporal reciprocity significantly circumscribes intertemporal bargaining, meaning that initial allocations will tend to be outcome-determinative of final distributions of harms, benefits, and entitlements when those distributions occur across time. Even advocates of cost-benefit analysis recognize that it lacks intrinsic tools for addressing distributional inequities; when cost-benefit analysis is performed intertemporally, the distributional fixation posed by intertemporal impacts thus creates a heightened need for supplemental distributional tools.

The second distinctive quality of “futureness” comes from the psychosocial phenomenon of time flow, which makes distinctions in time generally more challenging to draw than distinctions in space. This latter phenomenon does not prevent temporal line drawing, but it introduces a systematic challenge to principled temporal line drawing that does not arise in spatial line drawing, particularly in cultures where property lines are a familiar spatial concept.

Cost-benefit analysis is dependent upon meaningful valuation techniques to support the monetization and comparison of goods, risks, and harms. Meaningful valuations, in turn, must incorporate well-drawn time-signatures to account for the time value of money. The line drawing challenge created by time flow thus poses challenges to monetization for intertemporal valuations in cost-benefit analysis. These challenges relate to discounting, because discounting is the method used to account for the time value of money, once the time signatures of various goods are identified. But the phenomenon of time flow is itself distinguishable from questions of discounting, and should be thought of as providing distinctive puzzles to regulatory analysis in general, and to cost-benefit analysis in particular.

I begin below with an introduction to the practice of regulatory cost-benefit analysis. I emphasize two aspects of cost-benefit analysis that will prove to have particular temporal implications: cost-benefit analysis’ insensitivity to distribution, and its dependence on monetized valuations. After setting the institutional stage, I turn to the puzzle of whether—and what—might be distinctive about intertemporal valuations, and outline two phenomena that are particularly relevant to cost-benefit

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COLUM. L. REV. 941, 1004–09 (1999) (comparing intragenerational redistribution through foreign aid with intergenerational redistribution through environmental policies); Thomas Schelling, *Intergenerational Discounting*, 23 ENERGY POLY 395, 398–400 (1995) (comparing intergenerational climate change policies to foreign aid).

8. See R.H. Coase, *The Problem of Social Cost*, 3 J.L. & ECON. 1, 2 (1960).

practice: temporal asymmetry and the experience of time flow. I describe these phenomena, explain why each poses challenges to cost-benefit analysis, and prescribe potential opportunities for addressing these challenges within the institution of regulatory cost-benefit analysis.

## I. AN INTRODUCTION TO REGULATORY COST-BENEFIT ANALYSIS

Modern regulatory cost-benefit analysis is a systemized method of comparing the expected advantages and disadvantages of proposed policies.<sup>9</sup> The method relies on a process of monetization that converts nonmonetary costs and benefits into a common metric—money—by using market- and preference-based studies of people’s willingness to pay money to acquire benefits or avoid costs.<sup>10</sup>

The practice of regulatory cost-benefit analysis has elicited a broad array of justifications<sup>11</sup> and criticisms.<sup>12</sup> For our purposes, two of these will be particularly

9. See generally CASS R. SUNSTEIN, *RISK AND REASON: SAFETY, LAW, AND THE ENVIRONMENT* (2002); MATTHEW D. ADLER & ERIC A. POSNER, *NEW FOUNDATIONS OF COST-BENEFIT ANALYSIS* (2006); RICHARD L. REVESZ & MICHAEL A. LIVERMORE, *RETAKING RATIONALITY: HOW COST-BENEFIT ANALYSIS CAN BETTER PROTECT THE ENVIRONMENT AND OUR HEALTH* (2008).

10. See Arden Rowell, *supra* note 2, at 1510–17 (describing the relationships between risk, time, and money in regulatory cost-benefit analysis). See generally Lisa A. Robinson & James K. Hammitt, *Skills of the Trade: Valuing Health Risk Reductions in Benefit-Cost Analysis*, 4 J. BENEFIT-COST ANALYSIS 107 (2013) (describing current agency methodologies of valuation).

11. For a valuable treatment of various efficiency-based defenses of cost-benefit analysis, see Matthew D. Adler & Eric A. Posner, *Rethinking Cost-Benefit Analysis*, 109 YALE L. J. 165, 187–93 (1999), presenting Pareto, Kaldor-Hicks, and unrestricted utilitarian defenses of cost-benefit analysis. For other normative justifications for the use of cost-benefit analysis, see REVESZ & LIVERMORE, *supra* note 9, at 9–19, discussing the theory and practice of regulatory cost-benefit analysis, and arguing that it offers a valuable way to address problems of scarce resources; SUNSTEIN, *supra* note 9, at 54–55, 151–52, arguing that cost-benefit appropriately places discretion in the hands of technocratic experts; Adler & Posner, *supra*, at 167–69, defending cost-benefit analysis as a systemized decision procedure, “a method for achieving desirable results,” and arguing that it is justified “even if it sometimes produces undesirable outcomes, as long as the total costs associated with CBA (the costs of undesirable outcomes, plus procedural costs) are lower than the total costs associated with alternative decision procedures”; Robert W. Hahn & Cass R. Sunstein, *A New Executive Order for Improving Federal Regulation? Deeper and Wider Cost-Benefit Analysis*, 150 U. PA. L. REV. 1489, 1517–21 (2002), advocating for cost-benefit analysis as a tool for improving transparency; Eric A. Posner, *Controlling Agencies with Cost-Benefit Analysis*, 68 U. CHI. L. REV. 1137, 1140 (2001), arguing that cost-benefit analysis presents a method for the President, Congress, and the judiciary to control agency behavior; Cass R. Sunstein, *Cognition and Cost-Benefit Analysis*, 29 J. LEGAL STUD. 1059, 1059–73 (2000), arguing that cost-benefit analysis can “debias,” or reduce cognitive errors; Cass R. Sunstein, *Cost-Benefit Default Principles*, 99 MICH. L. REV. 1651, 1653–56 (2001) [hereinafter Sunstein, *Cost-Benefit Default Principles*], describing how cost-benefit analysis reduces risk and therefore improves consistency; compare Robert H. Frank, *Why is Cost-Benefit Analysis So Controversial?*, 29 J. LEGAL STUD. 913, 921–27 (2000), defending cost-benefit analysis as an abstract normative principle.

12. See, e.g., MATTHEW D. ADLER, *WELL-BEING AND FAIR DISTRIBUTION: BEYOND COST-BENEFIT ANALYSIS* 88–114 (2012) (criticizing cost-benefit analysis on a variety of grounds, including that it is an incomplete decision procedure, particularly in circumstances where affected populations face significant inequity); FRANK ACKERMAN & LISA HEINZERLING, *PRICELESS: ON KNOWING THE PRICE OF EVERYTHING AND THE VALUE OF NOTHING* (2004) (criticizing CBA for being so confusing that it defeats its usefulness as a decision procedure, among other reasons); Martha C. Nussbaum, *The*

relevant. First, cost-benefit analysis is notoriously poor at managing distributional issues.<sup>13</sup> Although it can be modified or supplemented with tools that are distributionally sensitive,<sup>14</sup> cost-benefit analysis has no intrinsic mechanism for distinguishing between desirable and undesirable distributions of costs and benefits. Second, quantitative cost-benefit analysis is dependent upon its monetization processes.<sup>15</sup> If these valuation processes break down, the very goal of the cost-benefit project—to make disparate goods, harms, and resources comparable to one another—is undermined. For this reason, agencies and courts tend to be rightly wary of any valuation processes that introduce a bias or an incommensurability into a cost-benefit analysis.

Despite continued discussion of its strengths and challenges, cost-benefit analysis is now used pervasively in the modern American regulatory state.<sup>16</sup> When permitted by statute,<sup>17</sup> federal agencies are required by executive order to perform cost-benefit analyses prior to promulgating any major rule.<sup>18</sup> Cost-benefit analyses prepared by agencies are substantively reviewed by the Office of Information and Regulatory Affairs (OIRA).<sup>19</sup>

As a general matter, agencies may proceed only if the benefits justify the costs, and only if the chosen policy maximizes net benefits.<sup>20</sup> The executive requirement to perform a cost-benefit analysis has existed since 1981, when President Reagan

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*Costs of Tragedy: Some Moral Limits of Cost-Benefit Analysis*, 29 J. LEGAL STUD. 1005, 1032–33 (2000) (criticizing the application of cost-benefit analysis to circumstances where a threshold, rights-based approach is deemed necessary, as in setting basic entitlements for citizens of a state); ELIZABETH ANDERSON, VALUE IN ETHICS AND ECONOMICS 190–216 (1993) (criticizing cost-benefit analysis as a form of commodification).

13. For an overview of critiques, as well as the presentation of his own, see ADLER, *supra* note 12, at 119–24.

14. See, e.g., *id.* (describing how cost-benefit analysis could be modified with distributional weights).

15. See Rowell, *supra* note 2, at 1510–17 (addressing the role of monetization in regulatory cost-benefit analysis).

16. For an overview, see REVESZ & LIVERMORE, *supra* note 9; Cass R. Sunstein, *The Real World of Cost-Benefit Analysis: Thirty-Six Questions (and Almost as Many Answers)*, 114 COLUM. L. REV. 167, 167–78 (2014).

