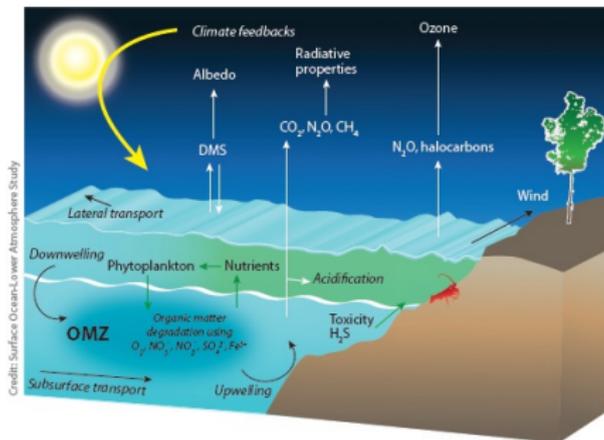


Rethinking the Discount Rate for the Social Cost of Carbon



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Introduction

- The social discount rate for computing the Social Cost of Carbon (SCC) is much debated and researched.
- New computational methods have been developed, for example, using a stochastic growth rate to endogenize the correlation among economic growth fluctuations, damage estimates, and the discount rate (Barrage and Nordhaus, 2024; EPA, 2023).
- Some issues have received less attention:
 1. **Shadow Price of Capital/Perfect Capital Market Assumption**
 2. **Ramsey Discount Rate Sensitivity to Model Specification** (Krutilla and Reuveny 2002, 2004; Xepapadeas, 2005)
 3. **Path Dependent Growth and Discount Rates** (Krutilla and Reuveny 2002, 2004; Stiglitz and Weiss, 1981; Azariadis and Stachurski, 2005)
 4. **Underestimated Marginal Rates of Time Preference** (Stiglitz and Weiss, 1981; Azariadis and Stachurski, 2005)

Presentation Objectives

- This presentation addresses items 2-4.
- Shows how one modification to the SRM, adding wealth to utility, changes the form of the discount rate and gives the possibility of path dependency.
- Considers the implications of credit rationing for marginal rates of time preference.
- Makes short- and long-term recommendations for discount rates for computing the SCC, given the state of information.

Capital in Utility

- Stocks of nature in environmental economics (Atkinson et al., 2018)
- Human capital (Oreopoulos and Salvanes, 2011)
- Health state dependent utility functions (Finkelstein et al., 2009)
- Social capital and institutions (Shiroka-Pula et al., 2023).
- Wealth enters utility functions in macroeconomics (Michaillat and Saez, 2021)

Reformulated Models with Wealth in Utility

$$1. \text{Max}_{wrt} C/L \int_0^{\infty} \left[\frac{\left(\frac{C}{L}\right)^{1-\eta} + \left(\frac{K}{L}\right)^{1-\eta}}{1-\eta} \right] e^{-\rho t} dt$$

$$\text{s.t.} \frac{dK}{dt} = K^{\sigma} (TL)^{1-\sigma} - C - \delta K$$

$$\text{Discount Rate: } r = \sigma k^{\sigma-1} - (n + \delta) = \rho + \eta g - \left(\frac{C}{k}\right)^{\eta}$$

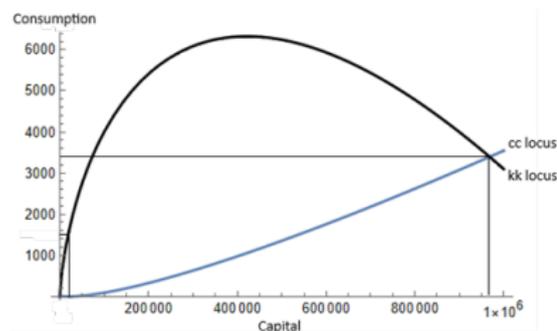
$$2. \text{Max}_{wrt} c \int_0^{\infty} \left[\frac{c^{1-\alpha}}{1-\alpha} + \frac{k^{1-\beta}}{1-\beta} \right] e^{-\rho t} dt$$

