Evolutionary foundations of pro-social preferences

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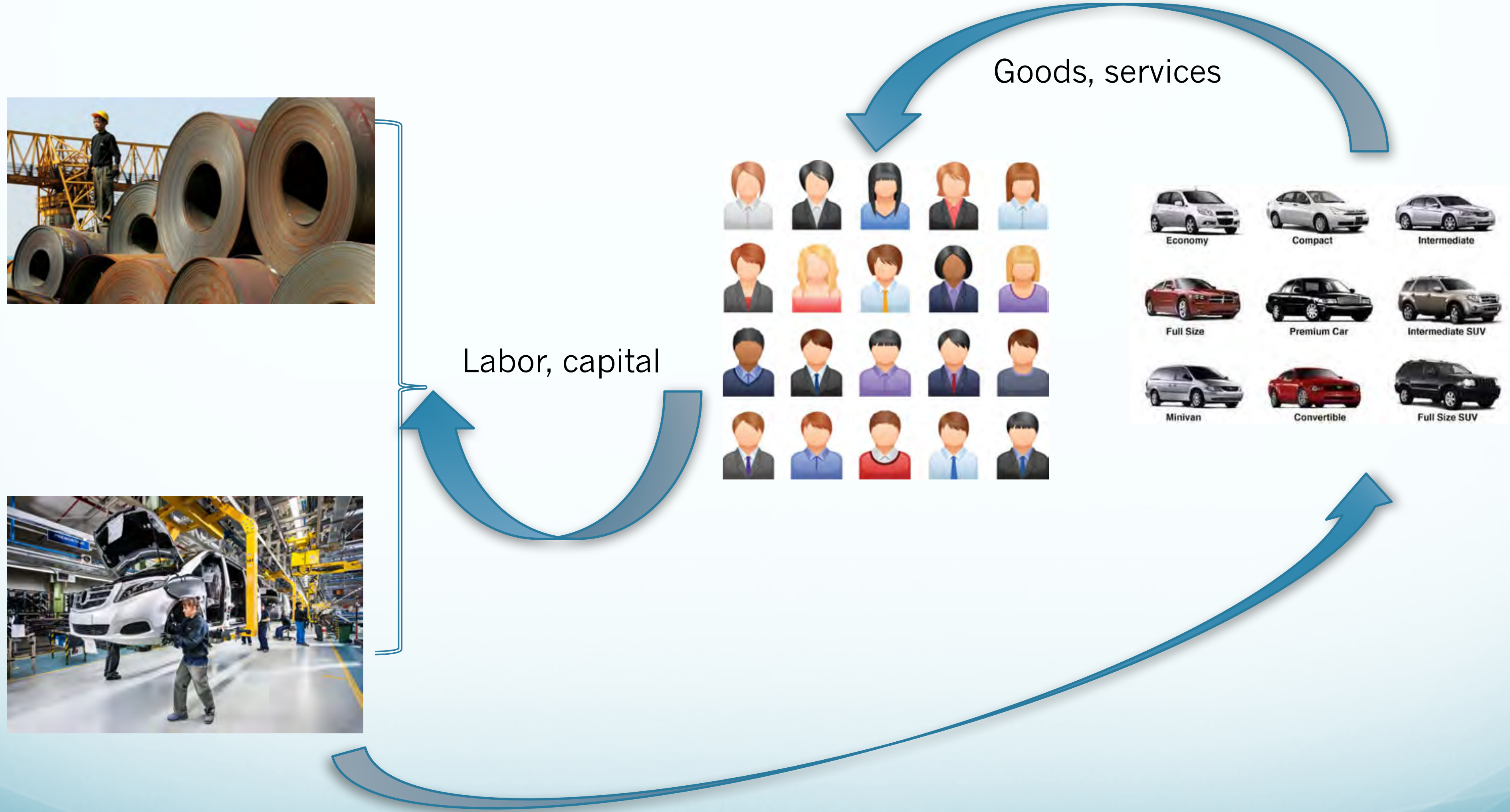
What is economics about?

Labor, capital

Goods, services

The Question: are resources utilized efficiently?



The Question: are resources utilized efficiently?

