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"How we cooperate: A Kantian explanation"

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Cooperative Humans

- M Tomasello. Among the 5 species of great ape, humans are the unique cooperative one
  - Humans mime and point (pre-linguistic communication)
  - Only humans have sclera
- Experiments with cooperation to acquire food, with human infants and chimpanzees
- Social evidence
  - Large states, large fraction of national income collected through taxation
  - Large firms
- Language would not have evolved in a non-cooperative species

Economics has a thin theory of cooperation

- Multi-stage games with punishments of non-cooperators, and of non-punishers of non-cooperators.
- The so-called cooperative outcome is a *Nash equilibrium* of this complex game.
- This defines exactly what Elster calls a *social norm*
- But is this the most parsimonious explanation? Are there not many examples of spontaneous cooperation that do not rely on enforcement via punishment/ostracism?

Behavioral economics: Exotic preferences

- BE inserts exotic arguments in preferences, such as a concern for the welfare of others, receiving a warm glow (Andreoni), a sense of fairness
- …. And then it derives cooperative behavior as the *Nash equilibrium* of the altered game
- In other words, BE still uses the *non-cooperative template* of Nash Equilibrium to explain cooperation
- But is NE the right tool for explaining cooperation?

Source of cooperation: Solidarity

- "A community experiences solidarity just in case its members have *common interests* and must work together to address them"
- Benjamin Franklin: "We all hang together or, most assuredly, we will each hang separately"
- Not altruism. I work with you as it's the best way to reach my goal.
- Recognition that we are all in the same boat

Symmetric games

- Matrix games: symmetric matrix
- All players have the same preferences, all have same strategy space
- Nash player: "given what others are playing, what is the best strategy for me?"
- Kantian player: "What is the single strategy I would most like all of us to play?"
- E.g.: Prisoners' dilemma with two strategies: I'd prefer we both play C than that we both play D.

The Prisoners' Dilemma

	C	D
C	(1,1)	(-1,2)
D	(2,-1)	(0,0)

Simple Kantian Equilibrium

- Game with payoff functions $V^i(s^1, \ldots, s^n)$
- A *simple Kantian equilibrium (SKE)* is a strategy s^* such that for all *i*, $s^* = argmax_s V^i(s, s, \ldots, s)$
- In a game with a *common diagonal,* SKE exists.

	A	***B***
A	(0,0)	(b,a)
B	(a,b)	(1,1)

The game is str. monotone increasing if and only if $b > 0$ and $1 > a$

Monotonic games

- A game is specified by the payoff functions $\{V^i\}$ of the players. The strategy space for each player is an interval of non-negative real numbers.
- A game is *(strictly) monotone increasing* if each player's payoff function is strictly monotone increasing in the contributions of the other players.
- A game is *(strictly) monotone decreasing* if the payoff of each player's payoff function is str. monotone decreasing in the strategies of the other players

The two failures of Nash equilibrium

- Monotone increasing games are games with *positive externalities.* A typical example is when the efforts are contributions to the production of a public good.
- Monotone decreasing games are games with *negative externalties* or *congestion effects.* A typical example is when fishers exploit a common-pool resource, a fishery

If a strictly monotone game is differentiable, then its interior Nash equilibria are Pareto inefficient.

