THE EFFECTS OF CHOOSING A DISCOUNT RATE ON CLIMATE POLICY AND FOREST ROTATION LENGTH

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Abstract

An economic concept that has the ability to dictate whether or not abatement efforts are taken to reduce greenhouse gas emissions is discounting. The selection of a discount rate can have serious ramifications in climate change policy development. Discount rates can be highly variable and selected in a seemingly arbitrary manner. Eighteen pieces of literature are reviewed to study the variability and the rational for discount rate selection. The discount rate could determine whether or not capital is invested in climate change mitigation at present [positive rate] or if the costs are delayed to future generations [near zero rate]. Research on negative discount rates has yet to be fully developed. With no commonly accepted method of selecting a discount rate, it is difficult for governments to collaborate or agree on climate change policies. By reviewing the three approaches to discount rates I will explain the advantages and disadvantages of each method. I intend to highlight the sensitivity of the discount rate on abatement efforts and the problems discount rates can present within the field of forestry.

KEWORDS: *climate change, discounting, discount rate, carbon, forestry, policy*.

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1.0 Introduction

Governments, on an international scale, are acting together to reduce the emission of greenhouse gases [GHG's]. This is in an effort to slow the effects of climate change, and to ensure the welfare of future generations. In an economy plagued by recession this is not an easy task. Spending made by governments to support climate change abatement must be justified through cost-benefit analysis. The solution of reducing GHG emissions is complicated as it is difficult to evaluate how capital will flow in an uncertain world. In an answer to this complication, governments use discounting. The primary objective of this essay is to determine how discount rates are applied to climate change mitigation policies and how these rates affect outcomes in the future. Also the essay will compare how different discount rates can influence an industry such as forestry. By highlighting these objectives an attempt will be made to determine which discount rate is most beneficial in climate change mitigation policy so that a standard may be developed.

Discounting is an individual's tendency to value a current benefit today, to be worth more now than that same benefit in the future. This occurs because money today can be invested and interest can be accumulated on this investment. Money in the future cannot be invested today, and so its value should be discounted at the interest rate that could have been obtained if that money were invested today. This rate of interest, then, is the discount rate. Discounting is valid as the result of two main factors. Firstly, if the amount of consumption increases, society will be in a better economic state in the future. Secondly, people are often impatient and prefer to acquire a benefit as soon as possible (Stern, 2007). Markandya and Pearce rationalize the use of discounting in *The World Bank Research Observer*:

> "… [I]ndividuals attach less weight to a benefit or cost in the future than they do to a benefit or cost now. Impatience, or 'time preference,' is one reason; another is that, since capital is productive, a dollar's worth of resources now will generate more than a dollar's worth of goods and services in the future. Hence an entrepreneur would be willing to pay more than a dollar in the future to acquire a dollar's worth of these resources now." (Markandya & Pearce, 1991).

The true complexity of discounting is not apparent in the example of an individual, but arises when dealing with society. A society does not face mortality and thus no 'time preference' is evoked (van den Bergh, 2004; Markandya & Pearce, 1991). It is also difficult to assess impacts across different peoples and nations. It is necessary to consider this as the effects of climate change will be felt for millennia, making aggregation across generations unavoidable (Stern, 2007). Climate change is a difficult matter affecting all members of society. The selection of an appropriate discount rate requires justification.

Choosing an appropriate discount rate depends on two approaches. First, is the opportunity cost of capital. Second is the social rate of 'time preference'. 'Time preference' is based on the expectation of being wealthier in the future (Azar & Sterner, 1996). Presently, the use of discounting in climate change mitigation is approached from two different angles, with a third angle briefly discussed. The first angle is that of using a high positive discount rate. The second angle is that of setting the discount rate to zero or a value near zero [henceforth referred to as a near-zero discount rate]. The third angle is that of a negative discount rate. Rational decision makers most commonly apply a positive discount rate to climate change policy (Arrow, Cline, Maler, Munasinghe, Squiteri, & Stiglitz, 1995). When using a discount rate that approaches zero, or becomes negative, one assumes that it is viable to invest large sums of capital in mitigating climate change for the benefit of future generations, even if the modeled problems of climate change were not to materialize (Azar, 2003). The selection of a discount rate has large implications for the subsequent policy decisions that will be made in regard to climate change mitigation.

