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ABSTRACT

Rules, Preferences and Evolution from the Family Angle*

This paper reviews the literature concerning the evolution of cultural traits in general and preferences in particular, and the emergence and persistence of rules or norms, from a family perspective. In models where every new person is effectively the clone of an existing one (either a parent or anyone else), there may be evolution only in the demographic sense that the share of the population who hold a certain trait increases or decreases. Evolution in the strict sense of new traits making their appearance occurs in models where the trait characterizing any given member of any given generation is a combination of traits drawn at random from those represented in the previous generation. Preferences may be altruistic or non-altruistic, but individuals may behave as if they were altruistic even if they are not, because a rule or norm may make it in their interest to do so. Evolutionary stability and renegotiation proofness play analogous roles, the former by selecting altruistic preferences, and the latter by selecting cooperation-inducing rules. The existence of population groups recognizable by outward characteristics like ethnicity or religious practice may convey useful information regarding imperfectly observable traits, such as preferences, of direct interest to individuals, but it may also lead individuals to judge others by their group membership rather than by their unobservable individual qualities, and thus to see them as possible foes.

JEL Classification: Z1, C78, D01, D02, D13, J13

Keywords: evolution, preferences, rules, socialization, matching, hold-up problem

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1 Introduction

In a widely influential book entitled *Chance and Necessity*, the 1965 Nobel prize winner for Physiology or Medicine, Jacques Monod, elaborates on the proposition that, starting with the infinitesimally small perturbation that broke the primeval equilibrium some 13 billion years ago, the history of the universe is punctuated by a series of random events, each of which caused the universe to deflect from its previous course and to start on a new one. Each of these turning points was unpredictable given all that had gone before, but conditioned all that came after.[1] The proposition has its roots in antiquity. The first to speak of "chance and necessity" was the Greek philosopher Democritus (5th-4th century BC). Three centuries later, in *De rerum natura*, the Roman poet and philosopher Lucretius used the word *clinamen* (Latin translation of the Greek $\pi\alpha\rho\varepsilon\nu\kappa\lambda\iota\sigma\iota\varsigma$, deviation) to denote a fortuitous occurrence that changes the course of events. Where living beings are concerned, a mutation is a *clinamen*.[2] Modern biological research has vindicated the intuition of Lucretius first and Darwin (1859) second, that natural selection determines which of the innumerable mutations randomly taking place in the biosphere will succeed. One of particular importance for the subject of the present paper is the switch from asexual to sexual reproduction. The latter is more energy intensive than the former,[3] but it yields greater variety, because a couple's offspring need not be identical to either parent. With sexual reproduction, there is thus a better chance that at least some members of a species will survive an adverse event. Another momentous mutation is, of course, that which gave rise to the species *Homo.*

Where humans are concerned, the problem with the proposition that everything depends on chance and necessity is that it appears to leave no room for free will. For this reason, Greek philosopher Epicures (4th-3rd century BC), and Lucretius in his wake, qualified the necessity part of the proposition as worse than the tyranny of the Gods. Monod (1970, 1971) sees a way out. All living beings, not just human ones, have three characteristics that differentiate them from inanimate objects. The first is "teleonomy", meaning that, in their structure and functions, living beings show evidence of some sort of project. The second is "autonomous morphogenesis", meaning that the project is completely internal: external agents and conditions may put obstacles in its way, but not direct it.

[1] See Monod (1970).

[2] Since the discovery of the DNA, it is established that a mutation is a copying mistake.

[3] Especially for the male of the species, who has to develop fancy plumage (or the like) and engage in extenuating courting routines to be selected by the female.

This gives living beings a certain degree of freedom. The third characteristic is "reproductive invariance", meaning that living beings transmit the essential information which describes them from one generation to the next. The latter seems to contradict the Second Law of Thermodynamics, according to which any macroscopic system can evolve in only one direction, that of increasing disorder ("entropy"). But the contradiction is only apparent, because the law in question refers to an isolated system. Inside such a system, there can be a local and temporary increase in order – paid for by an increase in disorder elsewhere in the system – without contradicting the Second Law. Taken together, these three characteristics make sense of man's ability (or hubris?) to swim against the tide of increasing entropy by constructing complex societies, and developing elaborate rules of conduct.

Does any of this matter for economics? In his *Theory of Economic Development*, first published in German in 1911, Joseph Schumpeter used the expression "creative destruction" to describe the process by which innovative firms push non innovative ones out of the market in much the same way as successful mutants prevail over non-mutants in the biological sphere.[4] Some qualify this, usually derogatively, as "economic Darwinism", implying that it constitutes an unwarranted application of biological reasoning outside its natural domain. Not everybody is aware, however, that Charles Darwin got the natural selection idea attending Thomas Malthus' Cambridge lectures. Rather than talk of economic Darwinism, we should thus be talking of biological Malthusianism. In any case, natural selection is not synonymous with competition, and certainly not with competition to death. In the animal world, carnivores prey on herbivores, and larger carnivores on smaller ones, but not to the point of mutual annihilation,[5] and only humans prey on each other.[6] In the vegetable world, a plant may overinvest in its root system in order to

[4]The original title of the book contains the word *Entwicklung*, which in German may mean either "development" or "evolution". Redvers Opie translated it as development, but Schumpeter himself, in his English writings, uses the word evolution.

[5]The celebrated Predator-Prey model has an equilibrium where the predator species annihilate the prey species on which they feed, and perish with them, but this equilibrium is unstable. The system converges to a stable equilibrium where both species survive because predators do not kill more preys than are born; see Lotka (1925) and Volterra (1926).

[6]The Latin expression *homo homini lupus* ("man wolf onto man"), originally used by the Roman playright Plautus (2nd century BC) in a comedy involving donkeys, *Asinaria*, was resuscitated by British philosopher Thomas Hobbes (1588-1679) to qualify man's selfish and competitive behaviour in the unregulated state of nature. That is a slander on wolves, who actually hunt in packs and do not prey on each other.

keep a neighbour of a different species at bay.[7] But, there are examples of trees linking roots ("spontaneous root grafting") with others of the same or different species, because that is their best defence against their worst common enemy, the wind. There are even reports of trees linking roots with the remnant of a cut tree, which could not otherwise survive without its foliage.[8]

Another notable example of economic influence on biological thinking is Richard Lewontin's 1961 article "Evolution and the theory of games". This article contains the first application of game theory – a branch of mathematics originally designed to address strategic interaction in the economic sphere – to evolutionary biology. Unlike game theory *tout court* where strategies are the object of conscious choice, evolutionary game theory assumes that the players have strategies "hard-wired" into them by natural selection.[9] On the face of it, evolutionary game theory seems better suited to describe the behaviour of beetles and micro-organisms, than of humans. It also clashes with the idea that all living beings have an autonomous project. Starting with Gary Becker's 1976 article "Altruism, egoism, and genetic fitness: economics and sociobiology", however, economists, biologists and game theorists have investigated the possibility that natural selection might determine not a person's strategy, but the preferences that lead a person to choose a strategy rather than another. That does not dispose of the free-will problem, but pushes it back one level.

The present paper focusses on the evolution of cultural traits, in particular of individual preferences. Section 2 examines the mechanics of trait transmission from one generation to the next, first without and then with sexual reproduction. Section 3 introduces parental decisions and looks at the dynamics of preferences. The hypothesis that preferences might be selected by evolutionary forces are also examined. Section 4 examines the possibility that individual decisions are constrained by family rules or social norms. It also looks at the way these rules or norms are enforced, and at the manner in which they affect matching and preference evolution.

2 Traits

We know that physical traits are genetically transmitted from (or through) parents to children. Are cultural traits (preferences, beliefs, etc.) transmitted the same way? In their 1981 book entitled *Cultural Transmission*

[7] See Callaway and Marshall (2007), and Dudley and File (2007).

[8] The first observation of this remarkable phenomenon goes back to Dutrochet (1833). For recent confirmation, see Bader and Leuzinger (2019).

[9] See Postlewaite (2011) on what does get hard wired.

and Evolution, Luigi Cavalli-Sforza and Marcus Feldman call the process by which these incorporeal traits are transmitted "vertical socialization" if the child is influenced by her or his own parents, "horizontal socialization" if the influence comes from the child's contemporaries, "oblique socialization" if it comes from the contemporaries of the child's parents, such as teachers, sport coaches and priests.[10] That leaves out a very important source of influence, namely the knowledge accumulated by previous generations. To the extent that such knowledge is communicated by parents or teachers, this falls under the rubric of vertical or oblique socialization. Beyond a certain point, however, that kind of knowledge is acquired by individual study of the books and articles in which it is embodied.[11] It is a sign of the segmentation of our discipline that this form of socialization, central to the economics of education, is totally ignored by the literature reviewed in the present paper.

Cavalli-Sforza et al. (1982) report survey evidence of vertical socialization. The effects are particularly strong where political tendencies and religion are concerned, but significant effects emerge also with regard to choice of entertainment and sports, superstition and beliefs, and customs or habits. Interestingly, the strongest evidence concerns traits that cannot have an important biological component. The stronger source of vertical socialization is the mother in some cases, the father in others, without significant interaction between the two. There is evidence of influence of horizontal and oblique socialization too, but this is weaker than that concerning vertical socialization. Bisin and Topa (2003), Bisin et al. (2004) and Kosse et al. (2020), find evidence of all three forms of socialization. Albanese et al. (2016) estimate that parental influence weakens, but does not vanish, as a child is exposed to external (school, peer group, etc.) influence. Confirming an early result in Loehlin and Nichols (1976) and similar results by others, Bjorklund et al. (2006) find that vertical socialization works not only with natural children, but also with adopted ones. That rules out genetic transmission. Ottoni-Wilhelm et al. (2017) report that, contrary to popular wisdom, children can be talked into doing good deeds, but setting them a good example

[10] Sending a child to a confessional school is a form of oblique socialization. See, for example, Cohen-Zada (2006).

