Intergenerational Conflicts of Interest and Seniority Systems in Organizations*

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Abstract

This paper studies the role of a proposed seniority system in an organization. The organization consists of at least three overlapping generations of short-lived members and chooses either a shortsighted or a farsighted action in each period. This results in intergenerational conflicts of interest. The old generation desires to obtain an immediate profit, while the middle and young generations have incentives to invest for future profits. We use a model of infinitely repeated games and demonstrate that the seniority system solves these conflicts in the sense that the farsighted action profile is sustainable in equilibrium.

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Keywords: Seniority system, endogenous choice of decision-maker, profit allocation rule, overlapping generations game, communication.

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1 Introduction

In the 1980s, it was generally believed that managers in Japanese firms were more concerned with long-term results, compared with managers in US firms. Kagono *et al.* (1985) conjectured that the reasons for this difference may be differences in financial markets, labor markets, and so on. In this paper, we investigate what supports the Japanese management style. Specifically, we show that the seniority system in organizations, which includes both the seniority-based *task allocation* system and the seniority-based *profit allocation* system, supports the Japanese management style.

We study an organization that consists of three overlapping generations (young, middle, and old). The organization plays a repeated prisoners' dilemma game. In each period, the organization chooses a farsighted action C or a shortsighted action D. The action C stands for Cooperation and D stands for Defection. The current profit of the organization depends on both current and previous actions, and is allocated among the current members.[1] In this situation, the old generation desires to obtain an immediate profit by choosing the shortsighted action D, whereas the middle and young generations have incentives to invest for future profits (i.e., they are willing to choose the farsighted action C). We demonstrate in this paper that the seniority system solves these conflicts of interest in the sense that the organization can sustain the farsighted action profile in equilibrium. Here the seniority system means that the middle generation person is the decision-maker of the organization under a low-powered reward scheme, whereas the old generation person is the residual claimant.

There have been some theoretical explanations of the positive relationship between seniority and wages. Two famous explanations of this relationship are the specific human capital theory and the incentive theory. The former was introduced by Becker (1962), who emphasized that on-the-job training increases workers' firm-specific productivity. Wages also increase with increases in productivity. Lazear (1979, 1981) described a model of a deferred compensation scheme as an incentive device. He concluded that the principal should keep part of the compensation for a worker as a deposit to prevent the worker from shirking. Moreover, this compensation scheme reduces the frequency and the costs of monitoring activities.[2]

These two theories are tested by empirical data in some works. The specific human capital theory is not well supported by empirical data (see, for example, Kotlikoff and Gokhale (1992) and Levine (1993)). On the other hand, the incentive theory is supported by data (see Barth (1997) and

[1] So examples of organizations studied in this paper include labor-managed firms and traditional Japanese firms.

[2] Other explanations are studied in Salop and Salop (1976) and Harris and Holmstrom (1982). The former introduced a model of self-selection and the latter introduced a model of insurance for risk averse workers who are uncertain about their own productivity.

Bayo-Moriones, Galdon-Sanchez, and Güell (2004)).

However, none of these studies examines the relationship between seniority systems and management styles in organizations. In this respect, our analysis differs from previous work.

Instead, our analysis can be regarded as a study of an endogenous choice of the decision-maker, as we will try to answer the question, "who (or which generation) is more appropriate as the decision-maker of an organization?" In the situation where conflicts of interest among generations exist, our answer is that the middle generation is the most suitable decision-maker under seniority-based wage schemes when the long-term stability of profits is necessary.[3]

From another point of view, the present paper is a study of corporate reputation management. In our model, the firm can choose a farsighted action or a shortsighted action. The former corresponds to building or keeping a good reputation and the latter corresponds to cheating consumers. Obviously, to maintain the good reputation of an organization, the management style is a matter of great importance. We show that an efficient seniority system helps to maintain a good reputation.[4]

We investigate the conflict situation in an organization within a framework of infinitely repeated games. Fudenberg and Maskin (1986) established a Folk Theorem in infinitely repeated games played by infinitely lived individuals with perfect memory of previous histories. Extensions to the world of mortal players are studied in Cremer (1986), Kandori (1992), and Smith (1992). In these studies, the stage game is played among different generations in each period. On the other hand, in our paper, it is assumed that the action of the organization is chosen by the current decision-maker, the current profit is dependent on the current action and the previous action, and the current profit is allocated among all the current members by profit allocation rules that represent the seniority-based wage system. So the stage game is not a variation of the game of public goods provision and is different from the existing literature.

