Intergenerational Fairness

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Overview

- What can be understood as a ***fairness approach*** to ***intergenerational justice***?
- What are the advantages/difficulties compared to other approaches?
- Some results and open challenges.

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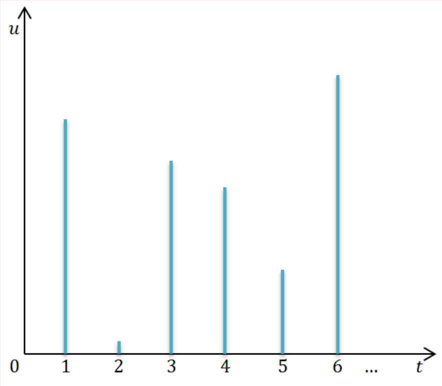
- Infinite utility streams
- Seminal contributions
- Properties



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- The axiomatic approach dates back to Koopmans (1960) and Diamond (1965).
- A large part of the literature deals with operationalizing the discounted utilitarian approach. A smaller part studies how to avoid Diamond's impossibility.
- For a review see Asheim (2010).

Literature

- Infinite utility streams
- Seminal contributions
- Properties

- Infinite time horizon
- Ordinal level comparability (and cardinal measurability)
- One size fits all

Approaching a fairness approach

Asheim (1991)

This is the first article that highlights the importance of the speicific economic situation for intergenerational justice.
After ruling out "unjust intergenerational allocations" and for a specific class of technologies, the previous difficulties of the literature are (mostly) avoided.

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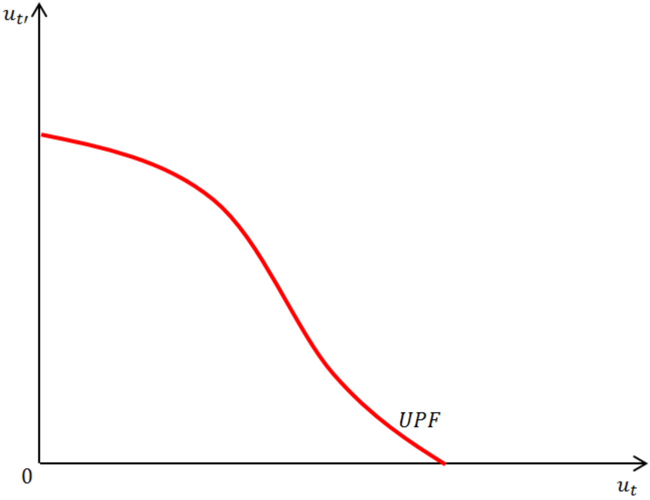
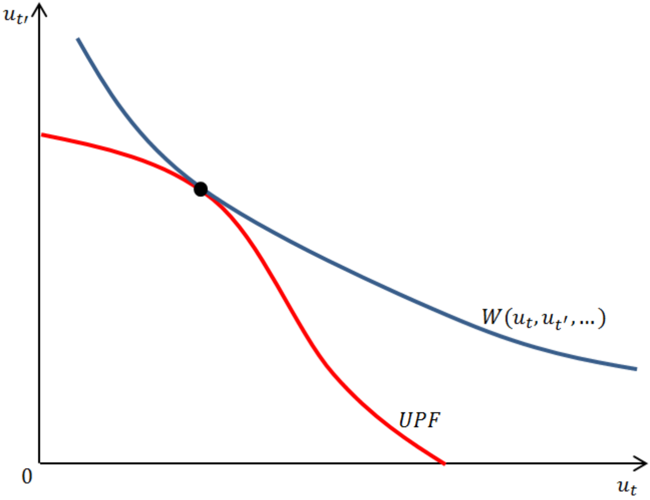
Intergenerational fairness

- The social desirability of alternatives is judged by how resources are distributed to the agents.
- Ethical considerations:
  - take into account economic circumstances (production technology, timing and resolution of risk, extinction possibility, population dynamics, ...);
  - respect each agent's preferences.
- The social viewpoint can be expressed as an allocation rule (see Thomson, 2011) or as a social ordering function (see Fleurbaey and Maniquet, 2011).