The arbitrary selection of a discount rate is problematic. The results of using different discount rates in such a large-scale, intergenerational issue are extreme. The advantages and disadvantages of each type of discount rate previously mentioned will be showcased after an analysis of their effects on climate change policy is completed. This will allow for those interested in the subject, as well as policy makers, to understand the use of each type of discount rate and help to ease the selection of an appropriate discount rate for environmental projects concerning climate change. When possible and appropriate, examples from within the field of forestry will be used.

In this essay a literature review takes place examining 18 pieces of work from both books and peer-reviewed journals. Each type of discount rate is reviewed under the appropriate subheading. At the end of this section a summary of the discount rates occurs. Following the literature review is a “Discussion and Analysis” section which details the sensitivities present in the selection of a discount rate, and outlines some specific problems that can arise as a result of discounting in the field of forestry. In this section a table has also been created to note the advantages and disadvantages of each discount rate, as is the opinion of the author. Finally, the conclusion of the essay will take place.

2.0 Literature Review

2.1 Positive Discounting

2.1.1 Why a positive discount rate?

The interests of the electorate incorporate the interests of future generations in their 'time preference' (Sumaila, 2005). Therefore, it has been suggested that governments acting on behalf of the electorate should discount at a positive rate. An appropriate time to use a positive discount rate is when there is growth in the economy. The larger the growth in the economy, the larger the social discount rate that should be applied. This has been the normal approach for more than a century (Gollier, 2002). Many economists apply a positive discount rate to environmental policies because this is how individuals, and to a lesser extent societies, make decisions (Arrow et al., 1995). Market rates of interest show how individuals make intertemporal decisions and therefore act to justify the use a positive discounting for climate change policies (Stern, 2007). The appropriate discount rate to be used for public projects should correctly measure the social opportunity cost of capital (Baumol, 1968). Present generations discount at a positive rate, and it is plausible to assume that subsequent generations would continue to do the same based on their 'time preference'; justifying the use of a positive discount rate in climate change policy.

This conventional use of a positive discount rate makes it possible for governments to install a climate change abatement 'policy ramp' (Nordhaus, 2007). The idea of a 'policy ramp' means that governments can introduce new policies over a period of decades rather than making more substantial efforts today. Substantial and immediate diversion of investments from elsewhere in the economy at present has the potential to compromise long-term growth by sacrificing alternative goals (van den Bergh, 2004; Healy, Price, & Tay, 2000; Arrow et al., 1995). A 'policy ramp' thus becomes an appealing option for governments when faced with the alternative of investing the large sums of capital now, as would occur when using a near-zero or negative discount rate. The 'policy ramp' provides the ability to invest more efficiently in human and physical capital now, building a more productive economy. This makes it the responsibility of future generations to meet the challenges of climate change (Dasgupta, 2007). The use of a positive discount rate is made even more defensible with the existence of uncertainty and risks.

2.1.2 Uncertainties and risk

Discounting allows for future costs and benefits to be evaluated at present value for the ease in making comparisons. The complexity of the climate system creates surprises and unexpected situations regarding climate change (Azar, 2003). This complexity is compounded by the presence of uncertainties and risks (Hellweg et al. 2003). Knightian uncertainty is immeasurable [probability distribution of outcomes is unknown] whereas risks are measurable [uncertainty of outcomes delimited by known probability distribution] (Greenspan 2004). Some of the uncertainties that lead decision-makers into using a positive discount rate, according to Hellweg, include:

- "Uncertainty about the presence of an individual or society in the future";
- "Uncertainty about the preferences of the individual";
- "Uncertainty about existence, magnitude, or quality of damage"; and,
- "[Uncertainty] whether the predictions of potential environmental impacts are reliable and whether future generations will perceive them as damage".

