

The Moral Economy of Communities: Structured Populations and the Evolution of Pro-social Norms

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Abstract

Why do communities persist despite their inability to exploit the efficiency-enhancing properties of markets and the advantages of universal enforcement of rules provided by states? One reason is the capacity of communities to foster cooperative behavior.

Communities align the individual and collective benefits and costs of people's actions. We model three mechanisms by which communities raise the net benefits to individual pro-social behaviors: *reputation*, *retaliation* and *segmentation*. Unlike most treatments of the evolution of group-beneficial traits our communities promote pro-social behaviors in the absence of altruistic agents. We further show that the restricted mobility associated with communities (*parochialism*) enhances these mechanisms. Communities are thus specifically adapted to settings that make formal property rights systems untenable and preclude the efficient centralized determination of outcomes.

Key Words: Cooperation, community, group-beneficial norms, reputation, segmentation.

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1 Introduction

The basis for the rise, fall, and transformation of communities, if we are correct, is to be sought not in the survival of vestigial values of an earlier age, but in the capacity of communities, like that of markets and states, to provide successful solutions to the problems that people confront in their contemporary social lives. By ‘community’ we mean a structure of social interaction characterized by high entry and exit costs and non-anonymous relationships among members. As with biological ‘groups,’ interactions among community members are more frequent and extensive than interactions with ‘outsiders.’¹ Like groups, but unlike firms and families, communities lack a centralized structure capable of making decisions binding on its members.² Examples of communities include residential neighborhoods, old boy networks, ethnic associations, and many business, trade and artisanal groupings.

By ‘norms’ we mean cultural traits governing actions that affect the well-being of others but that cannot be regulated by costlessly enforceable contracts. Other usages of the term norms have been proposed. Ours highlights the problem that norms pose, namely how social interactions might be structured to foster pro-social norm-governed behaviors. Pro-social norms are those whose increased frequency in a population enhances the average level of well-being. Examples of pro-social norms are truth telling, a predisposition to cooperate (either unilaterally or conditionally) in prisoner’s dilemma situations, ‘dove-like’ behaviors in hawk-dove interactions, and a predisposition to retaliate against others pursuing anti-social behaviors.

The importance of pro-social norms arises in interactions structured such that the uncoordinated (technically ‘non-cooperative’) actions of individuals lead to outcomes inferior to those that would have been attainable had coordination of the individual actions been possible. Examples are prisoner’s dilemmas, hawk dove games, and interactions with multiple equilibria some of which are unambiguously superior to others. These interactions are generically called *coordination problems* and the associated inferior results are termed *coordination failures*. The generic source of coordination failures is that the benefits and costs motivating individual action do not take

¹E. O. Wilson (1975) defines groups as “any set of organisms, belonging to the same species, that remain together for a period of time interacting with one another to a distinctly greater degree than with other conspecifics.” (p. 585)

²‘Clubs’ studied by economists and political scientists are in many respects like our ‘communities’ but they differ in that clubs have a formal collective decision making structure and supply a public good.

appropriate account of the related beneficial or costly consequences of the action on others.

Communities overcome free-rider problems and punish ‘anti-social’ actions, by supporting behaviors consistent with such pro-social norms as truth telling, reciprocity, and a predisposition to cooperate towards common ends. These norms are often considered to be the historical legacy of a traditional culture supported by intentional indoctrination and virtually universally adhered to in a population. But this account of community-based norms is unconvincing. First, groups appear to be quite internally heterogeneous with respect to many important norms and the theory of ‘deviance’ from universal norms does not provide an adequate understanding of the distribution of normative orientations in members of a group (Gintis 1975). Second, the implied power of intentional inculcation of norms is belied by many failed experiments in the social engineering of the psyche, the attempted construction of the “new socialist man,” in the former Soviet Union and elsewhere, being the most notable. Third, value orientations appear to be subject to quite rapid shifts, as witnessed by such events as the precipitous unravelling of indigenous cultures and the meteoric rise of modern feminism in the Twentieth century, suggesting that while history matters, particular norms are sustained by contemporary processes.

As an alternative to the idea that community-based values are the result of an inculcated legacy of the past, we here develop the view that the contemporary structure of social interactions that characterize communities, not the inertial weight of tradition or intentional indoctrination, account for the viability of the pro-social norms we have indicated. By the ‘structure of social interactions’ we mean the rules governing how members of the population meet, what actions they may take in their common activities, and what are the outcomes of these actions. We will later formalize the structure of social interaction by a set of rules pairing members of the population and describing the game structures of their paired interactions.

Our argument may be summarized as follows. First, communities influence the evolution of norms because they structure social interactions in ways that affect the benefits and costs of norm governed actions, and the acquisition and retention of norms is influenced by the associated pay-offs. Second, communities support equilibria with substantial frequencies of pro-social norms. We conclude that communities persist because they attenuate coordination failures not easily addressed by markets, states, and other competing institutions.³

³Of course communities as we have defined them may obstruct efficiency-enhancing

Our reasoning thus centrally concerns norms and the manner in which people come to have the norms they do. Because many of the traits in question are moral rules or behavioral regularities that, like one's accent, may not have been actively and purposefully chosen by the people in question, we require an approach more general than the standard economic view, whereby actions, or the rules governing actions, are instrumentally chosen to maximize an objective function. Instead, we adopt the evolutionary view that key to the understanding of behaviors in the kinds of social interactions we are studying is *differential replication*: durable aspects of behavior, including norms, may be accounted for by the fact that they have been copied, retained, diffused, and hence replicated, while other traits have not.⁴

Differential replication may result from individuals seeking to acquire and retain traits that have proven successful to others. Differential replication may also take place through less instrumental means: those with 'successful traits' may become privileged cultural models, such as parents or teachers. The process of differential replication also may work through the exercise of power by nations, classes, or other collectivities, as when those who lose wars adopt the culture, constitutions and the like of winners (Kelly 1985, Weber 1976).

2 Community Governance

Most if not all economic acts [among the Trobriand Islanders] are found to belong to some chain of reciprocal gifts and counter gifts, which in the long run balance... The real reason why all these economic obligations are normally kept, and kept very scrupulously, is that failure to comply places a man in an intolerable position... The honourable citizen is bound to carry out his duties, though his submission is not due to any instinct or intuitive impulse or mysterious "group sentiment," but to the detailed and elaborate working of a system, in which every act has its own place and must be performed without fail. Though no native however intelligent can formulate this state of affairs in a general abstract manner... every one is well aware of its existence and in each concrete case he can foresee the consequences.

Malinowski (1926):40.

