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Evolution and Interaction of Social Norms

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Abstract

We use the framework of random matching games and develop a two society model to analyze the interaction of societies with different social norms. Each agent repeatedly faces two different coordination games. A social norm of a society is a mode of behavior—strategy— which is adopted by a majority of agents in the society. There are many equilibria in this world. In addition to those equilibria in which two societies adopt the same social norm, there are other equilibria in which two countries adopt different social norms. The regions of existence of each of these equilibria will be characterized in terms of the relative size and the degree of integration of the two societies.

We apply evolutionary approach to this world to see what happens if the two societies are integrated over time. If the two societies begin with "distinctly different" social norms, people in the smaller society are more likely to adjust their behavior than those in the larger society as the two societies are integrated. When the process of integration proceeds further, the social norm of the smaller society is absorbed into the social norm of the larger one if the former is too small. If the two societies are of similar size, however, the integration results in an "eclectic" norm where agents in both societies adjust their behavior toward each other. It is shown that the "eclectic" norm leads to Pareto improvement. On the other hand, whether or not one norm is absorbed by the other is essentially determined by the relative size of the societies, and therefore, the smaller society whose norm disappears is worse off if its original norm is superior to that of the larger society.

Some extensions, including endogenous matching technology, policy issues, and a possibility of discriminatory behavior, are also examined.

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1. INTRODUCTION

Social norms are the modes of behavior to which the majority of a society subscribe. People follow a certain social norm because others do the same. People sometimes stop following a certain mode of behavior when others start behaving in a different manner. Social norms established in one region change over time. Changes are sometimes caused by technological innovations and development of new ideas; like mutation, they can be created within a region. In other cases, changes occur when societies with different societal backgrounds begin to interact. Such changes give rise to a transformation of social norms and/or an absorption of one norm by the other. This paper attempts to offer a framework to analyze these phenomena.

In order to analyze the evolution of social norms through such interactions, we formulate a non-uniform random matching model similar to the one used by Matsuyama, Kiyotaki and Matsui [1993], which analyzed the issues associated with international currencies. In this setup, a pair of individuals in the same society is more likely to be matched than a pair of those who belong to different societies. When two individuals are matched, they play one of two component games with equal probabilities. This setup of having multiple component games to play reflects the fact that there are a variety of situations that players encountered, and that coordinated actions in one situation may imply miscoordination in other situations. Introducing multiple component games enriches our analysis as we shall see.

When individuals from different societies are matched to play a component game, the action which follows a social norm of one society is often not a best response to the action prescribed by the other society; mismatch or coordination failure arises. Evolutionary pressure will change the social norm in order to alleviate coordination failure caused by the mismatch. However, a change in the social norm may create another mismatch, a mismatch with domestic social norm. This trade-off being taken into account, a new social norm will evolve.

When two societies with different social norms meet with each other, several distinct possibilities arise. First, two social norms, after some modification, may last as two distinct social norms. Jews, Chinese and Indians are well-known examples of world-wide merchants who depend upon their specific family network and/or methods of doing business which were taught by their predecessors. They keep their network/methods even if they leave their society of origin and immigrate into a new society with a different social norm.[1] Still, in some other situations they often follow the norm of the society they live in. These phenomena correspond to the equilibrium of our model in which two types of agents take a coordinated action in one situation and take uncoordinated actions in the other.

Second, two interacting social norms may be unified. In the process of unification, often people in the small society adopt the norm of the larger society. This tendency

[1] For some examples associated with Japan-U.S. differences, see Matsui and Okuno-Fujiwara [1995].

is not surprising as many historical developments have illustrated, e.g., tribal lives of Africa have been modified extensively by the western social norms.[2]

Third, yet another possibility exists where people in both societies modify their behavior patterns to induce an eclectic social norm. When Islam penetrated into Menahnkabau, a part of Indonesia, there were conflicts between Islamic Law and the Adat, a customary law which had been governing the traditional society . The conflict was rooted in the fundamental difference in the societies, patrilineal Islam and matrilineal traditional society. After some confusion and conflicts, a new custom was established where wealth originated from distant ancestors (called *Pusaka Tinnggi*) should be inherited in accordance with the Adat, while wealth created by the immediate relatives (*Pusaka Rendah*) should be governed by Islamic Law.[3] This phenomenon in which they coordinate on one norm in one situation and on another norm in other situations is well captured in our analysis.

We examine welfare implications of these changes as well. First, if the sizes of the two societies do not differ very much and a hybrid of the two norms appear, like the above example of Indonesia, welfare increases in both societies. Second, if the size of one society is sufficiently larger than that of the other, the social norm which is originally adopted by the larger society prevails in the world, and the welfare of the smaller society increases if and only if the original norm of the larger society is superior to that of the

[2]Of course, what was crucial in reality was not merely the relative size of two regions, but their relative economic and military strengths.

[3]For the details, see Bei [1975]. See also Steward [1955] for some other examples.

smaller society. It should be noted, therefore, that it is mere coincidence if the smaller society's welfare increases through integration.

