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Role-Reversibility, Stochastic Ignorance, and the Formation of Norms

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Abstract: While much is known about what types of norms are sustainable as rules of behavior, a lot remains to be done to understand the conditions that foster the emergence of efficient norms. This paper provides a contribution to this field, revisiting the conventional wisdom concerning the effect of role reversibility and stochastic ignorance on the emergence of norms. We develop a model of norms formation to study the differences and limits of role reversibility and stochastic ignorance. Role reversibility and stochastic ignorance are environmental conditions that minimize the strategic bias of individual choice. Under role reversibility, individual agents engage in actions knowing that in future time periods there may be a reversal of roles with other players. Each agent maximizes his or her expected payoff, knowing the status quo at the time of the action as well as the ex ante probabilities about his or her future roles. With role reversibility, a party's choice is influenced by the immediate cost of compliance with a norm. In contrast, under stochastic ignorance, players make their choices under a Harsanyi-type veil of uncertainty. Norms that are chosen under conditions of stochastic ignorance can be separated from those chosen under a role-specific context that clouds and biases the formation of norms. Consequently, norms that emerge under stochastic ignorance are more likely to be closer to first-best and to satisfy parties' participation constraints at any given time than are norms chosen under conditions of role reversibility.

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Notable scholars have considered the conditions under which principles of justice can emerge spontaneously through the voluntary interaction and exchange of individual members of a group. As in a contractarian setting, the reality of norms and customary law formation relies on a voluntary process through which members of a community develop rules that govern their social interaction by voluntarily adhering to emerging behavioral standards. Ullmann-Margalit (1977) suggests that optimal social norms emerge under conditions of "role reversibility." Harsanyi (1955) and Rawls (1971) suggest that optimal social norms emerge through the interaction of individual actors with "impersonal" preferences. The impersonality requirement for individual preferences is satisfied if there is "stochastic ignorance" about the future – decision-makers have an

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identical chance of finding themselves in any one of the initial social positions and each rationally chooses a set of rules to maximize his expected welfare.[3]

We develop a model of norms and custom formation under the alternative environments of role reversibility and stochastic ignorance. Under conditions of role reversibility, the status quo is known to each agent at the time of the action, but the actual roles in future time periods are known only on a probabilistic basis. Actors maximize their expected payoffs based on their ex ante probabilistic information about future interactions. Under conditions of stochastic ignorance, players make their choices under a Harsanyi-type veil of uncertainty. Each agent decides what to do before knowing the status quo and without knowing which role he will play in future time periods. In this case, actors also maximize their expected payoffs based on their ex ante probabilistic information about future roles.

We examine the conditions under which the privately rational choices of individual parties approach the social optimum. The two regimes of role reversibility and stochastic ignorance both are capable of reducing the strategic bias of parties' choices by separating decision-makers from the immediate contingencies of their actions. However, stochastic ignorance and role reversibility impact differently the parties' effort and participation incentives. Parties are more likely to endorse and commit to follow a social norm when choosing under stochastic ignorance than when choosing under role reversibility. Also, under stochastic ignorance, parties are willing to accept a higher compliance burden than the level they would choose under role reversibility. This suggests that stochastic ignorance is more effective than role reversibility in fostering greater compliance efforts and broader participation to social norms.

We further study the effect of group size on the emergence of norms and show that variations in group size have different effects upon the two regimes of stochastic ignorance and role reversibility. Under both regimes, it is more likely for norms to emerge when individuals interact in smaller groups than in larger ones, but different

[3] Rawls (1971) employs Harsanyi's model of stochastic ignorance in his theory of justice. However, the Rawlsian "veil of ignorance" introduces an element of risk aversion into the choice between alternative states of the world, thus altering the outcome achievable under Harsanyi's original model, with a bias toward equal distribution (i.e., with results that approximate the Nash criterion of social welfare). Further analysis of the spontaneous formation of norms and principles of morality can be found in Sen (1979); Ullmann-Margalit (1977); and Gauthier (1986).

effort levels will be induced by the two regimes of stochastic ignorance and role reversibility.

1. Formation of Social Norms

Social processes that produce customs and social norms rely on the voluntary participation of the members of a community. By voluntarily adhering to emerging behavioral standards, individual members contribute to the development of rules that govern their social interaction. These social processes of rule formation are different from traditional lawmaking processes in that the resulting rules emerge gradually through the independent and spontaneous adherence of community members to social norms rather than through political deliberation.

The literature on social norms focuses on non-contractual mechanisms and considers the situations that are more easily governed by spontaneous law. In an environment characterized by perfect incentive alignment, contracts or relationships are self-enforcing (Klein, 1996). In the presence of such an environment, cooperation results both in repeated games (in which the players are faced with high discount factors) and in one-shot games. With perfect incentive alignment no one has any reason to challenge emerging cooperative norms ex ante or to violate such norms ex post, and there is no need for any law or norm enforcement.