Communities as we have defined them structure social interaction in ways that foster (a) frequent interaction among the same agents; (b) partly as a result, low cost access to information about other community members; (c) a tendency to favor interactions with members of one's own community over outsiders; and (d) restricted migration to and from other communities.

economic arrangements and can persist nonetheless. See for example Platteau (1996).

⁴ The cultural transmission process may also be 'conformist,' whereby individuals copy cultural forms that have high frequency in the population. Key sources on cultural evolution are Cavalli-Sforza and Feldman (1981) and Boyd and Richerson (1985).

These structural characteristics, we will show, contribute to the ability of communities to promote pro-social behavior.

The structure of interactions in communities contrasts with that of markets and states, at least in their idealized forms. Market interactions are characterized by ephemerality of contact and anonymity among interacting agents while idealized state bureaucracies are characterized by long-term anonymous relationships. The relevant contrasts appear in Figure 1. States and markets have distinctive capacities and shortcomings as governance structures, but our concern here is with communities.⁵

	Ephemeral	Enduring
Anonymous	Markets	States
Personal	—	Communities

Figure 1: The Structure of Interactions in Different Institutions

Consider, for concreteness, a particular community facing a coordination problem of the prisoner’s dilemma type. Suppose the community is composed of a large number of people who interact in pairs, with available actions and payoffs as indicated in Figure 2, with the familiar payoffs⁶

$$a > b > c > d \quad \text{and} \quad a + d < 2b. \tag{1}$$

The actions taken by each are not subject to enforceable contracts. Universal defect is the dominant strategy equilibrium for this interaction.

	Cooperate	Defect
Cooperate	b, b	d, a
Defect	a, d	c, c

Figure 2: The Prisoner’s Dilemma: Payoffs (row,column)

Note: $a > b > c > d, a + d < 2b$

⁵We provide an information theoretic account of the capacities and shortcomings of markets, states, and communities in Bowles and Gintis (1998). See also Farrell (1987).

⁶The second requirement simply precludes the social optimality of alternating roles of defector and cooperator. Cooperation is universally prosocial only if we also have $a + d > 2c$, though we will not need this fact.

If the players could contract to play cooperate, they would surely do so. But the assumption that the behaviors in question are non-contractible, namely that the interaction is non-cooperative, precludes this. How might the structure of the community nonetheless induce universal cooperation? We have identified three ways in which communities solve coordination problems. Each is based on familiar game-theoretic models.

First, a high frequency of interaction among community members lowers the cost of gathering information, and raises the benefits associated with discovering the characteristics of those with whom one interacts. The more easily acquired and widely dispersed this information, the more will community members have an incentive to act in ways beneficial to their neighbors. Thus when agents engage in repeated interaction, they have an incentive to act in ways that build their ‘reputation’ for cooperative behavior (Shapiro 1983, Gintis 1989, Kreps 1990). This is the *reputation effect* of community.

Second, since in a community the probability is high that members who interact today will interact in the future, there is an incentive to act favorably towards one’s partners to avoid future repercussions (Axelrod and Hamilton 1981, Axelrod 1984, Taylor 1987, Fudenberg and Maskin 1986). The more multifaceted is the relationship among people involved in the interaction, the more opportunities there are for the later redress of opportunistic treatment. We refer to this as the *retaliation effect*.

Third, pro-social and anti-social behaviors typically involve conferring benefits and inflicting costs on others, in a situation where the costs and benefits in question are not subject to cost effective contracting. In a large population of many communities, the greater likelihood of interacting with a member of one’s own community than with a randomly selected member of the population enhances the frequency of likes interacting. A result is that pro-social behaviors are more likely to be rewarded, those with pro-social norms being more likely to interact with other pro-social agents, and conversely for anti-social behaviors (Grafen 1979, Axelrod and Hamilton 1981, Bowles 1996). This is the *segmentation effect*.

The retaliation, reputation, and segmentation effects above allow communities to support higher equilibrium frequencies of pro-social traits. These effects may be enhanced by the limited mobility among groups entailed by the high entry and exit costs characteristic of communities. We call this the *parochialism effect*. The parochialism effect operates not by inducing pro-social behaviors directly, but by enhancing reputation, retaliation, and segmentation effects under the appropriate conditions (Bowles and Gintis 1997). Note that the parochialism effect is distinct from group selection mechanisms, which depend upon inter-group differences in frequencies of

traits. Reputation, retaliation, and segmentation effects are supported by Nash equilibria within groups, and hence are viable in the absence of inter-group competition.⁷

Figure 3 summarizes these causal links between the structure of communities and the attenuation of coordination problems. In subsequent sections we will investigate the workings of each of these four effects, but first we will need to be more precise about how the payoffs associated with traits affect their differential replication, as this relationship is the key to understanding the effect of institutions on cultural evolution.

	Effect favoring the solution of coordination problems	Characteristic of community necessary for this effect	Variable in Model to Follow
Reputation	Enhanced value of reputations for pro-social behaviors	Low cost of information about other agents	δ
Retaliation	Punishment of anti-social behaviors	Frequent or long-lasting interactions	ρ
Segmentation	Disadvantageous pairing of anti-social agents	Non-random pairing of agents	σ
Parochialism	Enhanced pressures favoring pro-social traits	Limited migration among groups	μ

Figure 3: How Communities Solve Coordination Problems

⁷Note that our support equilibria with positive frequencies of pro-social traits in the absence of conformist cultural transmission. There is good reason to think that both conformism and group selection may contribute to the evolution of prosocial traits (Wilson 1980, Boyd and Richerson 1990, Soltis, Boyd and Richerson 1995, Wilson and Sober 1994). Our models investigate cases where these forces are not operative. Our model of parochialism is thus in the spirit of a suggestion by Hamilton (1975) that altruistic traits may proliferate in a single group due to the tendency for genetic relatedness to increase over time in the absence of significant in-migration.

3 Economic Institutions and Cultural Evolution

... the (Salem) 'witch hunters' of 1692... were (not) simple peasants clinging blindly to the imagined security of a receding medieval culture,... (they were) trying to expunge the lure of a new order from their own souls by doing battle with it in the real world.

(The accused were)... a group of people who were on the advancing edge of profound historical change. If from one angle they were diverging from an accepted norm of behavior, from another angle their values represented the "norm" of the future. In an age about to pass, the assertion of private will pose the direst possible threat to the stability of the community; in the age about to arrive it would form a central pillar on which that stability rested.

Boyer and Nissenbaum (1974):180,109.

Economic institutions and other rules of the game governing social life influence the structure of social interactions in a population, which in turn affects the payoffs associated with distinct behaviors governed by norms and other cultural traits. Because these payoffs influence the differential adoption, retention and abandonment of cultural traits, institutions affect the equilibrium distribution of cultural traits in a population. It follows that changes in the mix of institutions affect cultural evolution by altering the structure of social interactions and hence altering the process of cultural transmission.

