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The occurrence of potential complementarity and the Behavior of Bank-Coordinator and See Off Behavior

Nobuhiro Hobara
(Tokyo University of Social Welfare)

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Institute of Economic Research
Hitotsubashi University
Kunitachi, Tokyo, 186-8603 Japan

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Nobuhiro Hobara*

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Abstract

The effect of investment is often depends on tthe degree of the potential complementarity among industries. But we often find that the enterprise who are concerned with the investment can not find such a situation and the chance for the occurrence of the potential complementarity is not realized in vain. While, if bank behaves as coordinator among enterprises or the complementarity in industries, such a complementarity occurs and the social welfare could be improved. First, The present article studies the behavior of the bank as the coordinator and the occurrence of complementarity in economy with recognizing the rise of productivity as curatorial in two periods model. But, as the assets of enterprise also accumulate , enterprises get credit and get the needed fund only from market. Then, bank loses chance to get profit from cordination. So, in order not to lose the chance to get profit through their own operation, bank has incentive to see off the chance of profit on purpose. Next, we expand the two period model to many periods model and describe such a see off behavior of bank and argue the relationships among such a behavior, entrance of other banks and induce or deduce policy by tax or subsidies.

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*part time researcher E-mail: nohobara@ed.tokyo-fukushi.ac.jp nobuhiro.hobara@gmail.com

1 Introduction

Investment, which is important is for economy, is done by each firm. But the effect of investment is often depends on the complementary occurring among various industries or firms. Aghion and Howitt(1988) show that complementarity among various industries induces rapid economic growth. In fact, in rapid economic growth period of Japan, the introduction of oil make not only give strong electronic power but also various oil chemistry industries flourish,which contributes the rapid growth of Japanese economy.

Here, sometimes in order that such a complementarity occurs in economy, the certain scale of investment need to be done by each subject. Azariadis and Drazen (1990) exhibit the growth model, in which the productivity of human capital and growth rate are depend on the scale of investment by each individual. In rapid economic growth periods of Japan, many firms in the oil chemistry industry invest for construction of the certain scale of facilities, which contributes strong complementarity among industries and economic growth.

In order to describe the above situation, we consider the existence of potential complementarity among firms and if complementarity occur, the productivity and the growth rise. But we also assume whether the complementarity occur or not in economy depends on the scale of investment by each enterprise. If enterprise invest only below the certain scale, complementary does not occur.

Here, if all the fund needed for investment is not covered by the enterprise's wealth, enterprise must rent the fund from monetary market and so on. While,in monetary market, we often find that the scale of fund enterprise could rent depends on his own credit. So, we also must consider also relationship between complementarity and the credit in the monetary market. Hart and Moore(1984) assume that analyze relationship between the credit of enterprise and the scale of investment and show that the enterprise who have less wealth or less productivity could not rent the fund enough from monetary market.

So, in conjunction with Azariadis and Drazen (1990) , we also use the framework of Hart and Moore(1984) as tool analyzing relationship between the credit constraint of enterprise and the occurrence of complementarity. But we put weight to the productivity of enterprise more than wealth of enterprise as credit. Still more, in our model, the chance of the rise of productivity by occurrence of complementarity increase of the credit. In this way, we show mutual effect between the complementarity among industries and the credit in monetary economy.

Here, in market, where many subjects gathers, as each subjects may not find out such a complementarity or may be doubt if the other invest really till enough scale, each subject himself does not invest till level which give birth to complementarity. So, though economy has a chance of the rise of the productivity and growth rate by occurrence of complementarity, if the monetary transaction is done only in market, such a chance could not be realized.

While, if observer other than the subjects who invest exists and properly could find out such a potential complementarity and do proper ordination among enterprises, such a chance may be realized in economy. So, we assert that the existence of bank is needed in order to solve the problem of the occurrence of complementarity and the credit. The remainder of this paper is organized as follows. The second section describes the basic model describing the economy. The third section and the fourth section show the problem about complementary and assert the solution against such a problem,

2 The Model

There are many enterprises and stock holders in economy, both whose population are one[1]. Both can live for two periods and have utility function V.

$$V = c_0 + \frac{1}{R}c_1 \tag{1}$$

where c_0,R,c_1 respectively denote consumption in the zero period, time preference rate plus 1, the consumption in the first period. In the zero period, enterprises have wealth e_0 , while stock holders have wealth w_0 .

Each enterprise has his own investment project and ability to realize such a project. If enterprise has connect to his own project till last, the product function is shown as next.

$$y_1 = \alpha k_0 \tag{2}$$

where y_1,α,k_0,respectively,denote output in the first period, the productivity, investment in the zero period.

But, the project face two limited condition. First, if the enterprise does not connected to project till las as next show.

$$y_1 = \theta \alpha k_0 \tag{3}$$

Second, economy face two different economic situation, boom and rescission. In boom, economy has a chance that the productivity α rises. But such a chance is depended on the number of the enterprise which invest over the certain scale,$\bar{k}$[2].. While, in rescission, the productivity α remains constant. As each enterprise behave symmetrically here, the productivity α rises only when all enterprises invest over $\bar{k}$. At that time, the product function is shown as below.

[1]This setting is based on Hart and More (1984) and Kyotakli(1993)

[2]This setting is based on Azaridas and drawzen(1990)

$$y_1 = \alpha_H k_0 \tag{4}$$

While, in recession or when all the enterprise does not invest over $\overline{k}$ even in boom, the productivity α remains as below

$$y_1 = \alpha_L k_0 \tag{5}$$

The below relationship is also satisfied.

$$\alpha_H > \alpha_L \tag{6}$$

If the enterprise can not cover all the fund for his investment with his wealth e_0, he need to borrow the rest. We assume that there is a credit market in economy, where enterprise propose stockholder to rent the debt b_0 in the zero period and to return the debt plus interest rate back in first period. So, in zero period, stockholder decide how to distribute his wealth w_0 to consumption in the zero period c_0 and the credit b_0, based on his expectation about the equilibrium in the credit market, while, enterprises decide the sum of credit b_0 received and the scale of investment k_0 and get the output y_1 in the first period, based on his expectation, Their expectation include those about the productivity α, as α sometimes rises after investment.

In market,bargaining power operate enterprise that he stop investment project on the way if he get output stockholder that get output , otherwise he rely other enterprise

From the above argument, investment k_0 is the sum of the enterprise's wealth e_0 and the debt b_0 as below.

$$k_0 = e_0 + b_0 \tag{7}$$

The repayment of the debt plus interest rate rb_0 to the stockholder in the first period need to be covered by output $y_1 = \alpha k_0$ as below.

$$rb_0 < \theta \alpha k_0 \tag{8}$$

So, demand curve can be shown as below.(See Figure 1)

$$b_0 < \frac{\theta \alpha}{r - k\theta \alpha} e_0 \tag{9}$$

where the credit b_0 increase as productivity α and wealth of enterprise e_0 increase or the rate r decrease.

While, stockholder's decision about distribution of his wealth w_0 against c_0 and the credit b_0 is done by comparison R with r. When R is smaller than r, stockholder use all his wealth w_0 to consumption in the zero period. When R is bigger than r, he invest all his wealth w_0 to the credit b_0. So, the credit supply curve is drawn as below, which is kinked at $r = R$ (See Figure2)

The equilibrium is divided to the next three case. The case (1); the enterpriser asset e_0 is less relatively to asset of investor w_0 as below.

$$e_0 < \frac{R - \theta\alpha}{\theta\alpha} w_0 \tag{10}$$

The case (2); the enterpriser asset e_0 is abandoned relatively to asset of investor w_0 as below.

$$\frac{R - \theta\alpha}{\theta\alpha} w_0 < e_0 < \frac{1-\theta}{\theta} w_0 \tag{11}$$

The case (3); the enterpriser asset e_0 is more abandoned relatively to asset of investor w_0 as below.

$$e_0 > \frac{1-\theta}{\theta} w_0 \tag{12}$$

The case (3) is omitted in the below analysis.

The case(1) (See Figure 3) The demand curve and the supply curve are crossed at the horizon of supply curve. In equilibrium r is equal to R. Though the productivity α is over R and enterpriser want to rent more, all the wealth the w_0 is not invested and the credit b is limited as next.

$$b_0 = \frac{\theta\alpha}{R - \theta\alpha} w_0 \tag{13}$$

$$c_1 = (1-\theta)\alpha(e_0 + b_0 \tag{14}$$

So, economy does not enjoy social welfare.

The case(2) (See Figure 4) The demand curve and the supply curve are crossed at the axis of supply curve. The rate r in equilibrium is over time preference rate R and productivity α as below.

$$r = e_0 \frac{\theta\alpha}{w_0} + \theta\alpha \tag{15}$$

So, household invest all the wealth the w_0 to the credit b in the zero period without limitation as next.

$$b_0 = \frac{\theta\alpha}{r - \theta\alpha} e_0 = w_0 \tag{16}$$

In our model, though the productivity α rises, when the scale of the rise of the productivity α is small, the situation before and after investment are categorized into same Case. as well as Hart and Moore (1991) in which the productivity α remains constant.

3 strategic complementarity in the market and the importance of bank

But in our model, in boom and when the productivity α rises largely, different Case is realized from before investment. In our model, in boom, as the productivity α can rise, though the wealth of the enterprise e_0 is less and the credit b_0 is constrained (see Case 1 Figure 3) before investment, there is a chance that the productivity α rises after investment and all the wealth of the household w_0 is used for credit b_0 (see Case 2 Figure 4) .

