Promotion Policies and Distance to Frontier (very preliminary)

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Abstract

I develop an endogenous growth model where the equilibrium promotion policy of firms could change as an economy approaches to the world technology frontier. Prior to production, firms conduct a mission for productivity improvement undertaken by the lower layered employees. Both the good performance at this mission and the selection of high-ability manager are important for technological progress. There are two promotion policies for firms to select the manager. One is to promote the well performer at the lower layered mission. The other is to select a manager through an optional mission, where some agents are early selected and perform entrepreneurial activities instead of engaging in the lower layered mission. The former policy can encourage lower layered agent's activities but would result in a talent mismatch on the managerial position since essential skills and abilities vary between these two activities and good performance by lower layered employees is more important for adoption of the world frontier technology while high ability manager is for innovation. With the latter policy, firms can select suitable manager at the cost of the incentive of the lower layered employees. Closer to the world technology frontier, innovation becomes more important relative to adoption and firms would switch the promotion from the lower layer to the selection through the entrepreneurial mission. But the timing of switch by individual firms could be either earlier or later than the one from a social point of view and in an extreme case, there could exist a possibility that the switching is so late that the economy will be trapped in the undesirable promotion policy and fail to converge to the world technology frontier.

Keywords distance to frontier, promotion policy, economic growth, innovation, imitation, Peter principle, non-convergence trap, Japan.

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1 Introduction

When development economists and policy makers argue that "institutions matter for growth," we have to notice that there could be two quite contrasting types of underlying grounds to state so. Some calls for a "universal and sound" institutions which can enhance market trading. The other contrasting view that appropriate institutions depend on the development level of each economy and evolve as the economy catches up to the industrialized economy can be traced back to Gerschenkron (1962), which has been reduced to a formal economic model by Acemoglu, Aghion and Zilibotti (2003, 2006) and Zilibotti (2008), where they picked up the post-war experiences of Japan and Korea as remarkable examples that have achieved industrialization without adopting flexible, competition-oriented institutions that prevailed in Anglo-Saxon economies. The aim of this study is also to present a formalized view which is able to help us understand an institutional background of development experience, especially of post-war Japan.

Acemoglu, Aghion and Zilibotti (2006) and Aghion and Howitt (2009) argue that retaining old manager or financing old firms encourage long-term investment and imitation, whereas renewing managers from the low-skill olds to more talented youngs fosters innovation. In their view, it is considered that the post war Japan was able to achieve successful growth process with adopting appropriate institutional arrangement for imitation and catching up. This paper shares a common insight that selection of talented managers is important for more developed economy and Japan in the 21st century. However, while these preceding literatures regard a long-run relationships between firms and financial institutions or government as main engines of catching up process of Japan, I instead focus on the organizational arrangements inside the Japanese established enterprises, especially on its promotion policies.

A typical promotion policy of a Japanese firm is characterized by its "late promotion" compared with its contrasting counterpart, "fast track" which prevails in U.S. established enterprises. Non-owner managers of large established Japanese enterprises have their origins as the lower layered employees of each enterprise (internal promotion) and they are promoted to top position through a long term screening and competition process within a firm. Those researchers favorable to late promotion would argue that by devoting quite a long periods into screening of its employees, Japanese firms are finally able to have appropriate managers. On the other hand, so called

"Peter Principle"[1]; *in a hierarchy every employee tends to rise to his level of incompetence,* is tend to be more severe in Japanese firms. Abilities and skills necessary at the top of a hierarchy would be different from those of lower layered employees. Even though Japanese firms have been conducting careful and fair screening for promotion based on low layered employee's long term performance records, performance at the lower layer in a hierarchy may not reflect the abilities and skills essential for top management. But late and internal promotion of Japanese firms indeed contributed to promote the commitment of wide range of employees at the catching up stage of post war Japan.

In this paper, I develop an endogenous growth model where the equilibrium promotion policy of firms could change as an economy approaches to the world technology frontier. The model presented in this paper also builds on Acemoglu, Aghion and Zilibotti (2003, 2006). Growth-maximizing institutions or policies should evolve as a country catches up with the technological frontier. Therefore, as a country reaches closer to technological frontier, selecting talents becomes more important for growth. Prior to production, firms conduct a mission for productivity improvement undertaken by the lower layered employees. Both the good performance at this mission and the selection of high-ability manager are important for technological progress. There are two promotion policies for firms to select the manager. One is to promote the well performer at the low layered mission. This corresponds to the late promotion which is considered to prevail in Japanese firms. The other is to select a manager through an optional mission, where some agents are early selected and perform entrepreneurial activities instead of engaging in the low layered mission, which corresponds to so called fast track. The former policy can encourage the lower layered agent's commitment but would result in a talent mismatch on the managerial position since essential skills and abilities vary between these two activities and good performance by low layered employees is more important for adoption of the world frontier technology while high ability manager is for innovation. With the latter policy, firms can select suitable manager at the cost of the incentive of the low layered employees. Closer to the world technology frontier, innovation becomes more important relative to adoption and firms would switch the promotion from the low-layer to the selection through the entrepreneurial mission. But the timing of switch by individual firms could be either earlier or later from a societal point of view and in an extreme case, there could exist a possibility that the switching is so late that the economy

[1] See Peter and Hull (1969).

will be trapped in the undesirable promotion policy and fail to converge to the world technology frontier.