By a *culture* we mean a set of cultural traits. A cultural trait is a belief, value, or other acquired aspect of an individual that influences the individual's behavior in some durable fashion.⁸ A predisposition to help others, or to have large families, or generally to skip breakfast, are cultural traits, as are the practices of reciprocating social invitations and always selling to the highest bidder. Cultural evolution is the process of change over time in the distribution of cultural traits in a population. A cultural equilibrium is a distribution of cultural traits not subject to endogenous sources of change. A cultural environment is any social situation affecting the propensity of existing cultural traits to be adopted and retained by others (whether willingly, consciously, or not) and new cultural traits to be introduced.

Communities, like markets and states, are environments in which cultural traits develop and change. These different cultural environments may be distinguished by the way they favor the copying and hence growth of distinct cultural traits.⁹

⁸This framework draws on the sources mentioned in footnote 4. Others defining culture often stress aspects absent here, such as the functional or legitimating role of culture, its integrated nature and its grounding in historical tradition.

⁹Of course the structure of cultural transmission under which human societies acquire cultural traits is itself the result of both genetic and cultural evolutionary processes.

Suppose cultural evolution takes place under the influence of the differential replication of traits that are perceived to be successful by members of the population.¹⁰ Emulation of the cultural traits of individuals perceived to be socially successful is analogous to the reproductive success of biologically fit organisms. Emulation may be very rapid if the cultural traits correlated with success have no moral force, and are embraced only because of their expected consequences. Even where there is a conflict between deeply held moral value and the perceived success of individuals and groups who reject that value, there is a tendency for the moral value to be abandoned. This may happen through group selection, since groups that espouse the more successful value may simply displace groups that espouse the less (Soltis et al. 1995). In addition, individuals themselves may abandon inopportune values (Festinger 1957), or a new generation may simply refuse to embrace the inopportune values of the previous (Fromm and Maccoby 1970). Moreover, values found useful in one social setting (e.g., the workplace) may be unconsciously ‘transported’ to another, where they threaten and possibly displace more traditional values (Kohn 1969, Bowles and Gintis 1976). Finally, successful individuals may obtain positions, as governmental leaders, media figures, and teachers for example, in which they have privileged access to the population as cultural models and thus may be copied disproportionately for reasons associated with their location in the social structure rather than success *per se*, others deemed equally successful being less replicated (LeVine 1966).

Notice a rough learning rule underlying differential replication has replaced the role usually assigned to conscious optimization. We do not specify why traits are copied. The previous paragraph leaves this issue open. Rather, we simply posit that successful traits are more likely to be copied.

Cultural transmission based on the favored replication of successful traits may be modelled as follows. Let there be one of two mutually exclusive traits (x and y) present in each member of a large population (y may be considered to be the absence of x). Let p_x be the fraction of members of the population that has trait x , and let r_x be the rate of growth of p_x over time.¹¹ The structure of the transmission process is this: in a large population with a given distribution of traits, agents implement the strategy dictated by their

For this reason the transmission processes postulated must be capable of reproducing themselves. We do not explore this question here.

¹⁰This framework is derived from the models of cultural evolution cited above, but it is also consistent with a variety of other approaches. See, for instance, Bandura (1977).

¹¹We assume the population is sufficiently large that we can treat p_x and r_x as real numbers.

trait in a game that assigns benefits to each, following which the traits are replicated, generating a new population distribution. Equilibrium is defined as stationarity of the frequency of traits.

Suppose members of the population are randomly paired to interact in a two person game, the payoffs of which are denoted $\pi(i, j)$, the payoff to playing trait i against a j -playing partner. Thus the probability of an individual meeting an x -type is p_x , and the probability of meeting a y -type is $(1 - p_x)$. The expected payoffs are given by

$$\begin{aligned} b_x(p_x) &= p_x \pi(x, x) + (1 - p_x) \pi(x, y) \\ b_y(p_x) &= p_x \pi(y, x) + (1 - p_x) \pi(y, y). \end{aligned} \tag{2}$$

Read the first equation: “with probability p an x -person is paired with another x -person with payoff $\pi(x, x)$, and with probability $(1 - p)$ is paired with a y -person with payoff $\pi(x, y)$.”

Suppose at the end of each period each agent A , with probability $\gamma_1 > 0$, decides to reassess the value of his ‘type’ by comparing his b_i with that of a randomly chosen person B . If B has a lower payoff than A , we assume A does not change his cultural trait. But if B has a higher payoff than A , and if B is not of the same type as A , A shifts to B ’s type with a probability that is proportional to the difference in the payoffs to A and B , with a proportionality factor $\gamma_2 > 0$. Then we can show that (Gintis 1997)

$$r_x = \gamma_1 \gamma_2 [b_x(p_x) - \bar{b}(p_x)], \tag{3}$$

where $\bar{b}(p)$ is the average payoff in the population:

$$\bar{b}(p_x) = p_x b_x(p_x) + (1 - p_x) b_y(p_x). \tag{4}$$

It is obvious that the population distribution p_x will be unchanging if and only if $r_x = 0$. Rewriting (3) as

$$r_x = \gamma_1 \gamma_2 (1 - p_x) [b_x(p_x) - b_y(p_x)], \tag{5}$$

we see that population is in equilibrium if and only if

$$b_y(p_x) = b_x(p_x). \tag{6}$$

Thus a condition for an interior equilibrium (unchanging p_x) is that payoffs be equal. For a solution to (6), which we will call p_x^* , to be stable (i.e. to return to p_x^* when perturbed) a small increase in p_x (the fraction of those with trait x) must increase the replication propensity of the y trait

more than the x trait, thereby favoring the y trait in replication and lowering p_x . This can be written:

$$\frac{dr_x}{dp_x} < 0, \tag{7}$$

requiring that

$$\pi(y, x) - \pi(x, x) > \pi(y, y) - \pi(x, y) \tag{8}$$

We turn now to a consideration of each of the four effects of community governance.

4 Reputation

Honesty comes much more easily in a tiny community than it does in a great city, where misconduct always hopes that the multitude of alien tracks will cover up its own footprints.

Diamond Jenness, pp. 128-9, commenting on the Eskimo lack of fear of stealing.

Suppose now each agent is one of two types of players, which we call ‘nice’ and ‘nasty.’ An agent can determine whether a partner is ‘nice’ by paying an inspection cost $\delta > 0$.¹² A nice agent is one who either cooperates unconditionally, or who inspects and responds to a nice partner by cooperating and to a nasty partner by defecting. Otherwise an agent is nasty. There are clearly six pure strategies, as shown in Figure 4. We have named only three of these strategies, since the others are strictly dominated, and hence cannot appear in a Nash equilibrium: (a) and (c) are strictly dominated by Defect and (b) is strictly dominated by Trust.