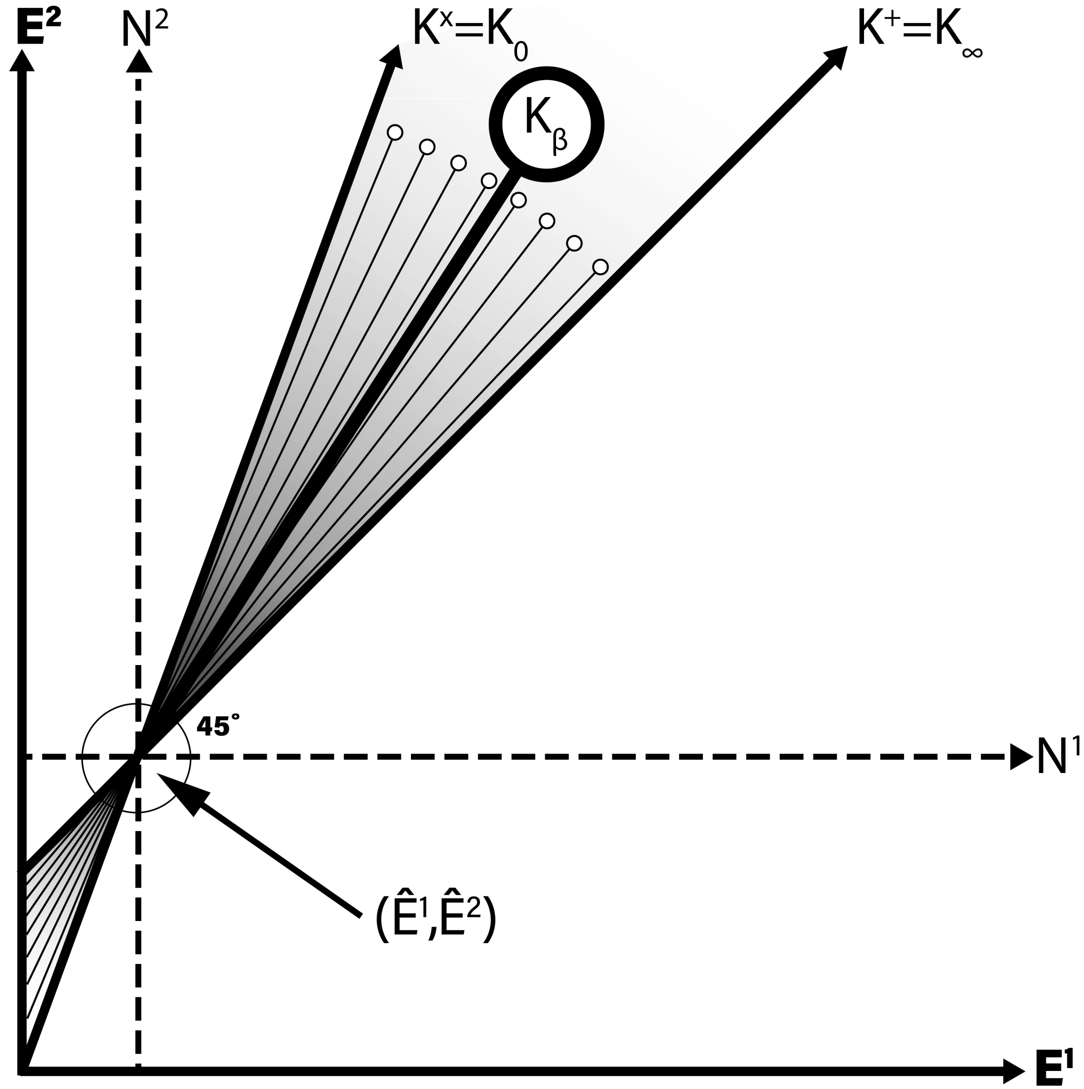
- This theorem summarizes the two major failures of Nash equilibrium from a welfare viewpoint
  - Inefficiency of NE of monotone decreasing games is known as *the tragedy of the commons*
  - Inefficiency of NE of of monotone increasing games is known as *the free rider problem*

In contrast:

- **The simple Kantian equilibrium (if it exists) of any strictly monotone game is Pareto efficient.**

Multiplicative Kantian equilibrium

- In games with *heterogeneous preferences,* simple Kantian equilibria generally don't exist.
- Let $V^1, \ldots, V^n$ be payoff functions of *n* players on the strategy space $[0,\infty)$.
- A strategy profile $(E^1, \ldots, E^n)$ is a *multiplicative Kantian equil'm* if no player would like to rescale the entire profile by any non-negative constant. That is:
- **For all players *i*, $\boldsymbol{V^i\left(rE^1, \ldots, rE^n\right)}$ is maximized at *r* = 1.**



E²
N²
Kˣ=K₀
K⁺=K∞
Kβ
45˚
N¹
(Ê¹,Ê²)
E¹

Multiplicative and additive Kantian equilibria

- In symmetric games, we have the Simple Kantian Equilibrium. In asymmetric games, SKE typically fail to exist, but we have *multiplicative Kantian* and *additive Kantian* equilibrium.