The rest of the paper is organized as follows. Section 2 presents a two-society model and finds equilibria of this model. Section 3 considers an evolutionary process to see how the people of the two societies adjust their behavior as physical integration of the two societies proceeds. Section 4 analyzes some welfare implications. Section 5 extends the basic model in three directions. First is to endogenize the matching probabilities. Second is to allow people to distinguish foreigners from home agents and take different strategy against them. Third is to extend the model to those with more than two societies. Section 6 concludes the paper.

2. MODEL

Consider a world in which infinitely many anonymous and identical agents are randomly matched to play some games. Time is continuous, the horizon is infinite, and each agent is expected to match with another agent once per unit of time. In each matching, two agents play one of two *component games* given in Table 1. The game to be played is randomly assigned by Nature with an equal probability. We assume that

$$0 < \alpha, \beta < \frac{1}{2} \tag{2.1}$$

holds, *i.e.*, that each game has two strict Nash equilibria, and that (L, L) Pareto dominates (R, R) in game G_α, and (r, r) dominates (l, l) in game G_β.

	L	R
L	$2(1-\alpha)$	0
R	0	2α

	l	r
l	2β	0
r	0	$2(1-\beta)$

Table 2.1: Component Games, G_α and G_β

	H	F
H	$1-p(1-n)$	$p(1-n)$
F	pn	$1-pn$

Table 2.2: Matching Scheme

The entire world is divided into two societies H (home) and F (foreign). Society H has the population fraction of $n \in (0,1)$, while society F has $1-n$. To express the fact that home agents meet home agents more often than foreign agents, we consider the following non-uniform matching scheme, which is similar to the one considered in Matsuyama, Kiyotaki and Matsui (1993). Table 2.2 shows the probability that a row type agent meets a column type agent in one unit of time. In the table, $p \in [0,1]$ is the parameter which determines the degree of integration of the two societies: $p = 0$ corresponds to an autarchy, while $p = 1$ implies complete integration.

We assume, in the main model, that each agent cannot distinguish one player from another. Then a (pure) strategy of an agent is given by one of four pairs, Ll, Lr, Rl, and Rr. In this world, a *(degenerate) strategy distribution* is given by a pair of pure strategies taken by two groups of agents (*e.g.*, (Ll, R^*l^*)) where the first (resp. second) pure strategy is the one taken by all the home (resp. foreign) agents[4]; asterisks are attached

[4] A non-degenerate strategy distribution is defined as a probability distribution over degenerate ones.

to indicate distributions of foreign agents.[5] Given n, p, and a strategy distribution, the payoff to a home agent who takes a certain strategy is given in a usual manner: for example, if the strategy distribution is (Ll, R^*l^*), and if he takes Rl, then his payoff is

$$(1 - p(1 - n))\beta + p(1 - n)(\alpha + \beta).$$

Similarly, the payoff to a foreign agent who takes Ll is

$$pn(1 - \alpha + \beta) + (1 - pn)\beta.$$

A strategy distribution, $(Ss', T^*t'^*)$, $(S, T \in \{L, R\},\ s', t' \in \{l, r\})$ is a (pure strategy) *Nash equilibrium* if Ss' (resp. Tt') maximizes a home (resp. foreign) agent's payoff against (Ss', Tt').

We now characterize the set of equilibria in terms of the relative size of the societies and their degree of integration. This society has multiple equilibria. First, for all values of n, p there exists an equilibrium of the form (St, S^*t^*), *i.e.*, the agents of the both societies take the same strategy. We call such an equilibrium a *unified social norm equilibrium.* Such a distribution is a Nash equilibrium because a strict Nash equilibrium is always played in both games.

There may exist other equilibria in which people in the two societies adopt different strategies, which we call *diversified social norm equilibria.* We find conditions for the existence of some of these equilibria.

[5]We attach no asterisk to a strategy of an individual foreign agent.

2.1. No-Coordination Equilibria

The diversified equilibria can further be classified into two classes. A *no-coordination equilibrium* is an equilibrium $(Ss', T^*t'^*)$ in which the home and foreign agents take different actions in both games, i.e., $S \neq T$ and $s' \neq t'$. There are potentially four no-coordination equilibria, but we only analyze (Ll, R^*r^*) and briefly mention (Lr, R^*l^*). Other equilibria are obtained from one of these equilibria by relabelling strategies and/or societies.

Consider (Ll, R^*r^*). The payoff of a home agent in the equilibrium is given by

$$(1 - p(1-n))(1 - \alpha + \beta). \tag{2.2}$$

On the other hand, if he deviates to Lr, he obtains

$$(1 - p(1-n))(1-\alpha) + p(1-n)(1-\beta). \tag{2.3}$$

Similarly, deviations to Rl and Rr will give him

$$(1 - p(1-n))\beta + p(1-n)\alpha, \tag{2.4}$$

and

$$p(1-n)(\alpha + 1 - \beta), \tag{2.5}$$

respectively. Using (1), we know (3) is greater than (4). Also, when (5) exceeds (2), so does (3). Therefore, the incentive constraint for home agents is

$$(1 - p(1-n))\beta \geq p(1-n)(1-\beta),$$

or

$$p(1-n) \leq \beta. \tag{2.6}$$

Likewise, the equilibrium payoff for foreign agents is

$$(1-pn)(\alpha+1-\beta).$$

And the most profitable deviation is to Lr, which gives

$$pn(1-\alpha)+(1-pn)(1-\beta).$$

Therefore, the incentive constraint for foreign agents is

$$pn \leq \alpha. \tag{2.7}$$

Two constraints (6) and (7) determine the equilibrium region for (Ll, R^*r^*).