We could grasp such a situation in Figure 5. Here, as enterprise wealth is e_0, the credit needed for investment over $\bar{k}$ is $\bar{k} - w_0$ Before the investment, as the wealth of enterprise e_0 is small and the productivity is low (α_L), the credit is less $b_0 < \bar{k} - w_0$ and the expected scale of the investment is below $\bar{k}$. While after investment or in the first period, if the productivity α rises (α_H), the credit $b_0 > \bar{k} - w_0$ in the equilibrium is abundant and the scale of the investment realized k_0 is over $\bar{k}$, so potential complementary occurs. and social welfare improve.

But notice that the rise of the productivity α is depended on the number of enterprises who invest over $\bar{k}$. So, unless all the stockholders and enterprise expect in the zero period that the productivity α rises and investment over $\bar{k}$ is done, such an investment is in fact not realized. If so, the rise of productivity α and the improvement of social welfare are not realized.

Here, there many stockholders and enterprises in market. So, every enterprise in the market does not always expect with confidence that all the other enterprises invest over $\bar{k}$, so he himself does not invest over $\bar{k}$. While, every stockholder in the market does not always expect with confidence that all the other stockholder invest all the wealth w_0 ,so he himself does not invest all the wealth w_0. So, if the money is transacted only in market, the chance of the rise of productivity could not be realized in economy.

In short, if the money is transacted only in market, we could have multiple equilibrium; the first equilibrium as like case 2, that all the enterprise and all the stockholder expect that the investment k_0 become over $\overline{k}$, all the wealth of the stockholder w_0 is used for the credit b_0 and the enterprise invest over $\overline{k}$ and the second equilibrium, as like case 1, that all the enterprise expect that the credit b_0 become under $\overline{k}$ and all the enterprise invest under $\overline{k}$

4 The roll of Bank on the occurance of the complementarity

Note that r rises with the rise of productivity α. So, if an observer other than the enterprises(such as a bank)exists in an economy and identifies such a difference in r as the profit margin and behave as a coordinator among enterprises, the multiple-equilibria problem may be solved. In addition, we assume that $1-n$ number of firms, do not invest but act as intermediaries among enterprises, the number of enterprises who invest is n. Under such an assumption, for example, the observer or coordinator (bank)proposes that stockholder lend some of their wealthw_0 in the zero period on the condition that the coordinator pay it back at$(R+\varepsilon)w_0$,which is$w_0$times by the rate of time preference Rplus premium for the stockholder $\varepsilon > R$ with certainty if the they accept the proposal. Because the multiple-equribria problem exists only in market. stockholders do not expect with certainty that $r > R$ is realized only in the market.[3].

Therefore, through such behavior by the observer or conditioner (bank), the needed credit Is realized, investment $\overline{k}$is done, and $r > R$ is realized in equilibrium as follower;

$$r_H = e_0 \frac{\theta \alpha_H(n)}{\omega_0} + \theta \alpha_H(n) \tag{17}$$

where n is the number of enterprises who invest over $\overline{k}$ Here, as n increases, productivityα and interest$r$ increase. As a result, creditb_0 sometimes becomes limitless(as in Case2) after investment, although it remains limited(as in Case1).before investment. Therefore, an enterprise could lend all the wealth of household as

[3]If we use a more complicated model that includes probabity decision, we could state with accuracy that investment by stockholder are decided w_0 see Hart and More 1984 is based on Hart and More (1984) and Kyotakli(1993)

credit($b_0 = w_0$) for investment, and investment —$\bar{k}$ is done. Complementarity occurs, and social welfare is improved. Next we consider the economic distribution of each subject and compare social welfare when bank is at work with when bank is not at work. We consider the effect of the operation of bank.We assume that the operation cost of each bank is zero for simplicity. Under this setting, we obtain the profits of all banks, consumption of the enterprises and consumption of the stockholder in the first period when bank is at work are the left-sides of inequality in the below equations. However, the right-sides of inequality in the equations indicate the sum of distribution of each subject(including consumption of stockholder in the zero period)without the bank or only in the market.

$$\pi_b = (r - \varepsilon)W_0 = (e_0 \frac{\alpha_H(n)}{\omega_0} + \theta \alpha_H(n) - \varepsilon)W_0 > 0 \tag{18}$$

$$c_{e1}^{b} = (1 - \theta)\alpha_H(e_0 - w_0)c_{e1}^{m} \tag{19}$$

$$c_{s1}^{b} = (R + \varepsilon)w_0 > c_{s1}^{m} + c_{s0}^{m} = Rb_0 + (w_0 - b_0) \tag{20}$$

In short, we find that by including the bank, the welfare of all the subjects improve, which could not be attained only in the market. We demonstrate the importance of banks for strategic complementarity.

5. Many periods model and the disappearance of roll of bank

We find out that the project of enterprise can be carried out and both the utility of enterprise and stockholder are improved through the operation of bank, though enterprise cannot collect the fund needed for his project from the market.

Here, though the assets of enterprise is constant and the difference between abandom wealth of enterprise case (see case1 Figure 3) and small wealth of enterprise (see case2 Figure4) is also constant in two period model , in many period model, the enterprise face the high productivity multiple times and the asset of enterprise accumulate, which make his credit increase and enterprise can collect the needed fund only from market after after some periods, though enterprise cannot collect the needed fund without the operation of bank in first period (Figure 12,)

- We describe such a change in situation through the accumulation of the asset of enterprise in many periods model. In order to do so, we change the previous assumption.

（１） in order to focus on the role of bank, we omit (Figure 11) , the case that the asset of enterprise in the first period, E_0 is abandoned and enterprise collect the needed fund for project only from market and there is not room for the operation of bank in first period.

（２） First, we assume that period means term unit when (high or low) productivity realize.

Next, in each period, productivity of enterprise α is not constant but can take two value; high productivity e^{α_H} or low productivity e^{α_L} in each period, where *e* is the boot of natural logarithm. The high productivity e^{α_H} realizes according to Poisson distribution with parameter *λ*.

Here, it is assumed that we call high productivity case when the productivity of enterprise potentially may be so high that the supply curve crosses the demand curve at vertical part of the supply curve and the bequest of enterprise and stockholder is over the needed investment and the enterprise can collect the needed fund for his project from market.

Otherwise, it is assumed that we call low productivity case.that the supply curve cross the demand curve at the horizon part of the supply curve.

But, so that such a potential high productivity is realized it is necessary that, besides such a potential high productivity event occur at probability λ , the needed fund for realize such a potential high productivity is carried out.

So, when the needed fund cannot be collected even if economy has the potential of high productivity, high productivity is not realized, which become to be similar to low productivity case.

As subjects can expect the occurrence of high potential productivity not certainly but probability potential high productivity is realized only by the operation of bank. While,if the arrival of high productivity occur and

So,the condition for the realization of high productivity e^{α_H} is (1)the high productivity e^{α_H} occurs with poison distribution (2) the scale of investment is really invested period means term unit when high or low productivity come

However, we assume that the high productivity e^{α_H} does not realise in the first period.

（３）

Third, the threshold which is needed investment for project is not constant but change as time goes and is shown as the below.

$$\overline{K}_n = e^{sn} K_0^* \qquad (20)$$

The accumulation of the bequest(asset)of enterprise and stockholder the supply curve and the demand curve moves through the accumulation of assets (bequest) of enterprise and stockholder in dynamic or numerous periods model. by which the credit for the enterprise increase and the demand curve uprises and the enterprise can get more fund from market. While, as the assets(bequest) of stockholder accumulate, so high productivity has to occur that all the assets(bequests) of enterprise and stockholder is turned for project of enterprise in economy in order to use assets (bequests) efficiently.

（４）Of cause, as the accumulation of the assets(bequests) of enterprise and stockholder is allowed, even in the case of low productivity, the bequest(investment)of enterprise and stockholder $E_n + B_n$ is sometimes over the needed fund $\overline{K}_n$. Then only if the occurrence of high productivity come, enterprise enjoy both getting the high productivity and collecting the need fund only from market.

(5) we assumed that all the capital invested for project is consumed and all the output is distributed into stockholder an enterprise. So the capital should once more time be invested be for project in next time.

Bank should pay c monitoring cost in each period get profit from the project of enterprise and distribute all the profit into enterprise and stockholder according to parameter θ

Under revised assumption, we model numerous model.