- **Theorem**: *Every simple, multiplicative, and additive Kantian equilibrium of a str. monotone game is Pareto efficient.*

- **Thus *cooperation* modeled as Kantian optimization, resolves both the free rider problem and the tragedy of the commons.**

Example: The Fishing Game

- Utility functions $u^i(x^i, E^i)$, quasi-concave
- The lake produces fish in amount $G(E^S)$, *G strictly* concave
- Fish are distributed by the rule ‘each keeps his catch’:

$$x^i = \frac{E^i}{E^S} G(E^S)\ .\ ¶$$

This defines a game where ¶

$$V^i(E^1, \dots, E^n) = u^i\left(\frac{E^i}{E^S} \mathrm{G}(E^S), E^i\right)$$

The tragedy of the commons: The Nash equilibrium of this game is always Pareto inefficient.

The Mult. Kantian equilibrium is Pareto efficient:

For all i:

$$\left.\frac{d}{dr}\right|_{r=1} u^i\left(\frac{rE^i}{rE^S}G(rE^S), rE^i\right) = 0.$$

I.e.: $u_1^i \cdot \dfrac{E^i}{E^S} G'(E^S)E^S + u_2^i E^i = 0.$

This is a *stronger* result than
The theorem on slide 13. Why?

I.e. $u_1^i G'(E^S) + u_2^i = 0$.

Or: $-\dfrac{u_2^i}{u_1^i} = G'(E^S)$

But this is the condition '*MRS*=*MRT*'
which is precisely the condition for
Pareto efficiency of the allocation. qed

Some examples of simple Kantian equilibrium

- 1. Recycling
- 2. Voting
- 3. Tipping
- 4. Queuing (or is this a social norm?)
- 5. ‘Doing my bit’
- 6. Soldiers protecting each other
- 7. Charity

More complex examples (asymmetric)

- 8. Akerlovian gift exchange
- 9. Ostrom's efficient solutions of commons' problems
- 10. Worker strikes
- 11. Dangerous political actions/demos
- 12. the Japanese firm
- 13. the Declaration of Independence
- 14. Giving blood and organs

The hunting game: Equal Division

Allocation rule:

$$x^i = \frac{G(E^S)}{n} \, .$$

The Nash Equilibrium of the Hunting Game

is characterized by:

$$MRS^i = \frac{MRT}{n} \, .$$

Additive Kantian Equilibrium: K^+

- Here, the counterfactual contemplates *adding* a constant to all efforts
- An ***additive Kantian equilibrium*** is a vector E :

$$\mathbf{E} = (E^1, \ldots, E^n) \text{ s.t.}$$

$$(\forall i)(\arg\max_r V^i(E^1 + r, \ldots, E^n + r) = 0)$$

The K^+ equil'm of the hunting game is PE

The equilibrium in this case satisfies:

$$\text{for all } i \quad \frac{d}{dr}\Big|_{r=0} u^i\left(\frac{G(E^S + nr)}{n}, E^i + r\right) = 0 \ .$$

You may compute this FOC reduces to:

$$MRS^i = MRT \ .$$

General Kantian variations

- A *Kantian variation* is a function

$$\varphi(E,r):\Re_+ \times \Re \to \Re_+$$
$$\text{s.t. } \varphi(E,1) \equiv E$$

-
- φ increasing in *r*

$$\varphi^{\times}(E,r) = rE; \quad \varphi^{+}(E,r) = E + r - 1$$

Allocation rules in (*u*,*G*) economies

- An allocation rule is specified by the *share functions*

$$\theta^{i}(E^{1},\ldots,E^{n})$$

$$e.g.\quad \theta^{\mathrm{Pr},i}(E^{1},\ldots,E^{n})=\frac{E^{i}}{E^{S}}$$

$$\theta^{ED,i}(E^{1},\ldots,E^{n})=\frac{1}{n}$$

Efficient Kantian pairs

- A pair (θ,φ) will be called an *efficient Kantian pair* if the K^{φ} equilibrium on all convex economies $(u^1,\ldots,u^n,G)$ using the allocation rule θ is Pareto efficient.

- Thus, we've shown that $(\theta^{ED},\varphi^{+})$ and $(\theta^{\mathrm{Pr}},\varphi^{\times})$ are efficient Kantian pairs.

