Trading Deficits for Investment: Optimal Deficit Rules for Present-Biased Governments

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Introduction

Public Debt in Advanced Economies

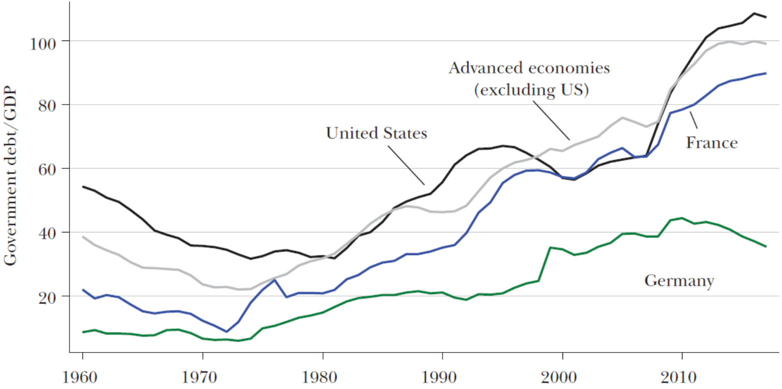

Figure 1: Figure from Yared (2019)

Introduction

- Standard theories of optimal government debt cannot explain the rise in debt to GDP ratios over the past decades
- Political economy models explain this trend by time inconsistent/present-biased governments (Yared 2019)
- **Narrative:** If a government is present-biased, deficit rules (e.g. balanced budget rule) are welfare improving (Tabellini and Alesina 1990)

Introduction

- Standard theories of optimal government debt cannot explain the rise in debt to GDP ratios over the past decades
- Political economy models explain this trend by time inconsistent/present-biased governments (Yared 2019)
- **Narrative:** If a government is present-biased, deficit rules (e.g. balanced budget rule) are welfare improving (Tabellini and Alesina 1990)
- But what if we include public investment? Deficit-investment trade-off in Peletier et al. (1999)

  "Our analysis hinges on the idea that budgetary institutions matter, not only for deficits, but also for public investment." (Peletier et al. 1999)

Introduction

What do we know about fiscal rules?

- Fiscal rules reduce public deficits (Heinemann et al. (2018), Potrafke (2025))
- Effect of fiscal rules on public investment in general unclear (Blesse et al. 2023; Potrafke 2025)

Introduction

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- Fiscal rules reduce public deficits (Heinemann et al. (2018), Potrafke (2025))
- Effect of fiscal rules on public investment in general unclear (Blesse et al. 2023; Potrafke 2025)
- Negative effect of deficit rules on public investment (Venturini (2020), Ardanaz et al. (2021), Janeba (2025))
- **Deficit Rule**:= numerical rule on general gov. deficit, no investment clause
- Alternative: Investment rules. Less effective in reducing deficits (Milesi-Ferretti (2004),von Hagen and Wolff (2006), Burret and Feld (2018))

In a Nutshell

Research Question: What is the optimal deficit rule for a present-biased government if there is a deficit-investment trade-off?

Method: Principal-agent model where the principal chooses a deficit rule to contain the present-biased agent

Results:

1. Optimal deficit cap $\bar{b}^*$ is binding, investment is inefficiently low
2. $\bar{b}^*$ decreases with present bias, increases with productivity of public investment
3. Absence of deficit rule may be superior to balanced budget rule (BBR)

Model Setup: Principal and Agent

- Principal with objective function over consumption c_1, c_2, discount factor $\delta \,\epsilon\, (0,1]$ and thrice diff'ble $u(\cdot)$ with $u' > 0, u'' < 0, u''' > 0$ (e.g. CRRA):

$$W_P = u(c_1) + \delta\, u(c_2), \tag{W-P}$$

- The agent maximizes welfare as the discounted sum of utility with present bias $\beta \,\epsilon\, (0,1]$

$$W_A = u(c_1) + \beta\, \delta\, u(c_2), \tag{W-A}$$

- Interpret as
  - Subsequent governments (e.g. Piguillem and Riboni 2021)
  - Normative benchmark (e.g. Halac and Yared 2014)

