Reputation Management and Seniority Systems in Firms*

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Abstract

This paper studies the role of a seniority based profit and task allocation system in a firm. The firm chooses either a farsighted or a shortsighted action in each period. The former corresponds to keeping or rebuilding a good reputation, while the latter to cheating consumers or giving up rebuilding. We assume that even if the firm chooses the farsighted (shortsighted) action, it may get a bad (good) reputation with positive probability. In this situation, we show that an efficient seniority system helps to maintain a good reputation in the sense that the farsighted action profile is sustainable in equilibrium. This is because under the seniority system, the decision-maker of the firm gives attention to both short- and long-term performances.

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1 Introduction

Recently, we have observed that a considerable number of Japanese firms have cheated consumers and some of these misconduct cases are brought to light by in-house whistle-blowers. Examples include beef-mislabeling scam (Yukijirushi Foods, Co., Ltd., Nippon Meat Packers. Inc., and Hannan Foods Group), mass food-poisoning case (Snow Brand Milk Products Co., Ltd.), and falsifying production or best-before dates (Ishiya Co., Ltd., and Akafuku Co., Ltd.).

This kind of shortsighted business strategies and the resulting troubles are omnipresent in the world. The aim of this paper is to show the role of a proposed management style as preventative measures against such a misconduct behavior.

We study a firm that consists of two overlapping generations (young and old). In each period, the firm chooses a farsighted action C or a shortsighted action D. The action C stands for Cooperation and D stands for Defection.

The firm has either a good or a bad reputation (G or B). The current profit of the firm depends on both current reputations and current actions, and it is allocated among the current members. Examples of firms studied in this paper include labor-managed firms, professional firms (e.g, law, accounting, and architectural firms), and traditional Japanese firms.

When the current reputation is G, choosing C yields a moderate profit, while choosing D yields additional gains from cheating consumers. When the current reputation is B, choosing C yields a negative profit. This is due to a cost of rebuilding a reputation. On the other hand, choosing D yields zero profit, because this action means a giving up recovery.

The current action determines the reputation. We assume that, even if the firm chooses the farsighted action C (the shortsighted action D), it may get a bad (good) reputation with positive probability. Specifically, choosing C yields the good reputation with probability $1-\varepsilon$ and the bad reputation with probability ε; choosing D yields the bad reputation with probability $1-\mu$ and the good reputation with probability μ.

We assume that these transition probabilities are independent of current reputations. This assumption is to simplify the analysis and to focus our attention on 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 reputation, and consequently, the set of possible profits in the next period).

In this situation, the old generation desires an immediate profit by choosing the shortsighted action D, whereas the young generation has an incentive to invest for future profits (i.e., he is willing to choose the farsighted action C). We demonstrate in this paper that an efficient seniority system solves these conflicts of interest in the sense that the firm can sustain the farsighted action profile in equilibrium. Here the seniority system means that the young generation person is the decision-maker of the firm under a low-powered reward scheme while the old generation person is the residual claimant.

The roles of a seniority based wage system in firms are studied in a large literature. Two famous theoretical explanations of the positive relationship between seniority and wages are the specific human capital theory and the incentive theory.[1] 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.

It is worth notice that there is no intergenerational transfer under these two theories. In the specific human capital theory, a worker's current contribution to the firm is compensated by current wages. In the incentive theory, the compensation for a worker's lifetime contribution is equal to the sum of lifetime wages, since it is a deferred compensation scheme.

However, in some real world cases, the seniority system has a property like a pay-as-you-go pension system. The present paper tries to capture this property, and in the seniority system studied in this paper, the young decision-maker chooses the current action and his choice determines the payoff of current old, since the old is the residual claimant.

Our message is, in essence, the seniority system is, not only the delayed compensation mechanism a la Lazear, but also the scheme that has an intertemporal effect on the managerial incentives. Under the system, the decision-maker of the firm is willing to give attention to both short- and long-trm performances.

The work most closely related to the present study is Ando and Kobayashi (2008). This paper tried to study the role of a seniority system in organizations. In a similar framework to ours, they demonstrated that the seniority system helps to

[1] 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 Bayo-Moriones et al. 2004).

maintain a good reputation in the sense that the farsighted action profile is sustainable in equilibrium.

