

**THE ENVIRONMENTAL TURN IN NATURAL RESOURCE ECONOMICS:
JOHN KRUTILLA AND "CONSERVATION RECONSIDERED"**

H. Spencer Banzhaf*
Georgia State University, PERC, NBER

December 2015

*Professor, Dept. of Economics, Andrew Young School of Policy Studies, Georgia State University, PO Box 3992, Atlanta, GA 30302. hsbanzhaf@gsu.edu.

I thank Kerry Smith, Polly Cleveland and participants in a session at the 2015 History of Economics Society meetings for comments on a previous draft.

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Environmentalism in the United States historically has been divided into its utilitarian and preservationist impulses, represented by Gifford Pinchot and John Muir, respectively. Pinchot advocated conservation of natural resources to be used for human purposes; Muir advocated protection from humans, for nature's own sake. In the first half of the 20th century, natural resource economics was firmly in Pinchot's side of that schism. That position began to change as the post-war environmental movement gained momentum. In particular, John Krutilla, an economist at Resources for the Future, pushed economics to the point that it could embrace Muir's vision as well as Pinchot's. Krutilla argued that if humans preferred a preserved state to a developed one, then such preferences were every bit as "economic." Either way, there were opportunity costs and an economic choice to be made.

I. INTRODUCTION

In popular discourse, one often hears about a tradeoff between economics and the natural environment. Historically, economists too, defining their discipline in terms of the science of material wealth and welfare, have spoken in these terms. By the 1960s, however, as economists came to redefine their discipline in terms of opportunity costs and as environmentalism became wrapped up in a new aesthetic consumerism, the tension of economics *versus* the environment gave way to a new economics *of* the environment. More than any other economist, John Krutilla forged this intellectual development. In contrast to earlier work by natural resource economists, which focused on *developing* resources, Krutilla pointed out that *preserving* resources also had value. Because development came at the opportunity cost of those preservation values, a science weighing reciprocal opportunity costs had to consider both sides of the ledger.

This paper tells the story of these intellectual moves. It consists of three parts. Part I reviews the historical background of the conservation movement in the United States, and the prominent schism between Gifford Pinchot and John Muir, a background against which Krutilla himself would frame his new ideas. Part II briefly considers Aldo Leopold, an ecologist who

wrestled with the inability of economics, as he saw it, to adequately justify the preservation of landscapes and ecosystems that he considered to have inherent value. In the face of the failure of economics to account for such values, Leopold advocated a new "land ethic" that would transcend economics. Part III then turns to Krutilla, who wrestled with similar issues as Leopold, but who came to a very different conclusion about the ability of economic science to defend preservation.

II. Gifford Pinchot and John Muir: Conservation or Preservation?

A crucial feature of the intellectual context in which Krutilla worked is the long divide between what are sometimes known as the "*conservation*" and the "*preservation*" sides of American environmental thought and politics, though these terms themselves have been politically contested and fraught with confusion. Crudely speaking, the conservation side advocated that resources be managed for sustainable use; the preservation side advocated that they be sheltered from use and kept in their wild state (or "locked up," as the conservation side would put it).¹ These two sides came to be personified by Gifford Pinchot and John Muir, respectively.

The son and grandson of wealthy real estate magnates and lumbermen, Gifford Pinchot (1865-1946) graduated from Yale University in 1889 and received post-graduate training in forestry at the *École nationale des eaux et forêts*, making him one of America's first professional foresters. His career swiftly grew: by 1898, he was appointed the second chief of the young US Division of Forestry (later to become the US Forest Service) and in 1900 he founded the Society of American Foresters. In the same year, he co-founded, with his father, the Yale School of Forestry. Eventually, he would become governor of Pennsylvania.

Pinchot advocated "wise use" of natural resources, which he interpreted in utilitarian terms, extending Bentham's maxim to encompass sustainability. He defined conservation as "the greatest good to the greatest number for the longest time" (Pinchot 1910 48, cit. Meyer 1997). In identifying threats to such wise use, he emphasized progressive-era concerns about waste and inefficiency as well as monopoly control, which concentrated natural wealth so that it would not flow to the greatest number (Pinchot 1947 pp. 506-7).

¹ The division is by no means unique to the American intellectual landscape. Worster (1977) contrasts the "imperial" approach epitomized by Linnaeus with the "Arcadian" posture of Gilbert White. Smout (2000) discusses the two rival themes of "use" and "delight" in the history of Scottish and English conservation.

John Muir (1838-1914) had a very different background. He was born in Scotland, moving to the Wisconsin frontier when he was 11. He worked on the family farm with his father, then in a machine shop, where he was expert on managing efficient work flows (Wolfe [1945] 2003). He always loved the wilderness, but led a fairly conventional life until an accident in 1867 left him blind for one month. After recovering, he decided life was too short to do anything but live for his passion, and so he went to the wilderness. He hiked 1000 miles from Indiana to the Gulf of Mexico, then famously hiked the Sierra-Nevada Mountains. There, he was inspired to think and write and, soon, to work on the signature project of his life: the preservation as wilderness of the area that would become Yosemite National Park. That work yielded fruit in 1890 with the passage of the Yosemite Act, the first act of conservation explicitly tied to preserving land in its wild state.² Understanding the need to watch over this new asset, Muir founded the Sierra Club in 1892 as an advocacy group and nascent political force.

In contrast to Pinchot's utilitarianism, Muir was a transcendentalist, reworking his orthodox Christian upbringing into a spiritual faith in Nature (Nelson 2010). He hiked with a well-thumbed copy of Emerson's essays, and his hero would eventually seek him out in Yosemite.³ To Muir, leaves, rocks, and bodies of water are "sparks of the Divine Soul." Landscapes are "blessed," "waters will wash away sins as well as dirt," and Nature shows material care ([1875] 1980 *passim*). Consequently, wilderness is the best avenue to divinity, for it best reflects God's creation, untarnished by human hands: "The clearest way into the Universe is through a forest wilderness" (quoted in Nash 1982 pp. 125-6).

Consistent with this spiritual view of Nature, Muir was explicitly anti-anthropocentric. "No dogma taught by the present civilization," he wrote, "seems to form so insuperable an obstacle in the way of a right understanding of the relations which culture sustains to wildness as that

² In contrast, Yellowstone, established in 1872, had been preserved as a "pleasuring ground" for its "curiosities." Earlier, the Yosemite Grant of 1864 had deeded 10 square miles to the State of California for a state park at Yosemite, but that small area soon became the center of a thriving tourist business (Nash 1982 Ch. 7). In contrast, the Yosemite Act of 1890 added nearly 1,200 square miles.

