The Social Discount Rate

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BGVW Ch.10 The social discount rate

Questions on the social discount rate

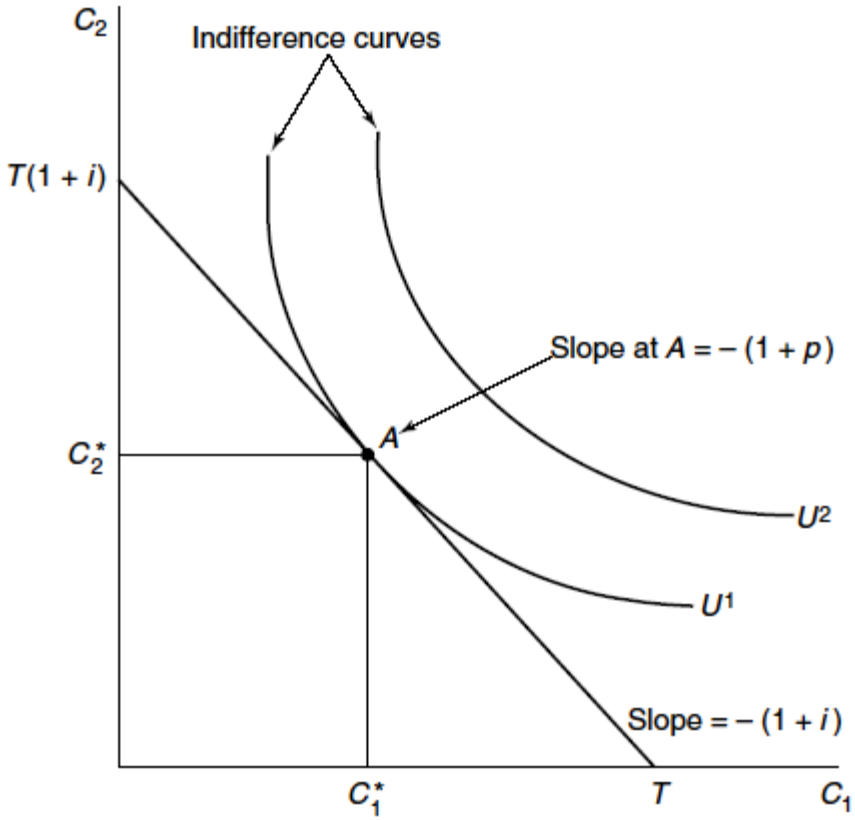
- Why discount?
  - Individuals evaluate present consumption more highly than future consumption
  - The rate of return on private investment is positive
- Questions
  - Can we use the market interest rate?
  - How to treat future generations?
  - Is the discount rate for investment (e.g., infrastructure investment) the same as that for consumption (e.g., government sponsored music concert)?

Approaches to the social discount rates

- Based on market interest rates
  - Perfect financial market: MRTP (Marginal rate of time preference) = MRRI (Marginal rate of return on private investment) = Market interest rate
  - Incomplete financial market:
    - MRTP, MRRI
    - WSOC (Weighted average of MRTP and MRRI)
    - Shadow Price of Capital
- Optimal growth rate approach
- Time-Declining Discount Rate
- No universally agreed social discount rate

