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Research article

Cost-Benefit analysis in the context of long horizon projects—a need for a social and holistic approach

Arif S. Malik*

Department of Electrical & Computer Engineering, College of Engineering, Sultan Qaboos University, Al Khod-123, Oman

*** Correspondence:** Email: asmalik@squ.edu.om; Tel: +0096824142566.

Abstract: Discounting has always been a controversial subject among economists and philosophers yet discounting practice remained an essential element of any public policy. The purpose of this paper is to argue against using the practice of discounting in Cost-Benefit analysis for large engineering/public projects particularly aimed at mitigating the effects of global warming, as it creates bias against the future generation. Using systems thinking approach the paper has counter argued against all the three arguments, used to justify discounting, i.e., pure time preference, the opportunity cost of capital, and risk. The paper has shown intuitively that both the consumption- and the investment-based rationales used to justify discounting are in conflict when we take the holistic approach to the environment. The paper clearly is on a topic of great significance for environmental economists and environmental policy specialists. The perspective taken in the paper is a thought-provoking one with the relevance of "systems thinking" for the discounting debate.

Keywords: Cost-Benefit analysis; public policy; discounting; discount rate; systems thinking; economic analysis

JEL Codes: D61, D63, O21, O22, P28

1. Introduction

The emphasis on sustainability implies a greater concern for the future and for the future generations as highlighted in *Our Common Future*, also known as the *Brundtland Report*, which

proposes (WCED, 1987): "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." The past models of the development process have tended to assume that the 'future will look after itself', whereas, the sustainable development approach acknowledges that the ability of the future to do this can be seriously impaired by actions taken now. The projects taken now whether good or bad will have consequences on future generations. Cost-benefit analysis (CBA) is the overriding criteria to select a policy or a project.

In economic analysis of any engineering project, discounting is a standard procedure used in cost-benefit analysis. With careful selection of the assumptions used in cost-benefit analysis, it can be made to support, or oppose, almost anything. This is particularly so when the decision being studied involves some cost or benefit, for which there is no market price or which, because of an externality, is not fully reflected in the market price (Pearce et al., 1990). Typical examples would be a project to build a hydroelectric dam in an area of outstanding natural beauty or a law to require factories to limit emissions of gases that may cause ill-health. Discounting tends to give less weight to future costs and benefits. The future environmental costs are either ignored or given less weight due to discounting in the economic analysis. In selecting the projects, a standard approach used is the cost-benefit analysis. It is because of this, the practice of discounting the future, a standard feature of the economic approach to inter-temporal decision-making, is discussed critically in this paper using systems approach concepts.

The perspective taken in the paper is a thought-provoking one with the relevance of "systems thinking" for the discounting debate. The paper argues against using the practice of discounting and shows that both the time preference and the opportunity cost of capital arguments, used to justify discounting, are in conflict when we take the holistic approach to the environment. The author believes that implication of this perspective is of great significance for environmental economists and environmental policy specialists.

The article is logically arranged in eight sections and each section is coherently tied up to the next section. After this brief introduction, the next section explains the meaning of discounting and effect of discount rates on projects selection. The third section gives the basic rationale (arguments) for discounting and the counter arguments used against the rationale. In the literature, the controversy exists over discounting the future but still greater controversy exists over "appropriate discount rates". The fourth section discusses this controversy over the discount rates and shows from the literature review that there is virtually no consensus among economists on discount rates. The fifth section explains why there is no consensus on discount rates because of the basic fallacy in social sciences as these are based on Cartesian principle of reductionist philosophy. The sixth section then emphasizes that the whole thing of discounting should be looked at from global perspective when the projects are of global nature such as projects for greenhouse gases abatement. It stresses on the need for systems thinking in inter-temporal decision-making. The seventh section then extends the argument to interest as the same arguments used to justify discounting are used to justify the interest fees in Capitalist economic system. In fact discounting is one upshot of the capitalist economy. Using hierarchical systems concept the section points out that the economic system itself is a managed sub-ecosystem and human society is currently engaged in a global effort to sustain the growth phase of this subsystem in which the interest is playing a pivotal role. The section concludes that in order to save the super hierarchical system (humanity as a whole and biosphere as a whole) the capitalist economic system compounded and nurtured by a system of interest must undergo the release phase to allow renewal

through the emergence of a fair and just economic system so that humanity and global ecosystem may persist. Finally, the last section concludes the paper.

