Lecture 1 on distributive intergenerational justice: Consequences and conflicts

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Conflict between the interests of the *present* and the interests of *future* generations

- Increasing investments in capital lower crurrent wellbeing, but bequeath future with a larger productive capacity.
- Abating greenhouse gas emissions lower current wellbeing, but reduces risk of catastrophic climate change.
- Preserving biodiversity lower current wellbeing, but increases future resilience.
- Conserving soil & water resources lowers current wellbeing, but decreases the risk of future malnutrition.
- Using antibiotics with care lowers current wellbeing, but reduces future health risks.

How **should** we treat future generations?

- **Reflective equilibrium** (Rawls, 1971)

  Ethical criteria should not only be judged by the ethical conditions on which they build, but also by their consequences in specific environments.

- E.g. consider the class of **utilitarian criteria**:

$$\max \int_0^\infty u(X(t))e^{-\rho t}dt$$

where $u(X) = \frac{1}{1-\eta} X^{1-\eta}$; $\eta > 0$ and $\rho \geq 0$

How **should** we treat future generations? (cont)

- Test ethical criteria in the DHS model:

$$Q = F(K,R) = K^{\alpha}R^{\beta} = X + I \qquad \alpha > \beta \geq 0, \quad \alpha + \beta < 1$$

(**D**&**H**, 1974; **S**olow, 1974)

Initial resource stock is finite, implying that the integral of resource inputs are constrained to be finite.

- Pessimistic w.r.t.
  - technological progress
  - renewable resources
- Optimistic w.r.t.
  - possibilities for substitution
  - depreciation

What are the ethical significance of resource constraints? Consider two different environments:

- Without resource constraints — $\beta = 0$
- With resource constraints — $\beta > 0$

For each of these: Consider two utilitarian criteria for intergenerational utility streams.

- Equal treatment of generations — $\rho = 0$
- Unequal treatment of generations — $\rho > 0$

Four cases:

	Without resource constraints	With resource constraints
Undiscounted utilitarianism	$\max \int_0^{\infty} \frac{1}{1-\eta} X^{1-\eta} dt$ s.t. $X = K^{\alpha} - \dot{K}$	$\max \int_0^{\infty} \frac{1}{1-\eta} X^{1-\eta} dt$ s.t. $X = K^{\alpha}R^{\beta} - \dot{K}$
Discounted utilitarianism	$\max \int_0^{\infty} \frac{1}{1-\eta} X^{1-\eta} e^{-rt} dt$ s.t. $X = K^{\alpha} - \dot{K}$	$\max \int_0^{\infty} \frac{1}{1-\eta} X^{1-\eta} e^{-rt} dt$ s.t. $X = K^{\alpha}R^{\beta} - \dot{K}$

Many potential people in the future

This observation might justify modeling the future as consisting of infinitely many (potential) people

- About 7.4 billion people are alive today
- Around 110 billion have ever lived; hence, the ratio of people who have ever lived in the past to people living now is about 15 to 1.
- With 500 million years left of the earth as acceptable habitat for humans, population stable at 1.05 billion with an average length of life equal to 71 years, the ratio of people who will potentially live in the future to people living now is about 1 million to 1.

Social welfare relation (SWR) over intergenerational wellbeing streams.

- A countable but infinite number of generations:

  $1, 2, 3, \ldots, t, \ldots$

- The instantaneous well-being of generation t is represented by utility x_t.
- A social welfare relation compares infinite wellbeing streams: Is it the case that ${}_1\mathbf{x}\, R\, {}_1\mathbf{y}$ where ${}_1\mathbf{x} = (x_1, x_2, x_3, \ldots, x_t, \ldots)$

  ${}_1\mathbf{y} = (y_1, y_2, y_3, \ldots, y_t, \ldots)$

Ethical conditions for intergen. preferences

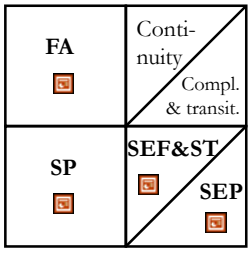
Types of ethical conditions:

Equity	Technical conditions
Sensitivity	Separability between periods

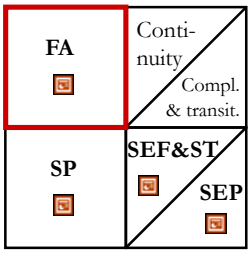
Ethical conditions for intergen. preferences

Important ethical conditions:

SWR: reflexive & transitive
SWO: complete & transitive
Numerical representability ⇒ SWO



If equal treatment of generations, then …



Long tradition for considering unfavorable treatment of future generations as ethically unacceptable

- Sidgwick (1907), Piguou (1932) and Ramsey (1928) considered the unfavorable treatment of future generations as ethically unacceptable.
- The quote from Pigou (1932, Part I, Chapter 2), where the preference for present pleasure over future pleasure is explained by our defective telescopic faculty, is well-known.
- Likewise, Ramsey (1928, p. 543) assumes that *«… we do not discount later enjoyment in comparison to earlier ones, a practise which is ethically indefensible and arises merely from the weakness of imagination».*

Maximin satisfies …

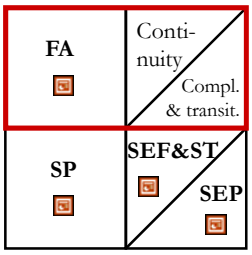
$_1\mathbf{x}\, R\, {}_1\mathbf{y}$

if and only if

$\inf_{t\geq 1} x_t \geq \inf_{t\geq 1} y_t$

Maximin
Rawls (1971)
Solow (1974)

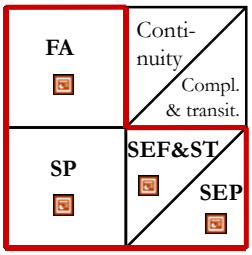
Only the worst-off generation matters!



Leximin satisfies …

What if the worst-off generation matters most, but the second worst-off generation is used to resolve ties, etc.

Leximin



Undiscounted utilitarianism satisfies …

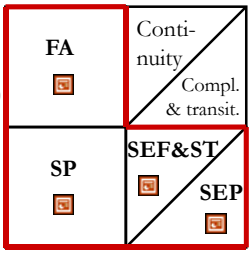
$_1\mathbf{x}\, R\, {}_1\mathbf{y}$

if and only if

$\exists \hat{T}$ s.t. $\forall T \geq \hat{T}$

$\sum_{t=1}^{T} u(x_t) \geq \sum_{t=1}^{T} u(y_t)$

Undiscounted utilitarianism
Ramsey (1928)
Overtaking
Atsumi (1965)
von Weizsäcker (1965)



If only the infinite future matters, then …

$_1\mathbf{x}\, R\, {}_1\mathbf{y}$

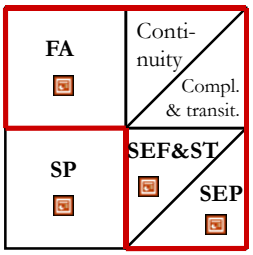
if and only if

$\liminf_{t\to\infty} x_t \geq \liminf_{t\to\infty} y_t$

Only the infinite future matters

Dictatorship of the future

Chichilnisky (1996)



Time-discounted utilitarianism satisfies …

$_1\mathbf{x}\, R\, {}_1\mathbf{y}$

if and only if

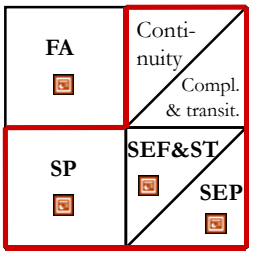
$\sum_{t=1}^{\infty} \delta^{t-1} u(x_t) \geq \sum_{t=1}^{\infty} \delta^{t-1} u(y_t)$

Time-discounted utilitarianism

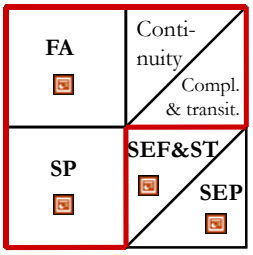
Koopmans (1960)

Dictatorship of the present

Chichilnisky (1996)



No social welfare relation satisfy …



Is it possible to treat an infinite number of generations equally?