³ The encounter proved disappointing to Muir. He invited Emerson to join him "in a month's worship with Nature in the high temples of the great Sierra Crown beyond our holy Yosemite," but Emerson and his companions preferred the comfort of a nearby inn. Emerson later reciprocated, writing from Massachusetts to invite him to "bring to an early close your absolute contacts with any yet unvisited glaciers or volcanoes" and join him as a permanent guest, for wilderness "is a sublime mistress, but an intolerable wife." Muir declined. (Nash 1982 p. 126).

which declares that the world was made especially for the uses of man" ([1875] 1980 pp. 235-6). To the contrary, nature's value was intrinsic. For example, to a question about what rattlesnakes are good for, "[a]s if nothing that does not obviously make for the benefit of man had any right to exist; as if our ways were God's ways," he answered that "they are good for themselves, and we need not begrudge them their share of life" ([1901] 1980 p. 200).

Holding one another in mutual respect, Pinchot and Muir initially were allies against the status quo and laissez faire, which Muir referred to as the "gobble-gobble school of economics" (Wolfe [1945] 2003 p. 102). But that alliance began to unravel as the necessity of making specific land use decisions exposed their differences. For example, in 1891, the United States had established its first "forest reserves," creating some 13 million acres of Federal forestland, but how those lands would be used was by no means clear. In 1896, Pinchot and Muir both were appointed to a committee of the National Academy of Sciences commissioned by the Secretary of the Interior to survey the newly created reserves and to make recommendations about their disposition. Muir assumed they would be preserved as wild places, like Yosemite; Pinchot favored managed development for wise use. The committee could not agree on a recommendation, and individual members soon turned to working against one another in a game of political chess. In the end, the wise use side won, as Congress declared the purpose of the reserves "to furnish a continuous supply of timber" plus sustainable mining and grazing. When they met later that year, a comment by Pinchot supporting the grazing of sheep on Federal lands so enraged Muir, who had long viewed sheep as "hoofed locusts" that denuded natural landscapes, that Muir declared "I don't want anything more to do with you" (Nash 1982 pp. 130-138). The fault line dividing the leading spokesmen for the romantic and the bureaucratic impulses in American environmentalism had widened to a cleft.

The final, epic battle between Muir and Pinchot was fought, appropriately enough for the history of American environmentalism, over a dam. In 1906, shortly after its devastating fire, the City of San Francisco petitioned the federal government to allow the damming of the Hetch Hetchy valley, some 150 miles away in Yosemite, for municipal water supplies. In the end, the political forces in San Francisco carried the day, and the Hetch Hetchy was dammed, but not before a seven year fight that further opened the divide between the conservation and preservation camps (Hays 1959, Nash 1982).

Muir and his allies launched a furious campaign to preserve their beloved Yosemite. They emphasized its spiritual significance. "Dam Hetch Hetchy!" exclaimed Muir, in the final words of his book, *The Yosemite*. "As well dam for water tanks the people's cathedrals and churches, for no holier temple has ever been consecrated by the heart of man" (Muir [1912] 1989 p. 218). Significantly, Muir and the "nature lovers" also appealed to Yosemite's value as a place for recreation. As Nash (1982) argues, this was a strategic mistake, for the proponents of the dam could just as well turn this argument to their advantage, with the resulting reservoir providing many more recreational opportunities for boating and fishing. Interestingly, outdoor recreation would continue to be a vexing question for the evaluation of dams and a major driver of the development of environmental economics (Banzhaf 2010).

For his part, Pinchot appealed to Science and put the problem in terms of the utilitarian calculus rather than spiritual values. In his testimony to Congress, he framed the question as centering on "whether the advantage of leaving this valley in a state of nature is greater than . . . using it for the benefit of the city of San Francisco. While he admitted the idea of preserving the valley was appealing when viewed in isolation, the city's need was "overwhelming" (Nash 1982 pp. 170-1).

The clash between Pinchot and Muir extended to the very definition of the word "conservation" and related vocabulary. Pinchot claimed to have personally coined the term (Pinchot 1947 p. 326), though historians have considered that claim rather dubious (Hays 1959 pp. 5-6). Using his vocabulary, "conservation" inherently meant the wise use of resources. Muir and his allies would be said to advocate "preservation" in contrast to "conservation." Just what the union of the two terms would be called is by no means clear. (As Hays (1982) notes, importantly, the term "environmental" or "environmentalism" did not come into play until the post-war period.) For their part, Muir and his allies were unwilling to concede the term "conservation" to Pinchot. In their rival vocabulary, the wise-use or utilitarian school and the preservationist school were two sides of the "conservation" coin.

It is tempting to reduce the differences between Pinchot and Muir to a simple difference in values: Pinchot valued timber, Muir preferred wilderness. But as Meyer (1997) argues, there are difficulties with that interpretation. Pinchot in fact first went into forestry as an act of propitiation, motivated by the sense of damage his family's lumbering business had done to the woods

(Miller 1992). He frequently referred to the sublimity and beauty of nature. Describing his reaction upon first seeing the Grand Canyon, he wrote, "awe-struck and silent, I strove to grasp the vastness and the beauty" (quoted in Meyer 1997 272). By the same token, Muir was hardly the prototype of the misanthropic deep ecologist as some would paint him. He frequently conceded the necessity of forestry and development.

On Meyer's reading, the differences between Pinchot and Muir were as much about politics as values. Muir sought a space for wilderness sheltered from the pressures of political economy and built Tocquevillian mediating organizations like the Sierra Club. Given his spiritual view of wilderness, a reasonable comparison would be to the space traditionally given to religion in American politics and the role of mediating institutions like the churches. In contrast, Pinchot dismissed love of wilderness as private feelings that had no place in his technocracy. In the debate over the Hetch Hetchy, he conceded private feelings for the beauty of the wild valley, but gave no role to them in public decision-making. "The fundamental principle of the whole conservation policy," he testified to Congress, "is that of use, to take every part of the land and its resources and put it to that use in which it will serve the most people" (quoted in Nash 1982 pp. 170-1). Since love of wilderness was by definition omitted from his version of the utilitarian calculus, Pinchot's science of conservation management led inevitably to the recommendation to develop.⁴

Thus, both sides recognized the values espoused by the others, but could make no room for them in their politics. According to Muir's poetic and spiritual approach, one must serve either Nature or mammon; no one can have two masters. According to Pinchot's scientific approach, spiritual values had no place in the utilitarian calculus.