17. For examples of statutory variation in what is permitted and required regarding cost-benefit analysis, see Sunstein, *Cost-Benefit Default Principles*, *supra* note 11, at 1664–67 (describing statutory variation ranging from flat bans on considering costs to cost-benefit requirements).

18. See Exec. Order No. 13,563 § 1(c), 3 C.F.R. 215, 215–16 (2012), *reprinted in* 5 U.S.C. § 601 app. at 816–17 (2012).

19. See *id.* § 6(b). Compare Cass R. Sunstein, *The Office of Information and Regulatory Affairs: Myths and Realities*, 126 HARV. L. REV. 1838, 1838–44 (2013) (arguing that OIRA acts primarily as an “information aggregator”), with Lisa Heinzerling, *Inside EPA: A Former Insider’s Reflections on the Relationship between the Obama EPA and the Obama White House*, 31 PACE ENVTL. L. REV. 325 (2014) (calling OIRA the “central player” in developing rules), and Michael A. Livermore & Richard L. Revesz, *Regulatory Review, Capture, and Agency Inaction*, 101 GEO. L.J. 1337, 1342–60 (2013).

20. See Exec. Order No. 13,563 § 6(b), 3 C.F.R. at 215. Rare exceptions arise where the use of cost-benefit analysis is prohibited by statute or other “law.” See *id.* § 1(b) (limiting directions in the Order “to the extent permitted by law”).

first issued an executive order to this effect.<sup>21</sup> Each President since Reagan has reaffirmed the requirement, although successive administrations have issued their own versions of the guidance.<sup>22</sup> In President Obama's case, this involved repealing a Bush-era Executive Order,<sup>23</sup> reaffirming a Clinton-era Executive Order,<sup>24</sup> and issuing a new and detailed Order on "Improving Regulation and Regulatory Review."<sup>25</sup> This latter document, drafted in consultation with Cass Sunstein, then Administrator of OIRA,<sup>26</sup> included a number of innovations over prior regimes, including the institution of a systematic new requirement for retrospective review of existing regulations.<sup>27</sup> Further, one critical new portion of the order stated that "each agency is directed to use the best available techniques to quantify anticipated present and future benefits and costs as accurately as possible."<sup>28</sup>

Some commentators have noted that this requirement, along with others in the same document, exhibit a heightened emphasis on the importance of quantification over prior cost-benefit orders.<sup>29</sup> This is an important aspect of Obama-era cost-benefit analysis. But another intriguing aspect of the order relates to the requirement that agencies address "future" benefits and costs as well as present ones. This is the first time that the future has been explicitly incorporated into a cost-benefit order.<sup>30</sup> Agencies have, of course, been addressing the expected

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21. See Exec. Order No. 12,291, 3 C.F.R. 127, 127–29 (1982), *revoked by* Exec. Order No. 12,866 § 11, 3 C.F.R. 638, 649 (1994), *reprinted as amended in* 5 U.S.C. § 601 app. at 802–06 (2012); *see also* Exec. Order No. 12,498, 3 C.F.R. 323 (1986) (requiring agencies to submit an annual regulatory plan and to adhere to cost-benefit principles).

22. See, e.g., Exec. Order No. 13,258, 3 C.F.R. 204 (2003), *revoked by* Exec. Order No. 13,497, 3 C.F.R. 218, 218 (2009); Exec. Order No. 13,563, 3 C.F.R. at 215–17.

23. Exec. Order No. 13,497, 3 C.F.R. at 218 (revoking Executive Order 13,258 and 13,422, which had amended Executive Order 12,866).

24. Exec. Order No. 13,563 § 1(b), 3 C.F.R. at 215 (incorporating by reference Executive Order 12,866).

25. Exec. Order No. 13,563, 3 C.F.R. at 215–17.

26. Cass R. Sunstein, a prominent law professor who has written extensively on regulation, has summarized his experiences at OIRA in a number of recent publications, including CASS R. SUNSTEIN, SIMPLER: THE FUTURE OF GOVERNMENT 17–27 (2013); Cass R. Sunstein, *Empirically Informed Regulation*, 78 U. CHI. L. REV. 1349, 1366–67 n.80 (2011), drawing in part on Sunstein's observations while at OIRA; and Sunstein, *supra* note 16, at 167–78. This was the first systematic incorporation of retrospective review as such into an Executive Order, although prior Presidential administrations also implemented periodic retrospective requirements. See Cary Coglianese, *Moving Forward with Regulatory Lookback*, 30 YALE J. ON REG. ONLINE 57 (2013) (summarizing past administrations' periodic retrospective review policies and calling for increased institutionalization and systemization of current retrospective review processes).

27. Exec. Order No. 13,563 § 1(c), 3 C.F.R. at 216. These include a heightened emphasis on the importance of quantification and the institution of a requirement for retrospective review of existing regulations. See *id.*; Sunstein, *supra* note 16, at 178–81.

28. Exec. Order No. 13,563 § 1(c), 3 C.F.R. at 216.

29. See, e.g., Sunstein, *supra* note 16, at 170–73.

30. Cf. Exec. Order No. 12,291, 3 C.F.R. 127, 127–29 (1982), *revoked by* Exec. Order No. 12,866 § 11, 3 C.F.R. 638, 649 (1994), *reprinted as amended in* 5 U.S.C. § 601 app. at 802–06 (2012); Exec. Order No. 12,866, 3 C.F.R. 638 (1994), *reprinted as amended in* 5 U.S.C. § 601 app. at 802–06 (2012); Exec. Order No. 13,258, 3 C.F.R. 204 (2003), *revoked by* Exec. Order No. 13,497, 3 C.F.R. 218, 218

impacts of their policies for some time.<sup>31</sup> But Executive Order 13,563 departs from prior guidance by affirmatively distinguishing between the treatment of present and future impacts. When taken in concert with the requirement to systematically perform retrospective review of rules,<sup>32</sup> Executive Order 13,563 can be reasonably read as placing unprecedented emphasis on the temporal aspects of cost-benefit analysis.

What are regulators supposed to do with this emphasis? How—and why—might regulators distinguish between “present” and “future” benefits and costs? In what way(s) does the future differ from the present, such that valuation methods or techniques might be implicated? Key executive guidance to agencies has for a number of years encouraged analysts to be transparent in their assumptions, including by stating the “time horizon for the analysis and the discount rates applied to future benefits and costs,” and given guidance on how and why regulators ought to engage in discounting of future benefits.<sup>33</sup> But is the distinctiveness of future benefits and costs comprised entirely of differences in appropriate discounting methodology, or are there other features of time that are also relevant to cost-benefit analysis? In the next section I argue that there are at least two such features and that a thorough accounting for future benefits and costs should address time asymmetry and time flow as well as discounting policy.

## II. THE DISTINCTIVENESS OF THE FUTURE

The aphorism “time is money”<sup>34</sup> is as familiar as it is incomplete. Of course time can be used to earn money, and it can even be monetized. Most of us, after all, accept money in exchange for large chunks of our lifetimes,<sup>35</sup> and we routinely pay to avoid spending time in undesirable ways—by opting to fly or drive long distances instead of walking, by purchasing new socks instead of darning old ones, by eating

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(2009); Exec. Order No. 13,422, 3 C.F.R. 191 (2008), *revoked by* Exec. Order No. 13,497, 3 C.F.R. 218, 218 (2009).

31. See, e.g., Rowell, *supra* note 2, at 1520–32 (discussing the Environmental Protection Agency’s (EPA) practice of monetizing future impacts as it existed prior to this executive order).

32. See Exec. Order No. 13,563 § 6.

33. See CIRCULAR A-4, *supra* note 4; OFFICE OF MGMT. & BUDGET, EXEC. OFFICE OF THE PRESIDENT, CIRCULAR A-94, GUIDELINES AND DISCOUNT RATES FOR BENEFIT-COST ANALYSIS OF FEDERAL PROGRAMS (1994), *available at* <http://www.whitehouse.gov/sites/default/files/omb/assets/a94/a094.pdf>; John D. Graham, *Valuing the Future: OMB’s Refined Position*, 74 U. CHI. L. REV. 51 (2007) (describing OMB’s approach to discounting future impacts).

34. BENJAMIN FRANKLIN, *Advice to a Young Tradesman*, in *THE POLITICAL THOUGHT OF BENJAMIN FRANKLIN* 51 (Ralph Ketcham ed., 1965).

35. A person who works forty hours a week from age twenty until age sixty-five, with two weeks of vacation a year, will work over 90,000 hours in her lifetime. By age sixty-five, this means she will have exchanged approximately 1/6 of the total hours of her life for wages. Of course, the amount for which we are able to sell our time varies significantly, with personal as well as demographic factors. See TIFFANY JULIAN & ROBERT KOMINSKI, U.S. CENSUS BUREAU, EDUCATION AND SYNTHETIC WORK-LIFE EARNINGS ESTIMATES (2011), *available at* <http://www.census.gov/prod/2011pubs/acs-14.pdf> (reporting that median lifetime earnings range from a low of \$704,005 for Hispanic females with education of none through eighth grade, to a high of \$4,754,930 for White males with a professional degree).



conveniently prepared foods instead of making everything from scratch. Furthermore, money has a time value—a dollar today is worth more than a dollar twenty years from now. Discounting quantifies this time value, which is what makes discounting so critical to quantified cost-benefit analysis.