Characterization of efficient K pairs

- **Proposition.** *An allocation rule can be efficiently implemented on the domain of convex economies with some Kantian variation if and only if the share rule is*

$$\theta^i(\mathbf{E}) = \frac{E^i + \beta}{E^S + n\beta}$$

- These rules are ’convex combinations of equal and proportional division of the output.

- The Pr and ED rules are the two classical rules of cooperative distribution. The proposition shows the intimate relationship between cooperation, so conceived, and Kantian optimization.

$$\frac{E^S + \beta}{E^S + n\beta} = \frac{1-\lambda}{n} + \lambda \frac{E^i}{E^S}$$

$$\text{try } \lambda = \frac{E^S}{E^S + n\beta};$$

$$\frac{E^i + \beta}{E^S + n\beta} = \frac{n\beta}{n(E^S + n\beta)} + \frac{E^S}{E^S + n\beta}\frac{E^i}{E^S} = \frac{\beta}{(E^S + n\beta)} + \frac{E^i}{E^S + n\beta} = \frac{E^i + \beta}{E^S + n\beta}$$

Movie 'A beautiful mind'

- In this movie about John Nash, the screenwriters give what they believe is an example of Nash equilibrium:
- https://www.youtube.com/watch?v=LJS7Igvk6ZM

Kantian optimization in market economies

- Thus far, I have discussed Kantian equilibrium in *games.*
- It turns out one can use the game theory to insert cooperation into market economies. In my book, I present general-equilibrium models of:
  - 1. A market-socialist economy
  - 2. An economy with a public and private good
  - 3. A global economy with greenhouse-gas emissions
  - 4. An economy of worker-owned firms

In each case there is Kantian optimization in *one market*, while the other markets are traditional.

I. A model of market socialism

- Market socialism (since Lange 1936) has been envisaged as a market economy where the state owns large firms, and allocates investment. There is a variety of models – with state ownership, worker-ownership, and ownership by other non-private actors.
- Socialism has always been conceived of as a system where citizens cooperate with other – more than they do in capitalist economies. But cooperative behavior *has not been modeled* in the market-socialist tradition, except in so far as state- or worker- ownership of firms represents cooperation.

- Now that we possess a *tool* to discuss cooperation -- namely, the formal model of Kantian optimization – we can try to embed it into a model of a market socialist economy to see what can be achieved.

- Here, I'll propose an economy where all trades occur on markets, and all decisions by economic actors, *except one,* are made in the usual way (maximizing utility or profits subject to constraints)
- Only the labor supply decision by workers will be non-traditional. The vector of labor supplies will be an additive Kantian equilibrium of a game, to be define.

Economic environment

*One good and labor.
* The good is used for consumption and investment.
* $x = G(K, E)$; G concave and differentiable
* $u^i(x, E)$, $i = 1, \ldots, n$. Concave.

* state owns firm share θ^0 ; citizens own shares $\theta^i, i = 1,...,n$. State endowment of the good : K_0 .
*labor endowments $\omega^i; i = 1,...,n$

A *flat tax* on all private incomes, rate *t*; proceeds distributed to citizens as demogrant.
Prices: $\mathbf{p} = (p, w, r)$

Profits when labor supply is

$E^S = \sum_i E^i$ and capital is K:

$$\Pi(K, E^S) = pG(K, E^S) - wE^S - rK$$

We define a game whose strategies are labor supplies:

$$I^i(E^i, E^S) = (1-t)\left(wE^i + \theta^i \Pi(K_0, E^S)\right)$$

$$+\frac{t}{n}\left(pG(K_0, E^S) - \theta^0 \Pi(K_0, E^S) - rK_0\right)$$

Define a game $\mathbf{V}_+$ by:

$$V_+^i(E^1, \ldots, E^n) = u^i\left(\frac{I^i(E^i, E^S)}{p}, E^i\right)$$

An *additive Kantian equilibrium* of this game is characterized by:

$$\arg\max_{\rho} u^i\left(\frac{I^i(E^i+\rho, E^S+n\rho)}{p}, E^i+\rho\right)=0$$

Walras-Kant equilibrium

A *Kant-Walras equilibrium at tax rate* t is a price vector $\mathbf{p} = (p, w, r)$, demands for the good $\mathbf{x} = (x^1, ..., x^n)$, labor supplies $\mathbf{E} = (E^1, ..., E^n)$, supply of good and demand for labor and capital (X, D, K), such that:

* (X, D, K) maximizes firm profits at $\mathbf{p}$
* $x^i = \dfrac{I^i(E^i, E^S)}{p}$
* $\mathbf{E} = (E^1, ..., E^n)$ is an additive Kantian equilibrium of game $\mathbf{V}_+$
* all markets clear:
  * $K = K_0$
  * $X = x^S$
  * $D = E^S$.