The payoff matrix for a pair of agents who agree to interact is now given by the normal form matrix shown in Figure 5.

We call a Nash equilibrium a *universal defect equilibrium* if all agents Defect, a *nontrust equilibrium* if some agents Inspect but no agent Trusts, and a *trust equilibrium* if at least one agent Trusts. There are no other types of Nash equilibria in this game.¹³ Not surprisingly, a universal defect equilibrium exists and is locally stable, so Defect is an evolutionarily stable strategy.

To investigate the possibility of a trust equilibrium, let $\alpha \geq 0$, $\beta > 0$, and $(1 - \alpha - \beta) \geq 0$ be the probability that strategies Inspect, Trust, and

¹²This treatment of inspection and trust is adapted from Güth and Kliemt (1994). The dynamics of this model are more fully explored in Bowles and Gintis (1997).

¹³We will assume that number x of players is sufficiently large that we can treat x as a continuous real variable. In particular, we assume any Nash equilibrium can be supported by all players choosing the appropriate pure strategies, and we will allow functions of x to be continuous over the positive real numbers.

<u>strategy</u>	<u>inspect</u>	<u>action</u>	<u>frequency</u>
Defect	no	defect	$1 - \alpha - \beta$
Trust	no	cooperate	β
(a)	yes	defect	—
(b)	yes	cooperate	—
Inspect	yes	defect if partner nasty	α
		cooperate if partner nice	—
(c)	yes	defect if partner nice	—
		cooperate if partner nasty	—

Figure 4: Strategies in the Inspect Variant of the Prisoner’s Dilemma

Defect are used, respectively. If there were no defection, then Inspect would be dominated by Trust because inspectors pay a cost without ever locating a defector, so all agents would Trust. But then Defect dominates Trust, which is a contradiction. Thus there is a positive level of Defect. If there were no Inspect, then again Defect would dominate Trust, which is impossible in equilibrium. Thus there must be positive levels of all three strategies if there are any trusters (i.e., $\beta > 0$) in equilibrium.

We now determine the population frequencies of Trust, Inspect, and Defect in a trust equilibrium. Let $\pi^i(\alpha, \beta)$ be the expected payoff to adopting strategy i in a population whose composition is described by α, β . Then by (6), the payoffs to each must be equal in equilibrium. Thus we have $\pi^I(\alpha, \beta) = \pi^T(\alpha, \beta) = \pi^D(\alpha, \beta)$, or

$$\alpha(b - \delta) + \beta(b - \delta) + (1 - \alpha - \beta)(c - \delta) = (\alpha + \beta)b + (1 - \alpha - \beta)d. \quad (9)$$

	Inspect	Trust	Defect
Inspect	$b - \delta, b - \delta$	$b - \delta, b$	$c - \delta, c$
Trust	$b, b - \delta$	b, b	d, a
Defect	$c, c - \delta$	a, d	c, c

Figure 5: Payoffs for the Inspect Variant of the Prisoner’s Dilemma

$$= \alpha c + \beta a + (1 - \alpha - \beta)c. \quad (10)$$

These equations imply (using an asterisk* to indicate an equilibrium value)

$$\alpha^* + \beta^* = 1 - \frac{\delta}{c - d}, \quad (11)$$

from which it is clear that the fraction adopting pro-social strategies (Inspect or Trust) varies inversely with the cost of information δ , attaining a value of unity when $\delta = 0$. Further, solving (9) and (10) for α and β , we get

$$\alpha^* = \frac{1}{a - c} \left[(a - b) \left(1 - \frac{\delta}{c - d} \right) + \delta \right], \quad (12)$$

$$\beta^* = \frac{1}{a - c} \left[(b - c) - (b - d) \frac{\delta}{c - d} \right]. \quad (13)$$

For such a solution to exist with $\alpha^*, \beta^* > 0$, equation (11) shows that we must have $\delta < c - d$. Then from (13), $\beta^* > 0$ requires

$$\delta < (c - d) \frac{b - c}{b - d}. \quad (14)$$

Notice that the right hand side of equation (14) is strictly positive, so such a $\delta > 0$ exists. Now $\alpha > 0$ follows trivially. Since equation (14) also implies $\delta < c - d$, given the prisoner's dilemma structure (1) of the payoffs, we see that (14) is necessary and sufficient for a mixed strategy Nash equilibrium with a positive level of Trust. In this case the frequency $1 - \alpha^* - \beta^*$ of Defect is $\delta/(c - d)$, which is an increasing function of the cost of inspection. Also, the frequency β^* of Trust is a decreasing function of δ , since from (13)

$$\frac{d\beta}{d\delta} = -\frac{b - d}{(c - d)(a - c)} < 0. \quad (15)$$

Since the payoffs to all strategies are equal in equilibrium, the expected payoff to all the players is the same as to Trust which, from (9), is $(\alpha^* + \beta^*)(b - d) + d$. Using (11), this gives

$$d + (b - d)(\alpha^* + \beta^*) = b - \frac{b - d}{c - d}\delta, \quad (16)$$

which decreases as the cost of inspection δ increases.¹⁴

¹⁴For completeness we should also deal with the case where only Inspect and Defect strategies are used with positive probability. If Inspect is used with probability $\alpha^* > 0$ then Defect must be used with the strictly positive probability $1 - \alpha^*$ in equilibrium. Since the payoff to Defect is c , the expected payoff to Inspect must also be c . Thus this equilibrium produces no social benefits over the universal Defect equilibrium. Such an equilibrium can be shown to be unstable under a replicator dynamic, so it will not be observed in practice (Bowles and Gintis 1997). We will not consider this equilibrium further.

In sum, we have four distinct reputation effects based on the capacity of community to provide low-cost information on the types of those with whom one interacts. First, reduced cost of information may make possible an equilibrium in which trusting behaviors occur (14). Second, in such an equilibrium the amount of trusting behavior will be greater the lower is the cost of information (15). Third, if trusting occurs in equilibrium, the average payoff to all members of the population will vary inversely with the cost of information (16). Finally, the fraction of the population defecting will vary directly with the cost of information (11).

5 Retaliation

Antonia did not speak to Juan for 15 years. He had offended her in public while she was mourning for her husband. . . through gossiping and chatting, the community of women [in Oroel, a Spanish town of 150 inhabitants] evolves a fund of information, impressions and understandings. . . which they draw on and interpret in order to make decisions about their daily interactions.