1st Theorem of Welfare Economics (1950's)

If : (1) if there is a market for every good,

(2) prices are known,

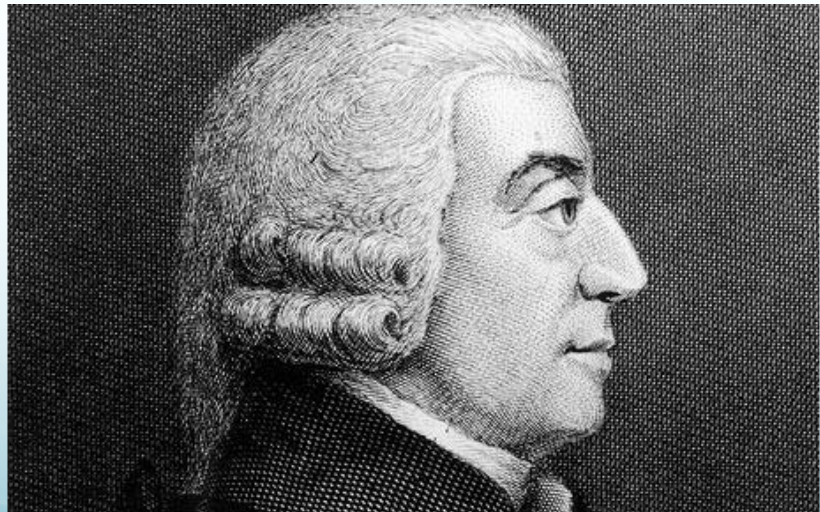
and (3) no individual or firm has power over prices,

then any market equilibrium is efficient.

In particular, the 1st Theorem is true even if individuals care solely about own material well-being.

"It is not from the benevolence of the butcher,
the brewer, or the baker that we expect our dinner,
but from their regard to their own self-interest."

Adam Smith (*The Wealth of Nations*, 1776)



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Such as situations with externalities…

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not covered by the 1st Theorem?

… or interactions within smaller groups
(firms, families, etc.)

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But in reality *preferences* can help fix these problems.

Caring about team-mates reduces the propensity to free-ride on them.

In situations not covered by the 1st Theorem,
it is crucial to know what people want.

Economists need to take
a closer look at human preferences.

Several paths to better understand human preferences:

- estimate preferences empirically
- build theory based on insights on human preferences in psychology and sociology
- build theory of the evolution of human preferences based on evolutionary logic (evolutionary biology, evolutionary anthropology)

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- … technological adaptation

- ... cultural evolution

- … genetic evolution
- E.g.: 90% of all Tibetans carry a rare "high altitude" gene variant

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- Evolutionary logic:

1. Human populations have evolved under scarcity of resources
2. Not all who are born survive and not all who survive reproduce
3. Those alive today have ancestors who were successful at surviving and reproducing: we have inherited their preferences

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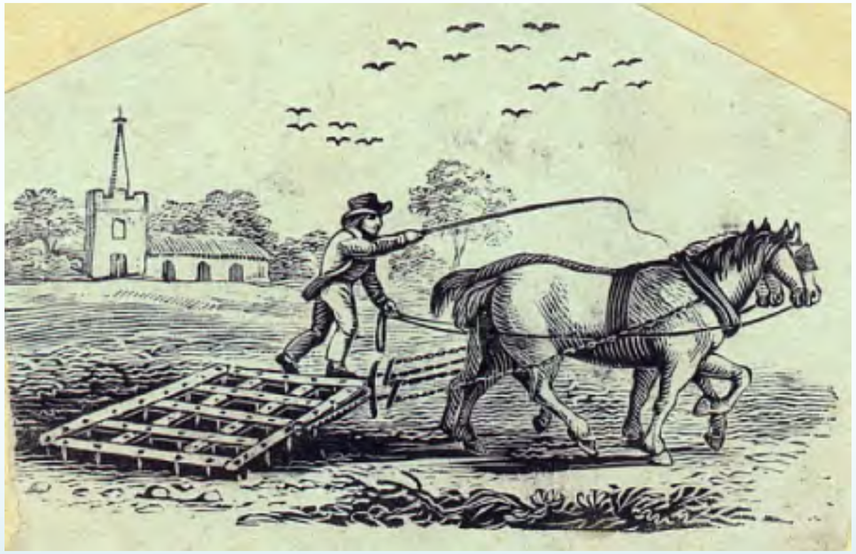
- If *reproductive success* is the name of the game, shouldn't humans simply be expected to seek to maximize reproductive success?
- The main challenge of this research is to answer this question, and to understand why (or why not)
- Literature on preference evolution [Frank (1987), Güth and Yaari (1992)]