When incentives are not aligned but parties face symmetric payoffs, social norms that promote cooperation and maximize group welfare also maximize individual expected payoffs. It follows that, from an ex ante point of view, situations characterized by symmetric payoffs do not present an opportunity for strategic preference revelation in the face of emerging norms.[4] Ex ante, parties will not withhold their support for cooperative norms, since such cooperative norms maximize their expected well-being. The expected costs and benefits of alternative rules are the same among the members of the group. In these symmetric environments, each individual has incentives to agree to a set of rules

[4] Fon and Parisi (2002 and 2003) show that the presence of homogeneous players was a necessary condition for the emergence of optimal customary rules. An important insight derived from their model is that, even in the presence of heterogeneous players, when the players face ex ante uncertainty over their future roles, their actions will approximate those obtained in the ideal case of identical players.

that maximize her expected share of wealth, such that the aggregate welfare of the group is maximized.[5] In this context, Cooter (1994b) suggests that social norms will evolve successfully when the ex ante individual incentives are aligned with the collective public interest. Cooter (1994b: 224) calls this proposition the "alignment theorem."

The same alignment of private and social cooperative incentives is believed to be present when parties reverse their future roles or when they choose a course of action under a veil of stochastic ignorance. In this paper, we formally analyze this claim and verify the extent to which an alignment of private and social incentives is present. The analysis partially supports the conventional wisdom, stressing that strategic behavior may undermine incentive alignment and cooperative outcomes when norms necessitate costly compliance efforts.[6]

In the presence of asymmetric players, difficulties arise at the ex ante stage, when players are faced with the choice of whether or not to endorse emerging norms and to participate in emerging customary practices. Traditionally, strategic preference revelation is viewed as a hindrance to the spontaneous emergence of cooperation. This problem is believed to be minimized in situations of role reversibility or stochastic ignorance with asymmetric players (Parisi, 1995). With respect to role reversibility, Fuller (1969: 24) observes that frequent role changes foster the emergence of mutually recognized and accepted duties. Fuller points out that "in a society of economic traders ... the members of such a society enter direct and voluntary relationships of exchange. ... Finally, economic traders frequently exchange roles, now selling, now buying. The duties that arise out of their exchanges are therefore reversible, not only in theory but in practice."[7]

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[5] In the absence of perfect incentive alignment, the discount factor plays an important role. In the existing literature, in situations with a probability of future interaction, the discount factor's role is critical. The discount factor captures two analytically distinct elements. First, it acts as a function of the players' time preference. Second, the discount factor is utilized as a proxy of the probability of future interactions. Environments promoting a high probability of future interaction and a low time preference are more likely to induce socially optimal equilibria (Axelrod, 1981 and 1984).

[6] A related area of research in the social norms literature considers the role of morality and internalized obligations as a means for inducing cooperation in conflict games (see, e.g., Gauthier, 1986; and Ullmann-Margalit, 1977). Internalization of the norm is a source of spontaneous compliance. For example, individuals internalize obligations when they disapprove and sanction other individuals' deviations from the rule, or when they directly lose utility when the norm is violated.

[7] As an historical illustration of an environment that reflected these conditions, we can think of the formative period of the medieval law merchant (*lex mercatoria*), when traveling merchants acted in the dual capacity of buyer and seller. When they articulated a rule of law that was favorable to them as sellers, it could have had the opposite effect when they acted as buyers, and vice-versa. This role reversibility

Similarly, stochastic ignorance is believed to induce each member to agree to a set of rules that benefits the entire group, thus maximizing her expected share of the wealth. Conditions of role reversibility and stochastic ignorance, coupled with behavioral standards that generate disincentives to adopt opportunistic double standards,[8] are therefore believed to foster the emergence of optimal norms via spontaneous processes.[9]

In the following, we formally analyze these claims, giving separate treatment to the two conditions of role reversibility and stochastic ignorance.

2. Optimal Social Norms for a Cooperation Problem

In our stylized setting, social norms impose costs on certain groups of individuals and create benefits for others. We adopt the Benthamite criterion of welfare and define efficient social norms as those that maximize the social welfare function; that is, the sum of all players' payoffs for all time periods. Since aggregate payoffs for all players is what matters for a Benthamite social problem, the relative frequency with which each player is on the receiving side rather than on the giving side of the interaction is unimportant. Not all efficient social norms are likely to enjoy the support and compliance of all members of society, given the possible uneven distribution of costs and benefits across different members of the group. We therefore examine the conditions under which efficient norms hold among a group of players.