Model Setup: Resource Constraints

- The period budget constraints are given by

$$c_1 + i = y_1 + b, \tag{BC-1}$$

$$c_2 + R\,b = y_2 + F(i, A) \tag{BC-2}$$

- c_t static public good/government consumption, i investment into public capital, b public deficit, R interest on public debt
- $F(\cdot)$ thrice continuously diff'ble, strictly concave, fulfills Inada conditions
- Deficit rule:

$$b \leq \bar{b} \tag{DR}$$

The Agent's problem

- Agent max. W_A subject to (BC1), (BC2) and (DR) with Lagrange multiplier μ
- Optimality conditions reflect the **deficit-investment trade-off**:
  1. Consumption c_1, c_2 functions of $\bar{b}$

$$u'(c_1) = \beta\,\delta\,R\,u'(c_2) + \mu \tag{1}$$

  2. Investment i function of $\bar{b}$

$$F'(i, A) = R + \frac{\mu}{\beta\,\delta\,u'(c_2)} \tag{2}$$

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- Agent's consolidated FOC:

$$u'(c_1) = \beta\,\delta\;F'(i, A)\,u'(c_2) \tag{FOC-A}$$

The Principal's Problem

- Let i^* solve (FOC-A). The Principal's problem is given by

$$\max_{\bar{b}} W_P = u(c_1) + \delta\, u(c_2) \tag{3}$$
$$\text{s.t.} \quad c_1 + i^*(\bar{b}) = y_1 + \bar{b}$$
$$c_2 + R\,\bar{b} = F(i^*(\bar{b}), A)$$

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- Principal's optimality condition from choosing $\bar{b}$

$$(1 - i_b^*)u'(c_1^*) = \delta u'(c_2^*)(R - F_i(i^*, A)i_b^*) \tag{FOC-P}$$

- Optimal deficit cap $\bar{b}^*$ solves (FOC-P), exists and binds. It is second best since

$$F'(i^*(\bar{b}^*)) > R \tag{4}$$

Comparative Statics

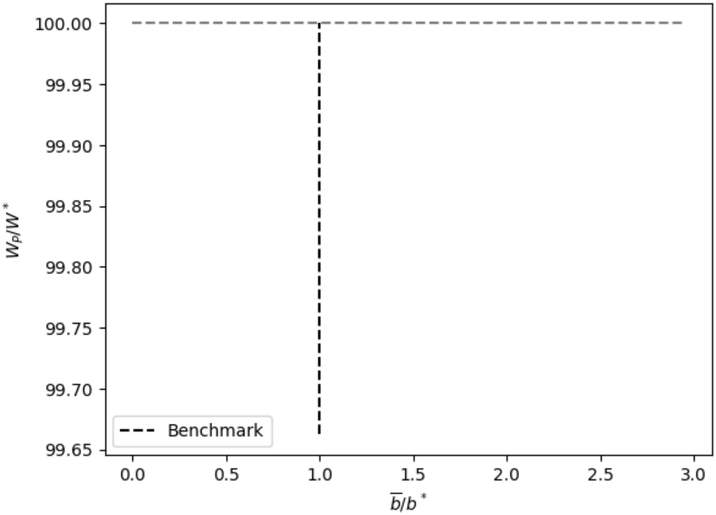
- We use the implicit function theorem to show that

$$\frac{\partial \bar{b}^*}{\partial \beta} > 0, \tag{5}$$

$$\frac{\partial \bar{b}^*}{\partial A} > 0. \tag{6}$$

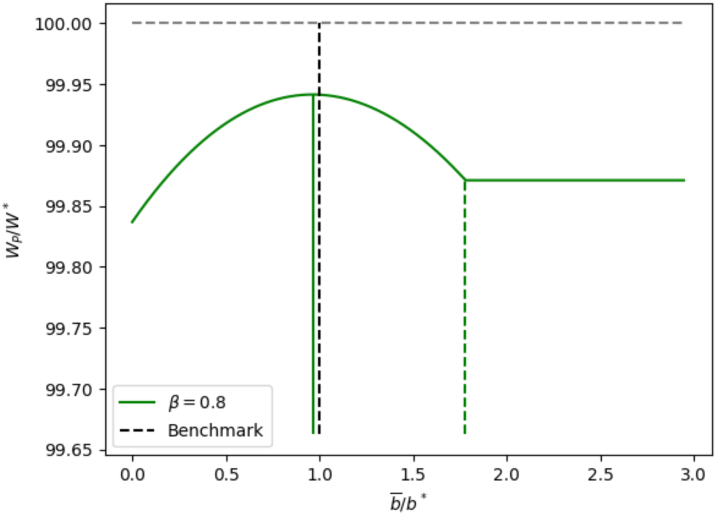
- The higher the present-bias $1/\beta$, the stricter the deficit cap
- The higher the productivity of public investment A, the laxer the deficit cap
- Necessary ▸ Assumption concerning the relative curvature of utility $u(\cdot)$ and production $F(\cdot)$, very similar to Tabellini and Alesina (1990)

Third Best Analysis



Third Best Analysis

(a) Debt ceiling is only a second-best instrument.