The uncertainty about technologies that may be at the disposal of future generations also explains why decision-makers would choose a positive discount rate. The costs and environmental damages associated with the premature phasing out of existing technologies with new inefficient low carbon technologies could prove costly (Azar, 2003). Positive discount rates slow the phasing out of existing technologies. This also makes mega projects, such as the creation of hydroelectric dams for electricity generation, which are damaging to the environment, less attractive than at lower rates of discount (Markandya & Pearce, 1991).

Alternatively, positive discount rates allow for investments that would have benefits for the use of current generations. These include investment in research and development for low carbon technologies, investment in education, and finally investment in other factors to encourage the stability of a productive economy needed for continual growth. This will allow for more efficient and superior technologies to be invested in thus replacing existing technologies when they are more optimal. A positive discount rate reduces the risk of investing substantial amounts of capital in abatement efforts at present. This happens even though it is possible that no high damage scenario may materialize (Azar, 2003). With all of the uncertainties involved it is easy to see why a positive discount rate has been the standard for climate change mitigation. However, with uncertainty about everything in the distant future, it can be stated that the most fundamental of all uncertainties is that of the discount rate itself (Weitzman, 1998).

2.1.3 Declining discount rate

The use of the declining discount rate is a new approach to discounting at a positive rate. This discount rate is higher in the near future than it is when operating further into the future. The fact that the further a value occurs into the future, the lower is the appropriate discount rate, is a commonly accepted idea. This idea is further compounded by the previously mentioned uncertainties in section 2.1.2 (Price, 2011; Weitzman, 1998; Dasgupta, 2007; Stern, 2007; Gollier, 2002). A benefit of using a declining discount rate is that it places importance on future generations, while still taking into consideration the values of present generations. Individual rates of 'time preference' are not constant for different types of issues or time periods, and this is likely true for society as well (Azar & Sterner, 1996). Declining discount rates are becoming more popular in the literature, but are also being adopted by national governments such as those of the United Kingdom and France (Price, 2011).

Declining discount rates become problematic in forestry; especially in temperate regions with longer forest rotations. Declining discount rates make forestry appear more profitable. This is because of the increased value of carbon sequestration in the future, as it benefits future generations. This is only the case however, if the reason for the given declining discount rate is realized. That is to say, a new problem could arise if the discount rate is chosen solely on the 'time preference' of the present generation, and future generations act to revise the rotation length based on their preferences (Price, 2011). An analysis of this case will occur later in the paper.

2.2 Near-zero Discounting

2.2.1 Why a near-zero discount rate?

Positive discount rates are based on market rates. These rates could prove to be myopic in nature. A society - unlike individuals - does not have a time preference (van den Bergh, 2004; Markandya & Pearce, 1991). Nicholas Stern has popularized the use of a near-zero discount rate in his report for the UK government, *The Economics of Climate Change*. Many have criticized this review, and it is in these critiques that some of the most clearly explained rationales of using a near-zero discount rate are found. The following are provided in a review by William Nordhaus:

- Near-zero discounting magnifies impacts in the distant future and rationalizes large cuts in emissions now;
- Near-zero discounting deems future generations as important as present generations;
- Near-zero discounting makes it possible to have large tradeoffs in income today, to increase future income by a tiny fraction; and
- Near-zero discounting makes decision making necessary even when outcomes are uncertain. (Nordhaus, 2007).

Although viewed by some as criticisms of near-zero discounting, these points form a basis for this angle of present research. The sole reason discounting is possible is due to the fact that future generations are not here to make claims on their rights (Azar & Sterner, 1996). However, Stern argues that if future generations exist, they have a right to our ethical attention (Stern, 2007). This is in line with a statement made by Christian Azar, that cost-benefit analysis is not appropriate for large-scale issues when human lives and nature are at risk (Azar, 2003). Still, there are risks in effect and Stern states that a zero discount rate is complex and not practical because the existence of future generations is not certain. As such, he uses a rate based on 'time preference' of 0.1% in addition to a growth rate of around 1% (Stern 2007). This is much different than most economists and western governments who use a discount rate between 5% and 8% sometimes reaching as high as 10% (Gollier, 2002).

