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# The Discounting Confusion: An Ecological Economics Perspective

Frank G. Müller*

**ABSTRACT**

Factors impacting on the discounting process are mirrored in every aspect of human activities, be it the philosophical, the aesthetic, the religious through to the environmental and scientific experiences. In short, discounting is a controversial concept, and yet, the economic profession seems to ignore that issues related to "long-term" discounting are complex, multifaceted, and far from settled. The environmental community in particular has expressed reservations about discounting, because this process —an inherently myopic one— embodies a built-in bias against the future generations.

It will be argued here that the danger to ecological sustainability is of a specific nature, namely, it relates to the lack of substitutability between human-made capital and natural capital. If this assumption is accepted, then it follows that using a discount rate is an inadequate instrument for achieving sustainability. Thus, it will be argued that the implementation of the precautionary principle, e.g., in form of "safe minimum standards" of ecosystem protection, provides a successful approach for achieving sustainability.

**Keywords:** discounting, sustainability, safe minimum standards.

**JEL Codes:** Q50, Q57

## Confusión en la tasa de descuento: una perspectiva desde la economía ecológica

**RESUMEN**

Los factores que influyen en el proceso de descuento se reflejan en todos los aspectos de la actividad humana, ya sea lo filosófico, lo estético o lo religioso a través de las experiencias ambientales y científicas. En resumen, el descuento es un concepto controvertido, y, sin embargo, la profesión económica parece ignorar que las cuestiones relacionadas al descuento de "largo plazo" son complejas, multifacéticas, y lejos de resolverse. La comunidad ambientalista, en particular, ha expresado reservas acerca del descuento, ya que este proceso —uno inherentemente miope— incorpora un sesgo implícito contra las futuras generaciones.

Se argumenta que el peligro para la sostenibilidad ecológica es de carácter específico, es decir, que se refiere a la falta de posibilidad de sustitución entre el capital hecho por el hombre y el capital natural. Si se acepta esta hipótesis, entonces se deduce que el uso de una tasa de descuento es un instrumento inadecuado para el logro de la sostenibilidad. Por lo tanto, se puede argumentar que la aplicación del principio de precaución, por ejemplo, en la forma de "normas mínimas de seguridad" de protección del ecosistema, proporciona un enfoque exitoso para lograr la sostenibilidad.

**Palabras clave**: descuento, sostenibilidad, normas mínimas de seguridad.

**JEL Codes:** Q50, Q57

* Professor of Economics, Department of Economics, Concordia University, Montreal, PQ, H3G 1M81455 De Maisonneuve Blvd. West, e-mail: frank.g.muller @sympatico.ca

## 1. THE ISSUE

Life continues. Although nothing is certain, society and individuals are continuously involved in valuation processes of present vis-à-vis future consumption and/or production decisions. The future is all that remains of time, and the present is the point from which society makes these inter-temporal decisions. Thus, the introduction of passage of time as a crucial feature in these evaluation processes —a procedure which called "discounting" by the economic profession— is ubiquitous in every daily decision. Mainstream economics employs the concept of discounting as principle to ensure inter-temporal efficiency of resource allocation. In a modern textbook of environmental and natural resource economics it is stated as follows: "The concept of discounting and present value are based on a type of behavior called time preference, which suggests that people prefer to realize benefits sooner rather than later (and realize costs, later than sooner)" (Kahn, 2005, p. 38).

In reality, however, the issue is more complex. The factors impacting on the discounting process are mirrored in every aspect of human activities, be it from the philosophical, the aesthetic, the religious through to the environmental and scientific experiences.[1] In short, discounting is a controversial concept, and yet, the economic profession seems to ignore that issues related to "long-term" discounting are complex, multi-faceted, and far from settled. The environmental community, in particular, have expressed reservations about discounting, because this process —an inherently myopic one— embodied a built-in- bias against future generations. To realize the impacts of discounting, consider projects which generate "short"— and/or "intermediate"— turn benefits, but which may cause substantial long-term environmentally detrimental consequences for future generations. Examples of these types might be the failure of preventing the emissions of gases contributing to global climate change and/or to the loss of biodiversity.

This paper does not pretend to resolve the "discounting confusion", but rather it intends to present a survey and evaluation of the various determinants used to "justify" the discounting procedure and not what is the "right" discount rate.[2] Although the economic profession has advanced arguments, methods, and theories over what the appropriate "social discount" might be/should be, but little or too little attention received the issue of the discounting procedure.

The environmental community in particular is concerned about the compatibility of discounting with the concept of ecological sustainability. Although many economists are now accepting sustainability as a legitimate objective, but they tend to believe

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[1] C. Price wrote a very detailed, carefully evaluated monograph on the various issues of discounting. (Price, 1993).