The work most closely related to the present study is Dickson and Shepsle (2001). They studied a repeated public goods game in an overlapping generations (OLG) environment, and showed that there are three types of equilibria, including the seniority equilibrium. In the seniority equilibrium, young generations contribute to public goods provision, while old generations do not. This can be interpreted as a seniority-based task allocation system, because in this equilibrium the young generations exert effort, but they do not exert effort when they get older. Moreover, it is similar to our paper in that profit is distributed from the young generations to the

[3]Recently, some papers have dealt with endogenous choice of decision-makers. See, for example, Aghion and Tirole (1997).

[4]In management literature, corporate reputation management has received much attention recently. See, for example, Fombrun and Riel (2003).

old generations. This may be interpreted as a seniority-based profit allocation system. However, there are considerable differences between us in the motivation and results.

First, in the Dickson and Shepsle paper, the task allocation and the resulting profit allocation are endogenously determined as the consequences of members' equilibrium behavior. On the other hand, our paper assumes that the task and profit allocation rules are exogenously given from the viewpoint of members. This modeling enables us to analyze the relationship between the seniority-based profit allocation rule and the seniority-based task allocation rule explicitly.

Moreover, in the present paper, we focus the situation where the current action choice by a firm has an intertemporal effect (i.e., the current action affects the firm's current profit and the set of possible profits in the next period). In addition, in our framework, deviation increases the current total profit of the firm. As a result, our framework has many applications (e.g., the study of corporation reputation management), which cannot be analyzed in the game of public goods provision.

Muthoo and Shepsle (2004) studied the allocation of agenda-setting (or bargaining) power in organizations under an OLG setting. They studied the properties of the optimal organizational structure and the conditions for sustaining the dynamically optimal outcome in equilibrium. Although the motivation of this paper is similar to ours, the models are quite different from each other. In Muthoo and Shepsle (2004), there are two overlapping generations of players, young and old, and it is assumed that the number of periods any particular player participates in is endogenously determined by his or her past performance. Therefore, the United States Senate, in which legislators have staggered terms of office, is a good example of the organization studied in their paper.

In this paper, we also study the role of intraorganizational communication. As mentioned above, we first study the situation where the decision-maker of the organization is the middle generation person. Then we show that intraorganizational communication is necessary to sustain the cooperative action profile if the decision-maker of the organization is the young generation person. The reason is that the young generation person is unable to observe directly the events that occurred before his or her entry into the organization. Moreover, we show that the seniority system also works in such situations as a device for solving intergenerational conflicts of interest.

Extensions to repeated games played by sequences of short-lived players with informational constraints are considered by Bhaskar (1998), Anderlini and Lagunoff (2005), Lagunoff and Matsui (2004), and Kobayashi (2004). Bhaskar (1998) established an Anti-Folk Theorem result in a line of Kandori (1992) and Smith (1992). Lagunoff and Matsui (2004) studied the role of public communication as a surrogate for memory in the same line as Bhaskar (1998). Anderlini and Lagunoff (2005) introduced intergenerational altru-

istic links in dynastic repeated games and demonstrated the emergence of cooperation. Kobayashi (2004) introduced another type of intergenerational altruistic links, known as passive altruism, and demonstrated a Folk Theorem in games played by organizations with short-lived members under a setting of imperfect memory of past histories.

The rest of the paper is organized as follows: Section 2 describes the model. Section 3 describes the main results. Section 4 studies the role of communication. Section 5 concludes.

2 The Model

We consider the following situation. Time is discrete, and periods are indexed by t ($t = 0, 1, \ldots$). There is an organization that consists of three overlapping generations. We call them Young, Middle, and Old. An individual enters the organization at some date t, and after three periods he or she retires from the organization and is replaced by a new entrant. We call the entrant at period t "agent t." The organization therefore consists of agents $\{t-2, t-1, t\}$ at period t. We introduce the agents -2 and -1, who enter the organization at the beginning of period zero.

$a_{t-1} \backslash a_t$	C	D
C	1	$1+g$
D	$-\ell$	0

Table 1: The payoffs

In each period, the organization chooses the current action $a_t \in \{C, D\}$. The action C stands for Cooperation and D stands for Defection. The payoffs $\pi_t(a_{t-1}, a_t)$ are given in Table 1, where the row indicates the organization's previous actions, and the column indicates the current actions. The numbers g and ℓ in the table are strictly positive. We assume that $\ell > g$, that is, sustaining C is efficient for the organization. Thus, the organization plays a kind of infinitely repeated prisoners' dilemma game.