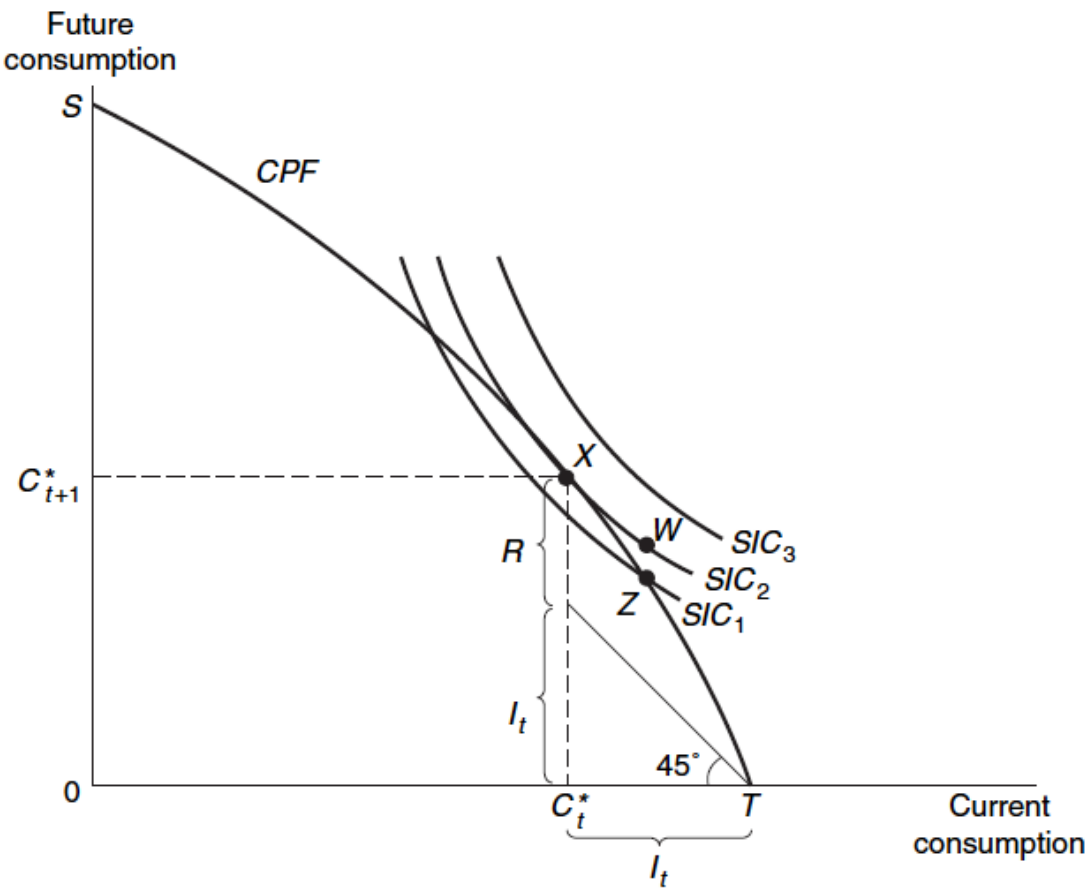
Marginal rate of time preference and market interest rate

- Marginal Rate of Time Preference (MRTP)
  - The value of consumption next year relative to consumption this year
  - Proportion of additional consumption that an individual requires in order to be willing to postpone consumption for one year
- MRTP = Market interest rate
  - Result from optimization of a consumer



Perfect financial market

- Marginal Rate of Return on private Investment
  - Sacrificing consumption this year yields more income in the future
- Perfect financial market
  - MRTP = MRRI = Interest rate
  - It is natural to set Social discount rate = market interest rate

