Charge Questions 1:

Applying the Ramsey Discounting Framework in an Intergenerational Context

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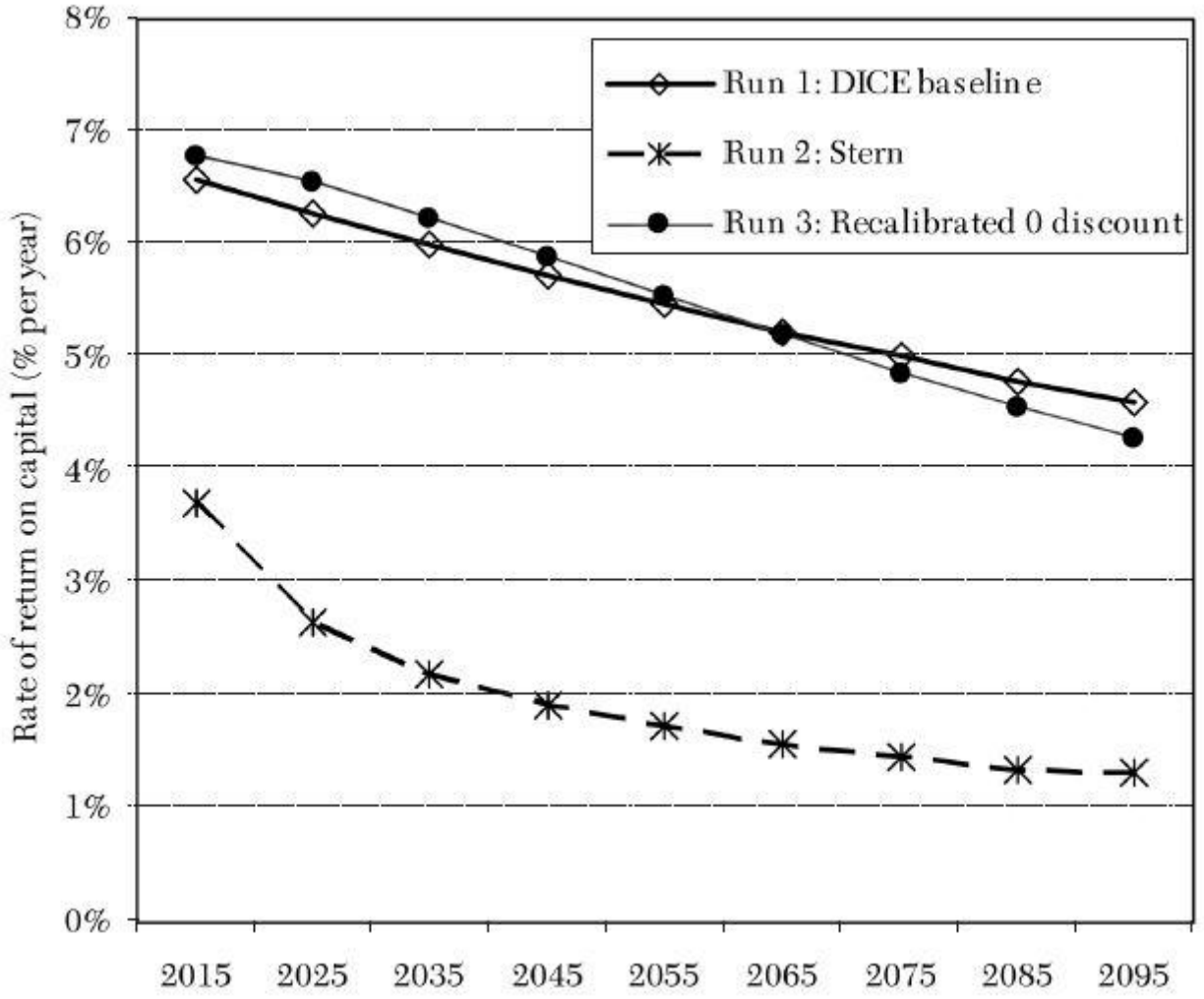
- EPA Guidelines suggest that Ramsey formula can be used to determine discount rates in an intergenerational context
- Consumption rate of discount (r_t) = $\rho + \eta \cdot g_t$
  where
  - ρ is the utility rate of discount
  - η measures how fast marginal utility of consumption falls as consumption grows [often assumed constant]
  - g_t is the growth rate of per-capita consumption at time t

Approaches to Choosing ρ and η

- "Descriptive" approach: Choose ρ and η so that the path of r_t approximates interest rates observed in the real world
- DICE model 2007: ρ = 1.5 and η = 2
- "Prescriptive" approach: Choose ρ and η based on ethical principles
- Stern Review: ρ = 0.1 and η = 1

Ramsey Discounting: DICE v. Stern



Extensions of Ramsey Formula

- Allow consumption to be uncertain (Gollier 2002)
  - Precautionary motive adds a third term to the formula
  - When rate of growth in consumption is normally distributed with mean μ and variance σ^2 and η is constant
  - $r_t = \rho + \eta\mu - 0.5\,\eta^2\,\sigma^2$
- Decouple intra-generational risk aversion from inter-temporal substitutability of consumption (Gollier 2002)
- Decouple intra-generational inequality aversion from risk aversion (Antoff et al. 2009; Tol 2011)
- Allow for ambiguity aversion (Traeger 2010; Millner et al. 2010)
- Generalize to multiple goods (Heal 2010; Sterner and Persson 2008)

Applying the Ramsey Discounting Framework in an Intergenerational Context

- **Question 1:** Is it appropriate to use the Ramsey equation in either a prescriptive or descriptive fashion to generate discount rates for benefits and costs over long horizons?
- **Question 1a:** Assuming that the parameters η and ρ could be determined, how, exactly, would the Ramsey framework be used in a discounting context?
  - Is the appropriate approach to embed these parameters in a structural model (such as an Integrated Assessment Model), so that discount rates can be determined endogenously?
  - How would the Ramsey equation be used to discount streams of benefits and costs generated in a non-climate context (e.g., in evaluating the benefits of groundwater protection)?

Applying the Ramsey Discounting Framework, Cont.

- **Question 1b:** What criteria should be used to determine the parameters η and ρ of the Ramsey formula? Should they reflect ethical considerations or attempt to reproduce observable behavior in markets?

- **Question 1c.** How should uncertainty be handled in a Ramsey framework? Is it appropriate to define probability distributions over η and ρ or should sensitivity analysis be used? How should uncertainty about g_t be handled?