High-Performance Work Systems and Interaction-Based Approach to Socioeconomic Behavior.

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Summary. The objective of this paper is to discuss the circumstances under which the practice of high-performance work systems centered on employment security, selective hiring and self-managed teams is justified. We use Blume and Durlauf (2001) model of socioeconomic behavior to study the performance of such an organization and compare the results with a more traditional incentive theory.

Keywords and Phrases: statistical model of socioeconomic behavior, theory of the firm, high performance work systems.

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1 INTRODUCTION

Recently the attention of researchers in human resource management was caught by so called high-performance work systems (HPWS). HPWS are organizations that utilize a managing approach which differs radically from the traditional hierarchical one. The main features of this approach, as summarized in Pfeffer (1998), are the following: employment security; selective hiring of new personnel; self-managed teams and decentralization of decision making as the basic principles of organizational design; comparatively high compensation contingent on organizational performance; extensive training; reduced status distinctions and barriers, including dress, language, office arrangements, and wage differentials across levels; extensive sharing of financial and performance information throughout the organization. Among the successful companies adopting this approach are, for example, Men's Warehouse, Southwest Airlines, and Proctor and Gamble.

HPWS approach to managing human resources is fundamentally different from the traditional one. For a summary of the later see Lazear and Rosen (1981). Some principles employed by HPWS are in direct contradiction with the traditional approach. For example, team self-management and compensation based on organizational performance is believed to create moral hazard in teams problem (Holmström, 1982), reduced status distinctions reduce competition for promotion and make it harder to induce the first best based on relative performance evaluations (Lazear and Rosen, 1981).

Lawrence and Lorsh (1967) documented that the difference in the human resources management strategies depends on the size and type of organizations. Small enterprises rely primarily on the financial incentives, big organizations rely on financial incentives to some extent, but also put a value on a commitment of workers to the organizations, while civil services do not rely on financial incentives at all. Lawrence and Lorsh come to a conclusion that there is no uniformly optimal way to design an organization.

The best studied way to design organization is through a system of incentive contracts. For an introduction to this approach see Holmström and Tirole (1989). The main idea of proponents of HPWS, on the other hand, is to create an organization based on employee involvement rather than on explicit financial incentives. However, the traditional approach offers few tools to model this idea formally. In this paper we apply the interaction-based approach to socioeconomic behavior developed by Blume and Durlauf (2001) to explain the performance of HPWS. We will also study the dependence of performance of HPWS on the size of organizations through some numerical examples.

The main difference of the interaction-based approach from other types of economic modelling is its focus on direct interdependence between economic actors. In Blume and Durlauf (2001) this is achieved by postulating social preferences. From the point of view of the long-run outcome, postulating social preferences is equivalent to sticking with individual preferences, but assuming that agents are boundedly rational and adjust their choices gradually, where the adjustment reflects partially the gradient of the individual's utility and partially imitation of peers' choices (Basov, 2002).

This paper is organized as follows. Section 2 briefly reviews the interaction-based model of socioeconomic behavior by Blume and Durlauf (2001). Section 3 applies this model for explaining the performance of HPWS. Section 4 concludes.

2 A REVIEW OF THE INTERACTION-BASED MODEL OF SOCIOECONOMIC BEHAVIOR

In this section we will give a brief review of a simple variant of the interaction-based model of socioeconomic behavior by Blume and Durlauf (2001). The model introduced below has been used to interpret out-of-wedlock births and high school dropout rates (Brock and Durlauf, 2001).

Consider the population of I individuals. Suppose that each individual faces a binary choice problem. Let the elements of the choice set be labelled -1 and 1. Suppose that each individual's utility is quadratic in her actions and in the actions of others and each individual experiences a pair of stochastic shocks $\varepsilon_i(-1)$ and $\varepsilon_i(1)$, which influence the payoffs associated with the respective choices. Each individual is assumed to posses expectations which apply to the choices of the others in the population. Formally,

$$U(\omega_i) = h\omega_i - \frac{1}{2}E_i \sum_{j \neq i} J_{ij}(\omega_i - \omega_j)^2 + \varepsilon_i(\omega_i), \tag{1}$$

where $\omega_i \in \{-1, 1\}$ and $E_i(\cdot)$ is the expectation the individual i possess about the choice of individual j. Assume that all terms J_{ij} are positive. They can be interpreted as a measure of disutility of nonconformity.[1] Typically, one will assume that J_{ij} is big if individuals i and j consider themselves to be peers and close to zero otherwise. This means that this term can be manipulated by changing the perception of individual j by individual i.

