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Abstract

In this paper, we argue social/corporate norms play an important role in achieving higher productivity and better economic welfare. We define "social norm" to be a standard of behavior suggested by a social custom, i.e., a customary choice of actions in each social situation. We reinterpret the well-known Nash equilibrium as a "norm equilibrium". Norm equilibrium is a stable social norm, stable in the sense that there is no incentive to deviate from the behavior suggested by the prevailing social norm. This interpretation requires less information than the traditional interpretation. Moreover, we need not concern the problem of refinement because it is the social norm itself which refines the equilibria. We apply this concept to the labor market. The key assumption is that the level of individual worker's effort is a private information to workers as a whole, i.e., individual worker's effort is known to her fellow workers in addition to the worker herself. We show that the different work norms may emerge in different corporations at an equilibrium. In "prestigeous firms it is the cooperation which is the prevailing work norm, while in "non-prestigeous" firms non-cooperation is the norm. Thus, efficiency wage holds without the existence of unemployment. Some implications of this interpretation of Japanese labor market are discussed.

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1. Introduction

In this paper, I shall attempt to analyze an aspect of employment relationship which, I believe, plays an important role in Japanese firms: the aspect of work norm. Many observers of Japanese firm have pointed out that work norm and/or social norm plays an important role in the Japanese production system. Although this observation may be obvious, there have been only scattered attempts in economics literature which seriously analyze this aspect of Japanese firms[1/]. The reason is, again, obvious. Economic theory has offered almost nothing to deal with the problem of social norm.

In what follows, I introduce the concept of "norm equilibrium" which has recently been proposed in Okuno-Fujiwara and Postlewaite [1988]. This concept, which is essentially a reinterpretation of the well-known "Nash equilbrium", is based on the view that a social norm is a mechanism to enforce a certain (possibly mutually beneficial) social agreement without relying upon an explictly written contract. It works as an enforcement mechanism because society punishes a deviator from the prevailing social norm and rewards the members who follows it. Similar ideas have been recently put forward by Milgrom, et. al. [1988] and Kandori [1988].

In this interpretaion of social norm, a concept of social status is introduced. That is, each member of the society is assumed to carry a status which, like whether he/she carries the credit card, is identifiable to other members. Formally, a social norm is a pair of social standard of behavior and transition mapping. Social standard of behavior is a prescription of the choice of action as a function of what status the member of the society has and of what statuses other members have. Depending upon whether the member has followed or deviated from the social standard of behavior, his/her status will change in the next period according to the prevailing transition

mapping. Each individual member of the society, with the knowledge of the social norm, chooses the best available action in each occasion. A social norm is called an norm equilibrium if it is most advantageous to choose the action suggested by the social standard of behavior at all possibile occasions.

In this model, status is a way to keep track of the history of each member of the society, i.e., sufficent statistics, whether he/she has been acting according to the social norm. A social agreement, though quite complicated, may be easily implemented with a social norm as each individual's choice requires only local information, such as social norm itself and statuses of other members.

In this paper, we shall interpret the status to be the name of the company to which he/she works. This interpretation makes the concept of social norm especially attractive because it is not necessary to create any extra mechanism for information transmission that would make statuses publicly observable. In other words, a purpose of this paper is to elucidate that yet another role of an organization such as firms exists and it lies in the fact that being a member of an organization automatically conveys an economically relevant information to others.

We assume that each individual firm has a different work norm. In a group of (prestigious) firms the prevailing work norm is to "cooperate" and/or work with "corporate loyalty", while in others it is not to cooperate. Because there is a potential slackness such as moral hazard and information sharing, firms with the cooperative work norm can attain higher productivity and workers obtain higher utility. This work norm is sustainable in the society, because the possibility of being dismissed from the prestigious firm and thereby losing a higher payoff, creates a sufficient

threat to individual workers. Put differently, nurturing corporate loyalty in prestigious firms, which is suggested by the company norms, gives positive return to each worker in terms of higher compensation and better life than those in other firms. Thus, work norms in each individual firm in the society together with the rule of hiring/relocating workers constitute a stable (or sustainable) social norm.

Of course for this mechanism to work, cheating and deviating from the company (work) norm must be identifiable by managers. As, normally, the level of work effort and other private information which is potentially crucial for the performance of the firm is not observable by managers, it is vitally important for firms to construct an implementation mechanism so that workers reveal their private information honestly.

The mechanism we consider in this paper relies upon the sharing of private information among fellow workers. This idea is put forward in the context of implementation mechanism by Maskin [1977], Maskin [1985], Postlewaite and Schmeidler [1986] and Saijo [1988]. If private information is shared with at least two others, one can easily construct a Nash implementation mechanism that satisfies several desirable properties. This is so because if other two fellow workers, who know the same private information, are expected to reveal the information truthfully, it is always optimal to reveal the information honestly as long as there is some penalty involved in not doing so.

