# The Evolution of Social Norm: Economic Modeling

Preliminary Draft

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## Introduction

The basic theory of the "social norm" is one of the core issues of our "Soft Law Project."[1] Our previous paper[2], which was originally presented at the 1st COE Symposium in March 2004, reviewed how economics – together with other disciplines such as sociology or sociological psychology – can analyze social norms and what the possible our future agenda might be. In that paper, we identified three different lines of argument that have been discussed: (1) Incentive structure of the social norms, (2) Stability and transition of the social norms, and (3) Interrelationship between social norms and the law.

[1] "Soft Law and the State-Market Relationship: Forming the Base for Strategic Research and Education in Business Law" (Graduate Schools for Law and Politics, University of Tokyo), sponsored by 21st Century COE Program of the Japan Society for the Promotion of Science (JSPS).

[2] Fujita and Matsumura (2005).

The first question focuses on the question of why people obey norms that are not enforced by the state. One might say that they follow norms voluntarily simply because "they like it,"[3] and sometimes that might be true. However, there may be the possibility that conformity to a certain norm has a hidden incentive structure that binds the behavior of members of the society. Recent literatures in law and economics scholarship have revealed the incentive structure of many social norms. For instance, one might explain the observance of cooperative social norms, which looks disadvantageous at first glance, as equilibrium in an infinite, repeated game.[4] Alternatively, we could consider a costly conformity to certain social norms a signaling behavior of the players – one that conveys certain private information to the other party.[5] Both explanations can be integrated.[6] Several analyses along these lines have been discussed since our Project began and the outcomes have been published.[7]

The second question is why a certain specific norm is chosen among all possible equilibria. Although this question is often confused with the aforementioned first question, it is theoretically a completely separate one. The argument of the incentive structure only shows the regularity of people's behavior forms equilibrium, and does not explain why a specific equilibrium is chosen among possible ones. There are also related questions as to whether a chosen equilibrium is optimal, and how stable it is. This relates to the economic theory of the formation and transformation of the norms and customs, to which much attention has been drawn in recent economic literatures.[8] The "front line" of game theory focuses on this issue,[9] and it has also much to do with such approaches as "new institutional economics" (e.g., North (1990))

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[3] There are two different types of "they like it" situation. The first is a situation where many people like to do the same thing and this leads the regularity in people's behavior. The second is the situation where conforming to the "social norm" creates pleasure. People may not like to do "A" in itself, but once many people do "A" and "A" becomes a social norm, then conformity creates utility. The former is a pattern in which behavior people like becomes social norm and the latter is in which people like the behavior because it conforms to the social norm.

[4] It is well known that when the discounting factor is low enough (i.e., the players are sufficiently patient), a cooperative strategy that guarantees each player a minimum required payoff is possible (Folk Theorem). See, Myerson (1991), p. 331, Gibbons (1992).

[5] For example, it is often gifts in the form of certain goods (such as souvenirs) that are preferred to gifts in a form of money. It is costly to choose appropriate souvenirs, and it is even more costly for those who do not know much about the receiver. In this case, the behavior to send souvenirs rather than money could work as a signal that indicates the sender's knowledge of or enthusiasm for the receiver. See, Posner (2000), Ch. 4.

[6] A costly conformity to certain social norms could be interpreted as a signaling of a low discount factor (patience) in the players, which facilitates cooperative behavior in repeated games. See, Posner (2000).

[7] See, for example, Seshimo (2005).

[8] As a seminal work, see, Sugden (1986). As a more recent work, see, Matsui (2002).

[9] For the literatures of evolutionary game theory, see, Part I. C.

or "comparative institutional analysis" (e.g., Aoki (2001)) – both of which explore the formation and transformation of the institutions.

Finally, there is another line of literatures that focuse on the interrelationship between legal rules and social norms. If there is the possibility for social norms to be inefficient, one would naturally ask whether state intervention could improve a situation. The state (including courts, legislators, administrative body, etc.) can affect an inefficient social norm through a direct intervention such as outright prohibition,[10] or through a more indirect intervention (such as a public campaign) that simply creates a "focal point" among multiple equilibria. Either way, the effort may not be promising when one considers the ability and incentive of the state. The desirability of the "incorporation strategy" in the Uniform Commercial Code and other legal rules, which is discussed in this symposium, addresses a more delicate relationship between law and social norms.[11]

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Although all three lines of previous study must be further developed, the focus of this essay is devoted exclusively to the second aforementioned question. This choice is more exogenous than endogenous. During previous discussions in the Seminars, the Symposia or the Study Groups of Project, it was felt that the systematic study of the dynamics of social norms is lacking in Japanese legal scholarship.[12] This may be partly attributed to the fact that the recent developments in economic literatures are too heavily technical for lawyers and if this is the case, an introductory note for this field would help the situation. As such, this essay does not intend to propose a new

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[10] It is usually assumed in economic literatures that direct state intervention has only an exogenous effect (i.e., raising the cost of certain behaviors). Recent law and economics literatures sometimes focus on the endogenous effects of state interventions and argue for a possible "preference-shaping policy." See, Sunstein (1986) and Sunstein (1993).