2.2.2 Uncertainties and risk

If future generations are as important as present generations, then the impacts of climate change in the future are magnified and abatement efforts are required today. High discount rates favor myopic policies that exaggerate unsustainable resource use and lead to problems such as deforestation and overfishing (Sumaila, 2005; Markandya & Pearce; 1991). Therefore, setting the discount rate to near-zero allows for investment in new, low carbon technologies because environmental impacts in the future are seen as being detrimental to future existence. This investment occurs because at a near-zero discount rate, only the opportunity of capital limits decisions, and so development is encouraged (Sumaila, 2005). Development takes place even though there is a chance that future generations may be richer. Spending today on this abatement will result in benefits that occur in the future, as nothing concerning climate change takes place immediately. Arguments can also be made stating that future generations are at risk from our rapacity, as they are not here to bargain or remind us of our obligations to them (Dasgupta et al. 1999). Finally a near-zero discount rate can be justified by not allowing for technological progress to be a utopian solution. Due to the fact that we rely on natural resources and ecological services that are finite in existence, it is reasonable to assume no technological change when evaluating the long-term consequences of economic policies (Dasgupta et al., 1999). Future generations are being left with a climate altered by those past and present, and for this reason, it is the duty of present generations to take action against climate change.

2.3 Negative Discounting

2.3.1 Why a negative discount rate?

The use of a negative discount rate is not widely discussed in the literature, especially that pertaining to climate change or forestry. Some authors point to the possibility of using a negative discount rate under certain situations but the idea is not fully developed and is perhaps underappreciated (Stern 2007; Azar & Sterner 2006). Sumaila notes that discounting fails to capture human proclivity, most notably in regards to the education of one's children. The education of children, Sumaila also notes, generally leads to a negative net present value of capital. This negative value is disregarded to the parent's confidence that children have received the tools necessary for survival. Whether or not this selflessness occurs at all levels of society is more difficult to assess (Sumaila, 2005). Individuals may take into consideration different rates of discount in personal, as compared to societal, matters (Sumaila, 2005). This may make the case for the use of a negative discount rate. Discounting assumes that consumption is growing and this may not be a valid argument when looking at the long-term intergenerational effects of climate change. If consumption falls then the appropriate discount rate would be negative (Stern, 2007). This is a possible scenario if, over time, the global population were to continue to grow and average consumption per person were to fall. If we become poorer in the future, a negative discount rate would be applied (Azar & Sterner, 1996). Another situation that could arise and warrant the use of a negative discount rate is if the availability of scarce or natural resources fell. If development was to continue, and deterioration of the environment was to occur as a result, the use of negative discounting would be justified when dealing with climate change mitigation policy.

2.4 Summary of Literature

No matter which discount rate is selected for use in climate change mitigation, an effort will be taken to reduce the effects associated with climate change. However, this occurs to varying degree. The most extreme abatement efforts occur when a negative discount rate is applied, but it is not common that this discount rate is evaluated in climate policy. The next most rigorous efforts occur when a near-zero discount rate is applied in policy. The least efforts towards climate change abatement occur when a positive rate is used. It can be seen that with such a wide range of outcomes possible from the selection of a discount rate that no policy maker or economist should choose a discount rate arbitrarily. A positive discount rate is appealing to climate skeptics and governments concerned with the costs associated with abatement efforts. This is due to the fact that a climate ‘policy ramp’ is created and capital is slowly directed towards climate change policy. Using a declining discount rate is perhaps even more beneficial to the idea of climate change because it incorporates the values of both present and future generations. A declining discount rate is a somewhat new idea and is not immune to its own problems. The near-zero discount rate, sitting in-between the other discount rates examined, is perhaps the rate causing the most discussion in current research. A near-zero discount rate calls for action to happen now due to the potential catastrophes that could result from climate change. Although arguments can be made pertaining to the use of a negative discount rate, it seems unlikely that this discount rate will make it into climate change policy. Now that each discount rate has been examined in the literature, in following sections of the essay an effort will be made to demonstrate what the use of each rate would in fact mean.