Nash implementation, rather than dominant strategy implementation, is reasonable in our context because of our social norm setup. First, although there is no dominant strategy, Nash strategy is chosen as a best response to the prevailing social norm. Thus the information requirement to choose the Nash strategy is not very imposing in our interpretation. Second, although

there may be potentially multiple Nash equliibria in the society (i.e., in the mechanism), it is the prevailing social norm that forces members of the society to act according to the norm. In short, it is the social norm which refines Nash equilibria.

Our model may be considered as an extension of efficiency wage literature (for its detail see, e.g., Shapiro and Stiglitz [1984] and Okuno-Fujiwara [1988]). The differences between the current formalization and the usual ones are twofold. First, we show that the work incentive can be maintained without unemployment, as long as there is a difference in payoffs that workers can obtain in the economy. Second, we show that monitoring by the management can be replaced by the mutual auditing of workers about the fellow workers' effort choice. Needless to say, replacing each of these by the usual assumption would leave our conclusion intact.

In this interpretation, one of the most important roles that lifetime employment, spiral promotion and corporate union play in Japanese firms lies in the fact that these "systems" make the information sharing much easier. Having worked in the same firm and same shop floor enables many fellow workers to easily and simultaneously identify the cause of line breakdowns, possibility of cost reduction and potential improvement in productivity by rearranging production plans. This may be clearer if we consider the opposite situation where the responsibility of works is devided into many small parts. This occurs when trade unions prohibit non-member workers from participating in jobs covered by the union, and/or each worker has experience only in one part of the job. In such a situation, because workers have never been exposed to other jobs throughout the career, it would be extremely difficult to obtain and identify the relevant information.

Another important implication of this setup is that, though lifetime employment is potentially important, the guarantteed lifetime employment works against the proposed incentive mechanism. The author believes, contrary to the U.S. practice where lifetime employment is guarantteed at least for senior workers by a written agreement between the union and the management, lifetime employment in Japan is only a desirable social ideal and employment for life is granted to workers only if economic conditions permit to do so. Without this freedom to dismiss workers in the management's part, there is no disciplinary threat which would support higher effort level in the workers' part.

This paper is organized as follows. In the next section, the concepts of social norm and norm equilibrium will be defined. Section 3 will introduce a simple model of firm, discuss two different work (corporate) norms, and identify conditions for these norms to constitute a norm equilbrium. Section 4 will discuss the incentive problems underlying the norm equilibrium and show that, if the private information is shared with two other fellow workers, revealing the information honestly is the best response under the corresponding social norm. Section 5 will show that a society consisting with identical members and identical technology may have different outcome if the underlying social norms are different. Section 6 concludes the paper with implication to Japanese economy.

2. Norm Equilibrium

2.1 A society is a set of many conflict situations. Members of the society face one conflict situation on one day and another on the other day. To analyze what will happen in a society, therefore, the framework of traditional game theory is not necessarily adequate. It is not because the

traditional game theory assumes the game under consideration to be independent of the rest of the world; game theory focuses on a conflict situation in its isolation. Implicit behind this formulation is that players are "rational"; they are assumed to be free from their background, such as their personal history, societies they are brought up, and the context that the "game" means in the society.

Instead, games in which economists are normally interested (hearafter economic games) are not isolated games at all. In normal social interactions, such as shopping and working which potentially involve conflicts, we choose our customary actions--customary in the sense that they conform to the social norm--unless the behavior of someone involved is not in accordance with our expectaion/experience. Economics being a social science, considering these contexts of economic substance and customary actions seem to be critical in explaining the reality and making appropriate prediction of the real world.

To repeat, our social actions are heavily influenced by social norm and personal experience generated by the past social interactions. From this viewpoint, perhaps it is more appropriate to think an economic game as a <u>situation</u> in a society; a particular occurence of the conflict that repeatedly appear in a society. A society, on the other hand, needs to be interpreted as a colleciton of these situations which are themselves intricately intertwined and interdependent.

Of course, traditional game theory can, in principle, solve such a problem. Assuming all the relevant data of an entire economy to be common knowledge among all the members of the society, game theorists should apply the concept of Nash equilibrium (or even better, that of correlated equilibrium, see Aumann [1987]). But is it reasonable to assume that all the

details of each minute encounters common knowledge in a society consisting of millions of people? Moreover a society does not have any definite date when it ceases to function. As is exemplified by the Folk theorem of repeated games, in games with infinite horizon an enormous amount of Nash equilbiria are bound to appear. What then chooses which particular equilibrium to be realized? Traditional game theory offers no satisfactory answer to this question. The norm equilbrium interpretation of Nash equilibrium, which is briefly explained below, is designed to solve exactly this problem.

2.2 To facilitate the exposition, assume that all members of the society have an identical taste, live infinitely without any discount. However, assume death befalls on exactly $(1-\delta)\varepsilon(0,1)$ proportion of the living population and exactly the same size of the new population is born in each period. This makes each individual to act as if he/she has discount factor $\delta\varepsilon(0,1)$ in the expected utility terms.