[11] As Donald Cox suggested to you reviewer, the distruction of the library of Alexandria may be used as a natural experiment to test the hypothesis that books and articles matter for cultural transmission. There is indeed evidence that this catastrophe (caused not by a single fire in the 1st century BC as is widely believed, but by a series of fires over a number of centuries, and ultimately by lack of funding) set back knowledge more than a thousand years. In particular, Russo (1996, 2004) shows that we had to wait until the 19th century for mathematics to fully recover the level it had reached in the Hellenistic period.

is a waste of time (imprinting works with geese, but not with humans).

In Cavalli-Sforza and Feldman (1981), cultural traits are modelled as a single dichotomous variable taking either value a or value b.[12] Time is represented by the continuous variable t. Each person lives an instant. Reproduction is asexual, and each person begets a child. There is an exogenously given probability d_i that a person's trait $i = a, b$ is transmitted to that person's child, and a probability $1 - d_i$ that it is not. If the trait is not transmitted to the child, there is a probability π_i, equal to the fraction of the population who hold trait i (henceforth, of type-i persons), that the trait will be transmitted to somebody else. The child of a type- i person will then acquire trait i with probability

$$P_{ii} = d_i + (1 - d_i)\,\pi_i,$$

and trait $j \neq i$ with probability

$$P_{ij} = (1 - d_i)\,(1 - \pi_j)\,.$$

Solving for π_i and differentiating with respect to t yields the law of motion of the system,

$$\frac{d\pi_i}{dt} = (d_i - d_j)\,\pi_i\,(1 - \pi_i)\,. \tag{1}$$

As t tends to infinity, the solution path approaches a stationary state $\pi_i^* = 1$ if $d_i > d_j$, or $\pi_i^* = 0$ if $d_i < d_j$. In the long run, therefore, everybody holds the same trait, either a or b. Notice, however, that the traits are always the same. All that changes with the passage of time are the population shares of people holding either trait a or trait b. In other words, as the authors themselves emphasize, the dynamics are demographic. If we take trait evolution to mean that new traits appear and old ones disappear with the passage of time, there is no evolution.

Cigno et al. (2017, 2020) assume sexual differentiation and sexual reproduction.[13] Time is discrete. The transmissible trait, denoted by δ, is a continuous variable. In the full model to be examined in Section 4 of this paper, δ is a preference parameter, and people live two periods. At this stage, however, we are only interested in the mechanics of trait transmission in the absence of deliberate choice; the interpretation of δ does not matter. For comparability with Cavalli-Sforza and Feldman

[12] Towards the end of the book, the authors consider also the possibility that the transmissible trait might be continuous. But most of the analysis in the book and in the literature that it inspired assumes that the trait is dichotomous.

[13] The former does not imply the latter. There are sexually differentiated species where the female reproduces asexually, and others where the male does.

(1981), we then assume that each person lives one period, so that periods and generations coincide as in that model. In generation 0, there are n men and n women, where n is a large positive number. A fraction π of these men (women) are characterized by $\delta = \delta^H$, and the remaining $1-\pi$ by $\delta = \delta^L < \delta^H$. Initially, therefore, only two values of δ are observed, but others may emerge in subsequent periods. In each period, every man is matched ("married") with a woman,[14] and each of the resulting couples have a daughter and a son. This assumption, common in the literature reviewed in the present paper, preserves the balance of the sexes, and keeps population size constant.

As in Cavalli-Sforza and Feldman, socialization is not the outcome of deliberate action; it just happens. Here, however, there is only vertical socialization. In general, a child's trait may be expected to be a convex combination of her or his parents' traits. Exceptionally, it could lie outside that interval, but that is a rare event that can be safely disregarded in the absence of horizontal and oblique socialization. If the matching is perfectly assortative in δ ("homogamy"), children inherit their parents' common trait. The only values of δ that will ever be observed are then $\delta^H$and δ^L, and the distribution of δ will remain the same until an exogenous shock changes it. For traits to evolve, the matching must not be perfectly assortative (there has to be some degree of "heterogamy"). Suppose that δ is *ex ante* private information, so that it cannot be a criterion for forming a couple. The matching will then be random where the value of δ is concerned. As in other models of the same kind, marriage is thus a kind of personal *clinamen*, a once-in-a-lifetime random event that results in the birth of a daughter and a son. A far cry from the economics of the family literature, where marriage is modelled as the outcome of purposeful search, accompanied or preceded by educational investments aimed at improving the quality of the match.[15]

Consider first the possibility that a child's trait is equal to the mean of her or his parents' traits. Although, in generation 0, there are only $S(0) = 2$ values of δ, in period 1, there will be $S(1) = 3$, namely δ^L, $\frac{\delta^L+\delta^H}{2}$ and δ^H. In period 2, we will observe $S(2) = 5$ values, namely δ^L, $\frac{3\delta^L+\delta^H}{4}$, $\frac{2\delta^L+2\delta^H}{4}$, $\frac{\delta^L+3\delta^H}{4}$ and δ^H, and so on. In general, at $t \geq 0$, there will be $S(t) = 2^t + 1$ values of δ, generated by the function

$$\delta_t(j) := \frac{(2^t - j)\delta^L + j\delta^H}{2^t} = \delta^L + \frac{\delta^H - \delta^L}{2^t} j, \qquad j = 0, 1, \ldots, 2^t. \quad (2)$$

[14] In Cavalli-Sforza and Feldman (1981), nobody marries because reproduction is asexual, but here we must assume that everybody does to make comparisons possible.

[15] See Becker (1973, 1981b Ch. 4), Cigno (1991, Ch. 1 and 4), Peters and Siow (2002), and Iyigun and Walsh (2007).

Cigno et al. (2020) demonstrate that the distribution of δ is approximately binomial, and that the variance of this distribution tends to zero as t tends to infinity. In the long run, everybody will display the same value of δ, equal to the expected value of this trait in generation 0,

$$\delta^* = \pi\delta^H + (1-\pi)\,\delta^L.$$

An alternative and more realistic possibility is that a child's δ is a random variable normally distributed over the interval between the mother and the father's realized values of the same variable. The child's expected δ, rather than its realization, is then equal to the mean of the father and mother's realized values of δ. As n is large, this makes no qualitative difference to the dynamics of δ. Across couples with the same mean value of δ, realizations of the children's δ that are close to the parental mean will in fact occur more frequently than realizations that are far from it, and the distribution of the realized δ over the population as a whole will still converge, in the long run, to the value of δ expected in generation 0, δ^*. Taken together with random matching, sexual reproduction thus entails that (a) any initial trait heterogeneity will disappear in the long run, and (b) the long-run trait is entirely determined by initial conditions.

An instructive way of interpreting these results is to imagine a population originally characterized by a common value of δ, say $\delta = 1$. Without an exogenous shock, this population would remain homogeneous for ever. But, suppose there is an influx of immigrants characterized by a different value of δ, say $\delta = 0$. With random matching, the distribution of δ will eventually converge to a common value of δ. Cigno et al. (2020) calculate that, if the immigrants were one ninth of the natives, the population would return homogeneous, with a common value of δ very close to 1, after only ten generations. In other words, the immigrants would be absorbed fairly quickly by the native population. If the immigrants were more than one ninth, but no more than a half of the native population, it would take longer for the population to become homogeneous again, and the future inhabitants would not be much like the original ones. In other words, there would be blending rather than absorption. Whichever is the case, random matching by itself implies that it takes a relatively short time for a population to return homogeneous after a wave of immigration. That is not supported by the evidence however. As Borjas (1992, 1994) and Fernandez and Fogli (2009) show, some ethnic groups are still not fully integrated in US society many centuries after their forced or voluntary immigration into that country.

Models that endogenously account for persistent diversity will be examined in the following sections. At this stage, it is only worth pointing

out that, with sexual reproduction, diversity may persist if the matching is restricted to a subset of the population. Suppose, for example, that the population consists of two groups, A and B, recognizable by some observable trait, and that people marry only within the group to which they belong ("endogamy"). If the distribution of the unobservable trait δ is the same for both groups, that will not alter the prediction that this unobservable trait converges to a common value, δ^*. If the distribution differs across groups, however, A will converge to a value of δ, δ^*_A, and B to another, $\delta^*_B \neq \delta^*_A$. A population initially characterized by a wide spread of δ values, most of them in common to members of both groups, will thus be characterized, in the long run, by perfect homogeneity within, and sharp heterogeneity between the two groups, with all the dangers of sectarian strife that this entails. But, what explains the initial diversity? The idea that the species *Homo* emerged independently in different parts of the world appears to have been put aside. The current consensus seems to be that *Homo* developed in Africa and fanned out from there in all directions. Given this common ancestry, how did variety come about? Diamond (2005) favours geographic explanations. Others, including Ashraf and Galor (2013a, b), point the finger on distance from the common place of origin (the so called out-of-Africa hypothesis). In general, unless heterogeneity is endogenous, we need some exogenous shock to explain diversity.

3 Preferences, principles and values

We now specialize the exposition to a particular kind of trait, individual preferences. Principles or values are preferences worthy of praise, but still preferences – and thus not to be confused with norms or rules, which stop a person making the choice she or he would otherwise make given her or his preferences. Preferences concern a person's own lifetime plan, and possibly also that of others. Alternative lifetime plans may differ over the list of goods included (wine and Wagner rather than beer and Bob Marley), their timing (sooner rather than later) and their riskiness (low mean and low variance rather than high mean and high variance). Regarding other people's lifetime plans, a person's preferences may be benevolent ("altruistic"), indifferent ("selfish") or even malevolent ("spiteful").

In his most influential book, *An Inquiry into the Nature and Causes of the Wealth of Nations*, published in 1776, Adam Smith famously wrote: "It is not from the benevolence of the butcher, the brewer, or the baker that we expect our dinner, but from their regard to their own self-interest. We address ourselves not to their humanity but to their self-love, and never talk to them of our own necessities, but of their

advantages". In *The Theory of Moral Sentiments*, published in 1761, however, the same author had written: "How selfish soever man may be supposed, there are evidently some principles in his nature, which interest him in the fortune of others, and render their happiness necessary to him, though he derives nothing from it except the pleasure of seeing it." Did the father of Political Economy fall in contradiction? A possible answer is that our second quotation is of Smith the moral philosopher, not of Smith the economist, and that sentiments (moral or otherwise) are none of the economist's business. Another is that sentiments and rational calculation arise in different parts of the brain. The rational activities that differentiate humans from other animals take place in the upper cerebral hemispheres. By contrast, sentiments, common to all mammals, and emotions, present in all warm-blooded animals, are the product of the limbic system. Depending on which part of the brain is activated, the same person may thus be guided by rational considerations in some circumstances, by sentiment or emotion in others. Besides, as we will see in this and the next section, people may behave as if they were altruistic even if they are not.