The rest of the paper is organized as follows. Section 2 introduces the model. Section 3 examines the merits and demerits of both promotion policies for individual firms and describes their static choice of promotion policies. Section 4 characterizes growth maximizing promotion policy from a social point of view. In section 5, I compare dynamic decentralized equilibrium with growth maximizing promotion policies adoption and argue the possibility of a convergence trap. Section 6 concludes the paper.

2 The Model

2.1 Agents and Production

The economy is populated by a continuum of non-overlapping generations of one-period lived risk-neutral agents. The population is constant and each generation consists of a mass 1 of capitalists who hold property rights over "production sites," and a mass $L > 4$ of workers, each of which is endowed with one unit of labor that she supplies inelastically. Workers can also engage in the missions conducted in each production site and/or employed as managers. They are heterogenous in the productivities in some missions and managerial activities which need each worker's entrepreneurial talent. We assume that each worker is a high-ability entrepreneur with probability λ and a low-ability entrepreneur with probability $1 - \lambda$.

A unique final output y, which serves as numeraire, is produced competitively using labor and a continuum one of intermediate inputs according to the following aggregate production function

$$y_t = \frac{1}{\alpha} L^{1-\alpha} \left(\int_0^1 A_t(\nu)^{1-\alpha} x_t(\nu)^{\alpha} d\nu \right), \tag{1}$$

where $A_t(\nu)$ is the productivity of the intermediate good in sector ν at time t, $x_t(\nu)$ is the amount of intermediate good ν used in the production of final good at time t, and $\alpha \in (0, 1)$.

In each intermediate sector, there is one capitalist with the production site which can produce the intermediate good with the most productive technology, where 1 unit of intermediate good with productivity $A_t(\nu)$ is produced using 1 unit of final good. The leading firm decides the productivity improvements of each intermediate good prior to the production of each period. But a fringe of additional firms can imitate this leading technology

to some extent and also produce an identical intermediate good with productivity $A_t(\nu)$ using less efficient technology. Fringe firms need $\chi \in (1, 1/\alpha)$ units of the final good to produce one unit of intermediate good. χ reflects technological factors as well as institutional and political conditions associated with the ease of entry. A higher χ corresponds to a larger barriers to entry or a less competitive market. The leading firm will have to charge a price at most lower than the marginal cost of the fringe firms χ in order to obtain a positive profit.

Since the final good sector is competitive, aggregate inverse demand for each intermediate input is derived from the final good technology in (1) and becomes to

$$p_t(\nu) = (A_t(\nu)L/x_t(\nu))^{1-\alpha}. \tag{2}$$

When without the fringe firms, facing to this demand schedule, leading firms would charge a monopoly profit maximizing price, $1/\alpha$. Therefore the condition that $\chi < 1/\alpha$ implies that the productivity behindness of the fringes is sufficient small that the existence of the fringes really becomes a binding condition which forces the leading firm to charge a limit price,

$$p_t(\nu) = \chi, \tag{3}$$

Substituting (3) into (2) yields equilibrium demands:

$$x_t(\nu) = \chi^{-1/(1-\alpha)} A_t(\nu)L \tag{4}$$

Equilibrium monopoly profits are therefore obtained as

$$\pi_t(\upsilon) = \delta A_t(\nu)L, \tag{5}$$

where $\delta \equiv (\chi - 1)\chi^{-1/(1-\alpha)}$ is a measure of the degree of monopoly power and monotonically increasing in χ. When δ is high, this implies a less competitive market and the equilibrium prices and monopoly profits of the leading firms are higher.

For the symmetricity among sectors, aggregate output is given as

$$y_t = \frac{\chi^{-1/(1-\alpha)}}{\alpha} A_t(\nu)L,$$

where

$$A_t \equiv \int_0^1 A_t(\upsilon)d\upsilon$$

is the average level of technology in the country at time t. The equilibrium wage level is equal to the marginal product of labor in the final good production:

$$w_t = (1-\alpha)\alpha^{-1}\chi^{-1/(1-\alpha)} A_t$$

2.2 Promotion Policies and Productivity Improvement

The productivities of leading intermediate firms, $A_t(\nu)$, are improved through the activities and decisions carried out within each firm in advance of production. First, at the beginning of each period, each firm employes two workers as the low layer level employees in its organization and make each worker engage in an activity to improve the firm's productivity. After this mission is over, each firm needs to appoint a manager on its top just prior to the production and the ability of the manager could also affect $A_t(\nu)$, but in a different way from the preceding activities performed by the employees.

