How Exposure to Markets Can Favor Inequity-Averse Preferences

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Abstract

This paper shows how non-individualistic preferences can be individual fitness maximizing in market-integrated societies. In the model, individuals share an endowment, which is used for consumption and/or purchase of goods on the external market. We show that inequity aversion about endowment distribution can be an optimal response to merchants' price discrimination. Then, assuming that increased consumption means increased individual fitness, we argue that evolutionary selection can favor inequity-averse preferences. We also argue that our model can explain an empirical finding of Henrich *et al.* (2004) about the positive effect of a society's exposure to markets on its members' sociality.

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1 Introduction

The phenomenon that people have a preference for equity of money distribution is very interesting. As vast empirical evidence on people sharing money shows, alongside their own pecuniary interest, people also care about the money shares other people, even thoroughly unknown to them, receive from money division (for a comprehensive review, see Fehr & Schmidt (2006)). Furthermore, cross-country studies not only prove the ubiquity of inequity-averse preferences but also show that people's revealed amount of equity is very similar across different countries (see, e.g., Roth *et al.* (1991)). This eventually

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has led to the thought that other-regarding preferences are more characteristic of human nature than selfish ones, with the latter being an artifact of conventional economic modeling. (See Fehr & Schmidt (1999); Bolton & Ockenfels (2000); Charness & Rabin (2002) for popular representations of other-regarding preferences.) However, as argued in Henrich (2000), this finding and conclusion may not be as universal as been suggested and may pertain only to modern industrialized societies. Henrich (2000)—a study on the economic behavior of the Machiguenga Indians of the Peruvian Amazon—shows that the preferences of Machiguenga Indians revealed in experiments are rather own-regarding than other-regarding, setting forth the question about the foundations and evolution of human behavior and sociality observed in modern societies.

In order to see if the finding of Henrich (2000) constitutes a phenomenon beyond the society studied, a large project was initiated to obtain more evidence on indigenous people's economic behavior from different small-scale traditional societies from around the world. Arguably, by studying traditional societies it allows us to catch a glimpse of modern people's preferences as of an early stage of their social cohabiting—the foundations of human sociality—and the further evolution of those preferences. This project, documented in Henrich *et al.* (2001) and Henrich *et al.* (2004), consisted of carrying out economic experiments with members of the traditional societies studied. Among main findings is the existence of several between-group differences in people's revealed amount of sociality. One of the differences—the object of this paper—is that members of a market-integrated society (as measured, primarily, by the society's exposure to market exchange) behave on average more pro-socially (i.e., share more with others) than do members of an isolated society. To put it differently, the form of people's (including modern people's) preferences could be forged by the socioeconomic environment people live in.[1] Henrich *et al.* (2004, p.50–51) leave open the question of what explains the discovered empirical pattern, calling for more research on this important finding:

> "The challenge is to understand how and why unselfish behaviors and motives could evolve in the face of the material advantages accruing to selfish individuals."

And the current paper attempts to contribute toward a better understanding of this.

In this paper, we offer an evolutionary argument for the endogeneity of people's preferences documented in Henrich *et al.* (2001) and Henrich *et al.* (2004). We present a model in which a society's exposure to market exchange can favor the evolution of

[1] Among other evidence on the endogeneity of people's preferences, Buchan *et al.* (2002) document cross-cultural differences in people's propensity to trust and reciprocate. Herrmann *et al.* (2008) report a cross-societal variation in people's pro- and anti-social punishment behavior revealed in public goods experiments and link this variation to differences in norms of civic cooperation and the importance of the rule of law across countries. Bowles (1998) offers a systematic review of related theoretical and empirical literature.

inequity-averse preferences for money distribution, whereas selfish preferences prevail in isolated societies. The idea is that in a market-integrated society inequity aversion with respect to money distribution can attenuate the scope of (external) merchants' price discrimination and, subsequently, improve terms of trade with them ultimately leading to the higher consumption levels of the society's members. Then, with the assumption that increased consumption means increased individual fitness, inequity-averse preferences for money distribution can be individual fitness (i.e., own consumption) maximizing and eventually be favored by cultural selection through enculturation.[2]

As a simple example, illustrating the idea of this paper, consider an extended dictator game with consumption. There are two identical individuals and an exogenous endowment of size 1. Let the dictator be randomly chosen from the two individuals to split the endowment between them. Suppose that the endowment distribution resulting from a split is public information, but the individuals' own endowment shares are their private information. An individual's utility of an endowment share is equal to the number of units consumed of the only non-divisible good available on the external market that the individual can afford with his share. And the utility of the unspent endowment share is of a second order compared with the utility from the consumption of the external good (but an individual prefers more endowment everything else equal). Suppose there is a monopolist producer on the external market, who produces the good at some constant marginal cost of, say, 0.1. After learning about the endowment distribution, the producer charges the take-it-or-leave-it price for a unit of the good that maximizes her profits from following simultaneous trades with the two individuals. Within the setting described, what is the optimal endowment sharing rule that maximizes the dictator's utility? Obviously, it is not optimal for the dictator to keep all the endowment for himself. Because if he does so, the producer targets only the rich individual, i.e., the dictator, by setting the price equal to the size of the endowment, i.e., to 1, leaving the dictator with only one unit of the good consumed. Instead, the dictator could increase his consumption by giving the other individual a portion of the endowment large enough to make the profit-maximizing producer set the price aimed at both individuals, which would leave the dictator with some consumer surplus (or rather information rent) and more units consumed. (In our example, if the dictator gives the other individual 1/3 keeping 2/3 of the endowment for himself, then the producer finds it optimal to set the price equal to 1/3, and the dictator

[2] With regard to evolutionary selection, the emphasis in this paper is on the cultural transmission of behavioral traits (through enculturation) rather than on the much slower genetical transmission (through inheritance and mutation). As discussed in Cavalli-Sforza & Feldman (1981), the cultural transmission—in the form of vertical (parents to children) and horizontal (between any individuals) transmitions—turned more important in shaping people's behavioral (social and individual) traits when their social groups increased in complexity and size (after the introduction of agricultural practices some 10,000 years ago). The purpose of cultural transmission here is to have a much faster selection for traits (to take place at least within the lifespan of *homo sapiens*, but which normally takes several generations only) and to have a similar qualitative character of evolutionary dynamics as in models with genetical transmission (Bergstrom (2002)).

enjoys two units consumed.)

