TWO CAPITALISTIC RATIONALES FOR CONSERVATION

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Imagine that you are the director of the Office of Management and Budget. A proposal reaches your desk about a riskless project which will extract energy from the sun at an increased rate for 200 years. New production processes could use the energy to triple our GNP every year until 2180. Total project costs are negligible with one exception. The sun will explode and end life in 2180.

You reach for OMB Circular A-94, THE word since 1969 regarding "Discount rates and procedures to be used in evaluating deferred costs and benefits." Sure enough, after discounting benefits and costs, the project's net present value is phenomenal! Within weeks our government heeds the unanimous advice of investment analysts and commences the project. You sleep with comfort at having lived in the twentieth century.

Current capital theory is grossly inadequate as a tool for considering future generations' utility. There is something reprehensibly hedonistic about an investment decision rule which imposes a finite market value and time horizon on all rare, difficult to replace, or irreplaceable resources. This paper is an attempt to reconcile two concepts: MAXIM I - natural phenomena must be protected from destruction for short run gain; MAXIM II - capital theory discounting is the utility maximizing intertemporal allocation tool.

Pigou's unrest about "irrational discounting" [18, p. 29] of exhaustible resources is likely shared by today's environmentally aware economists. Today's analysts face a dilemma in the seeming inconsistency of maxims I and II. Using lower discount rates can slow down destruction of nature by inflating the present value of future benefits, but this is no solution for holders of maxim I. Why? Any positive discount rate would seem to place a finite market value on environmental attributes and thereby allow their destruction in the name of efficiency.² Holders of maxim I would reject any policy short of an outright ban on irreparable damage to natural phenomena. Such a ban would appear unacceptable to maxim II holders because it might imply foregoing utility maximizing investments.

Can a maxim I environmentalist also be a maxim II economist? This study consists of two separate theories which employ discounting, yet produce conservation. The first theory, INFINITE PRESENT VALUE (hereafter IPV), explains that capital theory can imply resource pricelessness under certain conditions. These conditions are: 1) the resource is a pure public good; 2) its benefits grow in value at a rate in excess of the discount rate; and 3) its

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dynamic benefit-quantity function is discontinuous. The reader is cautioned not to ask himself what he considers priceless. IPV is most fruitfully viewed as a pole which resource value may approach.

The second theory is the UTILITY MAXIMIZATION OF MANKIND PLAN (hereafter UMMP). UMMP explains that standard discounting procedures maximize utility only with respect to one point in time. Such maximization is 'time-specific.' UMMP provides a conceptual framework for maximizing the utility of all men regardless of when they live. It employs the discounting which Ramsey felt was "ethically indefensible." Using a different base time to define each man's objective (utility) function, it provides a blueprint for efficient environmental destruction and a solution for Ramsey.[19]

INFINITE PRESENT VALUE (IPV)

The case for IPV of some environmental attributes involves two steps: (1) establishing IPV as a theoretical possibility; and (2) explaining why it might occur in the real world. Step one includes a general equilibrium treatment of IPV, graphically. Step two discusses why benefits might grow fast enough for IPV to exist. Throughout this section, a two-final-good-world is assumed. Environmental attributes (E) represent the entire spectrum of natural phenomena and ecosystems. E will be variously represented as having substantial, limited or no regenerative ability. Manufactures (M) is the all-inclusive other good.

The Simple IPV Case

IPV of some benefit or cost stream results when the value of the stream grows faster than the discount rate r . If, for example, benefits = \$1 in the initial period (at time 0), benefits grow at 6% annually and $r=5\%$:

$$\$ \frac{(1.06)^0}{(1.05)^0} \frac{(1.06)^1}{(1.05)^1} + \dots = \$\infty$$

The owner of this income stream could be said to hold infinite wealth.³

In different contexts it has been argued that IPV options will not occur. The existence of such an option, Hirshliefer writes, "would necessarily set in motion forces that would adjust the rate of interest r upward so as to make the agent's attainable wealth finite again." The owner of the IPV option could purchase all other goods at market prices. However, "His attempt to exchange for consumptive purposes enormous future flows for large fractions of society's current income would drive up the price of the latter relative to the former -- raise the rate of interest r . The process can only stop when r rises high enough to make his wealth finite." [9, p. 88]⁴

This rebuttal to the possibility of an IPV option collapses, however, in the polar case of a pure public good. A public good is unique in the sense that individual ownership rights are not enforceable. No individual or group would seek to own a public good. A group could rationally and independently allocate resources toward producing protecting and improving public goods, but never toward owning them since there is no premium on ownership. Thus, the price of the public good to society is always the maintenance plus production plus opportunity costs. Price will not be bid up and r will not rise to choke off IPV.⁵

Consider the existence of wild birds as an example of a pure public good. If the occasional presence of free flying birds grows in value at a rate exceeding the discount rate, birdlife could have IPV.⁶ At the same time free birdlife would have no influence on the discount rate r . This results from the nonexistence of a private market for free birdlife.

