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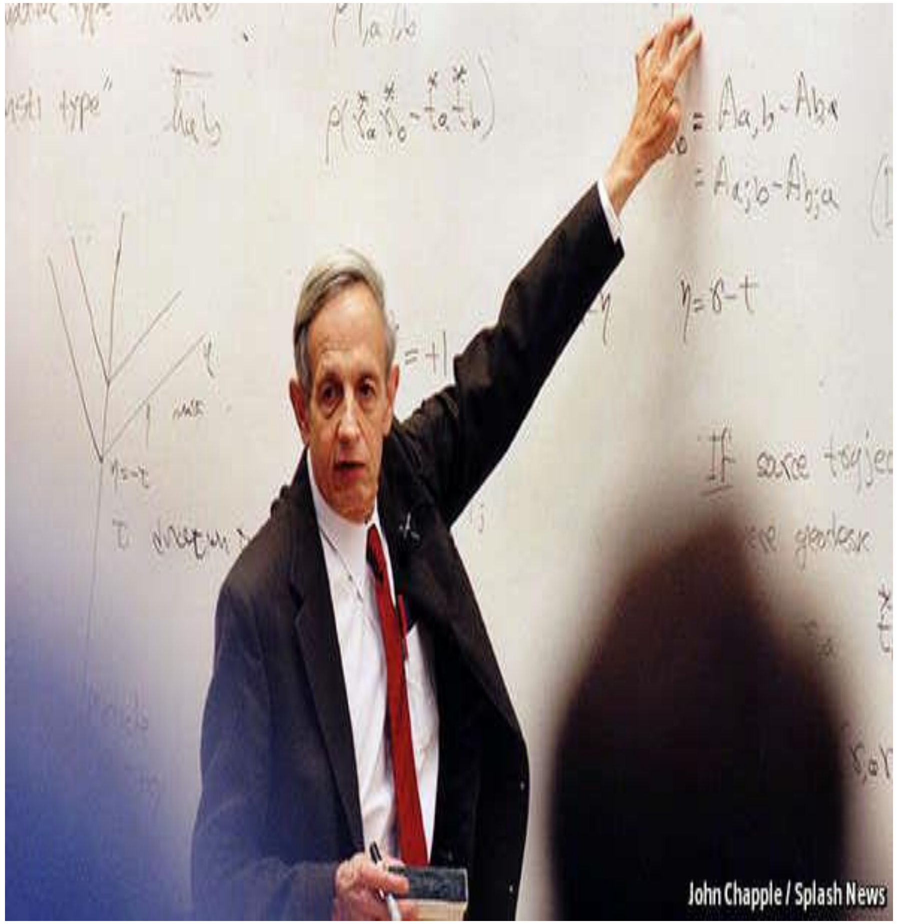
Kant vs Nash: Solving the Global Commons Goods Problem



by

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Ordem dos Economistas & SEDES, PT.

Vanessa Duarte
CEFAGE, University of Évora, PT &
IPSA RC 35, Toronto.

SASE World Congress
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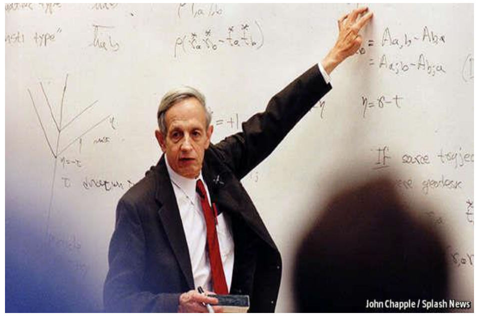
10:30-12:00

ROOM Florida 1- 1st Floor

Rio de Janeiro Brazil
Windsor Florida Hotel



Kant vs Nash: Solving the Global Commons Goods Problem

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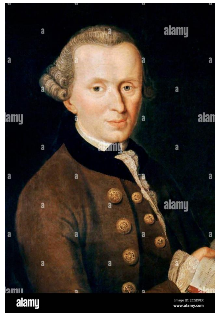
by

Miguel Rocha de Sousa (mrsousa@uevora.pt) & Vanessa Duarte

Abstract: We provide the notion of Kantian equilibrium versus Nash equilibrium, and try to recover the efficiency of Pareto allocations within public goods (global commons) and external effects (like pollution). Nash (1950a,b) provided the first solution to a non zero-sum non-cooperative game through a fixed point theorem. Nevertheless, market efficiency is not recovered when there are either externalities (like pollution, or the global common problems), or common public goods. Ostrom (1989) provided a solution in small numbers through cooperation in small lake ponds and lobsters aquaculture production and local water provision. Roemer (1992) studied theories of distributive justice and came forth with a solution to global commons problem of environment and pollution (Roemer, 2019). Nevertheless, Roemer’s solution, while solving the global commons incentive problem, by thinking out of the box, and providing a new framework provides a too much collective solution. We provide instead a communitarian solution, inspired by Christian ethics, namely Economics of Francis, Laudatio si, which also recovers the global incentive problem, but provides a different politico-economic perspective.



Key-words: Nash vs Kantian equilibria, Roemer, Laudatio si, Economics of Francis, Collective versus communitarian equilibria, private versus public provision, Global common goods, green house gas emissions, pollution, Peace versus war, Ethics versus Positive thought

JEL Codes: C70; C71; C72; D64; D70; D71; D72; O13; O19

July, 2023

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Active Research

Conclusions

Further Notes

Introduction — Theoretical Framework — Active Research — Conclusions — Furhther Notes

Introduction

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Motto | Research Question | Literature review | Climate Change | Game Theory

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Theoretical Framework – Climate Change