[11] Bernstein (1996) distinguishes "relation-preserving norms" (RPNs) and "end-game norms" (EGNs), and argues that it might be unwise for courts (or another third party, such as arbitrators) to apply the latter when disputes are referred to them. The argument can be best understood in the context of repeated games. The outcome resulting from the application of RPNs can be seen as a payoff for the parties' cooperative strategy. The outcome from the application of EGNs can be seen as the payoff of the parties' "trigger" strategy, in case other party does not cooperate. The party goes to the court when the other party does not cooperate and EGNs (trigger strategy) apply. This terminates the relationship with the party in question, but the possibility for this trigger strategy strengthens the stable relationship with other trade partners. On the other hand, if the courts apply RPNs to the dispute resolution, parties cannot introduce a "trigger strategy" into their games.

Bernstein's argument has an important implication, which the courts should be very careful to examine: the nature of the game is to not destroy the whole of a structure that is efficient. For empirical studies into customs in industry, see, Bernstein (1992) and Bernstein (1999).

[12] See, for example, Nakazato (2005).

theory or to report a new finding; rather, we wish instead to discuss how recent economic modeling can address and shed light on the intriguing subject of the evolution and transformation of social norms.

Part I explains the nature of the problem; by citing a classical example in economics of information, we show that an inefficient norm may be chosen among multiple equilibria. Subsequent Parts analyze the social norms using the simplistic model of evolution. First, we examine the pure coordination game with a symmetric payoff structure (Part II); we see the efficient outcome there is more stable than an inefficient one in a long-run evolutionary process. Second, we examine the coordination game with the asymmetric payoff structure (Part III). Compared to the previous Parts, the analysis in Part III shows that a suboptimal outcome can be more stable. Finally, we examine the whether the situation can be changed with communication among players. The simple model of a "cheap-talk game" is introduced, and the implications of equilibria choice and evolutionary stability are explored.

## I. Multiple Equilibria and the Possibility of Non-optimal Equilibrium

### A. Social Norms as Equilibrium

In this essay, as in our previous article, we use the term "social norm" as meaning "a behavioral regularity which is widely observed among the majority of the member of the society."[13] If we define the social norm in this manner, we can see it as the equilibrium of a game played by the member of a society. Such an equilibrium can be inefficient for many reasons.[14] The most obvious example is a norm in a small closed society that has a third-party effect on non-members and is suboptimal for the larger society as a whole. For example, social custom within industry can be inefficient from the viewpoint of society, including industry's customers. Cooperative trade customs can facilitate a tacit collusion, helping to achieve an oligopoly outcome among industries that can harm the consumers' welfare. A closed society of experts might develop a suboptimal (from the viewpoint of the whole society) standard of conduct in relation to non-expert customers. The University of Tokyo Hospital Case,

13 The reason for the use of this possibly debatable definition, see, Fujita and Matsumura (2005), p. 61.

14 For a discussion of the possibility of inefficient social norms, see, Posner (1996).

in which the Supreme Court refused to accept the customs among medical doctors as a proper standard of care in relationship to patients, is a typical example that focuses on this aspect.[15]

However, a theoretically more interesting situation is when the social norm becomes inefficient, even without such an outright third-party effect. This occurs typically in a situation where multiple equilibria exist.

## B. Multiple Equilibria and Suboptimal Equilibrium

Until the 1970s, many economists had been relatively optimistic in believing that a rational expectation would lead to an efficient equilibrium. Developments in the economics of information and game theory changed this perception. It has been well recognized that a suboptimal equilibrium can be chosen by the players and become stable in a multi-equilibria situation.

The following example will demonstrate how an inefficient outcome (social norm) can be an equilibrium. Akerlof (1980) suggests a possible scenario in which an inefficient social norm (referred to as a "social custom" in the original article) could survive, based on a simple model of asymmetric information. Assume a society in which Race A and Race B co-exist; there is no difference in productivity between the two races on average, but there is a difference in productivity among the individuals of each race. (For the sake of simplicity, let us assume that 50 percent of each race is of low productivity and the rest is high.) Each individual has a choice whether to work at a firm as an employee or to work at home. High-productivity individuals can produce 20 products at a firm and 12 at home, whereas low-productivity individuals can produce 10 at a firm and 6 at home. The payoff to the individuals is either (1) the salary from the employer when they work at a firm or (2) the value of the products when they work at home. Ultimately, for an unknown reason, employers embrace a

| | products | | payoff | |
|---|---|---|---|---|
| | firm | home | Firm | Home |
| Race A (high) | 20 | 12 | 15 | 12 |
| Race A (low) | 10 | 6 | 15 | 6 |
| Race B (high) | 20 | 12 | 10 | 12 |
| Race B (low) | 10 | 6 | 10 | 6 |

**Table 1**

[15] Supreme Court Decision February 16, 1961, Minshu [The Supreme Court Reporter] v. 15(2), p. 244.

prejudice that Race A is more productive on average, and they consequently pay more to the employees of Race A than of Race B (say, 15 to Race A and 10 to Race B respectively).