Axiom of equal treatment: Finite/Strong Anonymity (FA/SA)
Axiom of sensitivity: Weak/Strong Pareto (WP/SP)

- No SWR over infinite wellbeing streams can satisfy both SA and SP (Lauwers, 1997)
- No SWR over infinite wellbeing streams can satisfy both SA and WP (Fleurbaey & Michel, 2003)

Is it possible to treat an infinite number of generations equally?

Axiom of equal treatment: Finite/Strong Anonymity (FA/SA)
Axiom of sensitivity: Weak/Strong Pareto (WP/SP)

- No *continuous SWO* over infinite wellbeing streams can satisfy both FA and SP (Diamond, 1965)
- No *continuous SWO* over infinite wellbeing streams can satisfy both FA and WP (Fleurbaey & Michel, 2003)

Is it possible to treat an infinite number of generations equally?

Axiom of equal treatment: Finite/Strong Anonymity (FA/SA)
Axiom of sensitivity: Weak/Strong Pareto (WP/SP)

- No *numerical representable SWO* over infinite wellbeing streams can satisfy both FA and SP (Basu & Mitra, 2003)
- No *numerical representable SWO* over infinite wellbeing streams can satisfy both FA and WP (Basu & Mitra, 2007)

Is it possible to treat an infinite number of generations equally?

Axiom of equal treatment: Finite/Strong Anonymity (FA/SA)
Axiom of sensitivity: Weak/Strong Pareto (WP/SP)

- No *explicitly describable SWO* over infinite wellbeing streams can satisfy both FA and SP (Lauwers, 2010)
- No *explicitly describable SWO* over infinite wellbeing streams can satisfy both FA and WP (Zame, 2007)

Choice between

- **SP** + completeness, but not equal treatment
  - Time-discounted utilitarianism
    Axiomatized by Koopmans (1960)
- **FA** + **SP**, but not completeness
  - In prod. econ-s, only non-decr. stream are maximal
    Asheim, Buchholz & Tungodden (2001)
- **SA** + completeness, but not **SP**/**WP**
  - How can SA be combined with completeness?
    Main topic next time

Plan for lectures 2 and 3

Wed 2 Mar

- Lecture 2 on intergenerational distributive justice:
  Inequality along time only
  - Combine numerical repres. with ethical conditions like non-dictatorship and equal treatment, leading to various criteria. Relax sensitivity or time-consistency.

Mon 7 Mar

- Lecture 3 on intergenerational distributive justice:
  Ineq. along time, across space & over uncert. states
  - Motivate the need to take into account variable pop. & uncertainty. The 'repugnant conclusion' and other var. pop. principles are used to evaluate various SWOs.

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Undiscounted utilitarianism—without resource constraints

$$\max \int_0^\infty \tfrac{1}{1-\eta} X^{1-\eta} dt \quad \text{s.t.} \quad X = K^\alpha - \dot{K}$$

$$\dot{K} = sK^\alpha$$

$$X = (1-s)K^\alpha$$

$$\text{where} \quad s = \tfrac{1}{\eta} < \alpha$$

$\frac{1}{\alpha} < \eta < \infty$: Unacceptable inequalities?

