Social discounting and the environment

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Preface

Giving the future less weight than the present when making decisions is known as temporal or time discounting. The practice of discounting is perfectly sensible in private capital investment. However, for public investments, most notably those with long term consequences, many feel uneasy with what is known as social discounting.

This publication has been written primarily for the New Zealand Ministry for the Environment. It follows another by the same author titled *Future generations and the environment*. That report was prepared to assist Ministry staff (and their public watchdogs) to interpret one of the five objectives in the New Zealand Environment Act 1986, that is, to:

> "*Ensure that, in the management of natural and physical resources, full and balanced account is taken of ... the needs of future generations.*"

Future generations and the environment contains a chapter on time discounting. That was a useful beginning but it is not enough.

Because the debate about discounting is very technical and difficult to follow, it is tempting to leave the problem to the experts to sort out. But the choice of discount rate used to evaluate public investments concerns us all.

> "*... the choice of the rate of discount ... is much more than a technical matter of interest only to economists and policy analysts. It embodies the values on which we make social choices that affect the state of our economy and our environment*" (Lind, 1982, p.8).

The aim of this publication is not to resolve somehow the issue of discounting environmental and natural resource costs and benefits. It is the more modest aim of opening up the debate to a wider audience. Because this publication is intended for a wider readership, some of the explanations may seem trivial or oversimplified to economists. But the intent is not to break new ground but rather to break down barriers between disciplines.

During the late seventies and early eighties a very active debate on social discounting took place in New Zealand. An interesting account can be found in Forbes and Meister (1984). The setting of a 10% real discount rate for all government investment did not resolve the disagreement.

In 1986, one eminent New Zealand economist wrote somewhat sardonically:

> "... *we face the daunting task of deciding on the actual rate of discount... But in New Zealand this conundrum was solved long ago by divine edict: the discount rate for government evaluation shall be 10% in real terms... While the rationale of the 10% has never been explained to me, the wags have it that it came in with the decimal system...*" (Van Moeseke, 1986).

In the last few years the ground of the discount rate debate has shifted. Government investment in natural resource development has been largely replaced by private or quasi-private (State Owned Enterprise - SOE) investment. Private companies can, of course, target their own rates of return and SOEs are not bound by the 10% rule. But the choice of discount rate by resource developers is still of interest to a public concerned with the depletion of natural resources. More generally, in "*taking account of the needs of future generations*" (Environment Act 1986), the public servants charged with this task should not allow such needs to be discounted away to nothing.

The structure of this publication is as follows. Chapters 1 through 3 are primarily descriptive dealing with the use and context of discounting. In Chapter 4 the various rationales for discounting are discussed. Chapter 5 is about the dilemma economists face in choosing social discount rates. In Chapter 6 the "ecological" criticisms of discounting are discussed. In Chapter 7 some alternative approaches for guiding decisions with long term consequences are presented. Finally, in Chapter 8, I have tried to draw together some assertions about social discounting that should at least provide the basis for some debate.

Acknowledgements

I wish to thank the Centre for Resource Management and the Ministry for the Environment for the opportunity to work in this area.

A number of people have helped me clarify my thinking on this very confusing topic. Geoff Kerr and Reinhard Pauls at the Centre for Resource Management have been good listeners but are not responsible for the result.

The constructive feedback from reviewers has been particularly useful. I thank Owen Cox from the Forest Research Institute, Professor Paul Van Moeseke from Massey University, Cath Wallace from Victoria University and Professor Arthur Williamson from Canterbury University for performing this task.

I presented a seminar on the contents of this publication which was organised by the Ministry for the Environment in Wellington in May 1989. A number of those present had been participants in the discounting debate of the late seventies and early eighties. Their comments and questions were very useful and I have borne them in mind during revision of the text.

Finally, I should like to thank Tracy Williams for her competent editorial assistance.

Chapter 1 Introduction

1.1 The controversy and the confusion

When a cost is to be paid or a benefit is to be gained in the future rather than in the current year, it is reckoned to be of lower value. Thus, future values are discounted back to the present. The higher the discount rate, the lower future costs and benefits are valued compared with the present.

Discounting is relevant to many aspects of environmental and natural resource policy. How should non-renewable resources be allocated over time? Is it justifiable to deplete renewable resources to extinction? What environmental burdens can we leave for our descendants to bear? Should we invest in research and development when payoffs are uncertain and distant?

Discounting is not controversial when it clearly represents the opportunity cost of capital. Neither is individual "biological" discounting under question; we all give greater weight to interests closer to us whether in time or space.[1] We discount all the time or how else would we restrain our obligations? Discounting should not be condemned as selfish; we do not consider parents selfish when they place much greater value on the welfare of their own children than on that of others. However, most of us do feel uncomfortable when the welfare of remote people - remote in time or space - is discounted away to zero. Thus, "social" discounting is another matter.

Social discounting is both controversial and confusing. Social discount rates are bundles of different concepts and the ensuing confusion feeds the controversy. The controversy often falls along disciplinary lines, suggesting that dialogue may help resolve it.

> "*The concept of 'discounting the future' is a point of fundamental contention between economists and moral philosophers. To economists, the concept is virtually axiomatic and thus beyond dispute. To many philosophers, the notion is, at best, arbitrary and unproved and at worst, absurd*" (Partridge, 1981, p.8).

"Ecologists", using the word in the increasingly common broad sense to encompass scientists and others who see biophysical limits as important constraints on human behaviour, are another group who find the practice of discounting alien to their view

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[1] See Wright, 1988, pp.50-52 for a discussion of biological discounting.

of the world. In New Zealand, forestry scientists in particular have been vocal about the narrow forestry practice into which they are confined by a 10% discount rate.[2]

Controversy occurs on a variety of levels. The debate is not just about the size of the discount rate. Further:

> "*Fighting over the proper rate of discount, for example, leaves other more important questions unasked*" (Goodin, 1982, p.53).

What are these "*more important*" questions? In his paper, Goodin focuses on the first three below; the remainder occur throughout the literature in different guises.

Why discount at all?

Why discount all goods the same?

Why discount all time periods the same?

Can utility be discounted?

Is there such an entity as a social discount rate?

Is positive discounting unfair to future generations?

Is the context of discounting - dynamic cost-benefit analysis - inadequate where there are long term consequences?

Ideally, one could frame up a list of such questions and try to put the controversy to rest by answering them. But some issues are simply not resolvable. For instance, within the neoclassical economic framework there are two different optimal social discount rates. (See Chapter 5.) Moreover, the questions are not easily separated. The following statement illustrates the convoluted nature of the debate.

> "*Just one of the problems in the natural resource sphere is that the discount rate is not independent of the state of the environment: high discount rates both contribute to resource degradation and are a symptom of it*" (Pearce, 1987, p.263).