As I shall argue, dissatisfaction with this dichotomy—and particularly the exclusion of real values from the utilitarian calculus—led Krutilla to introduce important reforms in natural resource economics. Before getting there though, it will be useful to contrast Krutilla with a more famous figure in the American environmental movement, Aldo Leopold.

⁴ Later in life, Pinchot seems to have re-evaluated this position. As governor, he preserved the last large stand of virgin hardwoods (Miller 1992).

III. Do Economists know about Lupines? Aldo Leopold and the Environmental Turn in Conservation

Aldo Leopold (1887-1948) knew he wanted to be a forester from an early age. He went to a college preparatory school specifically for the purposes of going to Yale so that he could enroll in the School of Forestry, which had recently been founded by the Pinchot family. He arrived at Yale in 1904, first taking courses in the Sheffield Scientific School as preparation for the forestry school, where he did his graduate work. At Yale, Leopold obtained an interdisciplinary education in resource management, which included a great deal of economics, with a particular emphasis on Bentham's utilitarianism (Goodwin 2008). He began his professional career at the US Forest Service in 1909, during a period of time when it was headed by Pinchot himself. In 1933, he took a position at the University of Wisconsin's Dept. of Agricultural Economics, as a professor of Game Management. In 1935, he would co-found the Wilderness Society with Benton MacKaye, Bob Marshall, and others.

Leopold began his career firmly in Pinchot's conservation camp. But during his time at the Forest Service into the 1920s, he increasingly came to feel that forests and other resources needed to be managed for multiple purposes, and moreover that gaming and non-consumptive recreational uses should be given more weight than they were relative to the extractive activities like lumbering (Nash 1982, Callicott 1994, Newton 2006). In this respect, Leopold was perfectly in step with trends in natural resource management. The Forest Service had recently commissioned a report from Frank Waugh, a landscape architect (and father of leading agricultural and resource economics Frederick Waugh), which recommended recreation be given weight in management decisions.

While increasingly valuing these kinds of uses or purposes, Leopold still looked at the problem as a manager or economist would, as one of balance. He used marginal reasoning to think about the tradeoffs between consumptive and non-consumptive uses. Said, Leopold, "while the reduction of the wilderness has been a good thing, its extermination would be a very bad one." Explaining by analogy, he continued,

What I am trying to make clear is that if in a city we had six vacant lots available to the youngsters of a certain neighborhood for playing ball, it might be "development" to build houses on the first, and the second, and the third, and the fourth, and even on the fifth, but when we build houses on the last one, we forget what

houses are for. The sixth house would not be development at all, but rather...stupidity. (quoted in Nash 1982 pp. 187-8)

Eventually, however, Leopold became disillusioned with this way of thinking. To some extent, it could be said that he moved more to the preservation side of the spectrum from his start on the conservation side. He began as a forester, came to appreciate wilderness for its non-consumptive uses, and increasingly came to value wilderness for its own sake. But Leopold did not just shift positions in an existing intellectual landscape, he molded new ones. To Leopold, the conservation approach did not give enough credit to the intrinsic value of wildlife. By the same token, the preservation approach of "locking up" wildlife did not give enough credit to human beings. A third way was needed.

Leopold turned to the growing field of ecology as that third way. Man could live with wildlife as part of a complex web of interactions. This would require a new "ethic," a "universal symbiosis with land, economic and aesthetic, public and private" (Leopold 1933 p. 639, quoted in Callicott 1994). At the end of his life Leopold proposed a new interdisciplinary research and teaching project in "ecological economics," based on the premise that "industrialization is now bringing on a worldwide conflict between economics and conservation (ecology)" and that men from both sides of that conflict needed to be brought together to overcome the impasse (Lin 2014 p. 110, see also Newton 2006).

That Leopold, trained in conservation management and with a position in a department of agricultural economics, would frame the problem in terms of a conflict between economics and ecology is telling. To Leopold, economics—like Pinchot's calculus—inevitably discounted the intrinsic values of wildlife (Goodwin 2008). As he wrote in *A Sand County Almanac*:

Sometimes in June, when I see unearned dividends of dew hung on every lupine, I have doubts about the real poverty of the sands. On solvent farmlands lupines do not even grow, much less collect a daily rainbow of jewels. If they did, the weed control officer, who seldom sees a dewy dawn, would doubtless insist they be cut. Do economists know about lupines? (Leopold [1949] 1987 p. 102)

As Muir defended the rattlesnake, Leopold defended the mere existence of creatures absent narrowly construed utilitarian reasons for them. He understood that there were economic arguments for preserving nature, but he found these inadequate:

The emergence of ecology has put the economic biologist in a peculiar dilemma:

with one hand he points out the accumulated findings of his search for utility in this or that species; with the other he lifts the veil from a biota so complex, so conditioned by the interwoven cooperation and competitions that no man can say where utility begins or ends. (Leopold 1939 p. 727 quoted in Callicott 1994)

Leopold had no doubts about the real choice in this dilemma. The search for arguments based in utility, while sometimes valid, were too often futile—too ridiculous, even—to be the intellectual basis for conservation. Expanding on this point, Leopold wrote:

One basic weakness in a conservation system based wholly on economic motives is that most members of the land community have no economic value. Wildflowers and songbirds are examples. Of the 22,000 higher plants and animals native to Wisconsin, it is doubtful whether more than 5 per cent can be sold, fed, eaten or otherwise put to economic use. Yet these creatures are members of the biotic community, and if (as I believe) its stability depends on its integrity, they are entitled to continuance.

When one of these non-economic categories is threatened, and if we happen to love it, we invent subterfuges to give it economic importance. As the beginning of the century songbirds were supposed to be disappearing. Ornithologists jumped to the rescue with some distinctly shaky evidence to the effect that insects would eat us up if birds failed to control them. The evidence had to be economic in order to be valid. (Leopold [1949] 1987 p. 210)

For Leopold, something beyond economics was clearly necessary.

IV. John Krutilla and the Environmental Turn in Economics

If Leopold's distinctive move was to wed the romanticism of Emerson and Muir to the still ascending science of ecology, it was John Krutilla (1922-2003) who, remarkably, wed it to economics. Krutilla was a wilderness advocate, an avid outdoorsman who read Muir and Leopold, and friend of such figures as Margaret and Olaus Murie, leading US naturalists.⁵ Eventually he would serve as trustee of Environmental Defense (1971-74) and as an officer of the Wilderness Society (1973-76). Krutilla grew up on a Washington farm and earned a BA in economics from Reed College. He earned a PhD from Harvard in 1952, working under Walter Isard (regional economics) and Alexander Gerschenkrom (comparative economic systems and development), with a dissertation titled *The Structure of Costs and Regional Advantage in Primary Aluminum Production*. He began his career working with a natural resources development team at the Tennessee Valley Authority (TVA), but went to Resources for the Future (RFF) in 1955, where he

⁵ Personal communication with Kerry Krutilla, Oct. 20, 2015.

remained until his retirement in 1988.