What happens next? High-productivity individuals in Race B could earn more if they work at home than at a firm (12 and 10 respectively; see, Table 1). These individual therefore choose to work at home. Low-productivity individuals in Race B earn less if they work at home than at a firm (6 and 10 respectively; see, Table 1). Therefore, they choose to remain working at the firm. As a result, the average productivity of Race B employees at the firm becomes 10, which corresponds with their salaries. Individuals in Race A, regardless of their productivity, earn more working at the firm than at home (15>12, or 15>6) and therefore they choose to work at firm. The average productivity of Race A employees at the firm becomes 15, which correspond with their salaries. Overall, this becomes an equilibrium in the sense that neither party has an incentive to move or change.

This is a sort of self-fulfilling prophecy. Once the prejudice emerges that Race A is more productive and deserve a greater salary than Race B, it will create a real difference in productivity among both Race A and Race B employees at a firm. The differing productivity does not create the discriminatory treatment; rather, the discriminatory treatment creates differing levels of productivity.

The equilibrium referred to in this Section is not efficient. If the firm employs each race equally and pays 12.5 (i.e., the average of 15 and 10) to both, all individuals will work at firm because they will earn more than if they work at home (12.5>12 for high-productivity individuals and 12.5>6 for low-productivity individuals). It would ultimately maximize production in society. Nevertheless, all members of the society must voluntarily observe an inefficient social norm, once it emerges.

The most unfortunate characteristic of the model is that the follower of the social norm might not even be aware of a possibly better equilibrium. In the above scenario, although both the employer and employees would be better off in a society where Race A and Race B are treated equally, people might not even consider such an ideal situation possible. Under this circumstance, inefficient norms cannot be easily changed.

## C. Recent Developments in Game Theory

One might wonder why people choose inefficient equilibria at all when more efficient equilibria exist. In the scenario of Section B, we simply assumed that, "for an unknown reason, employers embrace a prejudice that Race A is more productive." But why does this happen at all?

Although it has been well recognized since the 1970s that there can be a suboptimal equilibrium in a multi-equilibria situation, the mechanism of the choice among multiple equilibria has not been fully examined in terms of theory, until recently. Following the lead of Schelling (1960), we can call something that tends to focus the players' attention on a specific equilibrium a "focal point effect," and the resulting equilibrium a "focal equilibrium." But how does a "focal point" arise? Economists were, at first, not ambitious to handle the issue within economic theory. For example, Myerson (1991) says "the focal point-point effect defines both an essential limit on the ability of mathematical game theory to predict people's behavior in real conflict situations and an important agenda for research in social psychology and cultural anthropology."

Recent game theorists, however, have attempted to elaborate an economic model to address the problem of equilibrium selection. Different approaches have been taken to exclude less plausible equilibria. Although some have attempted to explain equilibrium selection at the individual decision-making level introducing new "refinement" concepts, more literatures have shifted to "evolutionary" explanations that focus on how the equilibria converge through a long-term evolutionary process.[16]

This essay introduces elements of this evolutionary approach to the equilibrium selection process. We examine how simple $2 \times 2$ games with multiple equilibria converge into one stable situation. One of the most important features of the evolutionary approach is that, contrary to ordinary game theory or economic analysis in general, players are not assumed to be completely "rational," at least not in the sense that they choose the most appropriate strategy given their sometimes imperfect and incomplete information and an infinite deduction ability. In fact, in the model explained in the following Parts, the overwhelming majority of players simply mimic the seemingly most successful strategy played (i.e., they mimic the behavior of the most successful player in the existing game), with a few "idiosyncratic" players choosing their strategies randomly. In other words, the approach describes how a stable equilibrium emerges from the trial-and-error learning process, and the evolutionary approach can be understood as one possible approach to incorporating "bounded

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[16] Seminal works in the evolutionary approach can be traced back to Smith and Price (1973) and Smith (1982). An excellently reviewed recent development in the evolutionary approach is available in Fudenberg and Levine (1998).

rationality" and "learning" into economic modeling.

## II. Pure Coordination Game with the Symmetric Payoff Structure[17]

### A. A Simple Game with Multiple Equilibria

First, let us assume the following simple normal-form game. Each player has two strategies to choose from: Strategy L and Strategy R. The payoff to the each player through a transaction with others is as follows.

When both players choose L: 2

When both players choose R: 1

When each player chooses different strategy: 0

| | L | R |
|---|---|---|
| L | 2,2 | 0,0 |
| R | 0,0 | 1,1 |

**Table 2**

The payoff structure is "symmetric" in the sense that each player gets the same payoff from the transaction, although the *amount* of the payoff depends on the combination of both parties' strategies.

This game has two sets of Nash equilibria[18] with pure strategy: (L, L) and (R, R). There is no compelling reason for one equilibrium to be preferred by the players over the other.