[2] The literature on discounting is quite large, however, there are two outstanding publications by Hampicke (1992a) and Price (1993).

that a well-functioning market system will "automatically" achieve this objective (Randall, 2007, p. 91). To ensure that private and public projects are efficient, they are "pressing" these projects through a benefit-cost filter. However, it will be argued here that the danger to ecological sustainability is of a specific nature which cannot be captured adequately by the market mechanism, because it relates to the lack of substitutability between human-made capital and natural capital (i.e., ecosystem and/or biodiversity). If this assumption is accepted, then it follows that using a discount rate is not only an inadequate instrument, but also it is a counterproductive instrument for implementing ecological sustainability. Thus, it will be argued that the implementation of the precautionary principle, e.g. in form of "safe minimum standards" of ecosystem protection, provides a more successful approach for achieving sustainability (Randall, 2007, p. 96).

## 2. THE RATIONALE FOR DISCOUNTING

How do interest rates, and respectively discount rates, emerge? In this respect the more recent neo-classical literature, including the theories of natural resources, is relatively silent (e.g. Hartwick & Olewiler, 1998, 19ff). It appears that there is little concern about the emergence of a discount rate: instead its existence is accepted.[3]

In the literature, this phenomenon is introduced as follows: policy decisions and/or projects generate costs and benefits over time, and, in conventional economic terms, it is considered as "necessary" to attach weights to the stream of benefits and costs at different points in time. This procedure is regarded as appropriate for a single project as well for selecting among competing projects that have different net benefit streams over time. One option is to select unitary weights, which implies that society is indifferent regarding present and future consumption, if the future benefits of the project are consumption goods. Another option could be to assume a positive time preference for current over future consumption. In the case of investment opportunities this means that a unit of a factor production, when invested today will generate greater output tomorrow (i.e., the marginal productivity of capital is positive), and consequently, today's benefits should be weighted stronger than the same benefits generated tomorrow. The same procedure applies to present and future costs. Thus, discounting is the procedure through which the present value of benefits and costs of project(s) are determined.

The concept of discounting is easily comprehended in financial terms. A dollar income can be spent on immediate consumption, and, if the assumption holds, present consumption is "generally" preferred to future consumption, or alternatively, this dollar can be invested to produce higher income in the future. In financial terms, a dollar

[3] For a detailed history of thoughts about the development of the theory of interest, see e.g., F.A. Lutz. (Lutz, 1968), F.P. Ramsey (1928), or more recent N.H. Stern (2007).

of expenditure today taken from the saving account has opportunity cost of interest earnings foregone in the future, or a dollar of expenditure with borrowed funds is associated with the cost of interest payment.

The general formula for calculating the net present value for a project with a life expectancy of is:

$$NPV = \sum_{t=1}^{t=n} \frac{(B_t - C_t)}{(1+r_t)^t}$$

Where $B_t$ and $C_t$ are representing the benefits and the costs respectively at time $t$, and $r$ represents the discount rate. This formula is used as a decision rule for project evaluations. According to this formula a project could be realized, if the NPV is positive.

From the above statement follows that consumers' sovereignty and a positive return on investment are the twin pillars of discounting in a capitalistic market economy.

The first pillar, consumers' sovereignty, suggests that preferences do matter and that society's preferences e.g. for the present over the future should be accepted as well. The second pillar, the productivity of capital, states that if some factors of production are diverted for investment rather than consumption, those resources are expected to produce a higher level of future consumption. Obviously, it is worth waiting for the extra future benefits provided the costs in terms of impatience (the time preference cost) are exceeded by the future benefits. Thus, this suggests that there exists a fundamental link between consumers' sovereignty (time preference) and the productivity of capital.[4]

In what follows, it will be questioned the assumption that the value of future benefits has to be weighted by a uniform negative exponential function of time, an assumption that needs justification as well as the use of a discount rate when fundamental environmental issues are at stack.

## 3. A CASE FOR A UNIFORM NEGATIVE EXPONENTIAL DISCOUNTING FUNCTION?

The two main arguments for discounting within a market economy —consumers' sovereignty and return on investment— do not justify the application of a negative uniform discounting function. Consumers' sovereignty actually does provide a scientific rationale, because (private and/or social) time preference does not imply that earlier consumption will always more highly appreciated than future consumption. Return on investment is as well a questionable basis for such a specific discounting function,

[4] Graphical presentation can be found in most conventional textbooks; e.g., D. W. Pearce and R.K. Turner. (1990, p. 215) or C. S. Pearson (2000, p. 80)

because not all returns are fully re-invested due to numerous economic, social, or political reasons.