Productivity progress within each firm is derived from two types of complementary processes; (i) imitation or adoption of the world frontier technology and (ii) innovation which builds upon the existing knowledge stock in the country, and the productivity of intermediate good ν at time t is formulated as the following linear function of the two components which respectively capture each dimension of productivity growth:

$$A_t(\upsilon) = \eta_t(\upsilon)\bar{A}_{t-1} + \gamma_t(\upsilon)A_{t-1}, \tag{6}$$

where $\bar{A}_{t-1}$ is the world productivity frontier at time $t-1$, which is assumed to grow at the constant rate g,

$$\bar{A}_t = (1+g)\bar{A}_{t-1}. \tag{7}$$

The country level average productivity at time $t-1$, A_{t-1}, represents the public knowledge stock of the country at time t and I will maintain throughout article that $A_t \leq \bar{A}_t$ for all t.

$\gamma_t(\upsilon)$ reflects the entrepreneurial ability of the appointed manager in sector ν at time t. Thus the term $\gamma_t(\upsilon)A_{t-1}$ stands for the component of productivity growth stemming from innovation and this captures the idea that entrepreneurial abilities of the managers are more important for innovation than imitation. For simplicity, we assume that $\gamma_t(\upsilon) = \gamma > 0$ when the entrepreneurial ability of the appointed manager is high and $\gamma_t(\upsilon) = 0$ when the ability is low.

On the other hand, the term $\eta_t(\upsilon)\bar{A}_{t-1}$ stands for the productivity growth by imitation from the world technology frontier and $\eta_t(\upsilon)$ captures the performance results of the activities performed by two lower layered employees. Hence this activities are referred to as *the mission for imitation*. In this mission, each lower layered employee is assigned to her own task and $\eta_t(\upsilon)$ is assumed to be just the average of the two variables which stand for the achievement result of each employee's task;

$$\eta_t(\upsilon) = \frac{\eta_{1t}(\upsilon) + \eta_{2t}(\upsilon)}{2}$$

where $\eta_{jt}(\upsilon)$ can take one of two possible values; $\bar{\eta}$ and $\underline{\eta} = \bar{\eta} - \eta > 0$ and how likely each value is to take place depends on the extent to which each employee commits herself to the firm. For simplicity, I assume that employees have two choices; providing efforts or not. $\eta_{jt}(\upsilon)$ will be $\bar{\eta}$ with probability 1 when worker j provides efforts. Otherwise, $\eta_{jt}(\upsilon)$ would be $\bar{\eta}$ only with probability $\sigma < 1$ and $\underline{\eta}$ with $1 - \sigma$. The tasks are independent of each other; the result of an employee's task does not depend on the other employee's effort choice and there are no other factors which make both results correlate. Providing efforts implies that employees commit themselves to their employers and it requires each employee to incur associated disutility, $e\bar{A}_{t-1}$, and efforts are each employee's private information. The mission for imitation thus involves a standard moral hazard problem.

There is a strict timing order between the mission for imitation and the appointment of manager, in the sense that the appointment of manager follows after the results of each employee's task have been completely revealed to all parties. I assume that the managerial position yields each worker a status benefit $b\bar{A}_{t-1}$, $b \geq 0$. As shown in the next section, by using this status benefit as a reward for the successful performer of the mission for imitation, firms can relax each employee's incentive constraint. If a firm commited to promote the employee who has performed most to the manager, it implies that the mission for imitation can be considered as a tournament for the managerial position and the status benefit works as a prize of the tournament. In order to induce the commitment of lower layered employees, firms need to reward each employee's success in some manners. Applying this tournament mechanism, firms can make each employee's incentive larger and save the pecuniary expenditures for rewards necessary to implement each employee's commitment. "Late promotion," which prevails in the established Japanese firms, can be regarded as a promotion policy in line with this concept.

Entrepreneurial abilities of workers are initially unknown to firms and how to find a worker with high entrepreneurial ability is also an important concern for each firm. However, since the types of employees are assumed to be irrelevant in the mission for imitation, the performance results of lower layered employees can no longer help firms find a better manager. For the purpose of selecting suitable manager, firms can conduct an optional mission in addition to the original mission for imitation. This optional mission also needs two workers and each worker undertakes a *project* which will generate either a positive or negative net present value to the firm. This mission is simultaneously conducted with the original mission for imitation and the result of a project, which depends on the worker's entrepreneurial ability and

the match quality between the worker and the firm, are revealed to the all parties (including even the agents outside the firm) before the appointment of the manager. For simplicity, I assume that a project will succeed with probability 1 when both the worker's entrepreneurial ability and the match quality are high and probability 0 otherwise, independent of the type of the worker engaging in another project. Project results thus serve as the complete signals about $\gamma_t(\nu)$ in the case of promoting each worker to the manager.