### B. Modeling the Evolutionary Process

Let us assume that the game described in Section A is being continuously played by many people over a long period of time. We consider a group which consists of eight players. Players make transactions with one another within the group, and the payoff of each transaction is exactly the same as in the above game: (L, L) produces 2 for each member; (R, R), 1; and (L, R) and (R, L), 0. Total return to each player is the aggregate of the payoff of the transactions. For the sake of simplicity, we assume that each player makes one transaction with another member of the same society. Therefore, the return to each player depends both on the payoff from the transaction and on the number of other players. For instance, when four

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17 For more general arguments and precise proofs, see, Kandori, Mailath and Rob (1993).

18 A "Nash equilibrium" refers to a situation (or strategy combination) in which no player can increase his payoff by changing his strategy, given the strategy of other players. For a definition of Nash-equilibrium see basic textbooks on game theory, such as Gibbons (1992), p. 8.

members choose Strategy L and the other four Strategy R, the return is 6 (2×3＋0×4) for those players who chose Strategy L and 3 (0×4＋1×3) for those who chose Strategy R.

Let us further assume the following turnover of group membership. Players enter into and leave from the group continuously, but the membership of the group is kept constantly at eight individuals. Sometimes one new member enters while one old member leaves, and sometimes more than one new member enters while the same number of old members leave. Each player chooses his strategy when he enters the group and does not change it until he quits. An "*ordinary*" newcomer mimics the best strategy of the existing member who obtains the highest expected payoff. There also exist a small number of "*idiosyncratic*" newcomers who choose their strategy randomly. The choices of "idiosyncratic" newcomers do not follow the above pattern, but are simply unpredictable. The choice of an "ordinary" newcomer can be interpreted as an adaptation to the environment, and that of an "idiosyncratic" newcomer as the mutation; overall, it can be said that the above scenario describes the evolutionary process.

Where does this evolutionary process converge? Let us denote the situation where all members choose Strategy L as "Norm L", and that where member choose Strategy R as "Norm R". First we confirm how the transition between Norm L and Norm R occurs, and then where this evolutionary process converges.

## C. The Choice of an "Ordinary" Newcomer and the Transition between two Norms

First, let us confirm the choice of an "ordinary" newcomer. Table 3 shows the return for each member. The first row indicates the number of members who choose Strategy L and Strategy R respectively. The second and third rows indicate the payoff to the members with Strategy L and Strategy R, given the composition of the members in the first row. For instance, when seven members in the group choose Strategy L and one member

| Members with Strategy L/ Strategy R | Strategy L | Strategy R |
|---|---|---|
| 0 / 8 | - | 1×7=7 |
| 1 / 7 | 0×6=0 | 0×1+1×6=6 |
| 2 / 6 | 2×1+0×6=2 | 0×2+1×5=5 |
| 3 / 5 | 2×2+0×5=4 | 0×3+1×4=4 |
| 4 / 4 | 2×3+0×4=6 | 0×4+1×3=3 |
| 5 / 3 | 2×4+0×3=8 | 0×5+1×2=2 |
| 6 / 2 | 2×5+0×2=10 | 0×6+1×1=1 |
| 7 / 1 | 2×6+0×1=12 | 0×7=0 |
| 8 / 0 | 2×7=14 | - |

**Table 3**

chooses Strategy R, seven players with Strategy L get 12 (2×6+0×1) and one player with Strategy R (0×7) gets 0. Therefore, the "ordinary" newcomer will mimic seven members and choose Strategy L.

As is shown in the Table 3, if there were more than three players who had chosen Strategy L, an "ordinary" newcomer would choose Strategy L, because those who chose Strategy L obtained more then those who chose Strategy R. If there were fewer than three members who had chosen Strategy L, an "ordinary" newcomer would choose Strategy R.

Assume that all the players choose Strategy R at the initial stage ("Norm R"). "Ordinary" newcomers choose Strategy R, and even if an "idiosyncratic" newcomer appears at times, as far as they remain small in number, they are likely to be replaced by subsequent "ordinary" newcomers who choose Strategy R. Therefore, the situation is relatively stable and most (or all) members will continue to choose Strategy R.

However, it might be possible – though not at all probable – that more than three "idiosyncratic" newcomers will enter simultaneously or consecutively,[19] and that all of them will choose Strategy L. Once this happens, then an "ordinary" newcomer who enters next will also choose Strategy L. If the next newcomer is an "ordinary" one (as is quite likely so), he will choose Strategy L and furthermore, it is likely that most or all members of the group will come to play Strategy L. Thus, a transition occurs from Norm R to Norm L.

Although Norm L seems fairly stable, it might still be possible, with an even lower probability, that a future transition would occur. Even if all members choose Strategy L, if six or more "idiosyncratic" newcomers enter simultaneously or consecutively and all of them choose Strategy R, then Strategy R yields more than Strategy L. Therefore, subsequent "ordinary" newcomers will choose Strategy R and it is probable that all the members will play Strategy R in a mean time through the replacement of members. A transition from Norm L to Norm R occurs.