But the fact that time can be monetized does not make time literally morph into money. The difference is between metaphor and simile. If I make twenty dollars an hour at my job, we might say that spending an hour in line at the Department of Motor Vehicles is like losing twenty dollars. This may be a reasonable approximation of the value of a lost hour for me, insofar as it can be expressed in monetary terms. But finding that I have lost a twenty dollar bill from my pocket and waiting interminably for the number on my ticket to appear above a government clerk are not actually identical. Time is like money, in some ways. But in other ways it is like itself.

For the remainder of this symposium Article, I explore what makes time most like itself, and ponder what those features mean for a form of analysis that has focused so much on quantified time value. Quite separately from the voluminous literatures on discounting, the concept of time has puzzled theoreticians for centuries,<sup>36</sup> and commentators have long recognized the epistemological challenges that arise when attempting to predict and evaluate the future.<sup>37</sup> There is also a long tradition, enjoying a current renaissance, of evaluating the present's ethical and moral obligations to the future.<sup>38</sup> For purposes of this Article, I want to pull on these diverse literatures to focus on two specific aspects of time that seem distinct from discounting policy: time's physical features, which make it asymmetrical; and the social experience of time, which makes us understand it as occurring in one continuous flow. These features are fundamental both to how time actually works, and to how we experience it working. I will argue that both also have identifiable implications for cost-benefit analysis that go beyond the time value of money.

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36. St. Augustine, for instance, asks in his *Confessions*: “What, then, is time? If no one asks me, I know; if I want to explain it to someone who does ask me, I do not know.” THE CONFESSIONS OF ST. AUGUSTINE 287 (John K. Ryan trans., Image Books 1960) (c. 401 C.E.). For a compendium of influential philosophical perspectives on the philosophy of time, see THE PHILOSOPHY OF TIME: OXFORD READINGS IN PHILOSOPHY (Robin Le Poidevin & Murray MacBeath, eds. 1993). For a readable introduction to controversies in physics, see SEAN CARROLL, FROM ETERNITY TO HERE: THE QUEST FOR THE ULTIMATE THEORY OF TIME (2010).

37. See, e.g., DAVID HUME, AN ENQUIRY CONCERNING HUMAN UNDERSTANDING, § IV (Tom L. Beauchamp ed. 1999) (1748).

38. For an excellent symposium article on this question, see Neil H. Buchanan, *What Do We One Future Generations?*, 77 GEO. WASH. L. REV. 1237 (2009).

### *A. Temporal Asymmetry*

The asymmetry of time is generally thought to derive from the laws of physics.<sup>39</sup> Also called “time’s arrow,” or the “direction” of time,<sup>40</sup> this characteristic follows from what may be the most uncontroversial of all scientific theories: the Second Law of Thermodynamics, or the Law of Entropy.<sup>41</sup> This physical law postulates that across the universe, “disorder, or entropy, always increases with time.”<sup>42</sup> This creates a one-directional bias that contributes to a series of asymmetric phenomena that are so familiar to us that we do not even notice them. If you stir sweetener into your rice pudding, you cannot stir backwards to unsweeten it.<sup>43</sup> A dropped teacup does not reassemble itself and leap off the floor and back into a

39. For a careful attempt to parse the aspects of temporal asymmetry that derive from physical laws, and those that derive instead—or as well—from psychosocial constructions, see HUW PRICE, *TIME’S ARROW AND ARCHIMEDES’ POINT* 206–07 (1996).

40. The idea of “time’s arrow” was introduced by astrophysicist Sir Arthur Eddington: Let us draw an arrow arbitrarily. If as we follow the arrow we find more and more of the random element in the state of the world, then the arrow is pointing towards the future; if the random element decreases the arrow points towards the past. . . .

I shall use the phrase “time’s arrow” to express this one-way property of time which has no analogue in space.

A.S. EDDINGTON, *THE NATURE OF THE PHYSICAL WORLD* 69 (1927). It was further popularized by STEPHEN HAWKING, *THE ILLUSTRATED A BRIEF HISTORY OF TIME* 184 (updated & expanded ed. 1996); cf. PRICE, *supra* note 39, at 206–09 (warning that anthropocentric views of time can lead to misunderstandings about temporal asymmetry, but agreeing that some form of temporal asymmetry exists).

41. Eddington described the extent of acceptance of the Second Law this way: If someone points out to you that your pet theory of the universe is in disagreement with Maxwell’s equations [regarding the laws of electricity and magnetism]—then so much the worse for Maxwell’s equations. If it is found to be contradicted by observation—well, these experimentalists do bungle things sometimes. But if your theory is found to be against the second law of thermodynamics I can give you no hope; there is nothing for it but to collapse in deepest humiliation.

EDDINGTON, *supra* note 40, at 74. Modern popular books on physics describe the Second Law this way: “If you were asked to predict what currently accepted principles of physics would still be considered inviolate a thousand years from now, the Second Law would be a good bet.” CARROLL, *supra* note 36, at 32. That said, even the law of entropy has academics who advocate caution. See, e.g., PRICE, *supra* note 39, at ch. 2 (interrogating application of claims of time asymmetry following from the Second Law, and arguing that, while the Second Law itself does create a form of time asymmetry, this asymmetry is often misunderstood). For further treatments of the relationship between time asymmetry and physical laws, see *PHYSICAL ORIGINS OF TIME ASYMMETRY* (J.J. Halliwell et al. eds., 1994).

42. See HAWKING, *supra* note 40, at 184.

43. See TOM STOPPARD, *ARCADIA* 4–5 (1993):

THOMASINA: When you stir your rice pudding, Septimus, the spoonful of jam spreads itself round making red trails like the picture of a meteor in my astronomical atlas. But if you stir backward, the jam will not come together again. Indeed, the pudding does not notice and continues to turn pink just as before. Do you think this is odd?

SEPTIMUS: No.

THOMASINA: Well, I do. You cannot stir things apart.

SEPTIMUS: No more you can, time must needs run backward, and since it will not, we must stir our way onward mixing as we go, disorder out of disorder into disorder until pink is complete, unchanging and unchangeable, and we are done with it for ever.

hand.<sup>44</sup> Your finger hurts after you prick it with a needle, not before.<sup>45</sup> We break a few eggs to make an omelet; we cannot unbreak the omelet to make eggs.<sup>46</sup> We remember the past but not the future,<sup>47</sup> and understand causes to precede effects.<sup>48</sup>

Multiple robust literatures in multiple disciplines debate various aspects of this asymmetry,<sup>49</sup> and there are growing numbers of legal discussions devoted to analyzing the relationships between time and the law.<sup>50</sup> Still more exist on the relationship between law and particular aspects of temporal asymmetry, such as path dependence.<sup>51</sup>

Obviously the practice of cost-benefit analysis is not responsible for the Second Law of Thermodynamics, or for the fact that the present precedes the

44. See HAWKING, *supra* note 40, at 184 (“Imagine a cup of water falling off a table and breaking into pieces on the floor. If you take a film of this, you can easily tell whether it is being run forward or backward. If you run it backward you will see the pieces suddenly gather themselves together off the floor and jump back to form a whole cup on the table. You can tell that the film is being run backward because this kind of behavior is never observed in ordinary life. If it were, crockery manufacturers would go out of business.”).

45. Unless you are Lewis Carroll’s White Queen, who lives backwards and forwards in time. See LEWIS CARROLL, *THROUGH THE LOOKING-GLASS* 175 (London, Macmillan and Co. 1872) (“‘What *is* the matter?’ [Alice] said, as soon as there was a chance of making herself heard. ‘Have you pricked your finger?’ ‘I haven’t pricked it *yet*,’ the Queen said, ‘but I soon shall—oh, oh, oh!’”).

46. The French saying is that “*on ne fait pas d’omelette sans casser des oeufs*.” No similar aphorism exists to suggest that you cannot make an egg without unmaking an omelet.

47. Physicists believe that memory works in the direction it does because the past was more ordered—had lower entropy—than the present. See CARROLL, *supra* note 36, at 40–42. Because this experience is so basic to our perception of the world, reversing the trend creates a provocative literary device. Consider Merlin, who lives backward in T.H. WHITE, *THE ONCE AND FUTURE KING* (1958), or the narrator in MARTIN AMIS, *TIME’S ARROW: OR THE NATURE OF THE OFFENCE* (1991) (providing an unsettling narration of a German Holocaust doctor’s life in reverse chronology, such that torture and murder look like healing and life saving).

48. See, e.g., Michael Moore, *For What Must We Pay? Causation and Counterfactual Baselines*, 40 SAN DIEGO L. REV. 1181, 1230 (“Two of our bedrock intuitions about causation are that it is asymmetrical (if *c* causes *e*, *e* does not cause *c*) and that it has a one-way direction in time (causes must not succeed their effects in time).”). For a sophisticated and counterintuitive argument that, despite our strong intuitive understanding of causation, causes can sometimes *precede* effects, at least at the quantum level, see, for example, PRICE, *supra* note 39, at chs. 5–7.

