Theoretical Economics Letters, 2024, 14, 2471-2476
https://www.scirp.org/journal/tel
ISSN Online: 2162-2086
ISSN Print: 2162-2078

A Model of Incentives Effectiveness in Exercise

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How to cite this paper: Wang, X. (2024). A Model of Incentives Effectiveness in Exercise. *Theoretical Economics Letters, 14,* 2471-2476.
https://doi.org/10.4236/tel.2024.146122

Received: August 4, 2024
Accepted: October 2, 2024
Published: December 11, 2024

Abstract

The paper's proposed model combines bounded rationality and an incentive contract model to study the determinants of incentive effectiveness in exercise. The model explains the absence of field experiment findings on the subject of incentive effectiveness in exercise and suggests that the search for policy evaluations and empirical results should be spent on the study of behavioral contract theory and organizational economics.

Keywords

Exercise, Incentives, Contract, Agency, Organization

1. Introduction

The literature on the determinants of incentives to exercise has been largely devoted to field experiments. Examples are the works of Gneezy and Rustichini (2000), DellaVigna and Malmendier (2006), Charness and Gneezy (2009), and Royer et al. (2015). However, both in terms of field experiments and explicit behavior patterns, it is hard to discover attempts to derive hypotheses about the determinants of when and why incentives (do not) work to modify behavior in areas like forming habits, particularly in the area of exercise. This has led researchers or policymakers into the trap of exploring only the empirical determinants of performance measurement in behavioral interventions. Typically, the results of an agent's physical exercise performance measurement are associated with principal characteristics and (monetary or nonmonetary) incentive contracts designed in which they are given, with how agents interact with intrinsic motivations and social motivations, or even with incentives that matter in various and unexpected ways. In most field experiment studies that contain significant findings, the effect of extrinsic incentives on behavior, mostly the assumption that financial incentives can improve physical exercises, is hard to explain as a direct determinant of incentive effectiveness in exercise.

This paper takes a somewhat different approach to the analysis of exercise. Assume that the principal in question wishes to maximize incentive effectiveness in exercise. Due to the limitations of organization, the principal optimization decision can, at best, be seen as a rough approximation of the kind of local rationality implied by agency models. Clearly, there are constraints on this optimal decision process. One must necessarily be the constraint of structures and processes in the organization, especially hierarchical authority, which may either ameliorate or exacerbate incentive issues in exercise. A second constraint is best described as the bundle of characteristics available to the principal. These characteristics could be termed the components of the principal's preferences regarding the choice of various independent variables. The third constraint is that the agent type is private information. Such types include physical education they have received, preferences for different types of exercise, psychological makeup of exercise, even social status, et al. In part, the state of information may also be considered a reflection of the decision maker's characteristics as well as those of his environment. Thus, the paper proposed model combines Simon's (1955) bounded rationality model and Baker's (1992) incentive contract model to study the determinants of incentive effectiveness in exercise.

Prior to advancing to a formal statement of the problem, what is meant by "incentives effectiveness" must be addressed. Analogous to Lima's (1981) viewpoint, this is interpreted as maximizing agent evaluations of the contract designed by principals to incentivize physical exercises. Apparently, this is not always equivalent to maximizing agent effort. The latter variable is difficult to evaluate, but not impossible. For example, pre-tests and post-tests with physical fitness tests and medical testing technology are becoming increasingly adopted. The meaning of incentive effectiveness in this paper, specifically the quantity or quantities to be used in an incentive contract, has remained ambiguous. Nevertheless, in cases where a second-best contract is based on the principal's objective, it can be enhanced by incorporating additional performance measures. Since the problem below is an optimization problem, the precise definition of effective incentives may vary slightly on second-best contracts, because "external" constraints and "internal" constraints may affect different agents in different ways. However, the two concepts can be regarded as equivalent under the following specific assumptions. I will explore potential methods for formulating incentive contracts in situations where we need to explicitly consider both the "internal" and "external" constraints that define the problem of incentive effectiveness.