The set of pairs of n and p for which this no-coordination equilibrium exists is depicted in Figure 2.1. What matters here is the probability of matching with agents of the other society. For a home agent, the probability to match with foreign agents is $p(1-n)$, while for a foreign agent the probability of matching with home agents is pn. The larger the probability of matching with agents of the other society, the more weight one must place on the strategy they subscribe in calculating one's best response. If the home society is relatively small ($n < \frac{\alpha}{\alpha+\beta}$), then (6) is more likely to be violated, and vice versa. This is because, if the home society is relatively small, the probability of a home agent's matching with foreign agents is relatively large, and therefore, home agents are more affected by foreign agents than foreign agents are by home agents.

No-coordination equilibrium (Lr, R^*l^*) has similar characteristics. The region in which this equilibrium exists is given in Figure 2.2. Its boundaries are given by $p(1-n) = 1-\beta$ and $pn = \alpha$, the incentive constraints for home agents and for foreign agents, respectively.

2.2. Partial Coordination

Equilibria in the other class are called *partial coordination equilibria*. In these equilibria, two societies coordinate on the same action in one game but not in the other. We examine two specific partial coordination equilibria. One is (Lr, R^*r^*), and the other is (Ll, L^*r^*). Other partial coordination equilibria can be analyzed in the same manner.

First, note that in the strategy distribution (Lr, R^*r^*), nobody has an incentive to change his action in G_β since all the agents take the same action r. Therefore, the only candidate for a profitable deviation for home agents is Rr. The payoff of a home agent in (Lr, R^*r^*) is

$$(1-p(1-n))(1-\alpha+1-\beta)+p(1-n)(1-\beta).$$

On the other hand, if he takes Rr, his payoff will be

$$(1-p(1-n))(1-\beta)+p(1-n)(\alpha+1-\beta).$$

Thus, the incentive constraint for home agents is

$$(1-p(1-n))(1-\alpha)\geq p(1-n)\alpha,$$

or

$$p(1-n) \leq 1-\alpha. \tag{2.8}$$

Similarly for foreign agents, the only candidate for the deviation is Lr, and the incentive constraint is given by

$$pn \leq \alpha. \tag{2.9}$$

In fact, (9) is the same as (7), and the region in which this equilibrium exists is depicted in Figure 2.3.

The equilibrium region for (Ll, L^*r^*) is a mirror image of that for (Lr, Rr). It is given by two incentive constraints, (6) and

$$pn \leq 1-\beta. \tag{2.10}$$

This region is also depicted in Figure 2.3.

3. THE EVOLUTION OF SOCIAL NORMS THROUGH INTEGRATION

As we have seen in the previous section, for any set of parameter values, there exist multiple equilibria with qualitatively different patterns of behavior. If we look at these equilibria in a static situation, it is difficult, if not impossible, to predict which one is more likely to be found. This section uses a best response dynamic as a selection device to identify the equilibrium that emerges when the world starts with a certain strategy distribution.[5] We suppose that in the beginning there is no physical interaction, *i.e.*,

[5] See Gilboa and Matsui (1991) for the best response dynamic.

$p = 0$. Suppose further that the initial distribution is (Ll, R^*r^*), the no-coordination equilibrium examined in the previous section. This is the most interesting case in that miscoordination occurs between the two societies in both component games, and that neither society payoff-dominates the other in both games.

With this initial distribution, we look at an evolutionary process when p, the degree of integration, gradually increases with n being fixed throughout the process. We assume that the change in p is sufficiently slow so that any adjustment in strategy distribution is completed before p changes further. We analyze for the case of $n < \frac{\alpha}{\alpha+\beta}$. The opposite case can be analyzed in the same manner and will be shown in figures.

If $n < \frac{\alpha}{\alpha+\beta}$, the first constraint to be violated through the process of increasing p is $p(1-n) \leq \beta$. Once p goes beyond this constraint, then the incentive constraint for home agents are violated and they start taking Lr. This process continues until all the home agents take Lr, and the partial coordination equilibrium (Lr, R^*r^*) emerges. To see a further change, the case $n < \frac{\alpha}{\alpha+\beta}$ is to be divided into two subcases; (i) $n < \alpha$ and (ii) $\alpha < n < \frac{\alpha}{\alpha+\beta}$, ignoring the boundary.

In (i), when the home society is very small compared to society F, as p increases further, it is again the home agents' incentive constraint that is violated first. This happens when p increases beyond the constraint (8). In this case, each home agent has an incentive to switch his strategy to Rr. The unified equilibrium in which everyone uses the norm of the foreign society emerges. In other words, the norm of the home society is absorbed into that of the foreign society.

In subcase (ii), after reaching the partial coordination equilibrium (Lr, R^*r^*), it is now the foreign agents to switch their strategies. As we saw in the static analysis, they change their strategy to Lr when p goes beyond α/n. The unification occurs, too. But, in this case, the two social norms are mixed: in G_α, agents follow the norm originally established in the home society, while in G_β, agents follow the norm of the foreign society. These cases and the cases when $n > \frac{\alpha}{\alpha+\beta}$ are shown in Figure 3.1.