Furthermore, even among some mainstream economists seems to exist a strong intuitive perception, that this discounting procedure cannot be considered as appropriate systematically to diminish benefits and costs towards zero only due to the fact that they occur further into the future. Consequently, some more logical reasoning is necessary to explain why these values stream of benefits and costs should be diminished over time. This reasoning has to explain that it cannot solely be the passing of time that is the basis for such a discounting procedure, but factors which are changing over time. That means, the passing of time is only the frame within which these changes of values of benefits and costs occur. These factors have to be identified and assessed before a discounting procedure can be justified.

The debate here is not about what rate of discount should be applied, but rather about the procedure in mainstream economics, namely the weighting of the value of future goods or consumption by a uniform negative exponential function of time is an exceptional process, which requires explanations and justifications. If they cannot be established on reasonable grounds, than this procedure should be discontinued (Price, 1993, p. 131).

There are several factors which may not support the use of a uniform negative exponential discounting function. In reality, the physical, socio-economic and environmental surroundings do change over time, and consequently, their systematic effects may develop and impact on what individuals and/or society perceive as benefits and costs as the outcome of a distinct decision, e.g., deregulation of financial markets —the Wall Street disaster—. Or, individuals and/or society are changing their taste and appreciation over time and these changes affect how a particular good and/or occurrence will be appreciated, etc. All these factors contribute to a process that a particular good will—quite likely—have not identical values over time, and this includes the possibility that it is not certain or axiomatic that the good's value will diminish over time. Certainly, the value of the good will not follow the shape of a negative exponential function.

Recent contributions to this topic suggest that individuals follow rather a hyperbolic discounting procedure, i.e., the discount declines and then levels off with the consequence that after a certain time period the present value of projects no longer diminishes "substantially". Even if there may exist empirical evidence of hyperbolic discounting, then this procedure employed by mainstream economics still will substantially undervalue long-term protection gains of biodiversity and ecosystem functions, and thus threaten the objective of sustainability. Furthermore, even if individuals adopt hyperbolic discounting procedure, this still does not imply that a "social discount rate" will also be hyperbolic. (Gowdy, 270 ff).

### 3.1. The Case of Pure Time Preference or Myopia

One of the assumption of mainstream economics implies that individuals have an ingrained "impatience factor" or "myopia", that means they prefer to consume a unit of a good rather today than tomorrow. In this context it seems to be "overlooked" if this assumption of impatience is an empirical or a normative behavioral one. The literature seems to lean toward the later one and gives the impression that myopic behavior is socially acceptable. Representative for this view includes some of the well-renown economists like Böhm-Bawerk. He considers myopia as a general social feature and writes: "… The fact is evident, there is no doubt…Very blatant it is represented in children and savages. As several Indian tribes have in their senseless desire for few barrels of 'fire water' sold their land of their father …to the pale faces…Unfortunately, similar behavior can also be observed in highly cultivated countries" (translation by author; Böhm-Bawerk,1888, 332ff).

In contrast Georgescu-Roegen's sentiment is crisp, clear and does not need any explanation; paraphrasing his statement, he states when morning comes we will be as hungry and thirsty as today (N. Georgescu-Roegen, 1979, p. 101).

Over time economics has advanced and today it can be shown, using a control-theoretical approach, that individual and/or society's impatience are inconsistent and fundamentally irrational with maximizing an individual's or society's lifetime welfare. Nevertheless, some economists are still of the opinion that zero utility discounting is intellectually not compelling (e.g., Hepburn, 2007, p. 113). The mathematical proof shows that the utility integral is the largest when the individual or societies consume equal quantity per time period[5]. Thus, myopia is irrational, but in limits it may be even sympathetic in the sense who wants to be with a person who always acts totally rationally. In a broader context, normative individualism of mainstream economics must allow individuals to make decisions which they may later regret. The issue, however, is should myopic behavior be permitted when long-term ecological sustainability is threatened? This problem will be discussed further down.

In sum, pure time preference does not provide a basis for a negative exponential discount and/or hyperbolic function.

### 3.2. Nothing stays the same for ever over time

What an anger, dislike and/or pleasure are worth over time depend on how much individuals tolerate them, as well on their intensity. Thus, these factors of feelings, taste and/or level tolerance have a certain distribution in a given community at a given time period. Obviously, these factors undergo changes over time in ways which are unforeseen. However, it has to be stated, that time itself does not causes changes, it is only the direction along which relevant occurrences and processes take place (Price, 1993, 210ff).

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[5] For the mathematical proof see Hampicke (1992a, chs. 3 and 4) and Hampicke (1992b, 141ff).

Nevertheless, these likely changes of taste, preferences etc. are frequently given a residual role in time preference, and, therefore, a discussion is relevant how these changes are related to time. Here are some sources and processes of changes deliberated, and, again, it has to be questioned, if a negative exponential function of discounting is the appropriate approach to describe these changes.