$$\text{s.t.} \frac{dk}{dt} = k^{\sigma} - (n + \delta) k - c$$

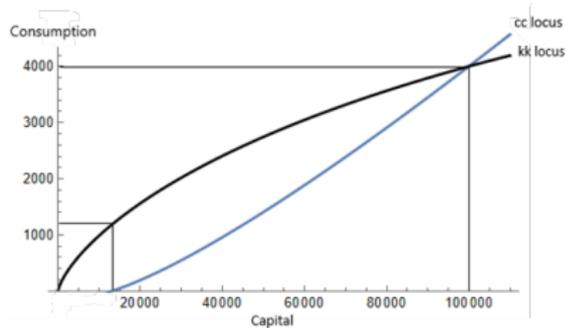
$$\text{Discount Rate: } r = \sigma k^{\sigma-1} - (n + \delta) = \rho - \frac{k^{-\beta}}{c^{-\alpha}}$$

Multiple Equilibria Possible

Varying η in Symmetric Model

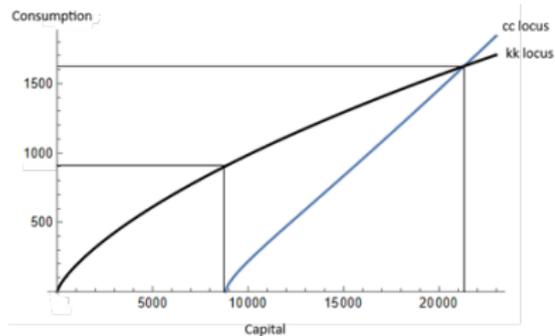


$$\eta = .5$$

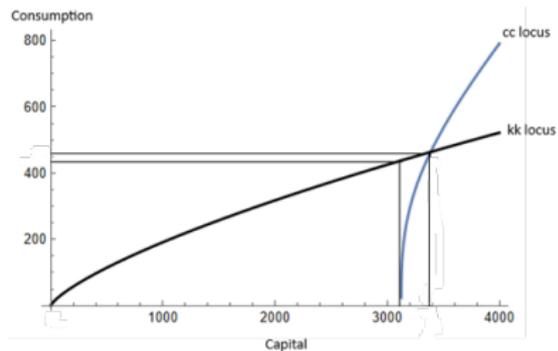


$$\eta = 1$$

Varying η in Symmetric Model

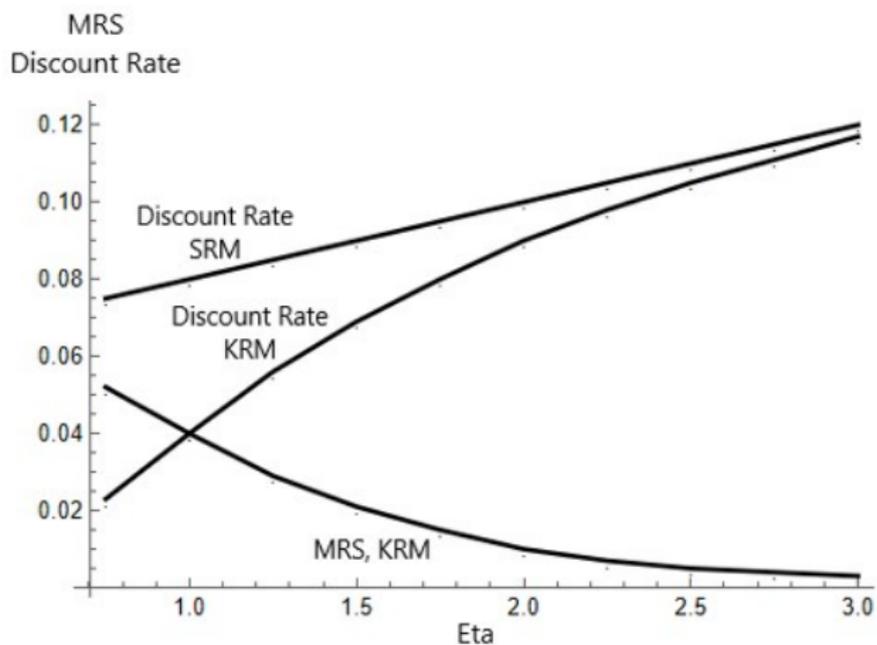


$$\eta = 1.5$$



$$\eta = 3$$

Discount Rate in SR and KR Models, Varying η



Credit Markets and MRTPs in High Income Countries

- Rates of return from large capital markets like the market for 10 year treasuries do not give reliable information on the marginal rates of time preference (MRTP) of many consumers.
- In the U.S., 99 percent of families beneath the 60th income threshold do not hold treasuries. Holdings of similar instruments (CDs/Saving Bonds) are also rare.
- Only 10.7, 32.8 and 53.7 percent of families in the 1st, 2nd, and 3rd income quintiles have retirement accounts.
- As of Q1 2025, the average credit card debt of U.S. adults was 4,538 dollars.
- Field studies and empirical research are consistent with consumer discount rates associated with credit rationing.
- Nominal discount rates for U.S. military personnel making choices about compensation packages varied between 10 percent and 54 percent (Warner and Pleeter, 2001).

Credit Markets and MRTPs in Mid/Low Income Countries

- Many consumers in low income countries transact in markets lacking formal financial institutions (Banerjee and Duflo, 2008).
- The supply of credit from formal institutions is limited.
- Lack of competition for financial services leads to predatory lending practices
- Nominal discount rates for low- and middle-income consumers in low income countries are about 4 percent per month (Banerjee and Duflo, 2008).
- Discount rates in low-income countries can be endogenously related to climate effects. For rural populations in Ethiopia, subjective discount rates rise/fall by 17 percent for a 10 percent loss/gain to income from droughts/high rainfall (Di Falco et al., 2019).

Key Takeaways

