Religion and Cultural Transmission

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From where do Religious Preferences/Beliefs/Identity come?

1. Individual Level: Religious Capital Approach

- Religious preferences/beliefs formed through religious participation (Iannaccone 1990).
- Hence religious groups may tolerate free-riding by newcomers in anticipation of future contributions (McBride 2015).
- *Evidence*: People who switch tend to join religious groups with similar theology and practices (Iannaccone 1998).

2. Social Level: Cultural Transmission Approach

- Religious preferences/beliefs acquired through (a) vertical transmission from parent to child and (b) social transmission (horizontal or oblique) (Cavalli-Sforza and Feldman 1981, Boyd and Richerson 1985, Bisin and Verdier 2000).

- Social transmission entails its own free-rider problems. Religious organizations may form to regulate production and transmission of religious beliefs/preferences (Carvalho 2016).

- *Evidence*: The strongest determinant of religious affiliation/participation is parental affiliation/participation (Iannaccone 1998).

Religion and Cultural Transmission

1. Basic approach: Bisin and Verdier (2000).

2. More general dynamics and link to evolutionary game theory: Montgomery (2010).

3. Cultural transmission in clubs: Carvalho (2016).

Motivation

- Prior to the 1960s, it was conventional wisdom among social scientists that immigrants from various ethnic and religious backgrounds would assimilate into American culture.
- It became obvious that this was not occurring not only in America, but elsewhere.
- High rates of homogamy persisted along with distinctive cultural traits:
  - Basque and Catalan culture in Spain,
  - Ultra-Orthodox Judaism in New York,
  - Conservatives and liberals in the United States.

The Bisin-Verdier Model

- Consider a simple baseline model of cultural transmission.
- Agents form a continuum and can have either cultural trait a or b.
- Each parent (asexually) produces one child, socializes them and then dies.
- With probability τ_i a parent with trait $i \in \{a, b\}$ successfully passes on her trait to her child (**vertical transmission**).
- With probability $1 - \tau_i$ the child is matched at random with someone from her parent's generation and acquires their trait (**oblique transmission**).

Dynamics: Exogenous Socialization

- Let q equal the proportion of type a individuals in the population.
- The probability that a type b individual has a type a child is $P_{ba} = (1 - \tau_b)q$.
- The probability that a type a individual has a type b child is $P_{ab} = (1 - \tau_a)(1 - q)$.
- In continuous time the dynamic is:

$$\begin{aligned} \dot{q} &= \underbrace{(1-q)\,P_{ba}}_{inflow} - \underbrace{q\,P_{ab}}_{outflow} \\ &= (1-q)(1-\tau_b)q - q(1-\tau_a)(1-q) \\ &= (\tau_a - \tau_b)q(1-q). \end{aligned} \tag{1}$$

The Melting Pot

- We have a melting pot, i.e. a monomorphic cultural equilibrium:
  - $q = 1$ is asymptotically stable if $\tau_a > \tau_b$.
  - $q = 0$ is asymptotically stable if $\tau_b > \tau_a$.
- How can we get cultural diversity, i.e. a polymorphic cultural equilibrium?

Endogenous Socialization

- Bisin and Verdier's contribution is to introduce a choice of socialization effort. For example:
  - teaching,
  - school choice,
  - residential choice,
  - homogamy.

Imperfect Empathy

- To model socialization choice, parents need to have preferences over the traits that their children can acquire.
- **Imperfect empathy**: parents evaluate their children's behavior based on their own preferences.
- Formally, a parent with trait i gets a payoff of V_{ij} if their child acquires trait j, where $V_{ii} > V_{ij}$ whenever $i \neq j$.

Objective Functions

- A parent with trait a in state q has payoff function:

$$U^a(q) = \underbrace{[\tau_a + (1-\tau_a)q]}_{P_{aa}} V_{aa} + \underbrace{(1-\tau_a)(1-q)}_{P_{ab}} V_{ab} - c(\tau_a).$$

  They choose socialization effort τ_a at cost $c(\tau_a)$ to maximize this function.