In this situation, there is a conflict among generations. The old generation desires to get an immediate profit, whereas the middle and young generations take account of future profits. Therefore, our question is whether cooperative action is sustainable in equilibrium.

We assume that each agent acts as the decision-maker of the organization only once in his or her life. We abbreviate the decision-maker as *the DM* hereafter. Moreover, we assume the symmetry of task allocation among generations (for example, the DM is always a member of the young generation). We call the generation assigned the task of DM *the DM generation*.

The profit obtained in period t is assumed to be allocated among the current members by an exogenously given and time-invariant allocation rule $\Lambda = \{\lambda_Y, \lambda_M, \lambda_O\}$. Here, $\lambda_j : \mathbb{R} \to \mathbb{R}$ is the allocation function for generation j of the organization. We assume that the allocation rule satisfies the following properties:

(P1) for all π_t, $\lambda_Y(\pi_t) + \lambda_M(\pi_t) + \lambda_O(\pi_t) = \pi_t$,

(P2) if $\pi_t \geq 0, \lambda_j(\pi_t) \geq 0$ for all j, and

(P3) for any $\hat{\pi}_t > \bar{\pi}_t$, $\lambda_j(\hat{\pi}_t) \geq \lambda_j(\bar{\pi}_t)$ for all j.

The first property means that the present profit (or loss) cannot be carried over to the following periods. The second implies that the minimum wage is zero if the profit is nonnegative. The third means that the wage is nondecreasing in π_t.

To summarize, the DM generation and the profit allocation rule characterize the organizational structure. We assume that the structure is exogenously determined and is common knowledge among the agents.

When each agent chooses his or her action, he or she is subject to an informational constraint. The agent is unable to observe what happened before his or her entry into the firm. He or she can observe the outcomes during his or her lifetime only. Then, each agent can choose his or her action depending only on his or her observed history if there is no additional information on the history of the organization's actions (e.g., messages from older generations). We will study the communication technology in Section 4.

Given the organizational structure and an agent's information on the histories, the agent t chooses his or her action to maximize his or her discounted sum of lifetime payoffs:

$$u_t = \lambda_Y(\pi_t(a_{t-1}, a_t)) + \delta\lambda_M(\pi_{t+1}(a_t, a_{t+1})) + \delta^2\lambda_O(\pi_{t+2}(a_{t+1}, a_{t+2})),$$

where $\delta \in [0, 1]$ is a common discount factor. In the above situation, we use the sequential equilibrium as a solution concept.

3 Analysis

In this section, we consider whether cooperative action is sustainable in equilibrium. More precisely, we will answer the question, "under which type of organizational structure is the cooperative action profile sustainable?" We will show that, under the seniority system, the agents can sustain the cooperative action by using a one-period memory trigger strategy, *the Markovian trigger strategy*. Here, the Markovian trigger strategy is the following strategy: the DM chooses C when $t = 0$ or if $a_{t-1} = C$, and he or she chooses D if $a_{t-1} = D$.

First, we define the notion of sustainability of the cooperative action.

Definition 1. *The organization can sustain the cooperative action profile if there exist an organizational structure (i.e., a pair of a task allocation rule and a profit allocation rule) and members' strategies that satisfy the following:*

1. *In every period, the realized action is C.*
2. *The members' strategies and beliefs constitute a sequential equilibrium.*
3. *The DM has strict incentives to choose C if the previous action is C in equilibrium.*

Now, let us explain the reason we impose the third condition in the above definition. In our overlapping generations environment, if we do not require the third condition, we can easily achieve the cooperative outcome in equilibrium. For example, consider the following organizational structure. The task allocation is that the Old agent is the DM. The profit allocation is that the Young agent obtains all of the profit or loss, and the Middle and the Old agents obtain zero for any π_t. Under this structure, the cooperative outcome is achieved by the Markovian trigger strategy. Obviously, if all other members choose this strategy, no one can gain from deviation. However, the above equilibrium is not stable in the sense that each DM only has weak incentives to choose C. Therefore, we require strict incentives for choice of the cooperative action in equilibrium.

3.1 Proportional Allocation Mechanism

In this subsection, we restrict our attention to the proportional allocation rule as a profit allocation rule, and consider whether cooperative action is sustainable in equilibrium. We denote the proportion for Young (Middle, Old, respectively) by λ_y (λ_m, λ_o, respectively), where $\lambda_y + \lambda_m + \lambda_o = 1$.