Concept of Pareto efficiency

- The state's utility function is. $u^0(x) = x$. Its budget constraint is:

$$px = \theta^0 \Pi + rK_0$$

- An allocation is *investment-constrained Pareto efficient (ICPE)* if there is no feasible allocation that can make any agent better off, without harming some agent
- Because this is a one-period model, there is no sense in which investment is intertemporally efficient. The state may be investing 'too much.'

Theorem. *At any tax rate* $t \in [0,1]$ *,*
a Walras-Kant equilibrium is Pareto efficient.

Proof:

1. Profit max $\Rightarrow pG_2(K_0, E^S) = w$
2. Compute K^+ equilibrium of $\mathbf{V}_+$:

By concavity FOC characterizing K^+ eq'm is:

$$\arg\max_{\rho} u^i\left(\frac{I^i(E^i+\rho, E^S+n\rho)}{p}, E^i+\rho\right) = 0$$

$$\frac{u_1^i}{p}\frac{d}{d\rho}\bigg|_{\rho=0} I^i(E^i+\rho, E^S+n\rho) + u_2^i = 0 \quad (**)$$

Now compute:

$$\frac{d}{d\rho}\bigg|_{\rho=0} I^i(E^i+\rho, E^S+n\rho) = (1-t)w + tw = w,$$

if $pG_2(K, E^S) = w$ (that is, if the firm is profit-maximizing).

$$\frac{d}{d\rho}\Big|_{\rho=0}\big((1-t)w(E^i+\rho)+$$

$$(1-t)\theta^i\Pi(K,E^S+n\rho)+$$

$$\frac{t}{n}(pG(K,E^S+n\rho)-\theta^0\Pi(K,E^S+n\rho)-rK)=$$

$$(1-t)w+0+\frac{t}{n}pG_2n=(1-t)w+tw=w$$

Therefore (**) becomes:

$$(\forall i)\left(\frac{w}{p} = -\frac{u_2^i}{u_1^i}\right) .$$

3. Profit max also $\Rightarrow pG_1 = r$.
4. These three conditions prove the eq'm allocation is Pareto efficient. ■

What's going on? Why no dead-weight loss?

- A Nash optimizer takes others' labor supplies as fixed when he chooses his labor supply. But with Kantian optimization, the worker postulates that if he increases his labor supply then so do all others.

- What he loses in the tax bite on his wage he gains back in the increased value of the demogrant. These two effects just wash. So the optimality condition is to equate the MRS to the *gross* wage, not the net wage. And this is the condition for Pareto efficiency.

Generalization to many goods is no problem

- Existence of W-K equilibrium:

- **Proposition.** *If all commodities are normal goods, and production functions obey Inada conditions and are homothetic, then Walras-Kant equilibrium exists for any* $0 \le t < 1$

- .Thus, Kantian optimiz'n in labor supply permits complete separation of equality from efficiency.

II. A fair and efficient solution to global warming problem

- The problem is usually conceived of as requiring the solution of three problems:
    - Setting a global budget for total carbon emissions (over the next 50 years, say)
    - Allocating emission rights, summing to this total, to different countries of the world
    - Setting a price for emissions permits, and opening trade in this market

- Each of these problems is a difficult political problem.
- Here I'll propose a solution that avoids all three problems. (It replaces them with problems that are, perhaps, politically easier….)

The economic environment

- There are *n* countries. Country has a production function for a single good, *x,* which is

$$G^i(K,E)$$

- Where *K* is capital and *E* is emissions.
- The country (which has a representative agent) has utility function'

$$u^i(x,E^*) = x - h^i(E^*)$$

- Increasing in *x* decreasing in total emissions.