However, they assumed that $\varepsilon = \mu = 0$ in our framework and tried to implement a *one-period memory trigger strategy*, but the present paper assumes positive values of ε and μ and tries to implement a *reputation-free cooperation strategy* (we call this the always-C strategy). Moreover, the present paper compares the always-C strategy to each of the three possible candidates of the optimal strategies and obtains a uniqueness result. In this respect, our analysis differs from Ando and Kobayashi (2008).

From another point of view, the present paper is a study of executive pay limits. Recently, President Obama called for executive pay limits in Wall Street. However, the pay limits may have negative side effects on the managerial incentives. David Wise, a pay consultant at Hay Group, says "A good compensation program is all about balancing short- and long-term performance. The old banking model relied very heavily on annual performance. The President's puts too much reliance on long-term compensation. The right answer is somewhere in the middle" (BusinessWeek, February 4, 2009).

It is believed that the claw-back provision is a better answer to the problem than the simple pay limits. Today, 2/3 of Fortune 500 companies already have the claw-back provision. It is the contract under which companies can reclaim bonuses that were paid out for performance that later turns out to be illusory.

We can conclude that, in essence, the seniority system studied in this paper has a similar property to that of the claw-back provision. This is because, under the system, the decision-maker of the firm gives attention to both short- and long-term performance.

The rest of the paper is organized as follows. Section 2 describes the model. Section 3 describes the main results. Section 4 concludes.

2 The Model

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

$r_{t-1} \backslash a_t$	C	D
G	1	$1+g$
B	$-\ell$	0

Table 1: The payoffs

$a_t \backslash r_t$	G	B
C	$1-\varepsilon$	ε
D	μ	$1-\mu$

Table 2: The reputation

The firm has either a good or a bad reputation. The reputation in the beginning of period t is $r_{t-1} \in \{G, B\}$. We assume that the initial reputation is G, i.e., $r_{-1} = G$. In each period, the firm chooses the current action $a_t \in \{C, D\}$. The action C stands for Cooperation and D stands for Defection. The payoffs $\pi_t(r_{t-1}, a_t)$ are given in Table 1, where the row indicates the firm's reputations, and the column indicates the current actions. The numbers g and ℓ in the table are strictly positive. Here, we assume the following:

Assumption 1. $\ell > g$

Assumption 1 means that the gain from deviation is less than the cost to rebuild a good reputation.

The current action determines the reputation. We assume that, even if the firm chooses the farsighted (shortsighted) action, it may get a bad (good) reputation with positive probability. As described in Table 2, choosing C yields the good reputation with probability $1-\varepsilon$ and the bad reputation with probability ε; choosing D yields the bad reputation with probability $1-\mu$ and the good reputation with probability μ. In this environment, it is natural to assume the following:

Assumption 2. $1-\mu > \varepsilon$

Assumption 2 means that choosing D yields a bad reputation with higher probability, compared to choosing C.

In this situation, there is a conflict between generations. The old generation desires to get an immediate profit, whereas the young generation takes 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 firm only once in his life. The old generation agent will not remain in the game in the next period, so he is not appropriate for the decision-maker. Therefore, the decision-maker should be always the member of the young 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.[2] In this paper, we restrict our attention only to the proportional allocation rule. We denote the proportion for Old by λ and that for Young by $1-\lambda$, where $\lambda \in [0,1]$.

To summarize, the generation assigned the task of decision-making 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 Young agent chooses his action, he can choose his action depending only on the current reputation r_{t-1}. Given the organizational structure and the current reputation, agent t chooses his action to maximize his discounted sum of lifetime payoffs:

$$u_t = (1-\lambda)\pi_t(r_{t-1}, a_t) + \delta\lambda\pi_{t+1}(r_t, a_{t+1}),$$

where $\delta \in [0,1]$ is a common discount factor.

3 Analysis

3.1 The firm's optimal strategy

In this subsection, we study the firm's optimal strategy under the situation where the firm is operated by an infinitely lived decision-maker. The one step deviation principle of dynamic programming tells us that there are four strategies that are the candidates of the most profitable strategy for the firm: the always-C strategy, the always-D strategy, the trigger strategy, and the alternating strategy (see Table 3). For example, the alternating strategy is the following: if the reputation is G, the firm chooses D and if the reputation is B, the firm chooses C.