Proposition 1. *The organization can sustain the cooperative action profile by the Markovian trigger strategy for any $\delta > 0$, if the DM generation is Middle and if the proportional allocation rule satisfies $\ell/\delta > \lambda_o/\lambda_m > g/\delta$.*

Proof. When the Middle agent is the DM, the necessary and sufficient conditions to ensure that each DM chooses the Markovian trigger strategy are as follows:

$$\begin{aligned} \lambda_m\pi(C,C) + \delta\lambda_o\pi(C,C) &> \lambda_m\pi(C,D) + \delta\lambda_o\pi(D,D) \\ \Leftrightarrow \lambda_o/\lambda_m &> g/\delta. \qquad (1) \\ \lambda_m\pi(D,D) + \delta\lambda_o\pi(D,D) &> \lambda_m\pi(D,C) + \delta\lambda_o\pi(C,C) \\ \Leftrightarrow \ell/\delta &> \lambda_o/\lambda_m. \qquad (2) \end{aligned}$$

Under the assumption of $\ell > g$, we can choose the profit allocation rule that satisfies (1) and (2). Thus, we obtain Proposition 1. ∎

We obtain the following implication from Proposition 1. When an organization consists of more than two generations, the organization can employ a type of "seniority system" as an organizational structure.[5] The seniority system satisfies the following properties: a middle management person is the DM of his or her organization and he or she faces a low-powered incentive scheme, whereas an old generation agent is the residual claimant. The young generation agent, who will become the DM in the next period, observes the current action of the current DM. Under this system, the agent who has the real authority (i.e., the middle management person) has no incentive to deviate from the equilibrium path, because it decreases his or her profit in the next period through the punishment behavior of the following generation. Moreover, once the deviation occurs, the next DM has a strict incentive to choose D. Consequently, this kind of seniority system can solve the intergenerational conflict in the organization.[6]

Obviously, to sustain the cooperative outcome, the DM has to satisfy the following two conditions: (i) he or she will remain in the game in the next period, and (ii) he or she knows the realized action in the preceding period. The latter condition is necessary to choose the Markovian trigger strategy.

The old generation agent will not remain in the game in the next period, so that he or she is not appropriate for the DM. When the DM is in neither the old nor the young generation, he or she satisfies these two properties. This is the key for Proposition 1. Although the young generation agent does not satisfy the latter property, he or she satisfies the former property. Therefore, if information on the previous history of the action is substituted in any way, the young generation agent may become a cooperative DM. We will consider this in Section 4.

3.2 A More General Allocation Rule

Under the proportional allocation rule, the organization cannot sustain a cooperative action if $\ell < g$. On average, if $\ell < g$, choosing C and D alternately is more profitable than sustaining C. However, under this action profile, the discounted sum of lifetime payoffs u_t is not equal to u_{t+1}. So in this subsection we study a more general allocation rule that represents the seniority system and show that the cooperative action profile can be achieved regardless of the values of ℓ and g when $\delta > 0$.

Note that, to sustain the cooperative action profile, the following condi-

[5]The wage profile becomes in practice the seniority-based wage on the equilibrium path, when λ_y and δ are sufficiently small. That is, $\lambda_y \pi(C, C) < \lambda_m \pi(C, C) < \lambda_o \pi(C, C)$.

[6]Spagnolo (2005) considers a repeated delegation game and shows that a low-powered incentive scheme helps firms' collusion.

tions are necessary if the DM generation is Middle.

$$\begin{aligned} \lambda_M(\pi(C,C)) + \delta\lambda_O(\pi(C,C)) &> \lambda_M(\pi(C,D)) + \delta\lambda_O(\pi(D,D)), \quad (3) \\ \lambda_M(\pi(D,D)) + \delta\lambda_O(\pi(D,D)) &> \lambda_M(\pi(D,C)) + \delta\lambda_O(\pi(C,C)). \quad (4) \end{aligned}$$

Note first that from the properties (P1) and (P2), $\lambda_M(\pi(D,D))$ and $\lambda_O(\pi(D,D))$ should be zero. Note also that a smaller $\lambda_M(\pi(C,D))$ is easier to satisfy inequality (3). Then we set $\lambda_M(\pi(C,D)) = \lambda_M(\pi(C,C))$. As a smaller $\lambda_M(\pi(D,C))$ is easier to satisfy inequality (4), we set $\lambda_M(\pi(D,C)) = -\ell$. $\lambda_O(\pi(C,C))$ should be not so large (to ensure the DM chooses D, if $a_{t-1} = D$) and strictly positive (to ensure the DM chooses C, if $a_{t-1} = C$). Consequently, conditions (3) and (4) become the following.