- This utility function embodies the concern for future generations that citizens have. Total emissions decrease utility because they increase global temperature. It must be the case that this disutility embodies a concern for future generations as well as the present one. There are many calculations of future damages due to global temperature and these would be embedded in these utility functions
- Notice there *is* no solution to the global warming problem *unless* people have concern for future generations. So it is reasonable to assume this can be expressed in preferences over global emissions

Endowments

- Each country is endowed with a labor force of particular skills, and capital $\bar{K}^i$
- Notice the utility function does not contain leisure. All workers supply their labor to their country's firm. Labor is immobile (for simplicity). Capital is mobile. Thus we consider the production function G^i to already include the labor input.
- An allocation $\{(x^i, K^i, E^i) \mid i = 1, \ldots, n\}$ is *feasible* if:

$$\sum x^i \leq \sum G^i(K^i, E^i)$$

$$\sum K^i \leq \bar{K}^S \equiv \sum K^i$$

- By usual methods, we show that an interior allocation is (globally) Pareto efficient iff:
    - (i) for all *I,j :* $G_1^i = G_1^j$ *and*
    - (ii). For all *i*:

$$G_2^i = -\sum_{j=1}^{n} \frac{u_2^j}{u_1^j}.$$

- In other words, the marginal products of capital and emissions are equal across countries, and a Sameulson condition holds for the public bad of global emissions.

How the economy works

- There is a price vector (*p,r,c*) where *p* is the price of the good, *r* is the rental rate for capital and *c* is price a firm must pay for emitting a unit of carbon (emissions).
- The firm will maximize profits: it will chose a plan (X^i, K^I, E^i)
- The carbon payments cE^i are paid into a global fund. These are returned to countries as a demogrant, according to an endogenously chosen share vector $(a^1, \ldots, a^n)$whose components sum to 1. Thus country *i* receives a demogrant of $a^i cE^S$.
- Thus the income of a country is
- $$I^i(E^i, E^S) = r\bar{K}^i + pG^i(K^i, E^i) - rK^i - cE^i + a^i cE^S$$

Unanimity Equilibrium

- Now we define a game whose payoff functions are:

$$V^i(E^S) =$$
$$u^i\left(\frac{r\bar{K}^i + (pG^i(K^i, E^i) - cE^i - rK^i) + a^i cE^S}{p}, E^S\right)$$

- A *unanimity equilibrium* of the game $\{V^i\}$ is a value E^* such

  for all *i*, E^* *maximizes* V^i

Walra-Kant equilibrium with emissions

<u>Definition</u>. A *global Walras-Kant equilibrium with emissions* is a price vector (p,r,c), demands for capital and emissions (K^i, E^i) by each firm G^i, a global vector of emissions supplies $(\hat{E}^1,...,\hat{E}^n)$, and a vector of consumptions $(x^1,...,x^n)$ such that:

and a share vector $(a^1, \ldots\ldots, a^n)$

Defn of Walras-Kant equ'm (cont.)

- For all i, $(K^i, E^i) = \underset{(K,E)}{\arg\max}(pG^i(K,E) - rK - cE)$
- E^S is a unanimity equilibrium of the game $\{V^i\}$;
- $x^i = \dfrac{r(\bar{K}^i - K^i) + (pG^i(K^i, E^i) - cE^i + a^i cE^S}{p}$
- $K^S = K^S, \sum_i E^i = E^S$ and $x^s = \sum_i G^i(K^i, E^i)$.

Note:

- Global emissions are not pre-specified
- There are no permits issued to countries -- thus, no market for permits
- The price of emissions emerges endogenously.

- **This contrasts with most proposals which require *centralized decisions* on all three of these questions. These are all *politically contentious issues.* The only exogenous parameter in this model is the share vector *a***

Theorem: Any W-K equilibrium with emissions is Pareto efficient.

- Recall the conditions for Pareto efficiency (see next slide)

1. By profit-maximization, we have:

$$\forall i \quad \frac{r}{p} = G_1^i, \frac{c}{p} = G_2^i \ .$$

2. It follows from the Fact characterizing Pareto efficiency that condition (i) holds. What remains to prove for condition (ii) is that

$$\frac{c}{p} = -\sum \frac{u_2^i}{u_1^i} \ .$$

Since E^S is a unanimity equilibrium of the game $\{V^i\}$ we have: $\frac{u_1^i}{p} a^i c + u_2^i = 0$.