2. Model

Effective incentive schemes align with principal goals and motivate agents. Technically, the overall problem for the principal is to optimize his utility function. The optimization of exercise effectiveness is a compensation problem. The utility function depends on a variety of factors, such as delegation and control in public bureaucracy (Y_1), e.g., sports product market regulation; administrative abilities and activities (Y_2); epistemic conditions of hierarchies to exercising (Y_3), et al. Let $\Theta = \Theta(\theta_1, \theta_2, \cdots, \theta_q)$ denote a finite set of agent types, $T = T(t_1, t_2, \cdots, t_p)$ denote a vector of transfer, $\mu(X, T)$ denote a probability measure on the cross product of X and T. For the principal, the reasonable and simplified decision problem can be stated as

$$\max U = \mathbb{E}_\mu\left[U\left(X, T, Y_1, Y_2, \cdots, Y_n\right)\right], \tag{1}$$

subject to

$$\mathbb{E}_\mu\left[V\left(X, T, \Theta, Y_1, Y_2, \cdots, Y_n\right)\right] = \bar{V}; \tag{1-1}$$

$$X = X\left(x_1, x_2, \cdots, x_m\right); \tag{1-2}$$

$$x_i \le \bar{x}_i, \quad i = 1, \cdots, m. \tag{1-3}$$

where $\mathbb{E}_\mu$ is an expectation operator, and $X \equiv X(x_1, x_2, \cdots, x_m)$ is the principal's incentives effective function, i.e., a vector of verifiable and observable actions is modeled as a function of characteristics that act on agents and principals, such as how often an agent exercises, how hard an agent is working, the duration of each exercising session, the exercising mode, the total amount of exercising load, and the advancement and increase in exercise stimulus over time, et al.; x_i is the amount of characteristic i by the principal to contribute to effective incentives, and $\bar{x}_i$ is the maximum amount of characteristic i available to the principal.

$U \equiv$ the principal utility functions;

$V(X, T, \Theta) \equiv$ the agent utility functions, $\bar{V}$ is the maximum utility available to the agent, and the constraint on X in (1-1) can be represented as a collection of inequality incentive compatible constraints $\mathbb{E}_\mu\left[V\left(X, T, \Theta, Y_1, Y_2, \cdots, Y_n\right)\right] \ge \mathbb{E}_\mu\left[V\left(X_j, T, \Theta, Y_1, Y_2, \cdots, Y_n\right)\right]$, $j = 1, \cdots, m$; On the other hand, there is evidence that $Y = (Y_1, Y_2, \cdots, Y_n)$ affects the way agents make decisions and coordinate across the organization. For example, the principal decides what the agent should do in exercising and incentivizes the agent to obey an insurance-based monetary program.

To solve problem (1), we will utilize the conventional Lagrangian method:

$$\begin{aligned} \mathcal{L} = {} & \mathbb{E}_\mu\left[U\left(X, T, Y_1, Y_2, \cdots, Y_n\right)\right] + \lambda\left(\bar{V} - \mathbb{E}_\mu\left[V\left(X, T, \Theta, Y_1, Y_2, \cdots, Y_n\right)\right]\right) \\ & + \sum_{i=1}^{m} W_i\left(x_i - \bar{x}_i + s_i\right), \end{aligned} \tag{2}$$

where the s_i are the m slack variables. The Kuhn-Tucker conditions are

$$\mathbb{E}_\mu\left[\frac{\partial U}{\partial X}\frac{\partial X}{\partial x_i} - \lambda\frac{\partial V}{\partial X}\frac{\partial X}{\partial x_i}\right] + W_i \le 0; \quad i = 1, \cdots, m. \tag{3-1}$$

$$\left(\mathbb{E}_\mu\left[\frac{\partial U}{\partial X}\frac{\partial X}{\partial x_i} - \lambda\frac{\partial V}{\partial X}\frac{\partial X}{\partial x_i}\right] + W_i\right)x_i^* = 0; \quad i = 1, \cdots, m. \tag{3-2}$$

$$\mathbb{E}_\mu\left[\frac{\partial U}{\partial Y_j} - \lambda\frac{\partial V}{\partial Y_j}\right] = 0; \quad j = 1, \cdots, n. \tag{3-3}$$

$$\mathbb{E}_\mu\left[V\left(X, T, \Theta, Y_1, Y_2, \cdots, Y_n\right)\right] = \bar{V}. \tag{3-4}$$

$$W_i \geq 0\,; \quad i = 1, \cdots, m\,. \tag{3-5}$$

$$x_i^* - \overline{x}_i + s_i \leq 0\,. \tag{3-6}$$

$$W_i\left(x_i^* - \overline{x}_i + s_i\right) = 0\,. \tag{3-7}$$

$$\lambda \geq 0\,. \tag{3-8}$$

$$x_i^* \geq 0\,. \tag{3-9}$$

There appears to be a technical difficulty with this approach to the optimization problem. If the principal's characteristic in the optimization problem contributes positively or negatively at all levels of incentives to exercise, then the solution to one part of the above problem may in some way construct mechanisms to induce second-best incentives. The first-best problem does not exist in model (1) for three reasons. First, for a particular principal, certain characteristics may contribute positively to effective exercising only up to a certain level. Beyond that level, these characteristics may detract from exercising. For example, the principal's discretion does have a systematic incentives effect on resource allocation to incentives exercising. However, a principal with higher discretion would be apt to produce particularly strong manifestations of ineffective behavior, such as corruption.