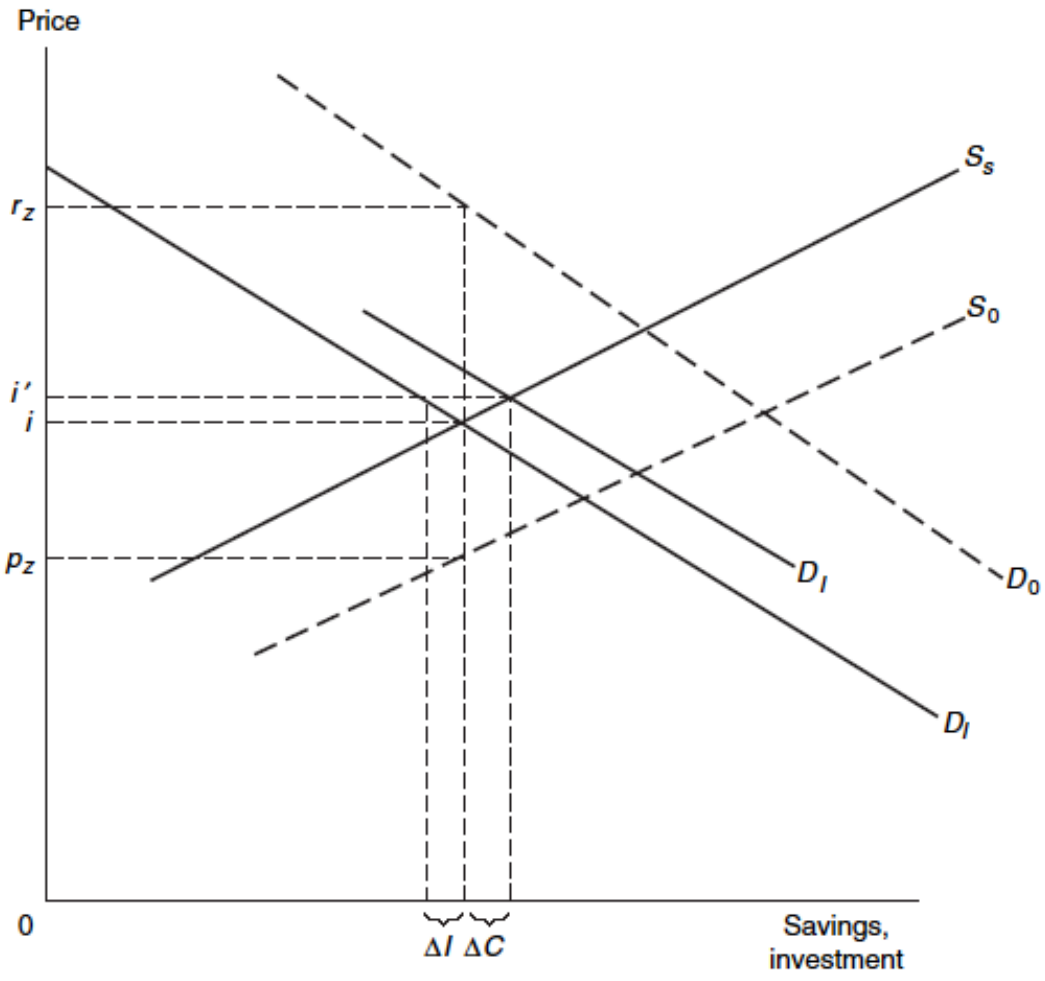


Incomplete markets: Second-best economy

- Market imperfections:
  - Taxes, Asymmetric information
  - MRTP ≠ MRRI
- Three approached to SDR (Social Discount Rate)
  - SDRs derived from market interest rates
    - MRRI of private investment
    - MRTP
    - Government borrowing rate
    - Weighted average of MRTP and MRRI
    - Shadow Price of Capital
  - Optimal growth rate approach
  - Time-Declining Discount Rate

Harberger: Tax Distortion

- Corporate income tax: Demand curve for investment funds↓
- Personal income Tax: Supply curve of funds↑
- MRRI (r_z) > Market interest rate (i) > MRTP (p_z)
- $r_z(1-t_r)=i$, $i(1-t_p)=p_z$
- Government investment by government borrowing: D_1'



Harberger: MRRI

- Harberger Formula
  - Increase in government investment:
    - Decrease in private investment: opportunity cost r_z
    - Decrease in private consumption: opportunity cost p_z
  - $SDR = ar_z + (1-a)p_z$
    - a: the share of investment decrease
- Savings are not responsive to interest rates ⇒ $1 - a = 0$:
  - $SDR = MRRI$

Numerical values of MRRI

- Before tax interest rate for corporate bonds = Before tax rate of return on investment
  - Interest payment can be included in the cost. No corporate tax.
  - Implicit assumption that all the investment is financed by borrowing
- Real interest rate for AAA bonds: 3 - 4% after the WW2, 4 - 5% recently
- Estimate by BGVW: 4.5%

Criticisms of using MRRI

- Private sector returns may be pushed upward by distortions caused by negative externalities and market prices that exceed marginal costs.
- Private sector rates of return incorporate a risk premium.
- A project might be financed by taxes, rather than by loans – hence, consumption would also be crowded out.
- A project may be partially financed by foreigners at a lower rate than 4.5 percent.
- There may not be a fixed pool of investment so that government may not displace private investment dollar for dollar. If the government is not fully employing all its resources, then complete crowding out of private investment is unlikely.

MRTP Method

- A government project is financed entirely by domestic taxes and if taxes reduce consumption, but not investment. Then SDR = MRTP(p_z)
- Numerical values of MRTP
  - Real after-tax rate of return on 10 year government bonds: 1.3% (1953 - 2002)
  - Estimate by BGVW: 1.5%, Sensitivity analysis 1.0%, 2.0%

Criticisms of using MRTP

- The use of MRTP as the SDR may justify very long-term investments that provide low returns at the expense of higher-returns in the private sector, thereby harming efficiency.
- Individuals differ in their preferences and opportunities – some save and some borrow and some save by reducing debt. Since reducing some debt isn't taxed, people who do this earn a much higher after-tax return than other people. It is not clear how one can aggregate these different individual rates into a single SRTP.
- Individuals are not always consistent and rational. Because many individuals simultaneously pay mortgages, buy government bonds and stocks and borrow on credit cards at high interest rates, it is unclear whether individuals have a single MRTP.

Weighted average approach: WSOC

- Weighted average of MRRI and MRTP: Weighted Social Opportunity Cost of Capital (WSOC)
- Weighting by crowding out ratio
  - WSOC = $ar_z + bp_z + (1\text{-}a\text{-}b)\, i$
    - i : interest rate for borrowing from foreingers
    - a: proportion of a project's resources that displace private domestic investment
    - b: the proportion of the resources that displace domestic consumption
    - 1-a-b: the proportion of the resources that are financed by borrowing from foreigners
- Numerical values of WSOC
  - Finance by taxes: Close to p_z =1.5%
  - Finance by debts: Close t o r_z = 4.5% or i = 3.7%
- Criticisms of using WSOC
  - The same problems with MRRI and MRTP
  - Different WSOCs for different projects

Shadow Price of Capital (SPC)

- Shadow Price of Capital (SPC)
  - The value of investment that a public project displaces should be estimated from the value of consumption that it produces.
- How to derive the shadow price of capital
  - Costs and benefits in each period are divided into those that affect consumption and those that affect investment.
  - Flows into and out of investment are multiplied by the SPC to convert them into consumption equivalents.
  - Changes in consumption are added to changes in consumption equivalents.
  - Resulting amounts are discounted at p_z.