Let $\alpha\varepsilon\mathbf{A}$ denote a <u>situation</u> or <u>status</u> of an individual member. For simplicity, we shall assume that there are only finite number of situations in the society. A situation/status α consists of a pair (g,i), where $g\varepsilon\mathbf{G}$ will be called a <u>game</u> or <u>social interaction</u>, $\mathbf{G}$ a <u>society</u>, and i an individual's <u>position</u> in g. A game g itself is a tuple $(N(g),S(g),U(\cdot;g))$ where

$$S(g) = \underset{i\varepsilon N(g)}{\times} S(g,i),$$

$$U(\cdot;g) = \{U(\cdot;g,i)\}_{i\varepsilon N(g)} \text{ and}$$

$$U(\cdot;g,i) := U(\cdot;\alpha) : S(g) \to \mathbf{R}.$$

$N(g)$ is sometimes referred as the set of <u>players</u> in the game g, while $S(g,i)$ is the set of <u>actions</u> for player at position i in the game g. In particular

if $\alpha=(g,i)$, $S(\alpha)$ denotes the set of actions for the individual at the situation/status α. $U(\cdot;\alpha)$ is his/her immediate payoff.

A Markov strategy is a mapping $\sigma:\mathbf{A}\to S(\mathbf{A})$ specifying a choice of action $s=\sigma(\alpha)\in S(\alpha)$ for each situation/status. When all members of a society chooses the identical Markov strategy, we call this startegy a social standard of behavior (SSB, for short). SSB is interpreted as a custom prevailing in the society. If a SSB, σ, prevails and if he/she chooses an action $s\in S(\alpha)$, an individual at the status $\alpha=(g,i)$ expects to obtain in the situation;

$$u(s,\sigma;\alpha) = U(s,\sigma(g,j)_{j\in N(g),j\neq i};\alpha).$$

If all the members of g (including him/herself) follows the SSB, his/her payoff is sometimes abbreviated as;

$$u(\sigma;\alpha) = u(\sigma(\alpha),\sigma;\alpha).$$

In the society, there is an implicit understanding of the transition of situations/statuses. A transition mapping $\tau:\mathbf{A}\times S(\mathbf{A})\to\mathbf{A}$ assigns a new situation/status $\alpha'=\tau(\alpha,s)\in\mathbf{A}$ in the next period if an individual member who holds a current status α chooses an action $s\in S(\mathbf{A})$. A newly born member is assigned some designated status (possibly randomly drawn from a set of statuses) in $\mathbf{A}$. A pair of SSB and transition mapping (σ,τ) is called a social norm and is denoted by $\mathfrak{B}$.

Fix the transition mapping, τ. If all other members of the society follows the SSB, σ, but an individual chooses a Markov strategy σ_i, his/her value or lifetime payoff at each sitatuion/status, $v(\sigma_i,\sigma;\alpha)$, is defined unambiguously by solving the following equations for all $\alpha\in\mathbf{A}$ simultaneously;

$$v(\sigma_i,\sigma;\alpha) = u(\sigma_i(\alpha),\sigma;\alpha) + \delta v(\sigma_i,\sigma;\tau(\alpha,\sigma(\alpha))).$$

If an individual follows the prevailing SSB, his/her lifetime payoff is abbreviated as;

$$v(\sigma;\alpha) := v(\sigma,\sigma;\alpha).$$

Different from the usual interpretation of Nash equilibrium, we assume only the social norm, $\mathcal{B}=(\sigma,\tau)$, and the associated lifetime payoffs, v, are common knowledge among all members of the society. However, we do not require the structure of the entire society, $(N(g),S(g),U(\cdot;g))_{g\in G}$, to be common knowledge. We only assume that each individual can identify his/her situation, $\alpha\in A$, and can comprehend the associated local knowledge, $(S(\alpha),u(\cdot,\sigma;\alpha))$. Namely, we assume that each individual understands the set of available actions for him/her and the resulting payoffs when other members of the society follow the social norm.

2.3 We shall call a social norm $\mathcal{B}^*$ a norm equilbrium if following the prevailing SSB is optimal among any other possible Markov strategies. Namely, a social norm $\mathcal{B}^*=(\sigma^*,\tau^*)$ is a norm equliibrium if for any Markov strategy, σ, and for all situation/status, α,

$$v(\sigma^*,\sigma^*;\alpha) \geq v(\sigma,\sigma^*;\alpha).$$

Given a SSB, σ, define the deviation incentive to play $s\in S(\alpha)$ at $\alpha\in A$ as $d(s,\alpha;\sigma) = u(s,\sigma;\alpha) - u(\sigma(\alpha),\sigma;\alpha)$, i.e., an increase in the immediate payoff by playing s instead of following the SSB or playing $\sigma(\alpha)$ at α. In view of the unimprovability routine in dynamic programing literature (see, e.g., Whittle [1983]), the following lemma is immediate:

Lemma 1:

$\mathcal{B}^*=(\sigma^*,\tau^*)$ is a norm equilbrium if and only if for all $\alpha\in A$ and $s\in S(\alpha)$,

$$d(s,\alpha;\sigma^*) \leq \delta[v(\sigma^*,\tau^*(\alpha,\sigma^*(\alpha))) - v(\sigma^*;\tau^*(\alpha,s))].$$

Namely, to compute whether following the prevailing SSB is beneficial or not, it is sufficient to check whether a deviation from the SSB gives an

immediate gain which exceeds the loss in the continuation payoff (evaluated by the prevailing values) in terms of the present value. In this sense, the problem each individual faces in this setup is much simpler than the usual interpretation of Nash equilbrium requires.