$\eta = \infty$ ("maximin"): Perpetual poverty

Discounted utilitarianism — without resource constraints

$$\max \int_0^\infty \tfrac{1}{1-\eta} X^{1-\eta} e^{-\rho t} dt \quad \text{s.t.} \quad X = K^\alpha - \dot{K}$$

$$K \to \left(\tfrac{\alpha}{\rho}\right)^{\frac{1}{1-\alpha}} \quad \text{as} \quad t \to \infty$$

$$X \to \left(\tfrac{\alpha}{\rho}\right)^{\frac{\alpha}{1-\alpha}} \quad \text{as} \quad t \to \infty$$

Unacceptable inequalities and perpetual poverty can be avoided by choosing ρ and η appropriately.

Undiscounted utilitarianism — with resource constraints

$$\max \int_0^\infty \frac{1}{1-\eta} X^{1-\eta} dt \quad \text{s.t.} \quad X = K^\alpha R^\beta - \dot{K}$$

$$\dot{K} = sK^\alpha R^\beta$$

$$X = (1-s)K^\alpha R^\beta$$

$$\text{where} \quad s = \beta + \frac{1-\beta}{\eta} < \alpha$$

$\frac{1-\beta}{\alpha-\beta} < \eta < \infty$: Unacceptable inequalities?

$\eta = \infty$ ("maximin"): Perpetual poverty

Discounted utilitarianism — with resource constraints

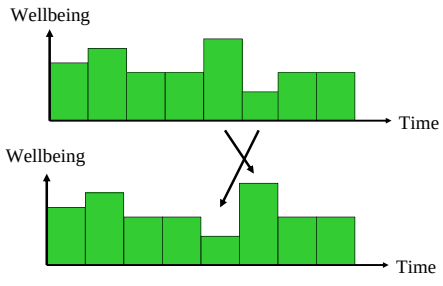
$$\max \int_0^\infty \frac{1}{1-\eta} X^{1-\eta} e^{-\rho t} dt \quad \text{s.t.} \quad X = K^\alpha R^\beta - \dot{K}$$

$$K \to 0 \quad \text{as} \quad t \to \infty$$

$$X \to 0 \quad \text{as} \quad t \to \infty$$

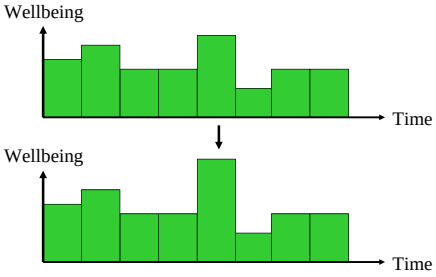
$\rho > 0$ leads to unacceptable inequalities and undermine the livelihood of future generations.

Finite/Strong Anonymity (**FA**/**SA**)



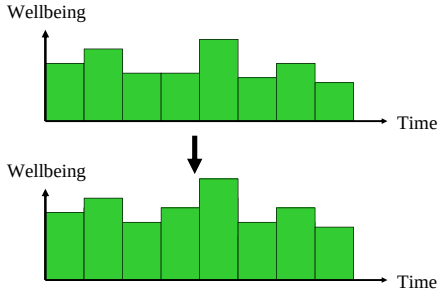
The two wellbeing streams are equally good.

Strong Pareto (**SP**)



The lower wellbeing stream is better.

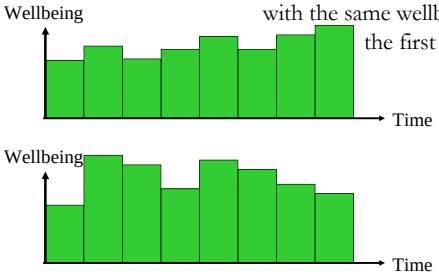
Weak Pareto (**WP**)



The lower wellbeing stream is better.

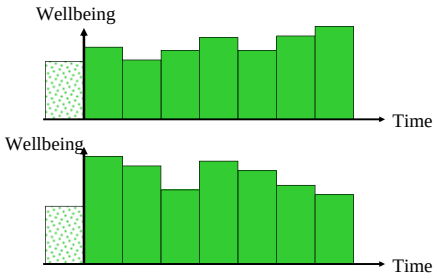
Separable future (**SEF**) & Stationarity (**ST**)

Consider two streams with the same wellbeing in the first period.