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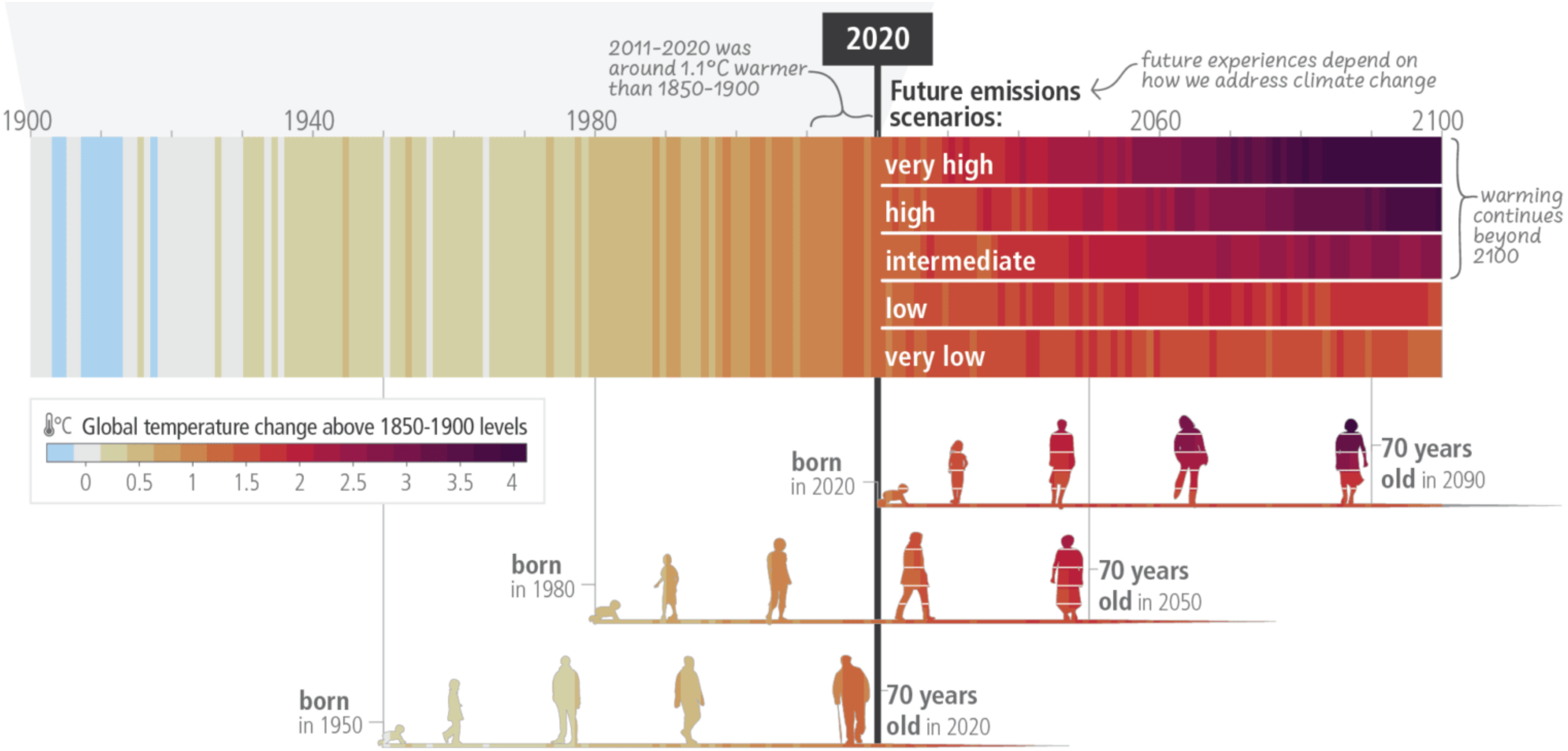

Figura 1
Observed (1900–2020) and projected (2021–2100) changes in global surface temperature (relative to 1850–1900)
Source: (IPCC, 2023)

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Nicholas Stern

Arthur Pigou

William Nordhaus

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Theoretical framework – Economics and Environment