Some types of consumption are determined by human physiological and psychological factors, e.g. every human requires food or yearns for recognition. However, individual preferences for the fashion or make in which these consumption commodities are received, is to a large extent associated to the circumstances how individuals became used to them and how they think what is appropriate to use them. Furthermore, consumption goods which are not absolutely necessities, particularly those which are in the public domain, are influenced by changing taste. Aesthetic qualities are especially influenced by changing taste, because they are not viewed as necessary and therefore are extremely short-lived, e.g., fashion of clothes or the designs of cars.

These changes are not just an expression of consumers' capricious behavior, but may be the result as a reaction to conform to social pressures and/or acceptance. Furthermore, not all experiences provide equal enjoyment or dis/pleasure at every stage of an individual's life-cycle. E.g., changes of individual's physical abilities and/or psychological disposition influence the values of these experiences, and, certainly, these values do not uniformly decline in form of an exponential or hyperbolic function over time.

### 3.3. Diminishing Marginal Utility and Individual Income

In a society of rapidly changing technical progress and increasing wealth, the growing availability of commodities leads to their diminishing marginal utility. This phenomenon is based on two lines of reasoning; the first assumed that there is an order of uses of inputs and/or resources and commodities. Following conventional reasoning, when they are limited and scarce, they are used to satisfy initially the most urgent demands. If over time they become more available, the demands of more trivial needs are being satisfied. The other line of reasoning refers to the observation refers to the observation, that if larger amounts of the inputs and commodities are consumed for the same demands, diminishing returns in the production process occur and consumers' satisfaction may occur. Since the main value of income is embedded in its power to purchase inputs and commodities, the marginal utility of raising income diminishes as well (Price, 1993, 133ff).

Diminishing marginal utility of increasing income is probably one of the most prominent concepts in economic analysis. It is the basis for the downward-sloping demand curve, or it provides the basis for quantitative decisions on the allocation of commodities between individual consumers and the society as a whole. Now with respect to discounting, the concept of diminishing marginal utility —in conjunction with the rate of return on investment and time preference— is one of the most referred

to economic rationale for discounting. Prominent economists support this reasoning, from the early utilitarians, to Böhm-Bawerk (1884), Harrod (1948) to Olson and Bailey (1981), and the list goes on.

At the core of the concept of diminishing marginal utility is the assumption —contrary to ecological economics thinking— that a world with perpetual economic growth is feasible. If this is the case, then the use of a rate of discount of zero causes substantial disadvantages for early generations, because according to a growth model that maximizes intergenerational utility integral these early generations are obliged to excessive saving which allows later generations to live in affluence and luxury. Consequently, the concept of utility discounting, considering decreasing marginal utility of income, corrects the alleged injustice and disadvantages of early generations to consume (Hampicke, 2000, p. 9).

This sentiment, that income and commodities available to richer future generations should be weighted less, is expressed by several prominent economists, e.g., Baumol states: "Average real per capita income a century hence is likely to be a sizeable multiple of its present value. Why should I give up part of my income to help support someone else with an income several times my own?" (Baumol, 1968, p. 800), or Tullock: "the next generation, however, is going to be wealthier than we are…" (Tullock, 1964, p. 334).

Thus, the presumption, that future generations will be more affluent serves as a justification for discounting.

Nevertheless, diminishing marginal utility by itself, does not justify discounting. A negative uniform exponential function exists only if in each time period the same proportional reduction in marginal utility takes places. Such a scenario is given if the utility function possesses the property of constant elasticity with respect to the quantity of consumption, and, furthermore if the growth rate of consumption remains constant in each time period. Thus, only in a society where individuals' income are growing exponentially at a constant percentage, where taste and preference remain constant over time, where marginal utility of income is also constant over time, where full information about the availability and affluence of all commodities exist and increase proportional to the increasing demand for them, in such a society one could discount marginal units of consumption at a single discount rate which represents the diminishing marginal utility of all consumption (Price, 1993, p. 227). A reality check tells us, that we are not living in such a world, but mainstream economics, nevertheless, continues with this discounting procedure.

It seems that the utility discounting argument is defect on two accounts: on empirical and methodological grounds. Empirically this argument is challenged by the fact that perpetual physical economic growth worldwide is impossible in a finite world. The on-going sustainability-debate is an expression of the concern for future generations; there is the likelihood, that instead of enjoying a life in abundance, they may rather experience environmental disaster, loss of biodiversity and lack of essential natural

resources. In other words, utility discounting is not just tempering with the —alleged— life-style in luxury of future generations, but it may actually accelerate the process of destroying their livelihood to support at least their basic needs.