Harding (1978):16.

We will show that if the prisoner's dilemma in Figure 2 is repeated with some probability, cooperation may be supported by the threat of retaliation against defectors, the threat being more effective the more likely is the repetition. If repetition is sufficiently likely, and if the time elapsing between repetition is sufficiently brief, the payoff structure is transformed so as to have two equilibria: universal defect, as before, and universal cooperate.

The transformed payoff matrix is called an assurance game (Sen 1967), because each player does best by cooperating as long as each can be assured that the other cooperate as well.¹⁵

Unlike the underlying prisoner's dilemma, for which defection is the dominant strategy (i.e., affords a player a superior payoffs whatever the action of the other player), the assurance game merely supports the socially optimal outcome (mutual cooperation) as an equilibrium that is sustained if each participant believes the others will play the cooperative strategy. We will see that the high exit and entry costs defining communities, and the consequent frequent and repeated interactions among community members, may in this manner transform an intractable coordination problem into one more amenable to solution. We will also see that communities may enlarge the basin of attraction of the mutual cooperation equilibrium and reduce the size of the mutual defection equilibrium, thus making cooperative outcomes more robust in the presence of stochastic disturbances.

¹⁵This game is also called a 'stag hunt,' after a parable given by J.-J. Rousseau (1755/1987).

Thus to the extent that the high exit and entry costs that characterize communities entail frequent and repeated interaction with the same individuals, they may support a cooperative outcome unattainable under more ephemeral conditions.

Repetition changes the interaction in two ways. It allows more complicated strategies, ones that take account of one's partner's prior actions, and it requires that payoffs be accounted for as expected gains over the entire interaction. Players might now want to adopt the so called nice Tit-for-Tat strategy: cooperate on the first round and on all subsequent rounds do what your partner did on the previous round. To keep things simple let us confine the choice of strategies to just Tit-for-Tat (T) and unconditional defect (D). The expected payoffs may now be calculated.

Suppose that after each play the above interaction is to be terminated with a given probability ρ , and repetitions occur over a brief enough period to justify ignoring the players' rates of time preference (an assumption of no consequence in what follows). When two Tit-for-Tatters meet, for example, they will both cooperate, and then continue to do so until the interaction is terminated (that is for an expected duration of $1/\rho$ iterations) giving expected benefits of b/ρ . When a Tit-for-Tatter meets a defector, the former will get d on the first iteration, and then both will defect until the game terminates, the expected number of iterations after the first iteration being $1/\rho - 1 = (1 - \rho)/\rho$, and the resulting expected payoffs thus being $d + (1 - \rho)c/\rho$. The resulting payoff matrix for the iterated game appears in Figure 6.

	Tit-for-Tat	Defect
Tit-for-Tat	b/ρ b/ρ	$d + (1 - \rho)c/\rho$ $a + (1 - \rho)c/\rho$
Defect	$a + (1 - \rho)c/\rho$ $d + (1 - \rho)c/\rho$	c/ρ c/ρ

Figure 6: The Payoffs in the Repeated Prisoner's Dilemma Game
(ρ is the probability of termination)

If the fraction of the population adopting Tit-for-Tat is τ (the remainder adopting unconditional Defect) and if members of the population are paired randomly to interact so that the probability of being paired with a Tit-for-Tatter is τ , expected returns to Tit-for-Tat and Defect, respectively, π^T and π^D are

$$\pi^T(\tau) = \tau b/\rho + (1 - \tau)\{d + (1 - \rho)c/\rho\} \tag{17}$$

$$\pi^D(\tau) = \tau\{a + (1 - \rho)c/\rho\} + (1 - \tau)c/\rho, \quad (18)$$

which, when equated to determine the equilibrium population fraction τ^* , yields

$$\tau^* = \frac{c - d}{2c - a - d + (b - c)/\rho}. \quad (19)$$

For payoffs and termination probability such that

$$\rho < \frac{b - c}{a - c} \quad (20)$$

and for $c > d$, we have $\tau^* \in (0, 1)$, giving an interior equilibrium. Note that (20) also ensures that the denominator of (19) is positive. The second condition must be true because the single period payoffs describe a prisoner's dilemma. The first will be true when the gains to universal cooperation relative to the gains to single period defection are great relative to the termination probability. The payoffs above and an interior equilibrium τ^* are illustrated in Figure 7.

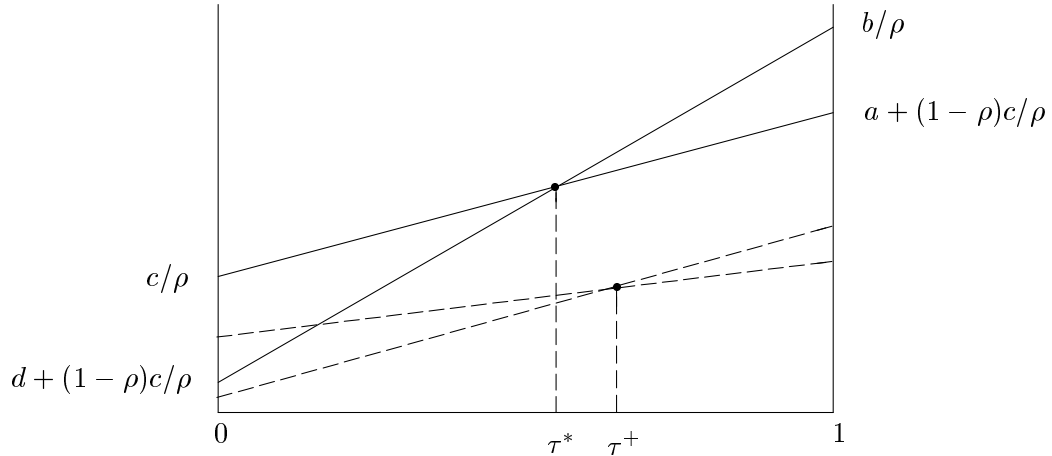


Figure 7: The Retaliation Effect: An increase in the probability of termination (dashed lines) diminishes, and may eliminate, the basin of attraction of the Universal Cooperate equilibrium.

But unlike the equilibria in the reputation game considered above, τ^* is unstable, small deviations from τ^* do not result in a convergence back to τ^* . This is because

$$\frac{d\pi^D(\tau^*)}{d\tau} < \frac{d\pi^T(\tau^*)}{d\tau},$$

violating the stability condition (7). We may see this as follows. For values of τ greater than τ^* the expected return to D relative to T is diminished, but as the payoffs were equal at τ^* the returns to D must therefore be inferior to T , which by the dynamic process described in Section 3 will lead to further increase in T rather than a return to τ^* . As a result there are three equilibrium population frequencies, namely 0, τ^* , and 1. The first and third are stable. The unstable equilibrium τ^* defines the boundary between the basin of attraction of the two stable equilibria.