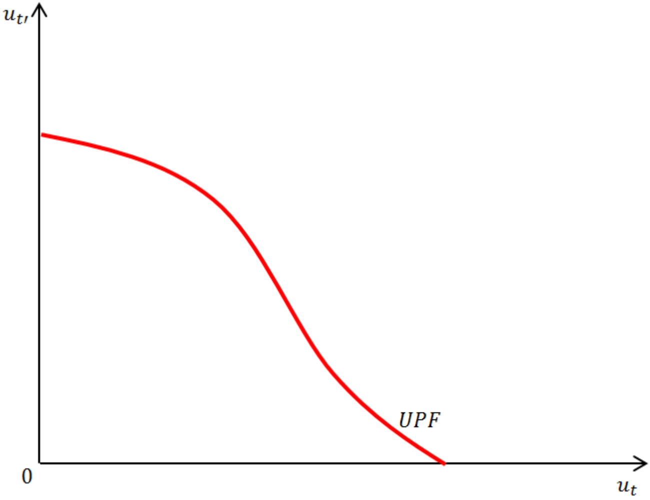
The utility possibility frontier



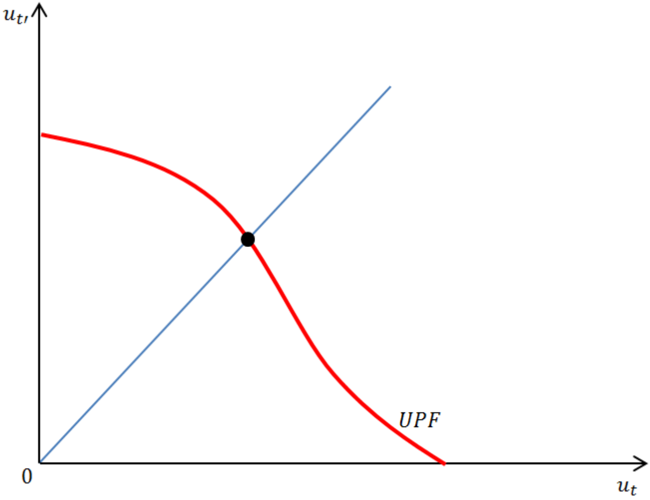
First best choice for W



A more basic problem



When is it that $u_t = u_{t'}$?



- When $u_t = u_{t'}$, generations t and t' are viewed as equally well-off.

- Then it is natural to associate to equal utilities an allocation of resources that is egalitarian and (under minor domain restrictions) efficient.

- The first result I will discuss is the emergence of an ***"Equity gap"*** *(based on "Intergenerational Egalitarianism," 2014a).*
- Efficiency and equity are extremely difficult to combine:
  - impossibility results arise already with very weak principles of justice;
  - thus, equalizing utilities does not correspond to very egalitarian distributions of goods.

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The model (1)

- Time is discrete and finite, i.e. $T \equiv \{0, 1, ..., \bar{t}\}$.
- In each period t, a stock of capital $k_t \in \mathbb{R}^2_+$ is used for production.
- Technology is time-invariant, linear, and separable across goods: $y_t \leq F(k_t) = \begin{pmatrix} \rho^1 & 0 \\ 0 & \rho^2 \end{pmatrix} k_t$.
- Production is shared between consumption of the currently living generation, i.e. $x_t \in \mathbb{R}^2_+$, and savings for future generations, i.e. k_{t+1}.
- For each $t \in T$, generation t has a preference relation R_t defined over $\mathbb{R}^2_+$, which can be represented by a Cobb-Douglas utility function.

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The model (2)

- An **economy** is a list $E \equiv (\underline{k}, F, R)$.
- Let $\mathscr{E}$ be the **domain** of economies E with at least one feasible allocation.
- For each $E \in \mathscr{E}$, let $A(E)$ be the set of **feasible allocations of E**.

- An **allocation rule** is a correspondence that selects a non-empty subset of feasible allocations for each economy in the domain.

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(Pareto) efficiency

For each $E \in \mathscr{E}$, $a \in A(E)$ is (Pareto) ***efficient*** *if there is no $a' \in A(E)$ such that for each $t \in T$, $x'_t \, R_t \, x_t$, and for some $t \in T$, $x'_t \, P_t \, x_t$.*

ε-no-domination

Let $\varepsilon \in [0,1]$. For each $E \in \mathscr{E}$, $a \in A(E)$ satisfies ***ε-no-domination*** *if for each pair $t, t' \in T$, $x_t \not\ll \varepsilon x_{t'}$.*

ε'-equal treatment of equals

Let $\varepsilon' \in [0,1]$. For each $E \in \mathscr{E}$, $a \in A(E)$ satisfies ***ε'-equal treatment of equals*** *if for each pair $t, t' \in T$ such that $R_t = R_{t'}$, $x_t \; R_t \; \varepsilon' x_{t'}$.*

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Theorem 1

Theorem

On the domain $\mathscr{E}$ and for each pair $\varepsilon, \varepsilon' \in (0,1]$, no rule satisfies efficiency, ε-no-domination, and ε'-equal treatment of equals.