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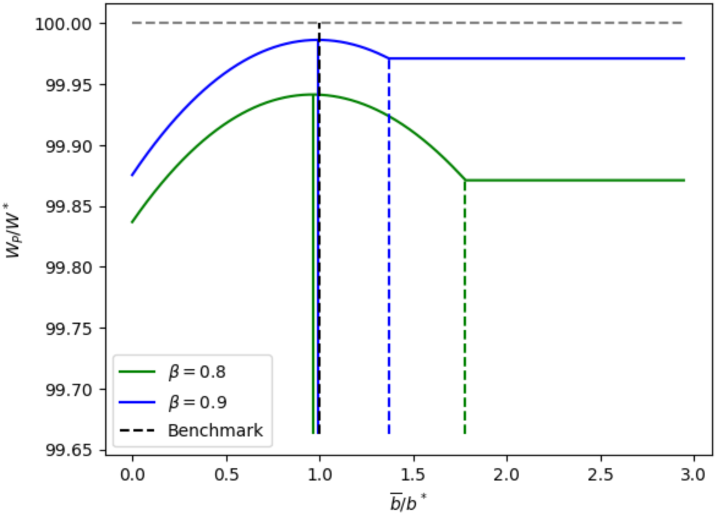
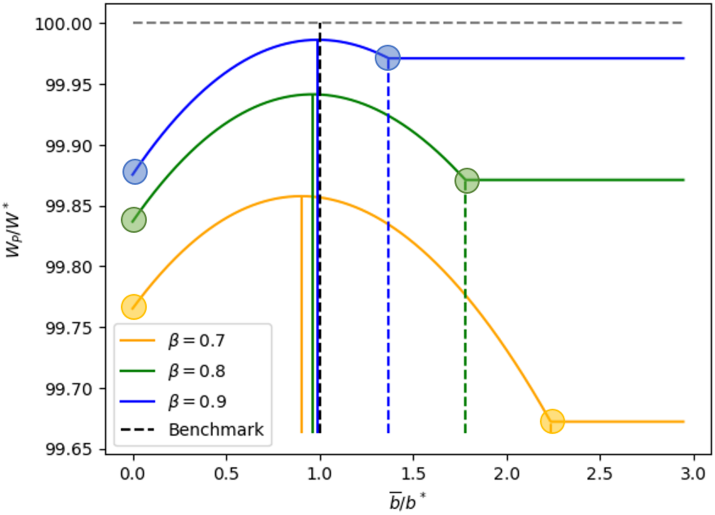


Third Best Analysis

(a) Debt ceiling is only a second-best instrument.

(b) For $\beta' \in (0,1)$, the principal is indifferent between the BBR and no deficit rule.



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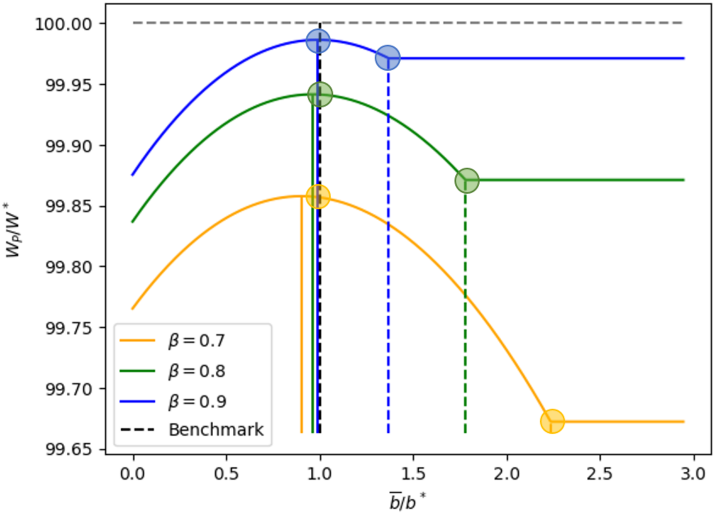
(a) Debt ceiling is only a second-best instrument.