Consider the problem of a social norm in the absence of any preexisting convention. At any point in time, voluntary participation to the social norm would impose costs on some parties while conferring benefits on others. For illustration, imagine the case of a rescue norm: one party is facing an emergency while other parties are faced with a decision of whether to voluntarily rescue the party in need. We assume that

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changed an otherwise conflicting set of incentives (buyer versus seller) into one that converged toward symmetrical and mutually desirable rules (see also Benson, 1989 and 1990; and Greif, 1989).

[8] Certainly, the emergence of consensus for a given rule does not exclude the possibility of subsequent opportunistic deviation by some individuals when roles are later reversed. This is a typical enforcement problem. Where rules are breached following role reversal, norms play a collateral yet crucial role in sanctioning case-by-case opportunism.

[9] The group's ability to impose a sanction obviously depends on an individual's accountability for his past behavior. In this setting, Benson (1992: 5-7) explores the role of reputation in situations of repeated market interaction, observing that reputation serves as a source of collective knowledge regarding past actions.

rescues, if carried out, yield a net social gain, such that the cost of the rescue activity is lower than its benefit. This ensures that rescues are socially desirable.

In each future period the norm becomes relevant, as one party will necessitate rescue from the others. Let e be the level of effort expended by others in fulfillment of the rescue norm. Assume that ae^2 is the total social cost of rescue borne by all giving parties, and that be is the total benefit enjoyed by the single receiving party. Hence, $be - ae^2$ is the social net benefit in each period. The marginal cost of effort level is assumed increasing: $MC = 2ae$ is an increasing function of e, while the marginal benefit of effort is assumed constant: $MB = b$ is independent of e.

Let there be N parties concerned, and let π_i be the probability of party i being on the receiving side. In this case, being the sole beneficiary of the rescue norm, party i receives benefit be. On the other hand, there is a $1-\pi_i$ probability that party i is called to undertake the rescue in fulfillment of the norm. All $N-1$ members of the rescue mission share the cost of rescue ae^2 equally. That is, given a probability of $1-\pi_i$, party i will pay the rescue cost of $ae^2/(N-1)$.

In each period, we assume that one and only one party needs help. The sum of the probabilities of *all* parties on the receiving end thus equals one: $\sum_{i=1}^{N} \pi_i = 1$. Since each party is involved in the rescue in each period, as the rescued or a rescuer, the sum of the probabilities of being on the receiving end or on the giving end for each party is 1. The sum of the probabilities of being on the receiving side or on the giving side for *all* parties must therefore be N. Consequently, the sum of the probabilities of *all* parties on the giving side must equal $N-1$: $\sum_{i=1}^{N} (1-\pi_i) = N-1$.[10]

We assume that all parties are risk-neutral. Given e to be the level of effort under the rescue norm, the social net benefit in each period is given by the following:

[10] Note that the total of the sum of the probabilities of *all* parties on the receiving end and the sum of the probabilities of *all* parties on the giving side is equal to 1 + (*N* - 1), which is *N*. This fact follows from our assumption that every party is involved in every rescue event.

$$
\begin{aligned}
SNB &= \sum_{i=1}^{N} [\pi_i \cdot (be) - (1-\pi_i) \cdot (\frac{ae^2}{N-1})] \\
&= be \cdot \left(\sum_{i=1}^{N} \pi_i \right) - \frac{a\,e^2}{N-1} \cdot \left(\sum_{i=1}^{N} (1-\pi_i) \right) \\
&= be - \frac{a\,e^2}{N-1} \cdot (N-1) \\
&= be - a\,e^2
\end{aligned}
$$

Since the Benthamite social welfare function sums the expected payoffs for all players for all time periods, the probabilities of each individual being on the receiving or giving side become irrelevant in the social problem. The use of ex post frequencies instead of ex ante probabilities or expectations would not change the solution to the social problem.

Assume that the cost and benefit functions are the same in every period from now till infinity, and that the social discount rate is r^S. Then the total discounted value of social payoffs from future periods is: [11]

$$
P^S = \sum_{t=0}^{\infty} \frac{1}{(1+r^S)^t} (be - ae^2) = \frac{1+r^S}{r^S} \cdot (be - ae^2) \tag{1}
$$

It is readily seen that the social optimal level of effort e^S is determined by equating social marginal cost and marginal benefit in each period. That is, the social optimal level of effort is given by:

$$
e^S = \frac{b}{2a}. \tag{2}
$$

3. Formation of Norms under Role Reversibility

The emergence of norms relies on the independent participation choice of members of the community. Individual members of the group decide whether to engage in a norm-creating activity and, if so, how much effort to spend towards such activity. When some members comply with a norm-creating activity, other members of the group draw a benefit.

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[11] Note that $\sum_{t=0}^{\infty} \frac{1}{(1+r)^t} = \frac{1+r}{r}$.