## D. The Long-term Stability of Norms

As explained in Section B, neither the situation where all members follow Strategy L (Norm L) nor the situation where all members follow Strategy R (Norm R)

[19] Although we described that "simultaneously or consecutively" for the sake of simplicity, the expression is too narrow. It is suffice that there exist more than three idiosyncratic newcomer exist in the group.

are completely immune to change, and transition could possibly occur from Norm L to Norm R or vice versa in the long term. Which situation is more likely to remain longer? The answer is obvious: the period of Norm L is longer. More than three "idiosyncratic newcomers" need to appear to change Norm R, while at least six "idiosyncratic" newcomers are needed to change Norm L. The more efficient Norm L is more stable than Norm R.

As far as a kind of "natural selection" mechanism along the above lines exists, the optimal equilibrium (Norm L in above scenario) is more "evolutionarily stable" than the suboptimal one. The period of optimal equilibrium will continue longer over a very long term.

This might give the reader the optimistic impression that the survivorship of a certain social norm suggests its efficiency. Unfortunately, the model does not necessarily imply this; the only thing shown is the *relatively* high stability for an optimal equilibrium in the long run. It may be possible that an inefficient equilibrium continues for a long period on an absolute basis. An inefficient equilibrium could survive 1,000 years, followed by a 5,000-year efficient era. It is especially true when the probability of the mutation (i.e., an "idiosyncratic" newcomer in the above hypothesis) is very low. An inefficient social norm continues for quite a long time in this situation (even when that period is shorter than the period of an efficient one) when the initial setting is inefficient (i.e., all members choose R in the above scenario).

## III. Coordination Game with an Asymmetric Payoff Structure

### A. The Payoff Structure of the Game

In the previous Part, we saw a situation where an optimal outcome survives longer when the payoff structure is symmetric. This somewhat optimistic story, however, does not hold when the payoff structure of each transaction is asymmetric. Assume another game, as follows. Just as in the scenario of Part II, players enter into and leave from the group continuously, the membership of the group is kept constantly at eight members, and they make transactions with one another randomly. Each player has two strategies to choose from: L and R. Each player chooses a strategy when he enters the group and does not change it until he quits. An "ordinary" newcomer mimics the best strategy of the existing membership that obtains the highest expected payoff. A small number of "idiosyncratic" newcomers choose their strategy randomly.

The only difference is in the payoff structure of the players. Let us assume that each player receives the following payoff through a transaction.

When both players choose L: 2

When both players choose R: 1

When player 1 chooses L and player 2 chooses R: player 1 gets -3 and player 2 gets 0

When player 1 chooses R and player 2 chooses L: player 1 gets 0 and player 2 gets -3

| | L | R |
|---|---|---|
| L | 2,2 | -3,0 |
| R | 0,-3 | 1,1 |

**Table 4**

This game also has two sets of Nash equilibria, each with a pure strategy ((L,L) and (R,R)), as in the transaction in Part II. However, it is more risky for each player to choose Strategy L, although it is more efficient for all members to choose Strategy L under this payoff structure. The payoff structure is asymmetric in the sense that each player could receive a different payoff when the choice of strategy differs among parties.

B. The Stability of the Equilibrium

Under the setting in Section A, the transition from Norm R to Norm L becomes more difficult than from Norm L to Norm R. Table 5 indicates the payoff to the members. The first rows show the number of the members who choose Strategy L and Strategy R respectively. The second and third rows indicate the payoff to the member who chooses Strategy L and Strategy R respectively, given the composition of the group in the first row.

| Members with Strategy L/ Strategy R | Strategy L | Strategy R |
|---|---|---|
| 0 / 8 | - | 1×7=8 |
| 1 / 7 | (-3)×7=-21 | 0×1+1×6=6 |
| 2 / 6 | 2×1+(-3)×6=-16 | 0×2+1×5=5 |
| 3 / 5 | 2×2+(-3)×5=-11 | 0×3+1×4=4 |
| 4 / 4 | 2×3+(-3)×4=--6 | 0×4+1×3=3 |
| 5 / 3 | 2×4+(-3)×3=-1 | 0×5+1×2=2 |
| 6 / 2 | 2×5+(-3)×2=4 | 0×6+1×1=1 |
| 7 / 1 | 2×6+(-3)×1=9 | 0×7=0 |
| 8 / 0 | 2×7+=14 | - |

**Table 5**

The Table suggests that at least six “idiosyncratic” newcomers choosing

Strategy L are necessary for the change to Norm L when all members choose Strategy R. In contrast, only three are needed to transform Norm L to Norm R.

As a result, the situation in which all members follow Strategy L (Norm L) is less stable than the situation in which all members follow Strategy R (Norm R). Under these circumstances, a suboptimal equilibrium (inefficient norm) is more stable than an optimal one (efficient norm).