The main finding of this example is that, in the presence of market exchange, by sharing with others one can increase the purchasing power of one's own, even diminished, share and, consequently, obtain more consumption. (Conversely, in the absence of market exchange, there are no own-consumption gains from sharing with others.) We can think of two approaches to relate this finding with the phenomenon of inequity aversion. The first is a rationalistic approach. In the above example, from a conventional utility function of consumption we obtain a non-monotonic indirect utility function of money (endowment), which can be interpreted to have underlying inequity-averse preferences for money distribution. Hence, it may be that inequity aversion is indistinguishable from rational (in terms of own-consumption maximization) behavior. However, this interpretation is inconsistent with empirical evidence on people's behavior in laboratory money-sharing experiments. If people are that rational to share with others in order to obtain a strategic advantage for future interactions, then they should realize that no strategic advantage can be obtained from sharing in laboratory experiments, which, nevertheless, they abundantly engage in.

The second approach about the above finding, which is also the approach of this paper, is that in societies exposed to market exchange people with inequity-averse preferences for money distribution obtain a higher material payoff than those with selfish preferences. Being more successful, inequity-averse preferences, therefore, are likelier to survive evolutionary pressures; accordingly, the mode of behavior induced by these preferences becomes more common in market-integrated societies. The converse is true for isolated societies—obsolete in the modern industrialized world—possibly explaining why we may observe more individualistic behavior in some traditional societies not observed elsewhere.

In this paper, we develop the above ideas into a formal model with evolution of preferences. The essential feature of the model is that we measure evolutionary fitness *not* in terms of monetary returns, which are the direct object of people's decision making, but in terms of the consumption that those monetary returns can later afford. More precisely, in our model individuals possess *subjective* preferences for money distribution, which they maximize when they share an endowment. But individuals' *objective* payoffs, or their objective utility with underlying "objective preferences", are the consumption levels that their own endowment shares—resulted from their actions (dictated, respectively, by their subjective preferences)—lead to. Then, we raise the question what subjective preferences generate the highest objective payoffs and, correspondingly, survive evolutionary pressures.[3]

[3] In a similar fashion, Huck & Oechssler (1999) develop an evolutionary argument for revengeful behavior presuming that the individual subjective payoff and subsequent evolutionary fitness resulting from strategies employed are not equivalent. The general models of evolution of preferences (see Ely & Yilankaya (2001); Ok & Vega-Redondo (2001); Dekel *et al.* (2007)) also differentiate between people's subjective and objective preferences.

As we show, because of general equilibrium externalities ensuing from a society's exposure to market exchange inequity-averse preferences for money distribution can render a higher consumption level than that rendered by individualistic preferences and, subsequently, the former are favored by cultural selection. We adopt the "indirect" evolutionary approach (see Güth & Yaari (1992), Ely & Yilankaya (2001)), when showing that the equilibrium play in our model is evolutionary stable, but the standard approach (Weibull (1995)) would render the same results, too. In fact, in our model the two approaches are interchangeable.

This paper also contributes to the evolutionary literature by providing a distinct and empirically supported argument on how non-individualistic preferences in the individual selection framework can survive evolutionary pressures. Typically, evolutionary models in favor of non-individualistic preferences require either a group-selection argument in the standard approach (for a review, see Bergstrom (2002)) or certain informational assumptions about the observability of others' preferences in the "indirect" approach (for a concrete example, see Bester & Güth (1998); for a more general argument, see Dekel *et al.* (2007)). This paper, however, bypasses all of the above: the result primarily hinges on general equilibrium effects.[4] Therefore, this paper instead falls into the "game of life" paradigm, arguing that people's behavior should be examined in a wider social context (see Binmore (1994, 1998); or Güth & Napel (2006) for an example related to the evolution of inequity-averse preferences).

The remainder of the paper is organized as follows. In Section 2, we develop and solve a model. In Section 3, we discuss the results obtained, link them to empirical studies, and offer some extensions. The last section concludes the study.

2 Model

2.1 Framework

With an allusion to the haystack model of Smith (1964), consider a river with a large number of small villages situated along its banks. Suppose that every village is dwelled by N farmers, randomly drawn from the population of farmers, and that there is occasional, but relatively infrequent migration of farmers between villages.