2. Discounting

Discounting is a standard technique used for making inter-temporal decisions in which future is given less weight than the present; thus, the process of converting monetary values backward in time to an equivalent amount is called discounting. Discounting procedures are fundamental to the theory and practice of cost-benefit analysis for evaluating proposed projects and public policies (Howarth, 1996). When weighing the costs and benefits of large public projects the selection of a discount rate is a key consideration and often a source of controversy. What is a social discount rate? The social discount rate is the rate at which society as a whole is willing to trade off present for future benefits (Harrison, 2010).

2.1. Effect of discount rate on project selection

When weighing the decision to undertake a project with long-term benefits versus one with short-term benefits and high capital cost versus low capital cost, the discount rate plays an extremely important role in determining the outcome of the analysis. Indeed, a number of project evaluation measures based on present worth criteria (e.g., net present value, discounted benefit-cost ratio, discounted payback period, return on investment) depend critically on the chosen discount rate.

All present worth criteria involves ranking alternatives according to their discounted profits and costs. For example, net present value (NPV) is calculated according to the difference between the present value of benefits and the present value of costs. Mathematically,

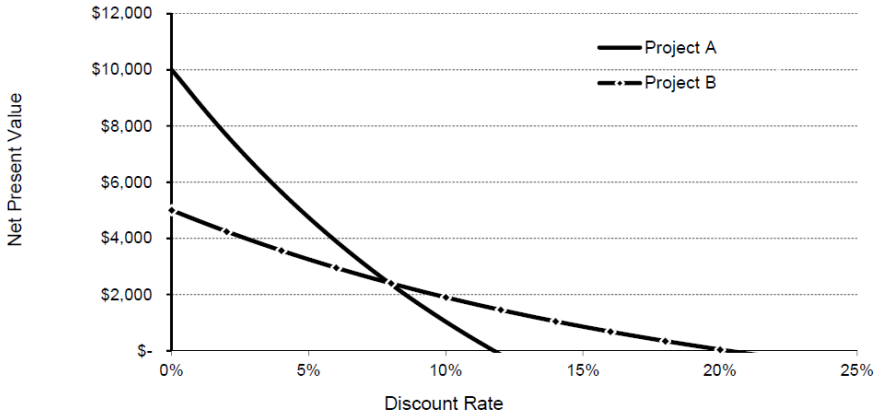
$$Net\ present\ vlaue\ = \sum_{t=0}^{N} \frac{B_t - C_t}{(1+i)^t} \tag{1}$$

where, B_t and C_t are benefits and costs streams in years $t = 0,1,..,N$ and i is the discount rate.

To illustrate the effect of discount rate on project selection let's assume that there are two Projects A and B with annual costs and benefits streams as shown in Table 1. By using the streams of costs and benefits in table 1 in equation 1 the net present value for each project is calculated for different discount rates. Figure 1 shows the effect, of changing the discount rate from 0% onward, on the net present value of the two projects. It can be seen that Project A is more economical when the discount rate is below 8% whereas Project B has a better NPV beyond 8% discount rate. At 20% discount rate none of the project, however, is economically feasible.

Table 1. Cost and benefit streams.

Project A		Project B	
Costs ($)	*Benefits($)*	*Costs($)*	*Benefits($)*
15,000	0	10,000	0
5000	0	0	5000
0	6000	0	4000
0	6000	0	3000
0	6000	0	2000
0	6000	0	1000
0	6000	0	0



Figuer 1. Effect of discount rate on project selections.

3. Rationale for and against discounting

Why do we have to discount the future values? The usual and most common argument given is because a dollar received today is more valuable than one received in the future. There are generally three main reasons used for applying discounting.

1. *Pure Time Preference:* humans are generally impatient and prefer instant gratification to waiting for long-term benefits.