3.0 Discussion and Analysis

3.1 Comparative Analysis of the Discount Rates

An attempt has been made to detail why the seemingly arbitrary selection of a discount rate in dealing with climate change mitigation can be problematic. This is troubling since climate change is one of the greatest issues affecting humankind today. Different discount rates, when applied to the issues associated with climate change, produce extreme results. This is especially true when aggregation across generations is considered. It is difficult to assess how capital will flow in an uncertain world. This issue is compounded by the fact that climate policy means alternative public goals must be sacrificed (van den Bergh, 2004). As governments act to reduce greenhouse gas emissions, it becomes curious to what effect the rights and welfare of current generations are being compromised. What must be asked is whether or not, and to what extent, climate change abatement efforts deserve to be fundamentally different than other public goals (van den Bergh, 2004).

At positive rates of discount, climate change abatement efforts are slowed and a ‘policy ramp’ is implemented. Large sums of capital are invested in areas of the economy in order to encourage growth, which benefits current generations. At near-zero rates of discount more substantial efforts are made to counteract climate change with investments in long-term projects and more efficient technologies. These types of investments occur even though the disasters associated with climate change may not happen, and even though these technologies may be underdeveloped. Finally, at negative rates of discount, large sums of capital would be invested today in order to prevent the effects of climate change, essentially impeding any growth in the economy for the benefits of future generations. The different results of these three types of discount rate dictate the extent to which climate change abatement takes place.

At high positive discount rates, cost burdens are shifted to future generations (Markandya & Pearce, 1991). This can be justified for a number of reasons. Discounting assumes consumption is growing and that even within a society there is a 'time preference'. The assumption of growth means that future generations will be richer than current generations, and, as a result, more capable to deal with any disasters that occur in response to climate change. It is also possible to assume that this richer society will be more adept at surviving in a new climate because of the technological advancements they will have made. As the discount rate rises, the importance that is placed on future generations lessens. In addition, the importance of catastrophic events that may arise as a result of climate change also lessens as it is deemed that richer future generations will be better able to handle these events. Selecting a high discount rate indicates that little to no abatement efforts will be taken in response to carbon emissions and their compounding effect on climate change as this effect is not deemed important. As a result, carbon emissions will continually increase in accordance with growth in the economy and the use of existing resources [Figure 1]. However, if uncertainty about the effects of climate change or the existence of society is introduced into the equation, then at high risks of catastrophe, with high damage ensued, significant abatement efforts occur. At high risks of catastrophe, with low damage ensued, significant abatement efforts do not occur and carbon emissions again begin to steadily increase [Figure 1]. When selecting a high discount rate, then, policy makers are not taking large strides towards protecting the rights and needs of future generations.