In a village, the farmers' joint work results in a publicly observed harvest surplus, henceforth, the endowment S. The farmers split the endowment among themselves, which results in a vector of endowment shares $\mathbf{s} = (\mathbf{s}_1, ..., \mathbf{s}_N) : \mathbf{s}_i \in [0, S]$ and $\Sigma_i \mathbf{s}_i = S$. Let the endowment distribution in the village, ensuing from an endowment split, be public

[4] Certainly, this paper is not unique in showing how individual selection can favor pro-social preferences. For instance, Becker (1976) presents a model in which egoists take actions as though they had altruistic preferences in order to benefit from others' altruism.

information, while an individual farmer's share is his private information. If used for own consumption, an endowment share s renders a farmer a material payoff of $U^0(s)$, $U^0_s > 0$, $U^0_{ss} < 0$ (which also denotes the reservation utility of an endowment share s). In the event the village is exposed to trades with external merchants (who do not belong to the population of farmers), endowment shares can also be used as a means of exchange, i.e., as money, to purchase goods from merchants.[5]

Merchants reach farmers by the river. Suppose they can offer one type of goods—"the good"—which, on the other hand, can be produced in various quality $q > 0$ with production function $C(q), C_q > 0, C_{qq} > 0$, and $\lim_{q \to 0} C(q) = 0$. The returns to scale from producing a given variety are constant. Merchants offer farmers a take-it-or-leave-it menu of price-quality (p, q) bundles of the good to choose from, where a price p is gauged in terms of the endowment. In their trade with farmers, merchants maximize their expected profits (returns less production costs), given the income distribution observed in the village, farmers' demand, and market competition, described more precisely below.

Assume that every farmer has a demand for at most one variety of the good. The consumption of a (p, q) variety of the good and of the remainder of an endowment share s renders a farmer a material payoff of $U^G(s-p, q), U^G_s > 0, U^G_{ss} < 0, U^G_q > 0, U^G_{qq} \leq 0, U^G_{sq} > 0$. A farmer considers purchasing a variety (p, q) only if it results in a non-negative net utility level U, defined as

$$U(q, s, p) \equiv U^G(s - p, q) - U^0(s)$$

with properties $U_s > 0, U_{ss} < 0, U_q > 0, U_{qq} \leq 0$, and $U_{qs} > 0$.[6] Furthermore, given a menu of price-quality bundles, a farmer chooses the bundle, if any, that maximizes his net utility U. Also, farmers have no bargaining power in their trade with merchants.

Finally, we consider three different scenarios of the external market structure. The first one is autarky: merchants are absent (e.g., some villages, situated high up the river, are not reachable). The second one is monopoly (some villages are reachable by only few merchants). The third one is perfect competition (other villages are reachable by many merchants).

[5] In the framework described, the "farmers" are chosen to allude to the historical division of labor into farmers, nomads, and merchants, which could potentially serve as a "real life" example for the subsequent argument about the cultural selection of inequity-averse preferences for money distribution. In addition, with "farmer" economy it is intended to refer to the traditional societies in Henrich *et al.* (2004), empirical findings of which our model aims to explain.

[6] All the listed properties of the utility function U are related to consumer preferences for normal goods (see, e.g., Mas-Colell *et al.* (1995)). In particular, the positive partial derivative U_s implies that a richer individual derives a higher utility from the consumption of the good (due to, say, smaller opportunity costs). Similarly, the positive cross derivative U_{qs} can be interpreted as meaning that a richer consumer values quality more (which also follows from the convexity of the Engel curves for high-quality goods).

2.2 Game of Life and Selection

2.2.1 Sharing rule and subjective preferences

In every village, Nature randomly selects a farmer to be the "dictator," who at own discretion is to divide the endowment into a vector of shares $\mathbf{s}$.[7]

Suppose that farmers have subjective preferences for endowment division. Let these preferences be characterized by the subjective utility function U^S such that a farmer i's utility from an endowment division $\mathbf{s}$ is

$$U_i^S(\mathbf{s}) = \mathbf{s}_i - \alpha_i \frac{1}{N-1} \sum_{j \neq i} g\left(\max\left\{\mathbf{s}_j - \mathbf{s}_i, 0\right\}\right) - \\ - \beta_i \frac{1}{N-1} \sum_{j \neq i} g\left(\max\left\{\mathbf{s}_i - \mathbf{s}_j, 0\right\}\right), \tag{1}$$

where $\mathbf{s}_i$ is own endowment share, $\alpha_i \in [\underline{\alpha}, \overline{\alpha}]$ and $\beta_i \in \left[\underline{\beta}, \overline{\beta}\right]$ are subjective preference parameters, initially distributed in the population according to some non-degenerate distribution, and g is a strictly convex function. The second term of (1) measures the utility loss from disadvantageous inequality, and the third term measures the loss from advantageous inequality.[8] In what follows, the interest lies in the third term of (1) and, therefore, for simplicity we assume that $\alpha_i = \beta_i$.

A farmer i, when selected to be the dictator, maximizes his subjective utility U_i^S with respect to endowment division $\mathbf{s}$. Let the dictator's share be $\mathbf{s}_1$ in an endowment division $\mathbf{s}$. To save on notation, we drop the subscript from the dictator's utility U^S.

2.2.2 Optimal division

The endowment division that maximizes the dictator's subjective utility is given by

$$\mathbf{s}^* = \arg\max_{\mathbf{s}} U^S(\mathbf{s}). \tag{2}$$

We can immediately make two observations about $\mathbf{s}^*$. First,

$$\mathbf{s}_1^* = \max(\mathbf{s}^*),$$

[7] As for the endowment sharing rule, we adopt the dictator-game framework, which is done for modeling convenience and also to show that inequity aversion can arise even under such an extreme form of endowment sharing. The main results are also robust against other sharing rules as, e.g., in the ultimatum game. What matters in the end is the presence of general equilibrium effects.