$$\begin{aligned} \delta\lambda_O(\pi(C,C)) &> 0, \quad (5) \\ 0 &> -\ell + \delta\lambda_O(\pi(C,C)). \quad (6) \end{aligned}$$

From (5) and (6), if $\ell/\delta > \lambda_O(\pi(C,C)) > 0$, the cooperative outcome can be sustainable.

To sum up, we obtain the following.

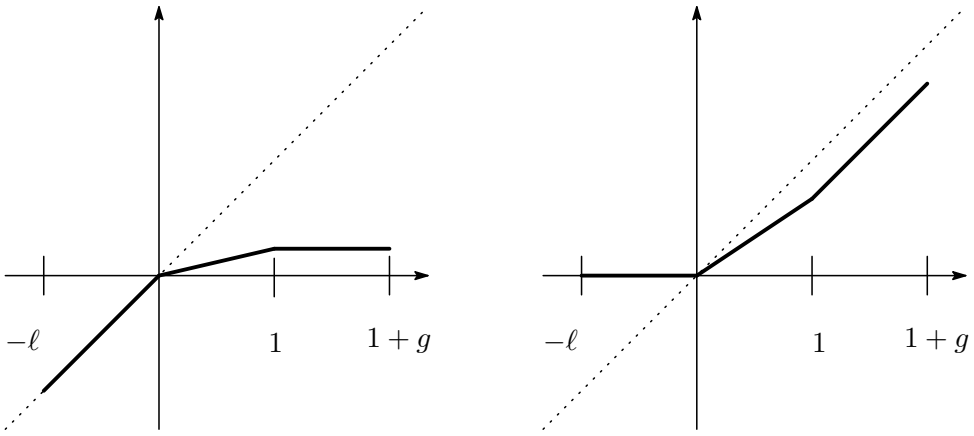
Proposition 2. *If the DM is Middle and the profit allocation rules are*

$$\begin{aligned} &\lambda_Y(\pi(C,C)) = \lambda_Y(\pi(C,D)) = \lambda_Y(\pi(D,D)) = \lambda_Y(\pi(D,C)) = 0, \\ &\lambda_M(\pi(C,C)) = \lambda_M(\pi(C,D)) = 1 - \min\{1, \ell/\delta\} + \varepsilon, \\ &\quad \lambda_M(\pi(D,D)) = 0, \ \lambda_M(\pi(D,C)) = -\ell, \\ &\lambda_O(\pi(C,C)) = \min\{1, \ell/\delta\} - \varepsilon, \ \lambda_O(\pi(C,D)) = \min\{1, \ell/\delta\} + g - \varepsilon, \\ &\quad \lambda_O(\pi(D,D)) = \lambda_O(\pi(D,C)) = 0, \end{aligned}$$

the organization can sustain the cooperative action profile by using the Markovian trigger strategy regardless of the values of ℓ and g if $\delta > 0$.

Figure 1 depicts an example of the profit allocation rule for Middle and Old described in Proposition 2. The current profits of the organization are on the horizontal axis and the allocations are on the vertical axis.

The profit allocation rule described in Proposition 2 satisfies the following properties. The temporary gain from deviation g does not go to the DM's hand, but goes to Old's hand. This removes the DM's deviation incentive. On the other hand, the temporary loss $-\ell$ goes to the DM. This guarantees that the DM will punish the deviant. We may regard this profit allocation rule as the seniority wage system. In practice the wage profile described in Proposition 2 seems to be the seniority-based wage on the equilibrium path, when $\ell/\delta > 1/2$. That is, $\lambda_Y\pi(C,C) < \lambda_M\pi(C,C) < \lambda_O\pi(C,C)$.



Middle Old

Figure 1: An example of the profit allocation rule for Middle and Old

4 The Role of Communication

In this section, we show that if information on the history of the action is substituted in any way, the agent of the young generation is able to be a cooperative DM. We introduce intraorganizational communication into our model and study how it works.

If the Old generation is the message sender, he or she tells the Young the previous action is D irrespective of the previous action, as it is a (weakly) dominant strategy irrespective of the profit allocation rule that satisfies the properties (P1)-(P3). Therefore, the sender should be the Middle generation.