Firstly, we describe the expected payoffs of these four strategies. Since the initial reputation is G, the expected (sum of discounted) payoff(s) of the always-C strategy is

$$\frac{1-\delta\varepsilon(1+\ell)}{1-\delta},$$

[2] Here we assumed that the present profit (or loss) cannot be carried over to the following periods.

Strategy\Reputation	G	B
The always-C	C	C
The always-D	D	D
The trigger	C	D
The alternating	D	C

Table 3: The four strategies

that of the always-D strategy is

$$\frac{(1+g)(1-\delta(1-\mu))}{1-\delta},$$

that of the trigger strategy is

$$\frac{1-\delta(1-\mu)}{(1-\delta)(1-\delta(1-\varepsilon-\mu))},$$

and that of the alternating strategy is

$$\frac{(1+g)(1-\delta\varepsilon)-\delta\ell(1-\mu)}{(1-\delta)(1+\delta(1-\varepsilon-\mu))}.$$

Secondly, we compare the expected payoffs between the always-C strategy and each of the other strategies, because the goal of this paper is to show that the firm can employ and implement the always-C strategy.

The condition under which the always-C strategy is better than the always-D strategy is the following.

$$\ell < \frac{1-\varepsilon-\mu}{\varepsilon} - \frac{1-\delta(1-\mu)}{\delta\varepsilon}g. \tag{1}$$

Similarly, the condition under which the always-C strategy is better than the trigger strategy is

$$\ell < \frac{\delta(1-\varepsilon-\mu)}{1-\delta(1-\varepsilon-\mu)}, \tag{2}$$

and the condition under which the always-C strategy is better than the alternating strategy is

$$\ell > \frac{g}{\delta(1-\varepsilon-\mu)} - 1. \tag{3}$$

When inequalities (1)–(3) are satisfied, it is better for the firm to use the always-C strategy than the other strategies. Figure 1 depicts the relationship among the values of g and ℓ and the area in which the always-C strategy is the most profitable strategy for the infinitely lived firm.

By using the fact that $\ell > g$ (Assumption 1) and the inequalities (1)–(3), we obtains the following.

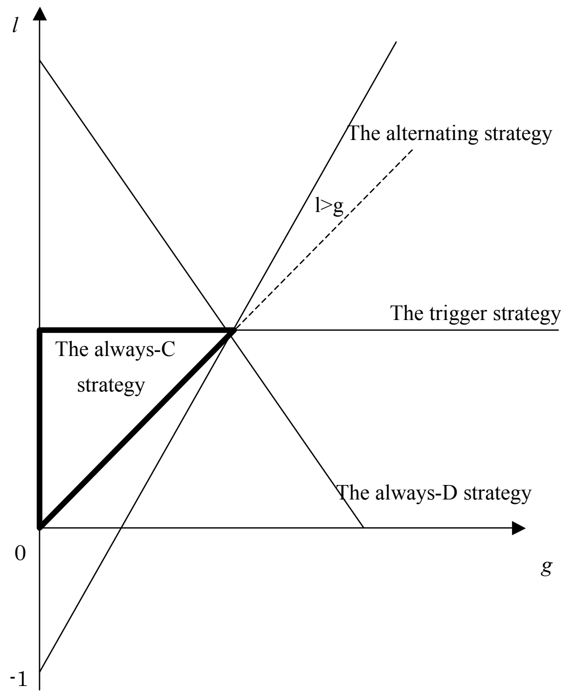

Figure 1: The region in which the always-*C* strategy is optimal

Lemma 1. *If the firm is operated by an infinitely lived decision-maker, the profit maximizing firm uses the always-C strategy if and only if* $\ell < \frac{\delta(1-\varepsilon-\mu)}{1-\delta(1-\varepsilon-\mu)}$.

3.2 The sustainability of the cooperative action in an OLG environment

In the rest of this section, we study the firm with OLG structure and 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 reputation-free cooperation strategy, *the always-C strategy*. Under the always-C strategy, the decision-maker chooses C irrespective of the current reputation r_{t-1}. First, we define the notion of sustainability of the cooperative action.