Note that the process of adjustment is irreversible in the sense that once coordination/assimilation occurs, a society cannot retrieve its old norm even if p decreases. The society loses its custom forever.

4. Welfare

This section examines some welfare implications, especially those of integration. First of all, in unified equilibria, the equilibrium payoffs to an agent, common to both types, are given by the following table.

$$\begin{array}{cc} \text{equilibrium} & \text{payoff} \\ (Ll, L^*l^*) & 1-\alpha+\beta \\ (Lr, L^*r^*) & 2-\alpha-\beta \\ (Rl, R^*l^*) & \alpha+\beta \\ (Rr, R^*r^*) & \alpha+1-\beta \end{array} \tag{4.1}$$

Under our assumption on α and β (that both are less than a half), Lr is the optimal strategy to coordinate upon. Consider the evolutionary process examined in the previous section with the initial condition of (Ll, R^*r^*), and suppose that p goes to 1 in the limit.

Then if n is between α and $1-\beta$, i.e., if the sizes of the two societies are not too different, the integration brings an improvement to both societies. Note that this result is not obtained if the world started with two similar social norms. Indeed, if the two societies both started from the same social norm, then there will be no further change. The world with diversified social norms attains a high level of welfare in the end.

If one society, say, society H, is sufficiently small compared to the other, or more specifically if $n < \alpha$, then the integration leads to (Rr, R^*r^*) the norm originally established in society F. There is no guarantee that the welfare in this distribution is higher than the welfare in the original one. Indeed, it is determined only by the relative size of α and β. If $\alpha < \beta$, then the home agents are worse off as the result of integration. This implies that the statement like "One norm absorbs the other because the former is better than the latter" is too simplistic a view.

5. EXTENSION

This section considers two modifications of the model developed in the previous sections. The first introduces the possibility of differentiating between home and foreign agents when taking strategies. The second is a model with more than two societies.

5.1. Endogenous Matching Probability

In the real world, matching is not completely exogenous. People often choose which group of people to meet with. Among various specifications, this subsection considers the following one. Suppose that each agent can choose the propensity to match with agents in the other society, $p_h \in [0,1]$ for a home agent, and $p_f \in [0,1]$ for a foreign agent. We allow agents in the same society to choose different propensities. Let $\bar{p}_h$ (resp. $\bar{p}_f$) be the average propensity of home agents. In order for the matching technology to be consistent, we assume that the actual matching probability with the other group is

$$\frac{p_h + \bar{p}_f}{2}(1-n)$$

for a home agent who chooses p_h, and

$$\frac{p_f + \bar{p}_h}{2}n$$

for a foreign agent who chooses p_f. A strategy of an agent is written as (Ss', p') ($S \in \{L, R\}$, $s' \in \{l, r\}$, $p' \in [0,1]$). Also, we assume that they can choose the propensity with no additional cost.

Suppose now that the initial state is an autarchy state, *i.e.*, $\bar{p}_h = \bar{p}_f = 0$, with (Ll, R^*r^*), written as $((Ll, 0), (R^*r^*, 0))$. It is easily verified, using the payoff structure and the linearity of the expected payoff in p_h, that the only possibilities for a best response of a home agent are $(Ll, 0)$, $(Rr, 1)$, and $(Lr, 1)$. Several results are immediate. First, a home agent obtains the payoff of $1 - \alpha + \beta$ in the initial state. Second, if he chooses $(Rr, 1)$, the probability of his matching with foreign agents is $\frac{1}{2}(1-n)$ since $\bar{p}_f = 0$. Therefore, his expected payoff will be

$$\frac{1}{2}(1-n)(\alpha + 1 - \beta). \tag{5.1}$$

Third, if he chooses $(Lr, 1)$, then his expected payoff becomes

$$\left(1 - \frac{1}{2}(1-n)\right)(1-\alpha) + \frac{1}{2}(1-n)(1-\beta). \tag{5.2}$$

Subtracting (12) from (13), we obtain

$$\left(1 - \frac{1}{2}(1-n)\right)(1-\alpha) - \frac{1}{2}(1-n)\alpha = (1-\alpha) - \frac{1}{2}(1-n).$$

Then $\alpha < 1/2$ implies that this expression is always positive. Therefore, $(Rr, 1)$ cannot be a best response.

Next, from the initial state payoff and (13), $(Lr, 1)$ is the best response to the initial state if and only if

$$\frac{1}{2}(1-n)(\alpha - \beta) \geq \beta. \tag{5.3}$$

A symmetric analysis gives us the result for foreign agents' behavior: $(Lr, 1)$ is the best response to the initial state for a foreign agent if and only if

$$\frac{1}{2}n(\beta - \alpha) \geq \alpha. \tag{5.4}$$

If neither (14) nor (15) holds, then the initial state $((Ll, 0), (R^*r^*, 0))$ continues forever. In particular, if $1/2 < \alpha/\beta < 2$, then no evolutionary change will occur regardless of the relative size of the societies.