(b) For $\beta' \epsilon (0, 1)$, the principal is indifferent between the BBR and no deficit rule.

(c) The principal prefers the benchmark deficit rule to no deficit rule.



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(a) Debt ceiling is only a second-best instrument.

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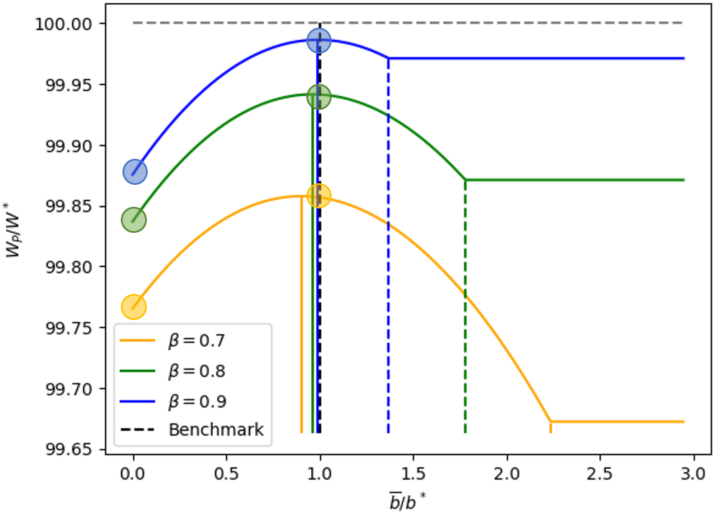
(c) The principal prefers the benchmark deficit rule to no deficit rule.

(d) For $\beta'' \epsilon (0,\beta')$, the principal is indifferent between the BBR and the benchmark deficit rule.



Summary

- Principal-agent model of present-biased government to capture deficit-investment trade-off of deficit rules
- Optimal deficit cap $\bar{b}^*$ is binding, investment is inefficiently low
- $\bar{b}^*$ decreases with present bias and increases with productivity of public investment
- Absence of deficit rule may be welfare superior to balanced budget rule for low levels of present bias

Bibliography I

Aiyagari, S. Rao and Ellen R. McGrattan (1998). "The Optimum Quantity of Debt". In: *Journal of Monetary Economics* 42, pp. 447–469.

Ardanaz, Martín, Eduardo Cavallo, Alejandro Izquierdo, and Jorge Puig (2021). "Growth-Friendly Fiscal Rules? Safeguarding Public Investment from Budget Cuts through Fiscal Rule Design". In: *Journal of International Money and Finance* 111, p. 102319.

Barro, Robert J. (1979). "On the Determination of the Public Debt". In: *Journal of Political Economy* 87 (5, Part 1), pp. 940–971.

Blesse, Sebastian, Florian Dorn, and Max Lay (2023). *Do Fiscal Rules Undermine Public Investments? A Review of Empirical Evidence*. URL: https://www.ssrn.com/abstract=4439420 (visited on 11/01/2024). Pre-published.

Burret, Heiko T. and Lars P. Feld (2018). "(Un-)Intended Effects of Fiscal Rules". In: *European Journal of Political Economy* 52, pp. 166–191.

Diamond, Peter A. (1965). "National Debt in a Neoclassical Growth Model". In: *The American Economic Review* 55.5, pp. 1126–1150.

Halac, Marina and Pierre Yared (2014). "Fiscal Rules and Discretion Under Persistent Shocks". In: *Econometrica* 82.5, pp. 1557–1614.

Heinemann, Friedrich, Marc-Daniel Moessinger, and Mustafa Yeter (2018). "Do Fiscal Rules Constrain Fiscal Policy? A Meta-Regression-Analysis". In: *European Journal of Political Economy* 51, pp. 69–92.

Jackson, Matthew O. and Leeat Yariv (2014). "Present Bias and Collective Dynamic Choice in the Lab". In: *American Economic Review* 104.12, pp. 4184–4204.

Bibliography II

Jackson, Matthew O. and Leeat Yariv (2015). "Collective Dynamic Choice: The Necessity of Time Inconsistency". In: *American Economic Journal: Microeconomics* 7.4, pp. 150–78.