[8] This utility function is essentially as in Fehr & Schmidt (1999), except for the function g. The role of this function is to have the marginal rate of substitution between own share and endowment inequality non-constant (unlike in Fehr & Schmidt (1999)), needed in our model to obtain different endowment divisions for different subjective preference parameters.

i.e., the dictator's share has to be the highest. (Otherwise, roughly speaking, the dictator can increase his utility by redistributing the difference between the highest share and his own share equally among all the farmers with lower shares.) The second observation is that all the other farmers in the group get equal shares:

$$\mathbf{s}_i^* = (S - \mathbf{s}_1^*)/(N-1), \quad i \geq 2.$$

From the first observation, we can ignore the second term in (1). Then, because of the convexity of function g the maximum of U^S is reached when the remainder of the endowment is distributed equally among the other farmers.

Having said that, the optimal division $\mathbf{s}^*$ is fully characterized by the dictator's share $\mathbf{s}_1^*$ only, which, in turn, is determined by his subjective preference parameter β. Let $\tilde{\mathbf{s}} : [\underline{\beta}, \overline{\beta}] \to [0, S]$ map a subjective parameter β into $\mathbf{s}_1^*$ of $\mathbf{s}^*$ in (2). Finally, in order to have a one-to-one mapping between β and $\mathbf{s}_1^*$, we restrict the domain $[\underline{\beta}, \overline{\beta}]$ to be such that $\tilde{\mathbf{s}}$ is a strictly monotone function with $\tilde{\mathbf{s}}(\underline{\beta}) = S$ (perfect selfishness) and $\tilde{\mathbf{s}}(\overline{\beta}) = S/N$ (perfect inequity aversion).[9]

2.2.3 Objective payoffs and the "veil of ignorance"

A farmer's objective payoff from an endowment division $\mathbf{s}$—his evolutionary fitness—is measured by the resulting consumption utility U^0 or U^G, which depends both on own endowment share $\mathbf{s}_i$ and on the menu of consumption bundles offered by merchants (i.e., on what the farmer can afford with his share).

Merchants design a menu of consumption bundles distinctly for every village after they learn about endowment distribution there. Obviously, the profit-maximizing menu is not invariant to different endowment distributions in a village. The assumption is that farmers cannot discern for themselves what menu will be offered by merchants and, subsequently, what objective payoffs their actions over endowment split will result in. Instead, they can be thought of as living behind the "veil of ignorance" about external markets or about what "game of life" they are part of. Therefore, if selected, a farmer divides the endowment according to his subjective preference only without making any prediction about what objective payoffs will result from his action at the end of the "game of life." Furthermore, the knowledge of other farmers' preferences or the population distribution of preferences is irrelevant for this dictator-like game (which is generally not the case in models with preference evolution; see, e.g., Ok & Vega-Redondo (2001) or Dekel *et al.*

[9] In what follows, we use the "indirect" evolutionary approach (Güth & Yaari (1992) and Ely & Yilankaya (2001)), where players rationally maximize their subjective preferences. Alternatively, we could think of the farmers as being "pre-programmed" to split the endowment—keeping $\tilde{\mathbf{s}}(\beta_i)$ and dividing equally the rest—as in the standard evolutionary approach, see Weibull (1995). Due to the specificity of the game studied, here the two approaches render identical results (which is not necessarily the case in general; see, e.g., Huck & Oechssler (1999)).

(2007)).

2.2.4 Games of life

Given the three external market structures, we distinguish, respectively, three "games of life" that farmers in every village can be part of. Each game of life comprises three stages. In the first stage, the farmers (in every village) play the dictator game $\Gamma = \{\beta_i, \hat{s}_i, E(U_i^S)\}_{i=1}^N$, where $\beta_i \in [\underline{\beta}, \overline{\beta}]$ is a farmer i's subjective inequity-aversion parameter, $\hat{s}_i \in [0, S]$ is an endowment share kept for himself by a farmer i if selected to be the dictator (with the rest of the endowment, $S - \hat{s}_i$, being divided equally among the other farmers), and $E(U_i^S)$ is a farmer i's expected subjective utility from a strategy profile $\hat{s} = (\hat{s}_1, ..., \hat{s}_N)$. In the second stage, after observing the resultant endowment distribution in the village, merchants design a menu of price-quality bundles $\{(p_j, q_j)\}_{j=1}^m$, where m is the number of bundles offered. And in the third stage, simultaneous trades take place; profits and consumption utilities are realized.

With merchants being profit maximizing and farmers — consumption maximizing in the second and third stages, respectively, each game of life can be reduced to one of the following "extended dictator games" with expected consumption payoffs. Define the three games of life by $\Gamma^k = \{\hat{s}_i, \Pi_i^k\}_{i=1}^N$, where $k = A$, M, and C stand for the different market structures studied: autarky, monopoly, and competition, respectively. As in game Γ, a strategy $\hat{s}_i \in [0, S]$ is an endowment share kept for oneself with the rest of $S - \hat{s}_i$ divided equally among the other farmers; $\Pi_i^k(\hat{s})$ is a farmer i's expected consumption utility from a strategy profile $\hat{s} = (\hat{s}_1, ..., \hat{s}_N)$ with the merchants' and farmers' optimal play at the later stages accounted for. The exact form of Π_i^k is specified later for each game separately.