The norm equilibrium is, by definition, necessarily a Nash equilibrium of the entire society. It is also a perfect Nash equlibrium if the population is infinite, as will be assumed in this paper. If the population is finite, however, it may not be a perfect Nash equilibrium. To see this, let p_t be the proportion of population who have been following the prevailing social norm throughout their lives. The value function $v(\cdot)$ and the deviation incentive function $d(\cdot)$ are both potentially functions of p_t as well. When a unilateral deviation from the social norm occurs, it will not affect this proportion p_t if the population is in finite. If the population is finite, however, P_t may change as unilateral eviation occurs and a norm equlibrium of our definition may fail to be a perfect equilbrium.

Our norm equilibrium may be, in a sense, a "locally perfect" Nash equilbrium. Suppose (i) the deviation incentive constraint in the lemma 1 is satisfied with strict inequality. Furthermore, (ii) even if some small proportion of population starts to deviate from the prevailing social norm, p_t remains close to one because deviators die while new population emerges. In this case, as deviation incentive is smaller than the gain in continuation payoff as long as p_t remains small, small deviation would not cause any further deviations. In this sense, the norm equlilibrium may be locally perfect[2/]. The social norm we shall consider in this paper satisfy this local perfectness.

In the succeeding sections, we shall apply this concept of norm equilibrium to the labor relationship in Japan.

3. Team Model

3.1 We consider an economy consisting of infinitely many physically identical firms and infinitely many physically identical individuals (called workers). There are infinite number of individuals living in the society in each period. Being identical, they have the same instantaneous utility function $U(w_t, e_t)$ where $w_t \in \mathbf{R}_+$ is the amount of consumption in period t and $e_t \in \mathbf{R}_+$ is the level of effort in t. $U(\cdot,\cdot)$ is assumed to be concave, and increasing in w_t and decreasing in e_t. Hence, workers are assumed to be risk averse.

Workers' pure discount factor is 1 but random death befalls on each individual with probability $1-\delta \in (0,1)$, while the same size of new generation is born, keeping the size of population constant. This makes individual's discount factor δ. We assume that borrowing and lending is impossible and hence (i) w_t is the same as the monetary compensation each individual receives, (ii) workers cannot post any bond when they enter the employment contract, and (iii) there is no bequest to the newly born generation.

There are infinitley many firms, of those some operate actively but some are potential entrants. All firms are risk averse with instantaneous utility function $G(\cdot)$ defined over profit. Being risk averse, $G'(\cdot)>0$ and $G''(\cdot)<0$ for all profit level. Firms try to maxmize the present discount value of utility stream generated from net cash flows with distcount factor $\delta \in (0,1)$. Each firm employs n workers where $n \geq 3$; a critical assumption as it will become evident later.

3.2 Each firm has an identical production function;

$$y_t = F(e_t, n_t)$$

where y_t is the amount of total output in t, $\mathbf{e}_t$ is the vector of efforts $(e_{1t},\cdots,e_{nt})$ where e_{jt} is the effort provided by the j-th employee in t, and η_t is the stochastic noise which is not observable by any member of the firm. $F(\cdot,\cdot)$ is assumed to be concave and increasing in e_{jt}. Moreover, $F(\cdot,\cdot)$ depends only upon the average level of effort, $\bar{e}_t = \sum_{j=1}^{n} e_{jt}/n$. Hence we write $F(\mathbf{e}_t,\eta_t)$ by $f(\bar{e}_t,\eta_t)$. We also write $f(\bar{e}_t,\eta_t|e_t) = f([(n-1)\bar{e}_t+e_t]/n,\eta_t)$ or the output when all but one workers choose $\bar{e}_t$ while the last worker chooses e_t and the noise term is η_t.

We assume that neither the effort choice of each individual worker nor the aggregate effort level is observable by the firm. Therefore, firms can only observe y_t in each period and the wage to each employee is a function of (possibly the history of) y_t only. To simplify our model further we shall assume, because of transaction costs and other reasons, firms can offer only one type of wage function; wage to each worker is a linear function[3/] of the current aggregate output only[4/5/], or $w_t = \psi(y_t) = ay_t + b$.

On the other hand, we assume individual effort of each worker is observable by the fellow workers. This creates a possibility of cooperation among workers who are, in effect, playing a repeated game non-cooperativley. The effort level, however, must be chosen before they know the aggregate output, and workers must suffer from uncertainty in wage payment.