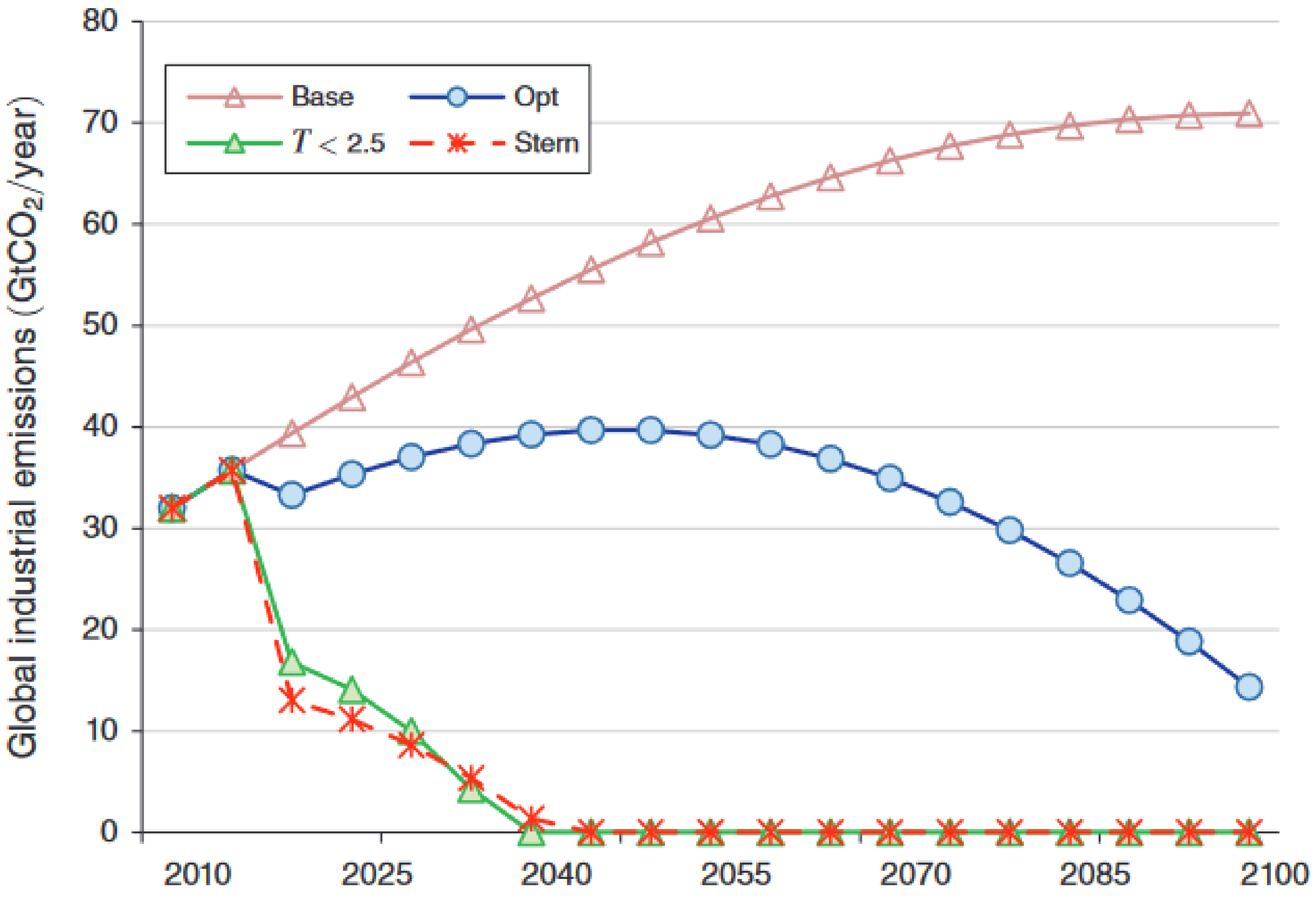

Figura 2
Global industrial greenhouse gas (GHG) emissions

Source (Nordhaus, 2018, p. 347)

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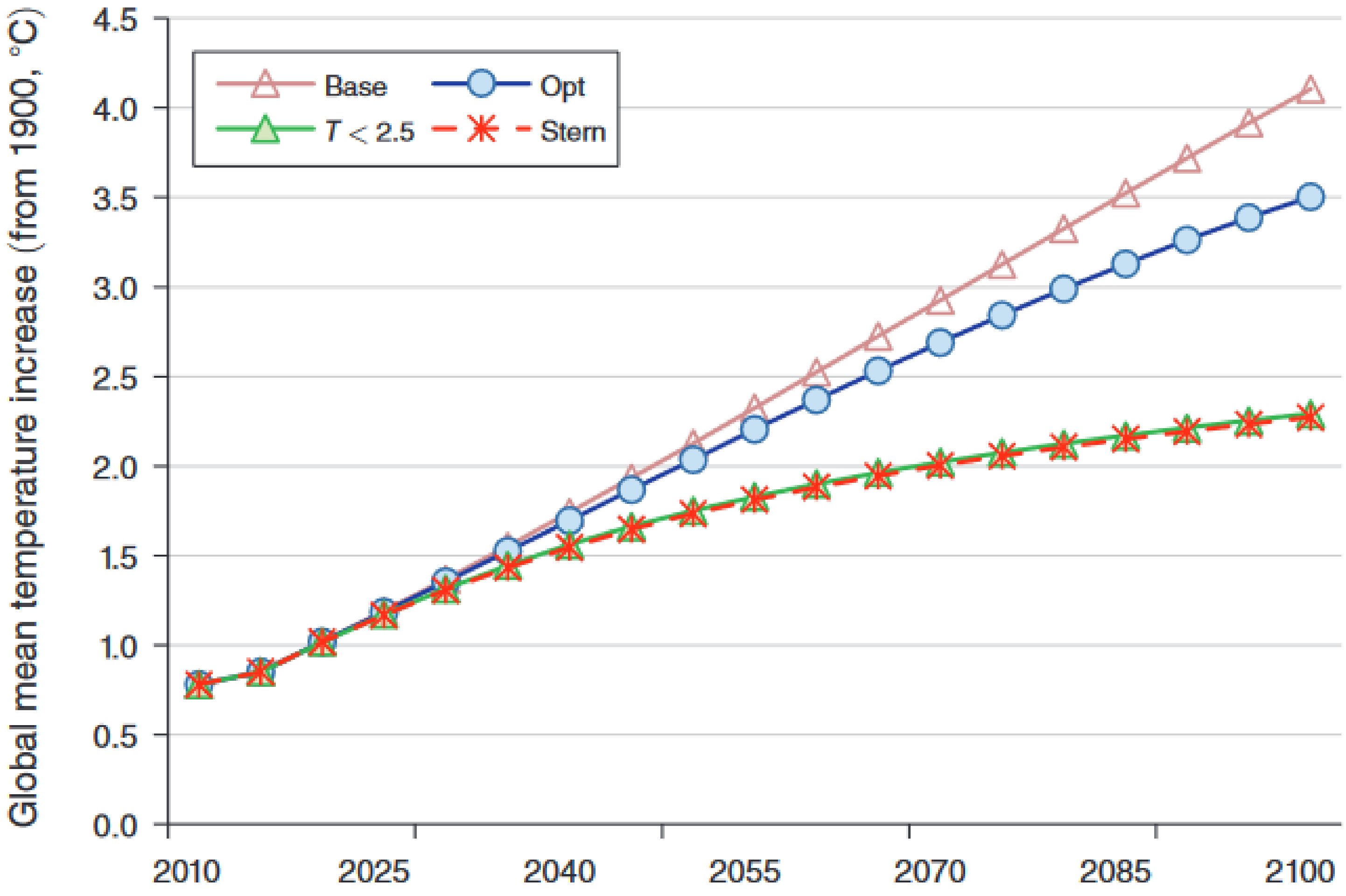

Figura 3
Average temperature rise under different scenarios (since 1900, ºC)Source: (Nordhaus, 2018, p. 348)

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John von Neumann and Oskar Morgenstern

John Nash

Fudenberg e Tirole

John von Neumann and **Oskar Morgenstern**

John Nash

Fudenberg and Tirole

John von Neumann e Oskar Morgenstern

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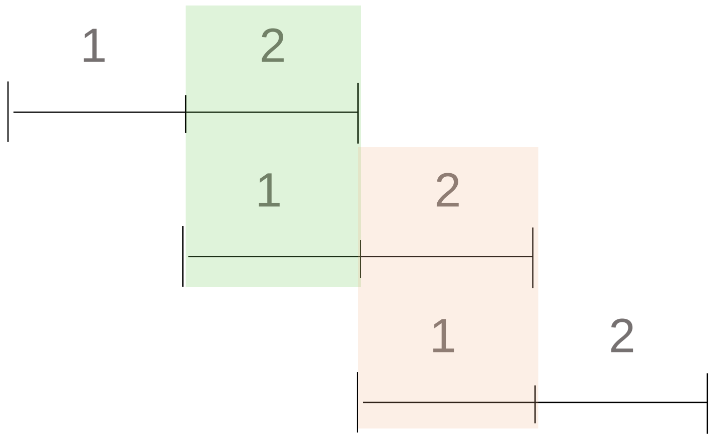