The stage game is played with the following timing of events. First, the Middle agent sends a message $m_t \in \{C, D\}$ to the Young agent. Then, the Young agent chooses his or her action $a_t \in \{C, D\}$.

Proposition 3. *Even if the DM is Young, the cooperative action profile is sustainable if* $\delta > 0$.

Proof. We consider the following profit allocation rule.

$$\lambda_Y(\pi(C,C)) = \lambda_Y(\pi(C,D)) = 1-\varepsilon, \lambda_Y(\pi(D,D)) = 0, \lambda_Y(\pi(D,C)) = -\ell/2,$$
$$\lambda_M(\pi(C,C)) = \lambda_M(\pi(C,D)) = \lambda_M(\pi(D,D)) = 0, \lambda_M(\pi(D,C)) = -\ell/2,$$
$$\lambda_O(\pi(C,C)) = \varepsilon, \lambda_O(\pi(C,D)) = g+\varepsilon, \lambda_O(\pi(D,D)) = \lambda_O(\pi(D,C)) = 0.$$

Let us consider the following strategies for each active generation.

Strategy for the sender of message: the sender sends C if $a_{t-1} = C$ and he or she sends D if $a_{t-1} = D$.

Strategy for the DM: the DM chooses C when $t = 0$ or if the message is C, and he or she chooses D if the message is D.

Under the above profit allocation rule and members' strategies, the following inequalities are satisfied.

$$\lambda_M(\pi(C,C)) + \delta\lambda_O(\pi(C,C)) > \lambda_M(\pi(C,D)) + \delta\lambda_O(\pi(D,D)), \quad (7)$$
$$\lambda_M(\pi(D,D)) + \delta\lambda_O(\pi(D,D)) > \lambda_M(\pi(D,C)) + \delta\lambda_O(\pi(C,C)), \quad (8)$$
$$\lambda_Y(\pi(C,C)) + \delta\lambda_M(\pi(C,C)) + \delta^2\lambda_O(\pi(C,C))$$
$$> \lambda_Y(\pi(C,D)) + \delta\lambda_M(\pi(D,D)) + \delta^2(\pi(D,D)), \quad (9)$$
$$\lambda_Y(\pi(D,D)) + \delta\lambda_M(\pi(D,D)) + \delta^2\lambda_O(\pi(D,D))$$
$$> \lambda_Y(\pi(D,C)) + \delta\lambda_M(\pi(C,C)) + \delta^2\lambda_O(\pi(C,C)). \quad (10)$$

Inequalities (7) and (8) are the conditions of truth telling for the sender (Middle) and inequalities (9) and (10) are the conditions of choosing the Markovian trigger strategy for the DM (Young). Then we obtain the result. ▌

Figure 2 depicts the profit allocation rule described in the proof of Proposition 3.[7] The current profits of the organization are on the horizontal axis and the allocations are on the vertical axis.

In the situation described in the proof of Proposition 3, Middle behaves as the in-company trainer and Young is on-the-job trainee. In this setting, the profit allocation rule should satisfy the incentive constraints for both Middle (the sender) and Young (the DM). When the conditions for truth-telling hold, the current DM knows the previous action on the equilibrium path and it is necessary to support the cooperative action profile.

We have assumed that the number of generations is three. As we have seen, the Old agent has no strict incentive to truth telling (i.e., to send D is a weakly dominant strategy irrespective of the previous action under the property (P3)) and an informational supplement is necessary for Young if Young is the DM. Therefore, we obtain the following.

[7]Note that, under the profit allocation rule described in the proof of Proposition 3, the wage profile is not the seniority-based wage on the equilibrium path. This is because the allocation rule is an extreme case, under which the cooperative action profile is sustainable regardless of the values of ℓ and g when $\delta > 0$. For example, when $\ell > 2$, we can construct a profit allocation rule that satisfies conditions (7)–(10) and that seems to be the seniority-based wage on the equilibrium path. The profit allocation rule is as follows:

$$\lambda_Y(\pi(C,C)) = \lambda_Y(\pi(C,D)) = \lambda_Y(\pi(D,D)) = 0, \lambda_Y(\pi(D,C)) = -\ell/2,$$
$$\lambda_M(\pi(C,C)) = \lambda_M(\pi(C,D)) = \varepsilon, \lambda_M(\pi(D,D)) = 0, \lambda_M(\pi(D,C)) = -\ell/2,$$
$$\lambda_O(\pi(C,C)) = 1-\varepsilon, \lambda_O(\pi(C,D)) = 1+g-\varepsilon, \lambda_O(\pi(D,D)) = 0, \lambda_O(\pi(D,C)) = 0.$$