Although physically identical, active firms are divided into two different categories; prestigious (denoted as P) and non-prestigious (denoted as N). This distinction reflects the difference in workers' perception about the exisiting "corporate norm" in each firm.

All the newly entering firms must become a N firm at first. Since entry is freely allowed, N firms must earn zero expected utility from profit. The fraction of P firms among all the existing firms will be denoted by $\gamma\varepsilon(0,1)$.

Over the long run, this fraction may change over time as some N firms may become a P firm. To become a P firm, N firms must spend some effort to nurture cooperative corporate norm. To simplify, we assume the following dynamics. If P firms are making positive expected utility, some N firms will become prestigeous by investing resources to nurture a cooperative norm. If P firms' expected utility is zero, however, there is no effort for N firms to become P firm, as the cost to do so makes the effort unattractive.

Finally, workers' status is classified as either P or N according to in which type of firms he/she works. When born, a worker will find a job at either P or N firm and this selection is done randomly.

4. Non-Prestigious Firms and Free Entry

4.1 At any firm, employment contract is as follows. Firms offer a wage function $\psi(\cdot)$ and at the same time solicits evaluation of fellow workers in each period[6/]. Wage is paid to all the current workers regardless of the evaluation. at least two of his/her colleagues say a worker's work performance was bad, however, he/she will be dismissed from the firm. A dismissed worker cannot find a new contract from P-firms and must settle at a N-firm.

Let a linear wage function $\psi(\cdot)$ be given. Let $BR(e,\psi)$ be the best response of an individual worker given other workers' average effort e;

$$BR(e,\psi) = \underset{e' \varepsilon R_+}{\text{argmax}}\ EU(\psi(f(e,\eta|e'),e'),e').$$

Then let $e_N^{\psi} \varepsilon R_+$ be the (one-shot) Nash equilibrium effort choice of each individual worker;

$$e_N^{\Psi} = BR(e_N^{\Psi}, \Psi).$$

Define $u^{\Psi}(e) = EU(\Psi(f(e,\eta)),e)$, the expected immediate payoff for each worker when all workers choose the effort level e. Let e_C^{Ψ} be the cooperative level of effort;

$$e_C^{\Psi} = \underset{e \in R_+}{\text{argmax}}\ u^{\Psi}(e).$$

Finally define $u_N^{\Psi} = u^{\Psi}(e_N^{\Psi})$, the level of expected utility when all workers choose the one-shot Nash effort level, and $u_C^{\Psi} = u^{\Psi}(e_C^{\Psi})$, the expected utility when all workers choose the cooperative effort level.

Lemma 2: If $0 < \Psi'(y)=a < n$, then

(i) $e_N^{\Psi} < e_C^{\Psi}$,

(ii) $u^{\Psi}(e)$ is increasing in e over $[e_N^{\Psi}, e_C^{\Psi}]$,

(iii) $u_N^{\Psi} < u_C^{\Psi}$ always holds.

Proof: Since Ψ is linear, u(e) is continuous and concave in e. At the Nash equilbrium effort level,

$$(a/n)EU_w(af(e_N^{\Psi},\eta)+b, e_N^{\Psi})f_e(e_N^{\Psi},\eta) + EU_e(af(e_N^{\Psi},\eta)+b, e_N^{\Psi}) = 0.$$

As $0 < a < n$, it follows that u(e) is increasing at e_N^{Ψ}. Then all the assertions follow immediately. Q.E.D.

4.2 Non-presitigous firms are the firms where, because of social norm, neither the firm (stockholders) nor the workers do not commit themselves to the continuation of the current employment relationship. It follows that all the labor relationship cannot extend more than one period[7/]. Therefore, we

shall assume that workers play a one-shot non-cooperative game given a wage function offered by the non-prestigeous firms.

Suppose all N-firms try to find the best one-shot Nash contract, with a constraint that the contract must offer an expected immediate payoff which is at least as large as the payoff that is guarantteed in the market. That is, let u_M be the expected immediate payoff that all the N-workers anticipate in the market. Let Ψ be the set of all linear wage functions and let $\Psi_N(u_M) = \{\psi \varepsilon \Psi \mid u^{\psi}(e_N^{\psi}) \geq u_M\}$, the set of linear wage functions which gives expected immediate payoff of at least u_M in the one-shot Nash equilibrium. Then the wage function offered by the N-firms is the solution of the problem:

$$\underset{\psi \varepsilon \Psi_N(u_M)}{\text{maximize}} \; EG(f(e_N^{\psi}, \eta) - \psi(f(e_N^{\psi}, \eta))).$$

We shall denote the solution of this problem by $\psi_N(u_M)$ and the associated expected utility level for the firm by $\pi_N(u_M)$.

As u_M increases, the constraint becomes more severe and the attainable expected profit for firms, $EG(\cdot)$, should decrease (or, at least, never increase). Moreover, as both firm and workers are risk averse, the slope of $\psi_N(u_M)$ lies between 0 and n. This follows because if the slope is at least n, firm is bearing (more than) all the risk associated with the production. This could not be an optimal contract given the fact that firms are also risk averse. To sum up:

Lemma 3: $\pi_N(u_M)$ is non-increasing in u_M and the slope of $\psi_N(u_M)$ with respect to output must be between 0 and n.