2.2.5 Preference evolution

For each game of life studied, we tackle the question of what subjective preferences, characterized by parameter β, are favored by cultural selection, with their share in the population (of a village) increasing at the expense of other less successful preferences. The approach is that of preference evolution or "indirect" evolution with a static stability concept of equilibrium so that in equilibrium no mutation (resulting, say, from an influx of other preference types due to migration of farmers) can give a higher material payoff than that of the incumbent types (Güth & Yaari (1992)). Based on the results of Ely & Yilankaya (2001), in our games of life studied, evolution selects those subjective preferences that lead to the choice of equilibrium strategies of the game of life in question. And we call those subjective preferences evolutionary stable.[10]

[10] Ely & Yilankaya (2001) studies finite games, while in our model the action space is allowed to be infinite: $\hat{s}_i \in [0, S]$. However, since we design our games in such a way that the existence of equilibrium is not an issue, then the results of Ely & Yilankaya (2001) apply to our setting as well despite a continuous

In our model, evolutionary stable preferences are those that yield the greatest consumption payoff. If $\hat{s}^k$ is an equilibrium strategy in game of life Γ^k, then an evolutionary stable subjective preference parameter is $\beta^k = \tilde{\mathbf{s}}^{-1}(\hat{s}^k)$.

2.3 Equilibrium Play

Case 1: Autarky

Consider game Γ^A, where the farmers are not exposed to any external trades, making it a standard N–player dictator game. The material payoff from an endowment share s is $U^0(s)$. Given a strategy profile $\hat{s} = (\hat{s}_1, ..., \hat{s}_N)$, the expected consumption utility to a farmer i is

$$\Pi_i^A(\hat{s}) = \frac{1}{N} U^0(\hat{s}_i) + \frac{1}{N} \sum_{j \neq i} U^0 \left(\frac{S - \hat{s}_j}{N - 1} \right).$$

The first term of Π_i^A is the farmer's utility of the endowment share $\hat{s}_i$ kept for himself when selected to be the the dictator, multiplied by the probability of being the dictator, and the second term is the sum of expected utilities of own endowment shares when other farmers divide the endowment. Since own strategy $\hat{s}_i$ has no effect on the second term of Π_i^A, the unique equilibrium strategy for all the farmers is

$$\hat{s}^A = S,$$

because of $U_s^0 > 0$.

Hence, the evolutionary stable preference type is

$$\beta^A = \tilde{\mathbf{s}}^{-1}(S) = \underline{\beta}.$$

In other words, in autarky selfish types prevail.

Case 2: Monopoly

In game Γ^M, in order to specify a farmer i's expected consumption utility Π_i^A, first, we need backwardly to solve for the optimal consumption bundles offered by the monopolist profit-maximizing merchant for a given endowment distribution.

After an endowment split in the village, the merchant observes the resultant endowment distribution with the support (s_1, s_2), $s_1 \geq s_2$, $s_1 + s_2 = S$, and the probabilities $1/N$ and $(N-1)/N$, respectively (this is because the dictator splits the remaining part of the endowment equally among the other farmers). Since individual shares are private information, the design of consumption bundles is a hidden-information problem for the

action space. Alternatively, we could make our games studied finite by simply discretizing the players' action and preference spaces, and then the results of Ely & Yilankaya (2001) would apply directly. For pitfalls lying with using continuous action spaces, see Oechssler & Riedel (2002).

merchant (Mussa & Rosen (1978)). With at most two distinct endowment levels in a village, the merchant offers the villagers at most two consumption bundles, respectively. We also assume that once the menu of bundles is offered, it is not subject to change. By this assumption, we rule out the possibility of the merchant's updating her beliefs about prospective buyers' wealth distribution after some trade has taken place (alternatively, we can assume that at the last stage only one trade with a random farmer takes place).

The merchant's problem is to design the menu of bundles $\{(p_1, q_1), (p_2, q_2)\}$ that maximizes her profit

$$\frac{1}{N}(p_1 - C(q_1)) + \frac{N-1}{N}(p_2 - C(q_2))$$

subject to the incentive-compatibility and individual-rationality constraints, respectively,

$$U(q_i, s_i, p_i) \geq U(q_j, s_i, p_j)$$
$$U(q_i, s_i, p_i) \geq 0, \quad i = 1, 2 \text{ and } j \neq i.$$

A closed form solution to the merchant's problem can be obtained only if we assume the utility function U to take a specific form, e.g., to be quasi-linear in price p. However, the general properties of the solution are invariant to the form of the utility function U given its properties (the concavity and the single-crossing property).

In particular, unless the merchant finds it optimal to serve only the richer farmer, the optimal menu of bundles $\{(p_1, q_1), (p_2, q_2)\}$ has the individual rationality constraint of the poorer farmers and the incentive compatibility constraint of the richer farmer binding (the single-crossing property ensures that the other incentive compatibility constraint holds). In this case, the richer farmer enjoys some positive information rent $U(q_1, s_1, p_1) > 0$, while a poorer farmer has none. But if the merchant finds it optimal to shut down on the poorer farmer—which happens when the difference in endowment shares, $s_1 - s_2$, is large enough—then the merchant serves only the richer farmer but leaves him with no information rents.

All in all, if we denote the shutdown value, determined endogenously from the merchant's problem, by s^*, then for the values of a poorer farmer's endowment share s_2 above s^*, but with $s_2 < s_1$, the merchant serves both the rich and the poor, with the net utilities $U(q_2, s_2, p_2) = 0$ and $U(q_1, s_1, p_1) > 0$. If we have $s_2 \leq s^*$ or $s_1 = s_2$, i.e., when the dictator makes a very unequal split or makes it perfectly equal, the merchant designs only one non-zero bundle (p_1, q_1), but for which the net utility is $U(q_1, s_1, p_1) = 0$.