- A parent with trait b in state q has payoff function:

$$U^b(q) = \underbrace{[\tau_b + (1-\tau_b)(1-q)]}_{P_{bb}} V_{bb} + \underbrace{(1-\tau_b)q}_{P_{ba}} V_{ba} - c(\tau_b).$$

First-Order Conditions

Define 'cultural intolerances'

$$\Delta_a = V_{aa} - V_{ab} \text{ and } \Delta_b = V_{bb} - V_{ba}.$$

- The FOC for an a type is:

$$(1-q)\Delta_a = c'(\tau_a).$$

- The FOC for a b type is:

$$q\Delta_b = c'(\tau_b).$$

Optimal Socialization Effort

Proposition 1. Optimal socialization effort varies as follows:

(i) τ_i is strictly increasing in 'cultural intolerance' Δ_i,

(ii) τ_a is strictly decreasing in q,

(iii) τ_b is strictly increasing in q,

(iv) $\tau_a > \tau_b$ if and only if $q < \frac{\Delta_a}{\Delta_a + \Delta_b}$.

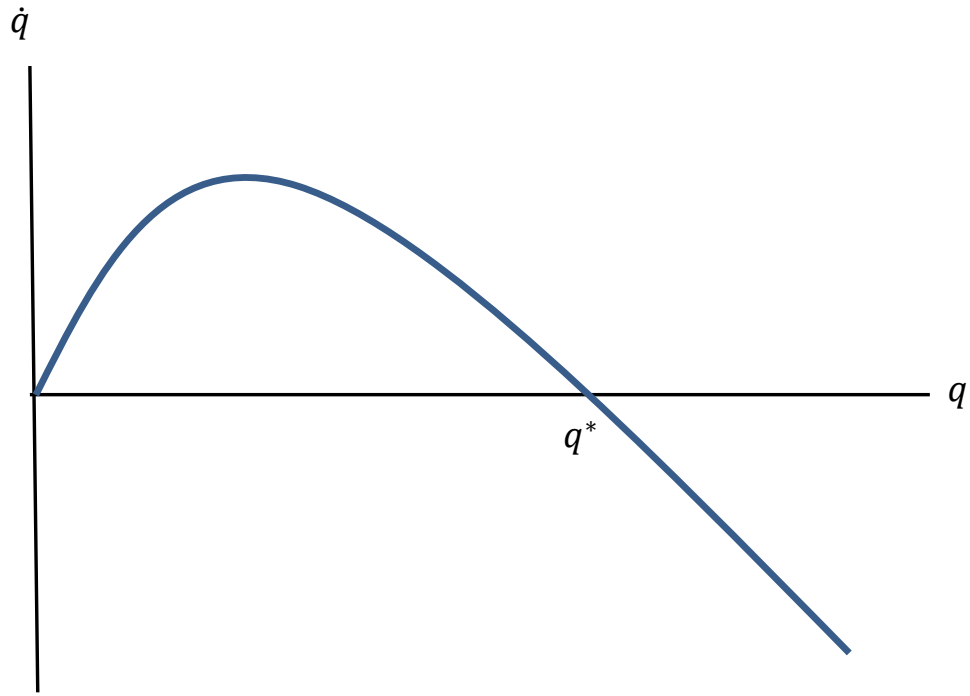
Hence 'minorities' expend more effort on socialization

- See evidence on religious minorities by Bisin, Topa and Verdier 2004.

Dynamics: Endogenous Socialization

Population dynamics are given by (1) except that now τ is endogenous.

Proposition 2. The process converges to the interior steady state $q^* = \frac{\Delta_a}{\Delta_a + \Delta_b}$ from any $q \in (0, 1)$.



Therefore, a polymorphic cultural distribution emerges from almost every initial state.

Generalizing the Analysis

- How can we extend the Bisin and Verdier framework to n traits?
- What is the relationship between Bisin-Verdier style cultural evolution and standard dynamics in evolutionary game theory?