Because of free entry to N-firms, the expected utility for N-firms must be zero at equilibrium. This occurs at the level of u_M when the value of π_N is zero. We assume that there is a unique solution for this. Then letting u_M^* satisfy $\pi_M(u_M^*) = 0$, u_M^* is the equilibrium payoff for N-workers and $\psi_N(u_M^*)$ is the equilbrium wage function of the N-firms. Finally, let e_N^* be e_N^ψ where $\psi = \psi_N(u_M^*)$, i.e., the work effort workers would choose given the wage function $\psi_N(u_M^*)$ and $u_M^* = u^\psi(e_N^\psi)$ where $\psi = e_N^\psi$.

5. Prestigious Firms and Social Norm

5.1 Let the social norm of the economy be as follows. Note that there are two status levels for workers, P and N, depending upon which type of firm in which the worker works. Note also that there are two kinds of action that each worker choose in each period, the choice of effort ($e \in \mathbf{R}_+$) and the evaluation of other workers. For the latter, we assume that each worker i ($1 \leq i \leq n$) will make announcement $m_i = (m_{i1}, \cdots, m_{in})$ at the end of the period where $m_{ij} \in \{B,G\}$ is i's announcement about j-th worker's performance in the period[8/]. If m_{ij} is G, i's evaluation about j's performance is "good" or "acceptable", while if it is B, the evaluation is "bad" or "unacceptable". For the simplicity of notation, we assume that each worker will make evaluation of his/her own work. Finally, let $\blacksquare = (m_1, \cdots, m_n)$ be a profile of workers' evaluations.

Fix $e_C^* \in \mathbf{R}_+$, a level of effort to be defined below. The prevailing SSB is a pair of mapping $\sigma := (\sigma^e, \sigma^m)$ where $\sigma^e : \{P,N\} \to \mathbf{R}_+$ while $\sigma^m : \{P,N\} \times \mathbf{R}_+^n \to \{G,B\}^n$ satisfying;

$$\sigma^e(P) = e_C^* \text{ and } \sigma^e(N) = e_N^*,$$

$\sigma_j^m(P,\mathbf{e}) = G$ if $e_j = e_C^*$ while $\sigma_j^m(P,\mathbf{e}) = B$ if $e_j \neq e_C^*$.

$\sigma_j^m(N,\mathbf{e}) = G$ for all $\mathbf{e}$.

In words, all P-workers are supposed to work at the level of e_C^*, the level of effort to be specified below, while all N workers work at e_N^*. Moreover, in P firms, the corporate norm is that all workers evaluate the fellow workers' effort correctly and report them honestly. In N-firms, however, they always conceal information about other workers' effort choice, reflecting their corporate norm (e.g., each firm and their workers think their interests are diametrically opposed).

The transition mapping for the j-th worker is a mapping τ such that:

$\tau(P,\blacksquare) = P$ if $\#\{i \mid m_{ij} = B\} < 2$ and $\#\{i \mid m_i = m_j\} \geq 2$,

$\tau(P,\blacksquare) = N$ otherwise,

$\tau(N,\blacksquare) = N$ for any $\blacksquare$.

In words, at P firms if at least two fellow workers evaluate his/her performance bad, he/she will be dismissed from the firm. Even if there are at most one fellow workers whose evaluation about his/her effort is bad, if his/her evaluation is different from others', he/she will be dismissed as well. Any dimissed worker must end up at a N-firm in the next period. Working for N-firms is an absorbing state and the worker must stay there for the rest of his/her life. Any newly born worker will find a new job either at a P-firm or at a N-firm, as vacancies are created by worker's death or dismissal. New job is assigned randomly. Given this social norm, all N-workers has present discounted payoff of $v_M^* = u_M^*/(1-\delta)$.

5.2 In this subsection we define e_C^*, the effort level chosen at the P-firms. For this purpose, recall first that BR(e,ψ) is the best response of individual worker's effort choice, given other workers choice of e and a linear wage function ψbeing offered by the firm. Define the deviation incentive from cooperative behavior under ψ:

$$d(e_C^{\psi},\psi) = EU(\psi(f(e_C^{\psi},\eta|BR(e_C^{\psi},\psi))),BR(e_C^{\psi},\psi)) - u^{\psi}(e_C^{\psi}).$$

Recall that Ψ is the set of all linear wage functions. Define $\Psi_C(u_M^*) = \{\psi\varepsilon\Psi|d(e_C^{\psi},\psi) \leq \frac{\delta}{1-\delta}[u^{\psi}(e_C^{\psi})-u_M^*]\}$, i.e., the set of all linear wage functions such that there is no incentive to deviate from the cooperative behavior provided that the deviation is detected by the firm. Let $\psi\varepsilon\Psi_C(u_M^*)$ and recall e_C^{ψ} and u_C^{ψ} are the associated cooperative effort and payoff levels. We first show that there is a $\psi\varepsilon\Psi_{\Psi}(u_M^*)$ such that $u_C^{\psi} > u_M^*$.