A model of the evolution of preferences in social interactions

Imagine… a pre-industrial society



A model of the evolution of preferences in social interactions

For example, suppose that:

- in each generation individuals work in teams of 2

- the material payoff to an individual making effort x when the other makes effort y is $\pi(x,y)$
  For example: $\pi(x,y) = 5(x+y)^{1/2} - x$

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Will evolution lead to **self-interested individuals**, with goal function $u(x,y) = \pi(x,y)$?
Or some other goal function?

- Extend the evolutionary game theory concept of *evolutionarily stable strategy* [Maynard Smith and Price (1973)]

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- If there exists $\varepsilon_0 > 0$ such that for all $0 < \varepsilon < \varepsilon_0$ the residents get a strictly higher average material payoff than the mutants, then $u_\vartheta(x,y)$ is evolutionarily stable against $u_\tau(x,y)$

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- A goal function $u_\vartheta(x,y)$ is evolutionarily stable if it is stable against all possible mutant goal functions

Three important modeling choices:

1. **What is the set of potential preferences?**

- **Specific classes of goal functions**:
  Bester & Güth (1998), Bolle (2000), Possajennikov (2000), Koçkesen, Ok & Sethi (2000), Sethi & Somanathan (2001), Akçay et al (2009), Alger (2010), Alger and Weibull (2010, 2012)

- **Few restrictions on the set of potential goal functions**:
  Ok & Vega-Redondo (2001), Heifetz, Shannon and Spiegel (2007), Dekel, Ely & Yilankaya (2007), Alger and Weibull (2013, 2016)

Three important modeling choices:

2. **Do individuals know each other's preferences?**

- **Complete information:**
  Bester & Güth (1998), Bolle (2000), Possajennikov (2000), Koçkesen, Ok & Sethi (2000), Sethi & Somanathan (2001), Heifetz, Shannon and Spiegel (2007), Alger (2010), Alger and Weibull (2010, 2012)

- **Incomplete information:**
  Ok & Vega-Redondo (2001), Dekel, Ely & Yilankaya (2007), Alger and Weibull (2013, 2016)

Three important modeling choices:

3. How are groups of interacting individuals formed?

- **Uniform random matching:**
  Bester & Güth (1998), Bolle (2000), Possajennikov (2000), Koçkesen, Ok & Sethi (2000), Sethi & Somanathan (2001), Ok & Vega-Redondo (2001), Heifetz, Shannon and Spiegel (2007), Dekel, Ely & Yilankaya (2007)

- **Assortative matching:**
  Alger (2010), Alger and Weibull (2010, 2012, 2013, 2016)

In Alger and Weibull (2013, 2016):

- matching of individuals is random but it may be *assortative*
- interacting individuals do not know each other's preferences
- minimalistic assumptions on the set of potential goal functions:
  - the set X of strategies is compact and convex
  - the material payoff function $\pi: X^n \Longrightarrow R$ is continuous
  - any potential goal function $u_\vartheta : X^n \Longrightarrow R$ is continuous and permutation-invariant in opponents' strategies

Recall:

Suppose that each individual has a
goal function *$u(x,y)$* that guides behavior

Will evolution lead to **self-interested individuals**,
with goal function $u(x,y) = \pi(x,y)$?
Or some other goal function?

Which goal function in the set of all continuous goal functions $u_\vartheta : X^n \Longrightarrow R$ is evolutionarily stable, if any ?