Thus, the stability of equilibrium in the long run depends on the payoff structure of the underlying games (transactions) and could be either optimal or suboptimal.[20]

### C. Excess Inertia: A Source of Asymmetric Payoff Structure

One might see the assumption of asymmetric payoff structure as being too arbitrary. To the contrary: we would like to emphasize that this is often the case in relation to social norms. The asymmetric payoff structure described in Section A implies the following: when many people follow Strategy R, it is very costly to switch to Strategy L, unless other players also switch to Strategy L at the same time. Such a scenario can be found where the problem of "excess inertia" exists.

Excess inertia can be caused for many reasons; it often occurs, for example, when "network externality" exists (i.e., the situation where the payoff to the player depends on the number of players who take the same action).[21] If there is an irreversibility it terms of switching strategy (i.e., once the player changes strategy, then the player cannot revert to the original one) and it is costless to switch the strategy at any time, the player would almost certainly take a "wait and see" attitude; in such circumstances, the equilibrium outcome would become inefficient.[22] Even if switching is not completely irreversible, inefficiencies caused by delay would occur as far as there are asymmetric costs in terms of switching back and forth.

Although the phenomenon of "excess inertia" is most often discussed in the context of technological innovation, it is also a key to understanding the development of social norms. Many social groups do not easily accept the former members who

[20] See, Kandori, Mailath and Rob (1993).
[21] See, Katz and Shapiro (1985).
[22] See, Matsumura and Ueda (1996). David (1985) offers an interesting explanation why existing keyboard layout "QWERTYUIOP" survives in the face of more efficient system such as DSK (Dvorak Simplified Keyboard). He points out that technical interrelatedness, economies of scales, and quasi-irreversibility of investment are the key to understand the phenomenon.

violated the norm and thus disobedience to the norm often has a quasi-irreversible effect.

## IV. Communication and Stability of Norms[23]

### A. The Setting: Introducing Communication Stage

In the previous Part, we have shown that less efficient equilibria can be more stable when their payoff structures are asymmetric. This Part introduces an additional element to the evolution of equilibrium: *communication among players*. In brief, it is suggested that communication can possibly make suboptimal equilibria less stable and optimal equilibria more stable.

In the previous Parts, the players (newcomers) simply chose between Strategy L and Strategy R when they entered the group. Here, we introduce the "communication" stage of the game, considering the following two-stage game.

Each player chooses his strategy when he enters the group and does not change it until he quits. The strategy consists of two parts: (1) In the first stage, each player chooses whether or not to communicate with another party. If he chooses to communicate, he announces something like "B" and listens to what his communications partner announces. If he chooses not to communicate, he says nothing, nor does he listen to what his partner says. Communication costs are denoted as "*b*", which is positive but arbitrarily small. The player can save this cost by choosing "not to communicate." (2) In the second stage, each player chooses either L or R. Let us assume the same payoff structure in the second stage as in Part III.

When both players choose L: 2
When both players choose R: 1
When player 1 chooses L and player 2 chooses R: player 1 gets -3 and player 2 gets 0
When player 1 chooses R and player 2 chooses L: player 1 gets 0 and player 2 gets -3

| | L | R |
|---|---|---|
| L | 2,2 | -3,0 |
| R | 0,-3 | 1,1 |

**Table 6**

[23] The argument in this Part is inspired by Matsui (1991) although the article rests on a quite different concept of stability ("cyclically stable set"). Farrell (1993) is also an important contribution to the cheap-talk games which analyze special kind of communication called "neologism".

The payoff for the player depends both on the choice in the first stage and on the choice in the second. There is, as in the games of previous Parts, a continuous turnover of members. An "ordinary" newcomer mimics the "best" strategy (i.e., that of the existing member who obtains the highest expected payoff). A small number of "idiosyncratic" newcomers choose their strategy randomly.