If the top is as good as the bottom, …

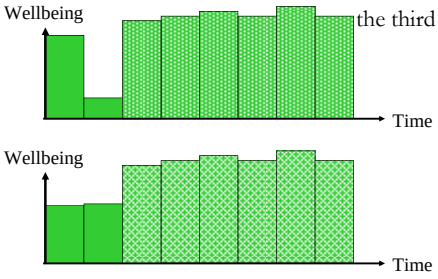
Separable future (**SEF**) & Stationarity (**ST**)



…, then the top is still as good as the bottom if the streams are pulled one period backward.

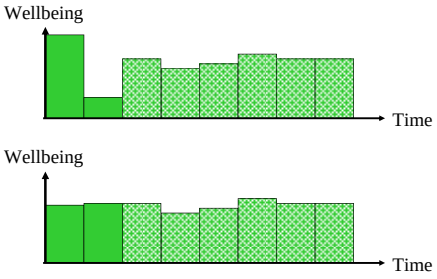
Separable present (**SEP**)

Consider two streams with the same wellbeing from the third period.



If the top is as good as the bottom, …

Separable present (**SEP**)



…, then the top is still as good with a different continuation.

No SWR over infinite wellbeing streams can satisfy both SA and SP (Lauwers, 1997)

1 0 1 0 1 0 … 1 0 …

0 0 1 0 1 0 … 1 0 …

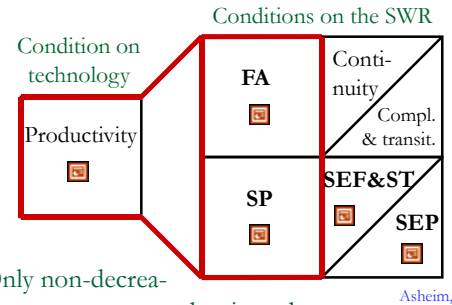
No SWR over infinite wellbeing streams can satisfy both SA and WP (Fleurbaey & Michel, 2003)

$\frac{1}{3}$ $\frac{2}{3}$ $\frac{1}{4}$ $\frac{3}{4}$ $\frac{1}{5}$ $\frac{4}{5}$ … $\frac{1}{k+2}$ $\frac{k+1}{k+2}$ …

$\frac{1}{4}$ $\frac{1}{3}$ $\frac{1}{5}$ $\frac{2}{3}$ $\frac{1}{6}$ $\frac{3}{4}$ … $\frac{1}{k+3}$ $\frac{k}{k+1}$ …

Justifying sustainability

Suppes-Sen grading princ. (Suppes, 1966; Sen, 1970)

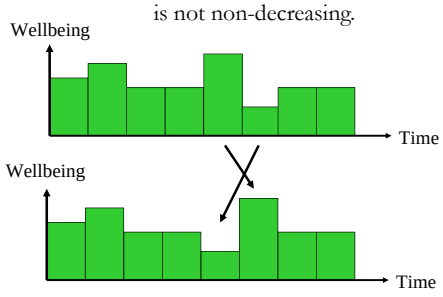


Only non-decrea-sing streams are undominated.

Asheim, Buchholz & Tungodden (2001)

Productivity

If a feasible wellbeing stream is not non-decreasing.



Then this wellbeing stream is feasible and inefficient.

Intergenerational preferences under resource constraints: The DHS model revisited

- DHS model (with resource contraints) is productive.
- If the SWR satisfies **FA** and **SP**, then only efficient and non-decreasing streams are undominated.
- Discounted utilitarianism leads to streams that are dominated under SWRs satisfying **FA** and **SP**.
- With $\alpha > \beta > 0$, there are effic. and non-decr. streams.

Conclusion:

- If $\beta > 0$ (i.e., with resource constr.), there are streams acceptable under SWRs satisfying **FA** and **SP**, but discounted utilitarianism does not lead to such streams.