One important rebuttal to the IPV possibility remains. Efficiency demands that we continue purchasing all goods until Marginal Benefit (MB) = Marginal Cost (MC). For a good with IPV this would initially imply spending our total present resources in its production or protection and still failing to reach equilibrium at point Z (figure 1). However, this process would involve trading present goods for future consumption and thereby raise the price of present goods relative to future goods. This price is the rate of time preference (RTP) or discount rate.⁷ In the next section we will show how discontinuities in the cost or benefit functions can prevent the RTP rise discussed in this paragraph.

Discontinuities and IPV in General Equilibrium

In this section we will use discontinuities in benefit functions to establish an IPV equilibrium where Marginal Cost of E (MC_E) exceeds Marginal Benefit of E (MB_E) [figures 2-a and 2-b]. This level of MC will be sufficiently low to eliminate RTP rising to choke off IPV as in the private good case or continuous functions public good case. Figure 2-a shows the result established in this section. At the equilibrium production level, E' , MC_E is below MB_E and has no appreciable impact on RTP, (i.e. the value of future, relative to present, consumption is unchanged. We could use discontinuities in cost function shown in Figure 2-b to produce the same result.

Such an analysis provides important insights. First, future production possibilities are critically dependent on current production decisions. Second, failure to recognize this dependence was merely inefficient in the past; in the future it could be fatal. Third, simultaneous determination of present consumption and its effects on future production possibilities is essential.

The model specifies that two goods, M (manufactures) and E (environmental attributes), are produced in each time period. Utility (U) is a function of M, E, and time (t);⁸

$$(1) \quad U = U(M, E, t).$$

A given quantity of E yields continuously increasing U as $t \rightarrow \infty$

$$(2) \quad \frac{\delta[U(E \text{ at } t)]}{\delta t} > 0.$$

U derived from a given quantity of M is constant through time;

$$(3) \quad \frac{\delta [U(M \text{ at } t)]}{\delta t} = 0$$

Increasing quantities of either E or M or both yield increasing U,

$$(4) \quad \frac{\delta U}{\delta E} > 0 \quad \frac{\delta U}{\delta M} > 0$$

Equations 1-4 are depicted in the preference map in figure 3. The solid lines represent points of equal utility at different points in time. Thus t_0 represents the initial period, and t_1 and t_2 subsequent periods;

$$U(E_0 \text{ at } t_0) = U(E_1 \text{ at } t_1) = U(E_2 \text{ at } t_2).$$

Figure 3 also assumes additively separable preferences or want independence in E and M. Most simply this means;

$$(5) \quad \frac{\delta [U(M)]}{\delta t} = 0 \text{ and } \frac{\delta [U(E)]}{\delta t} = 0$$

Figure 4 shows the M-E transformation curve for a production period. Its analysis will be simplified, but rendered no less relevant, by two assumptions. 1) M production involves only inputs E and L, a ubiquitous free labor supply. 2) Each time period has two segments. In the first segment production of M occurs. In the second segment: (a) M is consumed; (b) nature usually regenerates some E; and (c) E is enjoyed (non-destructive consumption). Utility is derived from consumption of M and enjoyment of E.

Let us examine figure 4. If no M were produced in t (i. e. period t), OE_t^M would exist as the t consumption segment began.

If E were a free good, production would occur at point Z and E_t^M of E would be destroyed. In this free E case, OM_t of newly produced M and OE_t^M of E would exist as the t consumption segment begins. Additional E destruction could occur only at reduced M.

Note that point Y on the transformation curve in quadrant 4 shows that a net loss of OM_t^M can yield a net man-induced production of $E_t^E E_t^E'$. This is equivalent to environmental restoration by foregoing current M production and spending M from previous periods.