2. *Opportunity Cost or Marginal Productivity of Capital:* dollars can be invested today, earning a positive rate of return.

3. *Risk:* there is uncertainty surrounding the ability to obtain promised future income. That is, there is the risk that a future benefit will never be realized.

All the three arguments are critically analyzed in the following paragraphs.

3.1. Pure time preference

3.1.1. Arguments in favor

Empirical evidence suggests that humans value immediate or near-term resources at higher levels than those acquired in the distant future. It is further argued that society, which consists of sum of its living individuals, also prefers the present to the future. Furthermore, the dominant underlying value judgment of Western economic philosophy is that people's preference should count (Pearce et al., 1990). Hence, it is difficult to argue with the proposition that if people prefer the present over the future, then pure time preference indicates that discount rates are positive. Thus, discounting has been introduced to address the issues raised by the existence of this phenomenon, which is known as time preference.

3.1.2. Counterarguments

There have been arguments against the use of time preference to influence social discount rates. Firstly, that the individual time preference is not necessarily consistent with individual lifetime welfare maximization (Strotz, 1955). There is a more general view shared by many economists, for example (Pigou, 1932; Ramsey, 1928), that there seems to be no "ethical" justification for putting a utility discount into the social welfare function. Secondly, the value judgment is improperly expressed. The argument is that it is tomorrow's satisfaction that matters, not today's assessment of tomorrow's satisfaction (Goodin, 1986). At-least this much is established in the literature.

But the question is any positive social discount rate used in a project that creates costs and benefits that are separated over a long period of time will discriminate against future generations and that is against the very spirit of sustainability; the definition of which says "meeting today's needs of development without compromising future generations' ability to develop".

3.2. Opportunity cost or marginal productivity of capital

3.2.1. Arguments in favor

The opportunity cost of capital is the expected financial return foregone by investing in a project rather than in comparable financial securities. Theoretically, firms invest up to a point where the rate of return on marginal projects is equal to the interest rate. Consumers' plans to save are brought to equality with producers' plans to invest and the ruling interest rate reflects both the time preference of consumers and the rate of return on capital (Kula, 1997).

3.2.2. Counterarguments

There have been attempts to discredit the rationale of discounting based on opportunity cost concept (Cowen and Parfit, 1992; Goodin, 1986; Parfit, 1983). For example, (Cowen and Parfit, 1992) argue that the opportunity costs of consumption are determined by the marginal return to capital, which, in turn, depends on investment levels, which depend upon how highly future benefits are weighted. If society as a whole valued all future periods equally, it would continue to invest until the rate of return

on those investments (and, thus, the opportunity cost) was driven to zero. That opportunity costs are the result of valuing future outcomes less, not a reason for doing so. In other words, if the interest is removed from the society the opportunity cost of capital will automatically fall to zero. But there is an argument against using low or zero discount rate that it will encourage more investment overall, and this may increase the demand for resources and environmental services (Turner, 2007). In the author's view this argument is not valid as we see that in the case of national economic development, the investment portfolio would consist of all projects to be carried out within the capital budget constraint as determined by the availability of the foreign exchange and local currency so the investment will only take place within the budget constraints and only those projects will be carried out that are economically justified and environmentally less harmful. As far as the private firms and businesses are concerned the government can impose resource taxes to discourage those projects which may harm the environment excessively.

On the contrary we can observe that high discount rates used in developing countries under the "prescription" of World Bank and other lending agencies are a cause of much environmental degradation as the selection of such rates opt for short-term measures designed to satisfy immediate wants, and at the expense of sustainable practices. In turn, poor prospects arising from environmental degradation actually assist in generating the poverty that causes high discount rates (poverty-trap).

3.3. Risk

3.3.1. Arguments in favor

Public projects involve uncertainty and risk. When public projects are undertaken there is a chance that future benefits will not be fully realized or realized at a higher level than estimated (there are also uncertainties associated with costs). The further out into the future these benefits are expected to be realized, the greater the risk that some unexpected event or factor will occur and diminish the value of the future benefit. This uncertainty is handled by adding a risk premium to the discount rate. For example, a 2 percent "premium" attached to the officially recommended 5% percent "test discount rate" has been used in the past in the UK (Pearce et al., 1990).