Given the merchant's optimal design of consumption bundles, a farmer's indirect material utility function Y of own endowment share s is given by

$$Y(s) = \begin{cases} U^0(s) & \text{if} \quad 0 \leq s \leq S/N, \\ U^0(s) + U(q_1, s, p_1) & \text{if} \quad S/N < s < S - (N-1)s^*, \\ U^0(s) & \text{if} \quad S - (N-1)s^* \leq s \leq S, \end{cases} \tag{3}$$

where (p_1, q_1) is the consumption bundle designed for the richer farmer (which is itself a function of the endowment share s); and s^* is the threshold endowment share discussed above.

Hence, in game Γ^M, a farmer i's expected material payoff (evolutionary fitness) is

$$\Pi_i^M(\hat{s}) = \frac{1}{N} Y(\hat{s}_i) + \frac{1}{N} \sum_{j \neq i} Y\left(\frac{S - \hat{s}_j}{N-1}\right). \tag{4}$$

Again, since a farmer's own action has no influence on the second term of Π^M but only on its first term, the expected payoff Π_i^M for every farmer i is maximized when his indirect utility Y in (3) is maximized.

From function definition (3), we see that for the endowment shares s in the interval $(S/N, S-(N-1)s^*)$ the material utility Y is increased by the information rent $U(q_1, s, p_1)$ over the reservation utility $U^0(s)$. For other values of s, the material utility is equal to the reservation utility $U^0(s)$ only (because the merchant leaves no information rents if endowment distribution is very unequal). Assuming that there exists the maximizer of function Y over the restriction $(S/N, S-(N-1)s^*)$, denote it by

$$\bar{s} = \arg\max(Y(s) \mid S/N < s < S - (N-1)s^*). \tag{5}$$

Since the reservation utility U^0 is strictly increasing, then the function value $Y(\bar{s})$ is the global maximum if

$$Y(\bar{s}) \geq Y(S)$$

or

$$U^G(q_1, \bar{s} - p_1) \geq U^0(S). \tag{6}$$

In other words, it is not obvious from the material payoff perspective whether the dictator should keep all the endowment for himself (and maximize his reservation utility U^0) or keep $\bar{s}$ and divide equally the remainder $S - \bar{s}$ among the other farmers (and enjoy some information rent). For condition (6) to hold, the size of information rent matters, which, on the other hand, is dependent on the form of the utility functions U^0 and U^G. Intuitively, condition (6) is likely to hold when farmers after a certain point become quickly satiated with the consumption of their own endowment and value the outside good highly enough. (See the numerical example following this subsection that illustrates the points raised.)

Returning to evolutionary fitness expression (4), if condition (6) holds (also suppose that if we have $Y(\bar{s}) = Y(S)$ then a farmer prefers the less unequal split), then the unique equilibrium strategy $\hat{s}^M$ for all the farmers is

$$\hat{s}^M = \bar{s},$$

and the evolutionary stable preference type is

$$\beta^M = \tilde{\mathbf{s}}^{-1}(\bar{s}) > \underline{\beta}.$$

On the other hand, if condition (6) does not hold, then the unique equilibrium strategy $\hat{s}^M$ for all the farmers is

$$\hat{s}^M = S,$$

and the evolutionary stable preference type is

$$\beta^M = \tilde{\mathbf{s}}^{-1}(S) = \underline{\beta}.$$

Case 3: Perfect competition

Consider game Γ^C, where there are many competing merchants on the external market. Here, unlike in the previous case, we have a competitive screening problem. Given that all the competing merchants' profits are equal to 0, the qualities offered have to be as in the symmetric-information case with the prices equal to the total cost of producing the corresponding qualities. Therefore, the price-quality allocation (p, q) aimed at a farmer with an endowment share s is determined by $p = C(q)$ and $U_q(q, s, p) = C_q(q)$. Since, as it can be easily shown, in perfect competition the net utility U, unlike in the monopoly case, always strictly increases in endowment share s, the expected material payoff Π_i^C for all the farmers i is

$$\Pi_i^C(\hat{s}) = \frac{1}{N}\left[U^0(\hat{s}_i) + U(q_i, \hat{s}_i, p_i)\right] + \frac{1}{N}\sum_{j \neq i}\left[U^0(s_j^{\#}) + U(q_i, s_j^{\#}, p_i)\right],$$

where $s_j^{\#} = (S - \hat{s}_j)/(N-1)$, and it is maximized for all i at

$$\hat{s}^C = S.$$

Hence, in game Γ^C, the unique evolutionary stable preference type is

$$\beta^C = \tilde{\mathbf{s}}^{-1}(S) = \underline{\beta},$$

i.e., in perfect competition selfish types prevail.

Summary

The proposition below summarizes the resultant evolutionary stable preferences for the games of life studied.

Proposition 1 *The evolutionary stable preference types* β *with respect to endowment distribution are*

- *in game* Γ^A*, autarky, —* $\beta^A = \underline{\beta}$*;*
- *in game* Γ^M*, monopoly, — if condition (6) holds, then* $\beta^M = \tilde{\mathbf{s}}^{-1}(\bar{s}) > \underline{\beta}$*, where* $\bar{s} < S$ *is defined by (5) and* $\tilde{\mathbf{s}}^{-1}$ *is the inverse of the mapping* $\tilde{\mathbf{s}}$ *from a preference type to the optimal own endowment share; otherwise,* $\beta^M = \underline{\beta}$*; and*
- *in game* Γ^C*, perfect competition, —* $\beta^C = \underline{\beta}$*.*

With regard to the link between market concentration and the type of evolutionary stable preferences, a more general prediction, not shown formally here, would be that the more monopolist the markets are, the more pro-social the preferences evolve. In other words, with more competitive markets and, accordingly, with less price discrimination, income inequality has weaker adverse effects on the consumption utility of the rich.