Result (n = 2)

$$u_\kappa(x, y) = (1 - \kappa) \cdot \pi(x, y) + \kappa \cdot \pi(x, x)$$

Alger & Weibull (*Econometrica*, 2013)

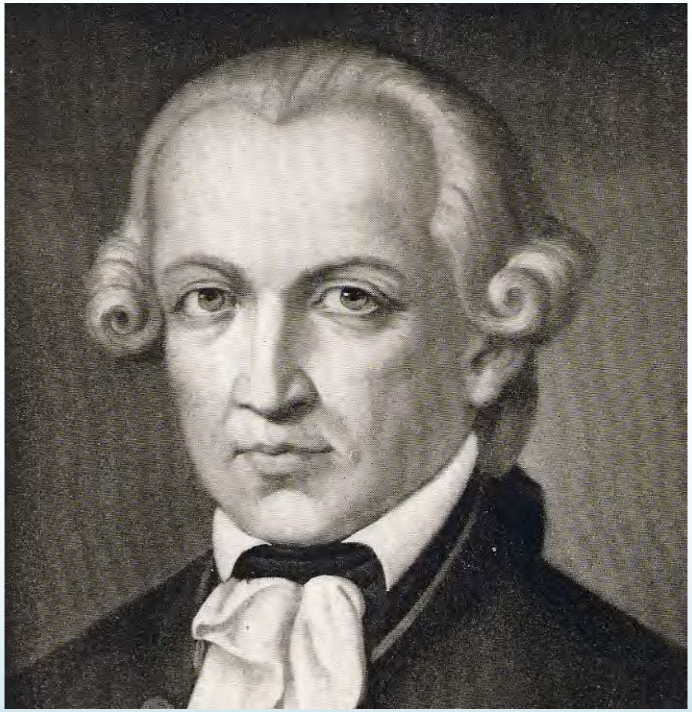
Result ($n \geq 2$)

$$\begin{aligned} u_\kappa(x,y,z) \;&=\; (1-\kappa)^2 \cdot \pi\,(x,y,z) + \kappa\,(1-\kappa)\cdot \pi\,(x,x,z) \\ &\quad +\kappa\,(1-\kappa)\cdot \pi\,(x,y,x) + \kappa^2 \cdot \pi\,(x,x,x) \end{aligned}$$

Alger & Weibull (*Games & Economic Behavior*, 2016)

These preferences have a Kantian flavor

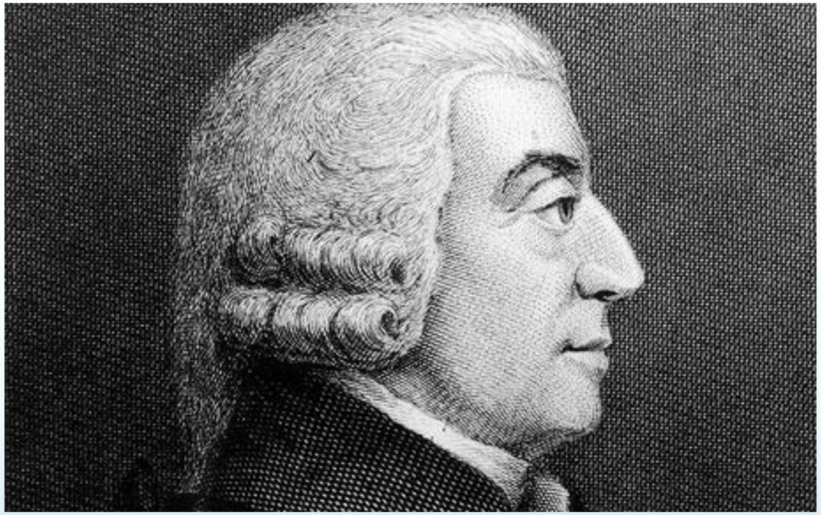
$$u_\kappa(x,y) = (1-\kappa)\cdot\pi\,(x,y) + \kappa\cdot\pi\,(x,x)$$



Immanuel Kant (1724-1804)

“When by natural principles we are led to advance those ends, which a refined and enlightened reason would recommend to us, we are very apt to impute to that reason, as to their efficient cause, the sentiments and actions by which we advance those ends, and to imagine that to be the wisdom of man, which in reality is the wisdom of God. ”