3.3.2. Counterarguments

While adding risk premium to the discount rates it is being assumed that the scale of the risk increases exponentially with time. There is no reason to believe that the risk factor takes this particular form and so the allowance for it through a single discount rate adjustment is invalid. This argument is widely accepted by economists (Dasgupta, 1972; Stiglitz, 1986). Usually, the preferred method for dealing with uncertainty is to directly adjust benefits and costs (or to perform the analysis quantifying the uncertainty and explicitly considering it in the estimates of benefits and costs) and not to change the discount rate (Pearce et al., 1990).

4. Controversy over social discount rates

As we have seen that the debate already exist on rationale for discounting but still greater debate exist on what the appropriate social discount rate should be. Various conceptual foundations have been proposed for the social discount rate, including the market rate of interest, the social opportunity cost of investment and the consumption rate of interest (Guo et al., 2006). In an interest-based economy under ideal conditions, where there are no externalities, taxes or market imperfections of any description, these various rates will be identical in equilibrium. However, no real economy satisfies these assumptions, so the debate exists on the conceptual foundations of the social discount rate. Nevertheless, there is a general consensus that the social discount rate should be based on the "social time preference rate" (STRP), which is the value society attaches to present consumption relative to future consumption. The Ramsey formula (Ramsey, 1928) gives us the expression for the "socially efficient" discount rate to use for cost-benefit analysis (CBA). Letting *i* denote the social discount rate, the Ramsey formula gives the relation:

$$i = \rho + \mu g \tag{2}$$

where ρ is the 'pure time preference rate' (PTPR), g is the growth rate of the economy and μ is the income elasticity of marginal utility. The PTPR is the utility discount rate, which reflects our time preference for utility. The growth rate of per capita consumption, g, varies from country to country. The income elasticity of marginal utility, μ, measures the rate of change of the utility derived from an extra unit of income as our income level increases. The literature suggests that this value is around unity (Guo et al., 2006). This implies that an extra dollar to a generation that has twice the consumption of the current one will only bring half as much utility to that generation. From a practical point of view, one only needs to specify values for the ρ, μ, and g to derive the discount rate. For instance, the UK government recommends a discount rate of 3.5% for CBA (for use across all departments and all projects) based upon the following figures: ρ = 1%, μ = 1 and g = 2.5% (Guo et al., 2006). The Stern Review (Stern, 2007), another important UK Government's document on economics of climate change, proposes a discount rate of 1.4% using ρ = 0.1%, μ = 1 and g = 1.3%. This low discount rate has already been criticized in (Nordhaus, 2007; Weitzman, 2007) for being too low. The United States Environmental Protection Agency recommends a discount rate of 2–3 percent, "the consumption rate of interest", and also using 7 percent. It recommends no discounting for intergenerational projects, and sensitivity testing with 2–3 percent and 7 percent (Harrison, 2010).

It is clear from above that there is a lack of consensus on the value of the time preference rate and on the value of the growth rate of consumption. As stated in (Jouini et al., 2010) there has never been consensus even among the experts on this subject. Different possible values for the parameters lead to very different values for the discount rate, which in turn lead to very different conclusions, as illustrated in Figure 1 and shown by the following example. For instance, the present value of $100 in 100 years time is $37 at a 1% discount rate, $5.2 at 3%, 76¢ at 5% and only 0.007¢ at 10%. This shows a small change in discount rate has a large impact on policy outcomes, meaning that arguments about the "correct" number become more intense. Second, exponential discounting at even moderate discount rates implies that costs and benefits in the far future are almost irrelevant to decisions made today.

Moreover, this lack of consensus among experts about the right values for the growth rate and the time preference rate reveals another more fundamental problem, namely the fact that agents differ in

their time preference rates as well as in their anticipations about the future of the economy. The Ramsey formula has been derived under the assumption of homogeneous agents (same time preference rate ρ and same anticipated growth rate of the economy g). This raises the question as to what extent does the Ramsey formula remain valid once heterogeneity in time preference rates and heterogeneity in anticipations about the future are taken into account.