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[2] "The effects of discounting at a 10% real rate, as the N.Z. Forest service has practised, has had profound effects on forestry." Among other things, it has "virtually confined production plantation forestry to radiata pine grown on short rotations" (Mead, 1986). "New Zealand Forestry" published an interesting exchange on the topic in 1986-87 (Fitzsimons, 1986; and Kerr, 1987). In reality, the New Zealand Forest Service used a 7% discount rate in their cost benefit analysis of all forest planting in 1986 (Pers. comm., Owen Cox, Forest Research Institute, 1989).

1.2 What worries people about discounting?

Many people feel uneasy when environmental goods and services are discounted in a cost-benefit framework. Conventional cost-benefit analysis (even with a low positive discount rate) seems to approve investment that will bring our generation some small net benefits but will inflict relatively large damage on future generations. Page makes this point with a "shock tactic".

> "*As you grow up, it is explained to you that the world is going to end very shortly because earlier generations wanted to live well... You might well call out to the ghosts of the first generation, demanding by what right it made its decision. It would be hardly satisfying to hear the answer, 'We took a vote of all those present and decided to follow our own time preferences'*" (Page, 1977a, pp.169-170).

Time discounting is, in the main, a technique of economics, but many economists are uncomfortable with it. Various pejorative terms like "*immoral*", "*myopic*", "*impatient*" and "*faulty telescopic facility*" have been used (Olson and Bailey, 1981, p.1). Pigou was one of the early critics.

> "*... there is wide agreement that the State should protect the interests of the future in some degree against the effects of our irrational discounting...*" (Pigou, 1932, p.29).

A later economist is far harsher. Writing on the generational time paths produced by economic models, Mishan says:

> "*In effect, the models are 'cooked up' so as to give the imprimatur of science to what is, after all, no more than a popular ethical judgement*" (Mishan, 1977, p.383).

The unease with discounting would be simpler to come to grips with if it were merely a matter of the size of the social discount rate. The popular version of the debate has "developers" with little regard for the (distant) future lining up with a high social discount rate against "conservationists" who argue for a low discount rate. But low social discount rates are not synonymous with preservation of the environment.

In the United States, environmentalists have favoured a **high** discount rate in the evaluation of regional water projects as a way of preserving natural areas. On the other hand, environmentalists have generally favoured a **low** discount rate in energy policy since high discount rates enhance the economic case for the rapid exploitation

of fossil fuel reserves (Lind, 1982, p.7). In New Zealand, similar inconsistencies have occurred.

Because the economic viability of a project is sensitive to the discount rate, the discount rate often becomes a strategic number. Thus criticism of the discount rate can be used (by various players) as a strategy for gaining some (value-based) end.

Chapter 2 The context of discounting

2.1 Dynamic cost-benefit analysis

Much of the unease directed at discounting is, in fact, misdirected. Rather the target should be its context, dynamic cost-benefit analysis, or at a deeper level, the underlying ethic of preference utilitarianism.

Cost-benefit analysis (CBA) is a framework for comparing the pros and cons (in dollars) of a project. When costs are incurred and benefits gained at different times, a dynamic cost-benefit model is used. Discounting is a weighting mechanism that enables costs and benefits that occur at different times to be compared.

When a firm considers putting money into a project, the future benefits (stream of profits) must be compared with the costs (both upfront and ongoing). The **market** or **private** discount rate used to do this is the interest rate. To a firm, earlier profits are more valuable than later profits since they can be loaned at interest.

Individuals also employ discounting in every day decision making, although most of us less formally than a firm does in planning its cash flow. Shall I buy now or save and buy later? **Consumer** discount rates vary enormously.

When the investment of public money is considered, another type of discount rate is sometimes used - the **social** or **public service** discount rate. (Whether these two are precisely the same for natural resource development agencies reformed into State Owned Enterprises is not clear.)

There are arguments from both ends of the spectrum that social discounting is not valid; one end maintains that government should discount at the same rate as the private sector, the other that discounting is not an appropriate weighting mechanism for government to use. In the middle is the standard position that the social discount rate is lower than the market discount rate.

There are two popular investment criteria in which the discount rate plays a critical role. The first involves bringing all costs and benefits back to the present, thus assessing the **net present value** (NPV). A positive NPV is a minimum indicator of "economic viability". The second criterion for acceptability is that the expected average rate of return (the **internal rate of return**, IRR) must be equal to the

discount rate. These criteria are not different versions of the same rule since they do not rank projects consistently.[1]

2.2 What worries people about cost-benefit analysis?

Some critics of cost-benefit analysis seem to believe that high positive discount rates are an integral part of CBA.[2] This is not so and it is essential to distinguish problems with CBA from problems with discounting.

What are the weaknesses of CBA? There are two common criticisms that are not the fault of CBA *per se*, but result from its misuse; these two are that CBA provides a too narrow basis for policy decisions and that there is potential for "*rule by experts*" (Pearce, 1983, p.2).

There are two major problems with CBA itself. The first is the problem of **valuation**. For instance, in a CBA of a forestry investment, the future price of timber must be predicted. But there is a more intractable valuation problem, namely the attempt to place dollar values on goods and services that are not sold. In an environmental context:

> "*The problem lies in the economic theory of value based upon the assumption that all assets are either reproducible or substitutable e.g., swimming pools for polluted beaches. Thus, at least in principle, permanent loss (non-reproducible) has zero value or has a value of infinity - permitting, perhaps, the surrogate value to be a function of the whim of the calculator!*" (Friend, 1979, p.72).

The necessity of expressing everything in dollars has been analogously (and colourfully) described as horse and rabbit stew. The rabbit is the small part that can satisfactorily be represented in dollars, whereas the flavour of the stew is dominated by the horse - the so-called intangibles (Norton, 1984, p.88). The horse is elusive.

> "*... we have to know the shadow price of environmental functions. And in most cases this cannot be found*" (Hueting, 1987, p.65).

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[1] "It is now widely (but not yet widely enough) realised that the present value criterion and the internal rate of return criterion lead to accepting and rejecting the same projects only if there are no budgetary limitations, if projects do not preclude one another, and if streams of net returns are first negative and then positive" (Stokey & Zeckhauser, 1978, p.167).

[2] See Pearce, 1985.

The second major criticism of CBA is that those who receive the benefits are not necessarily those who pay the costs; this is sometimes known as the **"divergence of costs and benefits"**. Cost-benefit analysis is a relaxation of Pareto optimality[3]; it does not matter where the costs and benefits fall and so compensation need only remain potential and not become actual (Page, 1977a, p.145).

> "... *trade-offs are all too easy to make when the gain is ours and the cost is someone else's*" (Pearce, 1977, p.360).