Intuition

- *Efficiency* forces taking into account the different conditions at different times (relative scarcity of goods); whereas
- equity impedes placing much importance to the time generations live in. Moreover:
  - *ε-no-domination* is based on comparing physical amounts;
  - *ε'-equal treatment of equals* is based on preferences;
- Thus: there is no common ground evaluation that allows combining the axioms, no matter how small (but positive) ε and ε' are.

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Weakening the equity axioms

n-period ε-no-domination

*Let $n \geq 2$ and $\varepsilon \in [0,1]$. For each $E \in \mathscr{E}$, $a \in A(E)$ satisfies **n-period ε-no-domination** if for each pair $t, t' \in T$ with $|t - t'| < n$, $x_t \not\ll \varepsilon x_{t'}$.*

n'-period ε'-equal treatment of equals

*Let $n' \geq 2$ and $\varepsilon' \in [0,1]$. For each $E \in \mathscr{E}$, $a \in A(E)$ satisfies **n′-period ε′-equal treatment of equals** if for each pair $t, t' \in T$ such that $|t - t'| < n'$ and $R_t = R_{t'}$, $x_t \; R_t \; \varepsilon' x_{t'}$.*

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Theorem 2

Theorem

Let $\varepsilon, \varepsilon' \in [0,1]$ and $n, n' \geq 2$. On the domain $\mathscr{E}$:

- *If n and ε are such that $(n-2)\varepsilon \neq 0$, then there exists a rule satisfying efficiency and n-period ε-no-domination. Furthermore, no such rule satisfies n'-period ε'-equal treatment of equals, unless $\varepsilon' = 0$.*
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An ethical dilemma

Time independent rules

- Efficiency + no-domination; *or*
- Efficiency + equal treatment of equals.

Sequential rules

- Efficiency + 2-period no-domination + 2-period equal treatment of equals.

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(Half-way) summary

- Intergenerational egalitarianism is extremely difficult to define:
  - a strong conflict between equity and efficiency arises;
  - and unveils an "equity gap."
- Overcoming such tension, leads to a new ethical dilemma for intergenerational justice:
  - short-term/long-term inequality trade-off.

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What comes next?

- Assume we made up our mind about the meaning of intergenerational egalitarianism.

- How to use such reference (identified by the allocation rule) to construct "acceptable" social preferences?

- I will try to give you some intuition for a different, but related, model dealing with risk ("Fair intergenerational utilitarianism," 2014b).

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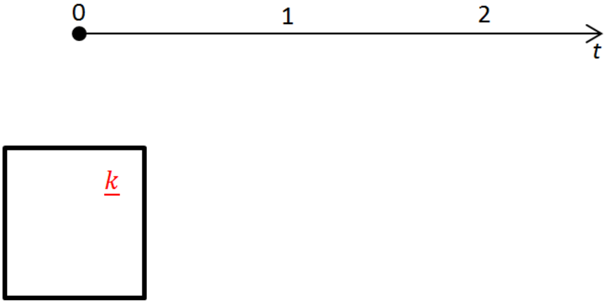

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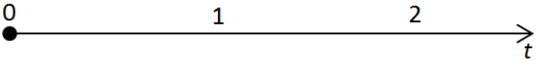
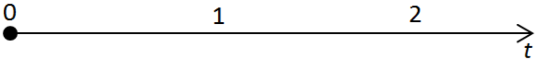
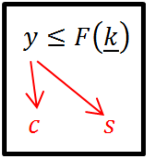


$$y \leq F(\underline{k})$$

Period 0





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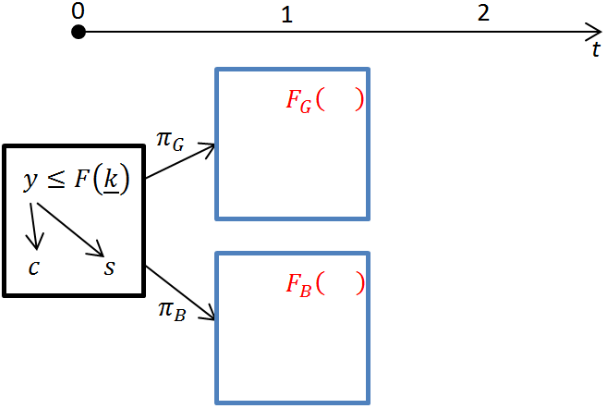