On the other hand, if (14) holds, then home agents start taking $(Lr, 1)$. Once this process starts, $(Lr, 1)$ becomes more appealing, and it reaches the state where every H agent takes $(Lr, 1)$. After the society reaches the state $((Lr, 1), (R^*r^*, 0))$, the incentive for foreign agents to change their behavior may arise. The only candidate for a best response, other than the current strategy, is $(Lr, 1)$. First, in the present state, the expected payoff of a foreign agent is

$$\frac{1}{2}n(1-\beta) + (1-\frac{1}{2}n)(1-\beta+\alpha). \tag{5.5}$$

Second, his expected payoff from taking $(Lr, 1)$ is

$$n(1-\alpha+1-\beta) + (1-n)(1-\beta). \tag{5.6}$$

Subtracting (16) from (17), we obtain

$$n - \alpha.$$

Therefore, if $n < \alpha$, then $((Lr,1),(R^*r^*,0))$ becomes an absorbing state. On the other hand, if $n > \alpha$, then $(Lr, 1)$ becomes a best response for foreign agents, too. The more foreign agents take this strategy, the more incentive do they have to follow it. The strategy distribution reaches $((Lr,1),(L^*r^*,1))$. This distribution becomes the absorbing state of the best response dynamic. This case exists only when $\alpha > \beta$ and $\alpha - 3\beta > \alpha(\alpha - \beta)$ hold.

Unlike the case of exogenous matching technology, it is always the case that people move toward a superior norm if they actually change their behavior. However, it is more likely in this case that people avoid interacting with foreigners, which leads to no improvement in social norms. It happens even when the hybrid norm is far better than the social norm established in either society, *i.e.*, when α and β are both close to zero.

5.2. Government Intervention

As the discussion in the previous sections illustrates, interaction with another society may harm the home society's welfare, not only because the short-run effect creates coordination failures associated with the matching with foreign agents who play differently in the component games, but also home agents' strategy may be unfavorably affected by the foreign agents' strategy through evolution. The extreme case of such phenomena occurs if the home society's strategy is initially optimal, i.e., Lr, while the foreign society's strategy is suboptimal, say, Rr. To make the result stark, suppose further that the relative size of the home society is almost negligible ($n = \varepsilon$) and p goes from 0 to 1. In such a case, in the short run, home agents suffer from miscoordination with foreign agents in G_α, while in the long run home agents' strategies will converge to Rr.

Faced with such a possibility, the home government may have an incentive to intervene. For example, it may be able to effectively close the society by forbidding any interaction with foreign agents. By doing so, it can avoid coordination failures in the short run and preserve the optimal social norm in the long run. Alternatively, it may be able to impose a tax/penalty for domestic agents who take some specific action, if taking the action is verifiable. For example, if it can impose a tax in the amount of $\gamma > 0$ for any player taking action R in G_α, the best response will be altered from Rr to Lr under a certain parameter set. By appropriately choosing γ, the government can preserve the home society's social norm even after interaction begins.[6]

All of the above results, however, critically depend upon the amount of information possessed by the goverment. In particular, the government is likely to have as little information as individual agents have and hence it is likely to be myopic. A myopic government is likely to assess that interaction with foreign societies is detrimental to the home society because the loss due to miscoordination with foreign agents in the short run tends to dictate its judgment rather than the potential merit of a change in domestic social norm in the long run.

5.3. Discrimination

If it is not too costly to take different actions against different opponents, agents may consider such a possibility.[7] In addition to the original two society model, assume that an agent can discern home agents from foreign agents and take different strategies against them if he pays $d > 0$ per game. The cost is either associated with discernibility of the two types of agents or a cost of holding two strategies/options available. Denote by $< Ss', Tt' >$ the strategy of a single agent who takes Ss' against a home agent and Tt' against a foreign agent. We also identify $< Ss', Tt' >$ with the strategy distribution in which everyone of one society takes this strategy. We consider an evolutionary process in which p changes very slowly relative to the speed of adjustment of the behavioral

[6]This policy may create some distortion, even if the tax revenues are returned to the domestic agents in the form of per capita subsidy. Again, the net effect may very well be negative.

[7]We do not attach any negative meaning to the term "discrimination" in the present context.

pattern of the society. When the society is at $(<Ss', Tt'>, <U^*u^{*'}, V^*v^{*'}>)$, it is in the best interest of a home agent (resp. foreign agent) to take $<Ss', Uu'>$ (resp. $<Tt', Vv'>$) on condition that he pays d. We assume $n < 1/2$ throughout the rest of the analysis.

We start with the initial condition $(<Ll, Ll>, <R^*r^*, R^*r^*>)$, which corresponds to the initial condition we focus on in the previous sections. By taking a discriminatory strategy, a home agent gains

$$p(1-n)(\alpha + 1 - \beta) \tag{5.7}$$

at the expense of d. Note that (18) is equal to zero at $p = 0$, and increasing in p. Therefore, if $d > 0$ is not too large, there exists a minimum $p > 0$, denoted by p_d, at which (18) is equal to d. Assume that this is the case, and that every home agent takes a discriminatory strategy $<Ll, Rr>$. Once we obtain the strategy distribution $(<Ll, Rr>, <R^*r^*, R^*r^*>)$, no further change in strategy occurs even if p changes since every pair of agents plays a strict Nash equilibrium in every game.