Dixit (2004) assumes that people are altruistic, but altruism decreases with distance (in its figurative as well as literal acception). Basu (2011) similarly maintains that altruism grows on acquaintance, and he reviews experimental evidence to this effect.[16] Becker (1973, 1974,1981a, b) restricts altruism to the family ambit. Indeed, he assumes that parents are altruistic only towards their own children ("descending altruism"), who do not reciprocate the sentiment. No love is lost among siblings (who may be "rotten" to each other),[17] or between spouses. The latter is somewhat contradictory, because Becker himself finalizes marriage to the domestic production of local public goods,[18] including not only children, but also companionship and love. It is thus as if he were saying that people fall in love with love, rather than with named persons. In Becker's wake, Manser and Brown (1980), and McElroy and Horney (1981) model marriage as a Nash-bargaining game. In those contributions, and in the literature that sprang from them,[19] the spouses cooperate to achieve an efficient allocation, and then split the utility gain equally between them. In this game-theoretical literature, the spouses are assumed to be self-interested, but it is an enlightened form of self-interest,[20] like that (mentioned in the Introduction) of trees linking roots

[16] On this, see also Kimbrough and Vostroknutov (2015).

[17] See Becker (1981b) and Bergstrom (1989).

[18] See Becker (1973, 1981b) and Folbre (1994).

[19] See, among others, Lundberg and Pollak (1993), and Bergstrom (1996).

[20] Cigno (2012) shows that a cooperative marriage is better than a non-cooperative

to better withstand the high winds. The same assumption crops up in several of the models we are about to review.

3.1 Marriage and fertility

Bisin (2000) and Bisin and Verdier (2001a, b) introduce volition in Cavalli-Sforza and Feldman by assuming that the transmission probabilities are conditional on costly parental actions. They examine a variety of alternative models, but the one of interest here is that in which reproduction is sexual, and each couple has a daughter and a son. The transmissible trait is still represented by the dichotomous variable $i = a, b$. Given that parental actions have a cost, they must also have a benefit, or they would not be undertaken. For a type-i parent, the utility V_{ii} of having a type-i child is assumed to be no lower than the utility V_{ij} of having a type-j child. The authors qualify this preference ranking as "imperfect empathy", meaning that parents evaluate their children's well-being by their own (not the children's) lights. In the version of the model that we are are about to illustrate, however, all the parents seem to care about is making their children the same as themselves. We will see further below how the authors justify this assumption.

Whatever the transmission technology is, it stands to reason that vertical socialization will be more successful or less costly if mother and father are of the same type, and thus agree about how to raise their children, than if they are of different types. The assumption made here is that transmission is possible only if the parental couple is homogamous (equivalent to saying that, for a heterogamous couple, the cost of the action is prohibitively high). For a type-i parent, the cost of vertically socializing a child of theirs is an increasing function $C\left(d^i\right)$ of the chosen transmission probability d_i. The expected utility of having a child (hence, of marrying) is consequently

$$W_i^{Het} = \pi_i V^{ii} + \left(1 - \pi_i\right) V_{ij}$$

if the other parent is of type $j \neq i$, or

$$W_i^{Hom} = \max_{d_i} \left\{ \left[d_i + \left(1 - d_i\right) \pi_i \right] V_{ii} + \left(1 - d_i\right) \left(1 - \pi_i\right) V_{ij} - C\left(d_i\right) \right\} \geq W_i^{Het}$$

if the other parent is of type i. Given that people would like their children to be the same as themselves, if preferences were observable, there would be only homogamous couples, and the distribution of the transmissible trait i in the population would never change (children would be effectively clones of their parents). For there to be change, there has

one, where the spouses have an inefficiently large number of children, and spend an inefficiently low amount of resources for each child.

to be heterogamy. Bisin and Verdier (2000a) engineer that by assuming that the population divides into two "restricted pools", consisting of persons of the same type, either a or b. Were it assumed that marriage candidates can deterministically choose which pool to draw from, that would be the same as saying that i is observable, in which case marriages would be homogamous. The authors assume instead that a type-i person can only choose the probability α_i of drawing a spouse from the pool of type-i persons, so that there is a probability $1-\alpha_i$ of drawing the spouse from the wrong pool. The cost of exercising this choice is an increasing function $H(\alpha_i)$ of α_i. Denoting by A_i the share of type-i persons who actually marry within their own pool, the probability that a person of this type will make a homogamous marriage is then

$$\varphi_i = \alpha_i + (1+\alpha_i)\frac{(1-A_i)\,q_i}{(1-A_i)\,\pi_i + (1-A_j)\,(1-\pi_i)}.$$

Given A_i, A_j and π_i , a type-i person chooses α_i so as to maximize her or his own expected utility,

$$EW_i = \varphi_i\left(W_i^{Hom} - W_i^{Het}\right) - H(\alpha_i).$$

The authors demonstrate the existence of a stable stationary state where part of the population holds the trait a, and the remaining part holds the trait b. There are also two homogeneous stationary states, one where everybody holds the trait a, and the other where everybody holds the trait b, but these states are unstable. Therefore, imperfect trait observability preserves heterogeneity even in the long run. As in Cavalli-Sforza and Feldman, however, no new values of the trait in question can emerge for the simple reason that only the original two are assumed to be possible. All that can change is the share of the population who hold either one or the other of the original values of i.

3.2 Cooperation

Many authors have addressed the question whether or under which conditions selfish people behave cooperatively in a two-person Prisoner's Dilemma game.[21] That is a relevant question to ask because, as *it* is well known, only the cooperative equilibrium of this game is efficient. Take, for example, the payoff matrix in Table 1.[22] Each player has two possible strategies: to cooperate, denoted by C, and not to cooperate, denoted by NC. A player would choose C if she thought that the other player would do the same, otherwise she would choose NC. In the absence of information or firm beliefs about what the other will do, neither

[21] See Rapoport and Chammah (1965).

[22] The example is drawn from Basu (2011, Ch. 6).

player will cooperate. At the (NC, NC) Nash-equilibrium, the allocation is $(3, 3)$, clearly inefficient given that the $(6, 6)$ allocation is also available.

Table 1: The prisoner's dilemma

	C	NC
C	6, 6	0, 8
NC	8, 0	3, 3

A way out of the dilemma is offered by the Folk Theorem, which says that cooperation will prevail if the game is played an infinite number of times by the same pair of patient players. As originally stated by Friedman (1971), the theorem presupposes complete information. Subsequent contributions have shown that, subject to additional assumptions, the theorem can be extended to many-person games, and finite-horizon games with incomplete information.[23] Other authors have shown that it may apply also to one-shot games, if the players are drawn at random from a large population. As the incentive to cooperate comes, in all cases, from fear of punishment,[24] we shall examine this line of argument in the next section under the rubric of rule or norm enforcement. Basu (2011, Ch. 6) tries a different tack. He points out that cooperation will prevail if both players attach a sufficiently large weight to each other's material payoffs. In Table 2 below, α is the weight that each player attaches to the other's material payoff ($0 \leq \alpha \leq 1$). For $0 \leq \alpha \leq \frac{1}{3}$, each person will play NC no matter what the other does. For $\frac{1}{3} < \alpha \leq \frac{3}{5}$, there is a multiplicity of equilibria. For $\frac{3}{5} < \alpha$, each person will play C no matter what the other does. A little altruism goes a long way. The value of α may depend on who the opponent is, or on the player's ability to see the latter as an individual rather than an anonymous member of large group. As already mentioned, Dixit (2004) similarly assumes that a person's attitude towards another depends on distance.

Table 2. The altruistic prisoner's dilemma

	C	NC
C	$6 + \alpha 6$, $6 + \alpha 6$	$\alpha 8$, 8
NC	8, $\alpha 8$	$3 + \alpha 3$, $3 + \alpha 3$

Like Gary Becker, Tabellini (2008) assumes descending altruism.[25] Individuals are not sexually differentiated, reproduction is asexual, and

[23] See Fudenberg and Maskin (1986).

[24] See Axelrod (1984, 1986).

[25] Like Bisin and Verdier (2000a), however, Tabellini uses the expression "imperfect empathy" to indicate that the benefit to the child is evaluated using the parent's preferences.

each person has a child. Time is discrete. Like Dixit (2004), Tabellini assumes that adults have moral scruples about cheating strangers, but these scruples diminish as the distance from the victim of cheating increases. Unlike Dixit, however, he assumes that attitudes towards strangers depend also on the agent's upbringing. As in Dixit, adults are located in a circle and randomly matched to play a two-person Prisoner's dilemma game. Here, however, the game is plaid only once.[26] Given that reproduction is asexual, a match is not a marriage. It can be a random encounter of any kind (business, social) other than reproductive. As usual, each player has a choice of two strategies: C (cooperate or "be truthful") and NC (not cooperate or "cheat"). In Table 3 below, c denotes the material payoff of being truthful, w the perverse pleasure of cheating, and $-l$ the all-too-human displeasure of being cheated. Assuming that l and w are positive, there is then a temptation to cheat.[27] Clearly, the lower l and w are, the less cheating will there be. Assuming that laws have the purpose of preventing anti-social behaviour including cheating, Tabellini takes l and w to be measures of law enforcement failure. The more effectively the law is enforced, the lower will l and w be. Moral scruples come into the picture under the guises of remorse for cheating (Tabellini calls it the "non-economic cost" of NC), $d > \max(l, w)$. Unlike the altruistic pleasure that a player derives from the other's material pay-off in Basu, the intensity of remorse is independent of what the other party gets, but it decays with distance from the latter at the exponential rate θ. Therefore, playing NC against an opponent located at the distance y carries the non-economic cost $de^{-\theta y}$. For any given θ, there is then a y up to which a person cooperates no matter what the other does. Beyond that distance, the player cheats remorselessly. There are two types of person. A "bad" person has a high $\theta = \theta^0$. A "good" one has a low $\theta = \theta^1 < \theta^0$. Obviously, good persons are disposed to trust (cooperate with) more distant persons than bad ones are. The reason why unrelated individuals are matched at random is that θ is private information.