- Pervasive credit rationing gives marginal rates of time preferences for average citizens above the discount rates in the largest and most liquid capital markets sourced by governments, institutional investors, and businesses.
- The possibility of multiple equilibria in modifications to the SRM and in the institutional economics/development literature suggests that local, regional, or national disparities in discount rates can persist, rather than converge to a single equilibrium as in a SRM.
- Modifications of the SRM change the form of the discount rate. The discounting implications need further research.

Near-Term Recommendations

Adopt constant rates of 3 and 5 percent (Frass et al., 2023)

- Obama/IWG adopted 5 percent in part to provide that some “... account should be given to the discount rates revealed by their [consumer] behavior.” (IWG, 2010, p. 23).
- These rates encompass the rate of return on capital computed in the standard way: using a riskless rate based as the real rate of return on 10-year Treasury notes, plus a capital premium (e.g., Barrage and Nordhaus, 2024).

Also use the 3 percent and 5 percent rates to calibrate a Ramsey discount rate with a stochastic growth rate. (Frass et al., 2023)

- This endogenizes the correlation among damage estimates, economic growth, and the discount rate, which declines over time.

Recommendation for the Longer Term

Develop country-specific discount rates for intergenerational discounting (Frass et al., 2023)

- For conceptual consistency, the assessed benefits of GHG policies in different countries should reflect the preferences in these countries, including for intertemporal tradeoffs.
- Evidence of disparate views of intertemporal tradeoffs is shown by the laxer national commitments of lower-income countries in climate agreements, and by their greater concern about intragenerational compensation than cutting carbon emissions.
- Using a global average discount rate implicitly provides a regressive distributional weight in the SCC computation.
- Developing country-specific discount rates should be less challenging than estimating local and country-level damages, and the pay-off is high, given the impact of discounting on the magnitude of SC-GHG estimates.