Krutilla's Early Work

With his background in regional and development economics, Krutilla's early body of work represented a fairly conventional, albeit successful, application of economic theory to benefit-cost analysis, construed in narrowly materialistic terms. It included numerous pieces in applied journals and one in the *Journal of Political Economy* (1962). In one piece that would have important echoes later, Krutilla (1955) argued that regional development programs are better evaluated using benefit-cost analysis than by attempting to empirically estimate changes in regional output or income. He also suggested it would be useful to understand a program's effect on the supply functions of factors (like power and water) which are inputs into the production of goods for which demand is likely to increase as income increases. He called these "strategic factors."

Most notably among his early body of work, Krutilla co-authored the book *Multiple Purpose River Development: Studies in Applied Economic Analysis* with Otto Eckstein in 1958. The book was a cutting edge application of benefit-cost analysis to water projects, which had been *the* setting in the US which to apply benefit-cost analysis for a quarter century (Banzhaf 2009, 2010, Porter 1995). To detailed institutional considerations of water projects, it united a more sophisticated understanding of microeconomic theory than previous practitioners had brought to the topic, including discussions of capital markets, the cost of public funds, external economies, indivisibilities, and so forth. It then applied their analytical framework to four case studies, including the Snake River in the Columbia River tributary system (Krutilla and Eckstein 1958 Ch. V).

Hells Canyon was notable as a battleground between two rival philosophies of development: a progressive version of government investment spearheaded by the US Army Corps of Engineers and the Bureau of Reclamation, championed by New Deal democrats, and a pro-business version led by Idaho Power and championed by Republicans (Brooks 2006). The Engineers proposed one massive dam, while Idaho Power proposed a series of three smaller dams. Eventually, Idaho power's plan prevailed, and the last of the three dams was completed in 1967.

In *Multiple Purpose River Development*, Krutilla and Eckstein evaluated the relative merits of the two rival projects. Considering the standard purposes of water development—namely

hydroelectric power, flood control, and navigation—they found the Engineers' plan to be more efficient, but found a convex combination of the two, a hypothetical two-dam project, would be more efficient than either. Though the book in general and the application to the Hells Canyon specifically represented the frontier of benefit-cost analysis at the time, the times were rapidly changing. As Krutilla himself would later concede with a note of regret (Fisher, Krutilla, and Cicchetti 1972), the book limited its consideration of economic factors to physical production. In particular, it treated the "preservation" of wilderness for its "scenic appeal" as an extra-economic consideration, a value "in addition to economic efficiency" rather than one factor in the economic efficiency calculation (Krutilla and Eckstein 1958 p. 265).

Conservation Reconsidered

Sometime in the early- or mid-1960s, Krutilla appears to have made a deliberate pivot to address that deficiency and to combine his outdoor avocation with his economics profession, an intellectual move that would characterize the rest of his career. With his wife, Shirley Krutilla, he began to take a series of courses offered by the US Department of Agriculture and the Audubon Society, courses on ecology, meteorology, geology, soil science, and so forth.⁶

The intellectual fruits of this pivot first appeared in 1967, when Krutilla published the article "Conservation Reconsidered" in the *American Economic Review* (1967a) plus a more discursive version in *Daedalus* (1967b). In those articles, he borrowed the language of "conservation" and "preservation," which still carried the historical echoes of the dispute between Pinchot and Muir and their respective intellectual heirs. Specifically, he argued that economists, by ignoring the concerns of the preservationists, implicitly had biased benefit-cost calculations in favor of wise-use conservationists.

In making this case, the most fundamental point that Krutilla made was that there was a tradeoff between developing a resource and preserving it. In other words, developing a resource came at the *opportunity cost* of preservation, potentially meaning the loss of a unique or special landscape.⁷ And these costs were very real. Said Krutilla, "When the existence of a grand scenic

⁶ Personal communication with Kerry Krutilla, Oct. 4, 2015.

⁷ Smith (2004) comments that the historical use of the term "undeveloped" for natural environments seemed to give the impression that there were no opportunity costs of development, whereas labeling them as "preserved" conveyed a very different impression.

wonder or a unique and fragile ecosystem is involved, its *preservation* and continued availability are a significant part of the real income of many individuals" (1967a p. 779, emphasis added). By these "individuals," he clarified that he meant "the spiritual descendants of John Muir, the present members of the Sierra Club, the Wilderness Society,..., and others to whom the loss of a species or the disfigurement of a scenic area causes acute distress and a sense of genuine relative impoverishment" (p. 779 n. 7).⁸ They valued the "mere existence of biological and/or geomorphological variety and its widespread distribution" (p. 781). Such values would come to be known as "existence values" in the environmental economics literature.

To this over-arching point, Krutilla added two specific reasons why analysts should consider weighting the benefit-cost scales more in favor of preservation. The first centered on uncertainty about the future. Krutilla noted that whereas a decision to preserve always left open the possibility of developing later, in contrast a decision to develop had *irreversible* adverse consequences for preservation, since the landscape would be irretrievably lost, a point that would be further developed by Fisher, Krutilla, and Cicchetti (1972) and taken up by Kenneth Arrow (Arrow and Fisher 1974). Furthermore, drawing on Weisbrod (1964), Krutilla suggested that even if preservationists had no value for the resource at present, the possibility that they might would generate an "option value" in the presence of such irreversibility. All this implied not only that benefit-cost analyses of development projects were biased in favor of development whenever they ignored these opportunity costs, but suggested that many market transactions involved the problem of free-riding on the preservation side of the ledger.

Second, Krutilla argued that private markets were quite adept at providing substitutes for those scarce resources which served as material or energy inputs in private production. Consequently, the value of developing natural resources was decreasing over time. In contrast, markets underprovided environmental quality because of its public good nature. Moreover, demands for outdoor recreation and for the existence values of environmental quality appeared to be increasing over time. This logic reversed the traditional emphasis in natural resource economics on conservation. Said Krutilla,

⁸ Muir, and his followers in the Sierra Club, and Leopold, and his followers in the Wilderness Society, appeared often as figures in Krutilla's writings from this point on. Additional instances include Krutilla and Cicchetti (1972), Fisher and Krutilla (1974), Fisher, Krutilla, and Cicchetti (1974) and many others.

the traditional concerns of *conservation* economics—the husbanding of natural resource stocks for the use of future generations—may now be outmoded by advances in technology. On the other hand, the central issue seems to be the problem of providing for the present and future the amenities associated with unspoiled natural environments. (Krutilla 1967a p. 778, emphasis added)

Here, Krutilla seems to have been hearkening back to his earlier notion of "strategic factors," in which he had suggested that public investments in development should target resources that were inputs into the production of outputs with growing demand (Krutilla 1955). Only now those inputs were reinterpreted more broadly to include preserved environmental amenities.