We assume that in economy, there are numerous periods and there are many enterprises and stockholders. their population is one. both live in two periods. We assume that enterprise have wealth E_0 in the first period and stockholder have as wealth B_0 in the first period and stockholder in the n period get utility from consumption in n -first-period $C_{n,1}$and bequest in n -second-period $B_{n,2}$ and have the utility function as the below.

$$V_n = C_{n,1} + \frac{1}{R} B_{n,2} \qquad (21)$$

Where the former of suffix show generation period and the latter of suffix show the former(one) part of each period when stockholder consume or latter(second)part of each period when stockholder leave the bequest to the next period.
Similarly, enterprise in the n period get utility from consumption in n-first-period $C_{n,1}$and bequest in n-second-period $E_{n,2}$ and have the utility function as the below.

$$V_n = C_{n,1} + \frac{1}{R} E_{n,2} \qquad (22)$$

where R is time preference+*1*. The stockholder in the n period distribute the bequest $B_{n-1,2}$which stockholder left into consumption C_{n1} and bequest $B_{n.}$ Here bequest B_n leave directly to stockholder in the n+1 period as the below.

$$B_{n-1,2} = C_{n,1} + B_n$$

(23)

Similarly, enterprise in the n period distribute the bequest left by enteprise in the n-1 period $E_{n-1,2}$ into consumption C_{n1} and bequest $E_{n.}$ Here bequest B_n leave directly to stockholder in the n+1 period as the below.

$$E_{n-1,2} = C_{n,1} + E_n \qquad (24)$$

however, the bequest of stockholder in the n period, B_n is invested for project indirectly through bank or directly through market. So, rB_n which B_n multiply return r; as $B_{n,2}$ is left to the enterprise in the next period n+1 period as shown as below.

$$rB_n = B_{n,2} = C_{n+1,1} + B_{n+1} \qquad (25)$$

Simmirally, the bequest of enterprise in the n period, E_n is invested for project indirectly through bank or directly through market. So, $r'E_n$ which $E_n$multiply return r', as $E_{n,2}$ is left to the enterprise in the next period n+1 period as shown as below.

$$r'E_n = E_{n,2} = C_{n+1,1} + E_{n+1} \qquad (26)$$

From the fugure of the utility function, when the return r or $r'$is over R , enterprise and stockholder use not consumption $C_{n,1}$ but bequest from the improvement of utility similiter to the previous session so, the demand curve is kinked at $r= R$ similar to the previous session. However here the investment by stockholder make the bequest to the next periods. The form of supply function is kinked at $r=R$.however here investment for project

However stockholder or enterprise invest his own assets into propject of enterprise, whose returns is used by not consumption in the next period but bequest.

As enterprise should pay the principal and return to stockholder from the output of himself, the credit for the enterprise B_n is constrained as the next.

$$B_n \le \frac{\theta\alpha}{r-\theta\alpha} E_{n-1,2} \tag{27}$$

However productivity α can take e^{α_H} or e^{α_L} according to passion distribution

（1） in the low productivity case

The investment of enterprise in *n* period, B_n is constrained by the bequest of enterprise as shown as next.

$$B_n = \frac{\theta e^{\alpha_L}}{R-\theta e^{\alpha_L}} E_{n-1,2}$$

(28)

Then the total investment K_n is shown as the below.

$$K_n = E_n + B_n = E_{n-1,2} + \frac{\theta e^{\alpha_L}}{R-\theta e^{\alpha_L}} E_{n-1,2} = \left(1+\frac{\theta e^{\alpha_L}}{R-\theta e^{\alpha_L}}\right) E_{n-1,2}$$

(29)

Then the production is shown as the below.

$$y_n = e^{\alpha_L}(E_n + B_n) = e^{\alpha_L}\left(1+\frac{\theta e^{\alpha_L}}{R-\theta e^{\alpha_L}}\right) E_{n-1,2} \tag{30}$$

This production is distributed into enterprise and stockholder as the below.

$$E_{n,2} = (1-\theta) y_n = (1-\theta) e^{\alpha_L}\left(1+\frac{\theta e^{\alpha_L}}{R-\theta e^{\alpha_L}}\right) E_{n-1,2} \tag{31}$$

$$B_{n,2} = \theta y_n = \theta e^{\alpha_L}\left(1+\frac{\theta\alpha}{R-\theta\alpha}\right) E_{n-1,2} \tag{32}$$

Here, both the bequest of enterprise and the bequest of stockholders depend on bequest of enterprise in the previous period. So, when we consider the bequest of enterprise and the bequest of stockholders, we have only to notice bequest of enterprise in the previous period, $E_{n-1,2}$.

（2） In case of high productivity (Figure14)

As till total investment $E_n + B_n$ is over the needed fund, $\overline{K}_n$ bank act for the sake of the profit

Through the operation of bank, all the assets(bequest)is distributed into investment for project of enterprise, the total investment for the project of enterprise K_n shown as the below.

$$K_n = E_n + B_n = E_{n-1,2} + B_{n-1,2} \tag{33}$$

Then output is shown as the below.

$$y_n = e^{\alpha_H}(E_n + B_n) = e^{\alpha_H}\left(E_{n-1,2} + B_{n-1,2}\right) \tag{34}$$

This output is distributed into enterprise and stockholder and form each bequest of enterprise and stockholder as the below.

$$E_{n,2} = (1-\theta)y_n = (1-\theta)e^{\alpha_H}(E_{n-1,2} + B_{n-1,2}) \tag{35}$$

$$B_{n,2} = \theta y_n = \theta e^{\alpha_H}(E_{n-1,2} + B_{n-1,2}) \tag{36}$$

（3） Introduction of The ;period when enterprise can collect the needed fund for high productivity only from market.

As high production e^{α_H} occur according to poisson distribution with λ and does not occur in the first period and the asset of enterprise is given as E_0 we can show the bequest of enterprise in the n period is shown as the next.

$$E_{n,2} = \left[\left(e^{\alpha H}\right)^{n\lambda}\left((1-\theta)e^{\alpha L}\left(1+\frac{\theta e^{\alpha L}}{R-\theta e^{\alpha L}}\right)\right)^{n(1-\lambda)}\right]E_0 \tag{37}$$

We also consider (28)and (29)and we can show the sum of bequest of enterprise and the bequest of stockholder in the n period, $E_{n+1} + B_{n+1}$ is shown as next.

$$B_{n+1} + E_{n+1} = \left(\left(1+\frac{\theta e^{\alpha L}}{R-\theta e^{\alpha L}}\right)\right)\left[\left(e^{\alpha H}\right)^{n\lambda}\left((1-\theta)e^{\alpha L}\left(1+\frac{\theta e^{\alpha L}}{R-\theta e^{\alpha L}}\right)\right)^{n(1-\lambda)}\right]E_0 \tag{38}$$

If $E_{n+1} + B_{n+1}$ is over the needed investment for the project $\overline{K}_n$, enterprise can get the needed fund for project only from market. We can get this period n*through the relationship where the sum of bequest of enterprise and bequest of stockholder $E_{n+1} + B_{n+1}$ equal with needed fund attain which attain at that time as the next.

$$B_{n^*+1} + E_{n^*+1} = \left(\left(1+\frac{\theta e^{\alpha L}}{R-\theta e^{\alpha L}}\right)\right)\left[\left(e^{\alpha H}\right)^{n^*\lambda}\left((1-\theta)e^{\alpha L}\left(1+\frac{\theta e^{\alpha L}}{R-\theta e^{\alpha L}}\right)\right)^{n^*(1-\lambda)}\right]E_0 \tag{39}$$
$$= \overline{K}_n = e^{s(n^*+1)}K_0$$

Then we log the above equation and get the below equation.

$$\log_e R - \log_e (R - \theta e^{\alpha_L}) + n^* \alpha_H \lambda + n^* \alpha_L (1-\lambda)$$
$$+ n^* (1-\lambda) \log_e (1-\theta) + n^* (1-\lambda) \log_e R - n^* (1-\lambda) \log_e (R - \theta e^{\alpha_L}) + \log_e E_0$$
$$= s(n^*+1) + \log_e K_0$$

(40)

We solve this equation about n^* and get the period when bank cannot get the profit as the below.

$$n^* = \frac{\log_e (R - \theta e^{\alpha_L}) - \log_e R - \log_e E_0 + s + \log_e K_0}{\alpha_H \lambda + \alpha_L (1-\lambda) + (1-\lambda) \log_e (1-\theta) + (1-\lambda) \log_e R - (1-\lambda) \log_e (R - \theta e^{\alpha_L}) - s}$$

(41)

This period n^* exists if denominator and numerator of the right side of this equation are plus as the below.

$$s + \log_e K_0 > -\log_e (R - \theta e^{\alpha_L}) + \log_e R + \log_e E_0 \quad (42)$$

$$\alpha_H \lambda + \alpha_L (1-\lambda) + (1-\lambda) \log_e (1-\theta) + (1-\lambda) \log_e R - (1-\lambda) \log_e (R - \theta e^{\alpha_L}) > s$$

(43)

(42) means that the needed fund for high productivity in the first period, K_0 is large. (43) means that the parameter of productivity is large than the parameter about the increase of the needed investment

We differentiate this equation about n^* by probability λ which is probability about occurrence of the high productivity and get the below.

$$\frac{\partial n^*}{\partial \lambda} = \frac{\left[-\alpha_H + \alpha_L + \log_e (1-\theta) + \log_e R - \log_e (R - \theta e^{\alpha_L})\right] \times \left[\log_e (R - \theta e^{\alpha_L}) - \log_e R - \log_e E_0 + s + \log_e K_0\right]}{\left[\alpha_H \lambda + \alpha_L (1-\lambda) + \log_e (1-\theta) + (1-\lambda) \log_e R - (1-\lambda) \log_e (R - \theta e^{\alpha_L}) - s\right]^2}$$

(44)

Here we find that, when the high productivity e^{α_H} is large, the period n^* when the bank become to be able to get profit is shorter as the probability λ increase.

$$\alpha_H \lambda + \log_e (R - \theta e^{\alpha_L}) > \alpha_L + \log_e (1-\theta) + \log_e R \quad (45)$$

While, when the low productivity e^{α_H} is also relatively large and the bargaining power of enterprise against enterprise $1-\theta$ is large, the period n^* when the bank become to be able to get profit is longer as the probability λ increase.

$$\alpha_H \lambda + \log_e (R - \theta e^{\alpha_L}) < \alpha_L + \log_e (1-\theta) + \log_e R \quad (46)$$

