Evolutionarily stable family ties: Max Weber meets Charles Darwin

Ingela Alger and Jörgen Weibull

May 8, 2014

1 Introduction

- Question: how much should one expect siblings to care for each other?
  - Alger and Weibull (AER 2010): "Kinship, incentives and evolution"
- Siblings may be an important source of help
  - help may be in kind or monetary
  - particularly important when formal insurance is weak
- Potentially important fitness consequences
- Preferences inherited from parents (genetically and/or culturally)

- Apply the general model of evolutionary stability of traits:
  - interaction? *two-stage interactions between sibling pairs: independent production decisions in the first stage, potential helping in the second stage*
  - heritable trait? *degree of altruism towards siblings*
  - is the trait observable? *yes*

1.1 The plan for the rest of the talk

- The game and equilibrium strategies
  - interaction: strategies and material payoffs
  - altruism
  - equilibrium strategies (given the siblings' degrees of altruism)
- Evolutionary stability analysis
  - how much assortativity?
  - evolutionarily stable degrees of altruism
- Discussion

2 The game and equilibrium strategies

2.1 The interaction

- Time line:

1. A pair of siblings simultaneously choose productive efforts.

2. Each sibling's random output is realized, $y_i \in \left\{y^L, y^H\right\}$. It depends probabilistically on own effort.

3. The siblings observe the outputs and choose transfers to each other.

- Sibling i's material utility:

$$\pi_i = \pi\left[\left(e_i, t_i\right), \left(e_j, t_j\right)\right] = E\left[b\left(y_i - t_i + t_j\right)\right] - c\left(e_i\right)$$

2.2 Preferences

- Degree of altruism towards the sibling

$$u_i = \pi_i + \alpha_i \cdot \pi_j$$

- Set of potential traits: $\alpha_i \in (-1, 1)$

- Given degrees of altruism α_A and α_B, the siblings play a game where:

1. Strategy: effort level, and transfer (conditional on outputs)

2. Payoff $=$ total (expected) utility

- Assume: the siblings observe each other's degree of altruism

2.3 Equilibrium

2.3.1 The second period

- The siblings observe the outputs and choose transfers

- In equilibrium: sibling i makes a transfer only if she is rich and j is poor

- i's transfer is increasing in α_i

2.3.2 The first period

- The siblings correctly anticipate the future transfers, $t(\alpha_A)$ and $t(\alpha_B)$, and choose their efforts

- A pair $\left(e_A^*, e_B^*\right) \in [0,1]^2$ is a NE iff

$$\begin{cases} e_A^* \in \arg\max_{e_A} u_A\left(e_A, e_B | t(\alpha_A), t(\alpha_B)\right) \\ e_B^* \in \arg\max_{e_B} u_B\left(e_B, e_A | t(\alpha_B), t(\alpha_A)\right) \end{cases}$$

- Equilibrium efforts as functions of the degrees of altruism: $e(\alpha_A, \alpha_B)$ and $e(\alpha_B, \alpha_A)$

2.4 Expected equilibrium material payoffs

- Let $p(\alpha_A, \alpha_B)$ and $p(\alpha_B, \alpha_A)$ denote the corresponding success probabilities

- Expected equilibrium material payoffs:

$$\begin{aligned}
\Pi(\alpha_A, \alpha_B) = & \; p(\alpha_A, \alpha_B)\, p(\alpha_B, \alpha_A)\, b\left(y^H\right) \\
& + [1 - p(\alpha_A, \alpha_B)]\,[1 - p(\alpha_B, \alpha_A)]\, b\left(y^L\right) \\
& + p(\alpha_A, \alpha_B)\,[1 - p(\alpha_B, \alpha_A)]\, b\left(y^H - t(\alpha_A)\right) \\
& + p(\alpha_B, \alpha_A)\,[1 - p(\alpha_A, \alpha_B)]\, b\left(y^L + t(\alpha_B)\right) \\
& - c\,[e(\alpha_A, \alpha_B)]
\end{aligned}$$

3 Evolutionary stability analysis

- Imagine now a large population, in which all sibling pairs engage in the interaction described above

- Preferences -> behaviors -> material payoffs

- Note that the environment is captured by:

  – the ratio y^L/y^H

  – the way in which effort affects the success probability

- We will see that the environment plays a role in shaping altruism...