This reinterpretation seems to have been in part a response to *Scarcity and Growth* (1963), a recent book by Harold Barnett (a colleague of Krutilla's at RFF) and Chandler Morse, and itself a milestone in the history of natural resource economics.⁹ After documenting in the greater part of their book that the costs of food and natural resources had not increased over time, Barnett and Morse reflected that natural resource scarcity could be overcome by self-generating technological change. As new resources and techniques substitute for old, they said, "the resource spectrum undergoes kaleidoscopic change through time" (p. 244). But in closing, they suggested that issues related to quality of life, to the distribution of income and "the intangible satisfactions derived from the appearance of the environment" (p. 252) may prove to elude substitution. What was needed, they suggested, was a more objective approach to our "value problem," a way to incorporate the tradeoffs between distribution, intangible benefits, and material wealth into the economic calculus. This was precisely the project Krutilla took up.

As Smith (2011) has noted, in "Conservation Reconsidered," we see Krutilla coming to grips with the same problems that so vexed Leopold. Leopold had argued that "one basic weakness in a conservation system based wholly on economic motives is that most members of the land community have no economic value.... When one of these non-economic categories is threatened, and if we happen to love it, we invent subterfuges to give it economic importance." These concerns led Leopold to forge compromises between economics, ecology, and other disciplines into a new land ethic. In contrast, Krutilla argued that if indeed we do love one of these categories in the land community, then that constitutes economic value. Their "mere existence"

⁹ Krutilla's young protégés at RFF, Charles Cicchetti, Anthony Fisher, and Kerry Smith, all recall that Krutilla was deeply affected by *Scarcity and Growth*. See Smith (2015) for additional discussion of its influence on Krutilla's thinking.

is a type of value. For Krutilla, development brings benefits but comes at the opportunity cost of foregoing preservation values (and vice versa); thus, the choice between development and preservation was itself an economic question. That is, the question was no longer one of economics *versus* the environment, but one of the economics *of* the environment.

A Shifting Landscape of Economic and Environmental Thought

These changes in Krutilla's thinking occurred within the context of larger intellectual developments in economics and the environmental movement. In economics, Lionel Robbins's (1935) definition of the field in terms of opportunity costs was rapidly displacing rival "classificatory" definitions. Those classificatory definitions had demarcated the territory of economics as limited to the business or material realms of life.¹⁰ When viewed in those terms, "spiritual" considerations such as the love of wilderness were decidedly non-economic.¹¹ But when viewed through the lens of Robbins's definition, natural resources are inherently scarce, so the choice to develop them or to preserve them entails opportunity costs, making it an economic choice. The distinction is illustrated in Figure 1. In the economics-as-material welfare view, the choice is about the trade-off between economics and wilderness. In the economics-as-opportunity-cost view, economics is elevated to govern the tradeoff between material welfare and wilderness. As Backhouse and Medema (2009) have shown, economists on both sides of the Atlantic were coming to embrace the new definition in the late 1950s and 1960s. Thus, it is no coincidence that Krutilla's intellectual evolution between *Multiple Purpose River Development* and "Conservation Reconsidered" occurred at the same time that Gary Becker was pushing labor economics to con-

¹⁰ For example, Marshall ([1920] 1946) defined economics as "a study of men as they live and move and think in the ordinary business of life. But it concerns itself chiefly with those motives which affect . . . man's conduct in the business part of his life [And] the steadiest motive to ordinary business work is the desire . . . for the material reward of work" (p. 14). Cannan (1922) similarly equated economics with wealth, which has to do with "material welfare" (pp. 1-3).

¹¹ See Banzhaf (2010) on the historical debates over this issue in natural resource economics during the 1940s and 50s.

sider the allocation of time, crime, and so forth. Both developments were an expansion of economics to new ranges of topics: opportunity costs were everywhere.^{12,13}

These changes in economics coincided with important historical developments in environmentalism. Indeed, properly speaking, one can hardly even speak of "environmentalism" before this period. Until World War II, the schism in American conservationism, represented by the rift between Pinchot and Muir, pitted natural resource managers pursuing efficiency against lovers of nature who approached nature on spiritual, rather than rational, terms. While those tensions remain with us today, the two categories of conservation and preservation re-arranged and reconfigured themselves in important respects. On one side, elements from the "preservationist" camp dropped Muir's spiritual focus and embraced the new science of ecology to bolster the case for preservation. For example, when Leopold transitioned from being a disciple of Pinchot to a lover of wilderness, he hardly dropped science in favor of spiritual transcendence. Rather, he fused a love of wilderness to new arguments for its importance drawn from ecology, while simultaneously urging people to abandon the zero-sum fight between development and preservation in favor of a new harmony between man and nature (Calicott 1994). At the same time, popular politics were giving stronger voice to conservation than ever before. The "conservationist" camp, which previously defined scientific management of resources only in terms of material uses, soon adapted to these political pressures (Banzhaf 2009, 2010, Hays 1982). As but one small but revealing example, during this period many state agencies simply swapped out their shingles reading "game managers" for ones reading "wildlife managers" (Hays 1982).

As Hays (1982) notes, the new "environmentalism" that emerged during this period was thus a fusion of ecology and the political economy of aesthetic consumption, rather than production. The changes in the applied economics of benefit-cost analysis reflected these broader

¹² As Backhouse and Medema (2009) note, Robbins's definition was simultaneously liberating and restricting. It liberated economists to consider new topics, but restricted them to using the tools of constrained optimization. In evaluating economics, Leopold had seen a discipline which could not yet conceive itself of addressing the environment in the way Krutilla would later do. But at the same time, to forge a new ecological economics, Leopold had been able to draw on a profession willing to embrace a wider set of human motives and a greater appreciation for institutions and history.