49. See, e.g., *TIME’S ARROWS TODAY: RECENT PHYSICAL AND PHILOSOPHICAL WORK ON THE DIRECTION OF TIME* (Steven F. Savitt ed., 1995).

50. Three excellent examples addressing the relationship between time and law are Rebecca R. French, *Time in the Law*, 72 U. COLO. L. REV. 663, 669 (2001), presenting an “open-ended conversation on time in the law by [analyzing] some of the variety of views of time that have appeared in other disciplines”; Alison L. LaCroix, *Temporal Imperialism*, 158 U. PA. L. REV. 1329 (2010), examining the Court’s treatment of temporal issues through multiple case studies; and Bruce G. Peabody, *Reversing Time’s Arrow: Law’s Reordering of Chronology, Causality, and History*, 40 AKRON L. REV. 587 (2007), reconsidering the way in which society thinks about time and causality within the law.

51. See, e.g., Stefanie A. Lindquist & Frank B. Cross, *Empirically Testing Dworkin’s Chain Novel Theory: Studying the Path of Precedent*, 80 N.Y.U. L. REV. 1156, 1170–72 (2005) (discussing scholarly accounts of path dependence); Francesco Parisi, *Entropy in Property*, 50 AM. J. COMP. L. 595 (2002) (applying the theoretical structure of entropy to property law); J.B. Ruhl & Harold J. Ruhl, Jr., *The Arrow of the Law in Modern Administrative States: Using Complexity Theory to Reveal the Diminishing Returns and Increasing Risks the Burgeoning of Law Poses to Society*, 30 U.C. DAVIS L. REV. 405 (1997) (applying complexity theory to the development of adaptive legal systems).

future. That said, the asymmetric nature of time has—and should be taken to have—important implications for the practice of cost-benefit analysis. The chief of these implications is that temporal asymmetry undermines the possibility of meaningfully reciprocal relationships between the present and the future. Resources, information, harm, and risk can only be transferred from the present *to* the future. The future cannot do the reciprocal: the future can pay no money to the present; can convey no information; can collect no damages; can impose no risk.<sup>52</sup>

Consider in this light the classic economic insight by Ronald Coase that risks and externalities are reciprocal.<sup>53</sup> Coase's insight does not apply intertemporally: risks and externalities are not reciprocal across time because time is unidirectional. The present can impose risks on the future, but the future cannot impose reciprocal risks on the present.

Take Coase's example of the polluting factory that imposes externalities on nearby residents.<sup>54</sup> As Coase explains, the traditional approach to managing this problem was to imagine that the harm runs only one way: that the factory (A) inflicts harm on the residents (B).<sup>55</sup> But this approach, he claims, ignores "The Reciprocal Nature of the Problem."<sup>56</sup> As Coase points out, the neighbors have risk imposed on them by the factory's choices, but the neighbors also create a risk for the factory of shutdown or damage assessment.<sup>57</sup> The risks are reciprocal, Coase argues, because both parties impose potential externalities on one another.<sup>58</sup>

Now consider the same situation, but where the parties are separated by time. Suppose that a defunct factory polluted a neighborhood in 1920, and people now living in that neighborhood are being exposed to risks from the residual pollution. The past factory imposed risk on the current residents. But because of temporal

52. This is not to suggest that the present does not play an active role in constructing, interpreting, and responding to past events. See Walter F. Murphy, *Merlin's Memory: The Past and Future Imperfect of the Once and Future Polity*, in *RESPONDING TO IMPERFECTION* 163, 171 (Sanford Levinson ed., 1995) (noting that we regularly "acknowledge that the present and the future may change views we hold about the past, [although] we nonetheless would reject the notion that the [present or] the future can affect the past"). Another objection would be that future persons can impose *future* resource demands, *future* harms, and *future* risks, and where an institution is durable, this may result in it experiencing—in the future—any of these harms or goods. But until the future arrives—whenever that is—it can bring nothing to the table; and once it arrives, we will no longer be at the table to discuss the matter.

53. See Coase, *supra* note 8, at 30–34.

54. See *id.*

55. See *id.* at 41–42.

56. See *id.* at 2. Coase explains:

The question is commonly thought of as one in which A inflicts harm on B and what has to be decided is: how should we restrain A? But this is wrong. We are dealing with a problem of a reciprocal nature. To avoid the harm to B would inflict harm on A. The real question that has to be decided is: should A be allowed to harm B or should B be allowed to harm A?

*Id.* Coase provides additional examples: "the case of a confectioner the noise and vibrations from whose machinery disturbed a doctor in his work. To avoid harming the doctor would inflict harm on the confectioner"; and "the problem of straying cattle which destroy crops on neighboring land. . . . The nature of the choice is clear: meat or crops." *Id.*

57. See *id.* at 41–42.

58. See *id.*

asymmetry, the risk is unidirectional; there is no risk of shutdown, or anything else, that the current residents can impose on the past factory.<sup>59</sup> Similarly, a factory that pollutes today can create externalities for future persons,<sup>60</sup> but those future persons have no reciprocal option available to them.<sup>61</sup> In Coase's original examples, he builds on the claim of reciprocity to describe why, in the absence of transaction costs, parties will bargain to an efficient outcome.<sup>62</sup> But here as well, the asymmetry of time creates fundamental distinctions between intertemporal and simultaneous relationships. For simultaneous decisions, risk may be helpfully considered to be reciprocal, since different parties can each impose externalities on one another. Because of this reciprocity, it is possible for parties to bargain to preferred solutions, at least in the absence of transaction costs.<sup>63</sup> But this is impossible in the context of intertemporal relations.

It is hard to overstate the bargaining asymmetry that exists between the present and the future.<sup>64</sup> Legal scholars are often concerned about inequities in bargaining

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59. Of course, if the factory were still extant, then the residents could sue the current owners for damages and/or an injunction. The injunction is obviously prospective only, but the damages might well be retrospective. Would damages awarded to the residents be a "harm" to the past owners of the factory? Some might think so. *See, e.g.,* Peabody, *supra* note 50, at 594 ("There is a category of circumstances—especially prominent in the field of law—where individuals and institutions in the present arguably go beyond mere reinterpretation of the past to actually amending it, producing genuine change not inherent in the preexisting political and legal order."). But this harm would occur, even if it did occur, only in the future: there is thus no point in time at which the present can imperil the future while the future imperils the present.

60. Of course, there are also options for current residents who wish to externalize costs to future factory owners, for example by establishing restrictive zoning constraints that make it more difficult for future factories to open or operate. But future factory owners cannot impose risks or externalize costs to current residents; externalities can still run only one direction.

61. The example is more complex had the factory continued to operate—had identity remained constant over time. As a behavioral matter, we might expect the current factory's decision making to internalize a portion of future legal liability concomitant with its expectations of future stable identity, see Daniel Bartels et al., Presentation at the Association for Consumer Research, Pittsburgh, PA: How the Perceived (Dis)continuity of Identity Affects Intertemporal Choice (2009), demonstrating that people are less willing to defer benefits as they expect changes in identity; although people normally appear to think of their future selves more like strangers than like their current selves, Hal Ersner-Hershfield et al., *Saving for the Future Self: Neural Measures of Future Self-Continuity Predict Temporal Discounting*, 4 SOC. COGNITIVE & AFFECTIVE NEUROSCIENCE 85 (2009), finding that fMRI brain images of subjects describing their future selves looked markedly different from scans of them describing their current selves, but markedly similar to scans of them describing a third party. As the quantity of that internalization increases—and particularly if it approached 100%—the result would begin to look very like a negotiated agreement between the future and the present. The baseline would be set entirely by the current actor, and, more specifically, by a product of the current actors' internalization factor, risk aversion, risk preferences, and expectations about future occurrences. Because the baseline is set unilaterally by the current actor, there would still be a difference between present/future and present/present relations, but the distributional impact of that difference would lessen as the present actor's internalization of the future increased. In discussing intertemporal distributional implications, then, agencies might reasonably incorporate a discussion of the extent to which they believe that future impacts will be internalized by the present.

62. *See* Coase, *supra* note 8, at 4–15.

63. *See id.* at 10.