Additional assumptions are required to determine the transformation curve's shape. First, M_t , the maximum M production possible at t , is a function of E_t^E , the initial E level, and technology at t . As time passes, the technological ability to exploit E and/or L grows;

$$(6) \quad M_t = M_t(E_t^E, L, t) \text{ and}$$

$$(7) \quad \frac{\delta M_t}{\delta E_t^E} > 0.$$

Second, M production is sensitive not only to the amount of E used, but also to the difficulty involved in using E. We will assume this difficulty rises as E^E , the initial E level at t , falls;

$$(8) \quad \frac{\delta M_t}{\delta E_t} > 0.$$

A real world example is the United States mustang population. Although freely available, the cost to fearless horse hunters rises as the mustang population falls.

Third, E_t is determined by OE_{t-1}^M , the E not used in t-1 production, and R, the capacity of nature to regenerate E. Real world examples of nature's regenerative capacity, R, abound. Rivers clean themselves, wind and rain wash the air, plants replenish oxygen. Thus, R accounts for the difference between the amount of E after production segment t-1, E_{t-1}^M , and the E available before production segment t, E_t^1 . For simplicity R is assumed to operate only if adequate E already exists. In figure 4, at E levels less than OR^* no natural E regeneration occurs.⁹ R^* is the tipping point.

Finally, OE_t^1 in figure 4 is the maximum E level attainable. This level results naturally when man performs no environmental damage.

The full operation of the model is shown in figures 5 and 6. Figures 5 illustrate three alternative growth processes. Figures 5.1 show a steady state economy with no growth in productive capability. Such a state is inconsistent with equation 7 above. Figures 5.2 show M production capability growing without changing E_t^M levels. This situation could result from legal constraints on E use coupled with improving production knowledge. Alternatively, if we recognize that M is an input in M production (we assumed it was not -- see equation 6), M accumulation could lead to figures 5.2 type growth.

Figure 5.3 should be examined carefully since they depict the growth closest to real-world experience. M output rises through E-exploitive technology progress while E_t^M and E_t^1 levels fall. This trade-off continues until man's ability to exploit free E overwhelms nature's regenerative ability (see figure 5.3d) $E_3^M < R^*$ and no E regeneration occurs. If private profit maximizing behavior is permitted in stage 5.3d, 5.3e production possibilities result. Note that 5.3e is equivalent to death of an ecosystem or, in the aggregate, the expiration of the environment and the life it supports.¹⁰

Figures 6 depict production possibility curves where maximum M production leaves $E_t^M = R^*$. Figures 6.1, 6.2 and 6.3 represent successive time periods and are analogous to figure 5.3d. Straight line segments were used in constructing these curves to facilitate exposition. Each curve's shape assumes production in the previous period left an E amount equal to OR^* . OR^* is the regenerative threshold point and the amount of E which, after one period of regeneration, yields $OE_1^1 (= OE_2^1 = OE_3^1)$. These curves also assume technological 'progress' through time. Thus, each production possibility curve is determined by technology and the previous period's production-consumption decision. Optimal decision making over time will require simultaneous solutions.

Recall equations 1-4 and figure 3. The continuously steeper indifference slopes described there are incorporated into figures 6. It was on the basis of this continual revaluing of E benefits that IPV was based. The task at hand remains to show why MC_E will not be infinitely high and thus induce a discount rate which chokes off of IPV.¹¹

The tangency positions in figure 6, S_t , all lie to the left of R^* . Pursuing any of these time-specific optima will lead to the production poss-

FIGURES

FIGURES 6

FIGURE 7

6.2

FIGURE 8.1

6.3

FIGURE 8.2

ibility curve in figure 7 in the next period -- certainly a suboptimal result at any reasonable discount rate! If S_t were to the right of R^* , time-specific suboptima, though inferior to a simultaneously determined dynamic optimum, would not result in catastrophic figure 7 type results.

Finally we can determine MC_E . MC_E in any period equals the utility lost moving from S_t to Z_t (figures 6), where Z_t is the maximum utility consistent with OR^* of E at time t . Thus, MC_E appears finite. The benefit is the infinitely valuable E enjoyment stream thereby protected.