3.1 How much assortativity?

- Assumptions:
  - a population of grown-ups where a proportion $1-\varepsilon$ have the resident trait and the residual proportion has a mutant trait
  - couples form randomly and are monogamous, and each couple has two children
  - each child is equally likely to inherit each parent's type (traits are not gender specific)

- Probability that the sibling of a child carrying the rare mutant trait also carries the mutant trait: $\sigma = 1/2$

- Note: if mating is non-random, so that with some probability a mutant grown-up will settle only for a match with another mutant (and otherwise the mutant will have a random match): $\sigma > 1/2$

- Note: if a child with some probability adopts the family value of a randomly drawn grown-up in the population, a “cultural parent” (and otherwise adopts one of its parents’ family values): $\sigma < 1/2$

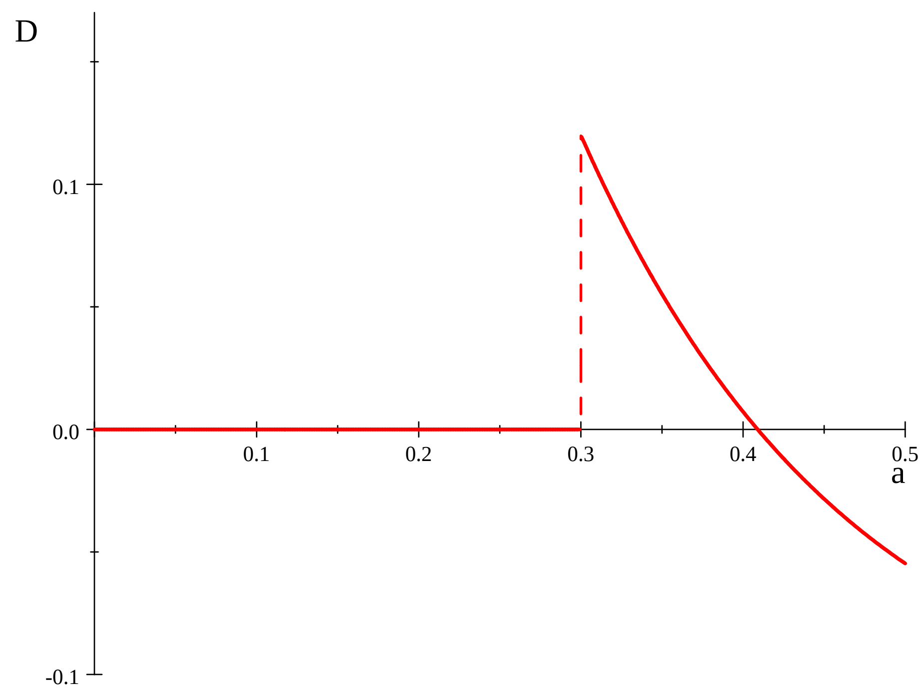
3.2 Evolutionary stability

- $\alpha \in (-1, 1)$ is *evolutionarily stable against* β if:

$$\Pi(\alpha, \alpha) > \frac{1}{2}\Pi(\beta, \alpha) + \frac{1}{2}\Pi(\beta, \beta)$$

- Let D be *the evolutionary drift function*:

$$D(\alpha) := \frac{d(RHS)}{d\beta}_{|\beta=\alpha}$$



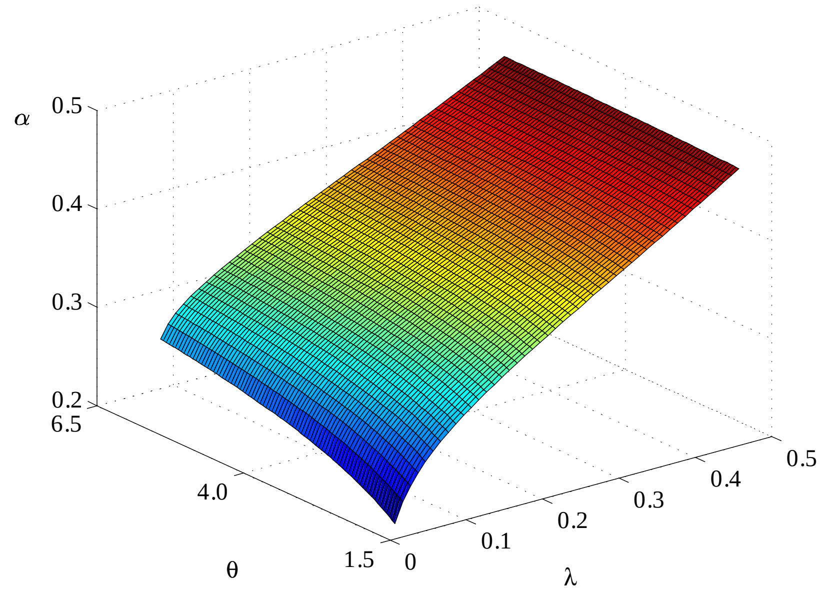
The evolutionary drift function.