The fact that compliance with a given norm creates total benefits that exceed total costs does not guarantee that the norm will be followed by the relevant individual decision-maker. We therefore consider parties' private incentives in order to identify the conditions under which efficient norms can emerge through the voluntary interaction of members of society.

Under conditions of role reversibility, players engage in actions knowing that in future time periods there may be a reversal of roles with other players. The status quo is known to each agent at the time of the action, but the actual role in a future time period is known only on a probabilistic basis. Actors maximize their expected payoffs based on their ex ante probabilistic information about future roles. Since the choice of action in compliance with the norm rests exclusively with the active player, we concentrate on the action of those who are called to uphold the norm exerting an immediate effort in the current period.

3.1 The Private Problem under Role Reversibility

Assume that there are N parties and that each party has the discount rate r, $r > 0$. In period 0, consider a representative of the $N-1$ parties who are called upon to exert some effort to rescue a single party in need of help. A representative rescuer assumes that all parties participate and share the social marginal rescue cost equally.[12] Hence, assuming joint participation in the rescue by all others, the individual rescuer bears cost $\frac{ae^2}{N-1}$ while the receiving party derives benefit be.

After period 0, starting from period 1 to infinity, there is the possibility of role reversal. Those who were rescuers may need help from others and vice versa. Looking at the uncertain future, each party estimates the probability that he will benefit from the emerging rescue norm. We assume that given uncertainty, heterogeneous parties face homogeneous ex ante expectations. In spite of the possible ex post differences in frequency of rescue, each individual estimates the ex ante probability based on group

[12] We will relax this assumption later, considering the difficulties arising from potential coordination problems when rescuers cannot systematically rely on the participation of all others to the rescue.

size. This allows us to concentrate on the impact of group size on the emergence of norms.

In a group of size N, the party reasons that the ex ante probability of his benefiting from the emerging norm is $1/N$. When he is the beneficiary, the benefit enjoyed is the social benefit be. Meanwhile, there is also a probability that the current rescuer may be called upon to rescue again in the future. Such ex ante probability is $1-1/N$. When this happens, the giving party would once again share the social cost of the rescue in equal parts with all other rescuers, facing cost $\frac{ae^2}{N-1}$.

Hence, in each of the future periods, the party's expected payoff is given by:

$$\frac{1}{N}be-(1-\frac{1}{N})\frac{ae^2}{N-1} = \frac{1}{N}(be-ae^2). \tag{3}$$

With the discount rate r, each of the $N-1$ parties will choose an effort level to maximize the total expected payoff for all periods. This total payoff includes the cost incurred in the current period and the total discounted value of expected payoffs from future periods:

$$\max_e P = -\frac{ae^2}{N-1}+\frac{1}{r}\cdot\frac{1}{N}(be-ae^2) \tag{4}$$

The optimal level of effort e^R under conditions of role reversibility is then the following:

$$e^R = \frac{(N-1)b}{2a(rN+N-1)}. \tag{5}$$

For the party who is confronted with the choice of whether to participate in the rescue with an initial cost in period 0, if he should choose to participate in the rescue, his private optimal level of effort is e^R.

To investigate whether the party should indeed participate in the rescue, the participation constraint needs to be considered. Substituting the optimal level of effort e^R in (5) into the objective function P in (4) provides P^R, the optimal participation payoff for the party:

$$P^R \equiv P(e^R) = \frac{b^2(N-1)}{4a\,r\,N(r\,N+N-1)}\,. \tag{6}$$

From the Envelope Theorem, it can be seen that $\frac{\partial P^R}{\partial a} < 0$, $\frac{\partial P^R}{\partial b} > 0$, and $\frac{\partial P^R}{\partial r} < 0$. With the Envelope Theorem, it also can be proved that $\frac{\partial P^R}{\partial N} < 0$. Since this latter result is more difficult to see, we provide the proof in the Appendix.

In order for the party to partake in the venture, the participation constraint $P^R \geq k$, for some k, should be met. Thus, the higher the value of P^R, the more likely the party will participate in the rescue venture. This means that norms of rescue that impose lower participation costs (a) are more likely to attract initial participation. Likewise, when the potential benefits (b) from the rescue norm are high, participation will be more likely. The party's discount rate (r) is also relevant for the participation constraint. A lower discount rate means that the initial rescuer attaches greater value to the benefit of potential rescues in the future, making her more willing to join the group.

A change in group size (N) has two countervailing effects. First, a larger group size lowers the immediate cost of participation, since it spreads the initial cost among a larger group. This encourages participation. Second, in larger groups there is a greater probability that the initial rescuer will be involved again on the giving side of a rescue, before ever enjoying the benefits of a potential rescue in his favor. This discourages participation. The Appendix proves that the second effect dominates the first. This means that when the number of potential participants increases, it is less likely that a potential rescuer will join in the group.