Until technology and tastes move S_t to the left of R^* , time specific maximizing which fails to consider impacts on future production prospects is merely inefficient (figure 6). A simultaneous solution which explicitly considers the future is optimal. The difference between time-specific and simultaneous optima, when S_t lies right of R^* , is the finite difference between MB_E and MC_E at output E -sub (figure 8.1). The optimal equilibrium is at V , output E -optimal (figure 8.1). Figure 8.2 is a reproduction of figure 2 and shows the IPV result.

In the above sections we focused on the crucial assumptions of benefit growth and showed that IPV is theoretically possible if: (1) the resource is a pure public good; (2) its benefits grow in value at a rate in excess of the discount rate; and (3) the dynamic benefit-quantity function is discontinuous.

Benefit Growth

This section examines alternative reasons we might expect benefit growth. Since long run inconsistency poses problems for these alternatives the long run implications of discounting are also examined. A synthesis of all long run implications provides a less elegant but perhaps more plausible case for IPV than thus far presented.

Population growth increases the value of a pure public good directly. Thus, if population grows by $X\%$, then $(1 + X\%)$ (unadjusted benefit growth rate) = the actual benefit growth rate to society. But population growth cannot continue forever and IPV is based on an infinite summation.

If E enjoyed income elastic demand, E revaluation would accompany every income change. E would be a social luxury good and its benefit growth automatic in prosperous times. But here, also, long run problems emerge. No matter how low E 's current services are valued, continual income growth and income elastic demand for E are inconsistent. Why? Eventually E purchases would consume all income since income elastic E demand implies that the annual percentage increase in E exceeds annual percentage change in income. Clearly, no goods can be luxury goods forever if income continuously grows.

Dropping our want-independence assumption in figure 3 and adding goods that are E substitutes, any increasing scarcity of substitutes for E would increase E 's value. In the long run only a finite number of substitutes can be destroyed, however, and E benefit growth is again thwarted.

Let us now examine the long run implications of discounting. First, note

that in a perfect market with no risk or corporate income tax the opportunity cost of capital equals the rate of time preference (RTP) [2], [13, p. 14]. Should the RTP or discount rate be constant over time? Marglin writes that a constant discount rate is used due to ignorance about the appropriate rates for different periods [13, p. 48-49]. Let us consider this. Discounting at 6% implies we value today's public goods 10.3 times as much as we value the same public goods forty years from now. This appears highly reasonable. But do you regard public goods in year 2072 ten times more valuable than public goods in year 2112? Or year 3072 goods ten times those in year 3112? It seems there is a strong case for a discount rate that declines through time. Even in the short run, non-declining discount rates (abstracting from risk factors) appears questionable. One final question to those who claim no concern beyond 50 or 100 years -- would you pay \$1 or even \$0.01 to allow life in year 2172, or year 3000? If so then consideration of distant benefits is warranted.

Combining a declining discount rate and a declining rate of benefit growth can result in IPV. Declining rates of benefit growth can be generated by any combination of the taste, income elasticity, population and substitute scarcity factors developed above.

IPV Conclusion

As we said initially, IPV is best viewed as a polar case which resource value may approach. IPV represents one economic rationale for conservation. Our plea for recognition of benefit growth and discount rate reduction through time is not, however, tied to IPV. Such recognition, if incorporated into investment criteria, can lead to preservation of some natural phenomena, like the Grand Canyon, and ecosystems, such as Lake Superior, which might otherwise be destroyed.

UTILITY MAXIMIZATION OF MANKIND PLAN (UMMP)

Part III develops a completely different reconciliation of maxim I and II than that discussed in Part II. The Utility Maximization of Mankind Plan (hereafter UMMP) produces conservation yet employs discounting. The nature of UMMP is revealed below in a parable about a social contract.

What Discounting Does

An appreciation of what discounting does is a prerequisite for understanding UMMP. The objective function which we maximize in public investment decisions is the society's utility. Discounting determines the present value of different cost and benefit streams. Benefits and costs are reflected by market values at different points in time. More distant benefits are less valuable, under typical assumptions, for several reasons including interim investment possibilities and preferences for earlier consumption.

The society's valuation of a public good benefit stream is frequently viewed as the sum of individuals' valuation (e.g. [13, p. 12] and [15, p. 87-89]). These are determined with either personal or citizen discount rates. (See [12] for the citizen case). The objective, regardless of the discount rate chosen, is to maximize the then current society's utility. If society, as composed in 1972, derives utility from citizen-like recognition of future needs, it may choose a lower discount rate. The effect is to revalue upward all future benefits. If 1972 society suffers no altruistic spirit it may use an unaltered discount rate. In either case discounting maximizes only 1972 society's utility,

1973 society will contain different people -- people of different preferences. 1973 society's utility is not being maximized in 1972 decisions. It is even more clear that 1972 decisions do not maximize year 2072 society's utility.