Numerical example

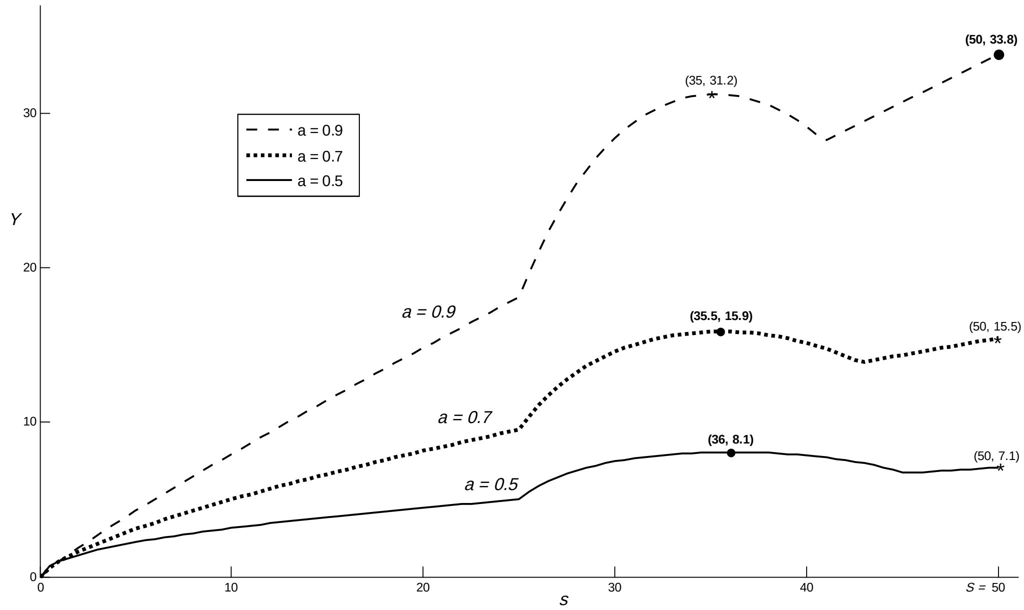
Here we illustrate the results obtained for the case with the monopolist merchant. Consider the following specification of the model. A farmer's reservation utility of his own endowment share $s \in [0, S]$ is given by $U^0(s) = s^a$, where $0 < a < 1$; the utility from the consumption of a (p, q) variety given a share s is $U^G(s - p, q) = (1 + q)(s - p)^a$ (so that $U^G(s - 0, 0) = U^0(s)$). The merchant's production function is given by $C(q) = q^b$, where $b > 1$. Let the parameters take the following values: the group size $N = 2$, the endowment $S = 50$, the cost function parameter $b = 2$, and the consumption utility parameter $a = 0.5, 0.7$, and 0.9. (We estimate the model for different values of a to illustrate the sensitivity of results with respect to different importance levels of own endowment consumption for material utility, as discussed when deriving condition (6)).

For this specification of the model, the numerically obtained values of the indirect utility function Y in (3) are plotted in Figure 1 below.[11] On the horizontal axis, we have own endowment shares s, and on the vertical axis we have the resultant utility levels Y (given the merchant's optimal play). The three graphs plot the indirect utility levels for the three different consumption parameter a values. The coordinates of the maximum points are given in bold and are contrasted with the coordinates of the other maximum candidate points. As we can see from the graph, when the value of a is not too high,

[11] The model was solved using Matlab and its function *fsolve* to solve systems of nonlinear equations.

i.e., when farmers do not value own produce (i.e., own endowment) too much relatively to the outside good, we have that farmers achieve the highest material utility by sharing with others (see the plots for $a = 0.5$ and 0.7). In general, it can be shown that the lower the values the parameter a takes, the more the farmers gain from sharing. The condition equivalent to (6)—when farmers are better off sharing with others—is that $a < 0.749$.

Figure 1. Indirect Utility Function Y



3 Discussion

3.1 Main Result

The primary purpose of our model is to offer an explanation for the empirical finding that members of market-integrated societies reveal to have stronger pro-social preferences than do members of isolated societies (which more thoroughly discussed later in this section). The results of our model, presented in Proposition 1, show: Evolutionary selection, based on individual fitness maximization, is likelier to favor the evolution of individualistic preferences in isolated societies and the evolution of inequity-averse preferences in market-integrated societies (given high enough market concentration on external markets and high enough valuation for external goods). Consequently, in the two types of societies people can exhibit different behaviors induced by their different preferences, as is empirically documented. The intuition behind this finding is that if a society is exposed to market exchange then inequity aversion can attenuate the scope of external merchants' price discrimination and improve the society's terms of trade—the effect absent in isolated societies.

If we attempt to take a more general stance, this paper shows how external factors—such as, among other things, exposure to market exchange—can have an influence on people's behavior and the shape of their preferences. In particular, besides genuinely altruistic considerations for other people (frequently adhered to when explaining experimental evidence on people's behavior, e.g., Levine (1998)), people may also acquire a preference for equity (of money distribution) in order to subdue a third party's adverse impact on their welfare. (Another example of a third party's adverse impact, besides rent extraction by merchants studied here, could be, for instance, levying income or consumption taxes by the central tax authority that aims to maximize its tax revenues.)

Finally, this paper is *not* an attempt to explain the phenomenon of inequity aversion observed in modern societies, which is by far more complex than this paper can possibly grasp. In this regard, it should rather be seen as an attempt to provide an additional insight or venue on how, besides many other factors, the phenomenon of inequity aversion could have arisen in modern societies. However, even with the model studied here, its findings could turn relevant for explaining differences in people's revealed amount of sociality between modern societies, which, even small, nevertheless still exist (see, e.g., Roth *et al.* (1991)). Since this paper also predicts a positive and direct relationship between market concentration and amount of people's sociality, then, with this relationship empirically tested, we could see if the postulated interdependence of people's preferences and economic environment is also relevant in modern times, which is left for future research.