Criticisms of using SPC

- It is difficult to explain to policymakers how and why NPV calculations are made.
- The method has heavy information requirements relative to other discounting approaches.
- The allocation of costs and benefits to investment and consumption may be subjective.
- The value of the SPC depends on the values of p_z and r_z and there can be subject to the criticisms that apply to determining these parameters.

Optimal growth rate approach

- Problems of market based SDRs
  - The problem of aggregating different individuals with different preferences,
  - Individuals do not behave rationally and consistently
  - Market rates do not appropriately reflect market failures
  - Market rates do not reflect the preferences of those currently alive and thus fail to account appropriately for the effects of long-term projects on future generations.
- Optimal growth rate approach
  - Derive the discount rate for consumption from the discount rate for utility
  - Account for the growth of real income
  - Discount rate (Ramsey Equation): $\rho_x = d + ge$: 3.5%

$$Max \int u(c(t))e^{-d\,t}\,dt$$

$$e = -cu''(c)/u'(c)$$

    - *d = the pure rate of time preference*: 1%
    - *g = the growth in per capita consumption*: 2.3%
    - *e = the absolute value of the rate at which the marginal value of consumption declines as per capita consumption increases*: 1

Stern Review

- Discount rate used by the Stern Review: 1.4%
  - d: 0.1%
  - g: 1.3%
  - e: 1
- CBA
  - The costs of climate change after 100 years are 5% of GDP. The cost of avoiding this is 1%
  - B/C = 5exp(100x(1.3% - 1.4%)) = 4.5
  - Alternative cases:
    - B/C = 5exp(100x(2.3% - 3.5%)) = 1.66
    - B/C = 5exp(100x(2% - 6%)) = 0.09

Stern, Sir Nicholas (2007) The Economics of Climate Change. Cambridge, UK: Cambridge University Press.
http://www.hm-treasury.gov.uk/Independent_Reviews/stern_review_economics_climate_change/sternreview_index.cfm

Time-Declining Discount Rates

- Empirical evidence suggests that people are time inconsistent – they use lower discount rates for events that occur farther into the future.
- Long-term environmental and health consequences have very small present values when discounted using a constant rate.
  - Spending a relatively small amount today to avert a costly disaster several centuries in the future may not be cost-beneficial.

Discount rate = 4%	
Year	Discount factor
100	0.019800040
200	0.000392042
300	0.000007762
400	0.000000154

- Constant rates do not appropriately take into account the preferences of future, as yet unborn, generations.
- Constant rates do not appropriately allow for uncertainty as to market discount rates in the future.
  - This uncertainty implies that lower and lower discount rates should be used to discount consumption flows that occur father and farther in the future. This results from averaging the discount factors, not the discount rates. A discount factor (=exp(– Discount Rate x Year)) is a concave function of a discount rate.

The social discount rate proposed by BGVW

- No intergenerational impacts (up to 50 years)
  - No crowding out of private investment
    - Market rate base: p_z = 1.5%
    - Optimal growth rate base: p_x = 3.5%
  - Crowding out private investment
    - Use the Shadow Price of Capital to convert the investment into equivalent consumption, and then discount it by 1.5% or 3.5%
- Intergenerational impacts
  - Do not crowd out private investment
    - Time declining discount rate
  - Crowd out private investment
    - For the first 50 years, the same as the no intergenerational impact case, and time declinig discount rate after that

The social discount rate in practice

- Discounting practices in government vary enormously. Many government agencies do not discount at all. Often the discount rate is prescribed by government review and monitoring agencies (e.g., OMB, CBO).
- US
  - OMB: 10% → 7%
    - Circular A-94, "Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs"
    - Circular A-4, “Regulatory Analysis” Base-Case 7% (based on average before-tax rate of return to private capital), Alternative 3% (based on Social Rate of Time Preference)
  - CBO: 2% (MRTP approach based on the U.S. Treasury borrowing rate), with sensitivity tests based on 0 and 4%.
  - Panel on Cost-Effectiveness in Health and Medicine: 3%, Sensitivity analysis 0%, 7%
  - EPA: 2 – 3%
  - GAO: Average nominal yield on Treasury debt maturing between one year and the life of project, less the forecast rate of inflation.
- CANADA
  - Federal Treasury Board Secretariat: 10% (1976) → 8%(2007)
- British Treasury Green Book2003
  - 3.5%, based on the optimal growth rate method
  - Time-declining discount rate for projects with effects that occur after 30 years.
- Japan: 4% for public works projects