I assume that this *entrepreneurial mission* itself is neutral to firms in the sense that ex ante expected value of a project is 0[2]. This implies that this mission should be conducted based only on the selection motive. When a firm committed to promote one of the lower layered employees to the managerial position in order to induce their commitments, it is not worthwhile at all for the firm to hold additional entrepreneurial mission. On the other hand, if a firm gives up making the lower layered employees to provide efforts, the firms must apply the entrepreneurial mission. The promotion policy which makes use of the entrepreneurial mission to find a suitable manager corresponds to a "fast track" or "early selection" policy.

3 Static Equilibrium

The final profit of a leading firm ν at period t is represented as;

$$\delta A_t(\upsilon) - W_t(\upsilon) - S_t(\upsilon) \tag{8}$$

where $W_t(\upsilon)$ is the total amount of monetary payments paid to the employees who engaged in the low layered mission and $S_t(\upsilon)$ is the compensation for the manager.

3.1 Incentives in Low Layered Mission

First we will consider the low layered mission more precisely. Despite the effort exertions by each employee are private information, firms can build a payment schedule conditional on the mission's performance results. Since the performance results of each employee's task are independent of each

[2] With letting G and L denote the resulting gain and loss of a project, respectively, this is equivalent to assuming that

$$\mu\lambda G + (1 - \mu\lambda)L = 0.$$

other's effort, a contract for each employee can be contingent on only two states; success or failure of her own task. In addition, the prospect to be promoted to the manager can also affect each employee's incentives.

In general, in order to effectively induce agents to make efforts, firms would reward them for success and penalize them in the case of failure. Due to a limited liability condition of low layered employees, however, they can not be penalized with a negative wage owing to the failure of their task. Then it follows that owners of firms will optimally set the wage in the case of failure to 0. Then each employee's incentive problem is described as follows; efforts will be supplied when

$$w + E(s)b\bar{A}_{t-1} - e\bar{A}_{t-1} \geq \sigma\left(w + E(s)b\bar{A}_{t-1}\right) + (1-\sigma)E(f)b\bar{A}_{t-1}, \quad (9)$$

where w denotes the wage paid to the employee when her task resulted in success, $E(s)$ and $E(f)$ stand for the probabilities that the employee will be promoted to the manager on the condition that she has succeeded or failed, respectively. By supplying efforts, employees can increase the success probability of her task from σ to 1, while she has to incur associated effort costs, $e\bar{A}_{t-1}$. An employee will thus choose to supply efforts when her expected benefits of effort exceeds its costs.

I assume that when a firm chose a "fast track"; the conduction of the entrepreneurial mission to select a good manager, there is no chance for the low layered employees to be promoted to the managerial position. As shown later in more detail, there is a possibility that neither of the projects in the entrepreneurial mission has resulted in success, therefore the firm has to search for a new agent for its managerial position. I assume that even then, firms will hire the manager from outside the firm instead of promoting one of its own low-layered employees. Note that this implies that $E(s)$ and $E(f)$ can take a positive value only when firms have committed to the promotion from the low layer and otherwise $E(s) = E(f) = 0$ since low layered employees can not have any prospect to be promoted. If $E(s) = E(f) = 0$, the condition (9) is reduced to:

$$w + e\bar{A}_{t-1} \geq \sigma w,$$

and a firm has to reward its low layered employees for success with the pecuniary payments,

$$\bar{w} = \frac{e}{1-\sigma}\bar{A}_{t-1}.$$

Next I will study the case where a firm commit to the "late promotion"; the promotion of a low layered employee to the managerial position. Then

the condition (9) is reduced to:

$$(1-\sigma)\left(w+(E(s)-E(f))\,b\bar{A}_{t-1}\right)\geq e\bar{A}_{t-1}. \tag{10}$$

It is natural to consider that when the results of both employee's task are same, firms will randomly promote one of them and otherwise the successful employee will be promoted. Suppose that an employee expects that the other one will succeed with probability q. Then, the former employee expects;

$$E(s)=1-q/2$$

and

$$E(f)=(1-q)/2.$$

Since it follows that

$$E(s)-E(f)=\frac{1}{2}.$$

and the condition for the effort supplying equilibrium is obtained as follows:

$$(1-\sigma)\left(w+\frac{b}{2}\bar{A}_{t-1}\right)\geq e\bar{A}_{t-1},$$

and finally, the pecuniary reward necessary to implement each employee's efforts is given by the following formulation;

$$w^{*}=\max\left(\frac{e}{1-\sigma}-\frac{b}{2},0\right)\bar{A}_{t-1}$$

It is straightforward that the larger is the status benefit b, the smaller the necessary pecuniary reward to induce efforts. As shown in the following sections, firms are inclined to choose the late promotion with a larger b since it implies that the total costs of efforts induction, $W_t(\upsilon)$ accordingly becomes smaller. When a firm induces efforts, final profit of a firm is given by;

$$E\pi_t^I(\upsilon)=\delta\left(\bar{\eta}\bar{A}_{t-1}+\mu\lambda A_{t-1}\right)-2\max\left(\frac{e}{1-\sigma}-\frac{b}{2},0\right)\bar{A}_{t-1} \tag{11}$$

Here, to simplify the following analysis but without losing the model's essential characteristics, I put a condition on the value of parameter associated with the efforts costs, e.