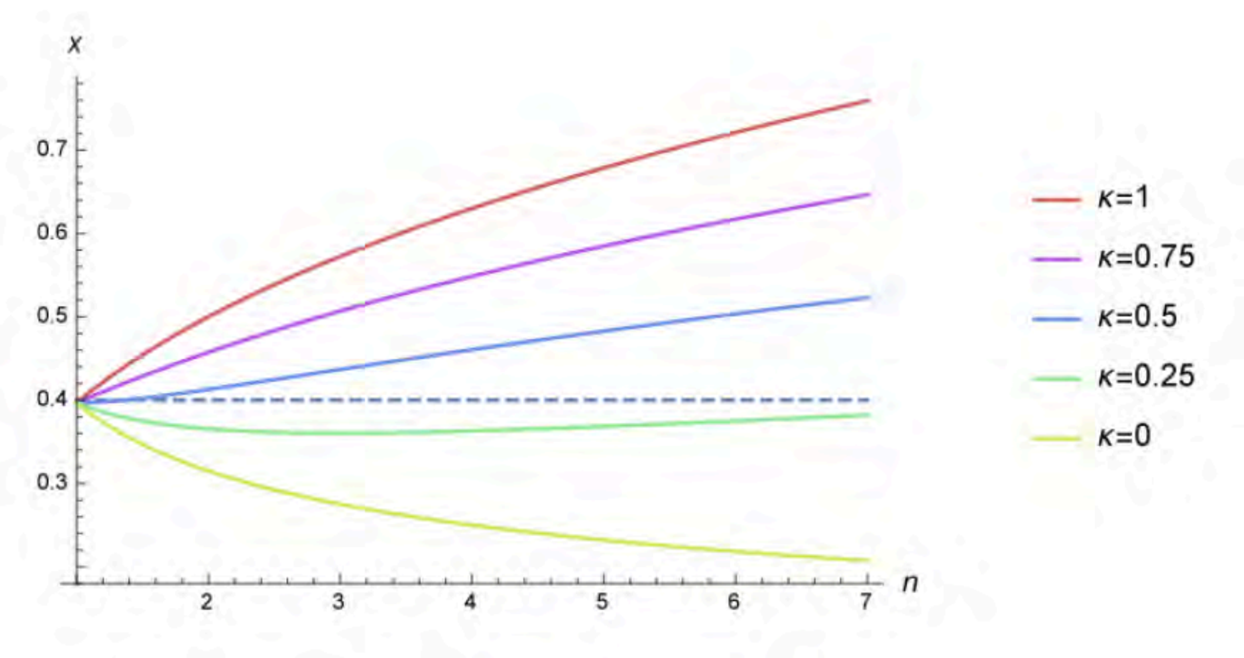
Adam Smith (*The Theory of Moral Sentiments*, 1759)



Adam Smith (1723-1790)

A public goods game

Material payoff: $\pi\left(x_i, \boldsymbol{x}_{-i}\right) = \left(x_i + \sum_{j \neq i} x_j\right)^{1/2} - x_i^2$



Alger & Weibull (*Games*, 2017)

A coordination game

- Initially there is only one possible action: B.
- Suddenly, action A is discovered or invented.
- If $\tilde{n}$ others take action A, the material payoff is $(n - \tilde{n} - 1)\,b$ from taking action B, and $\tilde{n}a$ from taking action A.
- Suppose that $a > b$, so that everybody would be better off if all switched to B.
- Will the players keep playing norm B, or will they switch to norm A?