It is readily confirmed that equation (20) implies that the payoff to Tit-for-Tat in a population with no defectors exceeds the payoff to Defect in that population or $b/\rho > a + (1 - \rho)c/\rho$ making Tit-for-Tat a best response to itself. We say that Tit-for-Tat is an *evolutionarily stable strategy* if there exists some positive frequency of defection in this population ϵ such that if the population share of Defect is below ϵ , the process of differential replication of traits will lead to its elimination (Weibull 1995). Thus invasion by a group of defectors comprising less than a fraction ϵ of the population will fail. Where (20) holds, Tit-for-Tat is thus an evolutionarily stable strategy, and the critical value of ϵ in the above definition is $1 - \tau^*$.

Two results concerning the governance effects of community follow. First the interaction will have an equilibrium of universal cooperation if the probability of termination is sufficiently low (universal defect will remain an equilibrium). This follows directly from condition (20) above: if an interior equilibrium exists and is unstable, $\tau = 0$ must be a stable equilibrium. Second, an increase in the probability of termination will reduce the basin of attraction of the cooperative equilibrium. This is because

$$\frac{d\tau^*}{d\rho} = \frac{(\tau^*)^2(b - c)}{\rho^2(c - d)}$$

which must be positive if the initial payoffs are a prisoner's dilemma and if $\tau^* \in (0, 1)$. Thus as the expected duration of interactions is reduced (an increase in ρ), the dividing line between the basin of attraction of universal defect and universal cooperation shifts toward the latter, widening the range of initial conditions yielding $\tau^* = 0$ as an outcome.

Condition (20) does not ensure that universal cooperation will take place. It ensures only that should universal cooperation occur, such cooperation would not unravel by the process of unilateral defection. This is the sense in which that continuity of interactions (low ρ) characteristic of communities favors cooperation.

6 Segmentation

Like ethnic businesses generally, [Korean rotating credit associations] encourage the ethnic solidarity they require. . . . bureaucratized financial institutions accelerated the atomization of the population rather than having, as previously thought, served the otherwise intractable needs of an already atomized population.

Light, Kwuon and Zhong (1990):48.

The high entry and exit costs that characterize communities result in populations being segmented, members of the communities making up the larger population interacting with outsiders less frequently than with insiders. Examples include members of a population residing in villages who engage in frequent exchanges with co-residents and occasionally exchange goods at a single market serving the entire population.

Suppose individuals are either defectors or cooperators in a single period prisoner's dilemma, and as before they periodically update their type in response to the relative success of the two strategies. By contrast to the reputation and retaliation models, in which members of the population are randomly paired to interact, the segmentation model is based on nonrandom pairing. The communities into which the population is segmented are more homogeneous with respect to type than is the larger population, either because they share a common ancestry and parents have privileged roles as cultural models, or because of a sorting process based on some characteristic correlated with the cultural traits under study.¹⁶

The clustering of likes attenuates coordination problems because pro-social behaviors such as cooperating in a prisoner's dilemma situation confer advantages to those with whom one interacts, while defecting inflicts costs. Thus a biased pairing process that disproportionately pairs likes with likes raises the payoffs to those exhibiting the pro-social traits. The segmentation associated with community allows those exhibiting pro-social behaviors to capture more of the benefits of the pro-sociality of others than would be the case under random pairing, and thus supports a greater frequency of these traits in a population.

We define the degree of segmentation as follows. If the fraction of the population who are cooperators is α , the probability that a cooperator will meet a fellow cooperator is no longer α but $\sigma + (1 - \sigma)\alpha$ where $\sigma \in (0, 1)$ is the degree of segmentation of the population. Correspondingly the probability of a defector meeting a fellow defector is now $\sigma + (1 - \alpha)(1 - \sigma)$. Note

¹⁶For example, if a group is the "offspring" of those sharing a trait, and if vertical transmission of cultural traits from parents is substantial, the groups will be relatively homogeneous by comparison to the larger population.

that $\sigma = 1$ implies pairing of likes with likes whatever the population composition, and $\sigma = 0$ implying random assignment. The degree of segmentation is thus identical to the degree of relatedness in Hamilton's rule governing the evolution of altruistic behaviors (Grafen 1979, Grafen 1984, Axelrod and Hamilton 1981). A particularly simple (if implausible) case arises if groups are entirely homogeneous, in which case σ is the probability that one's partner for an interaction will be drawn from the group rather than from the entire population, or in the example above, the fraction of exchanges at the village level rather than in the general market. The expected returns to each are then

$$\begin{aligned}\pi^C(\alpha, \sigma) &= \sigma b + (1 - \sigma)(\alpha b + (1 - \alpha)d) \\ \pi^D(\alpha, \sigma) &= \sigma c + (1 - \sigma)(\alpha a + (1 - \alpha)c).\end{aligned}$$

We take the pairing rule and the degree of segmentation as an exogenously given characteristic of the clustering of types supported by community and now consider its effect on the equilibrium level of cooperation.¹⁷ To find this effect, we find the value of α equating the two above expected payoffs, or

$$\alpha^* = \frac{\sigma(d - b) + c - d}{(1 - \sigma)(b - d - a + c)}$$

Depending on the payoffs this equilibrium may be stable or unstable. In the latter case α^* marks the boundary between the basin of attraction of stable equilibria at $\alpha = 1$ and $\alpha = 0$. Figure 8 illustrates the case of a stable interior equilibrium.¹⁸

Four results support our interpretation of the segmentation effect of community. First, there exists some value of $\sigma < 1$ such that universal cooperation is an equilibrium, even where the interaction is a single shot prisoner's dilemma. Call this critical value of the degree of segmentation σ' , which is simply the value for which $\alpha^* = 1$. Thus

$$\sigma' = \frac{a - b}{a - c} < 1,$$

¹⁷The pairing rule and σ might evolve under group selection pressures, because group-average benefits will covary with σ , though not necessarily monotonically for plausible cases. We do not explore this possibility here.

¹⁸The condition for stability given in Section 3 requires that the denominator of the above expression be negative, requiring for $\alpha > 0$ that the numerator be also negative, the intuition behind this result being clear from the vertical intercepts of the payoff functions in Figure 8. Stability obtains when the reward from unilateral defection ($a - b$) is larger than the penalty of cooperating against a defector ($d - c$).