Table 3. The remorseful prisoner's dilemma

	C	NC
C	c, c	$-l$, $c + w - de^{-\theta y}$
NC	$c + w - de^{-\theta y}$, $-l$	0, 0

Being altruistic towards their children, people care about the latter's happiness or success. Given that the equilibrium of the game depends on

[26] Therefore, there is no scope for reputation building as in Dixit (2004) or Gutmann (2011).

[27] If $l > w$, there is "strategic complementarity", meaning that, the more a player cheats, the more the other does, see Bulow et al. (1985).

both players' types, a parent will undertake a costly action (socialization of some kind) to make a child good if the probability that the child will be matched with a good player is sufficiently high to justify the cost – in other words, if the population share of good people, denoted by n, is large enough.[28] Even if none of the parents took action to make their children good, a share ν of the children would still turn out to have this quality. The interaction among parents deciding whether to make their children good, and between randomly chosen pairs of (grown-up) children playing a Prisoner's dilemma game, determines the maximum distance Y_t^1 to which good persons cooperate in generation t (Tabellini calls this the "scope for cooperation") as a function of the population share n_t of such persons in that generation,

$$Y_t^1 = \frac{\ln d - \ln\left[(w-l)\, n_t\right]}{\theta^1}. \tag{3}$$

It also determines the system's law of motion,

$$n_t = \nu + F\left(Y_t^1\right) n_{t-1}, \tag{4}$$

where $F(.)$ is shown to be an increasing function. Subject to certain parametric conditions, the system converges to a unique long-run equilibrium (Y^{1*}, n^*), where both variables are increasing functions of the hard core of good persons in the population, represented by ν.

In an extended version of the same model, people vote for either high or low law enforcement. In the long run, there are then two possible political-economic equilibria, one characterized by high enforcement and $n^* > \frac{1}{2}$, the other by low enforcement and $n^* < \frac{1}{2}$. Which will obtain depends on the initial share of good people. If n_o is below (above) a certain threshold, the system is always in a low (high) enforcement regime and will eventually settle at a low (high) enforcement equilibrium. If n_o lies between those thresholds, there may be multiple equilibria on the way to either a low or a high-enforcement equilibrium in the long run. Therefore, not only long-run outcomes, but also transitional dynamics depend on initial conditions. Tabellini finds support for this prediction in a sample of third-generation immigrants to the US. Trust among these immigrants is shown to be positively affected by the average degree of trust, and negatively affected by a track-record of government failure, in their respective countries of origin. Evidence of preference persistence among immigrants is reported also by Becker et al. (2020). Guiso et al. (2016) estimate that the Italian *comuni* which made themselves virtually

[28] Frequency-dependent payoffs are common in social institutions and typically give rise to multiple equilibria; see Cooper (1999).

independent of the Holy Roman Empire in the Middle Ages display, still today, greater civic sense than comparable cities which did not have that experience (and that the effect does not vanish after accounting for the fact that independence was not a random event).[29] The general idea is already in Myrdal (1957), where the diverging destinies of otherwise similar countries are attributed to the vicious or virtuous circles set in motion by historical accidents.

3.3 Evolutionary stable preferences

We have already recalled Malthus' influence on Darwin. Another instance of biology-economics interaction is evolutionary game theory. Evolutionary biology proceeds from two premises. The first is that an organism's "evolutionary fitness" (identified with reproductive ability) is genetically determined. Genes that give more fitness reproduce faster than genes which confer less. The second premise is that an organism's fitness is not determined in isolation, but interactively with other organisms. That gave Lewontin (1961) the idea of modelling evolution as a game. In the literature sparked-off by this article, a strategy's payoff is identified with the fitness of the species that practices it. Strategies are "hard-wired" into the agents' genes, rather than the result of conscious choice as in standard game theory. The game-theoretical Nash equilibrium concept – a set of strategies, one for each agent, such that no agent has an incentive to change her or his – is thus inapplicable. Maynard Smith and Price (1973) propose "evolutionary stability" as the biological analogue of the Nash equilibrium.[30] The strategy hard-wired into a species is defined to be evolutionary stable if a small group of invaders (or mutants of the same species) hard-wired with a different strategy would reproduce more slowly than the (non-mutant) members of the resident species, and eventually become extinct.

Evolutionary games do not look like the most appropriate tool for describing the behaviour of sentient beings. Indeed, they sit uncomfortably next to the utility maximization assumption at the basis of most microeconomics. To fend off this objection, economists and game theorists have investigated the possibility that utility functions or more generally preferences, rather than strategies, are determined by natural selection. Ahead of the field, Becker (1976) justified his descending al-

[29] Becker et al. (2020) do not explain, however, why immigrants from countries with a history of mutual trust and good government did not blend with immigrants from other countries, or with natives (we shall look into this in the next section). Equally, Guiso et al. (2016) do not explain why the inhabitants of Italian cities blessed with early independence did not intermarry with those of neighbouring and otherwise very similar cities.

[30] See also Maynard-Smith (1976, 1982).

truism assumption in evolutionary terms. But the research agenda is set in Güth and Yaari (1992): "Instead of assuming that individual preferences are exogenously given, we think of an evolutionary process where preferences are determined as evolutionarily stable".[31] According to this "indirect evolutionary approach", instead of endowing us with a fixed strategy that could turn out to be inappropriate in certain circumstances, or with an impossibly long list of instructions covering all eventualities, nature provided us with a criterion for judging by ourselves which strategy to follow. This approach has had considerable fortune.[32] Güth and Kliemt (1998) show that a particular aspect of a person's preferences, trustworthiness, may be evolutionarily stable. Evolutionary explanations of time preferences and risk attitudes are discussed in depth in Robson and Samuelson (2011). Given the focus of the present paper, we look in greater detail at preferences, altruistic or otherwise, regarding the wellbeing of fellow family members.

As we saw in the last section, for Bisin and Verdier (2000a), homogamy is desirable because it allows people moved by imperfect empathy to make their children copies of themselves. Bisin and Verdier (2001b) offer an evolutionary justification for this assumption in a model without sexual differentiation, where the dichotomous trait $i = a, b$ characterizing a person is a parameter of that person's utility function. The environment $e = a, b$ is a random variable. In this model, fertility is not only asexual, but also exogenous. Therefore, evolutionary stability cannot mean that incumbents are more fertile than mutants or invaders. It can only mean that the former are more successful than the latter at transmitting their own trait to their own children. Plausibly assuming that a parent can socialize its child to its own value of i for free, or to the alternative value by bearing a cost, a person's evolutionary fitness will be higher if this person's inherited trait is consistent with the environment ($i = e$), than if it is not ($i \neq e$). Preferences may be characterized by imperfect empathy as in Bisin and Verdier (2000a), or perfect empathy as in Becker (1976). In the second case, parents socialize their children to the value of the preference parameter that matches the environment irrespective of whether this is the same as their (the parents') own.[33] In the first, they socialize their children to their own value of the preference parameter irrespective of whether it matches the environment. Bisin and Verdier (2001b) demonstrate that imperfect empathy is

[31] See also Güth (1995).

[32] See Robson and Samuelson (2021) for a full exposition.

[33] According to this definition, perfect empathy coincides with what Tabellini (2008) calls imperfect empathy in the case where the cost of socializing one's child to a trait different from one's own is zero.

evolutionary stable if and only if the environment is sufficiently volatile (variance of e sufficiently high), and the cost of socializing a child to the parent's own value of i falls within a certain interval.

Alger and Weibull (2013, 2019) study how individuals with different types of preferences fare in pair-wise matchings. Once again, each pair play a Prisoner's dilemma game. Since reproduction is out of the picture and thus presumably exogenous, it must be supposed that the purpose of the encounter can be anything other than reproduction. The authors envisage two types of preferences, and thus of persons. One is *Homo oeconomicus*. The other, dubbed *Homo moralis*, is a combination of *Homo oeconomicus* and *Homo kantiensis* (after German philosopher Immanuel Kant). *Homo oeconomicus* acts selfishly in all circumstances. *Homo kantiensis* acts cooperatively if the other party does, non-cooperatively if the other party does not. Under uniform random matching, if the population is large and preferences are not observable,[34] *Homo oeconomicus* is shown to be evolutionary stable, and *Homo kantiensis* evolutionary unstable. If the matching is assortative in some observable correlate of individual preferences, *Homo kantiensis* may come out the winner.[35] Assuming that people's unobservable preferences are correlated with observable characteristics (labels) such as style of dress or religious practice, and that the probability of being matched is higher for individuals who carry the same label ("homophily"), however, Wu (2020) shows that assortativity may generate preferences other than *Homo oeconomicus* and *Homo kantiensis*.

The indirect evolutionary approach to preference determination is suggestive, but it raises two questions. The first is of timing. The development of the ancient part of the human brain, the limbic system, started millions of years ago, long before there were humans. If we wince at the sound of the wind going through the grass, it is because the archaic part of the limbic system, the amygdala, remembers a time when a rustle could signal the approach of a dangerous animal. The development of the modern part of the brain, the upper cerebral hemispheres, started much more recently, but still a good 250 to 500 thousand years ago. The entire process had two turning points, the catastrophic one that annihilated the dinosaurs and allowed mammals to colonize the Earth some 65 million years ago, and the mutation that gave rise to the species *Homo* around 1.9 million years ago. Nothing of a comparable magnitude has happened, and no perceptible change in the physiology of the human brain is thought to have taken place, since the invention

[34] These are necessary conditions. With some qualifications, they are also sufficient.