As far as the pure time preference is concerned, estimates for individuals' rates are usually positive for the simple reason that humans prefer good things to come earlier rather than later. Given the inevitability of death for individuals, a preference for benefits to accrue earlier rather than later is entirely sensible. However, at individual level PTPR may reflect different levels of impatience. In a setting with long-lived agents that represent present and future generations, these rates reflect divergence of opinion about the importance granted to the welfare of future generations relative to the present. At the social level, the distinction is drawn and even it has been argued to use zero PTPR by philosophers and economists for decades. A positive PTPR involves placing a lower weight on the welfare of future generations, which is impartial and contrary to intergenerational equity. Cline (Cline, 2004), for example, proposes to use a zero PTPR in evaluating climate change policies.

As far as the heterogeneity in anticipations about the future is concerned, agents (or experts) currently do not have a complete understanding of the determinants of long term economic evolution. Long-term forecast are subject to great errors and forecasts for the next century or millennium are subject to potentially enormous divergence. The debate on the notion of sustainable growth is an illustration of the degree of possible divergence of opinion about the future of society. Some will argue that the effects of improvement in information technology have yet to be realized and the world faces a period of more rapid growth. On the other hand, those who emphasize the effects of natural resource scarcity will argue for lower growth rates in the future. Some even suggest a negative growth in per capita GDP in the future, due to the deterioration of the environment, population growth and decreasing returns to scale (Jouini et al., 2010) (Burke et al., 2018). The debate among economists (and also among philosophers) on the notion of intergenerational equity, prompted by the challenges of climate change, biodiversity losses and nuclear waste management, is an illustration of this possible divergence (Heard, 2018). These issues have spurred economists and policy makers to think more carefully about long-term intergenerational trade-offs. Some economists have advocated abandoning discounting altogether, proposing alternative methods to value the future. Other economists conclude that although discounting (and cost-benefit analysis) is still very useful, it must be employed in a framework that guarantees intergenerational equity. A third view is that although conventional discounting is satisfactory for short-term decisions, it needs refinement before it can be legitimately used for long-term decisions (Cline, 2004; Turner, 2007). For example, declining discount rate schedule are proposed in (Arrow et al., 2013; Heal and Millner, 2014; Price, 2018). Most countries explicitly recommend sensitivity analyses with specified alternative discount rates (including no discounting) for health economic evaluation that accompany the base-case analysis to examine whether the results of the economic evaluation are affected by the choice of the discount rate and procedure (Attema et al., 2018). Tangren Feng and Shaowei Ke suggest near-zero social discount rate for critical issue in evaluating policies and projects that affect generations (Feng and Ke, 2018). Yet another view is for zero discounting meaning that the future counts for as much as the present (Malik, 2011) for intergenerational projects.

Heterogeneity in time preference rates and in anticipations about the future of the economy, and issues coupled with intergenerational equity are critical features that makes the debate on discounting and discount rates with virtually no consensus at all.

5. Fragmented worldview

Essentially all these approaches of finding an appropriate discount rate are based on reductionist philosophy. The atomic physicist Fritjof Capra has expressed this in a particularly lucid and eloquent way in his best-selling book entitled "The turning point", saying (Capra, 1983): "The triumph of Newtonian mechanics in the eighteenth and nineteenth centuries established physics as the prototype of a 'hard' science against which all other sciences were measured…. this tendency to model scientific concepts and theories after those of Newtonian physics has become a severe handicap in many fields, but more than anywhere else, perhaps, in the social sciences. (The social sciences deal with the social and cultural aspects of human behavior. They include the disciplines of economics, political science, sociology, social anthropology, and—in the view of many of its practitioners—history). These have been traditionally regarded as the 'softest' among the sciences, and social scientists have tried very hard to gain respectability by adopting the Cartesian paradigm and the methods of Newtonian physics. However, the Cartesian framework is often quite inappropriate for the phenomena they are describing, and consequently their models have become increasingly unrealistic. This is now especially apparent in economics. Present-day economics is characterized by the fragmentary and reductionist approach that typifies most social sciences. Economists generally fail to recognize that the economy is merely one aspect of a whole ecological and social fabric; a living system composed of human beings in continual interaction with one another and with their natural resources, most of which are, in turn, living organisms."