Moreover, we differentiate the period n*by the parameter about the specialty of the enterprise's project or bargaining power about distribution between enterprise and stockholder θ and get the below result.

$$\frac{\partial n^*}{\partial \theta}=\frac{\begin{array}{l}\frac{1}{R-\theta e^{\alpha_L}}\times(-e^{\alpha_L})\times\begin{bmatrix}\alpha_H\lambda+\alpha_L(1-\lambda)+(1-\lambda)\log_e(1-\theta)+(1-\lambda)\log_e R\\-(1-\lambda)\log_e(R-\theta e^{\alpha_L})-s\end{bmatrix}\\+\left[\frac{1-\lambda}{1-\theta}+\frac{1-\lambda}{R-\theta e^{\alpha_L}}\times(-e^{\alpha_L})\right]\times\begin{bmatrix}\log_e(R-\theta e^{\alpha_L})-\log_e R-\log_e E_0+s\\+\log_e K_0\end{bmatrix}\end{array}}{\left[\alpha_H\lambda+\alpha_L(1-\lambda)+(1-\lambda)\log_e(1-\theta)+(1-\lambda)\log_e R-(1-\lambda)\log_e(R-\theta e^{\alpha_L})-s\right]^2}$$

(47)

The value of the period n*is depended on the parameter about bargaining power about distribution between enterprise and stockholder . Moreover, we put $G(\theta)$ on the numerator of the above equation and put $G(\theta^*)$ on the below

$$G(\theta^*)\equiv\frac{1}{R-\theta^* e^{\alpha_L}}\times(-e^{\alpha_L})\times\begin{bmatrix}\alpha_H\lambda+\alpha_L(1-\lambda)+(1-\lambda)\log_e(1-\theta^*)+(1-\lambda)\log_e R\\-(1-\lambda)\log_e(R-\theta^* e^{\alpha_L})-s\end{bmatrix}$$
$$+\left[\frac{1-\lambda}{1-\theta^*}+\frac{1-\lambda}{R-\theta^* e^{\alpha_L}}\times(-e^{\alpha_L})\right]\times\begin{bmatrix}\log_e(R-\theta^* e^{\alpha_L})-\log_e R-\log_e E_0+s\\+\log_e K_0\end{bmatrix}=0$$

(48)

This means that, when $G(\theta)>G(\theta*)$ is satisfied, the period n* is shorter as θ increas.while, when $G(\theta)>G(\theta*)$ is not satisfied, the period n* is larger as θ increase.

6. See Off behavior of Bank

Bank lose the chance to get profit if the period when the both bequest of enterprise and stockholder is over the needed fund for project. The coordinator of the bank contribute the disappearance of the chance for bank themselves while bank get the profit as well as the profit of bank

In order to do so, we should also consider what kind of behavior bank.

First, we consider the sum of the profit of the bank in the n*period.

The assumption that high productivity occurs with λ means that in each1/λperiod,the high productivity occurs and $n^*\lambda$ times in total n* periods. So,we can show the profit of the bank in the period t （<$n^*\lambda$）（t=1, 2, …, $n^*\lambda$） as the below.

$$\pi_t=\left(E_t\frac{\theta e^{\alpha_H}}{B_t}+\theta e^{\alpha_H}-\varphi-R-\varepsilon\right)B_t \tag{49}$$

where B_t is assumed to be investment(bequest) of the stockholder in the t （<$n^*\lambda$）（t=1, 2, …, $n^*\lambda$） period$t$ （<$n^*\lambda$）（t=1, 2, …, $n^*\lambda$）, E_t is assumed to be investment(bequest) of the enterprise in the t （$<n*\lambda$）（t=1, 2, …, $n*\lambda$） period . As $E_{n+1}+B_{n+1}$ reflect the accumulation of the bequest of enterprise and stockholder till this period

Here, as chance of high productivity occur according to Possession distribution with λ, we can note (t-1) λperiod as the period one before chance of high productivity in the $t\,\lambda$ period.

and between these two periods when bank get the chance to get profit, there are 1/λ-1periods when low productivity realize.

So, we can show the relationship between two the bequests of enterprise in the (t-1) λ period $E_{t\lambda-1,2}$

and the bequests of enterprise in the (t-1) λ period $E_{(t-1)\lambda,2}$ when high productivity realize and bank get profit as the below.

$$E_{t\lambda-1,2}=\left[\left((1-\theta)e^{\alpha L}\left(1+\frac{\theta e^{\alpha_L}}{R-\theta e^{\alpha_L}}\right)\right)^{\left(\frac{1}{\lambda}-1\right)}\right]E_{(t-1)\lambda,2} \tag{50}$$

So, we can show the bequest of stockholder in the （$t\lambda$-1） period $B_{t\lambda-1,2}$ as the below.

$$B_{t\lambda-1,2}=\theta(1-\theta)^{\left(\frac{1}{\lambda}-2\right)}\left[\left(e^{\alpha L}\left(1+\frac{\theta e^{\alpha_L}}{R-\theta e^{\alpha_L}}\right)\right)^{\left(\frac{1}{\lambda}-1\right)}\right]E_{\lambda(t-1),2} \tag{51}$$

Moreover,we also consider the equation （35）, we can show the relationship between the bequest of enterprise in the t-1 period and the bequest of enterprise in the (t-1) λ period $E_{(t-1)\lambda,2}$ and the bequest of enterprise the as the λ (t-2), $E_{\lambda(t-2),2}$

$$E_{(t-1)\lambda,2}=\left\{\left[e^{\alpha_H}\right]\left[\left((1-\theta)e^{\alpha L}\left(1+\frac{\theta e^{\alpha_L}}{R-\theta e^{\alpha_L}}\right)\right)^{\left(\frac{1}{\lambda}-1\right)}\right]E_{\lambda(t-2),2}\right\} \tag{52}$$

Here, the degree on the the second prothesis（1/λ- 1 ）means that low productivity occur （1/λ- 1 ） times during two high productivity. So we can show the relationship between two periods, the t-1 period of high productivity and the t period of high productivity we can show the relationship between the bequest of enterprise in the $t$period and the bequest of enterprise in the zero period as show next.

$$E_{(t-1)\lambda,2}=\left\{\left[e^{\alpha_H}\right]^t\left[\left((1-\theta)e^{\alpha L}\left(1+\frac{\theta e^{\alpha_L}}{R-\theta e^{\alpha_L}}\right)\right)^{t\left(\frac{1}{\lambda}-1\right)}\right]E_0\right\}$$

(53)

As all the bequest is turned into investment for the project of enterprise through the operation of bank in the period of high productivity and we can change the above equation into the below.

$$E_{t\lambda}=\left[\left((1-\theta)e^{\alpha L}\left(1+\frac{\theta e^{\alpha_L}}{R-\theta e^{\alpha_L}}\right)\right)^{\left(\frac{1}{\lambda}-1\right)}\right]$$
$$\times\left\{\left[e^{\alpha_H}\right]^{t-1}\left[\left((1-\theta)e^{\alpha L}\left(1+\frac{\theta e^{\alpha_L}}{R-\theta e^{\alpha_L}}\right)\right)^{(t-1)\left(\frac{1}{\lambda}-1\right)}\right]E_0\right\}$$

(54)

Simillally, we can show the relationship between the bequest of stockholder in the period *t* and the bequest of enterprise in the period t as show next.

$$B_{t\lambda}=\theta(1-\theta)^{\left(\frac{1}{\lambda}-2\right)}\left[\left(e^{\alpha L}\left(1+\frac{\theta e^{\alpha_L}}{R-\theta e^{\alpha_L}}\right)\right)^{\left(\frac{1}{\lambda}-1\right)}\right]$$
$$\times\left\{\left[e^{\alpha_H}\right]^{t-1}\left[\left((1-\theta)e^{\alpha L}\left(1+\frac{\theta e^{\alpha_L}}{R-\theta e^{\alpha_L}}\right)\right)^{(t-1)\left(\frac{1}{\lambda}-1\right)}\right]E_0\right\}$$

(55)

As acording to we can show the revenue of bank in each period and sum the revenue, we summarize the revenue π_t from $t=1$to $t=n^*\lambda$ and the sum of the revenue of the bank from $t=1$to $t=n^*\lambda$ as next.

$$\sum_{t=1}^{n}\pi_t=\sum_{t=1}^{n}\left(E_{t\lambda}\frac{\theta e^{\alpha_H}}{B_{t\lambda}}+\theta e^{\alpha_L}-\varphi-R-\varepsilon\right)B_{t\lambda}=\sum_{t=1}^{n}\left[\theta e^{\alpha_H}E_{t\lambda}+(\theta e^{\alpha_L}-\varphi-R-\varepsilon)B_{\lambda t}\right]$$

(56)

If we assume that bank should pay c in each period as monitoring cost about productivity of enterprise,we can show the profit of bank as shown as next.

$$\Pi_n=\sum_{t=1}^{n*\lambda}\pi_t-nc=\sum_{t=1}^{n*\lambda}\left(E_{t\lambda}\frac{\theta e^{\alpha_H}}{B_{t\lambda}}+\theta e^{\alpha_H}-\varphi-R-\varepsilon\right)B_{t\lambda}-n^*c \quad (57)$$

Where $n^*$is decided according to, and means that bank get profit by medium during n^*periods. This assumption is justified by observation that the monitoring cost increase as bank monitor behavior or character of enterprise.