Assumption

$$e>\frac{\bar{\delta}(1-\sigma)^2\eta}{2}$$

where $\bar{\delta}$ is the value of $\delta=(\chi-1)\chi^{-1/(1-\alpha)}$ when $\chi=1/\alpha$.

The assumption above implies that even in the case that a firm can exercise its full monopoly power in the intermediate good market, taking the expected ability of the manager as given and when $b = 0$, the benefits gained by inducing low layered employees to supply efforts, $\bar{\delta}(1-\sigma)\eta\bar{A}_{t-1}$ can not be more than its costs, $\frac{2e}{1-\sigma}\bar{A}_{t-1}$. This also ensures that when a firm chooses the fast track promotion, the firm must give up inducing the low layered employees to supply efforts since they can not anticipate to obtain a status benefit b at all.

3.2 Entrepreneurial Mission and Managerial Labor Market

Next I investigate the firms which conduct entrepreneurial missions and do not make use of the promotion as a prize to induce the low layered employees to supply efforts. If a firm conducts the entrepreneurial mission, there can be three types of possible outcomes. With probability $(\mu\lambda)^2$ both projects result in success and with probability $\mu\lambda(1-\mu\lambda)$, only one project succeeds. Thus, firms are able to find at least one suitable manager with probability $1-(1-\mu\lambda)^2$. Both projects result in failure with the rest probability $(1-\mu\lambda)^2$.

I have already assumed that even in this last case, firms never promote the low layered employees to the managerial position. Then such a firm seeks for a manager outside the firm. On the other hand, note that among the firms which have conducted the entrepreneurial mission, a fraction $\mu^2\lambda^2$ of firms hold multiple (two) workers which have been revealed at least to have high entrepreneurial ability. This implies that a market for managerial (entrepreneurial) talents can hold. Note that in this market, the supply side, managerial candidates with successful record at the entrepreneurial mission, are short side since I assumed that $\mu\lambda < 1/2$. It is natural to think that all the trade surplus between the demand and supply sides would belong to the supply side. Firms on the demand side have an option to employ a manager from the outside labor pool instead of hiring a manager from the managerial labor market. The profit of the firm which employed a manager from the outside labor pool is given by

$$A_t(v) = \left[\sigma\bar{\eta} + (1-\sigma)\underline{\eta}\right]\bar{A}_{t-1} + \mu\lambda\gamma A_{t-1}.$$

Therefore the trading surplus at the managerial labor market corresponds to $\mu(1-\lambda)\gamma A_{t-1} + b$ and the compensation to the managers employed from the managerial market becomes $\mu(1-\lambda)\gamma A_{t-1}$.

When a firm obtains multiple managerial candidates, it is natural to think that the firm obtains a complete monopsonic power and equilibrium

compensation is equivalent to the amount which prevails in the managerial labor market. In the case that a firm has only one successful candidate, this implies that the situation is of a bilateral monopoly. For simplicity, we assume that all the trading surplus between them, which amounts to $\delta\left(1-\mu\left(1-\lambda\right)\right)\gamma A_{t-1}$, belongs to the firm. These results are summed up in Table 1

	$E\gamma_t(\nu)A_{t-1}$	$S_t(\nu)$
both succeeded $(\mu\lambda)^2$	γA_{t-1}	$\mu\left(1-\lambda\right)\gamma A_{t-1}$
only one succeeded $\mu\lambda(1-\mu\lambda)$	γA_{t-1}	$\mu\left(1-\lambda\right)\gamma A_{t-1}$
hire from MLM $(1-\mu\lambda)^2\frac{(\mu\lambda)^2}{(1-\mu\lambda)^2}$	$\mu\gamma A_{t-1}$	$\mu\left(1-\lambda\right)\gamma A_{t-1}$
hire from outside LP $(1-\mu\lambda)^2\left[1-\frac{(\mu\lambda)^2}{(1-\mu\lambda)^2}\right]$	$\mu\lambda\gamma A_{t-1}$	0

Finally, the ex ante expected profit of the firm which applies the entrepreneurial mission is given by;

$$E\pi_t^E(\upsilon)=\delta\left\{\left[\sigma\bar{\eta}+(1-\sigma)\underline{\eta}\right]\bar{A}_{t-1}+\left[\left(1-(1-\mu\lambda)^2\right)(1-\mu)+\mu\lambda\right]\gamma A_{t-1}\right\} \tag{12}$$