Thus, many see maximising the **present** value of benefits minus costs (max. NPV) as intergenerationally unfair.[4]

It is true that the use of the dollar as a numeraire causes great problems (and, like any numeraire, always will), and that CBA focuses on efficiency not equity. But what is CBA intended to achieve? No one methodology gives all the answers.

> "... *cost-benefit analysis is not a precise decision-making tool, but simply a means of summarizing information on some aspects of social welfare*" (Kerr, 1987, p.9).

Cost-benefit analysis works best on the margin, that is, when it is used to assess a project that is small relative to the economy.

Both Kerr and Pearce express concern with the way in which "*an outmoded conception of CBA*" (Pearce, 1985, p.674) is set up as a straw man. In fact, "*extended CBA*" (non-market valuation) is increasingly being used to make the case for the preservation of wilderness (Porter, 1982). Pearce makes the point that environmental destruction in practice often has nothing to do with CBA.

> "... *forest clearance in the Sahel or in Brazil, for example, has not been justified on CBA grounds but on grounds of macroeconomic objectives which reveal limited or non-existent understanding of the ecological requirements for survival*" (Pearce, 1985, p.674).

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[3] An outcome is Pareto optimal when no one is made worse off; under the present value criterion some people (or generations) can be made worse off as long as benefits exceed costs overall.

[4] Page comments on the present value criterion: "To an assembly of representatives drawn from all generations, this criterion would not look much more attractive than the scheme of vesting total ownership and management of the oceans' fisheries to one country this year, to another the next year, to another the following year would look to an assembly of present-day countries" (Page, 1977a, p.200).

Chapter 3 The mechanism of discounting

3.1 The mathematics

How does a discount rate of, say, 10% decrease the value of future costs and benefits relative to the present? Understanding the basic mathematics of discounting is crucial since the strategic nature of the discount rate is an outcome of the arithmetic of discounting.

Consider the most commonly used investment criterion, that of maximising net present value.

$$\text{Net value} = \text{benefits} - \text{costs}$$

In calculating net **present** value, benefits and costs must all be discounted back to the present. This is done using the following formula:

$$NPV = \frac{B_1-C_1}{(1+d)} + \frac{B_2-C_2}{(1+d)^2} + \ldots + \frac{B_n-C_n}{(1+d)^n}$$

Thus, if a project yields a net value 15 years from now of $1,000,000 and the real discount rate is 10%, then the net present value is:

$$\frac{\$1,000,000}{(1+0.1)^{15}} = \$239,000$$

There are two consequences of the mathematics of discounting that cause unease. The first is the sensitivity of economic viability to the size of the discount rate; the second is that over generational time, future costs and benefits virtually disappear. These two consequences are discussed in the next two sections.

3.2 The sensitivity of net present value to the discount rate

The result of calculations performed according to the formula above are extremely sensitive to the choice of the discount rate.

Consider for example, a company planning to build a new power plant. Should they build a coal-burning plant or a hydroelectric plant? Most of the cost of the thermally

generated electricity is due to the cost of coal - a stream of costs that stretches into the future. On the other hand, most of the cost of hydroelectricity is due to plant construction and is therefore concentrated in the present.

Suppose, for the sake of illustration, the coal plant would burn a million dollars worth of coal a year. The present cost of the coal burned in the twentieth year would be $149,000 at d = 10% but $554,000 at d = 3%. Thus a high discount rate favours the thermal plant because the fuel costs are heavily discounted. Conversely, a low discount rate favours construction of a hydroelectric plant.

An interesting example of the sensitivity of economic viability to the choice of discount rate occurred in 1959 when a CBA was performed on the proposed Passamaquoddy tidal power project. This was advocated as a joint Canadian-USA venture. The Americans used a discount rate of 2.5% resulting in a positive present value but the Canadians used a discount rate of 4.125% resulting in a negative present value (Stokey and Zeckhauser, 1978, pp.164-165). Presumably, the rational way out of the impasse - the Canadians subsidising the Americans - was not politically feasible.

In New Zealand in the seventies the loss of "economic viability" due to an increase in discount rate was used to curb over-enthusiastic government investment in irrigation projects. The Treasury insisted on a 15% discount rate for one class of projects rather than the standard 10% as a discouragement tactic (Pers. comm., A. McArthur, Lincoln University, 1990). A more direct method of expressing doubt would be preferable.

This sensitivity would not matter if discount rates could be determined objectively. But, historically, social discount rates have varied over a considerable range.

3.3 The long term

A second consequence of the mathematics of discounting is that, even at low social discount rates, the value placed on the welfare of future generations fades away to virtually nothing.

> "*The economic theory of discounting is a completely rational theory. For short periods of time it gives answers that seem intuitively right. For longer periods, we are not so sure*" (Hardin, 1981, p.224).

There are many dramatic examples in the literature to illustrate this effect. Pearce uses a hypothetical example involving the storage of radioactive waste (Pearce, 1983,

pp.52-53). Imagine that we know that a $10 billion accident will occur 500 years after we begin storing the waste. What is the present value of the cost of this accident using the relatively low discount rate of 5%?

$$\frac{\$10 \text{ billion}}{(1 + 0.05)^{500}} = 25c!$$

In general, people do not understand the power of compound interest (and, consequently, of discounting). This power may be better illustrated by discounting backwards in time. Manhattan Island was bought from its native American owners for 24 dollars. If we discount its present value at 6% back to the time of purchase, then 24 dollars was expensive! (Pers. comm., P. Van Moeseke, Massey University, 1989).

3.4 Some more definitions

Some more definitions will be useful at this point.

What is the difference between discount rates and interest rates? Arithmetically, the two are the same but they are used in different contexts. Interest rates are given to us; they are exogenous whereas discount rates are chosen[1]. (It is this element of choice and therefore, of values, that leads to such controversy over discounting.)

Further, the discount rate is a more general term than the interest rate. We do not speak of "social interest rates". Interest is earned on commodities including dollars whereas discounting is applied beyond dollars to utilities (Page, 1977a, p.149).

The difference between individual, market and social discount rates has already been discussed. There is one further important term. One reason why future values are discounted is inflation; we do not value $100 received next year as highly as $100 now in our pockets because we do not expect it to buy as much. In social discounting, this effect is usually subtracted out. Thus, if inflation is expected to average 8% over the time period of concern, a **nominal** discount rate of 18% is equivalent to a **real** discount rate of 10%. Expression of an NPV in **constant** dollars implies the use of a real discount rate.

Discount rates are generally positive. However, they may be zero or even negative as we shall see further on.

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[1] A good explanation of the difference between interest rates and discount rates is given in Stokey & Zeckhauser, 1978, pp.161-162.

Chapter 4 Rationales for social discounting

4.1 A mixture of rationales

The fundamental question to ask about discounting is why do it at all. To philosophers discounting is a mechanism for constraining obligations, and to economists it is a mechanism for trading off the future against the present.