The Period n^* when bank lose the chance to get profit come sooner as the increase of λ and the high productivity is attained by the operate of bank. So bank on purpose may try to ignore the chance of high productivity So ,we assume that bank ignore m times of the chance of high productivity while occurring at each *1/λ*peiods.

Here,the period n^* when bank lose the chance to get profit come sooner as the increase of λ and the high productivity is attained by the operate of bank. So bank on purpose may try to ignore the chance of high productivity in order to enjoy chance of profit as long as possible.

Finally,we notice such a see-off behavior of bank. We assume that bank see off chance of high productivity *m* times out of chance of high productivity occurred in each *1/λ* period. Then bank get chance of high productivity in each m/λ period

So, We put m/λ into λ in equation and change the equation about the period n^{**} when the bank lose the chance to get profit as the below. the period λ into the below

$$B_{n^*+1}+E_{n^*+1}=\left(\left(1+\frac{\theta e^{\alpha L}}{R-\theta e^{\alpha L}}\right)\right)\left[\left((e^{\alpha H}\right)^{n^{**}\frac{m}{\lambda}}\left((1-\theta)e^{\alpha L}\left(1+\frac{\theta e^{\alpha L}}{R-\theta e^{\alpha L}}\right)\right)^{n^{**}\left(1-\frac{m}{\lambda}\right)}\right]E_0=$$

$$K=e^{s(n^{**}+1)}K_0$$

(58)

$$n^{**}=\frac{\log_e(R-\theta e^{\alpha_L})-\log_e R-\log_e E_0+s+\log_e K_0}{\left[\begin{array}{l}\alpha_H\left(\frac{\lambda}{m}\right)+\alpha_L\left(1-\frac{\lambda}{m}\right)+\left(1-\frac{\lambda}{m}\right)\log_e(1-\theta)+\left(1-\frac{\lambda}{m}\right)\log_e R\\-\left(1-\frac{\lambda}{m}\right)\log_e(R-\theta e^{\alpha_L})-s\end{array}\right]}$$

(59)

We find out that n^{**}comes later than n^*comes as the increase of see-off-times *m* of bank under the condition that equation (45) which means that high productivity is very large is satisfied. We assume that the equation (46)is not satisfied and the equation(45) is satisfied in the below.

As the assts (bequests) is accumulated through the see-off of the bank, we can show the bequest of enterprise in each t period, $B^m_{t\lambda}$ shown as next.

$$B_{t\lambda}^{m}=\theta(1-\theta)^{\left(\frac{m}{\lambda}-2\right)}\left[\left(e^{\alpha L}\left(1+\frac{\theta e^{\alpha_L}}{R-\theta e^{\alpha_L}}\right)\right)^{\left(\frac{m}{\lambda}-1\right)}\right]$$

$$\times\left\{\left[e^{\alpha_H}\right]^{t-1}\left[\left((1-\theta)e^{\alpha L}\left(1+\frac{\theta e^{\alpha_L}}{R-\theta e^{\alpha_L}}\right)\right)^{(t-1)\left(\frac{m}{\lambda}-1\right)}\right]E_0\right\}$$

(60)

While, the bequest of enterprise in the period$t$（$<n^*\lambda$）（t=1，2，…，$n^*\lambda$ $E_{t\lambda}^{m}$ shown as the next.

$$E_{t\lambda}^{m}=\left[\left((1-\theta)e^{\alpha L}\left(1+\frac{\theta e^{\alpha_L}}{R-\theta e^{\alpha_L}}\right)\right)^{\left(\frac{m}{\lambda}-1\right)}\right]$$

$$\times\left\{\left[e^{\alpha_H}\right]^{t-1}\left[\left((1-\theta)e^{\alpha L}\left(1+\frac{\theta e^{\alpha_L}}{R-\theta e^{\alpha_L}}\right)\right)^{(t-1)\left(\frac{m}{\lambda}-1\right)}\right]E_0\right\}$$

(61)

According to (60)and(61), we find that the interval between each chance of profit is longer by the see-off behavior of bank is longer. During such an interval, the assets(bequests) of enterprise and the assets(bequests) of stockholder are accumulated and bank can collect larger assets(bequests) from stockholder and can add the return on larger assets(bequests) of enterprise.

so, bank increase the sum of profit from two points;(1)put of of periods when bank can get profit and (2)the increase of the profit in each period

But as monitoring cost increase according to the length of the optimal m*is decided endogenously. We will observe such a process.

First, the revenue the bank in each t （$<n^{**}\lambda$）（$t=1, 2, \ldots, n^{**}\lambda$） period can be shown by geometric progression with first term and common ratio as the below.

with first term and the common ratio as the below.

First term

$$E_1+B_1=\left\{\begin{array}{l}\left[\theta e^{\alpha_H}(1-\theta)e^{\alpha_L}\left(1+\dfrac{\theta e^{\alpha_L}}{R-\theta e^{\alpha_L}}\right)\right]^{\left(\frac{m}{\lambda}-1\right)}\\ +(\theta e^{\alpha_L}-\varphi-R-\varepsilon)\left[\theta(1-\theta)^{\left(\frac{m}{\lambda}-2\right)}\left\{e^{\alpha_L}\left(1+\dfrac{\theta e^{\alpha_L}}{R-\theta e^{\alpha_L}}\right)\right\}^{\left(\frac{m}{\lambda}-1\right)}\right]\end{array}\right\}E_0$$

$$=\left\{\left[e^{\alpha_L}\left(1+\frac{\theta e^{\alpha_L}}{R-\theta e^{\alpha_L}}\right)\right]^{\left(\frac{m}{\lambda}-1\right)}\left\{(1-\theta)\theta e^{\alpha_H}+(\theta e^{\alpha_L}-\varphi-R-\varepsilon)\theta(1-\theta)^{\left(\frac{m}{\lambda}-2\right)}\right\}\right\}E_0$$

common ratio

$$\left[\left((e^{\alpha H}\right)\left((1-\theta)e^{\alpha L}\left(1+\frac{\theta e^{\alpha_L}}{R-\theta e^{\alpha_L}}\right)\right)^{\left(\frac{m}{\lambda}-1\right)}\right] \qquad (62)$$

So, we can show the sum of revenue of the bank from 1 to n^{**}as shown as next.

$$\sum_{t=1}^{n}\pi_t=\frac{\left\{\left[\theta e^{\alpha_H}e^{\alpha_L}\left(1+\dfrac{\theta e^{\alpha_L}}{R-\theta e^{\alpha_L}}\right)\right]^{\left(\frac{m}{\lambda}-1\right)}\left\{(1-\theta)+(\theta e^{\alpha_L}-\varphi-R-\varepsilon)\theta(1-\theta)^{\left(\frac{m}{\lambda}-2\right)}\right\}\right\}E_0\times\left\{1-\left[\left((e^{\alpha H}\right)\left((1-\theta)e^{\alpha L}\left(\dfrac{R}{R-\theta e^{\alpha_L}}\right)\right)^{\left(\frac{m}{\lambda}-1\right)}\right]^{\lambda n^{**}}\right\}}{1-\left[\left((e^{\alpha H}\right)\left((1-\theta)e^{\alpha L}\left(\dfrac{R}{R-\theta e^{\alpha_L}}\right)\right)^{\left(\frac{m}{\lambda}-1\right)}\right]} \qquad (63)$$

Where dominator of this equation is assumed to be plus. as the revenue of the bank is plus.

Then,we can find that the revenue of the bank is increase function of m

So we equation minus monitoring cost $n^{*}c$ and differentiate this equation by m

And can get profit maximum condition as the below.

$$\frac{A}{B} - c \times (n^{**})' = 0 \tag{64}$$

Where A and B is shown as the next.

$$A=\left\{\left[\theta e^{\alpha_H}e^{\alpha_L}\left(\frac{R}{R-\theta e^{\alpha_L}}\right)\right]^{\left(\frac{m^{**}}{\lambda}-1\right)}\left\{(1-\theta)+(\theta e^{\alpha_L}-\varphi-R-\varepsilon)\theta(1-\theta)^{\left(\frac{m^{**}}{\lambda}-2\right)}\right\}\right\}E_0$$

$$\times\left\{1-\left[\left((e^{\alpha H})\left((1-\theta)e^{\alpha L}\left(\frac{R}{R-\theta e^{\alpha_L}}\right)\right)\right)^{\left(\frac{m^{**}}{\lambda}-1\right)}\right]\right\}$$

$$\times\left\{-\left[\begin{array}{l}\left((e^{\alpha H})^{n^{**}}\log\left((e^{\alpha H})\left((1-\theta)e^{\alpha L}\left(\frac{R}{R-\theta e^{\alpha_L}}\right)\right)\right)^{n^{**}\left(\frac{m^{**}}{\lambda}-1\right)}\times(n^{**})'\right.\\ \left.+\left((1-\theta)e^{\alpha L}\left(\frac{R}{R-\theta e^{\alpha_L}}\right)\right)^{n^{**}\left(\frac{m^{**}}{\lambda}-1\right)}\log\left((1-\theta)e^{\alpha L}\left(\frac{R}{R-\theta e^{\alpha_L}}\right)\right)\times\left(\left(\frac{m^{**}}{\lambda}-1\right)+\frac{1}{\lambda}n^{**}\right)\right)\end{array}\right]\right\}$$