3.2 The Efficiency Issue of Norms under Role Reversibility

To evaluate the efficiency of norms emerged under initial conditions of role reversibility, compare the privately optimal effort level e^R from (5) to the socially optimal level e^S from (2) and get:

$$e^R = \frac{(N-1)b}{2a(rN+N-1)} < e^S = \frac{b}{2a}.$$

This is true because $N-1 < rN+N-1$. Thus, the privately optimal level of effort e^R under role reversibility is a fraction of the socially optimal level of effort e^S.

Note that when the private party discounts the future less and less, the future expected benefits from the norm become larger and larger to compensate for the cost faced in the current period. As the discount rate approaches zero, the gap between private and social incentives tends to close: $e^R \to e^S$ if $r \to 0$. Hence the private optimum approaches the social optimum. Finally, it should be noted that a discrepancy between private and social optima may be exacerbated by an increase in the private discount rate, given the discounting of future benefits by private actors and the irrelevance of discount rates for the social problem. This result also sheds light on the difficulties of generating optimal norms when individuals have limited time horizons or when individuals only partially internalize the benefits of current norms on subsequent generations.

4. Formation of Norms under Stochastic Ignorance

The paradigm of choice under stochastic ignorance often has been examined in conjunction with the emergence of social norms and principles of justice. Harsanyi's (1955) "veil of uncertainty" and Rawls's (1971) "veil of ignorance" both suggest that optimal social norms can emerge through the interaction of individual actors with "impersonal" preferences. The impersonality requirement for individual preferences means that all decision makers have an equal chance of finding themselves in any one of the initial social positions. In such an environment, to maximize their own expected welfare, individuals will rationally choose a set of rules that also maximizes the well-being of society at large. In the following section, we examine the process of norm formation where individuals can endorse a norm before knowing whether the norm will first benefit or burden them at the time its application becomes necessary.

It should be pointed out that in the following exercise the paradigm of stochastic ignorance differs from the previously examined paradigm of role reversibility in that the choice takes place before the norm is applied in practice. In our rescue example, this may

be the case when individuals have an opportunity to discuss and reach a consensus on what should be the appropriate rescue norm within the group. Hence, under the paradigm of role reversibility, parties know their current role when participating in the process of norm formation without full knowledge of their roles in each of the future periods. Under stochastic ignorance, however, individuals articulate their preferred norm without yet knowing which role they will be playing when the norm is first applied or which role they will be playing in future periods.

4.1 The Private Problem under Stochastic Ignorance

The stochastic ignorance in our model takes the form of a Harsanyi-type "veil of uncertainty." Under conditions of stochastic ignorance, each agent chooses before knowing which role she will play in the future. Agents maximize their expected payoffs based on their ex ante probabilistic information about future roles.

The formulation of the stochastic ignorance problem is similar to the previously examined role-reversibility problem except that there are no current period costs or benefits, as parties adhere to a norm chosen ex ante. As before, each party assumes the ex ante probability of being a receiving party to be $1/N$ and the probability of being on the giving end to be $1-1/N$. When the party is on the receiving end, the benefit gained is be. Recall that we assumed when the party is on the giving end, the party shares the rescuing cost with all the other parties equally and faces cost $\frac{ae^2}{N-1}$.[13]

The expected payoff of each party is hence equal to the expression given in (3). Discounting the future payoffs with a discount rate r, the problem confronted by the party is then given in the following:

$$\max_{e} \; P = \frac{1}{r} \cdot \frac{1}{N}(be - ae^2) \tag{7}$$

The optimal level of effort e^I under stochastic ignorance is given by:

[13] This assumption later will be relaxed to consider cases of imperfect coordination and incomplete sharing of the initial rescuing costs.

$$e^I = \frac{b}{2a} \tag{8}$$

Substituting e^I into the objective function of the maximization problem (7) gives the optimal expected payoff P^I, where

$$P^I \equiv P(e^I) = \frac{b^2}{4arN} \tag{9}$$

Consider the participation constraint $P^I \geq k$ for some k. From (9) it is easy to see that P^I increases when b increases, or when either a, r, or N decreases. Thus, the qualitative impacts of these parameters on the issue of participation in the case of stochastic ignorance are similar to that in the case of role reversibility. Further, since the party does not have to face the upfront compliance cost under stochastic ignorance, it is easier for the participation constraint to hold when choices are made under the veil of uncertainty, ceteris paribus. Comparing the optimal participation payoff under role reversibility P^R in (6) and the optimal participation payoff under stochastic ignorance P^I in (9), it can be seen that $P^R < P^I$. In our example, this means that it is more likely that the party will adhere to a norm of rescue, if decided ex ante under stochastic ignorance, than to join in an actual rescue venture with the expectation of future role reversibility.