[35] This moderates Milton Friedman's much publicized contention that *Homo oeconomicus* predominates in all circumstances; see Friedman (1953).

of writing, a mere 5 200 - 5 500 years ago. If Monod has an advantage over Democritus, therefore, it is not in the size of the brain, but in the amount of knowledge that has accumulated in the 25 centuries separating the two. If we are interested in what has happened in historical time, it is then difficult to imagine any possible relation between changes in preferences or other personality traits, and changes in the physiology of the brain. Indeed, the literature inspired by Cavalli-Sforza and Feldman does not ask us to make any such connection. Any change in traits, including preferences, is attributed to socialization. As Becker (1976) and Alger and Cox (2020) would argue, however, if we are interested in understanding why preferences were the way they were before culture got to work on them, we have to reach for evolution in the biological sense. While the prevalence of trust towards unrelated individuals can be explained as an equilibrium outcome of games that are plaid today, descending altruism may in fact owe something to survival-of-the-species considerations going back millions of years.

The second is a question of interpretation. As originally defined, evolutionary fitness means ability to reproduce, and evolutionary stability means ability to reproduce faster than potential invaders. In Bisin and Verdier (2001a, b) there is reproduction, but the size of the progeny is exogenous and the same for everybody. If a value of the preference parameter prevails over the other, it is not because the individuals carrying the former have more children than those carrying the latter, but because the former are more successful in transmitting their preferences onto their own children. Alger and Weibull (2019) take the broad view that fitness and stability may mean different things, including ability to survive and ability to reproduce. In Alger and Weibull (2013), however, survival and reproduction are out of the picture. What do evolutionary fitness and evolutionary stability mean in that case? If the games people play are about business, fitness and stability may be taken to mean that cooperative firms prosper, and non-cooperative firms flounder.[36] Outside that realm, however, it is not easy to understand the mechanism by which a certain type of preferences prevails over another. The authors' talk of "ability to produce cultural offspring" brings to mind senior academics proselytizing among students and junior colleagues. But what does this mean if we are talking of ordinary social interactions? A possible answer is that *homo oeconomicus* imitates *homo kantiensis* if the

[36]Notice, incidentally, how far we are from Schumpeter's creative distruction idea. There, a successful firm is an innovator who drains customers and resourses away from competitors. Here, it is a firm that is good at making mutually advantageous deals with other firms. The biological analogy is thus with ants and bees, or with trees linking roots, rather than with sparrows and hawks.

latter is observed to be more successful in forming mutually beneficial relations (or the other way round if the opposite is true).[37] If that is the case, there is no preference evolution, just evolution of social mores. We will see in the next section that this kind of evolution may be aided by the emergence of family rules and social norms.

We have already mentioned evidence of the effects of socialization on a range of cultural traits. Where preferences in particular are concerned, Kosse et al. (2020) find causal evidence of both parental and social influence on children's pro-sociality in a purpose-built German sample. Chowdhury et al. (2020) similarly report evidence of intra-family persistence of pro-sociality, time preference and risk aversion in a large sample of families drawn from rural Bangladesh. The first set of findings is consistent with the hypothesis that preferences are transmitted vertically, horizontally and obliquely, the second that they are transmitted vertically, but neither set of findings has any bearing on the question whether preferences are selected by evolutionary forces. In the Bangladesh study, the sample breaks neatly into two clusters, a richer one consisting of relatively pro-social, patient and risk-tolerant families, and a poorer one consisting of relatively anti-social, impatient and risk-averse families. That is compatible with both evolutionary and non-evolutionary theories of preference determination, because long-run heterogeneity if predicted by models like Bisin and Verdier (2001b), where preferences are selected by evolutionary mechanisms, but also by models without evolutionary overtones, like the already examined political-economy version of Tabellini (2008), and others that will be examined in the next section. Besides, the finding that the richer cluster is more pro-social, etc. than the other may be simply explained by appealing to the argument, and to separate evidence,[38] that time-preference and risk-aversion decrease, and pro-sociality increases, as wealth goes up.

4 Contracts, norms and rules

In the game portrayed in Table 1 of the last section, the efficient allocation could be implemented by a legally enforceable contract stipulating that each signatory must play C. There are reasons, however, why such a contract may not be available. In the prisoner's dilemma story, the two players are simply not allowed to communicate between themselves. More generally, a contract may have a prohibitively high transactions

[37] This is known as the selective imitation hypothesis, one of the channels through which cultural group selection is supposed to operate; see Boyd and Richerson (2009).

[38] See, for example, Ogaki and Zhang (2001), Campbell (2006), Attema (2012), and Becchetti et al. (2016). Where pro-sociality is concerned, the relation with wealth is mediated by education.

or enforcement cost. If a mutually beneficial contract exists but cannot be implemented for whatever reason, we have what is called a hold-up problem. In the absence of a contract, however, the efficient allocation could be implemented by a family rule, a social norm or a law ordering all concerned to adopt the efficient equilibrium strategy.

A family rule differs from a social norm in that the former applies only to members of the same family, while the latter applies to all members of society. The distinction is worth maintaining even if, as it may well be the case in the long run, all families are governed by the same rule, because such a rule is enforced by other family members, while a social norm is enforced by a wider community. A law is such a norm, but one that is enforced by the State through its judicial and police apparatus. Acemoglu and Wolitzky (2020) compare the merits of "specialized enforcement" by the State, with those of informal community enforcement, and derive conditions under which the former is best at sustaining cooperation. Here, we concentrate on informal enforcement either at the family, or at the community level. As Binmore (2010) aptly puts it, "... norms are ... equilibrium selection devices that evolved for use in games that are seldom studied in economics laboratories". The evolutionary stability criterion examined in the last section is such a device. We will see in this section that analogous selection devices (without biological overtones) apply to family rules and social norms.

4.1 Family rules

An implication of Gary Becker's descending altruism assumption is that people can make negative transfers to their children (e.g., by making them work, and appropriating their earnings) while the latter are still young enough to be under parental control,[39] but not once the children have grown up, because the latter will not stand for it. If this nonnegativity constraint on parental transfers is not binding, and assuming that children have the same preferences as their parents (or that parents correctly internalize their children's preferences), the intertemporal and intergenerational allocation chosen by the latter will be a Pareto optimum. Children and parents' marginal rates of substitution of present for future consumption will then be equalized. If fertility is endogenous, the cost to the parents of having an additional child will be equated to the benefit. If the nonnegativity constraint is binding (i.e., if parents would like to take money away from their children, but the latter do not let them), however, the allocation will be inefficient.[40] The children's

[39] This possibilty is not actually considered by Becker, but there is nothing to prevent it occorring given the assumptions.

[40] See Cigno and Rosati (2005).

marginal rate of substitution of present for future consumption will then be larger than their parents', and the number of children higher than in the efficient allocation. If school-age children are allowed to work, child labour will be inefficiently high. As Baland and Robinson (2000, 2002) put it, the problem here is that a mutually advantageous contract whereby children borrow from their parents when the former are of school age and the latter of working age, and pay the loan back at more than the market rate of interest when the former are of working age and the latter of retirement age, is not implementable because minors cannot sign a legally binding contract with their parents (or with anyone else). If school-age children get anything from their parents in such circumstances, it will then be gifts, not loans. As we will see to be the case also in marital relations, in parent-child relations there is thus the possibility of a hold-up problem.[41] As already shown in Cigno (1993), a possible way out is an extra-legal rule that obliges working-age people to make positive transfers to their school-age children and elderly parents.

Let the life-cycle consist of three periods – school, working and retirement age – so that a family consists at any time of three generations. Assuming that a person's utility depends only on personal consumption (i.e., that this person is selfish), that reproduction is asexual, and that the number of children is a choice variable, Cigno (1993) demonstrates that a family rule ordering working-age family members to transfer at least a specified amount of income (or goods and services yielding the same utility) z to each of their school-age children, if they have any, and at least another amount x to their retirement-age parents, conditional on the latter having obeyed the same rule in their turn, may be self-enforcing in the sense that the number of children n chosen by a working-age person (who has to pay x to its parent and z to each of these n children) is a subgame-perfect Nash equilibrium. This faces a working-age person with a choice of two strategies: either to obey the rule ("comply" with it), have children, and rely on them for old-age support, or to disobey the rule ("go it alone" in the market), have no children and provide for old age by saving. For the former to be the equilibrium strategy, its payoff must be at least as high as the payoff of the latter. Given the fixed cost of having a child denoted by p, in equilibrium, the marginal return of children for a complier will then be sufficiently larger than the market interest factor r (taken to be exogenous because the family economy is immersed in a much larger market

[41] The problem does not arise if the parents are so rich and altruistic towards their children, that it is not optimal for the latter to borrow.

economy),

$$\frac{x}{p+z} > r, \tag{5}$$

to at least cover the fixed cost of compliance x. In equilibrium, therefore, selfish compliers have children and do not save.[42] Selfish go-it-aloners, by contrast, save and have no children.

People may thus make transfers (cooperate with their parents and children) even if they are selfish. The reason for this apparent altruism is that the conditionality on the obligation for working-age people to support retirement-age parents, such that only those who comply with this obligation are entitled to filial support, may make it in the former' interest to obey the rule (and thus to support or not support their parents, depending on whether the latter obeyed or disobeyed the rule in their turn).[43] Given that people are selfish, the amount they transfer to a parent or a child is always the prescribed minimum. All that changes if we assume descending altruism is that the number of children, and the amount transferred to each of these children (but not the amount transferred to the parents), may be larger than that minimum.[44] With or without altruism, however, a self-enforcing rule may not exist. Given that compliers do not save in view of (5), the payoff of the comply strategy does not depend on r. By contrast, as go-it-aloners must save in order to survive in old age, the payoff of the go-it-alone strategy is increasing in r. Consequently, the probability that a self-enforcing rule exists is decreasing in r. By a similar argument, the same probability is decreasing also in the share of retirement-age consumption that is covered by a public (hence, compulsory) public pension scheme, because the latter reduces the demand for filial support. Indeed, pension policy creates a negative externality, because it reduces the incentive to have children, and thus the implicit return to participating in the pension system.