The methodological basis of the argument if applied to the existence of diminishing marginal utility of one rational individual is relatively uncontroversial, but if applied to a group and/or society, there are long-recognized and unsolved issues of allowing interpersonal comparisons of utility, and these issues are even compounded in the inter-temporal and/or intergenerational context. (Hampicke,1992a, 267ff).

Thus, diminishing marginal utility does not provide a general acceptable justification for discounting.

### 3.4. A Need for an Environmental Discount Rate?

Over decades several economists have developed reservations about the philosophical foundations and the results of the applied discounting procedure. Despite these reluctances they are still following this "questionable professional tradition" of discounting. Maybe they resigned to the fact that discounting is such an integral part of mainstream economics which cannot easily be abandoned. It seems, the present discounting procedure provides an enormous institutional convenience by adopting an uniform standard procedure for assessing/evaluating projects. In this sense it provides consistency, even if this consistency appears only in the form of consistent errors (Price, 1993, p. 324).

In recent years, compromises have been suggested which propose to adjust the discounting procedure, so that its impacts on long-term projects are more lenient. Thus, discounting should also incorporate other factors, such as sustainability and the interests of future generations. In this context an important issue arises, namely whether environmental projects, which impact on future generations' well-being, should have some "adjustments" of the discount rate, or more pointedly formulated, whether the discounting procedure should even be considered as "impropriate" for environmental projects/programs. It seems that economists, including environmentalist, who argue in favor of an adjustment of the discount rate because of their sustainability concerns, may have a point here, but there are also other economists, e.g. Randall, who argue against such an adjustment. He states "…that repressing the discount rate is not just a crude instrument, it is a counterproductive instrument to promote sustainability" (Randall, 2006, p. 101).

Before addressing this question of sustainability, some confusion about suggested adjustments of the discount rate has to be cleared up. It seems that some economists follow a misconception by stating that without some form of discounting , society —today's and future ones— could never extract non-renewable natural resources, leaving them permanently untouched for all coming future generations… a paradoxical situation (Levin, 2012, p. 1), but a pseudo one. There is no evidence that even the strictest environmentalist suggest this situation, instead the resource use of ecosystem

services and biodiversity in the aggregate should be in such a manner so that the overall objective of sustainability will not be jeopardized.

Confusion one: "High" discount rates *per se* do not necessarily imply that they operate against sustainability and/or environmental protection, while "low" discount rates cannot necessarily be regarded as sustainability- and environmental protection-friendly. Obviously, high discount rates give little weight in present value terms of long-term, including environmental damages; i.e., the present values of environmental projects and programs e.g., such as avoided deforestation which prevents soil erosion, are diminished. The conventional wisdom in natural resource economics states that high discount rates lead to rapid resource exhaustion and/or high harvest rates of renewable resources. However, it also has to be recognized that high discount rates have a bias against the implementation of projects with long-term benefits streams, which is representative of natural resource development projects. In general, high real discount rates have negative impact on economic growth, resource development and on overall investment expenditures, with the result that high discount rates are slowing down the material throughput in the economy and, consequently, are reducing resource consumption and pollution emissions. In other words, the environmentalists are confronted with a dilemma, namely demanding low discount rates for assessing long-term environmental costs (i.e., making present values of environmental expenditures more attractive), while desiring high rates to discourage long-term natural resource projects with their anticipated undesirable environmental consequences (Pearson, 2000, p. 87).

Confusion two: Some suggestions for adjustments of discount rates supposedly to reflect environmental risk, uncertainty and interests of future generations, are even more controversial. On a superfluous glimpse, such adjustments may have some merits. Indeed, environmental impacts and consequences of many projects/programs are uncertain, their risks are asymmetrically distributed, and therefore, the decision maker might consider adjusting the discount rate by including a risk premium to account for potential environmental damaging events. However, on a second look, such a procedure is indefensible, because the risk premium is either completely arbitrarily chosen, or derived from an implicit risk probability distribution of a set of anticipated outcomes. If indeed such an implicit risk distribution function is available, it should be made explicit and used for determining the expected present values of the anticipated benefits and costs. The outcomes would be as expected: projects/programs with potentially large and asymmetrically damaging environmental risks will show "lower" and/or "negative" net present values. Thus, there is no need for adjusting the discount rate; But what about cases where only a very low probability of a truly catastrophic event in the future or, worse, no probability distribution, as in cases of uncertainty and/or ignorance, exist? (Pearson, 2000, p. 87).