The author believes that with fragmented worldview there will never be a satisfactory solution to the problem of discounting which is essentially by nature a systemic issue.

6. Systems thinking and discounting

McLaughlin and Davidson (McLaughlin and Davidson, 1994) describe systems thinking as: "Seeing Whole Patterns…. It's time for us to make the next leap in consciousness to holistic thinking—to seeing whole patterns. In contrast with the prevailing linear paradigm, the New Paradigm sees everything as interconnected and interdependent…. Thus it is critical to keep the large picture—the whole system—in mind in order to create any kind of lasting solution and to avoid undue focus on effects, rather than dealing with causes that may be part of another system altogether.

Holistic thinking or ecological thinking—seeing how everything affects everything else—is finally beginning to influence other national policies, such as economics, where piecemeal solutions never work, since all sectors of a nation's economy are interrelated and interdependent with the world economy. The systems view sees the world in terms of relationships and integrated wholes whose properties cannot be reduced to those of smaller units."

Perhaps, we would have to go a long way to find a clearer or more complete exposition of pure "Systems Thinking" than that contained in the above few lines. The depletion of ozone layer or increase in greenhouse gas emissions or the pollution of oceans is no more a concern of a single society presently living in any country. Similarly, society is no more a collection of living individuals whose preferences should count. Let us investigate the pure time preference, opportunity cost of capital and risk concepts from the holistic viewpoint.

When the pure time preference argument is looked at from the holistic viewpoint a question can be asked whose time preference are we talking about: whose capital and wealth are linking whose time? Is it the present society living in USA or Canada or is it in some African country? And what about the

generations to come who will take care of their time preferences? Therefore, from holistic viewpoint pure time preference argument is ethically and morally indefensible in the selection of discount rate.

Before analyzing the opportunity cost of capital concept with holistic viewpoint let us first examine the practical implication of this concept for selecting discount rates in different countries. Since the opportunity cost is linked to the prevailing conditions within a given country, the discount rate tends to vary, often significantly, from country to country. For developing countries, the discount rate used is much higher than the industrialized countries to reflect the scarcity of capital and the much larger profitability of new investment projects that compete for limited financial resources. Now as we see we have different discount rates for different countries so a project considered "good" in USA may not be "economically justified" in India. For example, a large scale coal-fired power plant which generates millions of tons of greenhouse gases in its lifetime may be economically justified in one country but may not be a good project in another country because of the use of different discount rates for selection of the project. Consider the holistic approach and we see that the harm to the environment is the same whether such kind of project is carried out in USA or in India or elsewhere. So in this regard the discount rate should not be linked to opportunity cost of capital in a country but in sustainability context to the environment.

As far as the risk argument for justification of discounting is concerned it may be noted that for an environmental project such as climate change mitigation project whose long-term benefits will come in the future should not have its benefits discounted on the basis of risk argument as there is more risk involve if we do not do adaptation and mitigation project. In this respect, the discount rate may even be negative. Therefore, from holistic point of view the risk argument also does not hold water as well.

It is clear from the above that no three arguments of time preference, the opportunity cost, and the risk can stand in the way of systems thinking or ecological thinking. These concepts are also used as tools to support the institution of interest (Ahmad, 1992), and the practice of discounting is just one of its obnoxious fruits. The practice of treating interest as an item of cost and ascribing it to the productivity of capital is based on the particular institutional setup of the capitalist society. In fact it is the institution of interest that makes it possible for capitalist economists to ascribe a positive return to capital that is its value productivity, and not the other way round (Siddiqi, 2001). The next section, using the hierarchical systems approach, emphasizes the need to change the present economic system so that renewable natural capital keeps functioning and maintaining itself and the global ecosystem may survive.