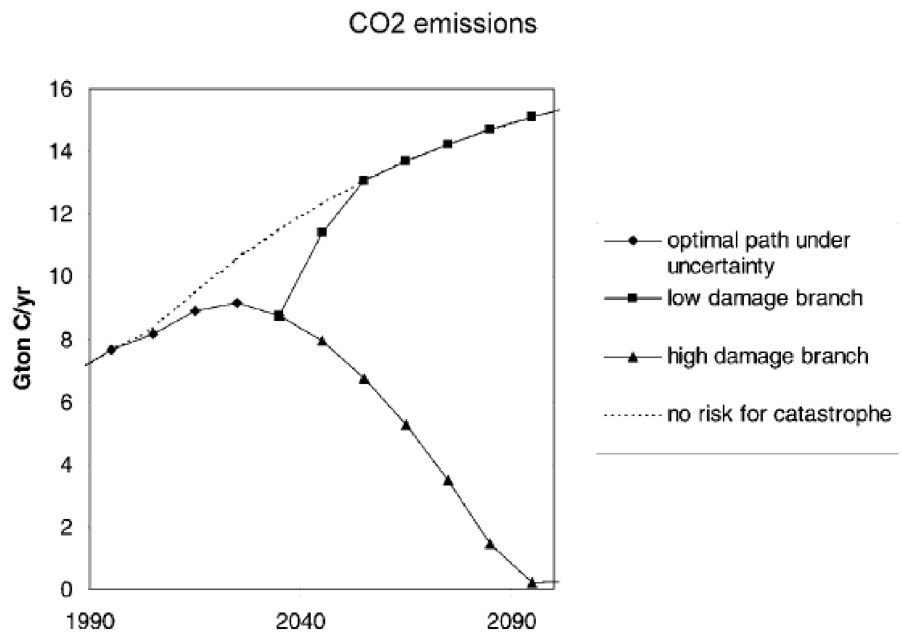

Figure 1: CO_2 emissions as a result of different levels of damage and catastrophe

Many advocates of near-zero discounting suggest that relying on technological advancements is not justifiable as we are currently dealing with a planet containing finite resources. This assumption may, however, prove to be erroneous. If one accounts for the potential of mass extinction of the population in climate change models [such as those presented by Nicholas Stern in his review], why not then, model the potential for a technological solution to the problem being developed? The inclusion, or exclusion of, many assumptions in regards to discounting highlights how fragile any 'justifiable' discount rate may be for scenarios involving climate change mitigation.

Focusing purely on climate change abatement made as a result of the discount rate, one can perceive very real changes in the pursuant policy. A review by Christian Azar found, using William Nordhaus' Dynamic Integrated Climate Economy [DICE], changes in the approach to discounting returns highly differing results in emissions reductions. Azar examines the difference between using a pure rate of time preference [ρ] of 0%/year and one of 3%/year while maintaining a negative marginal elasticity [α] of 1. Here, one can note that more substantial abatement efforts are in fact taken when the pure rate of 'time preference' is set to 0%/year, representing a case where discounting is being carried out at a rate 3%/year lower [Figure 2]. At higher discounting [3%/year], even with a 5% probability of catastrophe, less abatement efforts are made than at 0%/year discounting with no probability of catastrophe [Figure 2]. This showcases that a 3% change in the rate of discount can have substantial implications in the level of climate change abatement efforts to be taken. It also shows that the presence of a probability for catastrophe can critically change in the near term what is optimal in terms of climate change abatement.

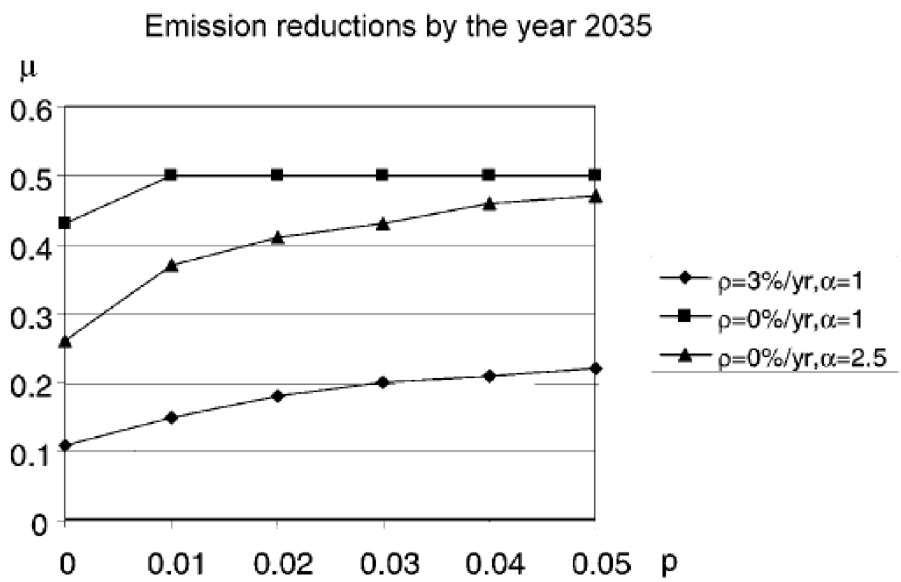

Figure 2: CO_2 emissions reductions [μ] as a function of the probability of catastrophe [ρ] under different assumptions of discounting (Azar, 2003).