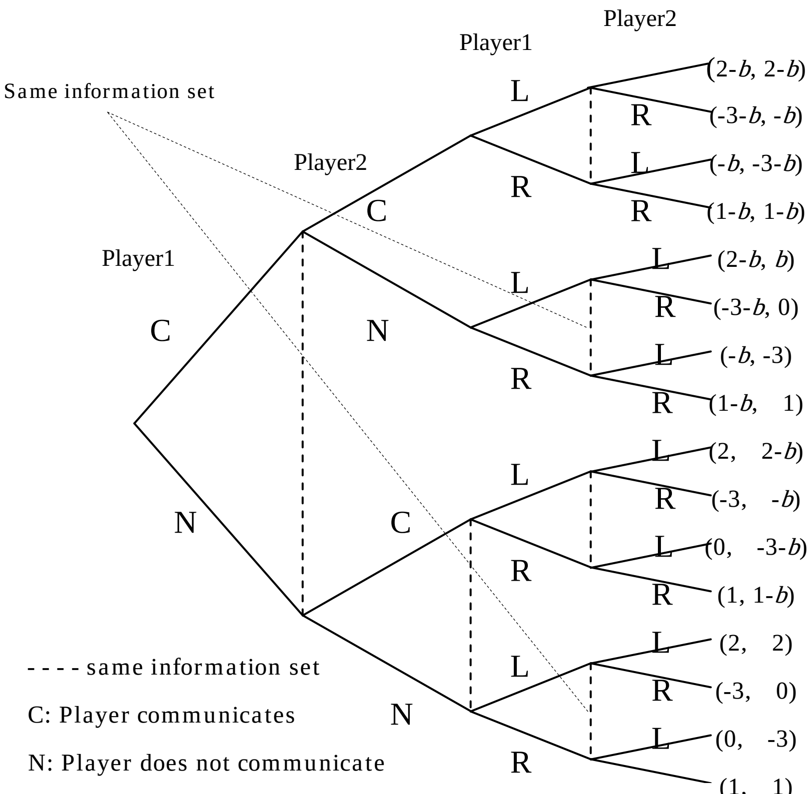

**Figure 1**

Let us denote the situation in which all members choose L in the second stage as "Norm L" and choose R in the second stage as "Norm R". We will examine how the transition between Norm L and Norm R occurs, and where this evolutionary process converges.

## B. Transition from Norm R to Norm L

First, let us examine the possibility for a transition from Norm R to Norm L. Suppose an initial situation where all players take the following strategy (Strategy I): "I will not communicate in the first stage and I will choose R in the second stage." Then, let us suppose that an "idiosyncratic"

| Members with Strategy I/ Strategy II | Strategy I | Strategy II |
|---|---|---|
| 0 / 8 | - | 2×7-7b=14-7b |
| 1 / 7 | 1×7=7 | 1×1+2×6-7b =13-7b |
| 2 / 6 | 1×1+1×6=7 | 1×2+2×5-7b =12-7b |
| 3 / 5 | 1×2+1×5=7 | 1×3+2×4-7b =11-7b |
| 4 / 4 | 1×3+1×4=7 | 1×4+2×3-7b =10-7b |
| 5 / 3 | 1×4+1×3=7 | 1×5+2×2-7b =9-7b |
| 6 / 2 | 1×5+1×2=7 | 1×6+2×1-7b =8-7b |
| 7 / 1 | 1×6+1×1=7 | 1×7+-7b =7-7b |
| 8 / 0 | 1×7=7 | - |

**Table 7**

newcomer begins to take the following strategy (Strategy II): "In the first stage, I will communicate and announce 'B'. In the second stage, I will take L if my partner also says 'B,' but will otherwise take R."

A newcomer's payoff from Strategy II is larger than that of the incumbent players who take Strategy I, if at least two "idiosyncratic" newcomers who choose Strategy II enter into the group. To see why, assume, for instance, the scenario where six members take Strategy I and two members take Strategy II. The two members who take Strategy II get 8-7b[24] while the other six get 7. [25] In contrast, if there is only one "idiosyncratic" newcomer taking Strategy II, Strategy II yields 7-b which is lower than Strategy I does (i.e.,7). (See, Table 7)

Because an "ordinary" newcomer mimics the best strategy (i.e., that of the existing member who obtains the highest payoff) and Strategy II is more successful than Strategy I[26], subsequent "ordinary" newcomers will also adopt Strategy II when there are (only) two or more members who take Strategy II. Compare the result with that of the previous Part. At least six "idiosyncratic" newcomers are required there (see, Part III. B), while only two are necessary here.

Note that when sufficiently large number of members chooses L in the second stage, an "idiosyncratic" newcomer gets even more if he chooses a new strategy "I will not communicate and choose L" and saves communication costs "*b*". If an "idiosyncratic" newcomer takes this strategy, subsequent "ordinary" newcomers will follow. Therefore, in the long run, players will stop to use communication at all. However, as we saw above, the possibility communication plays crucial role for transition of the Norm.

In sum, even when Strategy I is prevailing and all members choose R, only two "idiosyncratic" newcomers are needed to change the situation. The transition from Norm R to Norm L becomes dramatically easier when a communication stage is introduced into the game, even if the payoff structure of the second game is identical to that of the game in Part III.

## C. Transition from Norm L to Norm R

[24] When the two members with Strategy II meet, both of them say "B," choose L, and get 2. When they meet the other six members with Strategy I, they say "B," the other party says nothing, both choose R, and both get 1. Communication costs are 7b in total. Therefore they receive 8-7b.

[25] When the six members with Strategy I meet, both of them say nothing, choose R, and get 1. When they meet with two other members who choose Strategy II, they say nothing, the other party says "B," both parties choose R, and get 1. They therefore get 7 in total.

[26] We assumed that *b* is sufficiently small so that 8-7b>7.

Let us now examine the possibility of the transition from Norm L to Norm R. Suppose that initially, all players take the following strategy (Strategy III): “I will not communicate in the first stage and I will choose L in the second stage.” Does the introduction of the communication stage also facilitate the change the Norm R to Norm L? The answer is “no,” for the following reason.