This justification of discounting due to collective uncertainty of the future —not an argument for adjustment of the discount rate— appears initially quite convincing, so that

even economists e.g., like Sidgwick (1980, p. 412), Dasgupta and Heal (1979, p. 262), who cannot be accused of un-reflected routine, have favored it (Hampicke, 1992b, p. 135). This justification is based on collective uncertainty of the future and of future generations' interests and/or preferences. If the consequences of today's generation's actions are only likely to happen, but with uncertainty, do they have to be discounted? It seems that in the case of projects/programs of "minor" importance, discounting —the above caveats of the discounting procedure maintained— may be justifiable. E.g., today's society is planting pine trees instead of maple trees in an afforestation program after reflecting what might be in the best interest of future generations. Since the present generation is ignorant about future generations' taste and preference which species of trees they prefer, today's society may have chosen in their afforestation program the right species or may have selected the wrong one. A miss of future generations' taste may be regrettable, but this action does not have any life-threatening consequences for future generations' well-being. The situation is completely different in a scenario where today's society actions have serious negative consequences for future generations and may even threaten their survival. Consequently, inactions of the present generation to prevent climate change or not preventing nuclear arms proliferation may serve here as examples. Thus, that these are no discounting issues *per se* (Pearson, 2000, p. 87; Hampicke,1992b, 135ff).

In sum, all the arguments for discounting benefits and costs accruing to future generations are invalid. It seems that projects/programs are not being discounted, due to the passage of time, but rather due to their negative consequences will hit other generations. This is a case of *Ego-preference,* which means that today's society acts from a position of unchallenged power, because future generations are in no position to prevent today's generation's actions (Birnbacher, 1988, p. 33). Therefore, the transition to a civil international intergenerational community is only than achieved, if not only contemporaries, but also all future generations possess equal rights (Hampicke, 1992b, p. 136).

Thus, a special discount rate for environmental projects/programs is not justifiable, even so environmental projects/program seem to indicate towards a "lower" discount rate. Even if one could agree on such a rate, a "lower" discount rate would not guarantee sustainability and/or protect future generations' interests.

In the late 1980s a widely publicized report "Our common Future" by the UN World Commission on Environment and Development propagated and promoted the idea of sustainable development (WCED, 1987). Sustainability and/or sustainable development have become highly acceptable as a policy slogan to politicians and, to large extent, also to the national and international community. It seems, that the absence of an unambiguous and precise definition of this concept contributed to its wide-spread acceptance by governments, business, NGOs etc. to support the concept of sustainable development without questioning the adherence to economic growth as the over-arching policy goal.

Just two years after the publication of "Our Common Future" Pezzy compiled a list of sixty (60!) definitions of the concept of sustainable development (Pezzy, 1989). Apparently hardly a week passes without having some new entries in the ever-growing list of definitions. Many things are being regarded as sustainability; while in contrast, there is only one clear meaning of discounting. There is the perception that sustainability became politically widely acceptable, because of its "intended" vagueness. The concept can all-too-easily be understood as a new justification for economic growth (Victor, 2008, p. 21). It seems that this concept is considered politically practical, because in reality it is business as usual; nothing is expected to be changed. In this context, acceptability is a measure of ineffectiveness (Price, 1993, p. 340).

One of the most quoted descriptions of sustainable development is[6]:

"… development which meets the needs of the present without compromising the ability of future generations to meet their own needs." (WCED, 1987, p. 43).

This definition allows at least two opposing positions concerning the relationship between sustainability and discounting:

a. The paradigm of sustainability, by stressing equal rights for future generations, is ideologically incompatible with discounting. Discounting is biased against future generations; since it jeopardizes that future generations can fulfill their own needs. Sustainability and discounting are opposing concepts.
b. The paradigm of sustainability is complementary to discounting. Discounting allows efficient allocation of investment expenditures and in this sense sustainability guarantees intergenerational equity. The majority of mainstream economists, who are proponents of sustainable development, seems to favor this option (Price, 1993, p. 330).

Supporters of either option—sustainability without discounting versus sustainability with discounting—advancing by and large similar arguments for their position (Markandya & Pearce, 1988). Both groups are agreeing on the same goal, namely to achieve an "acceptable" standard of living for future generations. They differ in the sense by over-emphasizing problems of the alternative option, while down playing the weaknesses of their own. Furthermore, supporters of the not-discounting option do not intend necessarily to add more weight exclusively to environmental factors, but want to recognize the appropriate weight of all factors influencing a project/program. (Price, 1993, p. 339).

In sum, the on-going debate for adjustments and/or modifications etc. of the discount rate actually documents the state of confusion, reservation and dissatisfaction about discounting, namely, discounting does not provide reliable assessments of future

[6] This article does not intend to pursue further the debate of sustainable development. This literature on this topic is waste; e.g., see a.o. Pezzy (1989), Price (1993).

values, and, consequently, it is an improper and questionable process for project/program evaluation. Thus, ultimately the justification for discounting relies on the validity of the processes. In this context Price states: "the track of values through time is not generally a negative exponential: we violate the truth whenever we pretend otherwise" (Price, 1993, p. 344).