In the above case, discrimination may not be a good strategy in the long run from the viewpoint of the society as a whole, as it prevents further adaptation of social norm. Suppose $n \in (\alpha, 1-\beta)$. Then either home or foreign agents will start to discriminate against agents of the other society in order to avoid a loss from mismatch, but the social norm will not change any further and potential gains from achieving integration and adopting Lr will be lost. Public intervention may be called for in order to prohibit discriminatory behavior if the government has sufficient knowledge to be able to correctly foresee the future course of adaptation.

5.4. K Society Model

This subsection extends our analysis to a world with more than two societies. In such a model, the order of integration may matter. To see this, suppose that there are three societies, 1, 2, and 3, with equal sizes, 1/3. Let α be greater than 1/3. Assume further that there is no interaction between any two societies in the beginning, and that society 1 starts with Ll, while societies 2 and 3 start with Rr. If societies 1 and 2 first experience integration, then they end up with Lr since they are of equal size. If, after this integration, the society made of 1 and 2 (call it society 1-2) and society 3 are integrated, the world ends up with Lr. On the other hand, if societies 2 and 3 are integrated first and then this and society 1, then the world ends up with Rr since when society 1 and society 2-3 meet, their sizes are 1/3 and 2/3, respectively.

To get the starkest result, suppose that there are K societies. Then even if Ll is adopted by a single society, 1, with the size of $n_1 = 1/K$, and if the rest of societies, 2 through K, adopt Rr, the world may end up in Ll. To see that this may be the case, let the size of society $k = 2, \cdots, K$ be given by

$$n_k = \frac{K^{\frac{1}{K-1}} - 1}{K} K^{\frac{k-2}{K-1}}.$$

Note that we have $n_2 < n_3 < \cdots < n_K$ and $\sum_{k=1}^{K} n_k = 1$. Now, suppose that society 1 and society 2 are integrated first, that the integrated society absorbs society 3, and so on in such an order that society $k = 2, 3, \cdots, K$ is integrated by the compound society that consists of societies $1, 2, \cdots, k-1$. Since we constructed the example so as to satisfy $\sum_{\ell=1}^{k} n_\ell : n_{k+1} = K : K^{\frac{1}{K-1}} - 1$, the ratio converges to one-to-zero as K goes to infinity. Therefore, for a sufficiently large K, the society will end up with Ll. On the other hand, if societies 2 through K are integrated first, then the final outcome will be Rr for a sufficiently large K. In this example, the order of integration essentially determines the final outcome of the world.

6. Conclusion

In this paper, we have analyzed how societies with different social norms would interact in an evolutionary environment. Our model is certainly a restricted one. For example, members of two societies interact with each other directly, not through communication media, and the component games are simple coordination games with only two possible actions. However, within such a simple framework, we have shown some interesting results. There are various patterns of evolutionary paths: sometimes one social norm absorbs the other social norm, sometimes two original social norms are preserved without any change, while in other cases a new social norm may evolve as a result of interaction. Which pattern results depends on, among other things, the relative size of societies and the extent of their interaction. It may happen that the social norm of the smaller society is superior to that of the larger society, and if that is the case, the smaller society is worse off as a result of assimilation into the larger society.

If the matching technology is endogenously determined, it is always the case that people move toward a superior norm if they actually change their behavior. However, it is more likely in this case that people avoid interacting with foreigners, which leads to no improvement in social norms. It happens even when the hybrid norm is far better than the social norm established in either society.

An additional result of our analysis, which is implicit in the model, may be worth emphasizing before concluding the paper. As many analyses of coordination games have illustrated, a society is often trapped in an inefficient equilibrium, and escaping from such a trap is difficult. If we wait for the private sector to take the initiative, it may take a long time even if the system is shaken constantly (Foster and Young (1990), Kandori, Mailath and Rob (1993), and Young (1993)) or even if secret handshake (Robson (1990)) or communication (Matsui (1991)) is allowed.

There are several ways to accelerate a departure from such a trap even if the matching structure is not local (see Ellison (1993)). First, as illustrated by many policy-oriented analyses (see, e.g., Okuno-Fujiwara (1988)), the government may use subsidies and taxes to alter the incentives of the private sector. Such a policy, however, may require a lot of information and vast resources to implement. The second way is to create an euphoric expectation about the future to let people coordinate on an efficient outcome (see Matsuyama (1991) and Krugman (1991)).[8] Success of this type of policy depends on how private sectors react to the government propaganda.

The present paper identifies yet another possibility for coordination. Like artificially creating a hybrid by crossing two different genes, an interaction of societies affects social norms of each society and sometimes creates a hybrid of conventions, making the society escape from the trap. It should be emphasized again, however, that this happens only when the two societies are of similar size. If one society is sufficiently larger than the other, integration leads to a complete absorption of the norm of the smaller society by that of the larger one. Welfare may move in either direction if that is the case.