This entire study is motivated by a belief that distant (and not so distant) ecological hazards are not adequately considered in current decisions. Given this perspective we strongly hold that 1972 society's utility maximizing decisions are not those that 2072 society would have them make. Discounting is a time-specific utility maximizing tool as presently used. UMMP could improve everybody's utility by maximizing utility over time.

Parable: UMMP -- A Social Contract

Long ago, before life began, there was a celestial meeting of delegates from mankind. Each delegate represented a group of people homogeneous in the sense that, faced with similar market power and alternatives, their utility functions were identical. Delegates reflected their own (and thus their constituents') utility functions when they spoke or voted at the meeting. Voters were to be weighted by constituency size and delegates did not know when they were scheduled to exist.

The meeting opened with an address from Mother Nature, the coordinator of all earth life. "We have run simulations of the development of human civilization and technology on our computer. A pervasive myopia is evident. Barring some agreement here, humans will deteriorate environmental quality so much by 2000 A.D. that many of you here would find life unbearable. Our objective is to find a way to maximize mankind's utility."

Mother went on to explain that discounting of benefits and costs with respect to one point in time in no way reflected future individuals' desires. She noted that resources were divisible into three groups: (1) those necessary for life such as the oxygen generating ecosystem; (2) non-life-support resources yielding positive values throughout time; and (3) resources having positive value during some periods and negative or zero value at all other times, e.g. oil and most manufactures.

The problems were evident. When should resources be used? How should irreplaceable or difficult-to-replace resources be handled? Should it be first come first served despite Mother Nature's dire predictions?

The first delegate to speak represented Sierra Club types. "Obviously, we should prohibit any activity dangerous to life support elements. Natural phenomena like the Grand Canyon are so important to human experience that they should likewise be protected."

Gordon Tullock objected. "That's like taking from the poor and giving to the rich! Mother's simulation shows that per capita incomes rise rather consistently throughout time. If people in year 2000 decide they prefer cheaper electricity to an unchanged Grand Canyon I do not think saving that canyon for subsequent generations with higher incomes makes sense. We must rely on discounting to determine benefit stream values. If we don't we will pursue inefficient monument building lives." (This quote is a take off on [21].)

Another delegate, William Baumol, reluctantly agreed. "The future can be left to take care of itself." But Baumol did not wish to leave himself open to charges of hedonism. "Irreversibilities deserve special attention, of course, but that is a separate issue from discounting. We should subsidize preservation as we see fit." [2, p. 80].

Mother commented, "That ivory tower perspective was used and failed in our simulation."

One very wise man, Jesus Christ, was present. He was so wise that he represented only himself since there were no humans with whom he was even vaguely homogeneous. He addressed himself to Tullock, "Man does not live by manufactures alone."

Tullock accused Christ of being a cathedral builder and the battlelines were drawn -- discounters vs. preservationists. A consensus appeared hopeless. Was discounting the utility maximizing intertemporal allocation tool? Should natural phenomena be protected from destruction for short run gain? Mother threw up her arms in frustration. Days passed with no consenses in sight.

Finally, one James A. Doilney exploded with exhilaration. He had a plan which employed discounting but produced conservation. Doilney, predestined to become an economist, said his plan would achieve the utility maximization of all mankind. Most simply it said "conserve for others what you would have them conserve for you."

Said Doilney, "Most of the investment decisions man makes at one point in time are consistent with future generations' wishes. We would like our predecessors to pursue the most profitable investments available. In this way they can best accumulate additional capital which can be employed in subsequent investments. In short, our incomes will generally be greater if we are preceded by industrialists than if by cathedral builders." Tullock was smiling.

Doilney continued, "Of course, condemning our ancestors to accumulate capital and consume only enough to subsist would provide us with higher incomes. In what follows, however, we shall assume each generation saves (for future generations) that fraction of income which it would have past generations save for it, subject to the constraint that all generations, past and future, save the same proportion of income." (This quote was inspired by [17, pp. 3-5].

Another delegate, Edmund Phelps, interrupted, "You know, I was thinking about something like that myself -- sort of a golden rule of economic growth."