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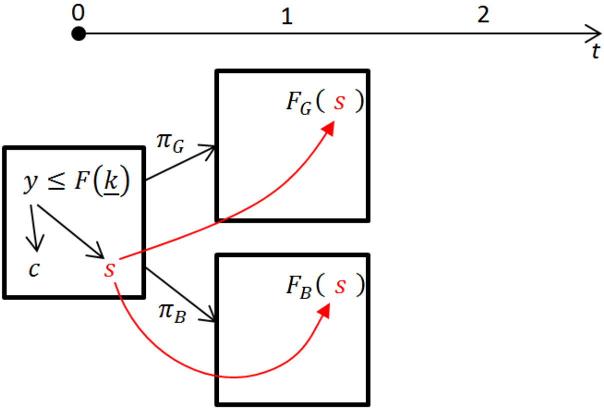

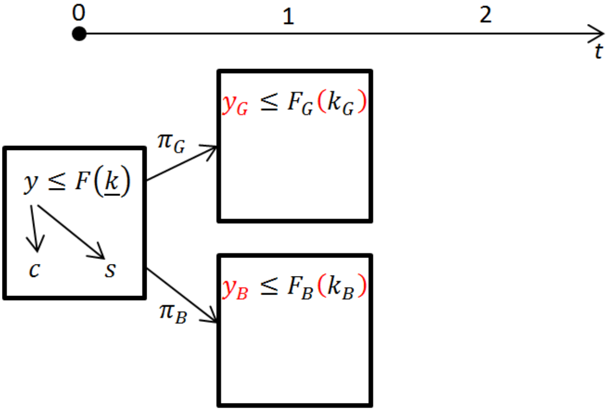
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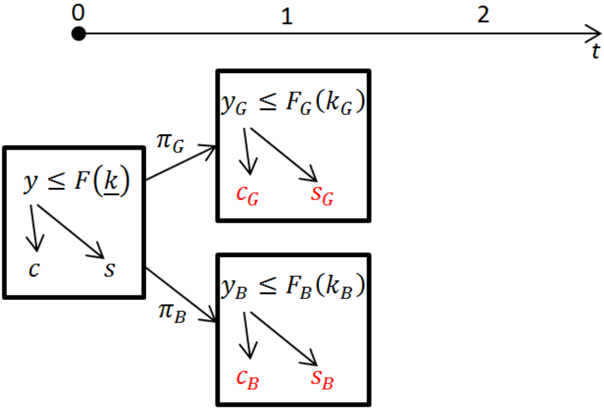
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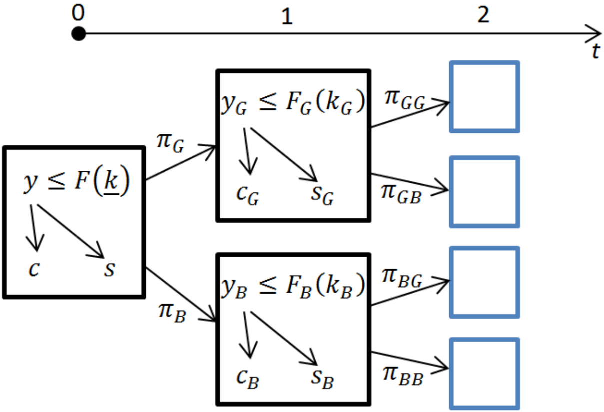

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A decision tree

$$D \equiv \left\langle \langle \pi_n, F_n \rangle_{n \in N}, \underline{k} \right\rangle$$

where:

- N is the event tree;
- $\underline{k}$ is the initial capital stock.

For each $t \in T$ and $n \in N_t$:

- $\pi_n \in (0,1]$ is the probability that node n is reached at t;
- F_n is the production function that transforms input k_n into output $y_n \in \mathbb{R}_+$; F_n is continuous, strictly increasing, and satisfies no-free lunch;
- output y_n can be consumed, c_n, or saved s_n;
- s_n determines the capital stock of the immediate successor nodes: $k_{n'} = s_n$ for each $n' \in N_{+1}(n)$.