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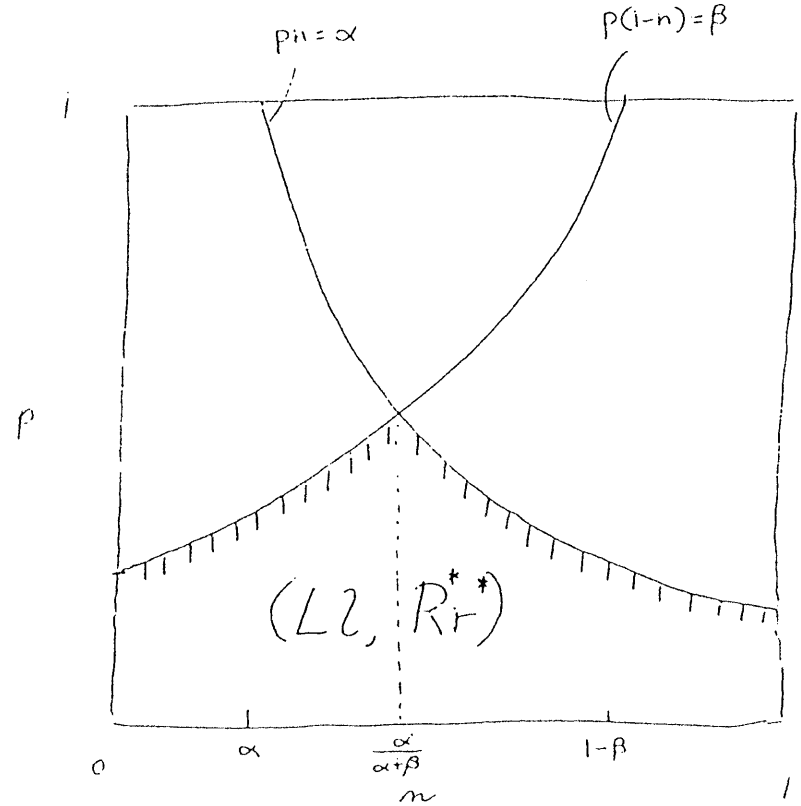
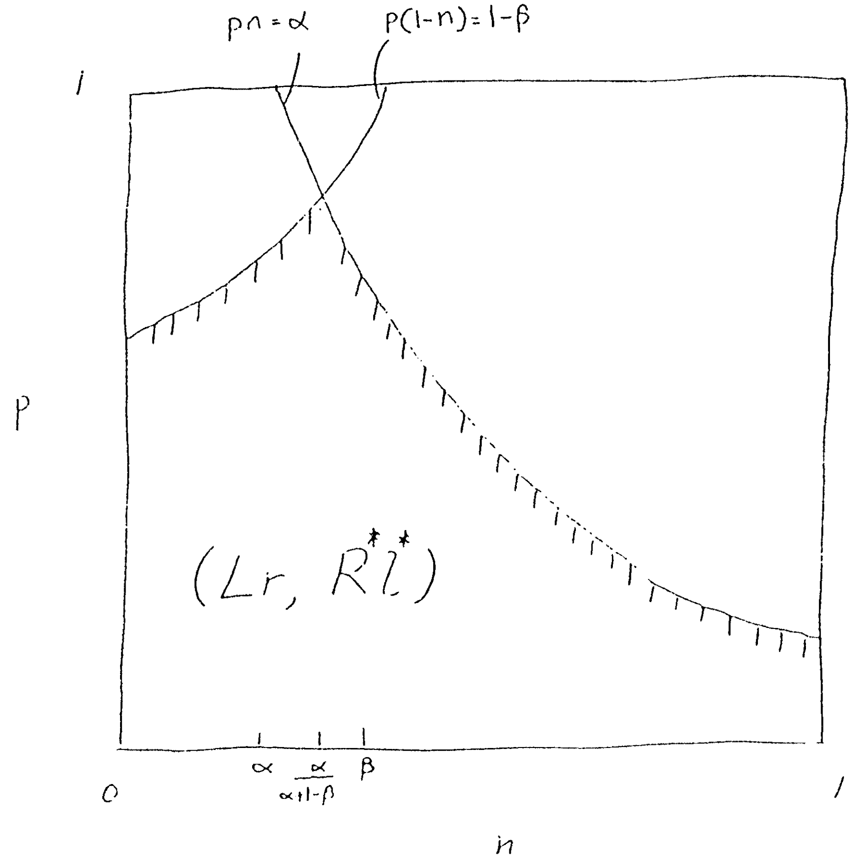


Figure 2.1



$pn = \alpha$
$p(1-n) = 1-\beta$
1
p
(Lr, R^*l^*)
0
α
$\frac{\alpha}{\alpha+1-\beta}$
β
1
n