Suppose an “idiosyncratic” newcomer takes the following strategy (Strategy IV): “In the first stage I will communicate and announce ‘B’. In the second stage, I will take L if my partner also says ‘B’, and will take R otherwise.” When one or two members take Strategy IV, it does not yield better net results than Strategy III[27]. At least three members are required for Strategy IV to create a greater yield and thus be mimicked by an “ordinary” newcomer. (See, Table 8)

| Members with Strategy III/ Strategy IV | Strategy III | Strategy IV |
|---|---|---|
| 0 / 8 | - | 2×7-7b=14-7b |
| 1 / 7 | 2×0+(-3)×7=-21 | 0×1+2×6-7b =12-7b |
| 2 / 6 | 2×1+(-3)×6=-16 | 0×2+2×5-7b =10-7b |
| 3 / 5 | 2×2+(-3)×5=-11 | 0×3+2×4-7b =8-7b |
| 4 / 4 | 2×3+(-3)×4=-6 | 0×4+2×3-7b =6-7b |
| 5 / 3 | 2×4+(-3)×3=-1 | 0×5+2×2-7b =4-7b |
| 6 / 2 | 2×5+(-3)×2=4 | 0×6+2×1-7b =2-7b |
| 7 / 1 | 2×6+(-3)×1=9 | 0×7+-7b =-7b |
| 8 / 0 | 2×7=14 | - |

Table 8

Next, let us suppose that an “idiosyncratic” newcomer takes the following strategy (Strategy IV’): “In the first stage, I will communicate and announce ‘B’. In the second stage, I will take R if my partner also says ‘B’, and otherwise I take L.” Strategy IV’ never yields a greater gain than Strategy

| Members with Strategy III/ Strategy IV’ | Strategy III | Strategy IV’ |
|---|---|---|
| 0 / 8 | - | 2×7-7b=7-7b |
| 1 / 7 | 2×7=14 | 2×1+1×6-7b =8-7b |
| 2 / 6 | 2×1+2×6=14 | 2×2+1×5-7b =9-7b |
| 3 / 5 | 2×2+2×5=14 | 2×3+1×4-7b =10-7b |
| 4 / 4 | 2×3+2×4=14 | 2×4+1×3-7b =11-7b |
| 5 / 3 | 2×4+2×3=14 | 2×5+1×2-7b =12-7b |
| 6 / 2 | 2×5+2×2=14 | 2×6+1×1-7b =13-7b |
| 7 / 1 | 2×6+2×1=14 | 2×7+-7b =14-7b |
| 8 / 0 | 2×7=14 | - |

Table 9

27 When two members choose strategy IV, it will yield 13-7b while members who choose strategy III get 14.

III, even if multiple idiosyncratic players enter the group simultaneously. (See, Table 9)

Finally, let us suppose an idiosyncratic newcomer who takes the following strategy (Strategy IV''): "In the first stage, I will not communicate. In the second stage, I will take R." This is completely identical to the game in the previous Part, and the result does not change. At least three "idiosyncratic" newcomers are required for a change in Norm.

Thus, the communication does not reduce the required number of "idiosyncratic" newcomers for transforming Norm L to Norm R (compare with the result of model in Part III). Because two "idiosyncratic" newcomers are necessary for Norm R being changed to Norm L, Norm L (efficient transition) becomes more stable than Norm R if communication is possible (inefficient transition).

The intuition underpinning the above result is as follows. Communication simply helps in the coordination of strategy. If the coordination does not improve the relative advantage of newcomers over the incumbents, it will not facilitate a change. The introduction of a communication stage does facilitate the transition from Norm R to Norm L, but not in the case of transitioning from Norm L to Norm R.

## Concluding Remarks

This essay introduces, albeit in a very limited manner, a recent economic model that treats the transition and convergence of equilibria and the possible implications in terms of the development of social norms. It shows that the long-term stability of the game depends both on (1) the structure of the underlying single game, and (2) the possibility for communication between the parties involved. When the underlying game has a symmetric payoff structure, the optimal outcome is more stable; when the underlying game has an asymmetric payoff – as is often the case – a less-than-optimal outcome can be more stable. When the parties can communicate with low costs, the optimal outcome is also more stable, even when the structure of the underlying game is asymmetric.

We do not claim that we can draw normative implications directly from evolutionary models at this stage ―― although we do see a curious consistency between the above hypotheses and the familiar argument that social norms are likely to be efficient when they emerge in close-knit groups[28] ―― nor do we claim that evolutionary game theory is the most promising tool for the study of social norms. We

[28] See, Ellickson (1991).

also do not claim that models in this essay are the only or the best approach to the evolution and transformation of the social norm. There are various other types of modeling that treat the long-term transition of equilibria even within the evolutionary game theory (see, Fudenberg and Levine (1998)). We simply claim that there have been less satisfactory theoretical efforts have so far taken as to the question of why a certain specific norm is chosen from among possible equilibria compared to other research agendas such as theoretical and empirical studies of incentive structures in social norms. In general, it could be said that the following is aligned with our general feelings on this issue:

"While I think we can be satisfied with some of what has been achieved with these tools, it is appropriate to be happily dissatisfied overall; dissatisfied with our very primitive knowledge about some very important things and happy that progress is being made" (Kreps, (1990), p. 185).

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