Allais, Samuelson and Diamond

John and Pecchenino

Vladimir Udalov

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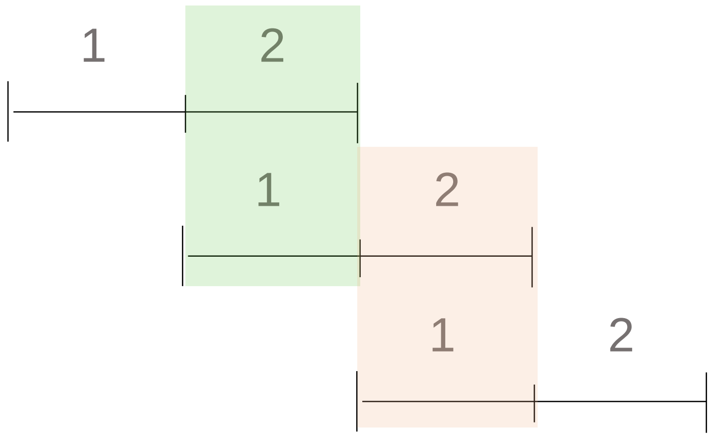

Allais, **Samuelson** and **Diamond**

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Theoretical framework – **OLG Model**

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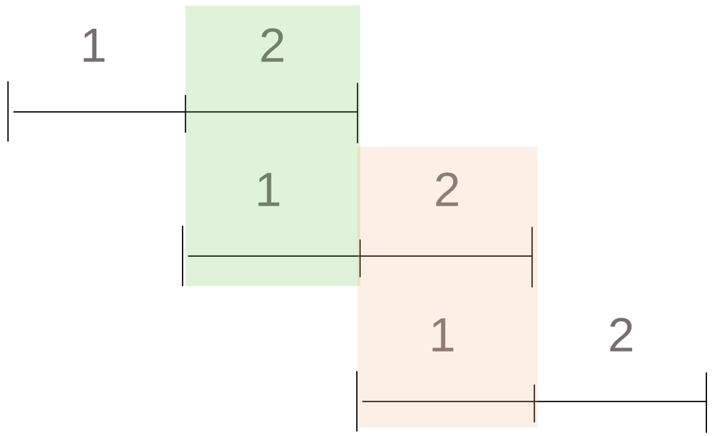

Allais, Samuelson and Diamond

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Theoretical framework – **OLG Model**

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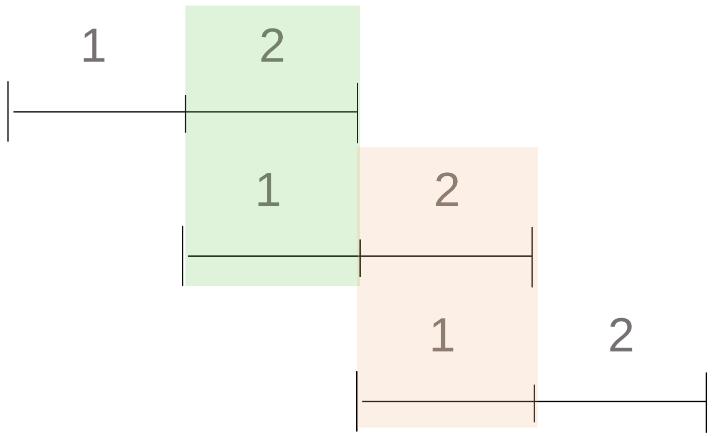

Allais, Samuelson and Diamond

John and Pecchenino

Vladimir Udalov

The clock is ticking and we need to ACT!

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Active Research – Intergenerational Concern

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$$U_t = \ln c_t^1 + \ln Env_t + \frac{1}{1+\delta}\left(\ln c_{t+1}^2 + \eta \ln Env_{t+1}\right)$$

- $\ln c_t^1$: Current Consumption
- $\ln Env_t$: Envionmental Quality At Present day
- δ: Intertemporal Discount rate
- $\ln c_{t+1}^2$: Consumption Next Period
- η: Intergenerational Concern
- $\ln Env_{t+1}$: Environmental Quality Next Period

Interest rate

Environmental Degradation

$$\left[\frac{\bar{c}}{\overline{Env}}\right]^{young} = \left(\frac{\bar{r}-\delta}{1+\delta}\right)\frac{\omega}{\eta} + \mu^1$$