For this, let $\hat{\psi}_C$ be defined as the wage function that yields the largest expected utility for P-firms, :

$$\hat{\psi}_C = \underset{\psi\varepsilon\Psi_C(u_M^*)}{\operatorname{argmax}} EG(f(e_C^{\psi},\eta)-\psi(f(e_C^{\psi},\eta))).$$

We shall denote the associated expected utility level for the firm by $\hat{\pi}_C$ and the associated expected utility level for workers by $\hat{u}_C$. Under the social norm defined in 5.1, all P-workers receives $\hat{v}_C = \hat{u}_C/(1-\delta)$ $(> v_M^*)$ level of expected lifetime payoff.

Lemma 4: If $\psi\varepsilon\Psi(u_M^*)$ then $u_C^{\psi} \geq u_M^*$. Moreover $\hat{u}_C > u_M^*$ and $\hat{\pi}_C > 0$.

Proof: If $\psi\varepsilon\Psi(u_M^*)$ then, as $d(e_C^{\psi},\psi) \geq 0$, by definition $u_C^{\psi} \geq u_M^*$.

As $\psi_N(u_M^*) \varepsilon \Psi_C(u_M^*)$, $\Psi_C(u_M^*)$ and its interior are both non-empty, and it follows $\hat{\pi}_C > 0$. To show $\hat{u}_C > u_M^*$, recall that $\hat{u}_C \geq u_M^*$ as $\hat{\psi} \varepsilon \Psi(u_M^*)$. Suppose $\hat{u}_C = u_M^*$, contrary to the assertion. Then $d(\hat{e}_C, \hat{\psi}_C) = 0$ and $\hat{e}_C = BR(\hat{e}_C, \hat{\psi}_C)$. Hence $\hat{e}_C$ must be the one-shot Nash equilbrium effort choice under $\hat{\psi}_C$, and $\hat{u}_C = u_C^{\psi} = u_N^{\psi}$ where $\psi = \hat{\psi}_C$. But this is a contradiction to lemma 2 and the assertion must hold. Q.E.D.

From the above lemma, P-firms can choose any wage function in $\Psi_C(u_M^*)$ to generate workers' incentive and yet provide the expected payoff at least as large as what N firms do. Moreover, the latter half of this lemma shows that P firms can even generate payoffs to workers strictly larger than u_M^* and obtain higher payoff to themselves.

Note that expected payoffs to workers and the management, as well as deviation incentive function, are all continuous functions of parameters of linear wage functions, a and b. It follows that there is a linear wage function $\psi^* \varepsilon \Psi(u_M^*)$ which generates cooperative payoff to workers larger than u_M^* and zero expected utility to firms, i.e.,

$$u_C^* = u^{\psi}(e_C^{\psi}) > u_M^*,$$

$$\pi_C^* = EU(\psi(f(e_C^{\psi}, \eta) - \psi(f(e_C^{\psi}, \eta))) = 0,$$

where $\psi = \psi^*$. Let the associated effort level be e_C^*, the P workers' effort choice dictated by the prevailing social norm. Under the social norm defined in 5.1., all P workers receive $v_C^* = u_C^*/(1-\delta)$ $(> v_M^*)$ level of expected lifetime payoff.

5.3 It is left to show that the social norm, (σ, τ), specified in 5.1 consitututes a norm equilibrium. In view of lemma 1, we must show that the condition of lemma 1 must hold for N-workers and P-workers. For N-workers,

the condition trivially holds because the actions generated by the labor contract forms a one-shot Nash equilibrium. For P-workers, deviation from choosing e_C^* must satisfy the condition because, if they deviate, other fellow workers will allways say the worker is not working according to the corporate norm and he/she will be dismissed. Here it is important that $n \geq 3$, the number of workers in a firm is at least three. For if there were only two workers and the reports were conflicting, it would not be possible for the firm to tell whether a worker is telling the truth or not[9/]. Deviation from announcing the truth about fellow workers again satisfies the condition, because deviation will cause the loss of P-worker status. Hence:

Proposition: The social norm $\beta = (\sigma, \tau)$ is a norm equilblirium. Under this norm equilibrium, all P-workers choose cooperative effort and obtain higher expected utility than N-workers. However all firms, regardless of P- or N-, earn zero expected utility.

5.4 A few remarks are in order. First, although we have shown that cooperative effort in P-firms are supported by the threat of dismissal, we should not necessarily interpret it as a pure threat (or negative incentive) and work atmosphere in P-firms is hostile. The difference in expected lifetime utility, $v_C^* - v_M^*$, also acts as a carrot (or positive incentive) for P-workers to facilitate cooperation. P-workers work cooperatively because, by doing so, they can attain a higher payoff. They also work at the cooperative effort level because they expect other workers to work at the same level and, hence, to work at this level is the work norm in the firm. They expect to cooperate precisely because there is an (negative or positive) incentive to do so.