But these general answers do not tell us how to discount; refining the rationale - the **why** of discounting - should tell us **how** to discount. And it is here that the controversy and the confusion discussed in the first chapter originate. Social discounting is based on a mix of (rarely stated) rationales.

It may be thought that rationales are revealed by the choice of discount rate. But this does not necessarily follow. While a high discount rate is generally taken as indicating less regard for the future, it could also, for instance, reflect a great pessimism about the future of humankind.

In this chapter I describe the various rationales that are given or assumed when the discounting mechanism is used. Various writers have discussed these rationales; the most complete attempts I have come across are those by the moral philosopher Derek Parfit (1983) and the public policy analyst Robert Goodin (1982). By focusing on the work of these two I do not wish to imply that economists are ignorant of their views.

Parfit lists six separate rationales and Goodin, four, but they cover much the same ground. These rationales are listed in Table 1.

Table 1. Rationales for social discounting after Parfit (1983) and Goodin (1982).

Parfit	Goodin
Democracy	
Probability	Uncertainty and risk
Opportunity costs	Opportunity costs
Our successors will be better off	Diminishing marginal utility
Excessive sacrifice	
Special relations	
	Pure time preference

Goodin's approach is much closer to the standard economic approach that forms the basis for the next chapter. Parfit goes somewhat deeper. He is not content to accept pure time preference as a rationale; he wants to know why people give preference to that which is closer in time.

The following discussion of Parfit's arguments is similar to that in Wright (1988). I have decided to reproduce it here because the arguments may become clearer in a different context.

4.2 Democracy

This argument is that if the majority of people in a country believe there is no need to worry about the future, then neither should the government. Individuals generally discount the future heavily and therefore so should a democratically elected government. Public policy should reflect the psychological time preference of the electors.

Parfit counters this by arguing that moral justification does not rest on majority beliefs. We do not approve Nazism because a majority of Germans supported it.

4.3 Probability

Uncertainty as a rationale for time discounting is presented at the beginning of utilitarian thought where Bentham gives it as one of two factors diminishing the value of a pleasure or a pain (Goodin, 1982, p.56).

The argument goes that uncertainty correlates with remoteness - in time, and in space to a lesser degree. We are uncertain about what will be viewed as valuable in the future; we are uncertain about the results of our actions and policies; we are uncertain about the achievements of future technology. Therefore, when we look ahead to future costs and benefits, we scale down their size.

But uncertainty does not always correlate with remoteness.

> "*... ignorance does not proceed by fixed percentage increments each year*" (Wenz, 1983, p.208).

and:

> "*When applied to the further future, many predictions are indeed more likely to be true*" (Parfit, 1983, p.33).

4.4 Opportunity costs

This is the "*most orthodox justification*" for discounting (Goodin, 1982, p.58). Benefits received earlier rather than later can be reinvested to yield more benefits. Thus, the argument is that the discount rate(s) used in the evaluation of public investments should be based on the rate of return that would be earned by alternative uses of the money. Under this reasoning, a zero discount rate is considered to favour the future over the present.

A basic problem with opportunity cost discounting is that it fails to distinguish between **investment** and **consumption.**

> "*It says that if you are thinking in terms of investments, you should demand the most advantageous rate of return, and you should discount less profitable investment opportunities in light of more rewarding ones. But there are some goods we want to consume rather than reinvest*" (Goodin, 1982, pp.58-59).

Freeman has argued that the opportunity cost concept of discounting can be used as a tool for intergenerational **equity** as well as intergenerational **efficiency** (Freeman, 1977). Because "*the exponential arithmetic of discounting works both ways*", part of the benefit from a project can be invested to provide monetary compensation when it is needed.[1]

There are a number of problems with this idea of an intergenerational compensation fund. There is no guarantee of compensation.

> "*The standard argument for discounting says that it is permissible to harm the future, as long as it might be possible to benefit the future on net balance by a compensating investment, <u>whether or not</u> the investment is taken*" (Page, 1983, p.55, my emphasis).

Further there is a presupposition that everything can be compensated for in money and another that "*the interest rate i actually <u>will</u> prevail throughout the period*", an unlikely possibility (Goodin, 1980).

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[1] Suppose a project with a positive NPV is initiated that imposes harms on the future. Freeman argues that some of the benefit from the project can be invested in order to provide compensation for these future harms. There will be plenty of money for such compensation. Just as discounting rapidly erodes a large future value to a small present value, interest compounds a small investment now into a large future amount. For some discussion of Freeman's compensation principle, see Mishan, 1982, pp.290-291, and Pearce, 1983, pp.54-55.

4.5 Our successors will be better off

If we believe that people in the future will be better off than we are now, we may decide to discount future benefits and costs. In economic language this is known as discounting for diminishing marginal utility. As more of a good is acquired the utility or benefit gained from each additional unit of that good falls. To not discount in an increasingly rich society is tantamount to the poor sacrificing for the rich.

Economists would question the validity of this rationale for discounting. They would prefer to see decreasing or increasing marginal utility dealt with explicitly by adjusting the values of future benefits and costs before discounting. However, this expectation does feed into pure time preference.

4.6 Excessive sacrifice

Consider a situation in which the present generation may bear a cost that yields benefits to an infinite number of future generations. No matter how large the present cost, it will always be outweighed by the sum of future benefits no matter how small the benefit to each future generation.

The corollary is that we must discount future benefits in order to avoid being obliged to make intolerable sacrifices for future people.

Parfit argues that although "*the argument from excessive sacrifice*" may be a valid reason for discounting in some instances, it is irrational to use it as a general argument for social discounting.

> "*Suppose that, at the same cost to ourselves now, we could prevent either a minor catastrophe in the nearer future or a major catastrophe in the further future. Since preventing the major catastrophe would involve no extra cost, the Argument from Excessive Sacrifice fails to apply. But if we take that argument to justify a discount rate, we can be led to conclude that the major catastrophe is less worth preventing*" (Parfit, 1983, p.35).

4.7 Special relations

It is observed that humans feel the greatest obligations to those closest to them both in space and in time. People feel greater responsibility to their children than to other children or to their great grandchildren. Most of us recognise stronger obligations to those with whom we have a special relationship whether it be shared

blood, values, country, race, generation or whatever. Thus, we discount for "*degrees of kinship*" (Parfit, 1983, pp.35-36).

This rationale is more commonly known as psychological discounting or biological discounting; economists tend to capture it within the expression "pure time preference".

However, discounting for kinship is not always acceptable. Parfit uses the example of atmospheric nuclear tests. Governments who protect their own citizens at the expense of aliens are not generally considered to be acting morally (Parfit, 1983, p.36).