Base value Assigned to Consumption

$$c_t^1 = c_{t+1}^2 = \bar{c}$$

$$Env_t = Env_{t+1} = \overline{Env}$$

$$r_{t+1} = \bar{r}$$

Active Research – **Youngsters**

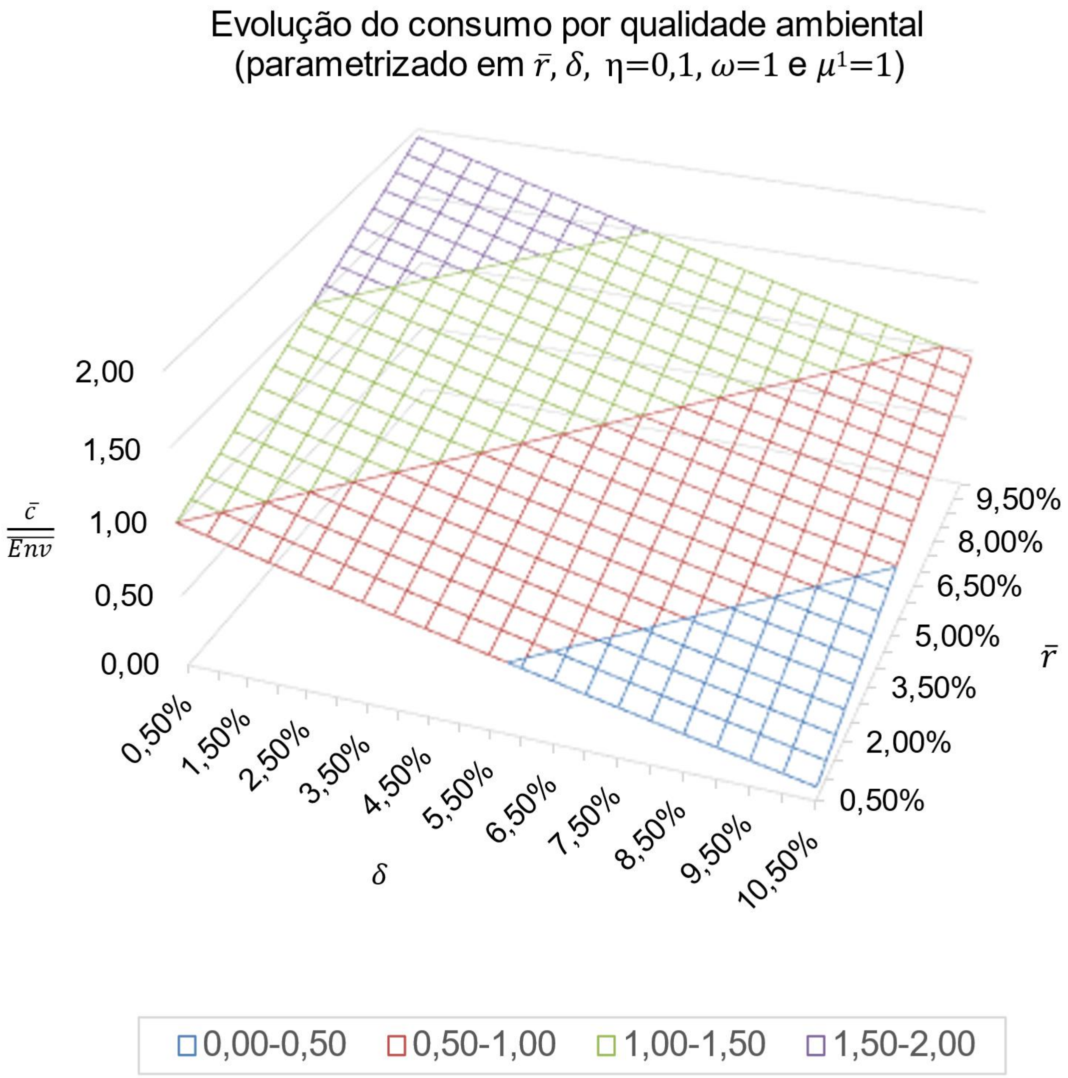

Figure 4
Evolution of consumption by environmental quality
Pica and De Sousa, 2023

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Without Intergenerational concern

$$V_t^{old} = \ln c_t^2 + \ln Env_t$$

With Intergenerational concern

$$U_t^{old} = \ln c_t^2 + \ln Env_t + \frac{\eta}{1+\delta} \ln Env_{t+1}$$

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$$\left[\frac{\bar{c}}{\overline{Env}}\right]^{old} = -\frac{1}{\omega} + \mu^2$$

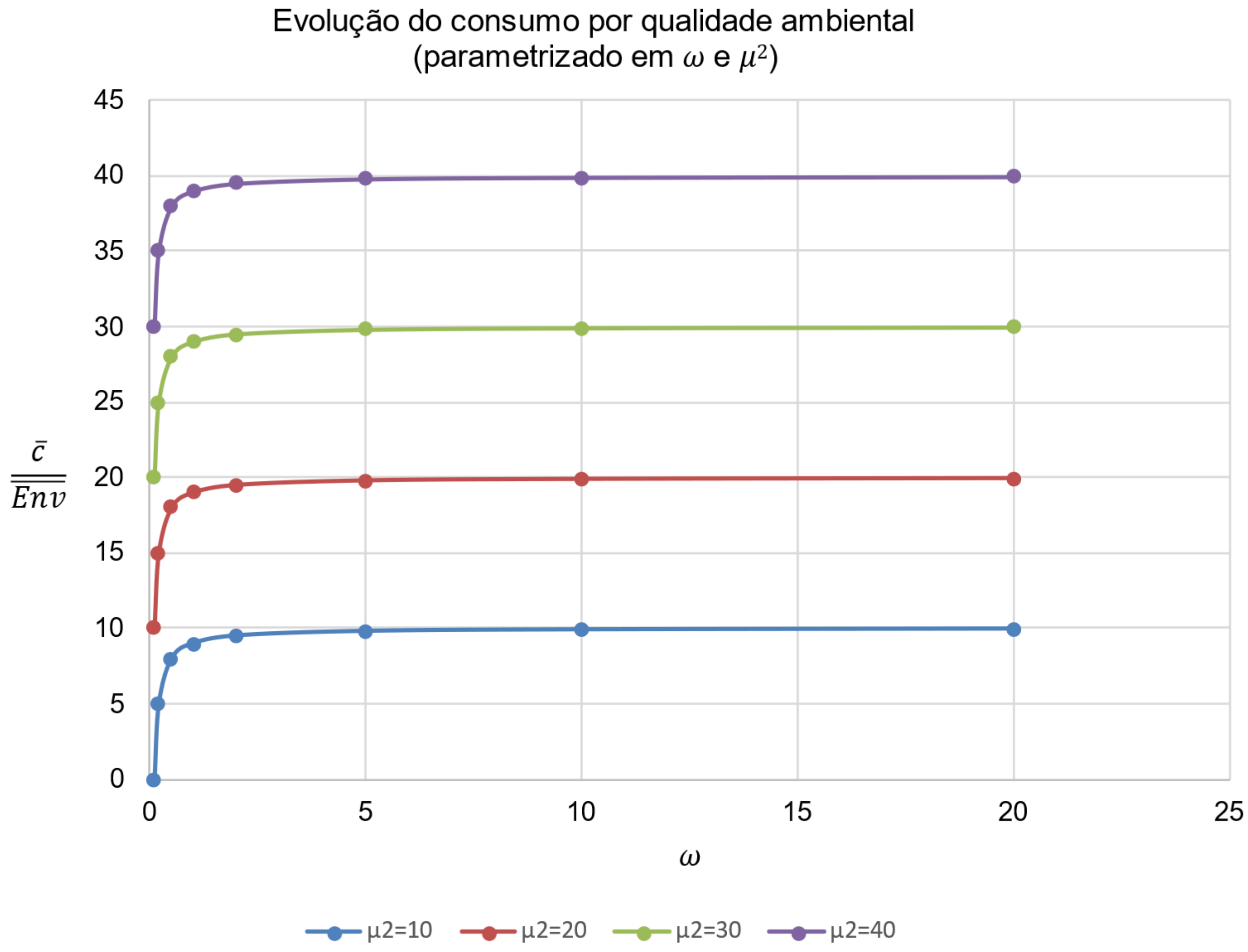


Figure 6
Evolution of consumption by environmental quality
Pica and De Sousa, 2023