Example:

- $y^L = \lambda y^H$, where $\lambda < 1$ measures *output variability*

- θ: *return to effort* parameter

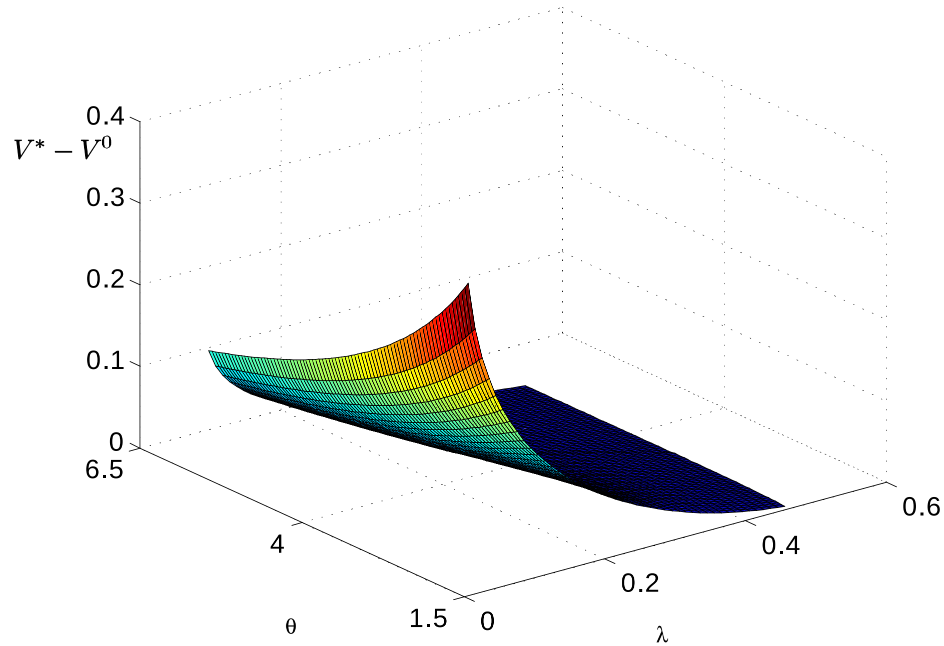
- Environment: (λ, θ): an environment (λ', θ') is *harsher* than another environment (λ, θ) if the low output is lower $(\lambda' \leq \lambda)$, and/or the marginal return to effort is smaller $(\theta' \leq \theta)$ with at least one strict inequality



Evolutionarily stable degree of altruism, as a function of output variability (λ) and marginal returns to effort (θ)

- Stable degree of altruism *lower* in harsher environments. Intuition?

- Free-rider effect stronger in harsher environments. More beneficial to mutate towards lower degrees of altruism.



Material benefit from sibling altruism

4 Discussion

- Our analysis suggests that the strength of sibling altruism depends on the environment

- Evolution by way of natural selection leads to weaker sibling altruism in harsher environments

- Some evidence that individualism developed in northwestern Europe prior to the industrial revolution:

  - In NW Europe, strong tendency among youngsters to seek employment in other families' farms

    * Kussmaul (1981): in 1380, more than half of men in East Anglian villages were employees (servants or labourers)

    * Hajnal (1982): in 17th century England, "the unit of production was the husband and the wife and hired labor, not children"

    * Many similar references in Macfarlane (1992)

- "The great achievement of ... the ethical and ascetic sects of Protestantism was to *shatter the fetters of the sib*. These religions established ... a common ethical way of life in opposition to the community of blood, even to a large extent in opposition to the family." (*Max Weber: The Religion of China*)

- Evolution by way of natural selection may explain Weber's observation about the "fetters of the sib" without recourse to Protestantism as a cause: perhaps "nature" selects family ties, and families select religions that fit their values

- Today: evidence that family ties vary in strength
  - Alesina and Giuliano (2010)
  - Cohabitation between parents and adult children:
    * An *inferior* good in the US [Rosenzweig and Wolpin (1993)]
    * A *normal* good in Italy [Manacorda and Moretti (2006)]
  - Evidence of persistence: second and third generation Mexican-American families have stronger kin ties than white Anglo families (Keefe et al, 1979, Keefe, 1984)
- Could our theory help explain why some countries, such as Sweden, have such a large welfare state?
- In turn, what is the effect of this welfare state on family ties?

- See also Alger and Weibull (JTB 2012)
- There we also study the evolution of altruistic preferences under complete information
- Other classes of interactions
- General results on how the evolutionarily stable degree of altruism may depend on the specifics of the interaction