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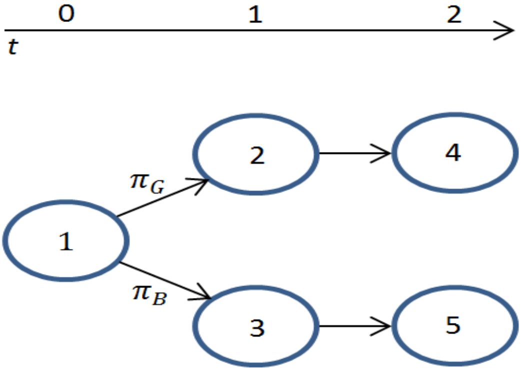
A risky intergenerational prospect



$$c \equiv (\{c_n\}_{n \in N}) \in C(D)$$

- The fair prospect $x \equiv \left(\{x_n\}_{n \in N}\right)$ is uniquely identified by the allocation rule $\phi : \mathscr{D} \rightarrow 2^{C(\mathscr{D})} \backslash \{\emptyset\}$.

- The fair rule ϕ satisfies:
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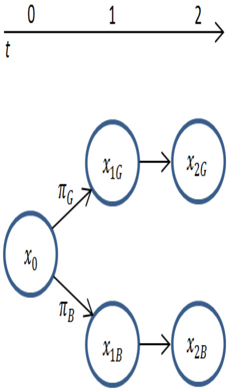


Interim egalitarianism

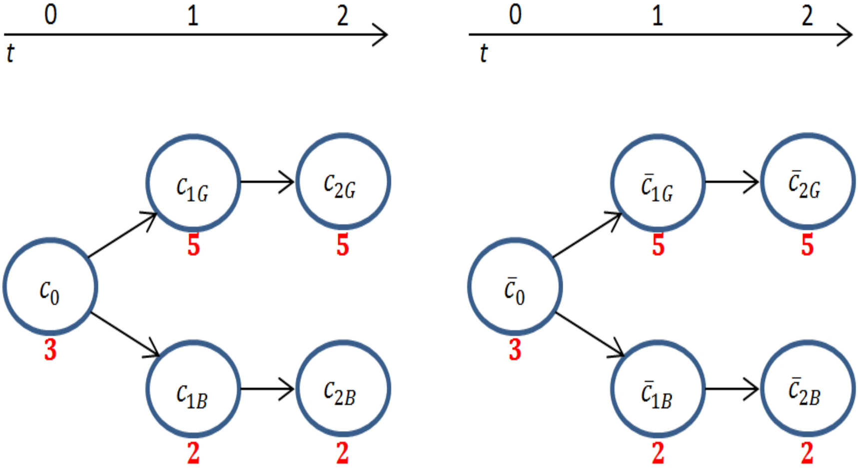
Let $\mu : \mathbb{R}_+ \to \mathbb{R}_+$ be strictly increasing and concave. For each $D \in \mathscr{D}$, each $x \in \phi(E)$, each $n \in N$, and each $t > t_n$:

$$x_n = \mu^{-1}\left(\frac{\sum_{n' \in N_t(n)} \pi_{n'} \mu(x_{n'})}{\sum_{\bar{n} \in N_t(n)} \pi_{\bar{n}}}\right)$$

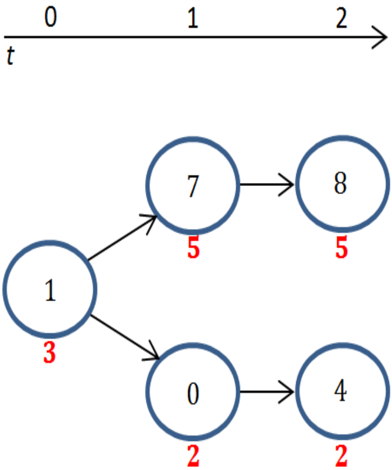
A SOF approach

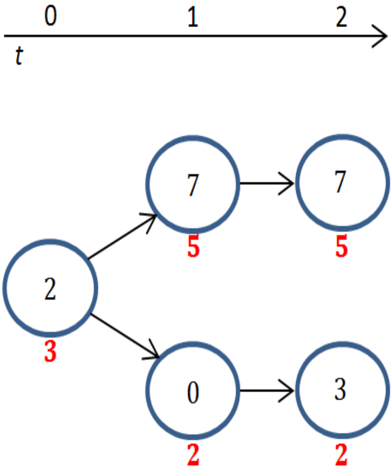
- For each $D \in \mathscr{D}$, a **social ordering** of D is a complete and transitive binary relation defined over the prospects $C(D)$.
- A **social ordering function** $\succsim$ assigns to each decision tree $D \in \mathscr{D}$ a social ordering of D denoted $\succsim_D$.
- Thus, $c \succsim_D \bar{c}$ means that the prospect c is socially at least as desirable as $\bar{c}$ for decision tree D.
    - The symmetric and asymmetric counterparts of $\succsim_D$ are $\sim_D$ and $\succ_D$.
- $V(c; D)$ is a welfare representation of $\succsim_D$.