$$+\left\{\begin{array}{l}\left[\left(\frac{m^{**}}{\lambda}-1\right)\log\left((1-\theta)\theta e^{\alpha_H}e^{\alpha_L}\left(\frac{R}{R-\theta e^{\alpha_L}}\right)\right)\right]\left\{(1-\theta)+(\theta e^{\alpha_L}-\varphi-R-\varepsilon)\theta(1-\theta)^{\left(\frac{m^{**}}{\lambda}-2\right)}\right\}\times\frac{1}{\lambda}\\ +\left[\theta e^{\alpha_H}e^{\alpha_L}\left(1+\frac{\theta e^{\alpha_L}}{R-\theta e^{\alpha_L}}\right)\right]^{\left(\frac{m^{**}}{\lambda}-1\right)}\left(\frac{m^{**}}{\lambda}-2\right)\log\left\{(1-\theta)+(\theta e^{\alpha_H}-\varphi-R-\varepsilon)\theta(1-\theta)\right\}\times\frac{1}{\lambda}\end{array}\right\}E_0$$

$$\times\left\{1-\left[\left((e^{\alpha H})\left((1-\theta)e^{\alpha L}\left(\frac{R}{R-\theta e^{\alpha_L}}\right)\right)\right)^{\left(\frac{m^{**}}{\lambda}-1\right)}\right]\right\}$$

$$\times\left\{1-\left[\left((e^{\alpha H})\left((1-\theta)e^{\alpha L}\left(\frac{R}{R-\theta e^{\alpha_L}}\right)\right)\right)^{\left(\frac{m^{**}}{\lambda}-1\right)}\right]^{n^{**}}\right\}$$

$$-\left\{-\left[\left((1-\theta)\theta e^{\alpha_H}e^{\alpha L}\left(\frac{R}{R-\theta e^{\alpha_L}}\right)\right)^{\left(\frac{m^{**}}{\lambda}-1\right)}\log\left((1-\theta)e^{\alpha L}\left(\frac{R}{R-\theta e^{\alpha_L}}\right)\right)\times\frac{1}{\lambda}\right]\right\}$$

$$\times\left\{\left[e^{\alpha_L}\left(\frac{R}{R-\theta e^{\alpha_L}}\right)\right]^{\left(\frac{m}{\lambda}-1\right)}\left\{(1-\theta)+(\theta e^{\alpha_L}-\varphi-R-\varepsilon)\theta(1-\theta)^{\left(\frac{m}{\lambda}-2\right)}\right\}\right\}E_0$$

$$\times\left\{1-\left[\left((e^{\alpha H})\left((1-\theta)e^{\alpha L}\left(\frac{R}{R-\theta e^{\alpha_L}}\right)\right)\right)^{\left(\frac{m^{**}}{\lambda}-1\right)}\right]^{n^{**}}\right\}$$

$$B = \left\{ 1 - \left[\left((e^{\alpha H} \right) \left((1-\theta) e^{\alpha L} \left(\frac{R}{R - \theta e^{\alpha_L}} \right) \right)^{\left(\frac{m^{**}}{\lambda} - 1 \right)} \right] \right\}^2$$

Bank select m^{**}as optimal seeoff periods.

We notice thatn^{**} and(n^{**})'is shown as net.

$$n^{**} = \frac{\log_e(R - \theta e^{\alpha_L}) - \log_e R - \alpha_L - \log_e E_0 + s + \log_e K_0}{\alpha_H \left(\frac{\lambda}{m^{**}} \right) + \alpha_L \left(1 - \frac{\lambda}{m^{**}} \right) + \left(1 - \frac{\lambda}{m^{**}} \right) \log_e(1-\theta) + \left(1 - \frac{\lambda}{m^{**}} \right) \log_e R - \left(1 - \frac{\lambda}{m^{**}} \right) \log_e(R - \theta e^{\alpha_L}) - s}$$

(65)

$$(n^{**})' = \frac{\partial n^*}{\partial m^{**}} = \frac{\left[\alpha_H \lambda - \alpha_L \lambda - \lambda \log_e(1-\theta) - \lambda \log_e R + \lambda \log_e(R - \theta e^{\alpha_L}) \right] \times \left[\log_e(R - \theta e^{\alpha_L}) - \log_e R - \alpha_L - \log_e E_0 + s + \log_e K_0 \right]}{\left[\alpha_H \left(\frac{\lambda}{m^{**}} \right) + \alpha_L \left(1 - \frac{\lambda}{m^{**}} \right) + \left(1 - \frac{\lambda}{m^{**}} \right) \log_e(1-\theta) + \left(1 - \frac{\lambda}{m^{**}} \right) \log_e R - \left(1 - \frac{\lambda}{m^{**}} \right) \log_e(R - \theta e^{\alpha_L}) - s \right]^2}$$

(66)

7. The entrance of other banks and See off Behavior Of Bnak

By see-off of bank,bank can increase his profit, but the chance to get the profit is lost in economy.

Here,if other banks can enter, such a chance may be overcome by entrance of other bank

Next,we will consider effet of entrance of bank on see-off of bank and the length of period when bank can operate.

First, we show the condition about the entrance of bank as the below.

(1) profit(revenue -cost)isnot zero

(2) the number of the see-off periods m is plus

Condition(2)argue about the existence of chance of entrance of other bank as the existence of see-off of bank we notice that even if profit is plus, when all the chances of high productivity are enjoyed by already entered bank, there arenot new chance of entrance.

Then the number of seeoff by bank is the number of the chances of the entrance of other banks.

We can get the number of banks which can enter by using these two conditions

We assume p as the number of banks which can enter.

From(1) we divide all the sum of revenue of bank by cost and get the number of banks which enter p_E***.

From (2)we caliculate p_M***=m***− 1 where m*** is the see-off periods that make profit of the bank maximize.

Finally we can get the number of bank p***=min[p_E***,p_M***]

But bank decides seeoff perio1sm* through profit maximization given the number of banks p

So, we consider the equation (1)is those decide seeoff periods m given the number of banks which enter p

While, we consider the equation (2)is those decide the number of banks which enter p given seeoff periods m given the number of banks which enter.

We get p_E***and m*** through collition between equation(1) and equation(2)

We assume p as the number of banks which enter,and can change the sum ofthe revenue banks face as the below.

$$\sum_{t=1}^{n}\pi_t=\frac{\left\{\left[\theta e^{\alpha_H}e^{\alpha_L}\left(1+\frac{\theta e^{\alpha_L}}{R-\theta e^{\alpha_L}}\right)\right]^{\left(\frac{m}{p\lambda}-1\right)}\left\{(1-\theta)+(\theta e^{\alpha_L}-\varphi-R-\varepsilon)\theta(1-\theta)^{\left(\frac{m}{p\lambda}-2\right)}\right\}\right\}E_0\times\left\{1-\left[\left((e^{\alpha H}\right)\left((1-\theta)e^{\alpha L}\left(\frac{R}{R-\theta e^{\alpha_L}}\right)\right)^{\left(\frac{m}{p\lambda}-1\right)}\right]^{\lambda n^{**}}\right\}}{1-\left[\left((e^{\alpha H}\right)\left((1-\theta)e^{\alpha L}\left(\frac{R}{R-\theta e^{\alpha_L}}\right)\right)^{\left(\frac{m}{p\lambda}-1\right)}\right]}\tag{67}$$

We can change the equation about the period n***when the operation of bank into the next.

$$n^{***}=\frac{\log_e(R-\theta e^{\alpha_L})-\log_e R-\log_e E_0+s+\log_e K_0}{\left[\begin{array}{l}\alpha_H\left(\frac{\lambda p}{m}\right)+\alpha_L\left(1-\frac{\lambda p}{m}\right)+\log_e(1-\theta)+\left(1-\frac{\lambda p}{m}\right)\log_e R\\-\left(1-\frac{\lambda p}{m}\right)\log_e(R-\theta e^{\alpha_L})-s\end{array}\right]}\tag{68}$$

While, monitoring cost is changed as the below by using$n$***.

$$n^{***}c \qquad (69)$$

Here,about equation 1, we differentiate profit of bank which is(61) minus (63) by *n* given *p* $n^{***}$is satisfied with equation (62) and we get the equatio aboutn^{***}

About equation 2,we put the above profit of bank on zero given *n* and we get the equation about p^{***}

From the fact that numerator of equation(61) is plus and $m/p\lambda$ of equation(61),we find that according to (62)the increase of *p* lead to the decreas of *m* and the increase of *n* under condition(2).

8.Transition From indirect Finance To direct Finance

The translation from indirect finance to direct finance is important. Our model give some vision to such a translation.

We assume that government can take next two policies (1) fix tax or subsidies τ against the entrance of bank tax or subsidies τ (2) government fix tax or subsidies t against distribution from enterprise to stockholder where τ or t is plus tax τ or t is minus subsidies

We consider the situation that, by such a tax or subsidies, government control the period *n* when the roll of bank where τ or$t$ is plus if tax is minus if subsidies

(1) policy that tax or subsidies τ against the entrance of bank tax or subsidies τ.
It has relationship to equation(63) about monitoring cost.

(2) policy that tax or subsidies τ against the entrance of bank tax or subsidies τ.
It has relationship to equation (35), (36) and (39), (40) about distribution between enterprise and stockholder

(1) If government fix tax or subsidies τ against the entrance of bank, equation about monitoring cost (63) is changed as the below.

$$n^{****}c-\tau \qquad (70)$$

The rise of the monitoring cost by fix tax or subsidies τ has influence on the number of the bank *p* and see-off period chosen by bank, *m* . if government fix tax or subsidies τ against the entrance of bank and the profit of bank decrease and the number of bank entrance *p* decrease. So,the number of the bank etrance p^{****} is decrease function of tax or subsidies τ , $p^{****}(\tau)$ if the bank entrance decrease, $m/p\lambda$ on equation increase. So, the see-off period $m^{****}$is increase function of tax or subsidies τ , $m^{****}(\tau)$.So, According to(68) the number of bank entrance p and see-off period m make the period n^{****}increase.