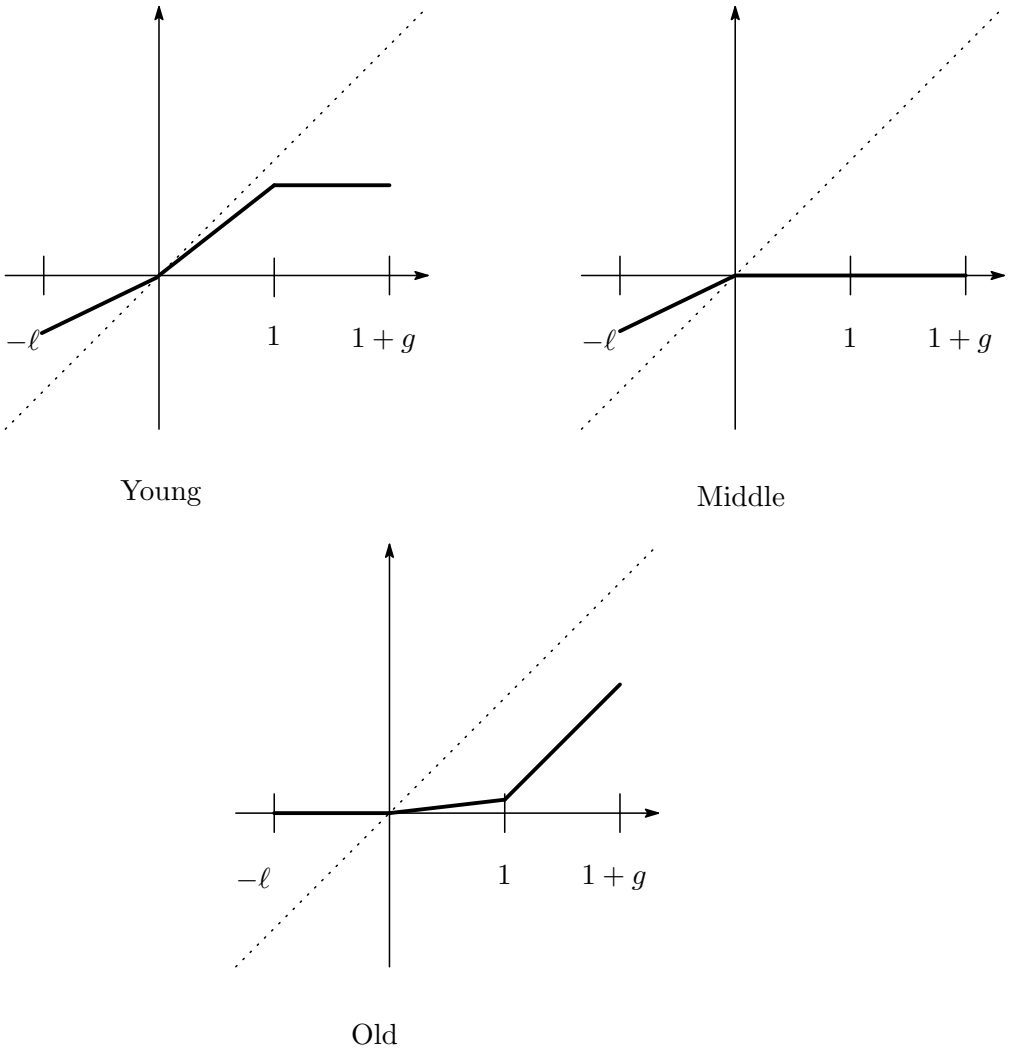


Figure 2: The profit allocation rule described in the proof of Proposition 3

Proposition 4. *If the organization consists of only two generations, the cooperative action profile is not sustainable for any δ.*

5 Conclusion

In this paper, we studied the situation where an organization is infinitely lived, while its composition changes, and there are intergenerational conflicts of interest. Under this situation, we showed that the seniority system solves these conflicts in the sense that the farsighted action profile is sustainable in equilibrium if the organization consists of more than two overlapping generations. Here the seniority system means that the middle generation person is the decision-maker of the organization and faces a low-powered reward scheme, whereas the old generation person is the residual claimant. This means that a separation of decision-making and profit allocation may be optimal in some situations. We also studied the role of intraorganizational communication.