Comparing alternatives



AXIOM: Intergenerational equity





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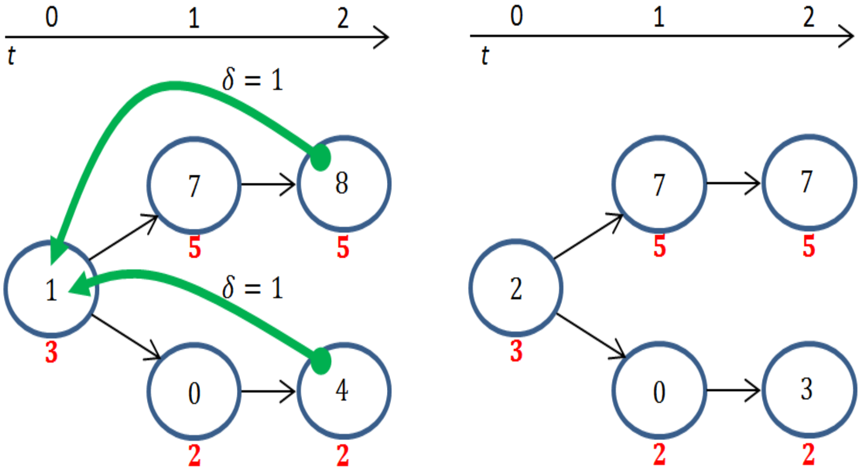

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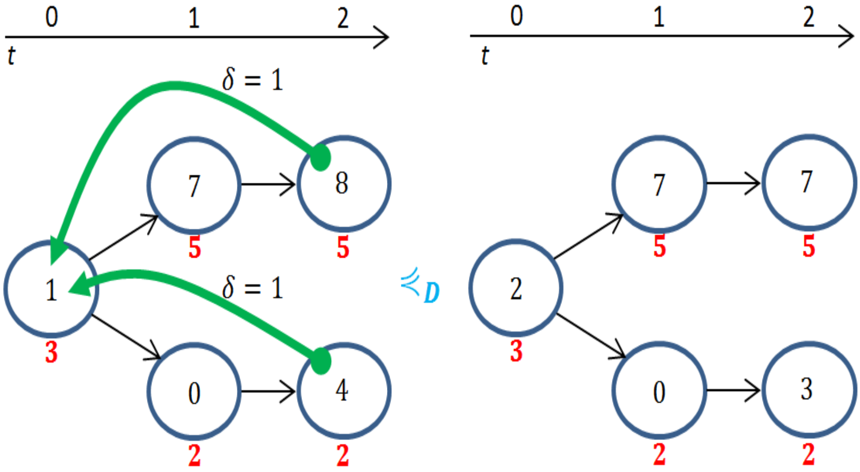


AXIOM: Intergenerational equity

Intergenerational equity

For each $D \in \mathscr{D}$, for each pair $c, \bar{c} \in C(D)$, for each pair $t, t' \in T$ and each $\delta \in \mathbb{R}_+$ such that:

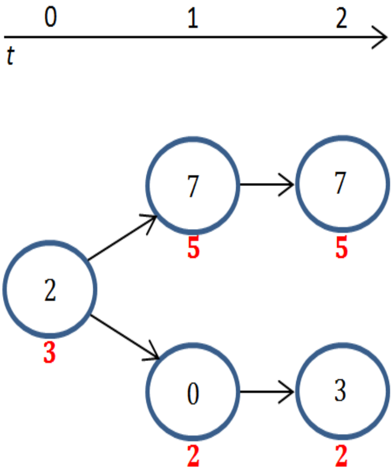
i) [donor] $c_n = \bar{c}_n - \frac{\delta}{\beta^t} \geq x_n$ for each $n \in N_t$;