What if several rules are self-enforcing? Cigno (2006) demonstrates that, out of all the family rules which support a subgame-perfect Nash equilibrium, there is one which is also renegotiation-proof, meaning that it is in nobody's interest to modify it. The renegotiation-proofness concept comes from Bernheim and Ray (1989), and Farrell and Maskin (1989), where the players are always the same, and the arrangement is thus to do with the way individuals behave towards their contemporaries.

[42] That is strictly true only under conditions of certainty. In the presence of uncertainty, compliers may have children *and* save. See Rosati (1996) for the case in which the uncertainty concerns the children's survival to working age.

[43] That is different from Axelrod (1986), where individuals are willing to punish someone who did not obey a norm by virtue of some *metanorm*.

[44] See Cigno (2006).

Cigno (2006) adapts this concept to a three-overlapping-generations context where the players change at each round, and the arrangement concerns the way working-age individuals behave towards their retirement-age parents and school-age children. The role renegotiation proofness plays in this class of games is analogous to that exercised by evolutionary stability in the evolutionary games examined in the last section. There, evolutionary stability selects a utility function out of those thrown up by random mutations. Here, renegotiation proofness selects a rule out of all those that are supported by a subgame-perfect Nash-equilibrium. Such a rule maximizes the lifetime utility of each family member, subject to the constraint that the payoff of complying with it for working-age family members (the only active ones at each date) is at least as large as the pay-off of deviating from it. If the constraint is not binding, the rule induces a Pareto-optimal allocation, such that the marginal rates of substitution of present for future consumption are equalized across school-age and working-age family members, and that the marginal return to income spent on school-age children by working-age parents is equal to the number of children.[45] Otherwise, the allocation will be a constrained Pareto optimum, where the marginal return to income spent on children is higher than the number of children. Barnett et al. (2018) demonstrate that public intervention in the presence of family constitutions is justifiable only on distributional grounds.

The renegotiation-proofness criterion addresses the question: what is there to stop any generation re-writing the family rule to their own advantage? To help the intuition, suppose that, at any given date, the working-age members of a family announce a new rule, different from the one currently in force. Will it stick? Not unless it Pareto-dominates the existing one. If the existing rule is undominated, the only way currently working-age family members can offer their children a better deal, and not loose in the bargain, is in fact to pay their now retirement-age parents less than the existing rule requires. But that makes the would-be innovators liable to punishment by their children, who will be better-off upholding the existing rule, which entitles them to pay their parents nothing, than acquiescing to the new one. A rule satisfying the double requirement of being a sub-game perfect Nash equilibrium, and undominated by any other rule that is itself a sub-game perfect Nash-equilibrium, is thus renegotiation-proof. We can think of such a rule as the family-level equivalent of what, in the political sphere, is called a constitution: the fundamental law that prevents a parliament from (among

[45] This result is reminiscent of the "golden rule" that the marginal return to capital must equal the the rate of population growth.

other things) legislating against the interests of future generations.[46]

There is empirical evidence that working-age persons behave as if they were governed by family constitutions. Using Italian micro-data, Cigno et al. (2006) find that credit rationing raises the probability of making intra-family money transfers. That is consistent with the hypothesis that such transfers are mandated by a family constitution, but not with the alternative hypotheses that they are either gifts, or payments for unobserved services received. Using French micro-data, Jellal and Wolff (2002) report that people who give attention to their parents are more likely to receive attention from their children, but they take this as evidence that children are altruistic towards their parents, and assume that this sentiment is inculcated into them by their (self-interested!) parents, rather than that a family constitution is at work. Using the cross-national panel Survey of Health, Ageing and Retirement in Europe, Klimaviciute et al. (2017) cannot reject the family constitution hypothesis. Using aggregate data, Cigno and Rosati (1992, 1996, 1997), Cigno et al. (2003), Fenge and Scheubel (2017), Gábos et al. (2009) and Galasso et al. (2009) find that saving and fertility rates respond to social security policy, and to labour and credit market conditions, in the way predicted by family constitution theory.[47] Billari and Galasso (2014), find the same using Italian survey data. Chiapa and Juarez (2016) estimate that parents who participated in the Mexican PROGRESA/Oportunidades conditional cash transfer program receive less old-age support from their children than parents who did not participate – much in the same way as retirement-age persons who benefit from a public pension are predicted by family constitution theory to receive less support from their working-age children than they otherwise would.

4.2 Preference evolution in the presence of family constitutions

Do family constitutions prevent or encourage preference evolution? Cigno et al. (2017, 2020) address this question in the context of a model with sexual reproduction. As anticipated in Section 2, the assumption is that, if a couple is formed, they have a daughter D and a son S. Once formed, the couple Nash-bargain over the allocation of their time endowments, and the distribution of their joint earnings. Compared with Cigno (1993, 2006), the analysis is specialized by assuming that, as is mostly the case in developed economies, what retirement-age people want and some-

[46] See Buchanan (1987).

[47] See also Cigno and Werding (2007).

times get from their working-age children is not income (which they had the opportunity to procure by saving or subscribing to a pension scheme when of working age), but attention, a good without perfect market substitutes that only a family rule can deliver if children are not altruistic towards their parents. Cigno et al. (2017) allow for the possibility that couples might be altruistic towards their children, and assume that individual wage rates are random variables with known density conditional on individual education. To focus on preference dynamics, Cigno et al. (2020) simplify the model by assuming that there is no altruism at all, and that the wage rate is a given constant, the same for everybody. The utility function of each member of the (f, m) couple is

$$U_i = c_{1i} + \ln c_{2i} + \max\left[0,\ \delta_i \left(\ln \beta a_D^i + \ln \beta a_S^i\right)\right], \tag{6}$$

where a_k^i is the amount of attention that $i = f, m$ may receive from child $k = D, S$ during retirement, δ_i is a measure of i's taste for filial attention, and β determines the minimum level of a_k^i below which filial attention yields negative utility (fleeting visits once in a while or the occasional phone call are a source of irritation rather than pleasure).[48] The δ parameter may differ across individuals, but its distribution in the population is assumed to be the same for men and women. Without descending altruism, the only possible benefit of having children, and thus of marrying, is that it may procure filial attention. A person whose δ is high enough to want to obey a family rule ordering her or him to provide attention for her or his parents will then seek to marry a member of the opposite sex with as high a δ as possible. If the value of δ is common knowledge as assumed in Cigno et al. (2017), it can be demonstrated that the matching will be positively assorted (the highest-δ men will marry the highest-δ women, the second highest-δ men will marry the second highest-δ women, etc.). In Cigno et al. (2020), however, δ is private information *ex ante* (it is observable by the partner only after the couple are married, and their children born), and it cannot thus be a criterion for couple formation. The matching will then be random where this trait is concerned. As in the earlier version of the model without sexual reproduction, whether a rule is self-enforcing and renegotiation-proof, and can thus be called a family constitution, depends on individual preferences and the economic environment.

If the values of δ characterizing different individuals are common knowledge, marriages are homogamous. Children are then identical to their parents, and δ does not evolve. The necessary and sufficient con-

[48] This threshold allows for the existence of a corner solution where parents receive no filial attention.

dition for a family constitution to exist is

$$\ln \beta\delta_i - \ln w - 1 \geq 0,\ i = f, m, \tag{7}$$

where w is the common wage rate. If f and m's preferences satisfy this condition, the two will marry. Given that their children's preferences also satisfy (7), the couple's daughter (son) then has an interest in marrying a man (woman) with the same preferences as herself (himself), and so will their granddaughters (grandsons), great-granddaughters (great-grandsons), and so on. It is shown that the constitution in question requires every working-age family member to give each of her or his retirement-age parents the amount of attention

$$a = \frac{\delta}{w}.$$

In the extreme case where all the couples satisfy a condition such as (7), everybody marries and has children. Consequently, the population replicates itself until and unless an exogenous shock (e.g., an immigration wave) sets it on a new course. At the opposite extreme, if none of the couples satisfy a condition such as (7), nobody marries, no children are born, and the population becomes extinct.

If the value of δ is private information until a marriage takes place, the matching is random. Assuming rational expectations, Cigno et al. (2020) demonstrate that a constitution then exists if and only if two conditions are satisfied. The first is that a restriction analogous to (7) holds even if f and m have different preferences,

$$\delta_f \left(\ln \beta\delta_f - \ln w - 1\right) + \delta_m \left(\ln \beta\delta_m - \ln w - 1\right) \geq 0. \tag{8}$$

The second is that conditions analogous to (8) are expected to hold for f and m's descendants and their randomly assigned partners, so that

$$E_t \left(\widehat{U}_{t+l} - R_{t+l} \mid \delta_f, \delta_m\right) \geq 0, \tag{9}$$

where t is the generation to which the (f, m) couple belongs, l is the number of generations that separate this couple from their d_{t+l} descendants, and $\widehat{U}_{d_{t+l}}$ and R_{t+l} are, respectively, the latter's equilibrium and reservation utilities. Denoting i's father by F_i, i's mother by M_i, and parent P_i's taste for filial attention by δ^{P_i}, where $P_i = F_i, M_i$, it is demonstrated that the amount of attention i must (and will) give P_i is

$$a_i^{P_i} = \frac{\delta^{P_i}}{w}. \tag{10}$$

No matter whether marriages are homogamous or drawn at random, the amount of attention due to a retirement-age parent if a family constitution exists is thus an increasing function of the receiver's taste for this good, and a decreasing function of the giver's opportunity-cost.

If *all* the couples drawn at random from the population at date t satisfy $(8)-(9)$, every member of that population will marry and have children. But, the same may not be true at $t+1$, because the first of these conditions may not hold for some couples even though the second did for their parents. There are then three possibilities. One is that conditions analogous to $(8)-(9)$ are satisfied for all couples from t onwards, in which case every member of every generation marries. Cigno et al. (2020) demonstrate that this will be the case from a certain generation onwards (which may even be generation 0), if w falls within a certain range.[49]. If that is the case, starting from that generation, the population will evolve in the way described in Section 2, and eventually converge to a homogeneous state where everybody has the same taste for filial attention δ^*. At the opposite extreme, if w falls outside the said range, $(8)-(9)$ will not hold for any of the couples randomly drawn at t, in which case that will be the last generation. In between these extremes, there is the possibility that the said conditions hold for some couples and there descendants, but not for others. Some lines of descent may then survive for ever, and converge to a descendance-specific value of δ, while others may become extinct after a certain generation. In the long run, the population may thus be heterogeneous. It may also be smaller than it was at the start, but all the surviving couples will be governed by a family constitution (not necessarily the same one for each of them).[50] In any case, there will be evolution in the strict sense that new values of δ appear, and old ones disappear.