4.0 Application of the Discount Rates to Forestry

The selection of a discount rate can also have very real and interesting consequences in the field of forestry. This is in response to many factors. These factors include the importance of forests in sequestering carbon, carbon storage in forest products, and also the deferred emissions from GHG' that occur even though carbon may be instantly volatilized through the burning of biofuels. Using a negative discount rate in the case of forestry would make conversion of the land base to forestry a very appropriate policy decision in order to sequester carbon. Forest rotation lengths would be increased indefinitely so long as they were able to act as carbon sinks. A low or negative discount rate increases the value of carbon stored in forests because this acts to benefit the environment of future generations. Near-zero discounting would have a similar, although less intense, result. A high value for carbon is responsible for extending rotation length, and elongates successive rotations (Price & Willis, 2011). Carbon values are therefore responsible, under a low discount rate, for increasing the social value of forestry (Price & Willis, 2011). Under a positive discount rate, conversion to forestry would not be common because there are more profitable uses for the land base in the short term, and rotation lengths would remain as they are today. In this case a single discount rate can be seen as having one result on forest rotation length, but, this is not always the case.

4.1 Forestry and the declining discount rate

Forest rotation length can become complicated in the case of using a declining discount rate. Its ability to account for the importance of both current and future generations is a good solution to discounting. A problem arises when the reason for using the declining discount rate is based on the 'time preference' of the current generation. The discount rate should instead consider the materialization of predicted environmental changes in the future. If ‘time preference’ is the reason for using the declining discount rate, it will be found that all generations agree that forestry will be profitable in the long term for the land base, but that conversion to forestry should in fact be postponed (Price, 2011). To demonstrate the idea of the declining discount rate complicating forest rotation length across generations, refer to Table 1. If the declining rate of discount is due to the ‘time preference’ of the current generation, rotations will be revised by future generations as the individuals in each generation will discount at a high rate in the short term. The problem then simply shifts one generation. How are subsequent generations expected to follow the plans set in place today with optimal felling time based on the ‘current’ [whenever that may be] opportunity cost of delaying these operations (Price, 2011). The establishment of beech [*Fagus sylvatica*], occurs with cash flows as shown in Table 1. According to the UK Treasury’s protocol, discount rates for 40, 80, and 120 years are respectively 0.26510, 0.08327 and 0.03101 (Price, 2011). A rotation length of 120 years is profitable as seen from the year 2009 but as seen from 2089, immediate felling is more profitable than waiting until 2129 and so the crop is felled prematurely (Price, 2011). Had that felling been predicted when the crop was established, it would not have been deemed worthwhile (Price, 2011). The issue becomes whether or not the current generation decides not to plant as a result of this or if they claim the right to enforce a 120-year rotation while stripping future generations of their own claim to that right (Price, 2011). Although a declining discount rate can be seen to benefit current generations while also taking into consideration the importance of future generations, in the case of forestry it provides a unique dilemma.

