1. Introduction

Cost-benefit-analysis is an indispensable instrument for evaluating the long-term impacts of the efficiency of policy measures. To make costs and benefits which occur at different points in time comparable, economists determine their present values through the application of a discount rate. In many cases, the size of this rate determines whether a project is classified as attractive or unattractive. This is particularly true for projects with long time horizons, such as the abatement of greenhouse gas (GHG) emissions. [1] Most commonly, economic theory derives this discount rate in the framework of optimal growth models in the tradition of Frank Ramsey.[2] The result, the well-known Ramsey formula, states that the consumption discount rate should be equal to the sum of the pure rate of time preference and the product of the elasticity of the marginal utility of consumption and the growth rate of consumption.

In the context of climate change, the correct parametrization of the Ramsey formula is very important as slightly different rates entail entirely different climate policy outcomes. With regard to the pure rate of time preference, this becomes especially difficult because different values can be motivated by different normative concepts. Not surprisingly, the question of its correct parametrization has given rise to a long and intensive discussion in climate economics. This debate, sometimes referred to as the Stern-Nordhaus Debate, as it took place most prominently between the two economists William Nordhaus and Nicholas Stern, can be characterized by two distinct lines of arguments:[3]

Nordhaus (2007) argues for the so-called *consumer sovereignty* approach, which demands that public projects should be evaluated with a discount rate that is compatible with observed time preferences. These are claimed to be given by the real interest rate, as it represents the opportunity costs of private investments. Because public and private investment should be evaluated with the same standards any discount rate below or above the real interest rate would induce inefficient investment decisions. This position is held, for example, by Stigler and Becker (1977), Samuelson and Nordhaus (1989), Manne et al. (1995) and Nordhaus (2008).

[1] See Arrow et al. (2013), p. 1.
[2] See Bayer (2000), p. 1.
[3] William Nordhaus and Nicholas Stern were not the only ones involved in this debate. For example, Weitzman (2007), Gollier (2006), Gollier (2010), Dasgupta (2007, 2008) or Tol and Yohe (2006) also made important contributions to it.

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In contrast, Stern (2007) argues that in long-term decision-making problems, actions taken at present will not only affect the well-being of individuals who live today, but also of those who are not yet in existence. In this regard, there is a distributional problem between individuals, not an intertemporal allocation problem of a single individual. From Stern's perspective, it would be ethically inappropriate to discriminate between individuals purely on the bases of their time of birth. The logical consequence is to set $\rho = 0$. This argument is called the *intergenerational equity* approach and is in the tradition of Pigou (1920), Ramsey (1928), Harrod (1948) and Solow (1974) or, in the context of the recent climate change debate Cline (1992).

As both arguments have their merits, it would be desirable to have a discounting scheme that incorporates both. Krysiak (2010) shows that this can be achieved in an overlapping generations (OLG) model which has been discussed by a number of authors who examine the relation between representative agent (RA) models and overlapping generations models. For example, Stephan et al. (1997) and Howarth (1998, 2000) analyze under which conditions representative agent models can be calibrated to yield the same outcome as OLG models. They employ numerical simulations of integrated assessment models. Schneider et al. (2008, 2012), in contrast, derive the relation between these two frameworks in a continuous time set-up and identify several shortcomings of the RA approach. Krysiak's approach differs from these studies in so far as he derives the discounting scheme from a set of normative assumption.

However, Krysiak (2010) does not draw any policy conclusions. In order to fill this gap, we apply the proposed discounting scheme in the latest version of the DICE model and present its implications for an optimal climate policy. It calls for a carbon price path which is just between the ones proposed by Nordhaus and Stern. Following this path, industrial emissions should be stabilized by mid-century and subsequently be substantially reduced. In this scenario, average global temperature will increase up to 2.5°C above the preindustrial level by the end of this century. We also analyze to what extent the choice of all relevant parameters drives the outcome of the intertemporal welfare maximization. It turns out that in the short run time preferences dominate the discounting scheme, whereas in the long-run only the risk of extinction affects the optimal growth path. This casts a cloud over the proposed discounting scheme as it seems to incorporate the two ethical stances successively instead of simultaneously.

This thesis is organized as follows: In section 2, we introduce the conceptual framework of Integrated Assessment Models (IAMs) and describe the specific characteristics of the model which will be applied here, DICE-2013R. In section 3, we give an overview of the Stern-Nordhaus debate and present the conceptual differences between the *consumer sovereignty* approach and the *intergenerational equity* approach. Section 4 introduces the concept of intergenerational discounting and explains how it is derived from overlapping generations models. In section 5, we firstly derive the discounting scheme as proposed by Krysiak (2010) (5.1), then present its main implications for optimal climate policy (5.2) and finally carry out a sensitivity analysis to check our results for robustness (5.3). The conclusions are presented in Section 6.

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