4.2 The Efficiency of Norms under Stochastic Ignorance

The results above confirm the conventional wisdom according to which ex ante choices made under stochastic ignorance are socially optimal. Comparing the privately optimal level of effort chosen under stochastic ignorance e^I in (8) with the social optimal level of effort e^S in (2), we see that they are in fact identical. Given the uncertain future and the absence of immediate costs, parties are willing to articulate norms that maximize their expected well-being and, by doing so, they maximize the well-being of society at large. This convergence of private and social incentives was not obtained under conditions of role reversibility, except for the limited case in which parties had zero discount rate.

These results shed light on an important difference between the frameworks of role reversibility and stochastic ignorance examined in this paper. When a norm is applied, it imposes costs on certain groups of individuals, creating benefits for others. Although efficient social norms yield benefits exceeding the costs that they generate, under role reversibility not all such norms would induce the widespread support and compliance of members of society given the uneven initial burden of costs across members of the group. No such strategic withholding of participation occurs when parties choose under conditions of stochastic ignorance.

These differences have important implications for the design of institutions that would foster the emergence of efficient norms. Whenever feasible, consensus on given norms should be promoted ex ante, rather than in the imminence of a situation requiring the application of the norm. Likewise, if there were third parties who are not involved in the current period but later may be affected by the norm, their opinions on a given issue may be valuable indicators of truthful social preferences. This is because the position of third-party spectators is very similar to those who choose under stochastic ignorance. As a matter of policy design, greater weight should be given to the opinions of the current neutral spectators, since the views of those who are directly involved on the giving or the receiving side of the norm are likely to be biased or short-sighted.

5. The Relevance of Group Size and Coordination Problems

The sociological and experimental literature places great emphasis on group size and how closely knit the community is when studying the conditions for the emergence of social norms.[14] We thus proceed to use our results to study further the sensitivity of the role reversibility and stochastic ignorance equilibria with respect to group size.

[14] Olson's (1971) seminal contribution to the theory of collective action provides an important basis for the well-known idea according to which cooperation is less likely in large group environments. More recent contributions have generated results that are partially at odds with the conventional wisdom. De Cremer and Leonardelli (2003) examine the idea that cooperation is driven by the need to belong, reaching the conclusion that norms of cooperation would more likely occur in large-group environments. Likewise, Haag and Lagunoff (2003), considering the size and structure of group cooperation, also suggest that cooperation is greater in larger groups than smaller. In spite of these incursions on the traditional claim, the experimental literature provides support to the traditional theory of group size, revealing that under most environments cooperation will be more likely to result when the group is quite small, or there is some factor such as reputation or coercion present. The relevance of group size on cooperation also has been

5.1 The Case of Stochastic Ignorance

We begin by recalling that the social optimum and the private optimum for the stochastic ignorance case were found to be identical: $e^I = e^S = b/2a$. It is readily seen that when the number of parties increases, there is no impact on the privately optimal level of effort e^I. That is, the group size does not matter for the determination of the optimal effort level under the stochastic ignorance case. In our rescue example, this means that parties would be inclined to articulate efficient rescue norms regardless of the size of the group. However, when the parties face an opportunity cost, such as the value of self-help in our rescue example, while endorsing a norm, group size may affect the participation decision. In other words, although the group size may have an impact on the willingness to participate in the emerging norm, it does not affect the choice of effort after joining in the emerging norm. As was pointed out above, from the optimal value P^I given in (9), we see that as the group size increases, it is less likely for the participation constraint to be satisfied. Hence, the more parties there are, the less likely it is for parties to be willing to endorse an emerging norm. These findings are consistent with the established wisdom in the sociological and anthropological literature, according to which small and close-knit communities are more fertile environments for the emergence of social norms under conditions of stochastic ignorance.

5.2 The Case of Role Reversibility

A similar investigation can be carried out with respect to the effect of group size when parties choose norms under conditions of role reversibility. Recall that the privately optimal level of effort e^R under role reversibility is a fraction of the socially optimal level of effort e^S. Differentiating e^R in (5) with respect to the number of parties N, we have:

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studied by psychologists. Sherif and Hovland (1961) study the effect of group size on communication and cooperative attitude. Sherif and Sherif (1969) also represents a classic work in this field, attempting to quantify (or more accurately put to the test in a laboratory) theories about effects on norm development by changing group size, etc.

$$\frac{\partial e^R}{\partial N} = \frac{2abr}{4a^2(rN + N - 1)^2} > 0 .$$

This indicates that, as the number of parties involved increases, the optimal level of effort chosen under role reversibility increases. This can be explained by the fact that larger groups allow for more spreading of the initial cost, thereby minimizing the strategic behavior of initial participants and making them willing to undertake a higher effort level. Further, it is easily shown that:

$$\lim_{N \to \infty} e^R = \frac{b}{2a(r+1)} < e^S .$$

This suggests that the impact of group size on effort level is limited and that, no matter how large the group, the effort level e^R would fall short of the socially optimal e^S.