Summing these equations over i gives $\frac{c}{p} = G_2^i = -\sum_1^j \frac{u_2^j}{u_1^j}$

Which proves Pareto efficiency.

- Note how the emissions market works. Each country sets its emissions by maximizing profits of its firm. This gives *firm demands* for emissions permits
- Each country's polity chooses a *supply of global emissions.*
- In equilibrium, all polities *agree unanimously* on the supply of emissions, which equals the global demand for emissions permits.

- Walras_Kant exists and is locally unique.
- To have degrees of freedom in distribution we can add a transfer to each country's income T_i, where the transfers sum to zero.
- The firm has a simple problem in this model. The difficult problem is for the citizenry, who must agree on the utility function, including the cost of global warming to future generations. And the global citizenry must find the Kantian equilibrium.

Viewing the equilibrium as *prescriptive*

- People will challenge the usefulness of the model on grounds that countries will not find the Kantian equilibrium
- We can view it as *prescriptive*, meaning this:
  - A Center collects country information on $(\bar{K}^i, u^i, G^i)$
  - It then computes the W-K equilibrium, which includes the share vector *a.*
  - *The share of country i in the carbon revenues is proportional to its marginal damages at equilibrium:*

$$a^i = k\,(h^i)'(E^S).$$

III. A model of worker-owned firms

There is an economy with one good. There are two kinds of labor – two occupations. The good is produced by a concave production function $G(E,D)$ where E and D are the levels of the two occupational labor supplies. We simplify here by ignoring the capital input.

There are n citizen-workers, partitioned into two elements:

$$I_1 = \{i \mid \bar{E}^i > 0 \text{ and } \bar{D}^i = 0\}$$

$$I_2 = \{i \mid \bar{D}^i > 0 \text{ and } \bar{E}^i = 0\}$$

where $\bar{E}$(or $\bar{D}$) is the endowment of labor the agent has in the E (or D) occupation.

Individuals have utility functions of the form $u^{1i}(x,E)$ or $u^{2i}(x,D)$ depending upon the kind of labor they possess. A worker has an endowment of occupational labor of $\bar{E}^i$ or $\bar{D}^i$.

The economy uses markets, with three prices, (p,w,d), p being the price of the good, w the wage of E labor and d the wage of D labor. There is one firm, utilizing the production function G. The firm maximizes profits. The profits accrue to workers in proportion to their labor supplies, as follows. A fraction λ of profits will be divided among the E workers in proportion to their labor contributions, while $1-\lambda$ fraction of the profits are divided among the D workers in proportion to their labor contributions. λ is an exogenous parameter of the model. Thus, for instance, the income of a worker of type 1 (that is, $i \in I_1$) will be:

$$wE^i + \frac{E^i}{E^S}\lambda\Pi \ , \tag{1.1}$$

where Π is the firm's profit, and $E^S \equiv \sum_{i \in I_1} E^i$. The analogous express holds for workers of type 2.

Given prices, consider a game V^1 whose players are the E workers. We are *given* a total labor supply $\hat{D}^S$ by the type-2 workers. The payoff functions for the E-workers are:

$$V^{1i}(E^1,...,E^n) = u^{1i}\left(\frac{wE^i + \frac{E^i}{E^S}\lambda(G(E^S,\hat{D}^S) - wE^S - d\hat{D}^S)}{p}, E^i \right); \qquad (1.2)$$

Analogously, given a total labor supply by the E workers of $\hat{E}^S$, consider a game among the D workers whose payoff functions are:

$$V^{2i}(D^1,...,D^n) = u^{2i}\left(\frac{dD^i + \frac{D^i}{D^S}(1-\lambda)(pG(\hat{E}^S,D^S) - w\hat{E}^S - dD^S)}{p}, D^i \right).$$

Let Δ be the price simplex $\Delta = \{(p,w,d) \in \Re^3_+ \mid p+w+d=1\}$. We now define:

<u>Definition.</u> A *Walras-Kant worker-ownership equilibrium with profit-share parameter* $\lambda \in [0,1]$ is