Definition 1. *The firm 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. *The members' strategies constitute an equilibrium.*

2. *The decision-maker has strict incentives to choose C in equilibrium.*

Now, let us explain the reason we impose the second condition in the above definition. In our overlapping generations environment, if we do not require the second 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 decision-maker. The profit allocation is that the young agent obtains all of the profit or loss, and the old agent obtains zero for any π_t. Under this structure, the cooperative outcome is achieved by the always-C 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 decision-maker only has weak incentives to choose C. Therefore, we require strict incentives for choice of the cooperative action in equilibrium.

3.3 The seniority systems

In this subsection, we will show that the always-C strategy constitutes an equilibrium, if the decision-maker is the young generation agent and if the value of λ is sufficiently large.

First, we describe the incentive compatibility conditions for the decision-maker (i.e., Young). The condition under which choosing C is better than D when $r_{t-1} = G$ is

$$1-\lambda+\delta\lambda(1-\varepsilon)-\delta\lambda\varepsilon\ell > (1-\lambda)(1+g)+\delta\lambda\mu-\delta\lambda(1-\mu)\ell$$
$$\Leftrightarrow \lambda > \frac{g}{g+\delta(1+\ell)(1-\varepsilon-\mu)}. \tag{4}$$

Similarly, the condition under which choosing C is better than D when $r_{t-1} = B$ is

$$-(1-\lambda)\ell+\delta\lambda(1-\varepsilon)-\delta\lambda\varepsilon\ell > \delta\lambda\mu-\delta\lambda(1-\mu)\ell$$
$$\Leftrightarrow \lambda > \frac{\ell}{\ell+\delta(1+\ell)(1-\varepsilon-\mu)}. \tag{5}$$

Under Assumption 1, we can easily conclude that the condition (4) holds if λ satisfies the condition (5).

Next, we describe the participation constraints. The participation condition when $r_{t-1} = G$ is

$$1-\lambda+\delta\lambda(1-\varepsilon)-\delta\lambda\varepsilon\ell \geq 0$$
$$\Leftrightarrow \lambda \leq \frac{1}{1-\delta(1-\varepsilon(1+\ell))}. \tag{6}$$

Similarly, the participation condition when $r_{t-1} = B$ is

$$-(1-\lambda)\ell + \delta\lambda(1-\varepsilon) - \delta\lambda\varepsilon\ell \geq 0$$
$$\Leftrightarrow \lambda \geq \frac{\ell}{\ell + \delta(1-\varepsilon(1+\ell))}. \tag{7}$$

The condition under which the right hand side of inequality (7) is less than 1 is $\varepsilon < 1/(1+\ell)$. Therefore, we assume this inequality.

Assumption 3.

$$\varepsilon < \frac{1}{1+\ell}.$$

Under Assumption 3, inequality (6) is always satisfied. Therefore, the value of λ has to satisfy the conditions (5) and (7).

To sum up, we obtain the following result.

Proposition 1. *Under Assumptions 1–3, the firm can sustain the cooperative action profile by the always-C strategy for any* $\delta > 0$ *if the decision-maker is the young generation and if*

$$\lambda > \max\left\{\frac{\ell}{\ell + \delta(1+\ell)(1-\varepsilon-\mu)}, \frac{\ell}{\ell + \delta(1-\varepsilon(1+\ell))}\right\}. \tag{8}$$

We obtain the following implication from Proposition 1.[3] When a firm consists of two (or more) generations, the firm can employ a type of "seniority system" as an organizational structure. The seniority system satisfies the following properties: the young worker who knows the detail of front-line business is the decision-maker of the firm, and he faces a low-powered incentive scheme, whereas an old generation agent is the residual claimant.

Under this system, the young agent does not have incentive to deviate from the equilibrium path. We can easily check this.

If the current reputation is G, choosing D yields the current gain from deviation. However, most of it goes to the old agent's hands, since the value of λ is large. On the other hand, choosing D yields a bad reputation with a high probability. When the reputation at the beginning of the next period becomes bad, the old has to pay the cost of rebuilding under the always-C strategy, if λ is large. Therefore, he does not have an incentive to choose D.