Finally, although group size plays a favorable role on the effort choice, it decreases the likelihood of participation to the emerging norm. (This is shown by $\frac{\partial P^R}{\partial N} < 0$ in the Appendix.) Hence, as the number of participants becomes larger, it is less likely that a party will join the group. This is because the probability of becoming a beneficiary of the emerging norm decreases with group size and, given an opportunity cost in participation and the presence of immediate compliance costs, this may bring participation below the threshold of convenience. However, if the party does decide to join the group, he would in fact be willing to expend more effort in compliance with the norm, given the fact that compliance costs are spread among a larger number of participants.

5.3 Group Size and the Emergence of Norms

The above results reveal that the two regimes of role reversibility and stochastic ignorance create different effort and participation incentives. Comparing optimal effort and participation under role reversibility and stochastic ignorance, we can see that:

$$e^R < e^I \quad \text{and} \quad P^R < P^I .$$

Participation constraints are more likely satisfied and effort levels are higher under stochastic ignorance than under role reversibility. This suggests that for the

purpose of fostering greater compliance efforts and broader participation to social norms, stochastic ignorance provides a more fertile environment than role reversibility.

Similarly, we can see that group size has different effects in the two regimes of stochastic ignorance and role reversibility. The comparative statics of the respective participation and effort levels shows that:

$$\frac{\partial P^R}{\partial N} < 0, \quad \frac{\partial e^R}{\partial N} > 0,$$
$$\frac{\partial P^I}{\partial N} < 0, \quad \frac{\partial e^I}{\partial N} = 0.$$

Under both stochastic ignorance and role reversibility, an increase in group size renders participation to emerging norms less likely. This implies that, regardless of the regime of norm formation, it is easier to encourage norm participation when individuals interact in smaller groups than larger ones. Group size, however, has a different impact on effort levels in the two regimes. Compliance efforts in regimes of role reversibility are sensitive to changes in group size. No such impact is visible in regimes of stochastic ignorance, as the willingness to expend effort under this regime is invariant to group size.

5.4 Coordination Problems and Evolutionary Traps in the Formation of Norms

The above results concerning the effect of group size should be revisited to consider the impact of possible coordination problems in the emergence of norms. The desirability of participation to an emerging custom depends on the expected participation of other members of the group to the custom. If the rescuer cannot rely on the support and widespread participation of other rescuers, the above results concerning the effects of group size on the participation constraint may be altered, given the lack of sharing of the initial cost in the first round. For example, if an initial rescuer needs to face the entire cost of the rescue in order to give a good example, she may be less willing to undertake the rescue or choose a suboptimal level of effort as a way to minimize the full upfront cost.

To understand the boundaries of the first-mover participation problem, consider the limiting case in which the initial rescuer acts alone, with no opportunity to count on the support and cost-sharing of other members of the community in the initial rescue

mission. The initial rescuer may engage in the rescue to set a good example, with the expectation that such an example will be followed by others in subsequent time periods, yet at the time of rescue she faces the full cost of the rescue mission with no support from others. In this case, the problem of the party can be formulated as follows.

$$\max_{e} \; P = -ae^2 + \frac{1}{r} \cdot \frac{1}{N}(be - ae^2)$$

The privately chosen level of effort $\tilde{e}$ is:

$$\tilde{e} = \frac{b}{2a(rN+1)}.$$

Clearly $\tilde{e}$ is less than e^S. In this case, group size has a detrimental effect for both the choice of effort level and the participation constraint. As the group size N increases, the privately optimal effort level $\tilde{e}$ goes down and it is harder to satisfy the participation constraint, since group size affects the future benefits without reducing the current cost.

This suggests that when there is no prior consensus on the desirability of a norm, those who wish to be pioneers for the establishment of a new norm face an initial private cost. Players are willing to face an initial cost in the expectation of a future benefit and would rationally undertake a rescue to avoid establishing a no-rescue norm that may harm them in the future. However, even in the face of desirable rescue norms, coordination problems may arise. With imperfect coordination, each member of the group might be willing to join the rescue if she could count on the participation of others, but may withhold participation if uncertain about others' choices. This may lead to suboptimal effort and participation to the establishment of new social norms. Another way to look at the issue is to think of it in terms of externalities. The action of the first-mover, if not supported by the immediate participation of others, would impose a private cost to and generate a social benefit partially internalized by the decision-maker. The larger the initial cost and the less group sharing of such cost, the greater the amount of externality not internalized. The presence of such externalities means that the initial action for the establishment of a new norm would be undertaken at a suboptimal level.