Random terms are assumed to be independent and extreme value distributed, which implies:

$$\Pr(\varepsilon_i(-1) - \varepsilon_i(1) < \gamma) = \frac{1}{1 + \exp(-\beta\gamma)}, \ \beta > 0. \tag{2}$$

The probability of realization of the value ω_i is now given by:

$$\Pr(\omega_i) = \frac{1}{Z} \exp(h\omega_i + \beta E_i \sum_{j \neq i} J_{ij}\omega_i\omega_j), \tag{3}$$

where Z is a normalization factor. Assuming that the choices of individuals are independent conditional on $E_i(\omega_j)$ one can derive the joint distribution of choices in the population. To close the model one has to assume that expectations $E_i(\omega_j)$ are validated in the equilibrium.

[1] Alternatively, they may be related to the degree boundedly rational individuals imitate each other (Basov, 2002)

Example 1 (Blume and Durlauf, 2001). Assume

$$\begin{aligned} J_{ij} &= \frac{J}{I-1} \qquad (4) \\ E(\omega_i) &= m. \qquad (5) \end{aligned}$$

Then the equilibrium condition becomes:

$$m = \tanh(\beta h + \beta J m), \qquad (6)$$

where the hyperbolic tangent is defined by:

$$\tanh(x) = \frac{\exp(x) - \exp(-x)}{\exp(x) - \exp(-x)}. \qquad (7)$$

For a derivation see Brock and Durlauf (2001). A simple graphical analysis of (6) will persuade the reader that the following are true:

1. If $\beta J < 1$ and $h = 0$ then $m = 0$ is the unique solution to (6).

2. If $\beta J < 1$ and $h \neq 0$ then there is a unique solution to (6) whose sign is the same as sign of h.

3. If $\beta J > 1$ and $h = 0$ then there exist three solutions to (6), $m = 0$ and

$m = \pm m(\beta J)$. Furthermore, $m(\beta J) > 0$ and

$$\lim_{\beta J \to \infty} m(\beta J) = 1. \tag{8}$$

4. If $\beta J > 1$ and $h = 0$ then for fixed β and J there exists $H(h) > 0$ such that:

a. if $|h| < H$ then there exist three solutions $m_1 < m_2 < m_3$ to (6) one of which has the same sign as h and the other two have the opposite sign. Furthermore,

$$\begin{aligned} \lim_{\beta J \to \infty} m_1(\beta J) &= -1 & (9) \\ \lim_{\beta J \to \infty} m_3(\beta J) &= 1; & (10) \end{aligned}$$

b. if $|h| = H$ then there exist two solutions to (6) one of which has the same sign as h and the other has the opposite sign;

c. if $|h| > H$ there exists a unique solution to (6)one with the same sign as h.

3 A MODEL OF ORGANIZATIONAL DESIGN

Assume that an organization consists of two layers, a lower layer with n_1 workers and an upper layer with n_2 workers. Suppose two levels of effort e_L and e_H are feasible and the output of a worker is a random variable with expectation equal to the effort level chosen. Concentrate for a moment on creating proper incentives for the workers on the lower layer. One way to do it is to stipulate two values of wage w_L and w_H[2] for the workers of the two layers and promote a worker from the lower to the higher layer based on her relative performance. In principle, this scheme allows to achieve the first best level of effort (Lazear and Rosen, 1981). However, if w_L is restricted to be non-negative (limited liability constraint), as the size of the enterprise becomes larger and the variance of output conditional on effort increases, the above mentioned scheme becomes too costly to the owner. Intuitively, this happens because the probability of winning the tournament decreases as the number of workers increases, and, hence, higher prizes are needed to induce effort. If information rents needed to induce effort by an explicit incentive

[2] w_H should be understood as a certainty equivalent of the incentive scheme higher level workers face.

contract on the lower layer are also large, the conventional organization is doomed to perform poorly.

An unexpected solution in this case is to give up the idea of creating explicit pecuniary incentives and to rely on social forces. Let us consider the consequences of the reduction of the wage differential between layers. This action makes little sense in a conventional model.[3] However, it can be justified in the interaction based model of socioeconomic behavior. To see why, let us introduce following notations:

$$\omega_1 = e_H - \frac{e_H + e_L}{2} \tag{11}$$

$$\omega_2 = e_L - \frac{e_H + e_L}{2} \tag{12}$$

and normalize $\omega_1 = -\omega_2 = 1$. Then the choice of effort is equivalent to choice of ω_i. Let the utility individual i gets from choosing ω_i be:

$$U(\omega_i) = h\omega_i - \frac{1}{2} E_i \sum_{j \neq i} J_{ij} (\omega_i - \omega_j)^2 + \varepsilon_i(\omega_i), \tag{13}$$

[3]at least as long as we abstract from the rent-seeking behavior

where $h < 0$. Here the first term is disutility of effort common to all individuals, the second term represents disutility of disconformity with one's peers, and the last term is an individual specific disutility of effort.