### 3.5. Safe Minimum Standard as an Alternative?

More fundamentally, regardless if one is a proponent or an adversary of discounting, the evaluation process in either situation is based on **monetary** values and prices. Mainstream economists assume that the price mechanism functions very efficiently, or can be made to perform to these expectations just through some fine-tuning with fiscal means, so that societies do not have to be preoccupied about the efficient implementations of projects/programs and even about possible limits to economic growth. Prices—allegedly - provide decision makers with the necessary information for appropriate actions to be taken, including how to deal with ecosystems' stability and protection of biodiversity. In their view, prices can be regarded as the most relevant conveyors of information.

However, there are at least two arguments which cause skepticism about this view that sustainability, protection of ecosystem and of the interests of future generations can be achieved through markets in which economic agents respond to a "correct" set of prices.[7]

The first caution is based on the reservations of the way in which the market process incorporates ecological considerations. Mainstream economics is still maintaining its un-reflected claim that environmental factors can be imbedded into the market pattern of relative prices and preferences, costs and benefits, and that they can ultimately be monetized. But can prices be established that could guarantee the resilience and stability of the ecosystem? The short answer is **no**! The objective of mainstream economics is always to determine the "optimal" level of pollution, which is attained where marginal abatement costs are equal to marginal damage costs. This "optimal" level pollution is also viewed as "optimal" environmental resource use. If one analyzes a bit deeper and exposes the factors which determine marginal cost, marginal abatement cost, marginal damage cost, marginal benefit, etc., then one enters again the world of relative prices and preferences. In the case of a chemical factory and a resort hotel e.g., the factors determining water quality are the state of pollution abatement technology and its costs for the polluter, the state of water purification technology and its costs for the pollutee, the price elasticities of goods and services produced, market competition, income levels of water re-creationists, etc. All these factors not only are changing constantly over time, but they are already distorted due to external effects. Thus, there is not only one

[7] Since decades, economists have analyzed the conditions necessary for prices to provide exact information. For details see for e.g., Victor (2008, ch. 3).

"optimal" level of pollution, but, in a historical and dynamic analysis, there are numerous ones. Now, if water recreation falls out of fashion, does this mean that water pollution can now reach 100% and e.g., a Pigouvian tax should be set at zero, because there are "no" external effects to be internalized? This is an obvious absurd result of mainstream economics, and it follows the logic of a paradigm which attempts to integrate ecological considerations into the market process and does not considered ecosystem stability and ecological sustainability independently (Maier-Rigaud, 1992). Prices as deposits of economic information obscure notions of ecological limits and thresholds, and thus, they can not guarantee sustainable outcomes. The price system as the exclusive mode of encoding information and communicating knowledge stands at the very center of our present global environmental crisis (Müller, 2001).

The second issue refers to the role played by the market mechanism to handle sustainability and the interests of future generations. In strictly economic terms, even if market failures are assumed to be fully correctable and market valuations are attainable in the "short-run", questions have emerged whether markets are able to generate efficient and intergenerational time paths that satisfy the interests of future generations, or can provide market valuations, even conceptually, due to the fact of "missing markets". Only if some mechanisms would exist that allows all future generations to express their preferences and to participate in contractual transactions in the market place, then decisions of resource allocation would have —at least hypothetically— the potential to attain sustainable outcomes. But according to Bromley "… the existence of a market still requires the willful coming together of two consenting agents to exchange for mutual gain" (Bromley, 1991, 87ff). In reality no such mechanism or institution are available nor will ever exist where a "willful coming together" of future generations is feasible. As yet unborn generations will only participate in market transactions when they are born, but they are not decision makers in today's markets. Thus, the fact that future generations are powerless in today's resource allocation decisions should persuade contemporaries to be prudent and cautious about the claim that a set of "correct" prices, discounted or not, could ever be determined that are compatible with sustainability and the interests of future generations.

In sum, the above statements do not imply that a civil international community cannot and will not conduct itself in a sustainable manner. It does emphasize however, that there are inappropriateness, limits and shortcomings to the extent to which the price mechanism and monetary valuation alone —discount rate adjusted or otherwise— will achieve the desired outcomes.

The achievement of sustainability and global ecosystem protection are pursued in the interest of future generations and are an imperative of intergenerational justice. With the exception of the area of non-renewable resources, for which substitutes have to be developed during their time of availability, the protection of future generations' interests demands —how else would it be possible— that limits and quotas are being set and

respected as "Safe Minimum Standards" (SMS) as suggested by von Ciriciany-Wantrup (von Ciriciany-Wanturp, 1968). It is not the intension here to determine exactly the SMS, but nevertheless few aspects with respect to its extent have to be elucidated.