¹³ Interestingly, at the end of his career, Krutilla (1981) would place his work in the context of helping to meet Robbins' critique of applied welfare economics based on the impossibility of inter-personal comparisons of utility.

trends. As I have shown elsewhere (Banzhaf 2010), starting from a focus on material development in the spirit of Pinchot, the political pressures to nudge benefit-cost ratios in *favor* of development ironically forced economists to consider the recreation values of reservoirs in the 1940s and '50s, against their better judgement that economics should be limited to material considerations and avoid such spiritual intangibles. Once that threshold was crossed, however, it was no great leap to apply recreation benefits and related values to the preservation side of the ledger.

Shortly after "Conservation Reconsidered," Krutilla and Cicchetti (1972) made this point quite explicitly and succinctly, arguing that the "nub of the analytical problem" for many conservation questions was a tradeoff between two alternative purposes.

One purpose, associated with extractive activities, would convert the natural environment into intermediate products to satisfy the requirements of industrial raw materials used in production of final consumption goods. The other purpose involves the retention of the natural environment for the provision of a flow of services which enter directly into the utility function of final consumers. (p. 2)

"Spiritual" values for nature could be handled by economics by reinterpreting nature as something that provided services directly to consumers, as well as (or instead of) to producers of material goods.

Hells Canyon Revisited

These broader intellectual currents rippled through the Snake River. In 1957, the year *Multiple Purpose River Development* appeared in print, Pacific Northwest Power, a consortium of four private utilities, proposed yet another project in Hells Canyon, downstream from the earlier three, at what was known as the High Mountain Sheep site. The Washington Public Power Supply System (WPPSS) soon proposed a rival project nearby; then in 1962 the Department of the Interior proposed an alternative federal project at the High Mountain Sheep site. Thus, three parties were rivals to develop the same area. In 1962, the Federal Power Commission (FPC) ruled in favor of the Pacific Northwest Power. The Interior department, headed by Secretary Stewart Udall, sued the FPC over this decision, in part on grounds that Interior's plan would better protect anadromous fish, as required by law. While an appeal to the FPC and a trial upheld the initial decision, the case would eventually go to the Supreme Court of the United States. In 1967 in *Udall v. FPC*, the court by a 6-2 decision remanded the case to the FPC, ordering it not

only to reconsider *which* development proposal was in the public interest in light of further evidence about fish protection, but also *whether any development* was in the public interest in light of such concerns. The majority opinion stated,

The issues of whether deferral of construction would be more in the public interest than immediate construction and whether preservation of the reaches of the river affected would be more desirable and in the public interest than the proposed development are largely unexplored in this record. We cannot assume that the [Federal Water Power] Act commands the immediate construction of as many projects as possible. . . . The grant of authority to the Commission to alienate federal water resources does not, of course, turn simply on whether the project will be beneficial to the licensee. Nor is the test solely whether the region will be able to use the additional power. The test is whether the project will be in the public interest. And that determination can be made only after an exploration of all issues relevant to the "public interest," including future power demand and supply, alternate sources of power, the public interest in preserving reaches of wild rivers and wilderness areas, the preservation of anadromous fish for commercial and recreational purposes, and the protection of wildlife. (*Udall v. Federal Power Commission* 387 U.S. 428 1967 p. 449)

For the first time in the bureaucratic turf wars over river development, preservationists now had a seat at the table. In a very real sense, the modern era of environmental politics in America was born.¹⁴

When the case was remanded to the FPC, Krutilla entered as an expert "Friend of the Commission" in 1969. In contrast to his earlier work on Hells Canyon in *Multiple Purpose River Development* (Krutilla and Eckstein 1958), Krutilla now applied the arguments of "Conservation Reconsidered" (Krutilla 1967a) to the problem.¹⁵ Working with a team of young economists whom he assembled at RFF, including Charles Cicchetti, Anthony Fisher, and Kerry Smith, Krutilla would continue to develop the ideas in "Conservation Reconsidered" and their application to the Hells Canyon case in a series of publications in the early- to mid-1970s, including Fisher, Krutilla, and Cicchetti (1972), Krutilla and Cicchetti (1972), and Krutilla and Fisher (1975).

¹⁴ Hays (1982) considers the Hells Canyon episode the most dramatic example of the transition from the old politics of conservation to the post-war politics of environmentalism. For more on the history of the Hells Canyon episode, see Brooks (2006) and Ewert (2001).

¹⁵ Krutilla's testimony was recorded in the hearing transcripts, *Before the Federal Power Commission: in the matter of Pacific Northwest Power Company and Washington Public Power Supply System, project no. 2243/2273*. Unfortunately, I have not been able to locate these transcripts. My understanding of Krutilla's testimony is based on his later work, which includes citations to and comments about the hearings.

The basic argument outlined in Fisher, Krutilla, and Cicchetti (1972) is illustrated in Figure 2. The curve $D^*(t)$ is a hypothetical path of what the optimal development over time would be *if*, hypothetically, it were possible to reverse development. The path shows periods of increasing development followed by periods of decreasing development. But since development is irreversible, the downward-sloping portions of this myopic path are impossible. Ruling those out, the optimal path becomes $D(t)$. To maximize the present value of net benefits, the constraint imposed by irreversibility leads to a smoothed path which, relative to the myopic one, undershoots development for a time where the myopic path would be at its peaks but then overshoots it where the myopic path would be at its troughs. Fisher, Krutilla, and Cicchetti then assert that the gross benefits of preservation are growing over time, while the gross benefits of development are shrinking, as technological change reduces the costs of substitutes, a point made in Krutilla (1967a). Consequently, $D^*(t)$ would decline monotonically. Since that is impossible, the optimal $D(t)$ entails a bang-bang solution in the present period with no further development in the future.

Fisher, Krutilla, and Cicchetti (1972) employ a fairly complicated simulation model to apply this analysis to Hells Canyon. The model involves parameters representing a rate of technological change in private substitutes, growth rates (and deceleration in growth) in intercept and slope terms of a demand function for preservation, population growth rates, plus the "conventional" benefit-cost parameters related to development benefits and costs and interest rates.¹⁶ Fisher, Krutilla, and Cicchetti (1972) find that given the simulated rates of change, a base-period annual preservation value of \$52,000 to \$147,000 annually would be enough to tip the balance toward preservation and away from further developing the Hells Canyon dam. Since this was a fraction of the best estimates of recreation values, Krutilla et al. concluded that the economics supported preservation. The road from Pinchot to Muir had come full circle. Rational management of natural resources no longer required development, as Pinchot viewed it, it could also come out on the side of preservation.

V. Conclusions

Early debates over conservation policy in the US left a landscape in which rational calculation about material well-being was opposed to spiritual values for nature that defied quantification.