Active Research – Strategic Interaction: Nash Equilibria

$$\eta = \left(-\omega + \mu^{*}\right)\frac{\omega\left(\bar{r} - \delta\right)}{\left(1 + \delta\right)}$$

$$\mu^2 - \mu^1 = \mu^*$$

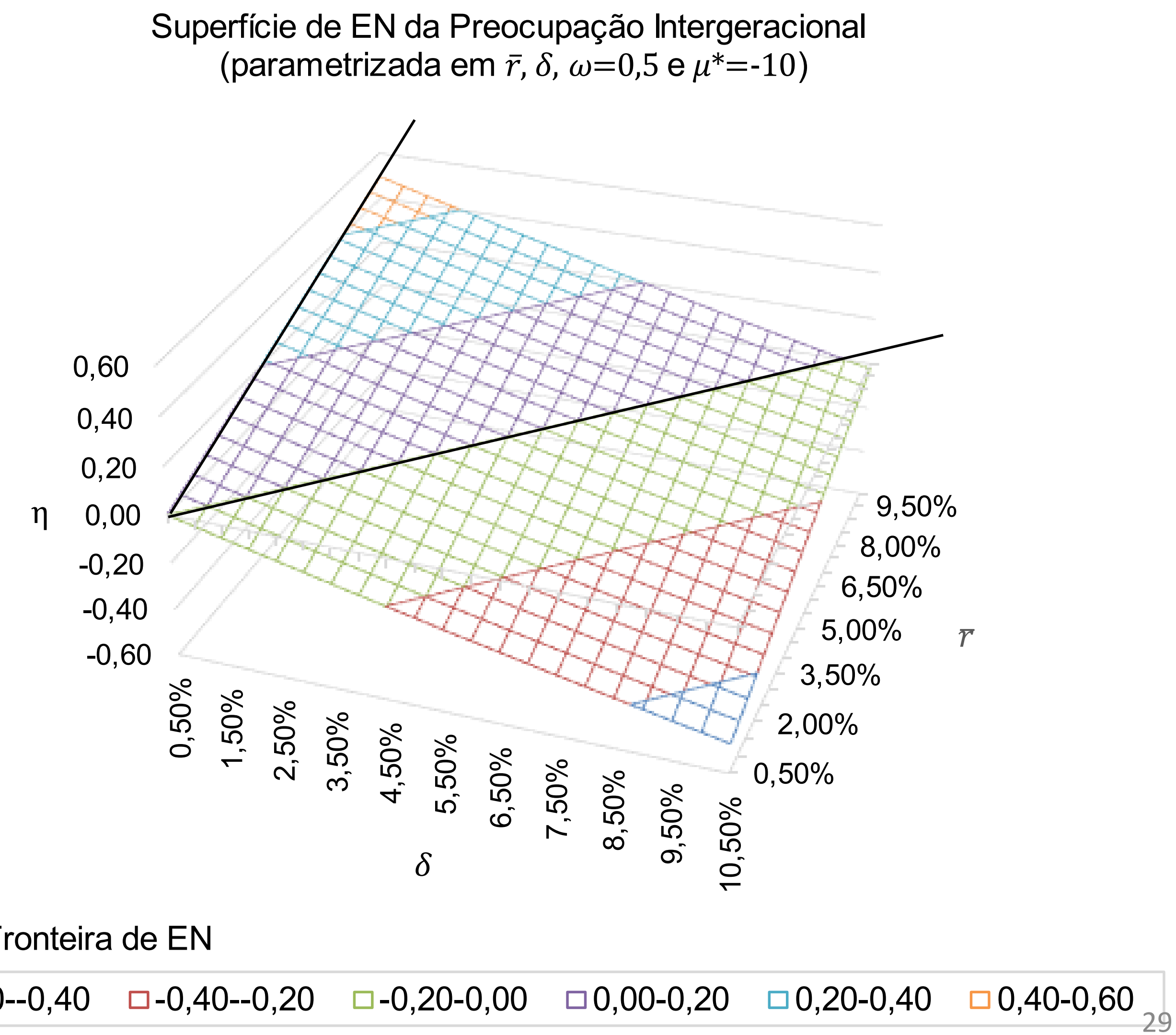


Figure 7
NE Surface of Intergenerational Concern
Pica and De Sousa, 2023

Active Research – Discussion of Results

youngsters

Intergenerational Concern ↗ ⟶ Consumption ↘

η

Active Research – Discussion of Results

Elderly

Consumption Evolution → μ^2

(consumption base value)

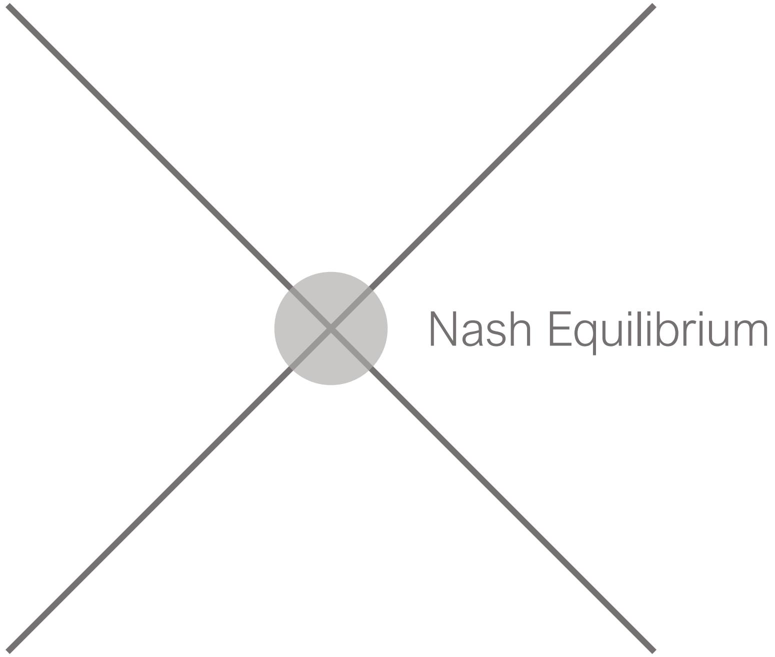
Active Research – **Discussion of Results**