Figure 2.2

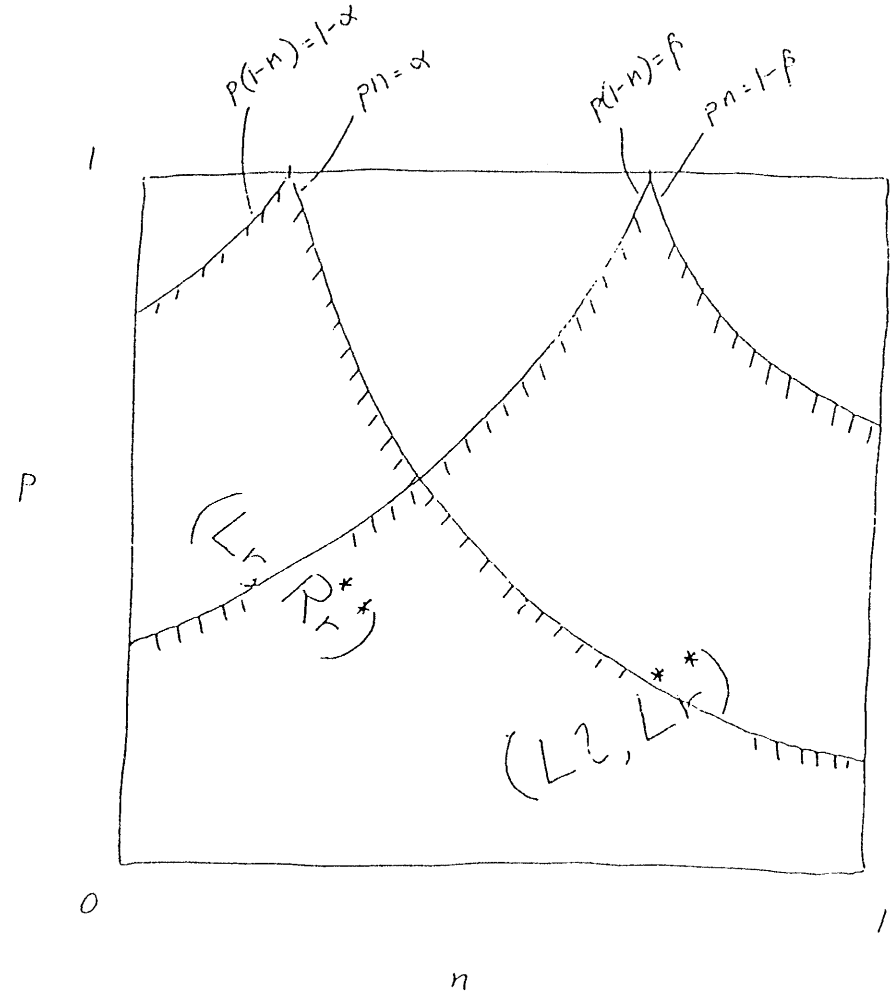


Figure 2.3

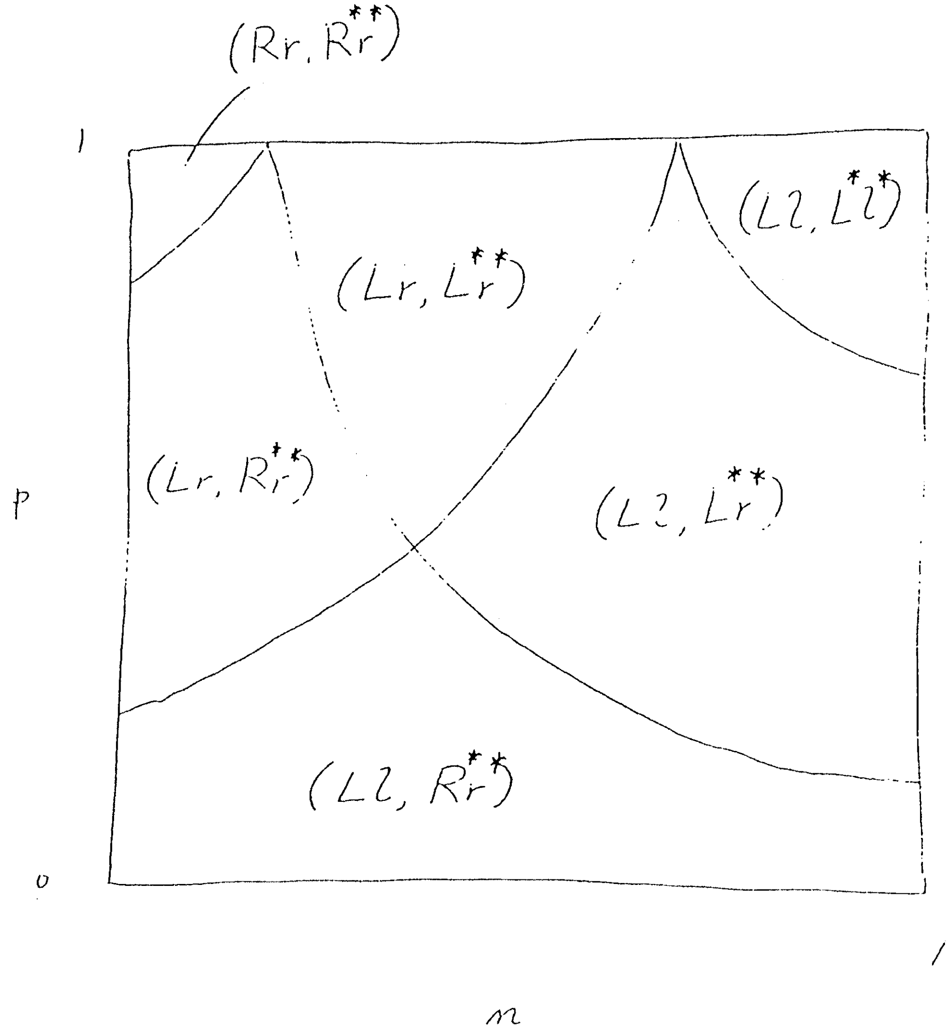


Figure 3.1