So, we find that if government consider the period $n^{****}$when bank lose the chance to get profit come sooner, it fix minus tax(subsidies) on the entrance of bank.

(2)while, if government fix tax or subsidies t against distribution from enterprise to stockholder, the equation about the distribution between stockholder and enterprise (35)、(36), (39) (40) is changed as the below.

(1) in the case of low productivity

$$E_{n,2} = (1 - t\theta) y_n = (1 - t\theta) e^{\alpha_L} \left(1 + \frac{t\theta e^{\alpha_L}}{R - t\theta e^{\alpha_L}} \right) E_{n-1,2} \tag{71}$$

$$B_{n,2} = t\theta y_n = t\theta e^{\alpha_L} \left(1 + \frac{t\theta\alpha}{R - t\theta\alpha} \right) E_{n-1,2} \tag{72}$$

(2) in the case of high productivit73y

$$E_{n,2} = (1 - t\theta) y_n = (1 - t\theta) e^{\alpha_H} (E_{n-1,2} + B_{n-1,2}) \tag{73}$$

$$B_{n,2} = t\theta y_n = t\theta e^{\alpha_H} (E_{n-1,2} + B_{n-1,2}) \tag{74}$$

These change of equations have influence on the equation through parameter θ have influence on equaqtion(62) about the period where bank lose the chance to get profit as parameter θ , which represent the bargaining power between enterprise and stockholder,is multified by $t$in equation (62) .whether the influence of tax t on distribution from enterprise to stockholder is minus or plus depend on the value of θ .So, government choose subsidies or tax on distribution from enterprise to stockholder according to the value of bargaining power θ.

The former deduce the distribution and the induce accumulation of assets of enterprise, while the latter Induce the distribution and deduce accumulation of assets of enterprise.

In order to describe such an effect of policy, we notice that p is decrease function of τ and we change the equation about the period n where the operation of bank is lost as the below.

$$n^{****} = \frac{\log_e (R - t\theta e^{\alpha_L}) - \log_e R - \log_e E_0 + s + \log_e K_0}{\left[\begin{array}{l} \alpha_H \left(\frac{\lambda p(\tau)}{m} \right) + \alpha_L \left(1 - \frac{\lambda p(\tau)}{m} \right) + \left(1 - \frac{\lambda p(\tau)}{m} \right) \log_e (1 - t\theta) + \left(1 - \frac{\lambda p(\tau)}{m} \right) \log_e R \\ - \left(1 - \frac{\lambda p(\tau)}{m} \right) \log_e (R - t\theta e^{\alpha_L}) - s \end{array} \right]} \tag{75}$$

$$\frac{\partial n^{****}}{\partial t}=\frac{\frac{1}{R-t\theta e^{\alpha_L}}\times(-\theta e^{\alpha_L})\times\left[\begin{array}{l}\alpha_H\left(\frac{\lambda p(\tau)}{m}\right)+\alpha_L\left(1-\frac{\lambda p(\tau)}{m}\right)+\left(1-\frac{\lambda p(\tau)}{m}\right)\log_e(1-t\theta)\\+\left(1-\frac{\lambda p(\tau)}{m}\right)\log_e R-\left(1-\frac{\lambda p(\tau)}{m}\right)\log_e(R-t\theta e^{\alpha_L})-s\end{array}\right]+\left[\frac{1-\frac{\lambda p(\tau)}{m}}{1-t\theta}+\frac{1-\frac{\lambda p(\tau)}{m}}{R-t\theta e^{\alpha_L}}\times(-e^{\alpha_L})\right]\times\left[\begin{array}{l}\log_e(R-\theta e^{\alpha_L})-\log_e R-\log_e E_0+s\\+\log_e K_0\end{array}\right]}{\left[\begin{array}{l}\alpha_H\left(\frac{\lambda p(\tau)}{m}\right)+\alpha_L\left(1-\frac{\lambda p(\tau)}{m}\right)+\left(1-\frac{\lambda p(\tau)}{m}\right)\log_e(1-\theta)+\left(1-\frac{\lambda p(\tau)}{m}\right)\log_e R-\\\left(1-\frac{\lambda p(\tau)}{m}\right)\log_e(R-\theta e^{\alpha_L})-s\end{array}\right]^2}$$

(76)

Here,we put denominator of equation on $H(\theta)$ and consider θ****which satisfy the below rlationship $H(\theta^{****})$.

$$H(\theta^{****})\equiv\frac{1}{R-t\theta^{****}e^{\alpha_L}}\times(-\theta e^{\alpha_L})\times\left[\begin{array}{l}\alpha_H\left(\frac{\lambda p}{m}\right)\lambda+\alpha_L\left(1-\frac{\lambda p}{m}\right)+\left(1-\frac{\lambda p(\tau)}{m}\right)\log_e(1-\theta^{****})\\+\left(1-\frac{\lambda p}{m}\right)\log_e R-\left(1-\frac{\lambda p}{m}\right)\log_e(R-\theta^{*}e^{\alpha_L})-s\end{array}\right]$$
$$+\left[\frac{\left(1-\frac{\lambda p(\tau)}{m}\right)}{1-\theta^{*}}+\frac{1-\frac{\lambda p}{m}}{R-\theta^{*}e^{\alpha_L}}\times(-e^{\alpha_L})\right]\times\left[\begin{array}{l}\log_e(R-\theta^{*}e^{\alpha_L})-\log_e R-\log_e E_0+s\\+\log_e K_0\end{array}\right]=0$$

(77)

then we find that if $H(\theta)>H(\theta*)$ the rise of t make the period when bank lose the chance to get profit later.

If $H(\theta)>H(\theta*)$ $H(\theta)<H(\theta*)$ the rise of t make the period come sooner.

We find that if $H(\theta)>H(\theta*)$ Subsidiese policy against distribution from enterprise to stockholder is effect, while if $H(\theta)<H(\theta*)$ tax policy against distribution from enterprise to stockholder which induce accumulation of the assets of enterprise is effect

Moreover, we find that the coefficient of p****(τ) can take plus or minus.

So, we find that the relationship between tax or subsidies t against distribution from enterprise to stockholder and tax or subsidies τ against the entrance of bank operate complementary or substitutionary.

The former policy is always effect in each period, while the later policy is effect only in high productivity period.

But we notice that in case that productivity e^{α_H} is large and barganing power of enterprise against stockholder $1-\theta$ is large, through only low productivity, the accumulation of the assets(bequests)of enterprise and stockholder increase sooner and the such an inverse case can occur the increase of λ may increase n^*.

9.Estimation

Next, we estimate about the above result of our theory. Especially, we focus on the result that (Result (1))bank try to supply fund to industries which have complementary in productivity each other in order to get the profit.(Result(2))bank on purpose try to see off the chance of getting profit by high productivity in order to enjoy the profit as possible as long.

In order to do so, we pick some industries which have complementary in productivity. And we examine which loan amount to these industries by bank have complementary or corelated relationship or not.

Here, we notice relationship between oil industry and oil chemistry industry in same industrial complex in Japan.

In Japan, there are (chemistry oil) industrial complex; Kawasaki, Mizushima, Goi, Iwakuni, Yokkaichi, Sakai, and so on. These industrial complex have main leading firm (of oil industry or of oil chemistry industry) (Mitsui Chemical or Asahi Kasei in Kawasaki, Mitsubishi Chemical or Asahi Kasei in Mizushima, Ube Industries in Goi, Mitsui Chemical in Iwakuni) and such a firm often is given loan amount by bank.(Showa Denkou from Fuji, Mitsubishi Oil and Mitsubishi Chemical from Mitsubishi, Asahi Kasei from Daiichi, Mitsui Chemical from Mitsui, and so on.

As Oil industry and Oil chemistry industry have complementary in productivity and if (Result(1)) is correct, we could find that bank supply enough fund to firms of oil industry and firms of oil chemistry industry at same time in order to realize complementary in productivity.

If (Result(2)) is correct, we also could find that the way for bank to give loan amount change. Because Japanese firms can become to collect the needed fund directly from market without support of bank after the Heisei period. It means that bank become to lose the chance to get profit. Against such a situation, before such a situation become serious, bank on purpose may try to see off the profit-chance in order to enjoy profit-chance as long as possible.

So, in order to examine two Results(1) and (2), we pick up firm of oil industry, firm of chemical industry in each industrial complex and main bank which give loan amount to such firms in each industrial complex and we research the loan amount from main bank to firm of oil industry and loan amount from main bank to firm of oil chemistry industry with be careful of distinction of times (data of the Showa period before bubble boom and data of the Heisei Period) and examine whether both loan amounts to oil industry and to oil chemistry industry have corelated relationship or not.