If the current reputation is B, the current young also has a strict incentive to choose C, since almost all cost is paid by the old and the young can obtain the

[3] If $\ell/(1+\ell) > (<)\mu$, $\frac{\ell}{\ell+\delta(1+\ell)(1-\varepsilon-\mu)} < (>) \frac{\ell}{\ell+\delta(1-\varepsilon(1+\ell))}$.

gain from rebuilding a reputation in the next period with a high probability. Consequently, this kind of seniority system can implement a cooperative action profile and solve the intergenerational conflict in the firm.

In essence, the system is not only the delayed compensation mechanism but also the scheme that has an intertemporal effect on the managerial incentives. Under the seniority system, the decision-maker of the firm is willing to give attention to both short- and long-term performances.

3.4 The possibility of multiple equilibria

In this subsection, we first describe the values of λ under which the firm can implement the trigger, the always-D, and the alternating strategies. Then, we show that the unique equilibrium is constituted by the always-C strategy if the value of λ is sufficiently large.

First, we describe the incentive compatibility conditions for the decision-maker to implement the always-D strategy. The condition under which choosing D is better than C when $r_{t-1} = G$ is

$$\begin{aligned}(1-\lambda)(1+g)+\delta\lambda\mu(1+g)-\delta\lambda > 1-\lambda+\delta\lambda(1-\varepsilon)(1+g)\\ \Leftrightarrow \lambda < \frac{g}{g+\delta(1+g)(1-\varepsilon-\mu)}. \qquad (9)\end{aligned}$$

Similarly, the condition under which choosing D is better than C when $r_{t-1} = B$ is

$$\begin{aligned}\delta\lambda\mu(1+g) > -(1-\lambda)\ell-\delta\lambda(1-\varepsilon)(1+g)\\ \Leftrightarrow \lambda < \frac{\ell}{\ell+\delta(1+g)(1-\varepsilon-\mu)}. \qquad (10)\end{aligned}$$

Under Assumption 1, we can conclude that the condition (10) is always satisfied if the condition (9) holds. Obviously, the participation constraints hold under the always-D strategy.

Next, we describe the incentive compatibility conditions for the decision-maker to implement the trigger strategy. The condition under which choosing C is better than D when $r_{t-1} = G$ is

$$\begin{aligned}1-\lambda+\delta\lambda(1-\varepsilon) > (1-\lambda)(1+g)+\delta\lambda\mu\\ \Leftrightarrow \lambda > \frac{g}{g+\delta(1-\varepsilon-\mu)}. \qquad (11)\end{aligned}$$

Similarly, the condition under which choosing D is better than C when $r_{t-1} = B$ is

$$\delta\lambda\mu > -(1-\lambda)\ell+\delta\lambda(1-\varepsilon)$$

$$\Leftrightarrow \lambda < \frac{\ell}{\ell + \delta(1-\varepsilon-\mu)}. \tag{12}$$

Under Assumption 1, we can choose the values of λ that satisfy the conditions (11) and (12). Obviously, the participation constraints hold under the always-*D* strategy.

Lastly, we describe the incentive compatibility conditions for the decision-maker to implement the alternating strategy. The condition under which choosing *D* is better than *C* when $r_{t-1} = G$ is

$$(1-\lambda)(1+g) + \delta\lambda\mu(1+g) - \delta\lambda(1-\mu)\ell > 1 - \lambda + \delta\lambda(1-\varepsilon)(1+g) - \delta\lambda\varepsilon\ell$$

$$\Leftrightarrow \lambda < \frac{g}{g + \delta(1-\varepsilon-\mu)(1+g+\ell)}. \tag{13}$$

Similarly, the condition under which choosing *C* is better than *D* when $r_{t-1} = B$ is

$$-(1-\lambda)\ell + \delta\lambda(1-\varepsilon)(1+g) - \delta\lambda\varepsilon\ell > \delta\lambda\mu(1+g) - \delta\lambda(1-\mu)\ell$$

$$\Leftrightarrow \lambda > \frac{\ell}{\ell + \delta(1-\varepsilon-\mu)(1+g+\ell)}. \tag{14}$$

Obviously, the conditions (13) and (14) are incompatible and therefore the firm cannot implement the alternating strategy under Assumption 1.