3.3 Firm's Decision

Comparing (11) and (12), I can characterize firm's equilibrium promotion policy decision as a function of the country's distance to the technological frontier. Setting $E\pi_t^E(\upsilon)=E\pi_t^I(\upsilon)$ from (11) and (12), yields the critical threshold

$$a_r\equiv\max\left(\frac{\delta(1-\sigma)\eta-2\max\left(\frac{e}{1-\sigma}-\frac{b}{2},0\right)}{\delta\left(1-(1-\mu\lambda)^2\right)(1-\mu)\gamma},0\right).$$

Proposition 1 *For all $a<a_r$, firms make use of the promotion to the manager as a prize at the imitative mission, and for $a>a_r$, firms adopt innovative mission and participate in managerial labor market, if necessary.*

As explained later, the threshold a_r is typically less than 1, so that there will be a switch of the promotion policy before reaching the technology frontier.

4 Growth Maximizing Promotion Policy

The law of motion of the distance to frontier (a_t) is given by

$$a_t = \frac{1}{1+g}\left(\bar{\eta} + \mu\lambda\gamma a_{t-1}\right) \tag{13}$$

when the promotion from the low layered employees is adopted, and

$$\begin{aligned} a_t &= \frac{1}{1+g}\left\{\left[\sigma\bar{\eta} + (1-\sigma)\underline{\eta}\right]\right. \\ &\quad \left. + \left[\left(1-(1-\mu\lambda)^2\right)(1-\mu\lambda) + (\mu\lambda)^2(1-\lambda)\mu + \mu\lambda\right]\gamma a_{t-1}\right\} \end{aligned} \tag{14}$$

when the entrepreneurial mission is chosen and the managerial labor market becomes active. I assume that the world frontier economies are growing under the conduction of entrepreneurial missions. This implies that near the frontier, the maximum growth rate of the economy must be the same as that of the frontier, thus it must be hold that

$$1+g = \left[\sigma\bar{\eta} + (1-\sigma)\underline{\eta}\right] + \left[\left(1-(1-\mu\lambda)^2\right)(1-\mu\lambda) + (\mu\lambda)^2(1-\lambda)\mu + \mu\lambda\right]\gamma$$

Given this condition, equation (14) ensures that an economy with entrepreneurial mission always converges to the world technology frontier. On the other hand, I also assume that

$$\frac{\bar{\eta} + \mu\lambda\gamma}{\left[\sigma\bar{\eta} + (1-\sigma)\underline{\eta}\right] + \left[\left(1-(1-\mu\lambda)^2\right)(1-\mu\lambda) + (\mu\lambda)^2(1-\lambda)\mu + \mu\lambda\right]\gamma} < 1.$$

This is a condition to ensure that an economy with a late promotion can not converge to the frontier, and setting $a_t = a_{t-1}$ in equation (13), a fixed point is obtained;

$$\begin{aligned} & a_{Trap} \\ = & \frac{\bar{\eta}}{\left[\sigma\bar{\eta} + (1-\sigma)\underline{\eta}\right] + \left[\left(1-(1-\mu\lambda)^2\right)(1-\mu\lambda) + (\mu\lambda)^2(1-\lambda)\mu\right]\gamma} \end{aligned}$$

An economy which continues to adopt late promotion finally converges to a_{Trap} and it follows that there is a growth maximizing switching point with comparing (13) and (14);

$$\hat{a} \equiv \frac{(1-\sigma)\,\eta}{\left[\left(1-(1-\mu\lambda)^2\right)(1-\mu\lambda) + (\mu\lambda)^2(1-\lambda)\mu\right]\gamma}$$

It is straightforward that $\hat{a}$ is increasing in η and decreasing in γ. The relationships between equations (13) and (14) as well as between $\hat{a}$ and $\hat{a}$ are depicted in Figure 1.

5 Equilibrium Dynamics and Convergence Trap

Now the comparison between $\hat{a}$ and a_r leads to four types of dynamic equilibria.

[1] When $a_r = \hat{a}$; In this case, the economy can grow along the upper envelope of the equation (13) and (14).

In general a_r can not coincide with $\hat{a}$. This is due to the fact that firms never internalize all the social benefits from the conduction of each mission. Although the status benefit b indeed contributes to relax the incentive constraints of each lower layered employee, due to the limited liability condition of employee, firms have to share out the outcomes of the mission for imitation with lower layered employees, as the form of monetary reward. On the other hand, entrepreneurial missions conducted in each firm clearly generate positive externalities to the rest of the economy through workings of managerial labor market. In equilibrium where fast track prevails, some firms supply managerial talents to the others and the some of the externality benefits are shared by managers as the form of the compensation for them.

[2] When $a_r < \hat{a}$; the economy switches entrepreneurial mission (fast track) in the stage where the promotion from the lower layer (late promotion) is desirable.