Strategic Interaction

$\mu^1 > \mu^2$

$\mu^2 = \mu^1$

$\mu^2 > \mu^1$



Environmental degradation ↗

Intergenerational concern ↗

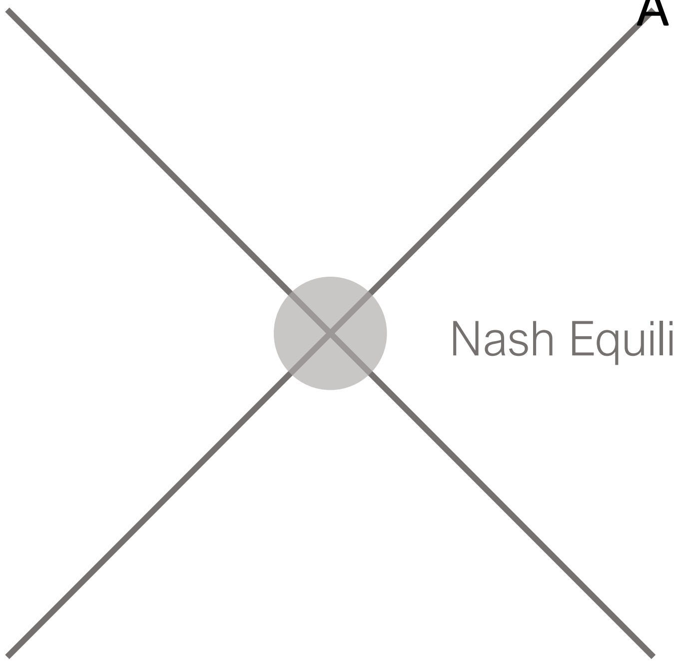
Active Research – Kant vs Nash Equilibrium

Strategic Interaction

$\mu^1 > \mu^2$

$\mu^2 = \mu^1$

$\mu^2 > \mu^1$



Nash Equilibrium

The Kantian equilibrium is not just a new objective function, is really a new problem.
A new parametrization, a new approach.

The **Nash equilibrium** is just an individual egoistical function, is really an old problem.

Environmental degradation

Intergenerational concern

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Strategic Interaction

The Kantian equilibrium is not just a new objective function, is really a new problem.
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Kantian Additive equilibria

Simple Kantian Equilibrium

Definition 1.1. [Roemer, 2019, p.13]:

”In a **symmetric game**, the strategy that each **would all** play is a simple Kantian equilibrium (SKE).”.

Monotonocity and Pareto efficiency:[Roemer, 2019,p.23]

A game V, with n players, with pay-offs: $V_i : Sn \rightarrow R$ for i = 1, 2, ..., n as per defined, is (strictly) monotone increasing if, for each i, V_i is (strictly) increasing on the strategies of other players $j \neq i$.

Common diagonal, definition (Roemer, 2019,p.23):

"If the pay-offs functions of all players coincide on the diagonal (p, p, .., p) ∈ Sn|S ∈ S".

The Kantian equilibrium is not just a new objective function, is really a new problem. A new parametrization, a new approach.

Example 2 -person-game[Roemer, 2019,p.23]

This condition of common diagonal is weaker than perfect symmetry.

For a 2-person-game, symmetry means p, q ∈ S, $V_1(p, q) = V_2(q, p)$ It is immediate, that this game has a common-diagonal, and thus a SKE.

Proposition 2.1.[Roemer, 2019, p.23]

a) If a game V possesses a common-diagonal, then a SKE exists.

b) In a strictly monotone game, any SKE is Pareto efficient. (Demo: Roemer, 2019, p.23-24.)

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Example 2 –prisioner's dilemma[Roemer, 2019,p.23]

Example 2-person Symmetric Games

Table 2.1. The prisioner's dilemma with 0 < b < c.

	Cooperate	Defect
Cooperate	(0,0)	(-c,1)
Defect	(1,-c)	(-b,-b)

The expected value of the row-player in the PDs problem is:

$V^{p}D(p, q) = -p(1-q)c + (1-p)q - b(1-p)(1-q)$

with p(q) → probability of the row (column) player cooperates.

Pareto efficiency is defined in terms of expected utility EU, and thus: $\frac{\delta V^{PD}}{\delta q} = pc + (1-p)(1+b) > 0.$

The mixed strategy prisioner's dilemma is strictly monotone increasing.

Thus, from proposition 2.1. the SKE of the mixed strategy prisioner's dilemma (PD) is Pareto efficient.

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Proposition 2.2.[Roemer, 2019, p.25]

a. The SKE of the PDs is Pareto efficient.

b. If $1 \leq c \leq 1 + b$, the SKE of the PDs game is $(p*, p*) = (1, 1)$.

c. If $c < 1$, the SKE of the PDs is $p* = 2b-p+1-c$
$2(1+b-c)$ and $0 < p* < 1$.

d. If $1 + b < c$, the SKE of the PD game is $p* = 1$.

(Demo: Roemer, 2019, p.25.)

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Example 2 –stag hunt game[Roemer, 2019,p.23]

Another example, by using the stag-hunt game:

Table 2.2. The stag-hunt game with a < 0 < b < 1.

	Cooperate(share)	Defect(grab)
Cooperate(share)	(1,1)	(a,b)
Defect(grab)	(b,a)	(0,0)

Grab (not unlike PDs) is not a dominant strategy. Skyrms (2004) studied the signals the players could have sent in order to meet the good nash equilibrium (share, share)=(1,1).

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So, let’s now proceed to asymmetric games

We have **dictator, ultimatum**, **trust games**.
We will deal woth classical V-N (Von-Neumann utility functions), with $u(0) = 0$
and $u(1) = 1$.