¹⁶ For the most detailed account of the model, see Krutilla and Fisher (1975) Chs. 5 and 6.

In the post-war period, however, that dichotomy was becoming increasingly untenable. Initially all too happy to concede the impossibility of measuring such spiritual values, economists in government were being dragged by political pressures into including recreation values in their benefit-cost analyses (Banzhaf 2010). Economists more broadly were reinterpreting their field as the study of opportunity costs, rather than by material wealth (Backhouse and Medema 2009). Preservationists following Aldo Leopold tried to build bridges between conservation and social sciences. Popular movements celebrated the natural environment with a new consumer spirit (Hays 1982). At the cross-roads of all these movements stood John Krutilla. Taking a little bit from all of them, he helped re-organize earlier debates framed in terms of economics versus the environment into a new field studying the economics of the environment.

REFERENCES

- Arrow, Kenneth J., and Anthony C. Fisher. 1974. "Environmental Preservation, Uncertainty, and Irreversibility." *Quarterly Journal of Economics* 88(2): 312-9.
- Backhouse, Roger E., and Steve G. Medema. 2009. "Defining Economics: The Long Road to Acceptance of the Robbins Definition." *Economica* 76: 805-20.
- Banzhaf, H. Spencer. 2009. "Objective or Multi-Objective? Two historically Competing Views for Benefit-Cost Analysis." *Land Economics* 85(1): 3-23.
- Banzhaf, H. Spencer. 2010. "Consumer Surplus with Apology: A Historical Perspective on Non-Market Valuation and Recreation Demand." *Annual Review of Resource Economics* 2: 183-207.
- Barnett, Harold J., and Chandler Morse. 1963. *Scarcity and Growth: The Economics of Natural Resource Availability*. Baltimore: Johns Hopkins University Press for Resources for the Future.
- Brooks, Karl Boyd. 2006. *Public Power, Private Dams: The Hells Canyon High Dam Controversy*. Seattle: University of Washington Press.
- Callicott, J. Baird. 1994. "A Brief History of American Conservation Philosophy." In *Sustainable Ecological Systems*, ed. by W. Wallace Covington and Leonard F. DeBano. Fort Collins, CO: Rocky Mountain Forest & Range Experiment Station.
- Cannan, Edwin. 1922. *Wealth: A Brief Explanation of the Causes of Economic Welfare*, 2nd ed. London: P.S. King & son.
- Ewert, Sara E. Dant. 2001. "Evolution of an Environmentalist: Senator Frank Church and the Hells Canyon Controversy." *Montana: The Magazine of Western History* (Spring): 36-51.
- Fisher, Anthony C., John V. Krutilla, and Charles J. Cicchetti. 1972. "The Economics of Environmental Preservation: A Theoretical and Empirical Analysis." *American Economic Review* 62(4): 605-19.
- Fisher, Anthony C., John V. Krutilla, and Charles J. Cicchetti. 1974. "The Economics of Environmental Preservation: Further Discussion." *American Economic Review* 64(6): 1030-9.
- Goodwin, Craufurd D. 2008. "Ecologist Meets Economics: Aldo Leopold, 1887-1948." *Journal of the History of Economic Thought* 30(4): 429-52.
- Hays, Samuel P. 1959. *Conservation and the Gospel of Efficiency: The Progressive Conservation Movement, 1890-1920*. Cambridge, MA: Harvard University Press.
- Hays, Samuel P. 1982. "From Conservation to Environment: Environmental Politics in the

- United States Since World War Two." *Environmental Review* 6(2): 14-41.
- Krutilla, John V. 1955. "Criteria for Evaluating Regional Development Programs." *American Economic Review Papers & Proceedings* 45(2): 120-32.
- Krutilla, John V. 1962. "Welfare Aspects of Benefit-Cost Analysis." *Journal of Political Economy* 69(3): 226-35.
- Krutilla, John V. 1967a. "Conservation Reconsidered." *American Economic Review* 57(4): 777-86.
- Krutilla, John V. 1967b. "Some Environmental Effects of Economic Development." *Daedalus* 96(4): 1058-70.
- Krutilla, John V. 1981. "Reflections of an Applied Welfare Economist." *Journal of Environmental Economics and Management* 8:1-10.
- Krutilla, John V., and Charles J. Cicchetti. 1972. "Evaluating Benefits of Environmental Resources with Special Application to the Hells Canyon." *Natural Resource Journal* 12: 1-28.
- Krutilla, John V., and Otto Eckstein. 1958. *Multiple Purpose River Development: Studies in Applied Economic Analysis*. Baltimore: Johns Hopkins University Press for Resources for the Future.
- Krutilla, John V., and Anthony C. Fisher. 1975. *The Economics of Natural Environments: Studies in the Valuation of Commodity and Amenity Resources*. Baltimore: Johns Hopkins University Press for Resources for the Future.
- Leopold, Aldo. 1933. "The Conservation Ethic." *Journal of Forestry* 31: 634-43.
- Leopold, Aldo. 1939. "A Biotic View of Land." *Journal of Forestry* 37:727-30.
- Leopold, Aldo. [1949] 1987. *A Sand County Almanac*. New York: Oxford University Press.
- Lin, Qi Feng. 2014. "Aldo Leopold's Unrealized Proposals to Rethink Economics." *Ecological Economics* 108: 104-14.
- Marshall, Alfred. [1920] 1946. *The Principles of Economics*, 8th ed. New York: Macmillan.
- Meyer, John M. 1997. "Gifford Pinchot, John Muir, and the Boundaries of Politics in American Thought." *Polity* 30(2): 267-84.
- Miller, Char. 1992. "The Greening of Gifford Pinchot." *Environmental History Review* 16(3); 1-20.
- Muir, John. [1875] 1980. "Wild Wool." In *Wilderness Essays*. Salt Lake City: Peregrine Smith.