Secondly, the answer partly depends on whether there are complementarities to specific characteristics of the principal's interconnected decisions. For example, suppose a principal implements two practices: deciding whether to invest in a flexibly trained physical educator, and whether to give agents more discretion in the organization of their exercising mode. Should this principal now adopt job creations, compensation incentives, or both? If these new practices enhance the total amount of exercise load for agents when combined with investment in a flexibly trained physical educator, then they should be integrated into the same system as well.

Finally, in addition to complementarities is suitable for modeling second-best situations where combinations of characteristics can lead to multiple local maxima, it should be noted that the problem as presented is extremely difficult to solve in situations where the functions U, V, and X are discontinuous or non-convex, or when the characteristics are discrete variables that cannot be adjusted continuously, and all constraints are not always binding (i.e., at least one of W_i and λ is negative).

The first order conditions (3-1)-(3-9) imply one usual and one unusual result. As is well known, Equation (3-3) implies that the principal will equate the ratio of marginal utility to marginal performance measures requirements across all major factors, i.e.,

$$\frac{\partial U}{\partial Y_j} \bigg/ \frac{\partial V}{\partial Y_j} = \frac{\partial U}{\partial Y_k} \bigg/ \frac{\partial V}{\partial Y_k}\,. \tag{4}$$

However, in order for incentives to be effective in promoting exercise, the model implies that the marginal utility from using characteristic i must be adjusted for the cost associated with using all of it (w_i), or the cost of using any more of it (if $s_i > 0$), i.e.,

$$\frac{\partial U}{\partial Y_j} \bigg/ \frac{\partial V}{\partial Y_j} = \left(\mathbb{E}_{\mu} \left[\frac{\partial U}{\partial X} \frac{\partial X}{\partial x_i} \right] + w_i \right) \bigg/ \mathbb{E}_{\mu} \left[\frac{\partial V}{\partial X} \frac{\partial X}{\partial x_i} \right]. \tag{5}$$

Equation (5) implies how a decision-maker would react if aware of his or her own deviation. From the standpoint of complementarities, this involves the consideration of a principal utilizing all of characteristic *i* and less than the total available amount of characteristic *j*. For characteristics *i*, $W_i > 0$ and $S_i > 0$. Therefore, the marginal utility from using one more unit of that characteristic will be lower than if the constraint were not present. As for characteristic *j*, $W_j = 0$, $S_j > 0$, and the principal is using less of the characteristics than is available. In this case, he has reached a maximum with respect to that particular characteristic.

Furthermore, different principals will probably propose differing incentive contracts. This will occur for some reasons. First, differing principals have different characteristics, and the principal's lack of knowledge of agents' preferences. The second reason for the difference in exercising mode will be the nature of the exercising effectiveness functions, and different principals will have different perceptions of what constitutes good exercising. The third reason is that *X* function will probably not have a unique maximum; even given the constraints, there is no reason to expect that two identical principals will propose identical incentive mechanisms. For example, principals can improve compensation payments in the dynamical process if they are given feedback on agent's performance measures.

3. Conclusion

To summarize the conclusions of this paper, a model has been presented which suggests that the principal will propose different contracts to incentives exercising due to different principal's characteristics and agents' private information, differing contracts of what constitutes optimal incentive, and different search paths to determine which of the available contracts works for organization in social sports. The model explains the absence of field experiment findings on the subject of incentive effectiveness in exercise, i.e., field experiments focus too much on financial incentives and too little on organizational factors, and suggests that the search for policy evaluations and empirical results should be spent on the study of behavioral contract theory. Finally, the model suggests that administrative abilities and activities are an important component of incentives effectiveness in exercise, and that good administrative departments are likely to become good regulators for workplace wellness programs or public health campaigns if they know how to promote health and prevent health conditions. For example, the public sector should get more public health information, and design self-funded commitment contracts to improve the long-term effectiveness of incentive programs.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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