Further, "*degrees of kinship*" do not decrease according to the mathematics of discounting. We feel obligations most strongly to the next generation, rather less to the next, and after that it tends to level out. Our feelings about the fifth generation from now are no different from those about the seventh generation from now.

4.8 Is a social discount rate justified?

Parfit's basic message is that **why** we discount will determine **how** we discount. He sees the mathematics of opportunity cost discounting as imposing an inappropriate form on other types of discounting. He is not saying that society should not discount but that there is no justification for **a** social discount rate, that is, for one formula and one value.

> "*It may often be morally permissible to be less concerned about the more remote effects of our social policies. But this would never be because these effects are more remote. Rather it would be because they are less likely to occur, or will be effects on people who are better off than we are, or because it is cheaper now to ensure compensation - or it would be for one of the other reasons I have given. All these different reasons need to be judged separately, on their merits. To bundle them together in a social discount rate is to blind our moral sensibilities*" (Parfit, 1983a, p.36).

Chapter 5 Choosing the "right" social discount rate

5.1 The lack of consensus

If the validity of social discounting (in the economic model) is accepted, at what rate should society discount? The failure of economists to agree on the procedure for choosing a social discount rate makes social discounting less than convincing to many.

In 1966, Resources for the Future held a conference on the appropriate rate of discount for evaluating water projects. After considerable debate, the question was asked of each participant: "*If you had to pick a single number, what would be your personal estimate of the appropriate rate?*" Answers varied from 2-4% to 20% (Lind, 1982, p.9). A second conference in 1977 came no closer to consensus on a single number.

> "... *at the time of this conference, the profession was no closer to agreement on the theory, on a procedure for computing the discount rate, or on a rate itself than it was in 1966. If anything, the work of the last decade showed that the issue is even more complex than we had thought and that the range of disagreement, not to say confusion, is as great as before*" (Lind, 1982, p.10).

In the last chapter we looked at the various rationales underlying social discounting. We saw that Parfit and Goodin were very suspicious of both the concept and the mathematics of social discounting.

However, most economists do accept the concept of social discounting. They see two basic rationales behind social discounting - **opportunity cost** and **time preference**. Where a philosopher like Parfit is concerned to know why time preference exists and whether it is "moral", most economists are content to accept that it does exist.[1]

Thus, the economists' problem is different. They look at two "valid" rationales for discounting and are faced with problems of choosing somehow between these two and of putting numbers on both.

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[1] I suspect economists would take issue with Parfit, and suggest that, at least some of the time, he is talking about problems of valuing future benefits and costs, not about discounting per se. It seems to me that this is what Goodin is doing with his discussion of "nontradable goods" (Goodin, 1982, pp.60-65).

In the quest for a social discount rate, to some extent the question of risk and uncertainty can be put to one side and dealt with separately. This leaves two candidates - should the social discount rate be the social opportunity cost of capital (SOC) or the social rate of time preference (STPR)?

5.2 Opportunity cost or time preference?

The social opportunity cost of capital has several other names in the economic literature such as the marginal efficiency of capital, the marginal net product of capital, and the rate of return.

If the social discount rate is taken to be purely the opportunity cost of capital, then there is no distinction to be made between private and public investments. Money for public investments is taken from the private sector via taxation and borrowing (Just *et al.*, 1982, pp.304-305). Accordingly, any distinction between public and private investments will result in misallocation of resources between the two sectors.[2]

However, most economists believe that the social discount rate should be less than the market interest rate. The two are only the same in an ideal market economy.[3]

> "*The market rate of interest ... may not reflect the value of using resources in investment projects which exceed the life of the present generation or in investment projects related to goods for which perfect markets do not exist (for example, public goods)*" (Just *et al.*, 1982, pp.299-300).[4]

It is because of the existence of public goods (including the welfare of the unborn) that the social rate of time preference may be different from the opportunity cost of capital. People acting collectively may choose different options from the way they

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[2] In practice company tax gets in the way. Even if company tax were eliminated the problem would not be solved because private investments are more risky (Baumol, 1968, p.798).

[3] See also Sen, 1984, pp.174-177 and Mishan, 1982, pp.234-236.

[4] Even if one believes that public investments should be discounted at the market rate of interest, what market rate of interest is to be used? As consumers we receive one rate of interest for our savings and pay another for loans such as mortgages. Businesses pay other rates. This variety is due partly to differences in risk (Page, 1977a, p.149). There is another problem with interest rates. "... it should be noted that interest rates are an important tool for macroeconomic policy; it seems unreasonable to have projects justified or not on the basis of the cyclical activity to which macroeconomic policy responds" (Just et al., 1982, p.300).

behave as individuals in the marketplace.[5] If the STPR is not equal to SOC then it is not directly measurable; it is the outcome of a conscious value judgement.

In what economists call a first-best world (one in which capital markets function perfectly), SOC does equal STPR. But we live in a second-best world. We are faced with two optimum social discount rates. SOC is optimal if one's focus is the efficient allocation of resources; STPR is optimal if the focus is consumer sovereignty (Pearce and Nash, 1981, p.164).[6]

What is the second-best social discount rate? One way out is the use of "synthetic" discount rates - amalgams of SOC and STPR (Pearce & Nash, 1981, pp.159-163).

In his exposition of the use of extended CBA in wilderness preservation, Porter summarises the economists' dilemma in hunting "*for a solution in the dark jungles of the second best*" (Baumol, 1968, p.789).

> "*Wilderness benefit-cost analysis cannot consider less than two interest rate concepts. One, the opportunity cost of capital (r), is eminently estimable, in principle and in fact. It is simply the (pre-tax) value of the productivity of the relevant marginal investments of the economy. The difficult estimate, in principle and in fact, is of the social rate of time preference (i). It must be used whenever society contemplates altering consumption, as opposed to investment, across time. But the greater ease of conceptualization and estimation of r, relative to i, has led some economists to recommend the rejection of i as a relevant ingredient in benefit-cost analysis*" (Porter, 1982, p.71).

5.3 A riskless social discount rate?

In dealing with uncertainty in dynamic cost-benefit analysis, a "risk premium" is sometimes added to the discount rate.

There are problems with this practice. For instance, uncertainty may not increase at, say, 2% per year and an inappropriate time path may be imposed on risk (Pearce, 1983, p.89).

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[5] This is known as the Sen-Marglin isolation paradox (Sen, 1984, pp.135-146).

[6] An effect of corporatisation and the use of a "more market" approach is the substitution of SOC for STPR.

Further, a risk premium is **added** to an interest rate when a stream of uncertain **benefits** (the return on the investment) is expected. When a stream of uncertain **costs** is expected, for example, environmental damages, a risk premium should be **subtracted** from the interest rate (Haveman, 1977, pp.368-369, Pearce, 1983, p.89). This distinction is not well understood.