- Muir, John. [1901] 1980. "The Yellowstone National Park." In *Wilderness Essays*. Salt Lake City: Peregrine Smith.
- Muir, John. [1912] 1989. *The Yosemite*. San Francisco: Sierra Club Books.
- Nash, Roderick. 1982. *Wilderness and the American Mind*, 3rd ed. New Haven: Yale University Press.
- Nelson, Robert H. 2010. *The New Holy Wars: Economic Religion vs. Environmental Religion in Contemporary America*. University Park: Penn State Press.
- Newton, Julianne Lutz. 2006. *Aldo Leopold's Odyssey*. Washington, DC: Island Press.
- Pinchot, Gifford. 1910. *The Fight for Conservation*. New York: Doubleday, Page, & Co.
- Pinchot, Gifford. 1947. *Breaking New Ground*. New York: Harcourt, Brace, & Co.
- Porter, Theodore M. 1995. *Trust in Numbers: The Pursuit of Objectivity in Science and Public Life*. Princeton, NJ: Princeton University Press.
- Robbins, Lionel. 1935. *An Essay on the Nature and Significance of Economic Science*, 2nd ed. New York: St. Martin's Press.
- Smith, V. Kerry. 2004. "Krutilla's Legacy: Twenty-First-Century Challenges for Environmental Economics." *American Journal of Agricultural Economics* 86(5): 1167-78.
- Smith, V. Kerry. 2011. "Inventing Price Systems and Substitutes for Them." *History of Political Economy* 43(2): 347-52.
- Smith, V. Kerry. 2015. "Krutilla's Conservation Reconsidered." Mimeo.
- Smout, T.C. 2000. *Nature contested: Environmental History in Scotland and Northern England since 1600*. Edinburgh: University of Edinburgh Press.
- Weisbrod, Burton A. 1964. "Collective-Consumption Services of Individual-Consumption Goods." *Quarterly Journal of Economics* 78(3): 471-7.
- Wolfe, Linnie Marsh. [1945] 2003. *Son of the Wilderness: The Life of John Muir*. Madison, WI: University of Wisconsin Press.
- Worster, Donald. 1977. *Nature's Economy: The Roots of Ecology*. San Francisco: Sierra Club Books.

Figure 1. Economics vs. the Environment contrasted with Economics of the Environment

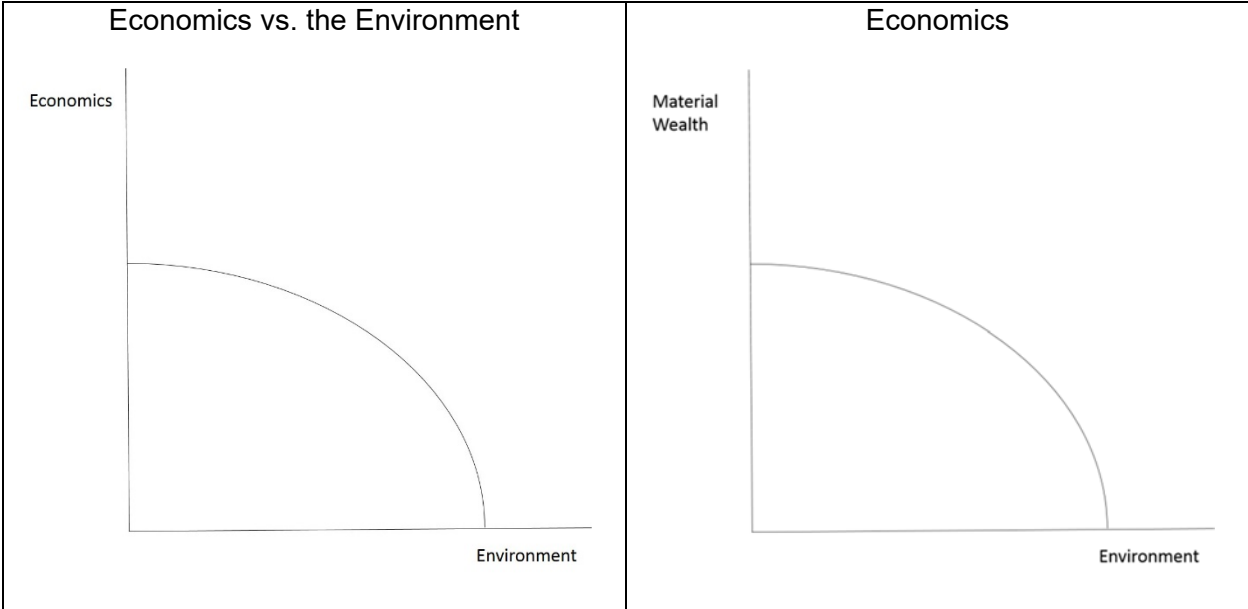
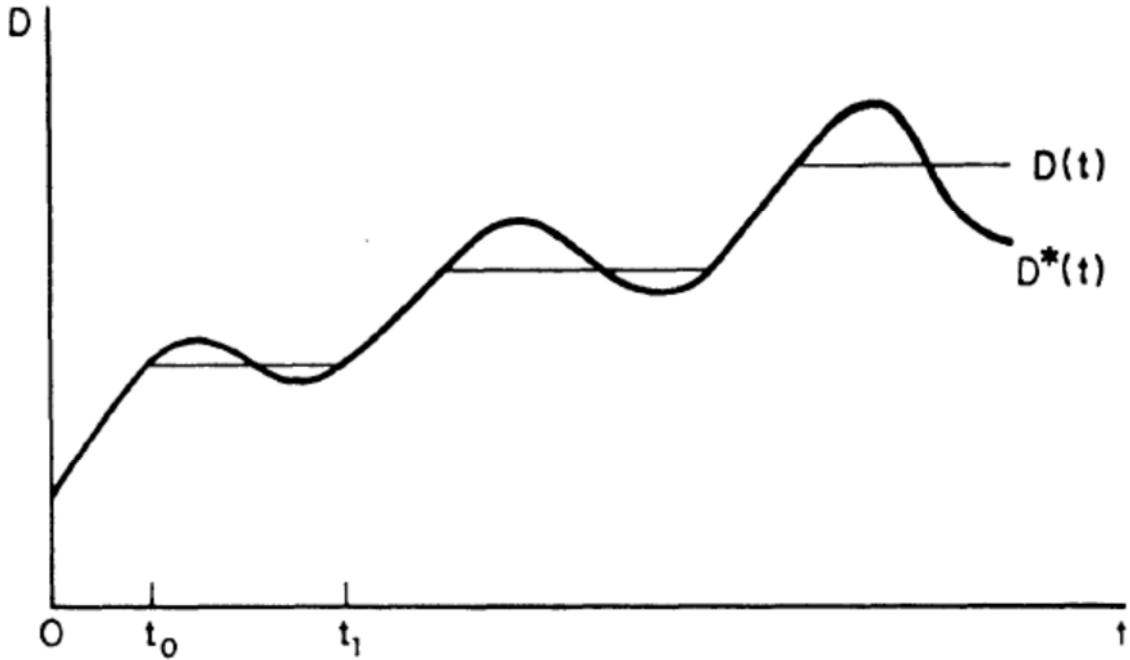


Figure 2. Irreversible Development



Source: Fisher, Krutilla, and Cicchetti (1972) p. 609.