7. Renewal cycle in systems theory and capitalist economic system

According to systems theory, the systems are not static, but evolve (more specifically economic, ecological and social systems) as a combination of dynamically occurring renewals in their components (Voinov and Farley, 2007). The renewal cycle has been observed in many natural and man-made systems. The renewal cycle assumes that a system goes through a series of stages, starting from growth, followed by conservation, then release or collapse and finally renewal. The phase of release does not necessarily mean loss or extinction of all components or species that make the system, but it implies that the systemic function that they perform is modified, at least temporarily. The released components may recombine to perform again as a similar system but the system itself will be different (Holling, 2001). Examples of release phase can be observed in man-made and natural systems, e.g., bankruptcy of a company, or forest fires. In bankruptcy of a company when employees are laid off, and assets are sold. It is the release phase and is the end of the company. It comes when the business as

a socioeconomic system is no longer sustainable, and can no longer extend the conservation stage. The components (human and material resources) may recombine in the form of another company (renewal), but that will be a different system. Similarly forest fires release organic material and nutrients thus ending a system. Forests may grow afterwards in the same place, but these will be different forests: they may have a different spatial and species organization.

Any effort to sustain a system beyond its natural conservation phase, to avoid the release phase, has harmful effects on its next higher hierarchical system of which it is a subsystem. For example, efforts to sustain failing industries and even sectors would prevent capital from being reallocated to other or more dynamic ones in their growth stages. Inefficient enterprises if kept afloat by huge subsidies keeping human and material resources unavailable for recombination decreases the overall adaptive capacity of the socioeconomic system by making it vulnerable to disturbances that lead to its collapse. The Soviet Union is a societal example of accumulated rigidities that became vulnerable to societal discontentment and revolt against it, which ultimately resulted in a sudden collapse. Similarly in studying managed ecosystems it has been observed that any attempt to manage a target variable for sustained production of food and fiber has resulted in less resilient and more vulnerable ecosystems (Holling, 1996). The collapse in these cases is usually observed at the next higher hierarchical level, i.e., over landscapes.

The economic system itself is a managed sub-ecosystem of the sustaining and continuing global ecosystem (Voinov and Farley, 2007). Human society is currently engaged in a global effort to sustain the growth phase of this subsystem. The integral feature of the economic system obsessed with growth and expansion is technological progress in an attempt to increase productivity.

The combined effect of technological and economic growth is that it has created an environment in which life has become physically and mentally unhealthy. Polluted air, irritating noise, traffic congestion, chemical contaminants, radiation hazards, and many other sources of physical and psychological stress have become part of almost everyone's life. Obsessed with expansion, increasing profits, and raising productivity, the industrialized world has developed societies of competitive consumers who have been induced to buy, use, and throw away ever increasing quantities of products of marginal utility (Capra, 1983). For example, in this consumption cycle, the total material flow still remaining in products or use 6 months after their sale in North America is just one percent. In other words, 99 percent of the stuff that is harvested, mined, processed, transported and that runs through this system is trashed within 6 months (Leonard, 2010) (This statement is not saying that 99 percent of the stuff being bought is trashed. Think beyond one's household to the upstream waste created in the extraction, production, packaging, transportation and selling of all the stuff he/she bought. For example, the No Dirty Gold campaign explains that there is nearly 2 million tons of mining waste for every one ton of gold produced; that translates into about 20 tons of mine waste created to make one gold wedding ring). Excessive consumption and strong emphasis on high technology not only create massive quantities of waste but also require huge amounts of energy. Most of the world energy comes from nonrenewable fossil fuels that are declining with the passage of time resulting in an increase in energy prices. In their attempt to maintain, and even increase, their current levels of production, the world's industrialized countries have ferociously exploited the available resources of fossil fuels. Some industrialized countries have even used their military might either directly to procure world natural resources or by installing or supporting undemocratic regimes in some countries to dictate policies that suits their own economic and strategic objectives (Perkins, 2011). The repercussions of these actions have created restlessness in the local populations and deep resentment against those industrialized countries involved in exploiting their resources directly or indirectly.