It has been suggested that such a risk premium should be left out of social evaluations. Two reasons have been put forward for this - the pooling argument and the Arrow-Lind theorem (Haveman, 1977, pp.369-370). The pooling argument is that the uncertainties attached to the investment of public funds are pooled and negate each other. The Arrow-Lind theorem states that even though individuals may be risk-averse, risk neutrality is the correct position for society. These two reasons for neglecting uncertainty only apply under certain conditions. Haveman concludes:

> "*In the literature, then, the existence of social risk aversion is an unsettled matter... In spite of the Arrow-Lind theorem, numerous economists consider that social risk aversion is relevant in evaluating uncertain activities*" (Haveman, 1977, p.370).

Chapter 6 Ecological concerns

6.1 Introduction

Much of the criticism directed at cost-benefit analysis (and consequently at discounting) is "ecologically" based. Many scientists (and others) are dismayed at the notion of enormous future ecological damages being discounted to virtually nothing in present value terms. Some, conscious of biophysical constraints, find optimistic assumptions about substitution and technological potential worrying. That maximising the present value of a biological resource can prescribe its extinction discredits the approach for many.

It is these concerns that the Ministry for the Environment should be bringing into the decision-making process. Who else will ensure that "*full account*" is taken of such concerns in resource management?

In this chapter these concerns are put into three groups. The first involves situations where a stream of costs, that is, environmental damage, stretches into the future. The second is concerned with physical differences between types of resources - something that is unrecognised by standard economic theory. The third area of concern is with the role of technology.

6.2 A legacy of environmental damage

There are two aspects of future environmental costs that cause greatest concern - **cumulative effects** and **irreversibilities.**

Environmental damage is characterised by non-linearity, synergisms, thresholds, and so on. Thus, the cumulative nature of much environmental damage is critically important. The next increment of pollutant may tip the balance.

Neoclassical economics is a discipline based on linearity, where wholes are sums of the parts.[1] Cost-benefit analyses performed discretely - isolated from each other - are unlikely to deal adequately with the non-linear cumulative nature of environmental damage.

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[1] I am simplifying here. For instance, the isolation paradox mentioned in 5.2, "the possibility of a social contract by which everyone will agree to do something he would not be ready to do individually" (Sen, 1984, pp.145-146), fits into a systems view of the world rather than an atomistic view.

In a report on discussions in the United States in 1985, the European "ecological economist" Christian Leipert wrote about his concern that the focus of the U.S. Environmental Protection Agency is on CBA's of specific projects resulting in "*a worm's eye view of the status quo*".

> "*The fact that this institution, with its enormous scientific arsenals, is concerned exclusively with projects at the micro-level reflects its integration into the dominant political process, which is limited to political intervention for solving acute environmental problems. A macro-observation of the co-evolution of industry and the environment over the past fifteen to twenty years might produce insights into the crisis-producing and over the long term, untenable nature of prevailing trends in production and consumption*" (Leipert, 1987, pp.360-361).

Linked to the problem of accumulation is that of irreversibility. To a physicist, everything is irreversible; whereas reversibility lies at the base of neoclassical economics.

If our generation dams a river, then future people will have electricity and water for irrigation, but they will not have the option of not damming the river. They will be richer in monetary terms but poorer in wild rivers. Their marginal utility for undammed rivers is likely to be higher than ours. Thus, a CBA should show benefits from the wild river increasing over time - thus partly negating the discounting effect. Hence, irreversibility *per se* is not seen as a problem in CBA except where it is coupled with uncertainty.

When we destroy an environmental good, we do not understand all the consequences. On the one hand, we may have destroyed an essential component in a food chain; on the other, technology may develop to make the irreversible, reversible. Economists have responded to the problem of irreversibility by developing the concept of "quasi-option value". Quasi-option value is defined as "*the expected value of information gained from delaying an irreversible decision*" (Kerr and Sharp, 1985, p.93). However:

> "*While quasi-option value is definable, it is useless for decision making.....*" (Kerr and Sharp, 1985, p.95).

On an ethical level, irreversibility is seen as a problem. Moral philosophers find the utilitarian perspective on the intergenerational problem to be inadequate. One economist, Amartya Sen sees a welfare approach to "*calculated pollution*" as inadequate, and draws a startling analogy with torture.

> *"The avoidance of oppression of the future generations has to be given a value of its own"* (Sen, 1984, p.195).

Various alternative moral theories for dealing with the future generations problem have been proposed; the one that seems to be gaining some degree of acceptance is Brian Barry's *"justice as equal opportunity"* (Barry, 1983). Under Barry's theory, a legacy of irreversible environmental damage is seen as constraining the opportunities of future people and is, therefore, unjust.

6.3 Different resource classes

The classification of natural resources into renewable and nonrenewable (and variants thereof) appears irrelevant to many economists. But there have been suggestions that physical characteristics of different resources should affect the discount rates used in their allocation. The case has been put in some instances for zero or negative discount rates.

Consider biological resources like fish. Part of the reason for overexploitation is *"the tragedy of the commons"*, but correction of this does not preclude extinction. What is overexploitation of the fisheries resource? To an economist it is overharvesting beyond the point of maximum present value. To an ecologist, it is harvesting beyond a sustainable level. Hence, from an ecological point of view, the discount rate should be linked to the biological productivity rate.[2]

> *"The present value criterion may transform renewable resources into essentially nonrenewable resources, time-dated for exhaustion, as is true in some cases for timber"* (Page, 1977a, p.167).

When might the discount rate be zero or negative? The analogy is often used of shipwrecked sailors in a lifeboat with one source of food - a store of decomposing hardtack (ship-biscuit). It seems reasonable that the sailors will value a fraction of a piece of hardtack received tomorrow more highly than a whole piece today; in effect a negative discount rate is used (Stokey and Zeckhauser, 1978, p.175).[3]

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[2] Biological resources can survive even if the biological productivity is less than the discount rate because the costs of extraction may rise to eliminate the profit from extraction as the resource becomes more thinly dispersed (Page, 1977a, p.167).

[3] If the hardtack decomposes, the discount rate should be negative; if the hardtack does not deteriorate, then a zero discount rate is appropriate. Discounting at a negative discount rate is not unknown; people frequently save at an interest rate less than inflation, that is, at a real negative interest rate. For an argument that the discount rate most appropriately applied to energy may be zero or negative, see Hall et al., 1979, p.502.

If however, the lifeboat washes up on an island and the sailors find they no longer live in a hardtack world but in one which can be made productive, a discount rate of zero would be unfair to the present.

There is some disagreement about the validity of the hardtack example. Does the sailor who values a fraction of hardtack tomorrow more highly than a whole piece today have a negative discount rate or is the benefit to be derived from a gram of hardtack rising fast enough to more than counteract a positive discount rate? The distinction seems to be a matter of definition rather than substance.