Doilney answered, "Exactly, but this will be a golden rule of conservation. It forces decision makers to explicitly consider costs they impose on future generations.

"For expository simplicity, consider a small island surrounded by oceans on which only four humans were scheduled to exist. One would be parachuted from the sky every 70 years and each would have a life potential of 70 years all of which had to be lived on the island. Before the first dropped in, all four held a meeting like this one. They did not yet know in what order they were to exist. Mother Nature warned them that life could get unbearable if time-specific utility maximizing economic growth were pursued.

"In her infinite knowledge Mother sketched all the possible sequences of investments which could be pursued during the island's manlife. If the first island dweller, man 1, had two investment alternatives, unconstrained development and ecologically constrained development, and man 2 had two alternatives given each or man 1's choices, and so on, there would be 2^4 or 16 possible investment path worlds. Some of these paths left men 3 and 4 sickly

due to a polluted water supply but well served by electric air conditioners, can openers and toothbrushes. Other paths left the island basically unchanged with islanders living increasingly less arduous coconut tree climbing, tomato plant growing lives. Figure 9 shows the paths.

"The men-to-be examined the investment tree. 1 represents unconstrained development and 0, ecologically constrained development. Thus, path 1111 represents continuously unconstrained growth, path 1110 three periods of unconstrained growth followed by one period of constrained growth. If no meeting had been held each man would have individually discounted with his time preference rate, the costs and benefits of specific 0 vs. 1 decisions he faced. Given real world experience it would appear that time specific utility maximization would lead consistently to decision 1 and thus path 111. Only when survival itself were at stake would we expect time-specific discounting to yield a 0 type decision.

"Each man compared alternative worlds such as 1111 or 0111. Islanders' income, earned and spent in foreign trade, was the same real amount each year. Each man determined how much yearly income, as man 4, he would pay to live in, say, world 1101 instead of 1111. Each discounted from birth to determine the benefit loss he would incur if man 3 developed unconstrained instead of constrained. Multiplying each man's present valuation of loss by $\frac{1}{4}$ and summing they determined the expected loss to later generation(s) from man 3's decision.

"The computation of loss imposed was more complex the more distant the decision being considered. For instance, in determining the effect of unconstrained development 1, by man 2, they had to determine effects on man 3 and man 4. They found that a simultaneous determination of all investments would provide the optimum expected-utility yielding investment path."

Doilney explained that "UMMP involves the explicit inclusion of future losses, as determined above, on the cost side of any cost-benefit computation. A partial solution could be envisioned as follows. Assume man at one point in time finds he can maximize his time-specific utility by exploiting the environment. If, after including the costs imposed on future men, project costs exceeded benefits the investment would be ruled out. If benefits still exceeded costs the investment would be pursued. This latter result could lead to destroying natural phenomena when the time specific benefits exceeded losses to present and future men." 12

As soon as Doilney finished, questioning began. How well could foreign trade income function in reflecting utility losses? Why should the men reveal their true preferences when 'gaming' might better maximize their expected utility? In any real world decision, why should men consider future

losses? Couldn't they always do better if they broke the celestial pact? Should benefits lost always be capitalized from birth?

Doilney acknowledged that UMMP had problems with its unique inter-generational public good perspective but noted that most of these problems were not unique to this plan. With respect to measurement difficulties he pleaded ignorance. These difficulties were immense. Apparently control theory, a skill in which he was untrained, was essential to full model building. To a standing ovation and shouts of bravo Doilney set out on the journey to rigorously develop UMMP.

UMMP Conclusion

The Utility Maximization of Mankind Plan (UMMP) described in the parable could be formalized. The all-human weighted utility function should be identical with any time-specific social welfare function. This assumption abstracts from the time-specific commercial molding of tastes [7, p. 208-220]. It also assumes we have a random sampling of humanity at any point in time. Given the social welfare function and perfect knowledge about investment alternatives and their consequences, a simultaneous solution could yield a map for maximizing utility through time.

In addition to gaming and other public goods problems, UMMP has a unique enforcement problem. Any society could maximize its time specific utility by ignoring future costs its decisions impose. Consider figure 10. Suppose UMMP in practice was approximated by figure 5.2 and thus utility growth path ABE. 1972 society could maximize its utility by pursuing path BCD which is described in figures 5.3. Of course, 1972 society, in its recognition that earlier societies had foregone similarly destructive options, might choose to conform to the global maximization plan.