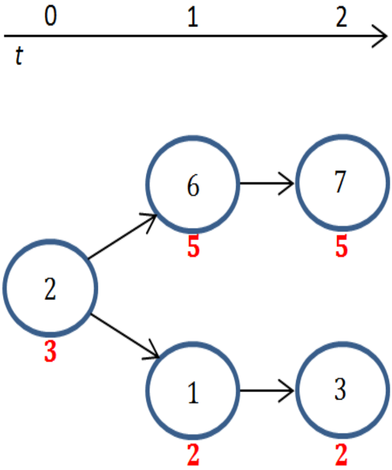
ii) [recipient] $c_{n'} = \bar{c}_{n'} + \frac{\delta}{\beta^{t'}} \leq x_{n'}$ for each $n' \in N_{t'}$;

iii) [ceteris paribus] $c_{n''} = \bar{c}_{n''}$ for each $n'' \in N \backslash \{N_t \bigcup N_{t'}\}$,

then $c \succsim_D \bar{c}$.

AXIOM: Risk-reducing transfer





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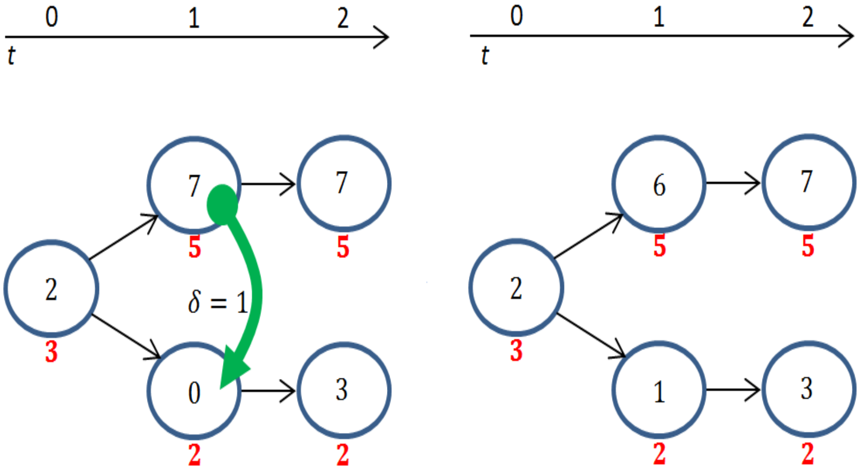

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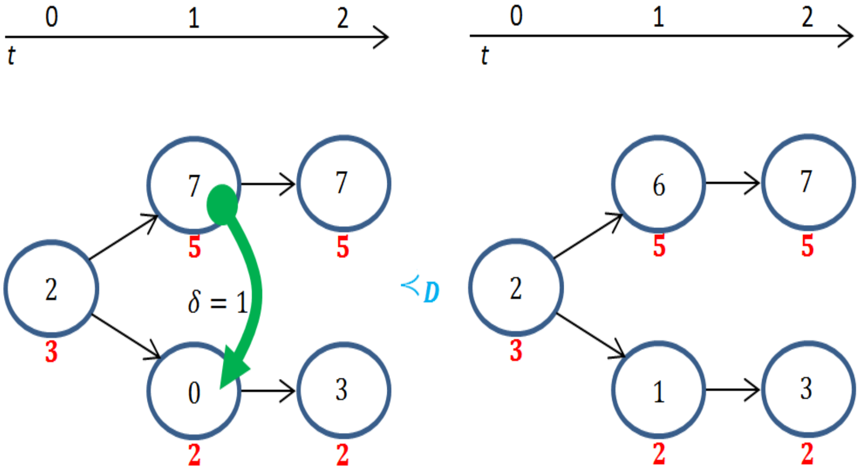

AXIOM: Risk-reducing transfer

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For each $D \in \mathscr{D}$, for each pair $c, \bar{c} \in C(D)$, for each $t \in T$, each pair $n, n' \in N_t$, and each $\delta \in \mathbb{R}_+$ such that:

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then $c \succ_D \bar{c}$.

Other axioms

Monotonicity

For each $D \in \mathscr{D}$ and each pair $c, \bar{c} \in C(D)$, $c > \bar{c}$ implies $c \succ_D \bar{c}$.

Generalized utilitarianism ($\equiv$2-*separability* + *continuity*)

For each $D \in \mathscr{D}$, $\succsim_D$ can be represented by $V(c; D) = \sum_{t \in T} v_t \left(\sum_{n \in N_t} u_n(c_n) \right)$, with v_t, u_n continuous functions.