- a price vector $(p,w,d) \in \Delta$
- consumption bundles (x^i, E^i) for all $i \in I_1$ and (x^i, D^i) for all $i \in I_2$

such that:

- the vector (x^S, E^S, D^S), where $x^S = \sum_{i \in I_1 \cup I_2} x^i$ solves the firm's profit maximization problem:
  - $$\max_{x,E,D} px - wE - dD$$
    $$s.t. \quad x = G(E,D)$$
- given D^S , $(E^1,...,E^{n_1})$ is a multiplicative Kantian equilibrium of the game V^1 for the type 1 workers,
- given E^S , $(D^1,...,D^{n_2})$ is a multiplicative Kantian equilibrium of the game V^2 for the type 2 workers.

<u>Proposition</u> <u>1</u> *Any Walras-Kant worker-ownership equilibrium such that the two occupational labor vectors are strictly positive is Pareto efficient.*

If there are *l* occupations, then there are *l*-1 degrees of freedom in how the firms' income Are distributed. This is the generalization of choosing λ as the share vector in this model With two occupations. In other words, we decide exogenously on how the value added in the firm Will be divided between the occupations and then, within occupations, income is divided in Proportion to labor expended.

Necessary psychological conditions for Kantian optimization

- Desire, Understanding, and Trust
  - Desire to cooperate
  - Understanding the conception of fairness embedded in Kantian optimization, and the efficiency consequences of doing so
  - Trust that others will Kantian-optimize, and not take advantage, by Nash optimizing

Quick Summary

- We have constructed a theory of cooperative behavior which embodies a moral position: in a situation of solidarity (where we are all in the same boat), we should all hang together, lest we each hang separately (Benjamin Franklin).
- We have *formalized* this idea as an equilibrium in a game

- I counterpose this approach to that of Behavioral Economics, which is to add exotic arguments to preferences, and then to employ Nash equilibrium
- This strikes me as inelegant, clashing: because NE is a non-cooperative idea

- How would you add exotic arguments to preferences to get these efficiency results?

- Indeed, economists therefore view cooperation as simply a version of non-cooperative behavior in a repeated game. This belittles the distinction between competitive and cooperative behavior. I think there is a *qualitative* distinction, and this requires modeling cooperation as an non-Nash behavioral protocol.

- I do *not* view Kantian optimization as an alternative to Nash optimization in truly one-shot games. For a psychological pre-condition of Kantian thinking is *trust* in others. What Tomasello calls *joint intentionality.* And that is only established over time and repeated experience with one's player-partners. It requires that we have a *common culture* (which summarizes the instructions on what 'the right thing to do' is, in many situations), or that we have a history of trust with our player-partners

- I have argued that, once we have a tool for modeling cooperation, we can insert it into general equilibrium models of economies to solve various problems that plague the Arrow-Debreu model. We can extend quite dramatically the set of problems that markets can solve efficiently and equitably – market socialism, global emissions of greenhouse gases, worker-owned firms. In each of these models there are *degrees of freedom* with respect to the degree of income inequality that can be attained without sacrificing efficiency.

An interpretation

- Thus, one can say that *market failures* are not really *market* failures but failures of *the non-cooperative optimization protocol* of Nash

- Another gloss: *Externalities* are internalized by Kantian reasoning in the presence of markets. So traditional inefficiencies in Nash-type (or Walras-type) models are due not to market failure, but using a defective optimization protocol

Positive or normative

- I believe there are many symmetric social situations where people play the Simple Kantian Equilibrium of the game. Whether they are doing so as part of a Nash equilibrium with punishments or by asking the Kantian question is difficult to establish.
- Multiplicative and additive Kantian optimization are more complex but not unduly so. If members of a group playing a game wish to cooperate and trust each other, they can learn
- E.g., the 180 representatives of nations in a climate conference
- Or the representatives of unions in a national labor confederation

Solidarity and Trust

- In sum, if a *situation of solidarity* exists ('we are all in the same boat'), and there is a *basis for trust*, Kantian optimization can be learned and applied.
- Finally, if economists understand this theory, they will come to interpret cooperative behavior in life in a new way … the theory gives us a tool to understand cooperation that is in sharp contrast to viewing it as a Nash equilibrium of a game played without solidarity or trust, where expressions of trust are merely cheap talk.