Assume no promotion decisions are made. Let $J_{ij} = 1$ if individuals i and j belong to the same layer, and $J_{ij} = \gamma$, $0 \leq \gamma \leq 1$ if individuals belong to different layers. Let γ be a decreasing function of $w_H - w_L$. The last assumption captures the idea the smaller the wage differential the more similar are individuals to each other, and hence the bigger the disutility of nonconformity. Decreasing differences in dress, language, and the scope of the responsibility presumably have a similar effect.

Assume that random terms are independent and extreme value distributed, and $E_i(\omega_j) = m_k$ if individual j belongs to layer k. Then the equilibrium of the model is determined from the following system:

$$m_1 = \tanh(\beta h + \beta((n_1 - 1)m_1 + \gamma n_2 m_2)) \tag{14}$$

$$m_2 = \tanh(\beta h + \beta(\gamma n_1 m_1 + (n_2 - 1)m_2)). \tag{15}$$

Theorem 1 *There exists a solution to the system (14)-(15).*

Proof. System *(14)-(15)* defines a continuos mapping of square $[-1,1]\times[-1,1]$ into itself. Hence, by the Brower Fixed Point Theorem a solution exists.

Q.E.D.

To study the nature of equilibria let us assume that $\beta n_i < 1$, $\beta(n_1+n_2-1) > 1$, and $|h|$ is small enough in a sense which will be made precise later. Further, assume

$$\gamma = \begin{cases} 1, \text{ if } w_H - w_L \leq w \\ 0, \text{ if } w_H - w_L > w. \end{cases} \tag{16}$$

If $w_H - w_L > w$ then system (8)-(9) has a unique solution (m_1, m_2) where both m_1 and m_2 are negative. Hence, workers on both layers on average shirk. If $w_H - w_L \leq w$ then system has a symmetric positive solution provided $|h|$ is below a threshold specified in Example 1. Hence, a mean effort above e_L can be induced by decreasing the differences between layers, but this is exactly the practice of HPWS.

To get some filling of what levels of effort can be sustained in the equilibrium consider two numerical examples.

Example 2 Let $n_1 = 96$, $n_2 = 97$, $\beta = 0.01$, and $h \in \{0, -5, -10, -15, -20\}$. Then for each value of h there are three symmetric equilibria. The effort levels in these equilibria are summarized in a table below

h	m_1	m_2	m_3
0	-0.95	0	0.95
-5	-0.96	0.06	0.95
-10	-0.96	0.11	0.94
-15	-0.97	0.16	0.93
-20	-0.97	0.21	0.92

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In this example the size of each layer's population is close to critical ($\beta n_i \approx 1$) and an equilibrium with high average effort level exists. Let us next consider small layers ($\beta n_i \approx 1/2$).

Example 3 Let $n_1 = n_2 = 51$, $\beta = 0.01$, and $h \in \{0, -2.5, -5, -7.5, -10, \}$. Then for each value of h, except for zero, there is only one equilibrium effort level with the same sign as h. The results are summarized in a table below

h	m_1	m_2	m_3
0	-0.17	0	0.17
-2.5	-0.43	$-$	$-$
-5	-0.52	$-$	$-$
-7.5	-0.57	$-$	$-$
-10	-0.62	$-$	$-$

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4 CONCLUSIONS

In this paper we applied the model of socioeconomic behavior of Blume and Durlauf (2001) to explain the performance of HPWS. As suggested by numerical examples, HPWS rules allow to sustain high average effort in equilibrium provided organization is big enough. The main advantage of this approach is that it is not necessary to pay information rent, the disadvantage is existence of a bad equilibrium with low average effort, which means that an organization has to solve a coordination problem. As an organization gets smaller, the system of social incentives performs poorly as indicated in Example 3. This conclusion is in rough agreement with stylized facts noted in the Introduction.

It is also worth noting that, even though under some circumstances an HPWS is capable of sustaining sufficiently high average effort, it is always lower than e_H. Hence, when information rents associated with financial incentives are small, explicit financial incentives are preferable.[4] Since different organization differ in observability of effort, size, and structure the results of the paper can explain why no uniformly optimal way of organizational design

[4] If the agents are boundedly rational, one has to re-examine the optimal financial contract. For an example of such approach, see Basov (2003).

exists.

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