Janeba, Eckhard (2025). "The Effect of Fiscal Rules on Public Investment: Theory and Application to the German Debt Brake". Mimeo.

Milesi-Ferretti, Gian Maria (2004). "Good, Bad or Ugly? On the Effects of Fiscal Rules with Creative Accounting". In: *Journal of Public Economics* 88.1–2, pp. 377–394.

Peletier, Ben D, Robert A. J Dur, and Otto H Swank (1999). "Voting on the Budget Deficit: Comment". In: *American Economic Review* 89.5, pp. 1377–1381.

Piguillem, Facundo and Alessandro Riboni (2021). "Fiscal Rules as Bargaining Chips". In: *The Review of Economic Studies* 88.5, pp. 2439–2478.

— (2024). "Sticky Spending, Sequestration, and Government Debt". In: *American Economic Review* 114.11, pp. 3513–3550.

Potrafke, Niklas (2025). "The Economic Consequences of Fiscal Rules". In: *Journal of International Money and Finance* 153, p. 103286.

Tabellini, Guido and Alberto Alesina (1990). "Voting on the Budget Deficit". In: *The American Economic Review* 80.1, pp. 37–49.

Venturini, Fiorenza (2020). "The Unintended Composition Effect of the Subnational Government Fiscal Rules: The Case of Italian Municipalities". In: *European Journal of Political Economy* 63, p. 101874.

Bibliography III

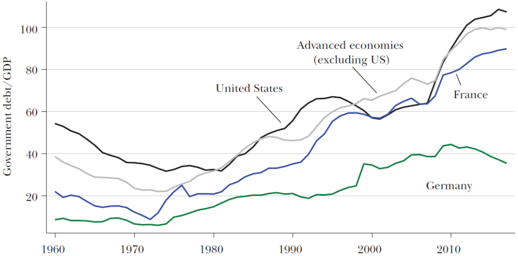
Von Hagen, Jürgen and Guntram B. Wolff (2006). "What Do Deficits Tell Us about Debt? Empirical Evidence on Creative Accounting with Fiscal Rules in the EU". In: *Journal of Banking & Finance* 30.12, pp. 3259–3279.

Yared, Pierre (2019). "Rising Government Debt: Causes and Solutions for a Decades-Old Trend". In: *Journal of Economic Perspectives* 33.2, pp. 115–40.

Appendix

Public Debt in the OECD

Figure 2
Government Debt in Advanced Economies
(percent)



Source: Government debt to GDP is gross central government debt as a percentage of GDP from Reinhart and Rogoff (2011) for 1960–2010, updated for 2011–2017 with the growth rate in debt to GDP from International Monetary Fund. GDP is from Feenstra, Inklaar, and Timmer (2015) for 1960–2014, and the 2014 GDP weight is assigned to 2015–2017.
Note: The sample of advanced economies is a balanced panel which includes Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, and United States. The line for advanced economies (excluding the US) represents the GDP-weighted average for each observation year.

Figure 3: Public Debt in Advanced Economies, figure from Yared (2019)

Appendix

Zoom - Present Bias

- Increase in debt ratios in OECD countries since 1970s cannot be explained by economic theories of optimal government debt (e.g. Aiyagari and McGrattan 1998; Barro 1979; Diamond 1965)
- Polit. economy theories: Present-biased, time-inconsistent government, because...
  - Ageing and heterogeneous discounting PB1: Heterogeneous Discounting
  - Tragedy of the commons PB2: Tragedy of the Commons
  - Political turnover (Piguillem and Riboni 2024; Tabellini and Alesina 1990)
- If a government is present-biased, deficit rules are welfare improving (e.g. Tabellini and Alesina 1990)

Return Presentation

Appendix

Present Bias: Ageing and Heterogeneous Discounting

- Aggregating preferences of agents with heterog. discount rates leads to time inconsistency (Jackson and Yariv 2014, 2015)
- Elderly have higher discount rate
- Demographic change increases present bias