We analyse immediatly **the stochastic dictator game**.

The traditional problem is to find a solution to expected utility:
$E(u) = (1/2)(u(x) + u(1 - y))$
Nevertheless, the **SKE** is different:
$\text{Max}_x\, E(u)$
And the solution yields for the first player:
$x = 1/2$ and of course for the second player $x = 1/2$.

The **standard dictator game** is **asymmetric**, but to put the game symmetric, by beginning before Nature moves.

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A new parametrization, a new approach.

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So, let's now proceed to asymmetric games

Ultimatum stochastic game.
i) Nature chooses the ultimatum.
ii) Ultimator presents an offer.
iii) other player accepts or rejects the offer.
Traditional approach: the unique sub-game perfect equilibrium is:
(x, z) = (1, 0).

But if we follow this new approach:
max(1/2)(u(x) + (1/2)u(z) st
$z \leq 1 - x$
This yields a unique solution:
(x, z) = (1/2, 1/2).

Accordingly to Roemer, this **solution (SKE) is more nearer** to the **world we observe**, rather than **simple Nash equilibrium.**
Intuitively, we use the **SKE protocol**, because "**we are all in the same boat".**

The Kantian equilibrium is not just a new objective function, is really a new problem.
A new parametrization, a new approach.

So, let’s now proceed to asymmetric games

Public good game.
2 players.
Each has M units of money.
Nature draws who plays first.
Player 1 choose x to player 2.
Player 2 receives a.x with a > 1, yet constant.

A. Conventional approach: **Nash equilibrium** yields a sub-game perfect equilibrium, with:
x = y = 0.

B. KE: Kantian equilibrium:
Before: (1/2).u(M − x + ay) + (1/2).u(M + ax − y) in order to choose (x, y)
This yields the following solution approach.

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So, let’s now proceed to asymmetric games

Public good game.
2 players.
$\text{Max}(1/2).u(M - x + ay) + (1/2).u(M + ax - y)$
in order to choose (x, y)
s.t.
$0 \leq x \leq M(\lambda)$
$0 \leq y \leq M + ax$
So, the first consatraint binds (λ) and the second lacks, using Khun-Tucker
(KT) conditions:

$(\delta x)\ -u'(M - x + ay) + a.u(M + ax - y) = \lambda \geq 0$
$(\delta y)\ au'(M - x + ay) = u(M + ax - y)$
This yields, as solution x = M.

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So, let’s now proceed to asymmetric games

Public good game. (SKE continued)
2 players.
(KT) conditions:
$(\delta x)\ -u'(M - x + ay) + a.u(M + ax - y) = \lambda \geq 0$
$(\delta y)\ au'(M - x + ay) = u(M + ax - y)$
This yields, as solution $x = M$.
By substituting, (δy) in (δx), Roemer finds:
$(a2 - 1).u'(M - x + ay) \geq 0$
which is surely true as $a > 1$.
Thus, (δy) leads us to:
$M - x + ay > M + ax - y$
because u is traditionally declining (marginal utility), so we have $x < y$
and
$y > M$.
So, we should expect $y < (1 + a).M$.
Thus, we find SKE as:
$x = M$ and $M < y < (1 + a).M$.

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A new parametrization, a new approach.

So, let’s now proceed to more analysis

We could tackle the issue of Kantian Additive versus multiplicative equilbria, a simple extension Roemer does quite well.

We could abridge a game among Kantian versus Nashers.

And finnally last but not least the global commons problem is approached in his Roemer (2019, chpt. 11, pp.159-175).

Instead of criss-crossing all the mathemaitcal details, from addtiive to multiplicairve and to the generalzation of public goods with externalities, IN SHORT the maths is CORRECT,

BUT and this is a great BUT

The interpretation can be instead of a kibutz, from the leftist tender lean or, for our case proposal, a Christian ethics approach.

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Christian Ethics in Roemer's thought

IN SHORT the maths is CORRECT,

BUT and this is a great BUT

The interpretation can be instead of a kibutz, for our case proposal, a Christian ethics approach.

The colective approach for the COMMON G(O)OD can be tackled by a COMMUNITARIAN Approach.

The Kantian equilibrium is not just a new objective function, is really a new problem.
A new parametrization, a new approach. **OURS a new Christian Ethics.**

Christian Ethics in Roemer's thought

The colective approach for the COMMON GOOD can be tackled by a COMMUNITARIAN Approach, detailing it:

i) Ostrom (1989) did it in small numbers for lobsters and aquaculture provision and water provision for small communities.

ii) we can make it for the common G(o)od! A truly ecumunical holistic approach can realign incentives.

iii) This is the main NEWNESS of our PAPER- redefine Kant versus Nash equilibria passing from nashian egoistic self centered equilbria to a COMMUNITARIAN approach (eg. **Jesuitic community** and **Laudatio si and EoF** by Pope Francis sj)

The Kantian equilibrium is not just a new objective function, is really a new problem.
A new parametrization, a new approach. **OURS a new Christian Ethics.**

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Conclusion

Environmental Heritage

Cooperation

Sustainable Development

Kant vs Nash

Communitarian Approach

Christian Ethics

Limits of Analysis and Further Work

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- Log linear deterministic model

  Stochastic model

- Simulations contingent on the positive ortant

  Cover the most important results to other ortants

- Equal intergenerational concern for young and old

  Extend to different parameters for both generations

- ***NEWNESS OF THIS APPROACH***

- Equal mathematical formulation of SKE BUT

  Extend to different parameters for both Christian

  Commutarian ethics vs Kibbutzian ethics.

Limits of Analysis and Further Work

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- ***NEWNESS OF THIS APPROACH***

- Equal mathematical formulation of SKE BUT

  Extend to different parameters for both Christian Commutarian ethics and Kibbutzian ethics.

- ***WE USE THE SAME LANGUAGE BUT WITH DIFFERENT ENDS/AIMS.***

- ***We all pray to the SAME G(O)OD but with different versions and intents?***

“Climate change is the greatest market failure the world has ever seen”

(Stern, 2007)

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- All presentations are different but benefitted from cojoint work and comments and interactions.
- No CoI claim the authors.Thank you for all the comments! mrsousa@uevora.pt