Some features of the SMS are:[8]

- Stressing the first word of this term, each standard contains a safety margin or a "conservation-biased safety margin" (Turner, 1988, p. 122). Societies have to accept to reduce their economic activities, i.e., a part of their potential activities, which they could execute, have to be considered taboo —do not touch it!—, and in addition include in these standards some additional safety and/or precautional margins. Contrary to today's treatment of the environment, this requires in many areas the reversing of the burden of proof. Thus, not only activities have to be prohibited which are proven without any doubt as damaging, but also activities have to be prevented which are at present not absolutely scientifically proven as harmless. E.g., in the area of biodiversity: not only species have to be protected which usefulness is more or less determined, but a future-oriented responsible society can only suggest an irreversible extermination of species if their noxiousness is determined with certainty (e.g., aids virus or swine flu). Since this is not the case in more complex species and species always act in population communities, this request for all practical purposes implies a comprehensive protection of the whole biodiversity (Norton, 1986).
- Future demands for natural resources and the pressure on the ecosystem functioning depend quantitatively upon the size of future populations. The request maintaining the core functioning of ecosystems and biosphere are independent of the size of future populations, in the sense that the self-regulation ability and capability of the biogeochemical systems have to be intact regardless of population sizes—unless global suicide is the aim. However, the problem is that future generations are facing increasing difficulties to respect ecological standards and thresholds when their populations are growing.

The implementation of the SMS is already reality, e.g., in form of marine protected areas. Conservation biologists have proposed complementing current sustainable policies with the establishment of a scheme of protected areas, e.g., marine protected areas, which are ocean areas within which human activities are limited and/or completely prohibited. According to the U.S. Federal Government marine protected areas are defined as "any area of marine environment that has been reserved by federal, state, tribal, territorial, or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein" (Executive Order 13 158, May 2000).[9]

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[8] For a detailed discussion of the SMS see e.g., Hampicke, (1992a, 310ff).

[9] For detailed information about marine protected areas of the USA, see www.mpa.gov.

At the biodiversity conference in Nagoya (2010) the international community agreed and/or planned further steps in this direction: e.g., Brazil enlarged the protected rainforest area by 32 million hectares, Canada has almost doubled its natural park area. Central America is planning an international bio-corridor; in sum about 15 percent of the earth's terrestrial surface enjoys some form of protective status. Similar plans are under discussion for the protection of the oceans.[10]

There are also other alternatives of addressing the "discounting issues" with respect to sustainability and intergenerational equity. There are countries (e.g., Denmark, Germany, Sweden) which have adopted long-term perspectives in their national strategies for achieving the objective of sustainability (Levin, 2012, p. 2; Müller & Hennicke, 1994 and OECD, 2006).

Thus, the acceptance of SMS is actually a departure from the market mechanism. SMS are only viable when all intervening generations re-assert their commitment to respect ecological limits and thresholds required for ecosystem and biosphere protection. SMS demands conceptually a multi-generational "social contract" to limit consumption in each generation to respect these standards so that sustainability is guaranteed for future generations. Thus, it ultimate success relies on the allegiance of each following generation (Randall, 2006, 116ff).

In implementing SMS, the collective aspect and/or cooperative behavior of this task has to be stressed. For pure market ideology is here no room! The individualistic society of a market economy has to learn how to arrive at issue-related correct and just, not despotic decisions. The first experiment of implementing a central decision making bureaucracy through a Marxian revolutionary process failed due to disregarding and/or belittling problems of individual motivations, bureaucracy and sheer power. However, those who are content and frolicking about the failure of the Marxian experiment may be celebrating prematurely: the social problems still remain un-solved: e.g., the questions of distributive justice become even more paramount, the more pronounced the biophysical limits of local and global ecosystems become.

If the international community accepts the concept of SMS, then actual an alternative to the present market economy paradigm is set in motion, namely an ecological global social market economy, where fairness and justice are the guiding principles.

## 4. CONCLUSIONS

This article intends to reduce some of the confusion about discounting in general, and about crucial environmental issues in particular. It was argued that there is no case for the use of an uniform negative exponential function in any economic circumstances, unless some very unrealistic conditions are fulfilled. More fundamentally, in the realm of

[10] www.conservation.org; Nagoya, Japan, Oct. 18-29, 2010.

environmental issues it is here argued that prices and monetary values are inappropriate conveyors of ecological information. Prices, as deposits of economic information, obscure notions of ecological limits and thresholds. Consequently, when sustainability, ecosystem functioning and protection of biodiversity are at stake, it is proposed to rely on SMS. The acceptance of SMS is a departure from the price mechanism and individualistic decision making in essential areas of the socio-economic system. If, and only if, the international community accepts SMS then an alternative to the present neo-liberal, profit-oriented society is set in motion, and hopefully, something more civil, like an ecological global social market economy may emerge.

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