Some would have us believe that future generations will be relatively richer and therefore suggesting sacrifices for them is playing Robin Hood in in reverse [21]. To these we note the growing scientific consensus that future human life will be nonexistent or gravely changed barring immediate sacrifice by us [5, pp. 216-247]. We also note a perhaps emerging consensus that life is NOT getting better, that line ABE (figure 10) has been sloping downward for some time [16].

UMMP implicitly assumes that all men are created equal whenever they are created. The above analysis is objective only within this ethical framework.

UMMP avoids a rigid constraint against use of irreplaceable resources. It specifically considers the differing utility yielding lifespans of resources, like coal and the Grand Canyon. It employs discounting in the evaluation of benefit and cost streams. It replaces emotion with economic logic in discussions of what should be preserved and why. UMMP, in short, is a capitalistic rationale for conservation for those who want one.

CONCLUSIONS

This study developed two capitalistic rationales for conservation, Infinite Present Value (IPV) and Utility Maximization of Mankind Plan (UMMP). Both were the result of a basic dissatisfaction with the implications of standard capital theory. Economists qua economists would recommend destroying the sun if the present value of benefits minus costs was positive! Economists have had little to say about the value of species and natural phenomena preservation.¹³ They have valiantly milked demand curves and given them an extra dimension (option value) in the search for preservation rationales [10] [11].

IPV is best viewed as a pole which resources yielding growing benefits may approach. Recognition of benefit growth can change many decisions without any change in capital theory. Recognition of discount rate decline can likewise be incorporated into decision analysis without any theoretical changes.

UMMP provides a new conceptual framework for conservation. It explicitly recognizes our responsibility to future generations and emphasizes that maximizing a time-specific objective function avoids that responsibility by design.

Both UMMP and IPV employ discounting yet produce conservation. Both recognize a necessity for simultaneous determination of present and future production and consumption. Internalizing all costs is, at best, a second-best solution. As Coase has lucidly established, time-specific full cost production does not mean environmental destruction must cease. It merely means that we include time-specific externality costs in comparing production alternatives [4].

If economics is to become relevant in long run environmental planning its time-specific perspective must be recognized.

FOOTNOTES

¹For present purposes we will consider natural phenomena to include rare vegetation, animal species and land formations.

²We will show this implication to be incorrect below.

³Note that the mathematics imply IPV regardless of when the benefit stream growth rate begins to exceed the discount rate. Thus benefit growth starting in 2072 can yield IPV in 1972 calculations.

⁴Thompson's IPV rebuttal [20, pp. 1205-6] parallel Hirshliefer's. Masse felt absence of continually rising profits and falling interest rates reduced IPV to a mere theoretical curiosity. [14, pp. 19-20] For an essentially different use of IPV see the optimal savings literature, e.g. [20] and [3].

⁵Note the conservationist refrain that wildlife continually becomes more important as our lives grow more artificial.

⁶I assume throughout that government revenue levels are independent of program requirements, i.e. that government spends what it can. This perspective makes RTP, not opportunity cost of alternative private investment, the relevant discount factor.

⁷This dynamic preference assumption is discussed below.

⁸This conception, R , of nature's regenerative capacity is, of course, a tremendous oversimplification. It does, however, reflect the threshold of disruption beyond which many ecosystems collapse. See Commoner [5 pp. 1-124] for a detailed description of such collapse.

⁹The relevance of the section above hinges on the validity of figures 5.3. For a well-documented and well-reasoned argument that present technological progress is E-exploitive see Commoner [8, pp. 140-177].

¹⁰Even in 5.3e human restoration of the environment may be possible by choosing a production point such as Y.

¹¹See section above for interest rate choke off discussion.

¹²The cost-benefit rule which results compares time-specific benefits with time-specific costs plus costs to future men. The future is only considered from this cost perspective. The only 'alternative legacies' future men can compare are those generated by investments for which time-specific benefits exceeded time-specific costs. Thus, no present generation is asked to undertake unprofitable investments.

¹³For an explicit exposition of one absurd result of time-specific discounting see [6] Fisher, Krutilla and Cicchetti show that if benefits of preservation are growing, this year's optimal decision may be to develop, next year's optimal decision to preserve. My emphasis on benefit growth in part II was complete before I became aware of similar emphasis in [6] and [11].

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