3.2 Empirical Evidence

Here, we give a short summary of empirical findings on indigenous people's behavior, documented in Henrich *et al.* (2001) and Henrich *et al.* (2004).

As already mentioned in the introduction, in response to the finding of Henrich (2000), which proves the behavior of Machiguenga Indians more selfish than that observed in modern societies, a large project was started to inquire into this finding more thoroughly. The aim of this project was to look into the foundations of human sociality and its origins with the help of studies on small-scale societies, which could possibly shed light on the evolutionary transition of modern people's preferences. Under this project, indigenous people from 15 different small-scale societies from around the world took part in experiments consisting of their playing ultimatum, public good, and dictator games. The results of this project are summarized in Henrich *et al.* (2001), and its full account is given in Henrich *et al.* (2004).

After regressing the measure of sociality revealed by indigenous people in experiments on their individual and societal characteristics, the contributors of this project discovered several empirical regularities. First, there is considerably more behavioral variability across the traditional societies studied than had been found in any study on modern societies. Second, no individual-level economic or demographic variables can explain any variation in behavior either within or across the societies. Lastly, the researchers observed two between-group differences in people's behavior. The first one is based on the importance of cooperation in a society's economic production, and the second — on the degree of market integration (as measured, primarily, by societies' exposure to external markets). Together, these two factors account for about a half of the variation among societies in mean ultimatum game offers with each of these factors being equally important.

The above findings are obtained from a regression that uses the data pooled from all the societies studied in this project. However, the finding that there is a positive link between market integration and amount of sociality is also supported by an individual study within this project. Ensminger (2004) is a study on the society of Orma of East Africa, which has significant variation in market involvement among its different societal groups. One of the questions raised in Ensminger (2004) is whether there is an effect of market integration on the fairness norms (mean offers in the experimental games conducted) of the Orma people. Ensminger (2004) finds a strong positive effect and concludes that the behavior of the Orma people is consistent with the general finding from the overall cross-cultural project that shows fairness increasing with market integration.

In line with the views expressed on the effect of market integration on fairness in other studies of this project, Ensminger (2004) suggests that fairness is learned in the course of market exchange and these socializing effects of the market permeate other spheres of everyday life. But besides this heuristic explanation, Henrich *et al.* (2004) essentially leave the question of what explains this effect open.

3.3 Model Extensions and Further Research Directions

In most societies, the distribution of people's preferences is more diverse than just one type of preference (see, e.g., Fehr & Schmidt (1999) for evidence on modern societies and Henrich *et al.* (2004) — on traditional societies). In our model, to achieve a non-trivial distribution of evolutionary stable preferences, besides that due to migration between villages, we could elaborate the model by introducing a noisy signal that merchants receive about the endowment distribution resulting from an endowment split. Then, the merchants would design consumption bundles for farmers based on the signal received. Due to the noisiness of a signal, there would be no single type of subjective preference that would be own-consumption maximizing for any signal realization, in particular, for game Γ^M with condition (6) met. Instead, different types of subjective preference would be evolutionary-fitness maximizing for different signal realizations, leading, eventually, to a more diverse distribution of evolutionary stable preferences. Similarly, we could subject the structure of the external market to different competitive shocks, which would also lead to a more diverse distribution of evolutionary stable preferences.

As already envisaged in Subsection 3.1, we can think of other mechanisms affecting the form of people's preferences. For instance, within our model, consider an effect on people's optimal (i.e., own-consumption-maximizing) behavior after the introduction of a uniform sales tax on the outside good. If the tax authority aims to maximize its tax revenues, then the model would predict people responding to the tax by reducing inequality in wealth on the grounds similar to the monopoly case studied above. On the other hand, if the tax imposed by the tax authority is negligible, then it would not have much impact on people's behavior. In other words, the importance of the government's role in the economy can also shape the appearance of people's preferences, with its more central role adding to more inequity aversion.

Relatedly, an interesting research question is: From the rationalistic own-consumption-maximization perspective, raised in the introduction, what is the optimal endowment (income) distribution that maximizes the dictator's utility? This is a different question from the one studied here, where the players maximize their subjective preferences characterized by the subjective utility U^S in (1). In game Γ^M, it may not be optimal for the dictator to split the remaining endowment evenly among the other players, provided he finds it optimal to give away some of the endowment. Instead, the dictator can do better by dividing the remaining endowment unevenly as it can be seen from the special case of $N = 3$ with the net utility function U quasi-linear in price p.

4 Conclusion

In this paper, we present a model, where, assuming that increased consumption means increased individual fitness, we show how inequity-averse preferences can survive evolutionary pressures in societies exposed to market exchange. The key driver of our results is that a reduction in one's own share in favor of less income inequality can increase the purchasing power of one's own, even reduced, share. This effect stems from the inability of markets under asymmetric information to extract all the rents from buyers. As a result, information rents available from trade can amply offset the direct utility loss from sharing with others. We argue that this result of our model can explain the empirical finding of Henrich *et al.* (2004) that in market-integrated societies people have stronger pro-social preferences than they do in isolated societies.

An important condition for our result to hold is that markets are sufficiently concentrated. A way to test the predictions of our model would be to see if there is a positive relationship between a market concentration index and measure of inequity aversion across different countries.

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