Table 1: Declining discount rates and optimal age for felling

Event	Cash flow per hectare	Discounted value seen from time AD 2009	Discounted value seen from time AD 2089
Establish	€2000	€2000	
Fell at age 80	€20,000	€20,000x0.08327=€1665	€20,000
Fell at age 120	€70,000	€70,000x0.03101=€2171	€70,000x0.26510=€18,557

5.0 Effects on Policy

Positive discount rates predict the behavior of the current generation and as a result of 'time preference' the likely behavior of future generations within their own perspective time frame. These rates prevent governments from making rash investment decisions in regard to climate change, which may impede growth. They may also inadvertently hamper the livelihood of future generations if the predicted damages do not occur. With so much uncertainty about what will in fact result from climate change it is difficult to deny the logic in selecting a positive discount rate. The apparent unethical nature of using a positive discount rate may be trumped by our inability to comprehend the potential in futuristic technologies. This places importance on future generations in regard to their ingenuity and adaptability. At near-zero discount rates, large sums of capital are invested in an effort to abate the effects of climate change. However, at near-zero discount rates, the volume of investments deemed profitable, may lead to greater environmental degradation in the future (Price, 2010). This could prove to be the reason why near-zero discount rates are not applicable to climate change mitigation. A potential solution to this problem would be varying the discount rate for particular projects and resources, but upon a closer examination, this proves too difficult (Markandya & Pearce, 1991). The limitation of this review stems from the fact that negative discount rates are not explicitly examined in regard to their effects on climate change mitigation policy. This is important because negative discount rates could be encountered if growth in the economy does not continue, if per capita consumption decreases, or if environmental degradation occurs. All of these are possible scenarios, especially in the face of climate change. Therefore, it is suggested that future research place more emphasis on this possibility. Selection of the discount rate is no simple task for climate change policy; however, it is the opinion of the author that a positive discount rate may be the preferable standard to be used. There are many practical advantages to this particular discount rate as compared to the other rates [Table 2].

Many authors, in current research, suggest that policy makers use a positive discount rate when making decisions regarding climate change mitigation policies. Nicholas Stern; however, has also popularized the idea that policy makers use a near-zero discount rate in making decisions. As further research is presented, policy makers need to have a clear understanding of what type of discounting is being carried out around the globe, and the advantages and disadvantages of each method. This can be done, as is the case in this review, by explaining each type of discount rate in detail, and then applying each rate to specific policy decisions. Governments and policy makers need to collaborate in an effort to work together in the face of climate change. The issues to be faced, as a result of climate change, will be aggregated across all nations and all generations, thus the selection of a discount rate cannot be arbitrary. Only with some level of consensus being reached on the issue of the selection of an appropriate discount rate will the real potential to deal with climate change mitigation be met.

Table 2: Advantages and disadvantages of each discount rate option

	Advantages	Disadvantages
Positive Discount Rate	- Reflects how individuals manage their investments; - Benefits current generations; - Presents the opportunity for a declining discount rate; - Allows governments to slowly initiate new climate change policies under a ‘policy ramp’; and - Allows for a technological solution to the ‘problem’.	- Views continual economic growth optimistically; - Deems future generations less important than current generations; - Problems arise with the declining discount rate in forestry; - Leaves society unprepared if problems from climate change materialize; and - Perhaps myopic in nature.
Near-zero Discount Rate	- Limits the time governments can use to debate the issue; - Requires immediate action; and - Accounts for the values of future generations.	- Removes the availability of capital from other areas of the economy, hindering growth; - Spends presently available capital when true outcomes of climate change are uncertain; and - Does not account for a technological solution to the ‘problem’.
Negative Discount Rate	- Calls for immediate and significant action against climate change; - Realizes that consumption and continual growth in the economy may in fact decline; - Views future generations as more important [a value shared by most, if not all parents]; and - Leaves the world in the best possible state if the problems associated with climate change do in fact materialize.	- Has been understudied in climate change; - Removes the availability of capital from other areas of the economy, hindering growth; - Spends presently available capital when true outcomes of climate change are uncertain; and - Does not account for a technological solution to the ‘problem’.

6.0 Conclusion

Through the examination of the objectives in this essay, it can be seen that the arbitrary selection of a discount rate in climate change mitigation is problematic due to the large array of resultant outcomes. In regards to forestry, the discount rate dictates not only the best use of the land base, but also the subsequent rotation length, and in the case of the declining discount rate, the value of timber to subsequent generations.

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