The Montgomery Analysis

- Agents form a continuum and possess one of n cultural traits, $i \in \{1, \ldots n\}$.
- Each parent (asexually) produces one child, socializes them and then dies.
- A parent with trait i will have a child with trait $j \neq i$ with probability:

$$P_{ij} = (1 - \tau_i)q_j \tag{2}$$

and a child with trait i with probability:

$$P_{ii} = \tau_i + (1 - \tau_i)q_i. \tag{3}$$

The Cultural Evolutionary Dynamic

- In discrete time:

$$q_i(t+1) = \sum_j q_j(t) P_{ji}. \tag{4}$$

- Substituting (2) and (3) into (4):

$$\begin{aligned} q_i(t+1) &= q_i(t)\left[\tau_i + (1-\tau_i)q_i(t)\right] + \sum_{j\neq i} q_j(t)(1-\tau_j)q_i(t) \\ &= q_i(t)\tau_i + (1-\tau_i)q_i(t)^2 + q_i(t)\sum_{j\neq i} q_j(t)(1-\tau_j) \\ &= q_i(t)\tau_i + q_i(t)\sum_{j} q_j(t)(1-\tau_j) \\ &= q_i(t) + q_i(t)\left[\tau_i - \sum_j q_j(t)\tau_j\right]. \end{aligned} \tag{5}$$

The Cultural Evolutionary Dynamic

- Taking the continuous-time limit, we have:

$$\dot{q}_i = q_i \left[\tau_i - \sum_j q_j \tau_j \right] \tag{6}$$

  for all $i = 1, \ldots n$.

- Clearly, when the τs are exogenous, the dynamic converges from every interior state to a monomorphic distribution centered on trait $\arg\max_i \{\tau_i\}_{i=1}^n$.

Endogenous Socialization

- Let us proceed along the lines of Bisin and Verdier (2000) except with n traits and a quadratic socialization cost:

$$\max_{\tau_i} \sum_j P_{ij} V_{ij} - \tfrac{1}{2}(\tau_i)^2, \tag{7}$$

where V_{ij} is an i type's payoff from having a child with trait j.

- The FOC is:

$$\begin{aligned} \tau_i^* &= (1 - q_i) V_{ii} - \sum_{j \neq i} q_j V_{ij} \\ &= V_{ii} - \sum_j q_j V_{ij} \\ &= \sum_j q_j \left[V_{ii} - V_{ij} \right] \\ &\equiv \sum_j q_j \Delta_{ij}, \end{aligned} \tag{8}$$

where Δ_{ij} is an i type's intolerance toward j.

The Replicator Dynamic

- Substituting into the dynamic (6), we have:

$$\dot{q}_i = q_i \left[\sum_j q_j \Delta_{ij} - \sum_j q_j \sum_j q_k \Delta_{jk} \right] \tag{9}$$

  for all $i = 1, \ldots n$.

- Interpreting Δ_{ij} as the payoff from playing strategy i against j, this becomes a well-known evolutionary dynamic:
  - The **replicator dynamic** operating on a particular population game, i.e. random matching to play an $n \times n$ coordination game.

Convergence Results

- Hence we can exploit standard results from evolutionary game theory on the replicator dynamic to study cultural evolution.

- Suppose that $\Delta_{ij} = \Delta_i$ for all $j \neq i$ (and $\Delta_{ii} = 0$), i.e. each group is intolerant of all other traits to an equal degree.

- Then this is a **strictly stable** game:

  - There is a unique Nash equilibrium (distribution of traits), which is globally asymptotically stable.

  - Every trajectory of the replicator dynamic in the interior of the n-dimensional simplex converges to this state.

- More generally, we can cast this as a potential game and exploit the corresponding results on such games.

Carvalho (2016) Analysis

- Potentially severe *free rider* and *externality* problems associated with cultural transmission.

  $\rightarrowtail$ *Organizations* emerge to deal with these problems.

  Cultural transmission occurs in these organized groups.

- Social transmission replaced by *institutional transmission* of a 'mainstream trait', for e.g. through education or mainstream media.

Organized Cultural Transmission

Organizations cultivate cultural traits through:

(1) Rules of participation in cultural activities:

- E.g. communal prayer, scriptural study and religious sacrifice $\rightarrow$ believer in organization's doctrine.

(2) Excluding nonmembers from social interactions.

Hence a cultural trait can be viewed as a **club good**:

— A central subject in the **economics of religion** (Iannaccone 1992, Berman 2000, McBride 2008).