64. For a discussion of constraints on intergenerational bargaining, see Sunstein & Rowell, *supra* note 6, at 194–96, 199–202 (comparing "Presentville" and "Futureville").

power, both because of moral and fairness concerns, and because of the distortions it can introduce into markets.<sup>65</sup> Intertemporal bargaining asymmetry should be understood to provide the quintessential example for both such concerns. Because causes precede effects, the future is completely dependent—physically, financially, emotionally, and literally—on the present. The future can make no credible threats, can bring no carrots to the bargaining table, can in fact only with difficulty, and through a proxy, express interests or preferences. Consider the basic question of the baseline that the parties will use to negotiate against. There is no way to set such a baseline because every decision that could lead to one outcome or another is in the control of the present rather than the future.<sup>66</sup> The future is powerless and penniless, and this poses deep constraints on the possibility of intertemporal bargaining.<sup>67</sup>

Compare the nonreciprocity of present/future relations to the potential reciprocity of domestic/foreign relations.<sup>68</sup> Where a domestic government is considering adopting a policy that would imperil foreign lives, it must constantly be aware of the possibility that the foreign government is considering similar policies. In this sense, the risks being considered are often reciprocal; and even when a particular set of risks is not reciprocal—for instance, an upwind country might impose relatively greater levels of air pollution risk on its downwind neighbors—there can at least be some package of risks that make negotiation fruitful. This negotiation is also likely to take place against existing baselines, such as on the assumption that both countries are entitled to keep their currently existing property, and that they will act under existing international legal norms. True, there may be an imbalance in bargaining power, and international law is not a perfect mechanism for enforcing international bargains. But every country will have at least some resources, some information, or some reciprocal risk to bring to the bargaining table. In this sense, even the poorest current countries are far wealthier than people who do not yet exist.

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65. Both concepts trace back to Adam Smith who claimed that part of the “moral philosophy” on which democratic market societies are premised is that the “fair” price is the competitive price, or the price that would prevail if both parties had equal bargaining power. *See* ADAM SMITH, *THEORY OF MORAL SENTIMENTS* 178–99 (*Liberty Classics* 1969) (1759).

66. *See* Sunstein & Rowell, *supra* note 6, at 194–96. This poses a distinctive challenge to setting intertemporal baselines in “negotiations” between the present and the future. That said, the fluidity of baseline-setting through time can sometimes be used strategically by the present. *See, e.g.*, James Salzman and J.B. Ruhl, *Gaming the Past: The Theory and Practice of Historic Baselines in the Administrative State*, 64 *VAND. L. REV.* 1 (2010) (examining the ways agencies act strategically in setting comparative baselines for purposes of regulatory policy).

67. Of course, the present can care about the future, and may unilaterally choose to confer benefits on the future. The present may also internalize some future harms; as such internalization increases, we might expect distributional impacts to be vitiated concomitantly.

68. As I have noted, comparing future and foreign impacts is a common rhetorical device, although the features highlighted in this Article suggest that the analogy may be limited. For much more on the valuation of foreign lives, see Arden Rowell & Lesley Wexler, *Valuing Foreign Lives*, 48 *GA. L. REV.* 499 (2014).

The distributional effects of temporal asymmetry are not a product of cost-benefit analysis. But in this case, the underlying phenomenon and the institution are particularly interactive: the underlying phenomenon creates significant distributional puzzles, and as discussed above, cost-benefit analysis is notoriously poor at managing distributional questions.<sup>69</sup> Recall that cost-benefit has no intrinsic tool either for accounting for the fairness of how costs and benefits are distributed across a population, or for shifting those costs and benefits to achieve a more desirable distribution.<sup>70</sup> Where there are other mechanisms in place to allow initial allocations to be traded, reallocated, or exchanged—as is the case in many cross-border applications—the fact that cost-benefit analysis itself does not address distributional concerns is simply a limitation of the tool that can be supplemented elsewhere. But when, as with intertemporal impacts, no meaningful bargaining can occur past existing allocation of entitlements and harms, this quality of cost-benefit analysis becomes increasingly worrisome, because a tool insensitive to distribution becomes determinative of future allocations. This puts, in turn, significant pressure on any other distributional safety nets that might back up cost-benefit analysis when it is applied to future impacts.

Temporal asymmetry thus poses distinctive challenges to regulators who are asked, as they are in Executive Order 13,563, to value present and future costs and benefits. How should regulators respond to this challenge? First, regulators should recognize that, when they engage in the task of valuing present and future costs and benefits as per Executive Order 13,563,<sup>71</sup> they are inevitably faced with enormous distributional challenges—challenges that will not be naturally solved through application of cost-benefit analysis. Of course, regulators must also deal with contemporaneous distributional challenges, and cost-benefit analysis is a recognizably poor tool for these problems as well. But however poorly cost-benefit analysis works to create fair distributions intratemporally, it at least offers some possibility of background bargaining for reallocation of harms or benefits. In intertemporal contexts, however, regulators should realize that such bargaining is deeply constrained, and that the final distribution of regulatory impacts will be almost, and perhaps entirely, a function of initial allocations.

What can be done with this recognition, especially within the contexts of current cost-benefit practice, and given the understanding that cost-benefit analysis struggles to manage distributional challenges? One answer is to use existing mechanisms for addressing distributional concerns, and to be highly vigilant about applying them to intertemporal contexts. Currently, agencies are permitted to

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69. For an overview of critiques, as well as the presentation of his own, see ADLER, *supra* note 12, at 119–24.

70. For a sophisticated approach to incorporating distributional concerns into decision procedures, see *id.* at 119–24. For some discussion of how Adler's recommendations might be implemented in the context of current regulatory cost-benefit analysis, see Arden Rowell, *Book Review: Well-Being and Fair Distribution: Beyond Cost-Benefit Analysis*, 33 RISK ANALYSIS 1379 (2013) (reviewing ADLER, *supra* note 69).

71. See *supra* note 68.

“consider” distributional concerns under Executive Order 13,563: “Where appropriate and permitted by law, each agency may consider (and discuss qualitatively) values that are difficult or impossible to quantify, including equity, human dignity, fairness, and distributive impacts.”<sup>72</sup> One clear prescription of the argument here is that agencies should address intertemporal distribution of costs and benefits in their regulatory analyses, and that these analyses should be made in light of the nonreciprocal nature of the relationship between the present and the future. Circular A-4 already recommends that agencies create a schedule of the expected stream of future costs and benefits,<sup>73</sup> although this appears to be a recommendation more honored in the breach. OIRA might begin to encourage—or even require—agencies to observe this recommendation more regularly, by routinely presenting information on the streams of benefits and costs over time. Of course, current persons are the only ones who will be able to read or interrogate agency disclosures of schedules of costs and benefits. Still, performing explicit analyses of the expected intertemporal distributional implications of a rule would have beneficial implications. It would highlight the sticky distributional implications of intertemporal impacts, which might allow for creative identification and deployment of supplemental distributional tools to address any inequities arising from initial entitlements. And it would retain ancillary institutional benefits, as intertemporal distributional schedules may be particularly useful upon retrospective review of existing action, and can allow for periodic updating based on whether a rule is cost-benefit justified in the future.

A second, more ambitious, response would be to incorporate distributional weights into cost-benefit analysis itself, a view championed by Matt Adler in his more recent work,<sup>74</sup> and which finds at least limited support in language in Executive Order 13,563 encouraging agencies to address “equity” in their cost-benefit analyses.<sup>75</sup> This response would be appropriate if policymakers believed that

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72. See Exec. Order No. 13,563 § 1(c), 3 C.F.R. 215, 216 (2012), *reprinted in* 5 U.S.C. § 601 app. at 816–17 (2012). Agencies are also required to do a form of distributional analysis separate from cost-benefit for policies expected to impact “minority populations” or “low-income populations in the United States.” See Exec. Order No. 12,898, 3 C.F.R. 859, 859 (1995), *reprinted as amended in* 42 U.S.C. § 4321 (2012) (“To the greatest extent practicable and permitted by law, . . . each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States . . .”). Insofar as future persons qualify as minority populations, agencies might also read this order to require an analysis of expected impact on those populations. For further discussion of how the distributional orders fit with cost-benefit requirements, see Arden Rowell, *Allocating Pollution*, 79 U. CHI. L. REV. 985, 1001–02 (2012).

73. CIRCULAR A-4, *supra* note 4, directs that an “analysis should also present information on the streams of benefits and costs over time in order to provide a basis for assessing intertemporal distributional consequences, particularly where intergenerational effects are concerned.”

74. See ADLER, *supra* note 12, at 119–24. Adler’s approach is developed for single-lifetime distributions but could be applied intertemporally.

75. See *id.*; Exec. Order No. 13,563 § 1(c), 3 C.F.R. 215, 216 (2012), *reprinted in* 5 U.S.C. § 601 app. at 816–17 (2012). For a discussion of how Adler’s recommendations might be implemented, see Rowell, *supra* note 70, at 1379–81.



the differences in distribution as between the present and the future was inequitable, such that the sticky entitlements created by intertemporal policies were distributionally problematic. That said, insofar as regulators believe this to be a difficult question, or believe that political guidance would be appropriate given the potential controversy of adding distributional weights to the future, they might do better to start with the moderate step of including intertemporal distributional implications in their distributional analyses.

Finally, and perhaps most controversially, regulators could consider revisiting their valuation methodologies when dealing with intertemporal impacts. Consider the basis for current monetizations: monetized estimates of people's willingness to pay (WTP) for future impacts. Current regulatory practice is based on underlying calculations that are insensitive to whether the life being imperiled is immediate or future; the same monetized valuation generally attaches regardless of the timing of the risk (although future lives saved are discounted back to present value to keep monetized values comparable).<sup>76</sup> An aggressive response to the problem of time asymmetry would be to bifurcate these valuations: to adopt different approaches to valuing immediate and future risks, to represent the differing distributional implications of managing intratemporal versus intertemporal impacts. This approach would have the virtue of explicitly addressing the distributional implications of time asymmetry, but would create challenges of its own because of a second feature of time that has important implications for cost-benefit analysis: the social and psychological experience of time as "flowing."