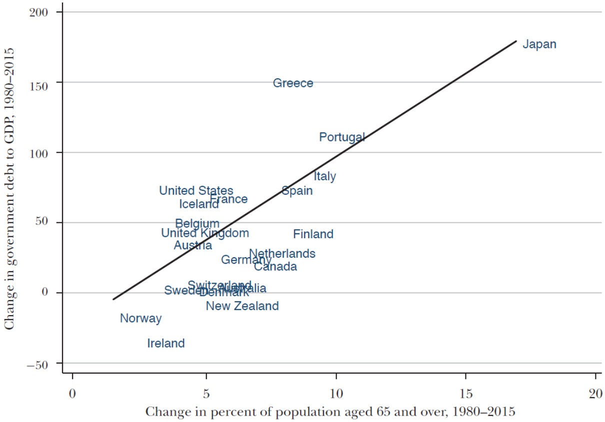


Figure 4: Δ % Pub. Debt and Elderly Pop. (Yared 2019)

Example Return

Appendix

Present Bias: Tragedy of the Commons

- More parties with greater ideological differences form government
- Lack of coordination: Each party...
  - ...targets spending towards its constituency
  - ...internalizes only fraction of the cost
- Prediction: Greater polarization and fragmentation are associated with greater deficits

Return

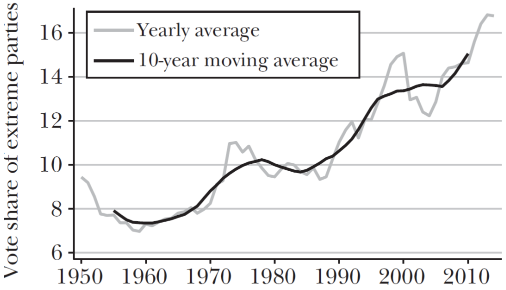


Figure 5: % Votes Extreme Parties in Advanced Economies (Yared 2019)

Appendix

Ageing and Heterogeneous Discounting

Example from Jackson and Yariv (2014): Constantine and Patience have discount factors of 0.5 and 0.8 respectively. They compare 10 utils at time t vs. 15 utils at time $t+1$. Objective function: Utilitarian welfare at time $t=0$ (present).

Trade-off $t=0$ and $t=1$ in favor of 10 utils in $t=0$

$$10+10>19.5=(0.5+0.8)\times 15$$

Trade-off $t=1$ and $t=2$ in favor of 15 utils in $t=2$

$$(0.5+0.8)\times 10=13<13.35=(0.5^2+0.8^2)\times 15$$

The trade-off is always in favor of the 15 utils in $t+1$, unless $t=0$. Jackson and Yariv (2015) extend the results to a much broader class of aggregation schemes and show that aggregation is either dictatorial, or time inconsistent.

▸ Return

The Agent's problem - T Periods

- Agent's max. problem

$$\max_{K_{t+1}} W_{A,t} := u(c_t) + \beta \sum_{s=1}^{T+1-t} \delta^s u(c_{t+s}) \tag{7}$$

$$\text{s.t.} \quad c_t + K_{t+1} = F(K_t) - r\,\bar{b}$$

$$c_{t+s} = c_{t+s}(K^*_{t+s+1})$$

- where K^*_τ with $\tau > t+1$ is the result of an analogous optimisation problem
- Use backward induction: FOC of agent at time t is given by

$$u'(c_t) = \hat{\beta}_t\, \delta\, A_{t+1}\, F'(K_{t+1})\, u'(c_{t+1}) \tag{8}$$

- where $\hat{\beta} := 1 - (1-\beta)\left(\partial\, C^*_{t+1} / \partial\, Y_{t+1}\right)$ and Y_{t+1} are resources at $t+1$
- Since $\partial\, c^*_{t+1} / \partial\, Y_{t+1}\, \epsilon\, (0, 1)$, it holds that $\beta \leq \hat{\beta}_t < 1$ for all t

Return

Comparative Statics

- For our comparative statics results on $\partial\bar{b}^*/\partial\beta$ and $\partial\bar{b}^*/\partial A$, we must assume a relationship between the relative curvature of utility $u(\cdot)$ and production $F(\cdot)$
- For log-utility, the condition is

$$(1+\delta)F^{(1)}F^{(3)} > (1+2\delta)\left(F^{(2)}\right)^2 \tag{9}$$

- This always holds for $F(\cdot)$ being Cobb-Douglas
- The condition is necessary for the results with respect to β and sufficient with respect to A
- In their analysis, Tabellini and Alesina (1990) rely on a very similar assumption

Return