We have already commented on evidence that cultural differences tend to persist. Of particular relevance to the issues discussed in the present section is evidence that a number of persons take care of their elderly parents despite the widespread assumption that altruism does not ascend, but the extent to which this happens differs even among neighbouring countries with very similar levels of economic and social development. Lowenstein and Daatland (2006) find that a majority of adults in Norway, England, Germany, Spain and Israel acknowledge some degree

[49]Intuitively, that is because, on the one hand, w raises the opportunity-cost of providing filial attention, but on the other, it relaxes the budget constraint and thus raises the demand for this good.

[50]These results become less sharp if descending altruism is assumed as in Cigno et al. (2017), because couples may then marry and have children even if they know that they will not get any attention from them. These couples will not abide by any family rule.

of filial obligation, but both the incidence and the intensity of this sentiment are higher in the two Mediterranean countries, than in the three North-European ones. Consistently with that finding, Klimaviciute et al. (2017) report that working-age Greek, Italian and Spanish people spend, on average, more than 33 hours a month attending to their elderly parents, while the Danish and the Dutch spend less than 11. Why such differences? An obvious answer is that national boundaries matter. As noted at the end of Section 2, even if couples are matched at random, if the matching is restricted to a subset of the population (e.g., to the home country), there will be several values of δ even in the long run. The substantial homogeneity within, and heterogeneity between, the two groups of countries considered seem to suggest, however, that other boundaries beside the national ones may be at play. An obvious candidate for this role is religion. Roman and Eastern Catholicism, and Judaism, all of which lay great stress on filial dutifulness,[51] predominate in the Mediterranean countries mentioned, whereas secularism and the reformed Christian churches prevail in the North-European ones. That raises the supplementary question, why are religions geographically distributed the way they are? A possible answer is what Myrdal (1957), already mentioned, calls a historical accident – not quite a *clinamen*, but still something that is exogenous to some an extent. Where Israel is concerned, the relevant historical accident is clearly the creation of the Jewish State, which has deep roots, but owes much to the Shoah. Where the distribution of Protestantism and Roman Catholicism between Northern and Southern Europe is, it is interesting to note the enduring influence of the *limen*, the Roman border. In what follows, we will see that a historical accident may set the ethnic boundaries within which a rule holds without the intermediation of religion.

4.3 Social norms

In principle, the same approach that was followed to demonstrate the possible existence of a self-enforcing, renegotiation-proof family rule could be followed to demonstrate also the possible existence of something analogous at societal level. Caillaud and Cohen (2000) develop a model very similar to Cigno (1993) to demonstrate the possible existence of what they call "common values in a society", but others call social norms. The problem with this approach is that it rests on the assumption that all currently working-age agents had the opportunity to observe, when of school age, the way all currently retirement-age agents behaved when of working age. That is a reasonable assumption to make within the family, but not if we are talking of a large and anonymous society, where each

[51] See Bisin et al. (2004)

member knows and has direct contact with only a very small fraction of the rest. The route followed by most other authors has been to extend the Folk Theorem from its original context, where the same pair of agents play the same Prisoner's Dilemma game a large number of times, to one where the players may change at each round. Okuno-Fujiwara et al. (1990), Kandori (1992) and others have shown that cooperation may prevail if all members of a large society are randomly matched to play the same two-person Prisoner's Dilemma.

The idea, based on Axelrod (1984, 1986), is that a "metanorm" inducing limitedly rational individuals to punish those who disobey a certain social norm may be evolutionary stable. Suppose that the norm requires everybody to cooperate (play C in the game portrayed in Table 1). If a person disobeys this norm (plays NC) in period t, her opponent will disobey it when playing against others from period $t+1$ onwards, thereby infecting another player who will in turn disobey from period $t+2$ onwards, and so on. Therefore, as in the intergenerational family game examined earlier in this section, the disobedient player is not punished by the direct victim (the two may never meet again), but by somebody else: there, by the offender's own children, here, by a randomly chosen stranger. Ellison (1994) demonstrates that this may ensure enforceability even if the players do not observe the outcomes of the games in which they are not involved, and do not know the identity of their past opponents. Camera and Gioffré (2017) extend the analysis to heterogeneous societies. This "contagious punishment" approach does not have the same informational requirements as Caillaud and Cohen (2000), but it shares with it the implication that everybody (not just the culprit) will be punished if anybody misbehaves. We are thus at the opposite extreme from Tabellini (2008). There, trust spreads like wildfire once a certain critical density of good people is reached. Here, mistrust spreads like the plague the moment anyone cheats. Neither of these two approaches assigns any role to what might be thought to be the primary motive for forming a relationship, namely reproduction.

Informational problems are negligible if the society to which a norm is supposed to apply is larger than the family, but still sufficiently small and interconnected for everybody's behaviour to be under everybody else's eyes.[52] In such a community, a norm prescribing cooperation is effectively enforced by the threat of exclusion and other forms of pun-

[52] How small is small enough? Dunbar (1992, 2010) finds that the maximum number of individuals with whom one can have stable relationships (as against simply remembering who they are) is determined by the size of the neocortex, the most evolutionary advanced part of the brain. For humans, this number ("Dunbar's number") is equal to 150, roughly the size of what anthropologists call a "clan".

ishment. Ellickson (1991) and Greif (1993) bring interesting examples of decentralized community enforcement. Cigno (2021) demonstrates that a cooperation-inducing norm originally enforced at the local community level in a primitive agrarian society may remain in force after emigration to a modern industrial one because it is in the immigrants and their descendants' interest to hold together by marrying among themselves, and thus to keep the same norm alive. This article provides an economic explanation for the remarkable empirical finding of Alesina et al. (2013), that European and US residents descending from immigrants whose ancestors experienced the plough when this was first introduced in their places of origin between 8 and 11 thousand years ago display still today, in their countries of destination, less equal gender attitudes than the descendants of populations who did not have that experience. According to Diamond (2005), the reason why the plough was introduced in some parts of the world and not in others is essentially geographical.

In the formal model, reproduction is sexual, the number of men is initially equal to the number of women, and each married couple have a daughter D, and a son S. Time is discrete. Men and women have the same utility function,

$$U_i = c_i + g_D + g_S, \tag{11}$$

where c_i denotes i's consumption of a private good, and g_K the quality (of life) of child $K = D, S$. Notice that D and S enter i's utility function symmetrically (no gender preference). If i is single, $g_K = 0$. If i is married, g_K is domestically produced by the couple using the amount of money y_K, and time ("attention") a_K, according to the production function

$$g_K = \ln y_K + \gamma \ln a_K, \ 0 < \gamma < 1. \tag{12}$$

Therefore, not only the father and the mother's money contributions, but also their time contributions, are perfect substitutes in the domestic production of child quality (a_K is the sum of K's father and mother's attention to K). In a modern industrial economy, i's wage rate w_i is equal to w^H with probability π, and to $w^L < w^H$ with probability $1-\pi$, where π is an increasing function of i's education, z_i. In such an economy, man and woman enter the model symmetrically in all respects.[53] Not necessarily so in a primitive agrarian economy, where wage rates (or physical productivities) do not depend on education. If the plough technology is not available, $w_i = w^L$ irrespective of gender. If the plough is available, however, $w_i = w^H$ if i is a man, $w_i = w^L$ if i is a woman, because handling this implement requires grip and upper body strength that are

[53] Indeed, there is nothing in the mathematics to say whether it is the man or the woman who actually bears the child.

characteristic of men rather than women. In a primitive agrarian economy, therefore, the plough technology generates a gender asymmetry.

The model has a two-stage structure, and is solved by backward induction. As stage 2, a working-age person i is endowed with one unit of time and b_i units of cash, and commands a known wage rate w_i. Endowments and wage rates are common knowledge. Men and women are matched by their reservation utility, equal to their utility as singles. Therefore, i's reservation utility is

$$R_i = c_i = b_i + w_i.$$

Where the couple formed by a particular woman f and a particular man m is concerned, it then follows that

$$w_m - w_f = b_f - b_m.$$

If the (f, m) couple marry, they Nash-bargain over the allocation of their joint cash and time endowments, and the destination of their joint earnings. In equilibrium, $y_K = 2$. If $w_f = w_m$, the couple share income-raising and child-raising work equally between them, and i's equilibrium utility is $U^\circ(R_i)$ for $i = f, m$. By contrast, if $w_f \neq w_m$, efficiency requires specialization according to comparative advantages. Therefore, in the Nash-bargaining equilibrium, the spouse with the lower wage rate raises children, and the one with the higher wage rate raises income, but their utilities are still equalized because the game is symmetrical. In this case, i's utility is $U^*(R_i) > U^\circ(R_i)$ for $i = f, m$. Given that $U^\circ(R_i) > R_i$ for all i, everybody marries. But, i will get the higher utility level $U^*(R_i)$ only if he or she marries a member of the opposite sex with wage rate different from w_i. If $w_i = w^L$, however, i will agree to specialize in child-raising activities only if he or she is guaranteed the same consumption level, and thus the same utility level $U^*(R_i)$, as his or her spouse. That can be arranged by either signing a legally enforceable contract before marriage (hence, before the children are born),[54] or requiring the high-wage spouse to give i the equilibrium amount of consumption at front. The former makes sense, however, only if the transactions-cost is no higher than $U^*(R_i) - U^\circ(R_i)$. Assuming that w is paid at the end or at any rate in the course of the period, the latter is feasible only if the high-wage spouse is endowed with enough cash to pay i at front.

[54] Marriage as usually intended is not a contract. It commits the parties to mutual support and sexual fidelity, but it gives neither party recourse to a court of justice for breach of contract. Cigno (2014) demonstrates that, under certain conditions (to do with the marital property regime, the cost of obtaining a divorce, and alimony rules), the threat of divorce may yield the same outcome as a legally enforceable pre-marital contract. But it cannot be assumed that these conditions are always satisfied.