### B. The "Flow" of Time

We are all familiar with the sense of time "flowing," of a continuity of experience that makes the passage of time feel as if it is moving with us, or past us. This perception is an old one, stretching back at least to the ancient Greek philosopher Heraclitus.<sup>77</sup> But it relates to modern psychological concepts as well, including the so-called "stream of consciousness."<sup>78</sup> Philosophers and physicists

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76. See Arden Rowell, *The Cost of Time*, 85 NOTRE DAME L. REV. 1505, 1524 (2010).

77. Heraclitus may be best known for the observation that "No man ever steps in the same river twice, for it is not the same river, and he is not the same man." The river/time metaphor has remained popular over succeeding millennia. See, e.g., STEPHEN SCHWARTZ, *Just Around the Riverbend*, in POCAHONTAS (The Walt Disney Co. 1995) ("What I love most about rivers is: You can't step in the same river twice/The water's always changing, always flowing."). For a reflective summary of the development of modern conceptions of time as they are reflected in the law, see French, *supra* note 50, at 676–89.

78. Further extending the river metaphor, psychologist William James described the sensation of time flow in this way:

Consciousness . . . does not appear to itself chopped into bits. Such words as 'chain' and 'train' do not describe it fitly . . . It is nothing jointed; it flows. A 'river' or a 'stream' are the metaphors by which it is most naturally described. *In talking of it hereafter, let us call it the stream of thought, of consciousness . . .*

1 WILLIAM JAMES, *THE PRINCIPLES OF PSYCHOLOGY* 239 (Dover Publications 1950) (1890). William James was the brother of novelist Henry James. Note that, far predating James, Buddhist philosophy

continue to debate whether time actually flows.<sup>79</sup> From a social and psychological perspective, however, it is clear that it does.<sup>80</sup>

What does it matter to cost-benefit analysis that people's experience of time is subjectively fluid? The implications on which I would like to focus follow from cost-benefit analysis' dependence on monetization. The project of quantified cost-benefit is directed toward finding a common metric across which to compare disparate goods. Anything that corrupts the monetization process—the process by which those disparate goods are expressed in the common metric of money—thus undermines the fundamental project of the analysis. My concern here is that time flow complicates several aspects of monetization. Some of these relate back to the discounting process. But others are separable issues that increase the difficulty of monetizing future costs and benefits (in comparison to immediate costs and benefits). Unlike with temporal asymmetry, these challenges are not unique to time flow. But they do follow from it, and perhaps recognizing their source can be helpful to crafting prescriptions.

I begin by outlining a set of challenges that cost-benefit analysis faces as a result of time flow, focusing on the difficulties regulators face in managing temporal scope of their analyses. I then identify prescriptions for at least partially responding to these challenges by increasing observation of existing guidance directing explicit identification of the schedule of costs and benefits, and through identification of a temporal “break-even” point.

Let us begin by considering the challenges time flow causes in identifying and setting a temporal scope for cost-benefit analyses. When is the future—when does it start, and when does it end?<sup>81</sup> Are there internal categories within “the future” that are importantly distinct from one another? Time flow makes these categories into moving targets. At the same time, these questions have heightened importance wherever “present” and “future” categories demand different policy implementations. I discussed one such reason for treating the future and the present differently above: temporal asymmetry means that intertemporal distributional impacts are sticky in a way that contemporaneous ones are not. But cost-benefit

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referred to the *Citta-samlāna*, “mind stream” or “mental continuum.” AMERICAN PHILOSOPHY: AN ENCYCLOPEDIA 737 (John Lachs & Robert Talisse eds., 2008).

79. For a readable summary of why, from the physicists' perspective, time cannot be meaningfully understood to “flow,” see CARROLL, *supra* note 36, at 21–25.

80. For a social psychology perspective on time, see ROBERT LEVINE, A GEOGRAPHY OF TIME, at xi–xx (1997) (discussing the social and psychological construction of time); *see also* MIHALY CSIKSZENTMIHALYI, FLOW: THE PSYCHOLOGY OF OPTIMAL EXPERIENCE (1990) (discussing studies finding that people report themselves as happiest when most absorbed in the “flow” of their own activities).

81. I focus here on questions of prospective scope, such as are regularly faced in traditional cost-benefit analyses. But the challenges faced in prospective contexts are equally difficult in retrospective review, an institution that has been in use periodically over the last few decades, but which gained significant and regularized support in Executive Order 13,563. *See* Exec. Order No. 13,563 § 1(c), 3 C.F.R. 215, 215–16 (2012), *reprinted in* 5 U.S.C. § 601 app. at 816–17 (2012).

analysis has an additional and fundamental implementation issue when it faces indeterminacy about the timing of benefits and costs.

For discounting purposes, agencies must clearly identify whether a cost or benefit will accrue in the present or in the future. Because money has a time value, time indeterminacy—whereby there is no particular time signature attached to a cost or benefit—undermines the analysis' ability to coherently monetize.<sup>82</sup> So unless a regulator knows when a cost or benefit accrues, and how far into the future, she cannot meaningfully discount the impact, which means she cannot meaningfully monetize. For purposes of regulatory cost-benefit analysis, then, it is critical that regulators have a clear idea of what and when impacts will count as occurring in the present and when they will count as occurring in the future. Particularly where there is no clear starting point for the future—a point at which costs and benefits will be treated as occurring in the “future” and therefore discounted—monetized valuations can be undermined.<sup>83</sup> Unfortunately, our experience of continuous temporal flow makes it challenging to know whether the future should be taken to start tomorrow, next week, next year, or with the next generation.

But the question of when the future begins is only half of the time segment that must be delineated to define the scope of a cost-benefit analysis. Agencies must also determine when a relevant analysis will terminate, or when the future “ends.” This problem interacts with a number of other challenges facing the valuation of the future, including particularly the fact that epistemological challenges are likely to increase as the relevant timeline becomes longer and longer.<sup>84</sup>

When a period of time is omitted from a cost-benefit analysis, it is like valuing all costs and benefits after that period at zero dollars. The selection of the relevant “end point” for an analysis thus affects the monetization of costs and benefits. The selection of the end point will not always matter to the final analysis, especially where many of the benefits are in the far-distant future.<sup>85</sup> One example of this type of puzzle, in which the determination of the endpoint was potentially relevant to policy choice, is the Environmental Protection Agency's analysis of the radiation risks posed by the proposed Yucca Mountain nuclear waste disposal site. The EPA

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82. See Rowell, *supra* note 2, at 1520–33 (showing that agencies rely on “value of a statistical life” (VSL) calculations based on people's willingness to pay to prevent time-indeterminate risks—or an undifferentiated combination of present and future mortality risks—and arguing that this leads to an undervaluation of regulatory benefits).

83. See *id.* (explaining that future impacts must be discounted, while immediate impacts must not be).

84. See Public Health and Environmental Radiation Protection Standards for Yucca Mountain, NV, 66 Fed. Reg. 32,074, 32,097 (June 13, 2001) (codified at 40 C.F.R. pt. 197) (explaining EPA's decision to use a 10,000 year endpoint for Yucca Mountain in part because there “is still considerable uncertainty as to whether current modeling capability allows development of computer models that will provide sufficiently meaningful and reliable projections over a time frame up to tens-of-thousands to hundreds-of-thousands of years”).

85. In such circumstances, the exponential impact of discounting makes distant-future impacts shrink down to irrelevance, even when the expected magnitude of those impacts is enormous.

chose to base its analyses on an endpoint 10,000 years in the future.<sup>86</sup> The National Academy of Sciences (NAS) arrived at a different number, finding “no scientific basis for limiting the time period of the individual-risk standard to 10,000 years or any other value,” recommending that the EPA conduct its assessments “for the time when the greatest risk occurs, within the limits imposed by long-term predictability of . . . the geologic environment,” which it categorized as “on the order of  $10^6$  [1,000,000] years at Yucca Mountain.”<sup>87</sup> The EPA concluded that “such an approach is not practical for regulatory decisionmaking,”<sup>88</sup> and stuck with its initial 10,000 year endpoint.<sup>89</sup> Its decision was then overturned as arbitrary by the District of Columbia Circuit.<sup>90</sup> The EPA’s rules were statutorily required to be “based on and consistent with” the recommendations of the National Academy of Science.<sup>91</sup> Following *Chevron*, the court concluded that Congress had not spoken directly to the question of the appropriate time scope of the analysis, but that the EPA was unreasonable to construe the end point of 10,000 years as “based on and consistent with” NAS’s recommendations to focus on periods of peak risk, which might extend a million years into the future.<sup>92</sup> The court went on to explain that the unreasonableness of the EPA’s construction was related to the way that they calculated their end point: “[h]ad [the] EPA begun with the Academy’s recommendation to base the compliance period on peak dosage and then made adjustments to accommodate policy considerations not considered by NAS, this might be a very different case.”<sup>93</sup> In this sense, the court rejected the EPA’s method of calculation in light of NAS’s recommendations about this particular policy, leaving ambiguous whether the selection of a 10,000-year end point would be appropriate for other cost-benefit contexts.