6. Conclusion

The existing literature on social norms shows that while the process of norm formation is often capable of supporting cooperative behavior by participating parties, individual participants may systematically fail to behave optimally. Also in this literature, the conditions of role reversibility and stochastic ignorance are regarded as instrumental to facilitating the formation of efficient norms. In this paper, we develop a model of custom formation to compare the environments provided by stochastic ignorance and role reversibility, where each is designed to foster participation and optimal compliance to social norms. The results reveal the importance of timing with respect to a player's endorsement of an emerging norm relative to the time in which compliance with the norm becomes necessary. The main differences between the effects of role reversibility and stochastic ignorance lie in the fact that role reversible processes require a "first mover" to trigger the formation of the norm, which can take place only in a context where action is necessary. In such settings, actors' preferences (and resulting actions) are biased by the immediacy of the situation, and thus any norm that begins in such a context is unlikely to be first-best. In contrast, norms that are chosen under conditions of stochastic ignorance can be articulated in the abstract, outside of the context of an imminent action. The parties are separated from the type of role-specific context that clouds and biases the formation of norms among heterogeneous parties. Consequently, norms that are formed when parties face uncertainty about their future roles are, through expression of belief, much more likely to be closer to first-best, and more likely to satisfy parties' participation constraints at any given time than are norms chosen through initial action under conditions of role reversibility. The economic model shows that the strength of both processes of norm formation depends on several environmental parameters.

We identified some important differences between role reversibility and stochastic ignorance. The results disclose several factors that may limit the ability of these conditions to yield socially optimal norms. Among these factors, attention was given to the effect of group size, cost and benefits of norm participation, and private discount rates on the formation of norms. We then proceeded to use our results to

examine the sensitivity of role reversibility and stochastic ignorance to changes in group size. Participation to emerging norms is negatively affected by an increase in group size under both regimes of stochastic ignorance and role reversibility. Compliance efforts, although negatively affected by group size in regimes of role reversibility, are not affected when parties choose in regimes of stochastic ignorance. In sum, role reversible processes tend to depend more crucially on the studied parameters than norm formation under stochastic ignorance, and thus are less conducive to the emergence of efficient norms.

Future extensions should consider different forms of stochastic ignorance. For example, a framework of a veil of uncertainty, as opposed to a strict Rawlsian veil of ignorance, could accommodate ex ante differences between subjects. Although parties do not know who will benefit from the norm first, they could face different expectations and probabilities of being on the giving or receiving side of the relationship. Such a model would unveil the relevance of different degrees of heterogeneity among members of a group for the emergence of efficient norms. Future extensions should build on these results to consider the conditions for the sustainability of existing social norms, when group size increases and when groups become more heterogeneous.

Appendix

The problem facing a representative rescuer with role reversibility is given as:

$$\max_{e} \; P = -\frac{ae^2}{N-1} + \frac{1}{r}\cdot\frac{1}{N}(be - ae^2)$$

Note that the first order necessary condition which defines the optimal level of effort $e^R = \dfrac{(N-1)b}{2a(rN+N-1)}$ is:

$$\frac{-2ae}{N-1} + \frac{1}{rN}(b - 2ae) = 0\,.$$

This condition can be rewritten as:

$$\frac{1}{rN}(b - ae) = \frac{2ae}{N-1} + \frac{ae}{rN} \qquad (10).$$

Hence, the optimal level of effort e^R must satisfy equation (10). Next, the optimal value function is found by substituting e^R in the objective function P:

$$P^R = P(e^R) = -\frac{ae^{R2}}{N-1} + \frac{1}{r}\cdot\frac{1}{N}(be^R - ae^{R2})\,.$$

The Envelope Theorem then implies the following.

$$\begin{aligned}\frac{\partial P^R}{\partial N} &= \frac{ae^{R2}}{(N-1)^2} - \frac{1}{rN^2}(be^R - ae^{R2}) \\ &= \frac{ae^{R2}}{(N-1)^2} - \frac{e^R}{N}\left(\frac{1}{rN}(b - ae^R)\right) \\ &= \frac{ae^{R2}}{(N-1)^2} - \frac{e^R}{N}\left(\frac{2ae^R}{N-1} + \frac{ae^R}{rN}\right)\end{aligned}$$

The last equality holds because e^R is the solution to the first order condition (10). Continue to simplify the last expression of the comparative static, we have:

$$\frac{\partial P^R}{\partial N} = ae^{R2}\left(\frac{1}{(N-1)^2} - \frac{2}{N(N-1)} - \frac{1}{rN^2}\right)$$

$$= \frac{ae^{R2}}{(N-1)^2 N^2 r}\left(Nr(2-N) - (N-1)^2\right)$$

$$< 0$$

The last inequality holds because there are at least two parties involved: $N \geq 2$. Thus, the fewer parties there are in the group, the higher the optimal payoff from participating in the custom.

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