This is the case when b is relatively small and Figure 2 depicts this type of equilibrium. In particular, in an extreme case such that $b = 0$, the economy can no longer experience the promotion from the lower layer ($a_r = 0$). Although the economy would adopt an inefficient promotion policy at its early development stage, the economy can finally converge to the world technological frontier.

[3] When $\hat{a} < a_r < a_{Trap}$.

In this case, the switching of promotion policy would delay compared to the efficient case. But the economy can switch out of the promotion from the lower layer before reaching a_{Trap}, and the economy can finally converge to the world technological frontier. Figure 3 depicts an equilibrium of this sort.

[4] When $a_r > a_{Trap}$.

This case is an extreme form of the case [3], where the equilibrium switching point a_r is not only larger than $\hat{a}$, but also exceeds a_{Trap}. An equilibrium of this case is depicted in Figure 4. The timing of decentralized switching to the adoption of entrepreneurial mission is so late that the promotion policy transition can never happen in the equilibrium. The economy in this case can also achieve a relatively faster growth at early stage of development. However, not only is growth reduced for $a_{t-1} < \hat{a}$, but also catching up process comes to halt at a_{Trap} and the economy is pushed into a non-convergence trap. This sort of equilibrium is likely to happen when the status benefit b is so large that firms have to incur little pecuniary costs to realize lower layered employee's commitment.

6 Conclusion and Discussion

In this paper, I presented an endogenous growth model where promotion policies of firms evolve with economic growth, and in turn, growth process is determined by the firm's policy choices. This study is highly inspired by the economic stagnation of Japan since 1980's and the model was built up to capture the following hypothesis.

Internal and late promotion policy which prevails in the Japanese firms was appropriate for the post-war Japan's economy to achieve a constant catching-up toward the frontier. Economic growth in relatively backward economy is associated with adoption or imitation of existing technologies. A late promotion policy succeeded in creating a desirable ground to implement efforts commitments of a wide range of stakeholders within a firm. And such a stakeholder's efforts would be driven to the adoption and imitation activities.

Although innovative decisions on the managerial position become more important than imitation as an economy reduces the gap to the frontier, late promotion policy has a drawback that it would fail to screen and/or foster the talents valuable for innovation. This is a typical application of the "Peter Principle"; late promotion tends to generate a mismatch of talent on the top of a hierarchy since the required abilities and skills necessary for lower layered stakeholder's activities and top management in charge of innovative decision makings are quite different and performance at the lower layered activities, on which the late promotion policy relies, would fail to reflect the entrepreneurial abilities of the employees.

In the model, firms have another option to select manager; *fast track* through the early selection of candidates and promotion of the agent with

a well performance at the entrepreneurial activities within the firm. With the model, I examined the gap between a growth maximizing promotion policies and those realized in a decentralized equilibrium. Since firms can not internalize all the benefits when determining individually optimal promotion policy, in general there exists some stages of development where the above two would not coincide. In particular, firms can not internalize some of the benefits of screening and/or fostering entrepreneurial managers which realized through the working of managerial labor market. One important conclusion of this study is that when the status benefit of managerial position is very large, firms would stick to late promotion policy even after the economy has approached the frontier enough, and there is a possibility that the economy stops converging before reaching the world frontier.

This conclusion implies that the Japan's economic slump since 1980's could be understood as such a trap of entrepreneurial talent selection. And there are some apparent evidences which can support the above view. First, there is no developed managerial labor market in Japan. Secondly, it is well acknowledged that the compensation payments for the managers of the Japanese established firms are quite low comparing to the those of U.S. managers. These are consistent with the equilibrium characteristics of the model when firms continue to choose late promotions. According to this argument, to restore a sustainable growth of Japan, it is required to get rid of the conditions hindering each firm switching their promotion policy. Since status benefit is a cultural parameter, however, it is difficult to influence it by ordinary economic policy tools and we have to apply an economic theory of endogenous cultural transmission for further understanding of it.

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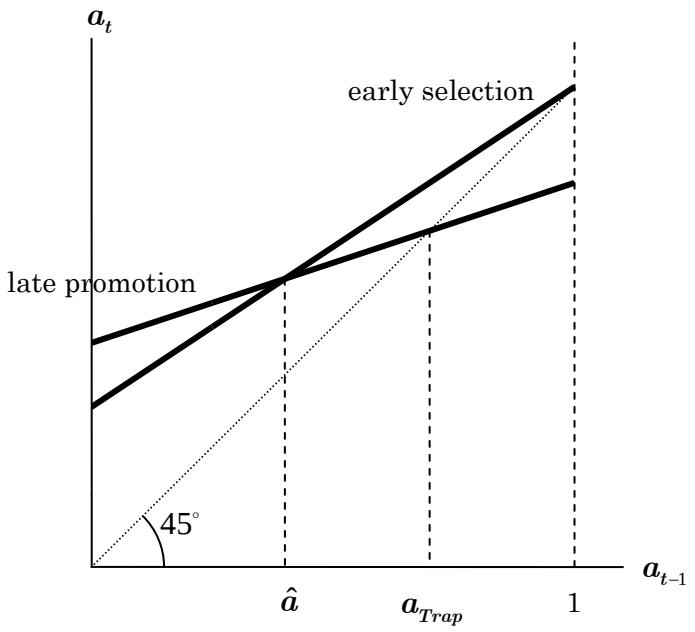