A final point that relates to the relationship between time flow and valuation in cost-benefit analysis is that there may be important internal distinctions to be made within “the” future. If we imagine the future stretching before us in a continuous line, are there segments that agencies should carve out and treat differently, either from each other or from the point at which we stand on the timeline? In this context, let us consider two important proposals in the cost-benefit

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86. See 40 C.F.R. pt. 197 (2014); *id.* § 197.20 (creating an “individual-protection standard” conditioning approval of the Department of Energy’s permit for Yucca Mountain on a showing that the site would sufficiently contain radiation for the 10,000 years following disposal); *id.* § 197.25(a) (creating a “human-intrusion standard” conditioning approval on a showing that the site was safe from human intrusion for 10,000 years following disposal); *id.* § 197.30 (creating a “ground water protection standard” requiring reasonable protection of groundwater for 10,000 years).

87. NAT’L ACAD. OF SCIS., TECHNICAL BASES FOR YUCCA MOUNTAIN STANDARDS 55–56 (1995).

88. Public Health and Environmental Radiation Protection Standards for Yucca Mountain, NV, 66 Fed. Reg. at 32,097.

89. See 40 C.F.R. pt. 197.

90. *Nuclear Energy Inst., Inc. v. EPA*, 373 F.3d 1251, 1266–73 (D.C. Cir. 2004).

91. Energy Policy Act of 1992, Pub. L. No. 102-486, § 801(a)(1), 106 Stat. 2776, 2921–22.

92. *Nuclear Energy Inst.*, 373 F.3d at 1266–73 (citing *Chevron U.S.A. Inc. v. Natural Res. Def. Council, Inc.*, 467 U.S. 837 (1984)) (addressing the challenge to “[t]he 10,000-year Compliance Period”).

93. *Id.* at 1274.

literature that present differing views of how “the” future should be segmented: that future generations be distinguished from future selves,<sup>94</sup> and that distant-future generations be carved out as distinct from future and current generations.<sup>95</sup>

A common way future segments are distinguished is along generational grounds. One important perspective, proffered by Richard Revesz and Michael Livermore, would distinguish between the segment of the future that represents future versions of ourselves, or the “current” generation, and the segment of the future that is populated by “future generations.”<sup>96</sup> Revesz and Livermore make this distinction because they believe that ethical obligations to future generations differ from ethical obligations to ourselves.<sup>97</sup> Thus, they create two segments along the timeline of the future: one dealing with the future that the current generation of people will experience, and the other dealing with the future that will be experienced by future (as yet unborn) generations.<sup>98</sup> They then tie this distinction to a difference in valuation policy, advocating for discounting of latent intragenerational harms, but for no discounting of harms to future generations.<sup>99</sup>

If Revesz and Livermore are right that ethical obligations vary intra- and intergenerationally, then this is a principled reason to treat the future as segmented, and potentially to adopt cost-benefit practices that reflect the reasons underlying the segmentation.<sup>100</sup> This might be a reasonable choice if, for instance, we understood the bargaining barrier created by temporal asymmetry to apply with more force where there is no useful proxy for the future’s interests, with less force if the future is internalized by the present, or if we thought that current people tended to be better proxies for their future selves than for future generations.

That said, the choice to distinguish between different segments of the future—in this case, future selves and future generations—creates some awkwardness in light of time flow: when will we count the next generation as having arrived, and

94. See REVESZ & LIVERMORE, *supra* note 9, at 107–17; Revesz, *supra* note 7, at 984–85, 1008–09 (distinguishing between “latent harms” to one’s future self and “intergenerational harms” to people who do not yet exist).

95. Posner, *supra* note 7, at 139–40.

96. See REVESZ & LIVERMORE, *supra* note 9; *cf.* Rowell, *supra* note 2, at 1538–40 (distinguishing discounting from ethical questions); Sunstein & Rowell, *supra* note 6, at 208 (arguing that questions of discounting are separable from ethical questions about what the present owes the future).

97. See REVESZ & LIVERMORE, *supra* note 9, at 107–17.

98. See *id.*

99. See *id.*; *cf.* Sunstein & Rowell, *supra* note 6, at 198–99 (arguing that discounting should be disentangled from the question of intergenerational equity).

100. It is also possible that the underlying distinction is sound—that current people have importantly different obligations to future selves and future generations—but that the distinction does not demand a distinction in valuation methodology. I have argued in the past that this is at least the case for discounting, which should apply to both intra- and intergenerational costs and benefits simply because discounting is required for coherent monetization policy. See Rowell, *supra* note 2, at 1516 (arguing that discounting some monetized benefits and not others would be “misleading” and unreasonable); Sunstein & Rowell, *supra* note 6, at 198 (“A refusal to discount, often justified as a way of assisting the future, is a singularly crude way of attempting to fulfill our obligations to future generations.”).

this generation as gone?<sup>101</sup> Of course these difficulties are not unique either to Revesz and Livermore's categorization of the future into these two segments, or to cost-benefit analysis in general—line-drawing challenges can arise in a multitude of contexts, even when those decisions are neither monetized nor overtly temporal, such as deciding whether a romantic relationship has proceeded to the point where a Valentine's Day gift is appropriate, or how many grains of sand count as a heap.<sup>102</sup> But the line-drawing issues created by temporal flow do pose specific difficulties for cost-benefit analysis when categorical segments of the future are used to define differing valuation techniques.

As it happens, agencies have not (yet?) adopted Revesz and Livermore's approach to segmenting the future for purposes of discounting policy. They have come closer to implementing another theoretical suggestion for segmenting the future, one proposed by Eric Posner. Posner has recommended that the "distant future" be distinguished from both the near future and the present.<sup>103</sup> In Posner's view, harms and benefits to the distant future are moral and political problems that "agencies cannot resolve outside of, and prior to, a political resolution by elected officials."<sup>104</sup> He uses this reasoning to justify distinguishing distant-future from future generations and current generations.<sup>105</sup> Based on his reading of the literature regarding American willingness to pay to protect foreign lives, Posner then proposes that distant-future generations be given "a weight of zero because the voting public values them very little."<sup>106</sup> Because the segment Posner carves out—distant-future generations—comes at the end of a timeline, and because he would weigh that segment at zero, this is the logical equivalent of creating an end point on a timeline just before reaching the "distant future"; as Posner explains, "[a] simple way of

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101. See Rowell, *supra* note 2, at 1538 ("[I]t is very difficult—perhaps impossible—to create an administrable distinction between latent harms and intergenerational harms. Time has a habit of moving forward, and people keep dying, being born, and having eighteenth birthdays: there is no fixed 'present' generation. This is a real problem for any regulatory system that seeks to apply different analytical standards to present and future people.").

102. For a classic discussion of line-drawing problems in law, see Frederick Schauer, *Slippery Slopes*, 99 HARV. L. REV. 361, 379 (1985).

103. Posner, *supra* note 7, at 139–40.

104. *Id.* at 140, 143 ("[A]gencies act within a thick institutional and political environment that bars them from directly implementing moral precepts—or that would result in perverse outcomes if agencies did try to directly implement moral precepts.").

105. See *id.* at 140.

106. See *id.* at 142. Posner reasons that "[i]f Americans living today value living foreigners at about 1/2000 of an American, it seems highly unlikely that they will value future Americans much more." *Id.* at 141 (footnote omitted). Posner cites Wojciech Kopczuk et al., *The Limitations of Decentralized World Redistribution: An Optimal Taxation Approach*, 49 EUR. ECON. REV. 1051, 1075 (2005). The study on which Posner relies concludes that "the U.S. on average valu[es] the well-being of foreigners only 1/6 as much as an American citizen, and less than 1/2000 for the residents of the poorest of the developing economies." *Id.* (alteration in original). Posner does not explain his choice to focus on the low end of this spectrum. For reasons discussed above, I believe there are significant differences between the issues involved in valuing foreign and future lives, which make the back-of-the-envelope application of Kopczuk et al.'s study inappropriate. See also Rowell & Wexler, *supra* note 68, at 47–55. But regardless, Posner's institutional concern about the appropriateness of making controversial political and ethical decisions within the confines of regulatory cost-benefit analysis still remains.

putting this point is that agencies should ignore the effects, both positive and negative, of their regulations beyond fifty or one hundred years.<sup>107</sup> Posner's approach to distant-future generations is thus an example both of creating definitional "segments" and of setting an identifiable end point to the time scope. This is a straightforward approach, but even it is complicated by the experience of time flow: whatever cut-off point is chosen will create the appearance at least of arbitrariness on either side of the line. Again, a familiar problem in law, but one that in this case has an identifiable source—the subjective experience of time flow—and an identifiable institution affected by it, namely regulatory cost-benefit analysis.