To conclude the paper, we make three comments. First, in the present paper, we assumed for simplicity that each individual lives three periods and acts as the decision-maker of the organization only once in his or her life. In the real world, however, managers typically work for many years. The insights of our model are that the manager must not be of the old generation and the rewards for the managers are sufficiently low-powered.

Second, we assumed that there is a generation assigned the task of decision-making. We assumed this to simplify the analysis and we can extend the present model to the situation of decision by a majority. In such a situation, it is necessary for the young generation person to mimic the middle generation person's action to sustain the farsighted action profile in equilibrium.

Finally, we also assumed that the organization chooses an action in each period and the current profit depends on both current actions and previous actions. We can extend the present model to the situation of repeated interaction among firms consisting of overlapping generations of members. We plan to study this topic in another paper.

References

[1] Aghion, P., Tirole, J., 1997. Formal and real authority in organizations. Journal of Political Economy 105, 1–29.

[2] Anderlini, L., Lagunoff, R., 2005. Communication in dynastic repeated games: 'Whitewashes' and 'coverups.' Economic Theory 26, 265–299.

[3] Barth, E., 1997. Firm-specific seniority and wages. Journal of Labor Economics 15(3), 495–506.

[4] Bayo-Moriones, A., Galdon-Sanchez, J. E., and Güell, M., 2004. Is seniority-based pay used as a motivation device? Evidence from plant level data. Centre for Economic Performance Discussion Paper No 646.

[5] Becker, G. S., 1962. Investment in human capital: A theoretical analysis. Journal of Political Economy 70, 9–49.

[6] Bhaskar, V., 1998. Informational constraints and the overlapping generations model: Folk and anti-folk theorems. Review of Economic Studies 65, 135–149.

[7] Cremer, J., 1986. Cooperation in ongoing organizations. Quarterly Journal of Economics 101, 33–49.

[8] Dickson, E. S., Shepsle, K. A., 2001. Working and shirking: Equilibrium in public-goods games with overlapping generations of players. Journal of Law, Economics, & Organization, 285–318.

[9] Fombrun, C. J., Riel, C. V., 2003. Fame & Fortune: How Successful Companies Build Winning Reputations. Financial Times Management.

[10] Fudenberg, D., Maskin, E., 1986. The folk theorem in repeated games with discounting or with incomplete information. Econometrica 54, 533–554.

[11] Harris, M., Holmstrom, B., 1982. A theory of wage dynamics. Review of Economic Studies 49, 315–333.

[12] Kagono, T., Nonaka, I., Sakakibara, K., and Okumura, A., 1985. Strategic vs. Evolutionary Management: a U.S.-Japan Comparison of Strategy and Organization. North-Holland, Amsterdam.

[13] Kandori, M., 1992. Repeated games played by overlapping generations of players. Review of Economic Studies 59, 81–92.

[14] Kobayashi, H., 2004. Folk theorem for infinitely repeated games played by organizations with short-lived members. Osaka Prefecture University Discussion Paper New Series No.2004-3.

[15] Kotlikoff, L. J., Gokhale, J., 1992. Estimating a firm's age-productivity profile using the present value of workers' earnings. Quarterly Journal of Economics 107, 1215–1242.

[16] Lagunoff, R., Matsui, A., 2004. Organizations and overlapping generations games: Memory, communication, and altruism. Review of Economic Design 8, 383–411.

[17] Lazear, E. P., 1979. Why is there mandatory retirement? Journal of Political Economy, 1261–1284.

[18] Lazear, E. P., 1981. Agency, earning profiles, productivity, and hours restrictions. American Economic Review 71(4), 606–620.

[19] Levine, D. I., 1993. Worth waiting for? Delayed compensation, training and turnover in the United States and Japan. Journal of Labor Economics 11(4), 724–752.

[20] Muthoo, A., Shepsle, K., 2004. Agenda-setting power in organizations with overlapping generations of players. University of Essex, Discussion paper #553.

[21] Salop J., Salop S., 1976. Self-selection and turnover in the labor market. Quarterly Journal of Economics 90, 619–627.

[22] Smith, L., 1992. Folk theorems in overlapping generations games. Games and Economic Behavior 4, 426–449.

[23] Spagnolo, G., 2005. Managerial incentives and collusive behavior. European Economic Review 49(6), 1501–1523.