The Model

Society consists of:

- A finite set of risk-neutral individuals I, partitioned into two (nonempty) communities I_a and I_b (e.g. secular and religious).
- Two cultural traits $k \in \{a, b\}$.
  - Let a be the 'mainstream' trait and b be the alternative identity.
- Two risk-neutral organizations (or groups): organization A (B) cultivates trait a (b).

Types

(1) Each $i \in I_\theta$ receives a payoff of $V_{\theta k}$ from acquiring trait k, where $V_{aa} - V_{ab} \equiv \Delta_a > 0$ and $V_{bb} - V_{ba} \equiv \Delta_b > 0$.

- We refer to members of I_a as mainstream types and members of I_b as alternative types.

(2) c is an individual's (privately known) cost of joining an organization, which is determined by an independent draw from the distribution F.

Timing

- **Date 0.** (*Strictness*) Each organization $\ell \in \{A, B\}$ announces its strictness, s_ℓ—the minimum level of participation required of its members.

- **Date 1.** (*Joining*) Each individual i can choose to become a member of an organization, $m_i = \ell \in \{A, B\}$, or be unaffiliated, $m_i = n$.
  - M_ℓ is the set of organization ℓ members,
  - $N = I - M_A \cup M_B$ is the set of unaffiliated agents.

Timing

- **Date 2.** (*Participation*)
  - Each member $i \in M_\ell$ chooses participation level $x_i \geq 0$ in group ℓ's activities, at cost x_i^2.
    - Assume all $i \in M_\ell$ are constrained to choosing $x_i \geq s_\ell$.
    - Unaffiliated agents are excluded: $x_i = 0$ for all $i \in N$.

Cultural Transmission

- **Date 3.**
  - The average level of participation among ℓ members is:

$$\bar{x}_\ell \equiv \frac{1}{|M_\ell|} \sum_{i \in M_\ell} x_i \,.$$

  - *Group transmission:* The likelihood $i \in M_A$ acquires trait a through group transmission is $\bar{x}_A$ (similarly for B).
  - *Institutional transmission*: If group transmission fails, i acquires the mainstream trait a with probability one.

Individual Payoffs

- In both cases, the expected payoff to a (θ, c)-type agent i who joins ℓ is then:

$$u_i = V_{\theta k}\bar{x}_\ell + V_{\theta a}(1 - \bar{x}_\ell) - x_i^2 - c.$$

- The probability that $i \in N$ acquires the mainstream trait a is one.

  $\Longrightarrow$ the payoff when unaffiliated is $V_{\theta a}$.

Organizational Payoffs

- Each organization ℓ maximizes aggregate participation in its activities:

$$X_\ell = \sum_{i \in M_\ell} x_i \, .$$

Mainstream vs Alternative

Proposition 3. Recall the *cultural intolerance* of I_b members is $\Delta_b \equiv V_{bb} - V_{ba}$.

There exists a unique SPE of this game. In this equilibrium:

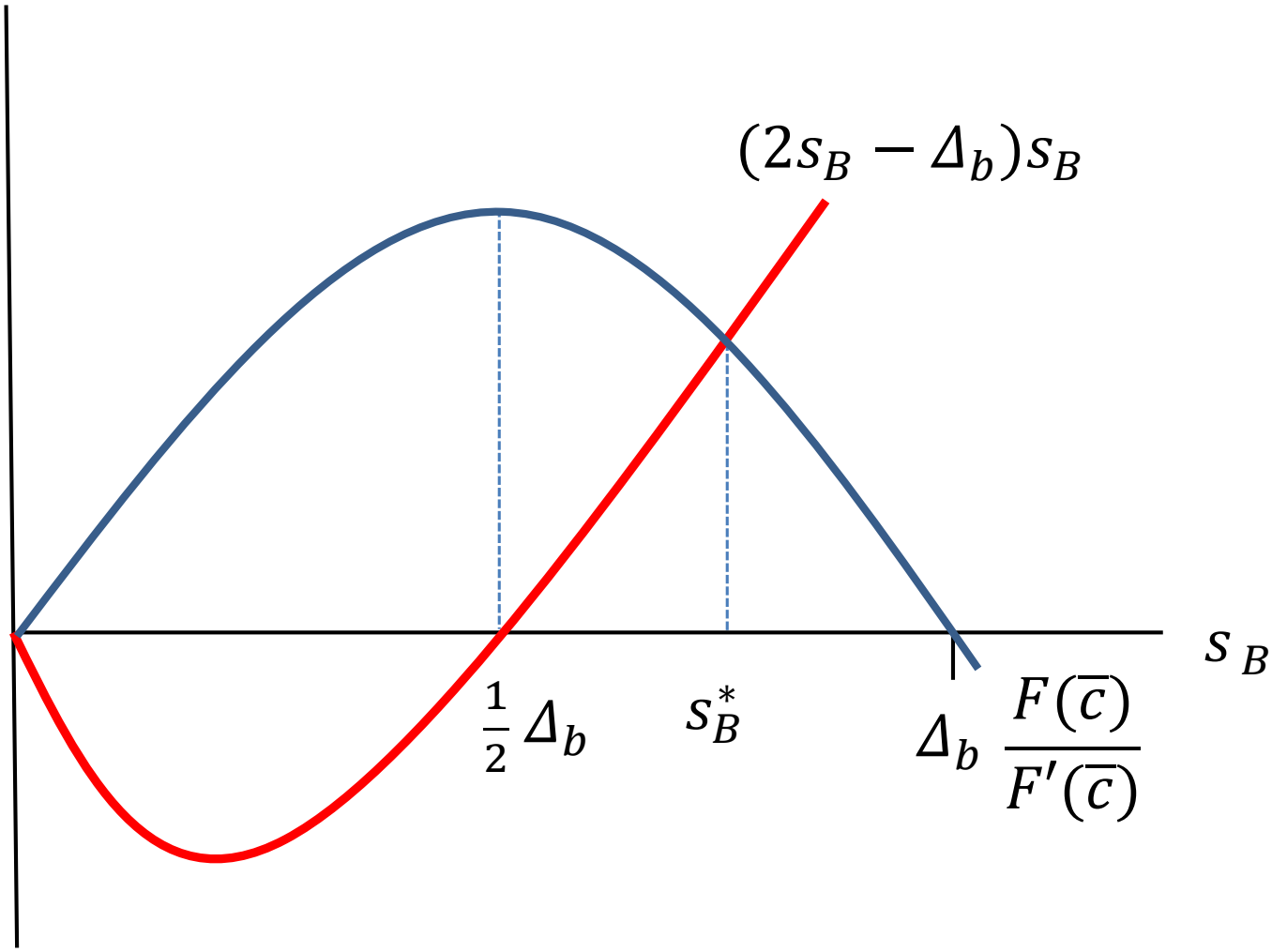
(i) All a-type individuals remain unaffiliated: $I_a \subset N$.

(ii) Organization A attracts no members: $M_A = \emptyset$.

(iii) For all $i \in M_B$, the participation rule binds: $x_i^* = s_B^*$.

(iv) For organization B, strictness is $s_B^* \in \left(\frac{1}{2}\Delta_b, \Delta_b\right)$ and expected membership size is $|M_B^*| \in \left(0, |I_b|\right)$.

Equilibrium strictness



The Role of Tension

- Intoleranace Δ_b can be reinterpreted as 'cultural tension', which is an important concept in the **sociology of religion**:

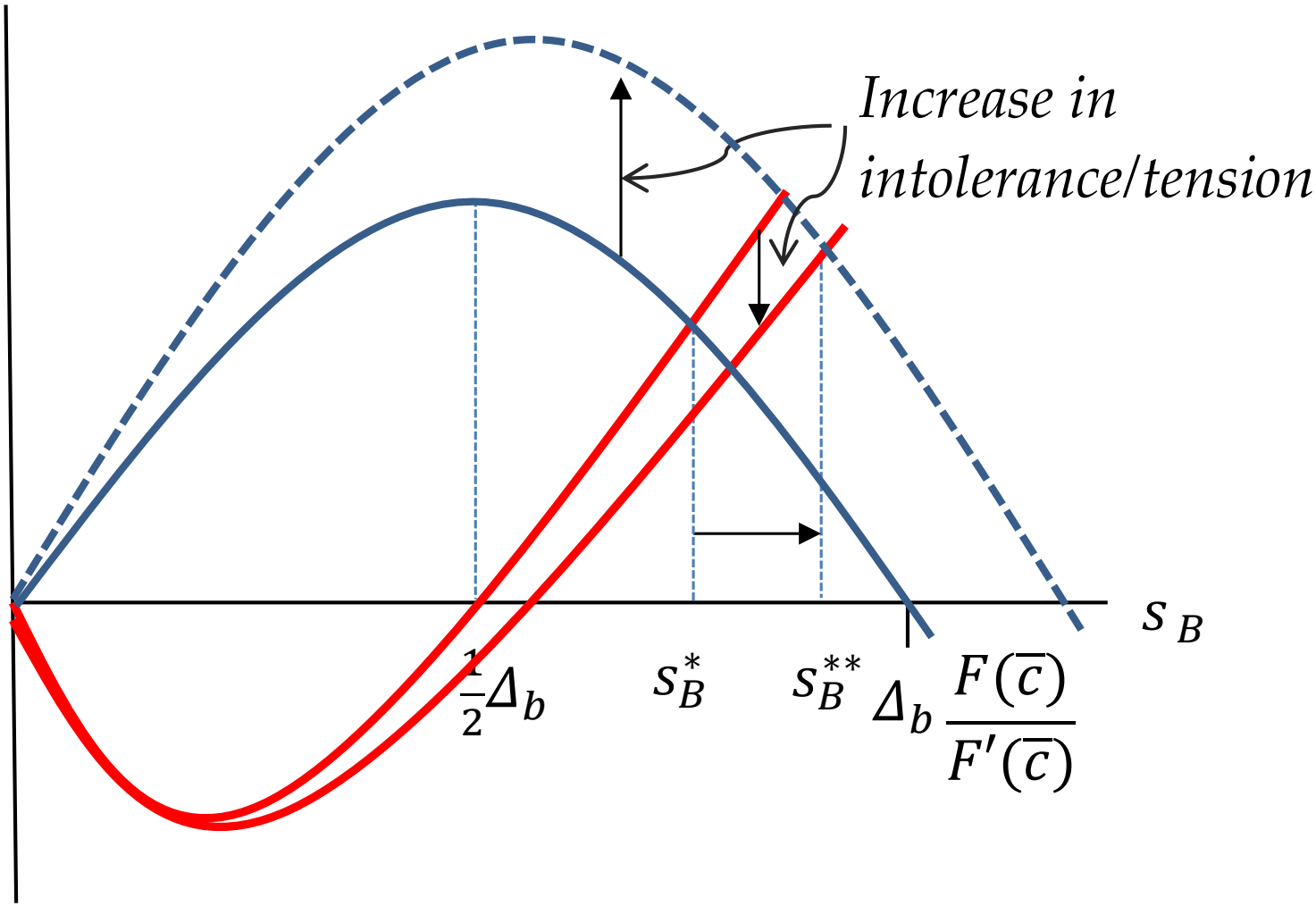
  "All religious groups can be located along an axis of tension between the group and its sociocultural environment", where tension is defined in terms of "distinctiveness, separation, and antagonism".

  Stark and Finke (2000, p. 143)

- Here, tension dictates strictness and total participation:

Proposition 4. In the subgame perfect equilibrium of the game, organization B's strictness s_B^* and total participation X_B^* are strictly increasing in Δ_b.

The Role of Tension



Implications

* Organizations that form will tend to be ones cultivating oppositional culture.

* Stricter religious organizations will have doctrines far from the mainstream worldview.

* Groups cultivating oppositional cutural traits will have an advantage in collective action.

Extensions

- Long run:
  - Suppose $|I_a|/|I| = q^t$. Then $\lim_{t\to\infty} q^t = 1$
- What if institutional transmission is noisy?
  - Acquire mainstream trait with prob. $p \geq \frac{1}{2}$.
- Contest over institutions and cultural cycles.

Further Work

- Role of cultural leaders:

  Hauk & Mueller 2015, Verdier & Zenou 2015, 2018, Carvalho & Koyama 2016, Carvalho, Koyama & Sacks 2017, Prummer & Siedlarek 2017.

- Two dynamic radicalization strategies in clubs (Carvalho & Sacks 2018 w.p.):

  1. Extremist influence,

  2. Niche construction.

- Identity (veiling) and cultural transmission (Carvalho 2013).