Given the line-drawing problems created by temporal flow, what are agencies' actual practices regarding the setting of scope? Even within a single agency, practice seems to vary with different rules, different risks, and different statutory regimes. Most EPA rules, for instance, use scopes less than fifty years—three rules proposed by EPA in 2014 used 2022, 2030, and 2050 as their end points<sup>108</sup>—but I have already cited one instance where the Environmental Protection Agency performed an analysis with a 10,000-year scope.<sup>109</sup> In some particular statutory and risk contexts, the scopes triggered are consistent across agencies: for instance, the Social Cost of Carbon, a central figure used across agencies to estimate the monetized impact of each ton of carbon emissions (and often used in concert with other types of benefits estimates), is explicitly calculated based on damage estimates to 2300 AD,<sup>110</sup> and the Paperwork Reduction Act, triggered when a rule causes reporting changes, typically results in the inclusion of annualized reporting costs for the first three years after the rule goes into effect.<sup>111</sup> But in other cases, the exact scope of

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107. Posner, *supra* note 7, at 143.

108. See Standards of Performance for Municipal Solid Waste Landfills, 79 Fed. Reg. 41,796, 41,829 (proposed July 17, 2014) (to be codified at 40 C.F.R. pt. 60) (Notice of Proposed Rule Making (NPRM) referencing thirty years of cost data); Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units, 79 Fed. Reg. 34,830, 38,840 (proposed June 18, 2014) (to be codified at 40 C.F.R. pt. 60) (costs and benefits through 2030); Standards of Performance for New Residential Wood Heaters, New Residential Hydronic Heaters and Forced-Air Furnaces, and New Residential Masonry Heaters, 79 Fed. Reg. 6330, 6333 (proposed Feb. 3, 2014) (to be codified at 40 C.F.R. pt. 60) (costs and benefits through 2022); EPA, OFFICE OF AIR QUALITY PLANNING & STANDARDS, OFFICE OF ATMOSPHERIC PROGRAMS & OFFICE OF POLICY, REGULATORY IMPACT ANALYSIS FOR THE PROPOSED CARBON POLLUTION GUIDELINES FOR EXISTING POWER PLANTS AND EMISSION STANDARDS FOR MODIFIED AND RECONSTRUCTED POWER PLANTS, § 4-12 (2014) (Regulatory Impact Analysis (RIA) for same rulemaking reporting costs as far out as 2050).

109. Nuclear Energy Inst., Inc. v. EPA, 373 F.3d 1251, 1266–73 (D.C. Cir. 2004); see also *supra* notes 86–93 and accompanying text.

110. See INTERAGENCY WORKING GRP. ON SOCIAL COST OF CARBON, UNITED STATES GOVERNMENT, TECHNICAL SUPPORT DOCUMENT: SOCIAL COST OF CARBON FOR REGULATORY IMPACT ANALYSIS UNDER EXECUTIVE ORDER 12866, at 25 (2010), available at <http://www.epa.gov/oms/climate/regulations/scc-tsd.pdf>.

111. See, e.g., Control of Air Pollution from Motor Vehicles: Tier 3 Motor Vehicle Emission and Fuel Standards, 79 Fed. Reg. 23,414, 23,622 (Apr. 28, 2014) (to be codified at 40 C.F.R. pts. 79, 80, 85, 86, 600, 1036, 1037, 1039, 1042, 1048, 1054, 1065, 1066) (annualized reporting costs over three-year period for PRA).

the calculated costs and benefits are far more ambiguous, and there is no general practice of routinely identifying the scope chosen or the reasons for that selection.<sup>112</sup>

Now let us consider how agencies might respond to the challenges that time flow poses to valuation for purposes of cost-benefit analysis. One useful response would simply be to begin implementing the existing guidance in Circular A-4 about identifying the schedules of costs and benefits. As I will argue below, it would even be possible to use this type of analysis to identify a temporal break-even point by which the proposed rule has paid for itself: a point in time determined by the cost-benefit analysis itself, which can thus provide a meaningful place to identify the endpoint for the scope of the analysis.

What scope *should* be included in this explicit schedule of costs and benefits? As noted above, agencies have to treat costs and benefits that occur in the future differently from those that occur immediately, for discounting purposes as well as for the distributional reasons following from time asymmetry.<sup>113</sup> This is what makes the scope question—and particularly the question of starting scope—particularly important. Fortunately, precisely because the subjective flow of time deprives us of a single natural starting point, there are multiple possible reasonable choices. I suggest that agencies should use a year from initial promulgation of the analysis as their cut-off point—a practice they already use for purposes of discounting, since discounting in whole years is practically easier than using smaller periods. This aligns treatment of future costs and benefits for discounting and nondiscounting purposes, and while it is still subject to the moving-target problem, it is an intuitive and reasonable starting point.

What should the *end* point of an analysis be? Sometimes, of course, this will be determined by statute. But often it is not, in which case agencies must choose between many possible end points. One option in such cases would be to adopt a single consistent end point, regardless of context. This is one way to understand Posner's suggestion of ignoring distant-future generations. But some rules (like those affecting climate change) are massive and important, and will have many latent costs and benefits, and others (like small reporting requirement changes) are much smaller, or will be cost-benefit justified in a very short amount of time. This suggests that adopting a single consistent time scope, while beneficial in its simplicity, could be overinclusive for quick and unimportant rules, and underinclusive for slow-moving and important rules.

Another approach to managing time scope where there are no statutory restrictions would be to embrace inconsistent time scopes, so long as those scopes were meaningfully tied to some aspect of the underlying rule. This approach is the

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112. Circular A-4 directs agencies that their analysis should “cover a period long enough to encompass all the important benefits and costs likely to result from the rule,” but there is no practice in place to explain why (or even state that) the chosen scope encompasses the important benefits and costs. CIRCULAR A-4, *supra* note 4.

113. See Exec. Order No. 13,563, 3 C.F.R. 215 (2012), *reprinted in* 5 U.S.C. § 601 app. at 816–17 (2012) (distinguishing “present and future costs and benefits”); Rowell, *supra* note 2.



one recommended in Circular A-4, which directs that agency analyses “should cover a period long enough to encompass all the important benefits and costs likely to result from the rule.”<sup>114</sup>

This recommendation seems at once eminently sensible and rather vague. What, after all, counts as “important benefits and costs”? And which comes first: the selection of the scope or the identification of the important costs and benefits? Here I want to propose a relatively straightforward method of identifying a minimum time scope that is derived from a tailored understanding of the costs and benefits in any particular rulemaking, and which lends meaning to the decision of which benefits and costs are “important.” This proposal is that agencies should include an end point to their time scope that extends at least to the “temporal break-even point”—the time point at which the rule has become cost-benefit justified in terms of current dollars. Agencies often engage in so-called “breakeven analysis” when they face the question of how high nonquantifiable benefits would have to be to justify costs.<sup>115</sup> As Cass Sunstein argued recently, this sort of analysis is most useful “*when agencies are able to identify a lower or upper bound for regulatory benefits, with the identification taking the form of either point estimates or estimates of expected value*”<sup>116</sup>; in such cases, breakeven analysis helpfully identifies missing information, specifies conditions under which benefits would justify costs, and illuminates which cases are particularly difficult.<sup>117</sup> These same virtues can be applied intertemporally through the application of a temporal break-even point.

It is striking to note that in the significant history of cost-benefit orders requiring agencies to promulgate rules that are cost-benefit justified, no order has identified a particular time *by which* those rules must be cost-justified.<sup>118</sup> Temporal break-even points provide a principled mechanism for managing the time-flow-based line-drawing issues that cost-benefit analysis otherwise faces in setting analytical endpoints.

## CONCLUSION

Two qualities of time—temporal asymmetry, which makes the present always precede the future; and the experience of time as continuously “flowing”—create identifiable implications for cost-benefit analysis, and particularly for valuing future costs and benefits. To respond to the challenges created by time asymmetry, regulators should adopt a special solicitude toward the distributional impacts of cost-benefit analysis that occur through time, as these impacts cannot be bargained

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114. See CIRCULAR A-4, *supra* note 4.

115. See Cass R. Sunstein, *The Limits of Quantification*, 102 CALIF. L. REV. 1369, 1369–70 (2014).

116. See *id.* at 1392.

117. *Id.* at 1392–93.

118. See Exec. Order No. 12,291, 3 C.F.R. 127, 127–29 (1982), *revoked by* Exec. Order No. 12,866 § 11, 3 C.F.R. 638, 649 (1994), *reprinted as amended in* 5 U.S.C. § 601 app. at 802–06 (2012); Exec. Order No. 12,866, 3 C.F.R. 638; Exec. Order No. 13,258, 3 C.F.R. 204; Exec. Order No. 13,422, 3 C.F.R. 191 (2008), *revoked by* Exec. Order No. 13,497, 3 C.F.R. 218, 218 (2009); Exec. Order 13,563, 3 C.F.R. 215 (2012).

around like contemporaneous distributional impacts. To respond to challenges exacerbated by time flow, regulators should be clear in the temporal scope they adopt for their analyses, and should consider calculating temporal “break-even” points to identify the time point when the benefits of a rule will have justified the costs. These recommendations are consistent with executive guidance already in place, but the concerns raised in this Article suggest that both agencies and the Office of Management and Budget should do more to ensure that this guidance is followed in practice.