Thus the question of a "fair" discount rate depends critically on beliefs and assumptions about limits to productivity, substitutability and the potential of technology.

> "*While many economists realize the inability of the present value criterion to resolve conflicts across generations, they may not recognize it as a serious failure. They tend to think that the world economy is not a hardtack one, but an investment one in which the future will be better off than the present... Conservationists, on the other hand, tend to think that the world has certain hardtack tendencies and may, unless steps are taken, drift irrevocably into a hardtack economy*" (Page, 1977a, p.170).

6.4 Technology and substitutability

Why is it acceptable for a biological resource such as a fish species to be made extinct by the application of the present value criterion? The response to this lies in the assumption that technology will continue to outpace depletion. The famous study by Barnett and Morse in 1963 showed that the prices of raw materials have fallen in real terms over the last century in the United States (with the exception of timber).[4] However, extrapolation of this trend into the future is being increasingly criticised. For instance:

> "*Of course the past century can hardly be taken as a guide to the next century. The enormous tracts of land that were opened up in the past century were quite literally a last frontier. Neither the path of technology nor the search for new resource bases, such as the sea, is bound by previous history*" (Page, 1977a, p.176).

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[4] This expression of the Barnett and Morse finding is rather simplistic. They compared market prices of raw materials not prices at the pithead. Falls in market price will be affected by efficiency gains at all levels. Depletion is but one factor. (Pers. comm., P. Van Moeseke, Massey University, 1989.)

Goodin expresses this problem in terms of "nontradable goods" - goods that cannot be bought and sold in the marketplace. The loss of nontradable goods "*cannot be made good by gains (however large) in stocks of other goods*" (Goodin, 1982, p.67).[5]

Mistrust of technology is widespread; increasingly, it is recognised that technological advance creates problems as well as solves them.

> "*Arguments to the effect that 'technology' will solve the resource problem are naive in that they fail to comprehend the fact that technological change is not itself costless*" (Pearce, 1977, p.361).

Many of these costs are environmental. Page draws attention to a "*Gresham's law*" of technology.[6]

> "*A century ago air pollution was mostly visible black soot, now it is much more complicated, with its pollutants more deadly and less visible... The natural selection of the market favours those technological improvements least likely to run into government prohibition; that is, ones whose effects are least visible and definite*" (Page, 1977a, pp.177-178).

Some interesting work has been done in New Zealand on incorporating technological change into the social discount rate (Van Moeseke, 1988). Paul Van Moeseke has proposed that the discount rate used in setting mineral depletion programmes equal "*the long-run rate of technical progress plus the secular rate of appreciation*". This, he contends, neutralises "*intergenerational bias*". If the rate of technical progress is 1% and the real price rise (reflecting increasing scarcity) is 2%, then a 3% discount rate is "fair".

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[5] I have discussed this in an earlier publication in terms of "unallowable harms" and "essential goods" (Wright, 1988, pp.65-70).

[6] Gresham's law, which originated in the sixteenth century, states that "bad money drives out good money", that is, coins with a high proportion of base metal would remain in circulation while coins containing valuable metal would be hoarded. The law is useful in understanding environmental problems. For instance, in the USA, a Gresham's law of pollution and labour has been observed where states with lax pollution and labour laws attract industry.

Chapter 7 Alternative intergenerational decision criteria

7.1 Uncovering the ethic

Cost-benefit analysis is, as Kerr reminds us, "*no more than a means of presenting information which relies on an underlying set of value judgements*" (Kerr, 1987, p.9). However, in practice, the underlying value judgements are seldom mentioned and the criterion that net present value be positive is taken as an objective rule.

The popular ethical judgement underlying cost-benefit analysis is the moral theory known as preference utiltarianism. It is not universally accepted as an adequate moral base for governing our behaviour toward our contemporaries, let alone as a grounding for our responsibilities towards people in the future.[1]

Other criteria for making decisions with long term effects have been suggested; in each case there is an implicit moral theory. Consideration of these alternative criteria should focus on both the criterion and its underlying ethic. Three criteria and their associated ethics are discussed in this chapter.

7.2 The sustainability criterion

An emphasis on justice rather than utility that derives from the work of John Rawls lies at the base of the concept of sustainability.

The concept of sustainability obviously strikes a chord in the environmentally concerned; a majority of submissions on the proposed resource management legislative reforms in New Zealand "*favoured sustainability being the keystone of the new laws*" (Ministry for the Environment, 1988, p.15).

A great deal of effort has gone into attempts to define sustainability.[2] For the purpose here, a simple definition is adequate.

> "*The basic requirement is sustainability, which we take to mean (i) conditions for the survival of mankind, and (ii) conditions for the tolerable survival of mankind*" (Pearce, 1985, p.673).[3]

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[1] There is a growing literature of alternative moral theories on which we might base our obligations to future generations (Wright, 1988, pp.12-35).

[2] For one effort in this country, see Baines et al., 1988.

[3] I am aware that some will object to the anthropocentric nature of this definition.

Page argues that we need two criteria (with different strengths and weaknesses) for governing resource use policy. The conservation (sustainability) criterion and the efficiency (present value) criterion "*do not clash head-on*" since one "*looks to the long run, the other to the short run*" (Page, 1977a, p.204).

On the other hand, in a debate with Doeleman on the validity of cost-benefit analysis, Pearce claims that "*modern*" extended cost-benefit analysis can incorporate the requirement of sustainability using the new concepts of option value, existence value and bequest value. Doeleman's response is that, in practice, the political reality of CBA is one of high discount rates (Pearce, 1985, p.676).

7.3 Almost-anywhere dominance and Pareto dominance

In an attempt to show that discounting is only one way of going about intergenerational allocation, Talbot Page proposes two other candidate criteria - **almost-anywhere dominance** and **Pareto dominance.**

> "*The purpose of this article is, by way of a few simple illustrations, to place the discount rate mechanism in the more general context of intergenerational social choice. By doing so, it can be seen that discounting, as it is traditionally practised, is just one among many possible decision rules - and a narrow one at that*" (Page, 1977b, p.377).

The almost-anywhere dominance criterion is simply that a majority of the generations affected by a project "vote" for it. Page describes it as an intergenerational version of majority voting in contrast to discounting which he sees as "*the dictatorship of the present generation*".

The Pareto dominance criterion is that a project is only socially preferred if all affected generations vote for it; it is tantamount to intergenerational unanimity voting. It is not necessary that the benefits of the project exceed the costs to all generations as long as compensation is made.

How might we guess how future generations will vote? Pearce and Nash propose the use of a "*regret matrix*" to make explicit the options and the costs of having generations disagree with each other on a particular programme (Pearce and Nash, 1981, pp.209-211).