Otherwise, there is a hold-up problem as in the Baland-Robinson case examined earlier. As in that case, the problem may be avoided if the efficient equilibrium can be imposed, in this case by a social norm (more about that in a moment).

At stage 1, i's parents play the same game that i will play with her or his spouse at stage 2. They thus give i the equilibrium amount of money $y_i = 2$. In a modern industrial economy, i's parents split y_i between cash in hand b_i and educational expenditure z_i, so as to maximize

$$E(R_i) = \pi(y_i - b_i)\left(b_i + w^H\right) + [1 - \pi(y_i - b_i)]\left(b_i + w^L\right),$$

subject to the condition that i must be able to pay off her or his future spouse in advance if w_i turns out to be high, and he or she is thus to specialize in income or food production,

$$b_i \geq 2\gamma. \tag{13}$$

Obviously, $E(R_i)$ will be larger if (13) is not binding. In a primitive agrarian economy, where education does not raise productivity, i's parents set $z_i = 0$. Where the plough technology is available, they set $b_i = 2 + \frac{w^H - w^L}{2}$ if i is a girl, and $b_i = 2 + \frac{w^H - w^L}{2}$ if i is a boy, so that, at stage 2, $R_i = 2 + \frac{w^H + w^L}{2}$ and $U_i = U^*(R_i)$ irrespective of i's gender. The norm thus ensures that i will get the highest possible utility, irrespective of gender, for the given y_i. Where the plough is not available, the parents set $b_i = 2$ irrespective of i's gender, but i's stage-2 reservation and equilibrium utilities will be, respectively, $R_i = 2 + w^L < 2 + \frac{w^H - w^L}{2}$ and $U_i = U^\circ(R_i) < U^*(R_i)$, no matter what i's gender is, but lower than if the plough were at hand.

Is there any need for a social norm regulating marital division of labour and distribution of output? Not in a primitive agrarian economy without plough technology, where husband and wife produce the same amount of food. In such an economy, (13) is never binding, but the highest utility $i = f, m$ can get at stage 2 is $U^\circ(R_i)$. In a plough-using agrarian economy, by contrast, a norm saying that the wife must raise children, the husband must produce food, and each spouse must get the same share of the food produced, is needed to implement the efficient equilibrium – otherwise she would not agree to specialize in an activity that does not produce any food. The norm that makes it possible for each spouse to get $U^*(R_i) > U^\circ(R_i)$ is enforced by the threat of punishment at the hands of the entire parent generation, because every member of that generation has a daughter and a son, and it is thus in their common interest that their sons should be allowed to pursue their comparative advantage in food production, but their sons-in-law should not be allowed to turn this comparative advantage into a bargaining advantage

at their daughters' expense. In equilibrium, the threat is never carried out, and the norm is implemented at zero cost.[55] The norm will support an efficient equilibrium even if some members of the original community emigrate to a modern industrial economy where individual productivity depends on education rather than gender.[56] Given the norm, parents will in fact invest in a son, but not in a daughter's education (or will give her just the legal minimum), because she will do no paid work. The sons of these immigrants will then preserve their comparative advantage in income-raising, and the daughters in child-raising activities, even though none of them will ever handle an ox-drawn plough.[57]

Would an amended norm stipulating that the spouse with the higher education must specialize in income-raising activities, and the other in child-raising activities, irrespective of gender, do just as well as the ancestral one in the modern industrial environment? The answer is no, because it would induce parents to give their daughters the same amount of education as their sons, and half the educational investment would consequently be waisted. Therefore, the amended norm is Pareto-dominated by the ancestral one, and it will not be selected. The ancestral norm is renegotiation-proof. Of course, also a norm saying that men must take care of domestic activities, and women go out to make money, is renegotiation-proof. But, switching from the old to the new norm would bring no benefit, and possibly carry a transactions cost. Therefore, it will not happen. Notice that gender roles are not pre-ordained. Had the plough not been invented, men and women would have continued to share all activities equally as before. Had the use of an ox-drawn plough required an ability to talk gently to the ox (rather than grip and upper body strength as it actually does), and were this a characteristic of women rather than of men, the plough would have given women a comparative advantage over men in agricultural production, and the norm would have then ordered men rather than women to take care of the home. Whichever is the case, the descendants of ancient plough users have an interest in marrying among themselves to preserve their com-

[55] As argued in Boyd and Richerson (1992, 2002), punishment can stabilize any norm within a group if it is cheap to the punishers and costly to the punished.

[56] As an alternative, the efficient allocation could be implemented by a legally enforceable pre-marital contract. But, such a contract is expensive to negotiate and enforce, while obeying the norm costs nothing.

[57] Consistently with evidence in Alesina et al. (2013) that the legacy takes the attenuated form of a lingering belief about how domestic life ought to, rather than it actually is organized, Cigno (2021) shows that, if time spent with children enters the utility function as a luxury good, the time allocation induced by the ancestral norm ceases to be efficient when wage rates are high enough for both spouses to demand this good.

munity enforcement mechanism, and thus to retain their ancestral norm in the new country. Coleman (1988) calls such a norm "social capital".[58]

Cigno (2021) makes the point that male chauvinism and son preference are neither necessary nor sufficient to explain the persistent heritage of the plough. This does not mean, however, that male chauvinism and son preference do not exist. Indeed, practices like female infanticide, genital mutilation and social seclusion cannot be explained without a good dose of misogyny. It must also be said that the existence of a rationale for young people descending from ancient plough users (or belonging to any other kind of group) to marry among themselves in order to preserve an efficiency-enhancing social norm lends itself to the distorted interpretation that parents have a right, or even the duty, to decide precisely whom their children should marry. Press reports (not only from traditional societies, but also from immigrant enclaves in modern ones) of young women murdered by their parents or relatives for refusing an arranged marriage are a sign that the threat of punishment is not always sufficient to enforce a rationally unjustifiable imposition.

5 Conclusion

Three points stand out from the literature reviewed in this paper. The first is that models inspired by the pioneering work of Cavalli-Sforza and Feldman (1981) do not permit new preferences or more generally cultural traits to emerge, because every new person is effectively the clone of an existing one (either a parent or somebody else). In those models, there may be evolution only in the demographic sense that the share of the population who hold certain traits increases or decreases. Evolution in the strict sense of new traits emerging occurs in a model outside that tradition like Cigno et al. (2020), where the value of the preference parameter which characterizes a given member of a given generation is a convex combination of a pair of preference parameter values drawn at random from those observed in the previous generation, and thus possibly never observed before. In all this literature, the mainspring of cultural evolution, culture itself, is curiously out of the picture, – as if the knowledge accumulated in thousands of years of study of nature and society had not left a mark.[59]

[58] Borrowing from sociology and psychology, Akerlof and Kranton (2000) argue that group norms are internalized by group members, who then feel good if they behave and cause others to behave in accordance with what they perceive as their group identity, and bad if they or others do otherwise. If that were the case, the male descendants of ancient plough users would continue to object to an egalitarian division of child-raising activities even if (see last footnote) they are rich enough to attach direct utility to time spent with their chidren.

[59] See footnote 11 for the effect of the distruction of the library of Alexandria.

The second point concerns the achievement of an efficient cooperative equilibrium in a Prisoner's dilemma type of game. This may come about because the players are altruistic. Indeed, Güth and Kliemt (1998), Bisin and Verdier (2001b) and Alger and Weibull (2013, 2019) demonstrate that altruistic preferences may be evolutionary stable and thus prevail over selfish ones. Alternatively, players may behave as if they were altruistic even if they are not because a family rule or social norm makes it in their interest to do so as in the literature sparked-off by Axelrod (1984, 1986). Given such a rule or norm, it makes no qualitative difference whether people are altruistic or not. Cigno (1993, 2006) and Cigno et al. (2017) further demonstrate that a family rule requiring working-age family members to support their retirement-age parents may be not only self-enforcing, but also renegotiation-proof. Evolutionary stability and renegotiation proofness thus play analogous roles in fostering cooperation – the former by selecting altruistic preferences, the latter by selecting rules that make it in the players' interest to behave as if they were altruistic.

The third point concerns the role of population groups identifiable by observable characteristics. Bisin and Verdier (2001a, b), and Wu (2020), assume that such groups exist. Tabellini (2008) endogenously determines the size of the group.[60] Cigno (2021) provides an economic rationale for keeping the group together through endogamy. To the extent that the unobservable traits of direct interest to individuals, for example the preferences of the person with whom they are matched, are more likely to be found inside than outside a certain group, this allows people to improve the quality of their matches. There is a negative side to it however. If we are talking of marriage rather other forms of partnership, endogamy tends to erode the common ground, and it ultimately reduces the population to a limited number of sharply differentiated types (see Section 2). There is then the danger, highlighted by Basu (2011, Ch. 6), that members of other groups will be seen as potential adversaries. There is a positive side too. Suppose that the individual preferences more widely represented in a certain group are compatible with the existence of mutually beneficial family rules or social norms, while those more widely represented in another are not. If group membership is a matter of choice (in other words, if the observable characteristics are labels that can be changed at will, like style of dress, dialect spoken or religion practiced), the danger may turn into an opportunity. As Boyd and Richerson (2009) would argue, members of the dysfunctional group will in fact migrate to

[60] For Dunbar (1992, 2010), there is a biological limit to the size of the group; see footnote 52.

the one which more successfully enforces pro-social behaviour.[61] Like selective imitation,[62] this selective migration argument falls under the heading of cultural group selection.[63]

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[61] In this context, "migration" may mean either becoming part of a social group governed by different norms, or marrying into a family governed by different rules, than the one to which one is born.

[62] The selective imitation hypothesis is mentioned in footnote 37, in relation to the Alger and Weibull approach to preference evolution.

[63] This approach highlights other channels, additional or alternative to comparative fertility and comparative survival, through which evolution might operate. For an outline of this approach and a review of the evidence, see Richerson et al. (2016). We are grateful to Donald Cox for bringing this literature to our attention.

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