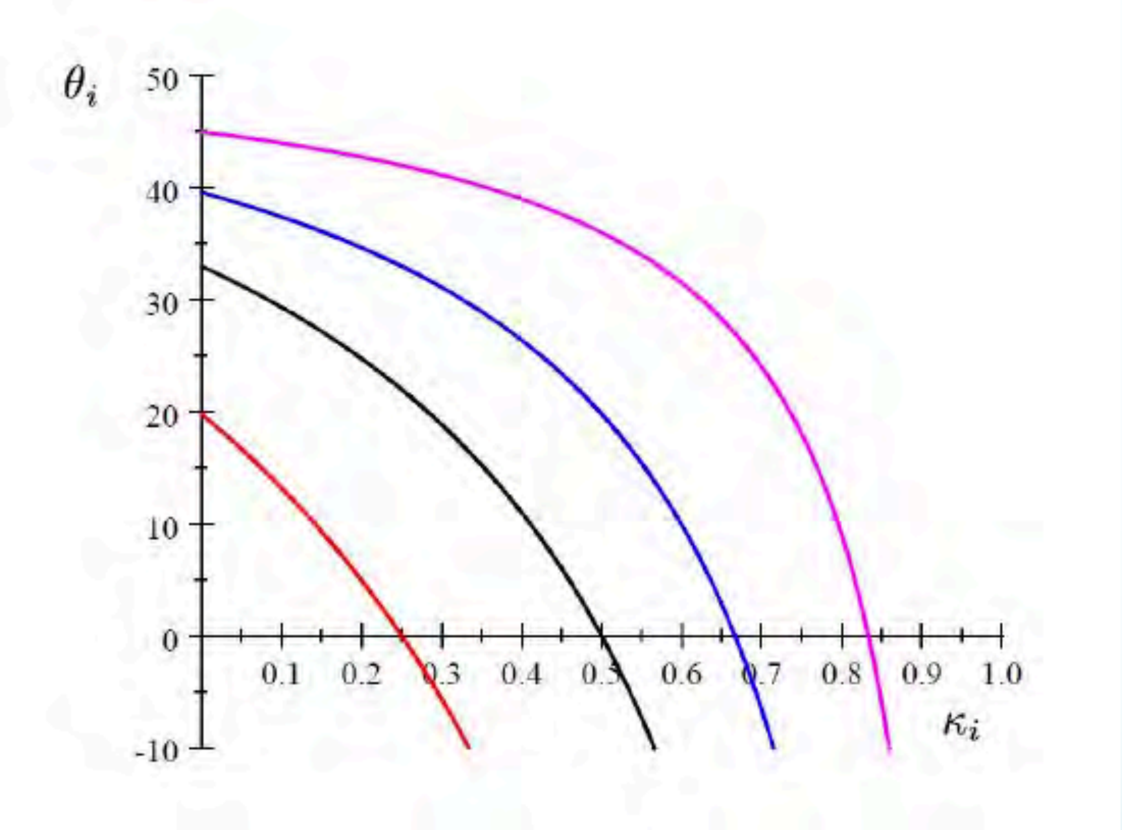
A coordination game

- Suppose that the n players are *homo moralis*, with varying degrees of morality: $\kappa_i \in [0,1]$

- A *homo moralis* with degree of morality κ_i switches from B to A if and only if

$$\frac{\tilde{n}}{n-1} \geq \frac{b - \kappa_i a}{(1-\kappa_i)(a+b)} \equiv \theta_i$$

A coordination game



Red: a/b=4
Black: a/b=2
Blue: a/b=1.5
Pink: a/b=1.2

Alger & Weibull (*Games*, 2017)

Externalities

- A standard model of consumption with external effects
  - A *continuum* of consumers, two consumption goods, one environmentally neutral and one harmful
  - The quality of the environment depends on *average* consumption of the second good, and hence each individual's impact on the environment is nil

Externalities

- Each consumer derives utility from own consumption and from the quality of the environment: $u(x_1, x_2, \bar{x}_2)$

- Utility of *Homo moralis* : $u_\kappa(x_1, x_2, \bar{x}_2) = u(x_1, x_2, (1-\kappa)\bar{x}_2 + \kappa x_2)$

Externalities

- Necessary first-order condition on each individual's consumption:

$$\frac{u_2\left(x_1^\kappa, x_2^\kappa, x_2^\kappa\right)}{u_1\left(x_1^\kappa, x_2^\kappa, x_2^\kappa\right)} \quad = \quad p - \kappa \cdot \frac{u_3\left(x_1^\kappa, x_2^\kappa, x_2^\kappa\right)}{u_1\left(x_1^\kappa, x_2^\kappa, x_2^\kappa\right)}.$$

Alger & Weibull (Book Chapter, 2017)

Conclusion

- Economic theory + evolutionary logic:
  a theory of the long-term evolution of preferences
- Allows to understand which forces in our evolutionary past have shaped our preferences
- May help us understand cultural differences
- May help us study how economic systems affect preferences. For example, do firms prefer to hire amoral or moral individuals ?

Merci !

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