Page illustrates the three criteria - discounting, almost-anywhere dominance and Pareto dominance - by comparing a **hypothetical** solar energy programme with a **hypothetical** nuclear energy programme (Page, 1977b, pp.378-379). The solar programme is expensive initially and net annual benefits build up slowly. However, once established the net benefits remain virtually constant into the future. The nuclear programme is far more attractive for the first two generations, but due to waste disposal and risk costs is less attractive than solar thereafter.

In Page's example, the discounting criterion favours the nuclear programme (unless d is lower than 1%). The almost-anywhere dominance criterion favours the solar programme and the Pareto dominance criterion favours neither.

Page is not advocating either criterion as an alternative to discounting. His point is that other intergenerational social choice rules can be devised and that discounting focuses rather too much on **efficiency** at the expense of **equity**. He notes that equity has been incorporated into social choice within generations in a piecemeal rather than a consistent fashion and suggests that we bring equity into intergenerational social choice in the same way.

Thus, rules of thumb such as "*any programme which benefits only one generation and hurts all others is socially unacceptable*" may be the best way of capturing our concerns for intergenerational equity.

Chapter 8 Conclusions

8.1 Some assertions about social discounting

I have termed the following statements "assertions" because not everyone will agree with them. They do not comprise a systematic summary of the content of the publication but rather are intended to capture the main concepts.

(a) Discounting at a positive rate is not necessarily unfair to the future.

The fundamental concern about discounting the future is that it is unfair to people in the future; that maximising NPV is a path to efficiency and not to equity.

Discounting future costs and benefits is not necessarily unfair to future people. In some situations, "developers" will want a high discount rate and "preservationists" will want a low discount rate; in other situations, the opposite will occur.

On the other hand, we have to keep in mind that we are maximising net **present** value.

> "*The status quo situation is one of privilege for us, and no rights for the future*" (Bromley, 1988, p.19).

(b) The economic viability of a project measured in terms of NPV may be extremely sensitive to the discount rate.

Sensitivity to the discount rate grows as benefits and costs stretch further into the future. Thus, the choice of discount rate is strategic. At the very least projects should be tested for their sensitivity to changes in the discount rate (as well as to changes in benefits and costs).

> "*In practice, a good deal of sterile argument may be avoided by first using a range of interest rates to assess project performance, discussion of the correct rate of interest only being required where different interest rates have a significant effect on the performance and choice of different projects*" (Norton, 1984, p.87).

(c) The discount rate is often not the appropriate focus for environmental concern.

> "*Indeed, trying to protect distant futures by dropping the discount rate may well be counterproductive, precisely because that inflates payoffs in the medium term (where the initial investments in large-scale, environmentally damaging projects are likely to be recouped) while still virtually ignoring really long-term costs*" (Goodin, 1982, p.68).

The appropriate focus may be the non-commensurability of market and non-market values or the underlying ethic of preference utilitarianism.

If the result of a CBA is seen as unjust to people in the future, then it is preferable to raise the value of future costs and benefits rather than play around with the discount rate. Thus, the way to deal with long-lived environmental externalities is to value them properly before discounting. But:

> "*... we have to know the shadow price of environmental functions. And in most cases this cannot be found... In most cases the NPV formula is meaningless for environmental measures. Making use of it wrongly gives decisions the aureole of objectivity, whereas in fact completely subjective figures are entered whose correctness cannot be proved*" (Hueting, 1987, p.65).

(d) There are several different reasons why society might discount future effects and the reason for discounting should be reflected in the choice of size, sign and mathematical function.

When social discounting is employed the rationale(s) should be explicitly stated. Discounting positively at a fixed percentage per year really only captures the opportunity cost rationale.

Thus, the notion of one national social discount rate applied to everything does not have a sound basis. Further, those who advocate one public service discount rate do not agree on what it should be or how it should be derived.

> "*There may ... be an argument for biasing resource allocation to the present, although whether that bias should be the same as that which results from the use of positive real discount rates (of about 10% in advanced economies) is very questionable*" (Pearce, 1977, p.361).

(e) The long term is a major problem for CBA; the main areas of long term concern are long-lived environmental externalities.

The discounting mechanism breaks down in the context of intergenerational social choice. Mishan shows that the economist's basic axiom of valuation based on individual preference is violated.

> "*... a rate of discount r could value a marginal $1000 of benefits to be enjoyed by some nth generation in the future, at, say, only 10 cents today. Members of this nth generation might well be indifferent as between $1000 enjoyed at, say,* y_{250} *and $500 enjoyed at an earlier date,* y_{230}*, at which two dates they are all alive. But in the nature of things, they cannot be assumed to be indifferent between an additional $1000 at* y_{250} *and 10 cents at* y_1*, a time long before they are born*" (Mishan, 1981, p.505).

Discounting is a useful tool for allocating benefits and costs within one lifetime. Beyond one lifetime, the problem becomes one of distribution not allocation, justice not efficiency.

(f) The political reality of CBA (and discounting) is often different from the extended "enlightened" CBA developed by pioneering theorists and practitioners.

> "*Politicians also suffer from Pigovian myopia, i.e. they discount the future heavily and they are subject to political externalities*" (Taylor, 1987, p.11).

Cost-benefit analysis is very open to manipulation. When a positive NPV is perceived as a hurdle to be cleared then there is a temptation to massage input parameters. While politicians may discount the future heavily, others may be tempted to discount too lightly.

(g) Some strong critics of discounting see it as still having a role in intergenerational social choice.

For instance, Talbot Page proposes that opportunity cost discounting be used to define the intragenerationally efficient set of projects. Then concepts of intergenerational equity can be used to select the intergenerational social choice

(Page, 1977b, pp.380-381). Presumably, by efficiency Page means a positive NPV.

In other words, identify the projects with positive NPVs, but do not necessarily select the project with the maximum NPV.

(h) The discounting (and CBA) debate is not one of economists versus the rest.

Statements such as:

> "*Economists frequently find themselves reviled by environmentalists and others for supposedly applying a simplistic narrow, short-sighted and materialistic calculus to public policy issues which leads them to short-change future generations, the environment, mother nature and all her creatures*" (Anon., 1982, p.1)

are themselves simplistic. Most of the material used in the preparation of this publication has been written by economists.

8.2 Some recommendations for social discounters

Although the assertions in the section above contain implicit advice, it may be useful to distil from them some specific recommendations for practitioners of social discounting.

* Be explicit about the moral stance and rationale underlying the particular discounting exercise. Then let this influence the choice of discount rate and mathematical function.

* Be fully aware of the power of the mathematics of standard discounting. Test the robustness of the CBA result to variations in discount rate (and other input parameters).

* Use a pluralistic approach to decision making where non-market values dominate the CBA and cannot be adequately expressed in dollars. Use the CBA as a sieve to avoid economic disasters but recognise that it captures only one set of information.

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