We will describe the relationship among the values of λ under which each strategy is implementable. The maximum value of λ that satisfy the condition (9) is less than the minimum value that satisfy the condition (11). The positional relationship between the minimum value of λ that satisfy the condition (8) and each of the threshold values is depending on the parameters. The relationships are depicted in Figure 2.

Therefore, we obtain the following.

Proposition 2. *The unique equilibrium is constituted by the always-C strategy,*[4] *if*

$$\lambda > \max\left\{\frac{\ell}{\ell + \delta(1-\varepsilon-\mu)}, \frac{\ell}{\ell + \delta(1-\varepsilon(1+\ell))}\right\}. \tag{15}$$

3.5 The firm can implement the optimal always-*C* strategy

Under sufficiently large values of λ, the firm can achieve the cooperative action profiles when the always-*C* strategy is the most profitable strategy for the firm.

Proposition 3. *The firm can implement the always-C strategy under a broader area in the (g, ℓ) plane, compared to the area under which the firm's optimal strategy is the always-C strategy.*

[4] If $\mu > (<) \varepsilon\ell$, $\frac{\ell}{\ell+\delta(1-\varepsilon-\mu)} > (<) \frac{\ell}{\ell+\delta(1-\varepsilon(1+\ell))}$.

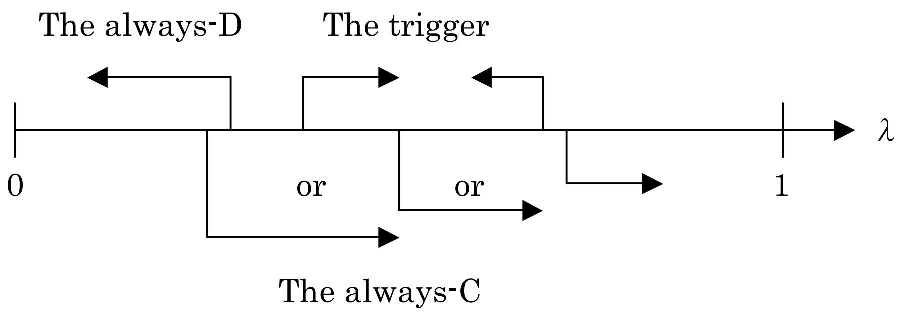

Figure 2: The always-C strategy constitute the unique equilibrium under sufficiently large values of λ

Proof. When $\lambda = 1$, the minimum value of ℓ that satisfy the condition (15) is $1/\varepsilon - 1$ and this relationship is equivalent to $\varepsilon < 1/(1+\ell)$ (i.e., Assumption 3). We can show that $1/\varepsilon - 1 > \delta(1-\varepsilon-\mu)/(1-\delta(1-\varepsilon-\mu))$ (See Figure 3). ∎

4 Conclusion

In this paper, we studied the situation where a firm 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. Here the seniority system means that the young generation person is the decision-maker of the firm 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.

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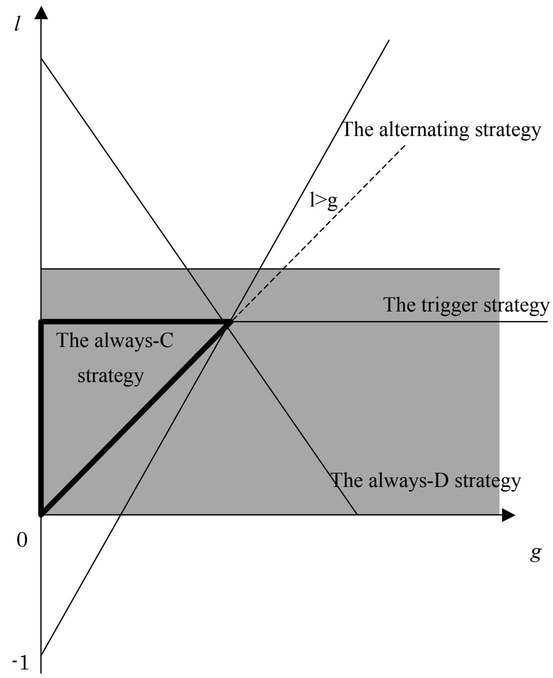

Figure 3: The region in which the always-*C* strategy is implementable

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