Figure 1

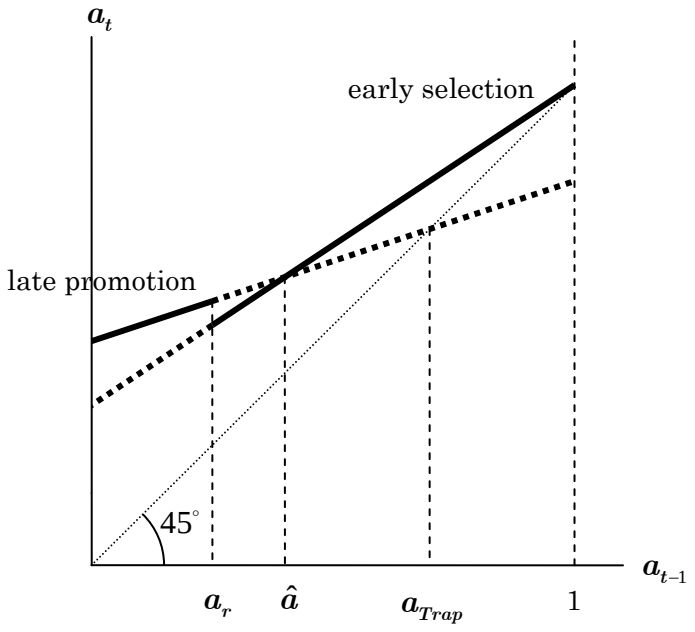

Figure 2

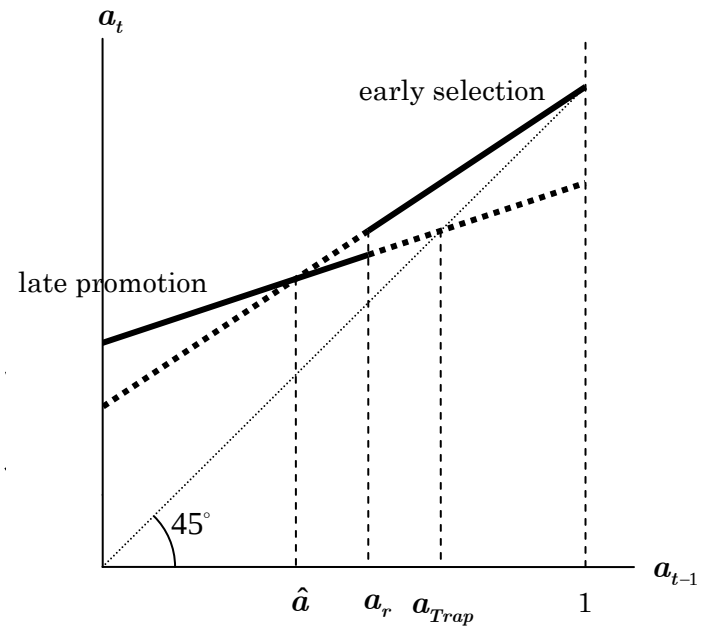

Figure 3

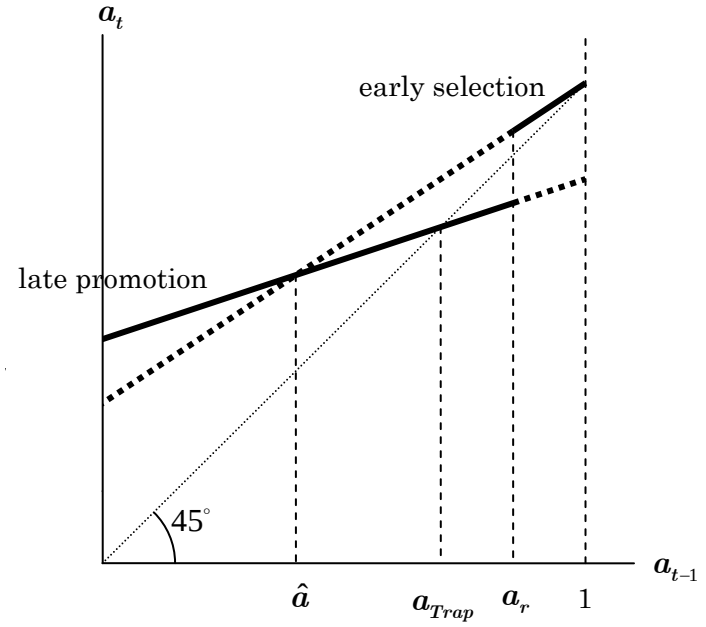

Figure 4