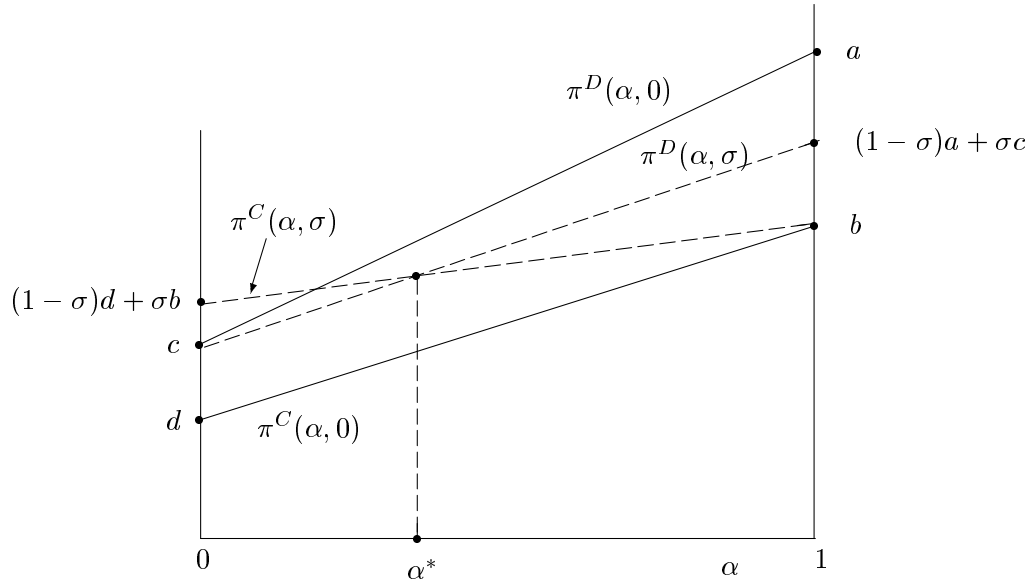


Figure 8: The Segmentation Effect: Stable Interior Equilibrium Case

where the inequality holds because the prisoner's dilemma payoffs specify $b > c$.

Second, there exists some value of $\sigma < 1$, call it σ'' , such that for $\sigma > \sigma''$ some level of cooperation may be sustained as an equilibrium. This is the value of σ for which $\alpha = 0$, or

$$\sigma'' = \frac{c - d}{b - d},$$

which is less than one because $c < b$.

Third, if α^* is stable, an increase in segmentation will increase the frequency of cooperation in the population. This is because $d\alpha^*/d\sigma$ has the sign of $(c - b)(b - d - a + c)$, which is positive for a stable equilibrium.

Fourth, if α^* is unstable, then α^* separates the basins of attraction of the all defect and the all cooperate stable equilibria, and an increase in segmentation will enlarge the basin of attraction of the universal cooperation equilibrium because, for the reasons supplied just above, $d\alpha^*/d\sigma < 0$ in this case.

7 Parochialism

... the advantages of widespread generosity [among llama herders in the Peruvian highlands] outweigh the advantages of cheating or ignoring those who are not one's kin... the custom of [reciprocal generosity] once adopted, might have been strongly selected for at the group level. In our models, herd systems that practice it have larger and far more stable herds after 100 years than systems without it... universal adherence... —even if it includes giving good breeding stock to non-kin—can make it possible for one's children to pass on more animals to one's grandchildren. It does that by ensuring that there will be lots of other herds around from which the children and grandchildren can get (help) when they need it.

Flannery, Marcus and Reynolds (1989):202.

If subgroups in a population exhibit differing levels of pro-social norms, and hence experience coordination failures of differing extent, a high rate of migration into a relatively pro-social group may render the cooperative equilibrium unattainable. ‘Parochial’ cultural values that reduce the rate of migration may thus interact synergistically with the pro-social norms themselves to help maintain stable cooperative interactions in communities. We show this by adapting a model of Boyd and Richerson (1990) to the prisoner’s dilemma interaction we have used to illustrate our three previous community effects.

To illustrate, we return to our model of the retaliation effect, but we now embed the group studied in Section 5 in a population composed of many groups. Interactions take place only within groups, but in each period some migration among groups takes place, with a fraction μ of each group relocating each period.

The migration process is the following. As before, individuals interact for an indeterminate number of periods with termination probability ρ , and following termination of the interaction they update their behaviors through inspection of the payoffs of others. Following this updating, a fraction $\mu \in (0, 1)$ of the group leaves and is replaced by new community members drawn randomly from the larger population. More complicated and more realistic models of migration—those taking account of the probability that migrants will choose successful groups as their destinations, for example—would not alter the results that follow (Bowles and Gintis 1997). The higher the entry and exit costs the lower will be μ .

Suppose the frequency of those playing Tit-for-Tat in a particular group is τ , and its change over time due to updating of behaviors is governed by

$$\tau' = \tau + \dot{\tau} dt$$

Migration alters the composition of the updated population, converting the post updating, pre-migration frequency τ' to the post-migration frequency

τ'' according to

$$\tau'' = (1 - \mu dt)\tau' + \mu\bar{\tau} dt,$$

where $\bar{\tau}$ is the frequency of Tit-for-Tat players in the larger population.¹⁹

The equilibrium frequency of Tit-for-Tatters in the group must satisfy $\tau = \tau''$ (the frequency must be stationary) or

$$\frac{\dot{\tau}}{\tau} = \frac{\mu}{1 - \mu} \left(1 - \frac{\bar{\tau}}{\tau} \right), \quad (21)$$

which may be read: the effects of trait switching due to updating (the left hand term) must just be offset by the effects of migration. As one would expect, where the trait frequency in the group is equal to the population average, migration has no effect on within group frequency and so (21) requires that $\dot{\tau} = 0$, or equivalently that condition (6) obtain.

We know from (5) that the rate of growth of the population frequency $\dot{\tau}/\tau$ can be expressed

$$\begin{aligned} \frac{\dot{\tau}}{\tau} &= \gamma_1\gamma_2[\pi^T(\tau) - \bar{\pi}(\tau)] \\ &= \gamma_1\gamma_2(1 - \tau)[\pi^T(\tau) - \pi^D(\tau)] \end{aligned}$$

Using the payoffs for the retaliation game (17) and (18), this may be expressed:

$$\frac{\dot{\tau}}{\tau} = \gamma_1\gamma_2(1 - \tau) \left[\tau \left\{ 2c - a - d + \frac{b - c}{\rho} \right\} - c + d \right].$$

Using this expression and the equilibrium condition above we define an equilibrium population frequency, τ_μ as is shown in Figure 9 for a population in which $\tau_\mu > \bar{\tau}$. To see if τ_μ is stable, suppose $\tau > \tau_\mu$. The effects of migration on the population composition more than offset the effects of behavioral updating in light of the payoffs in the previous interaction, and hence $d\tau/dt < 0$. The opposite is true for $\tau < \tau_\mu$, so by (7), τ_μ is stable.