Second, one may doubt whether there indeed exists a possibility of dismissal in Japanese labor relationship where lifetime employment is a custom. However, as Koike [1977] has forciflly agreed, Japanese lifetime employment custom does not mean a guarantteed lifetime employment. Contrary to the American custom where all the senior workers have their job guarantteed by written agreements, Japanese custom is an implicit agreement that firms do their best not to dismiss workers even if economic conditions turn sour.

In fact, Shimada [1988] reports the Honda of America Manufacturing, in the process of transplanting Japanese management system, actually dismissed few workers. They did so, however, after public debate of the entire company and the final decision was made by voting among seven representatives; six chosen form employees and only a single member represented the management side. In Japan, similar process exsits but the process is rather tacit. Managements may come to a worker who they think is inappropriate for the firm, and they would suggest to leave the firm; the excercise of "shoulder patting". This would not work if the worker is considered to be working well among his/her fellow workers, as other workers would start protecting this worker.

Third, we did not analyze the enforceabiility of this contract (or social norm) from the firm's side[10/]. To do so, however, requires explicit treatment of management/stockholders in centives. This is clearly out of the scope of the current paper. I shall relegate the analysis for another occasion.

Fourth, the key aspect of our social norm lies in the fact that all the P-workers can identify fellow workers' effort choice. For this to be possilbe, workers in the shop floor can identify what is the responsibility of

other workers and whether other workers are acting accordingly in each contingency. This means that P-workers must be "multi-functional", capable of carrying out many different jobs. In Japanese shop floors, this is achieved by job rotations and on the job training.

Fifth, the parameter γ, which is a fraction of N-firms in the society, played no role in our analysis. Indeed, an important implication of our analysis is that there are multiple equilibria in our model as any value of γ would make the social norm of 5.1 an norm equilibrium. The performance of the economy is quite different, however, depending on the value of γ. As γ increases, more and more firms become prestigeous and both average payoff of the members (workers) of the society and productivity of the economy improves. In short, social norm is an important determinant of the society's economic performance.

6. Concluding Remarks

In this paper, I have shown that work norms and corporate norms play an important role in attaining higher utiltity for workers and higher productivity (i.e., higher effort level). What I stressed is the multi-functionality of employees which make it easy to evaluate other workers' choice of actions.

I think cooperative culture and multi-functionality are even more important when workers have private information such as a discovery of possible improvement in production lines. This occurs because proper effort may differ in each contingency and achieving the best result may require coordination of all the workers in the floor and/or the firm. When choosing proper action by each worker is complementary, coordination will generate a sizable productivity increase even if an increase in productivity is minute.

In this sense, choosing proper effort (or work) may require (i) sharing of private information and (ii) trust that other workers will choose the best action contingent on the information. A corporate norm that enhances cooperation would create exactly these incentives. I leave the analysis of this issue for an other occasion.

Footnotes

1/ An example is Okuno [1984]. See also Akerlof [1980] and Kreps [1984]. The latter emphasizes the role of corporate culture in general.

2/ For more detail of these problems and definitions, readers are referred to Okuno-Fujiwara and Postlewaite [1988]. Kandori [1988] has a norm equlibirum which gives rise to a perfect Nash equilibrium.

3/ For the justification of linear wage function, see for example, Holmstrom and Milgrom [1987] and Hart and Holmstrom [1987].

4/ Making wage as an increasing function of age or years of experience, or even of an individual worker's job performance, is another device for creating work incentive (see, e.g., Lazear [1979], Kanemoto and MacLeod [1987], Shapiro and Stiglitz [1984] and Okuno-Fujiwara [1988]). In this paper, we shall assume away these possibilities and yet show that there is a work incentive created by work norm.

5/ Japanese bonus system is sometimes argued to be exactly this type of wage function. For the detail, see Okuno [1984], Weitzman [1984] and Freeman and Weitzman [1984].

6/ Since the effort level of each individual worker is observable by fellow workers, it is possible to design a wage function which depends upon his/her effort level reported by the fellow workers. We shall not consider this possibility in this paper. Note, however, this information provided by the fellow workers will be used for the decision of dismissal in this paper, and allowing this to be used for wage determination will only solidify our conclusion.

7/ We assume, however, that both parties must commit to the employment relationship in the period. This is assured because, wages are paid after the completion of the work and penalizing the non-payment of wages is enforced by a third party.

8/ It is not necessary to assume each worker's effort is identifiable by all other workers. As a matter of fact, we can significantly reduce this informational requirement by assuming that each worker's effort is observable by only two other workers. In this case, announcement of i-th worker's effort choice must be made by these two workers.

9/ It may be possible for firms to fire both workers when their reports are conflicting. However, it is not clear if the firm can still maintain the cooperative work norm, when it dismisses workers on the ground that their opinions are in conflict.

10/ For the problem of enforceability and a possible enforceable contract, see Bull [1985] and Kanemoto and KacLeod [1987].

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