Economic growth conceived in terms of higher production not only ignores the ecological and social costs of development such as pollution and depletion of non-renewable resources but also results in stresses and strains on individuals and families (Siddiqi, 2001). The capitalist concept of development also ignores the fair distribution of wealth. How can the development of human society be conceived of in terms of amassing of wealth only, irrespective of whether this wealth is available to the bulk of its members or not. The enormous expansion of economic output throughout the industrial era has provided material benefits and more comfortable lives for a minority. Yet billions of others have been excluded and exploited in the process (Greco, 2009). This distributive injustice condemns most of the world population to live in debt. The effect of debt is like a blood transfusion from sick to healthy. Each person born in Latin America owes already $1,600 in foreign debt; each child born in Sub-Saharan Africa carries the burden of a $336 debt interest, for something that their ancestors have long ago paid-off. In 1980 the debt of Southern countries amounted to $567 billion; since then, they have paid $3450 billion in interests and write-offs, six times the original amount. Despite this, this debt had quadrupled by the year 2000 reaching $2070 billion (Hamed, 2013). The huge debt in under-developed and disadvantaged countries has made a poverty-trap. For example, in Pakistan and Tunisia, International Monetary Fund (IMF) bailout loans are being used entirely to repay old debts—in Pakistan's case, to pay previous IMF loans. In Portugal, the IMF and EU loans are simply paying off the reckless banks (Dear et al., 2013). There is more than abundant evidence that the repayment of loans of these poor countries is achieved at the cost of consumption of natural capital and the degradation of the environment (Dear et al., 2013; Perkins, 2011; Shah, 2010).

Thus the present setup of the economic system is maintained only at the cost of higher hierarchical levels. Simply sustaining the present economic system will certainly threaten the global ecosystems. Collapse of these higher hierarchical levels is something that the human species, and indeed, many, many other species, cannot afford. In order to save the super hierarchical system (humanity as a whole and biosphere as a whole) the capitalist economic system compounded and nurtured by a system of interest must undergo the release phase to allow renewal through the emergence of a fair and just economic system so that humanity and global ecosystem may persist.

8. Conclusion

Discounting has always been a controversial subject among economists and philosophers yet discounting practice remained part and parcel of any public policy. The paper has argued against using the practice of discounting in CBA for large engineering/public projects particularly aimed at mitigating the effects of global warming, as it creates bias against the future generation. It has been shown intuitively that the three arguments of time preference, the opportunity cost of capital and risk are in conflict when we take the holistic approach to the environment. When the pure time preference argument is looked at from the holistic viewpoint the question is whose time preference we are talking about—a society living in a developed world or a society living in less developed world or a society yet to come. When the opportunity cost concept is seen from holistic approach we find that there are different opportunity costs for the same project, having same global environmental impacts, done in developed world or in some underdeveloped world and hence there is no agreement on the same discount rate. When we look at risk argument we find that there is more risk involved if we do not do public-interest long-term project, for example a project that mitigate the environmental impact, hence discounting the benefit with some positive discount rate of such a project based on risk argument is absurd.

Same these arguments are also used in putting forward the institution of interest. Interest creates a social bias within a society and within countries creating gap between rich and poor and thus leading to unsustainability. Discounting actually is a practice justified in particular economic institutional setup and that is the reason why the leading economists keep the practice of discounting alive. The perspective taken in the paper is a thought-provoking one with the relevance of "systems thinking" for the discounting debate. It is believed that implication of this perspective is of great significance for environmental economists and environmental policy specialists.

What is clear from the above discussion is that we need a paradigm shift—a complete change in perspective if we really want to address the core issue of sustainability in its comprehensive context, i.e. sustainability issue of economic, environment and equity. There is a need to engage meaningfully with a complex systems approach to social and natural systems. While the full implications of the quantum change in perspective has yet to filter down to the level of general consciousness the forest has been starting to clear and the path is opening with new advances in recent developments in physics, ecology, psychology and many other fields. No doubt, there may be reluctance due to powerful vested interests related to both cognitive belief systems and to the institutional position. However, with courage and commitment the harmful effects of untrue economic theory can be challenged. The time preference, the opportunity cost and the risk concepts are the tools to support the institution of interest and hence discounting. Nevertheless, as we notice no such concepts can stand in the way of systems thinking.

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Conflict of interests

The Author declares no conflict of interest.

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