Recall that in the retaliation model universal cooperation (by use of the Tit-for-Tat strategy) was a stable equilibrium for sufficiently low termination probabilities, and this being the case, the higher payoffs to members of this group could have fostered the proliferation of the trait through differential growth of the favored population. The presence of intergroup migration alters this result in the following way.

¹⁹For simplicity of exposition, we assume the general population is sufficiently larger than the community in question that we can consider $\bar{\tau}$ to be unaffected by migration.

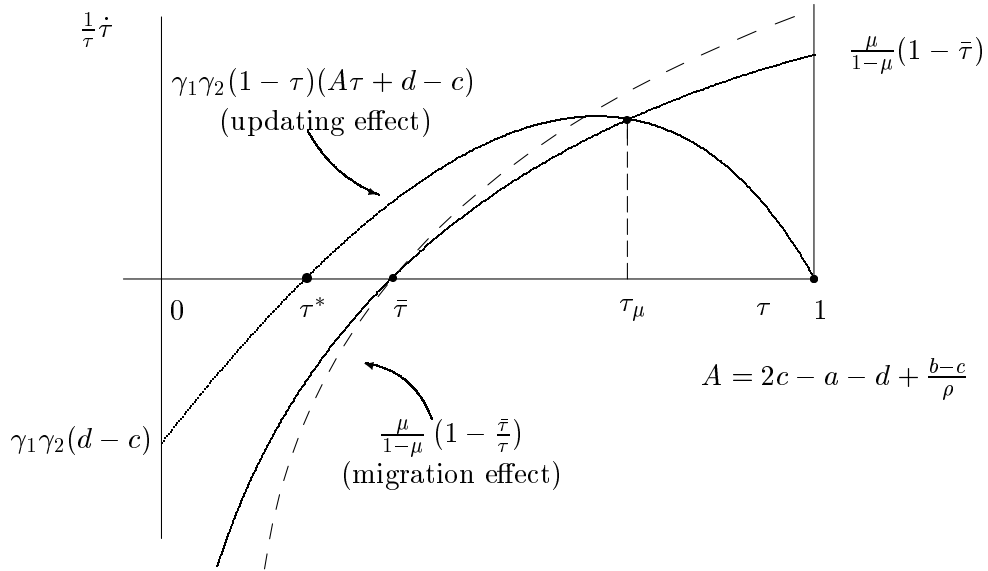


Figure 9: The Retaliation Effect with Migration: Increased immigration (dashed lines) reduces equilibrium frequency of cooperative behavior.

First, if the frequency of Tit-for-Tat players at τ^* is lower than that of the larger population, $\bar{\tau}$, as is shown in Figure 9, then

$$\frac{d\tau_\mu}{d\mu} < 0.$$

This means that an increase in the rate of migration will reduce the frequency of Tit-for-Tat players and increase the frequency of defectors in equilibrium, as is indicated by the dashed line in Figure 9.

Second, if $\bar{\tau} < \tau^*$ (not shown) there will exist either one equilibrium with a low level of cooperation (below τ^*) or three equilibria, two being stable equilibria, one with a high and one with a low level of cooperation, and an unstable equilibrium intermediate between these two.²⁰ In this case an increase in the rate of migration will decrease the level of cooperation at the upper stable equilibrium and increase it at the lower, and there exists some rate of migration sufficiently high as to eliminate the high cooperation equilibrium altogether.

²⁰It may occur that the equilibria coincide.

8 Conclusion

What the entrepreneurial group of Islamic small businessmen most lacks is not capital, for... their resources are not inadequate, not drive, for they display the typically "Protestant" virtues of industry, frugality, independence and determination in almost excessive abundance; certainly not a sufficient market. What they lack is... the capacity to form efficient economic institutions... Despite the advantages of such bold and rugged, not to say ruthless, individualism in stimulating creativity and destroying customary constraints on enterprise in a traditional society, it seems that... it also involves very important limitations on the capacity to grow... by limiting the effective range of collective organization.

Geertz (1963):23,126.

Personal interactions among agents are structured by communities, markets, states, and families, as well as other institutions. The importance of communities in this nexus of governance will evolve at least in part in response to the balance of benefits conferred by the community effects just identified relative to the opportunity costs of community governance and the corresponding benefits of alternative institutional structures. Though we will not model the process here, we think it reasonable to suppose that populations whose interactions are regulated by a balance of community and other governance structures that successfully address coordination failures will tend to grow and to occupy new territories, to absorb other populations, and thus to replace other less successful governance structures. The selective pressures operating in these cases may include military and economic competition as well as people replacing unsuccessful governance structures by successful ones observed in other societies.

Communities have properties allowing them to persist in a world of market exchanges and modern states despite their inability to exploit the efficiency-enhancing properties of markets and the advantages of universal enforcement of rules provided by states. Among these properties, and the one explored in this paper, is the capacity of communities to foster cooperative behavior among community members and thus to avert or attenuate costly coordination problems of the prisoner's dilemma type. Similar results hold for more general payoff structures (Bowles 1996). By inducing pro-social behaviors, communities may also support the norms and values that regularize and justify these behaviors, given that people typically seek consistency between their actions and their valuations.

We have not shown that communities have persisted for these reasons. We have shown only that they might have. Other reasons are commonly suggested, prominent among which is the view that communities and their associated values have persisted by virtue of the conformist and other inertial tendencies of the process of cultural transmission. We do not doubt

that these tendencies are present and are sometimes decisive. But for reasons indicated at the outset, we do not believe that any purely inertial or backward-looking approach can provide an adequate explanation of the emergence and persistence of either community-based social interactions or their associated social norms.

Rather our strategy has been to depict communities, like states and markets, as modern governance structures whose patterns of proliferation, diffusion, decline and extinction are regulated by contemporary processes. Far from being vestigial anachronisms, we think communities may become more rather than less important in the nexus of governance structures in the years to come, since communities may claim some success in addressing governance problems not amenable to market or state solution.

Many have argued that as production shifts from goods to services, and within services to information-related services (Quah 1996), and as team-based production methods increase in importance, the gains from cooperation will increase as well. The reason is that monitoring such activities by those not directly involved is generally costly or impossible and hence neither the complete contracts required by well-functioning markets nor the centralized information required by state regulation are feasible. If, as we suspect, this is the case, we may expect the viability of communities to increase rather than to ebb. On the other hand the kinds of social exclusion often associated with community-based social interactions often violate strongly held universalistic norms and may motivate either legal prohibition or other evolutionary disabilities not considered in this model.

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