Proportionality

For each $D, D' \in \mathscr{D}$, if the set of feasible alternatives of D is proportional to that of D' then $\succsim_D = \succsim_{D'}$.

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The main result

Theorem

The following statements are equivalent:

1. *a SOF $\succsim$ satisfies:*
   - *intergenerational equity;*
   - *risk-reducing transfer;*
   - *monotonicity;*
   - *generalized utilitarianism;*
   - *proportionality;*
2. *each $\succsim_D$ can be represented by the FIU criterion.*

FIU

$$V(c;D) =$$

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$$v_t(c_t;D) =$$

FIU

$$V(c;D) = \sum_{t} \tilde{\beta}_t \frac{v_t(c_t;D)^{1-\rho}}{1-\rho}$$

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$$v_t(c_t;D) = \left[\sum_{n \in N_t} \qquad \left(c_n\right)^{\gamma}\right]^{\frac{1}{\gamma}}$$

$$\tilde{\beta}_t =$$

The Fair Intergenerational Utilitarian criterion

FIU

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$$\tilde{\beta}_t = \beta^t \left(\frac{\sum_{\bar{n}\in N_t}\pi_{\bar{n}}x_{\bar{n}}}{x_0}\right)$$

What does the FIU family do? (1)

- It allows to disentangle:
  - intergenerational inequality aversion (captured by the parameter ρ);
  - aversion to *intrinsic risk* (captured by the concavity of the function μ in the definition of the fair prospect);
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What does the FIU family do? (2)

- It introduces a role for the time disclosure of risk and, as a consequence, different discounting formulas are characterized:
  - no technological difference across histories $\Rightarrow$ exponential discounting;
  - indifference to intrinsic risk (linear μ)$\Rightarrow$ exponential discounting;
  - 1 step resolution of risk $\Rightarrow$ quasi-hyperbolic discounting.
- In general, discounting depends on risk, its resolution over time, and the planner's risk attitude.

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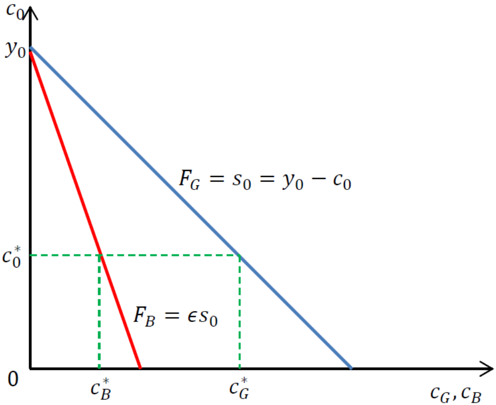

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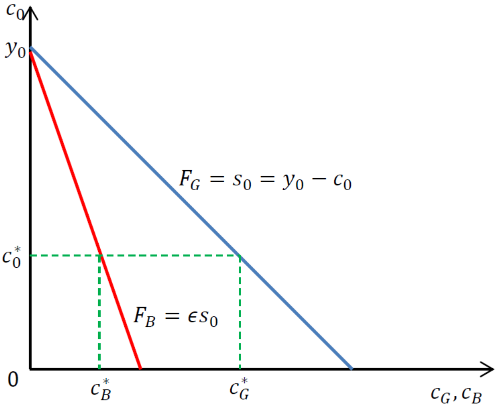

- What happens when, all else equal, the technology of a node becomes worse and worse?

What does the FIU family do? (3)

- the FOC for the utilitarian criterion (with CRRA utility) is:

$$(c_0^*)^{-\lambda} = \beta \left[\pi_G (1 - c_0^*)^{-\lambda} + \pi_B \varepsilon (\varepsilon (1 - c_0^*))^{-\lambda} \right]$$

- the FOC for the FIU criterion is:

$$\left(\frac{c_0^*}{x_0}\right)^{-\rho} = \beta \left[\pi_G \left(\frac{1 - c_0^*}{x_G}\right)^{\gamma - 1} + \pi_B \varepsilon \left(\frac{\varepsilon (1 - c_0^*)}{x_B}\right)^{\gamma - 1} \right] \xi$$

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Summary

- Intergenerational fairness seems to be a powerful tool to investigate intergenerational distributive justice.

- A two step approach can be adopted:
  - first, identify the meaning of equity by means of an allocation rule;
  - second, evaluate the social trade-off between equity and the quantity of resources distributed.

- More work is needed:
  - Sequential rules (axiomatic justification, growth/development consequences, ...);
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Thank you!