If both loan amount have corelated relationship, we could conclude that bank give loan amount to both industries with being careful of complementary in productivity between both industries.
So, we get data about bank loan amount to firms in oil industry and oil chemistry industry in each (chemistry oil)industrial complex from Japanese firms groups; Data book Series, Separate volume of Weekly Toyo-Keizai published by Toyo Keizai Inc. (data about from 1970s to 1990s) and calculate corelated coefficient between these loan amount to oil industry and oil chemistry industry.
As such a calculated result, we get result shown as table, the loan account to firm of oil industry and that to oil chemistry industry in same complex.
We find that loan amount to firms of Oil industry from bank and loan amount to firms of oil chemistry industry in each industrial complex roughly have strong correlation. So, we could conclude that bank give loan amount to these industries with be careful of complementary in productivity. (corresponded with Result(1))
While, comparing the correlation before bubble boom(on upper)with the correlation before bubble boom(on lower), we find that the relationship between loan amount against oil industry and oil chemistry industry after bubble boom become weaker than those before bubble boom.
So, we could conclude that bank on purpose see off the profit chance and refrain from giving loan amount to these industries after bubble boom. (corresponded with Result(2))

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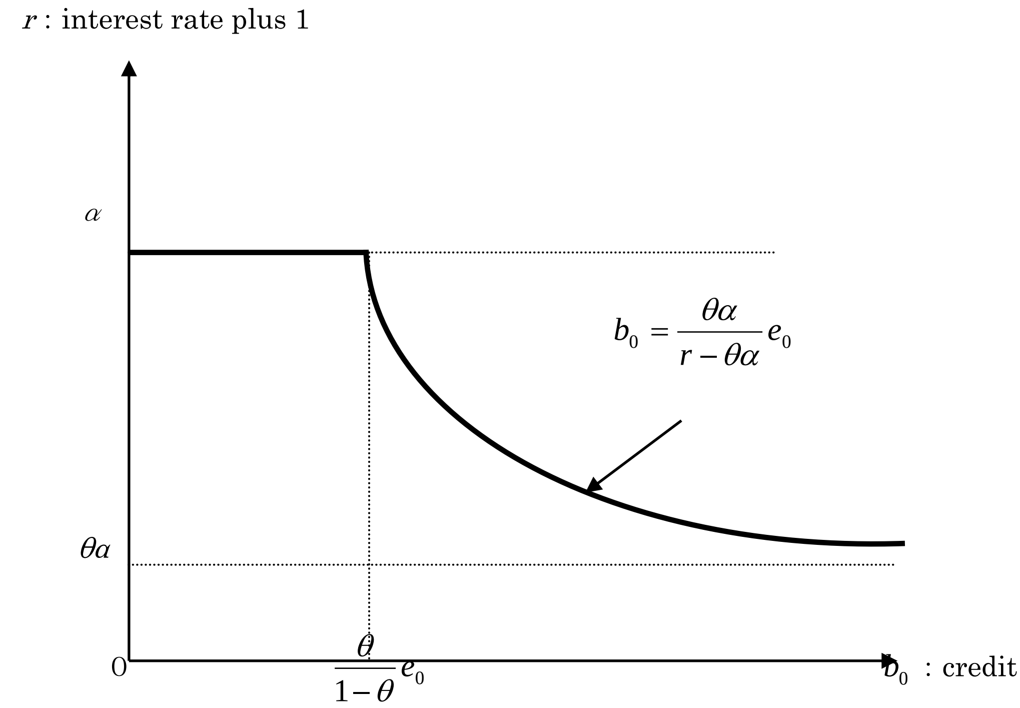
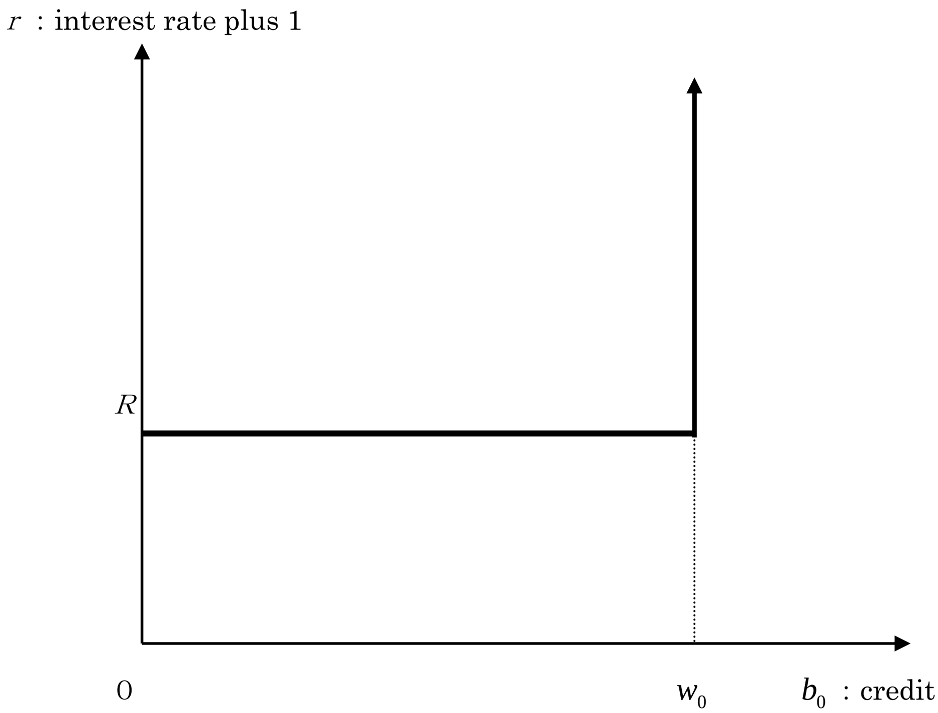
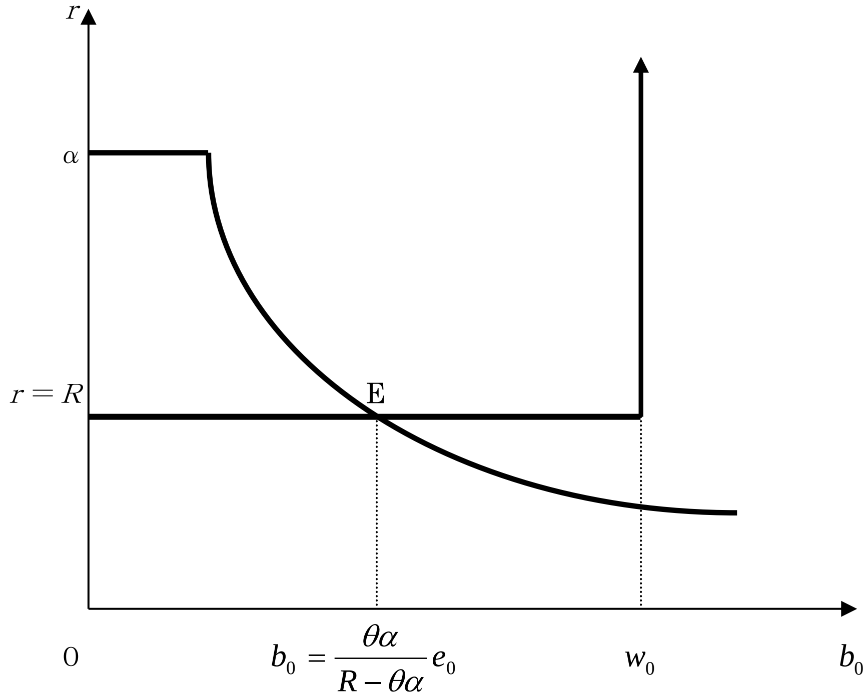
(Figure1)　the credit demand curve of enterprise



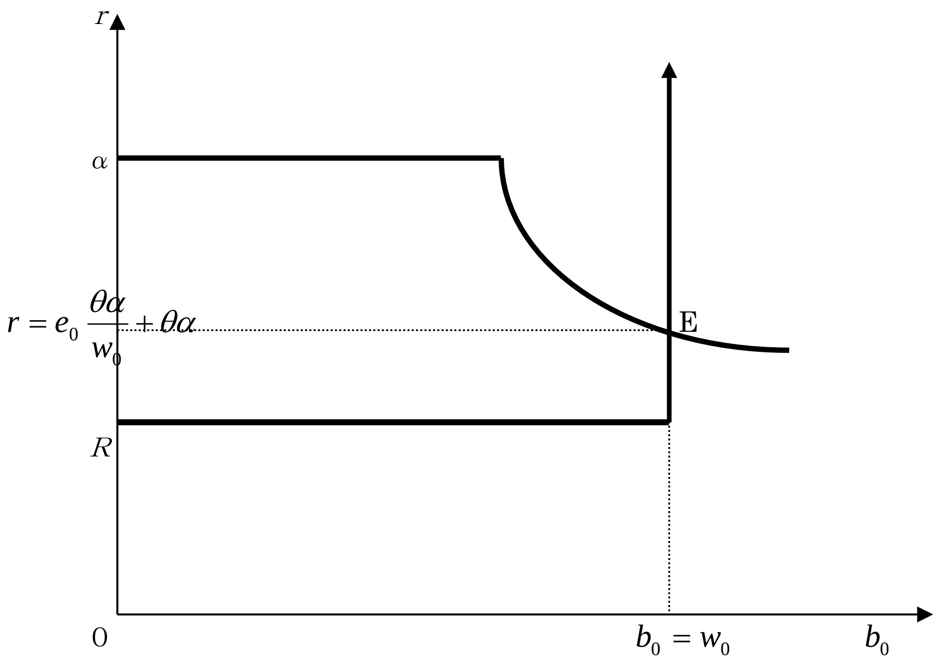
(Figure２)　the credit supply curve



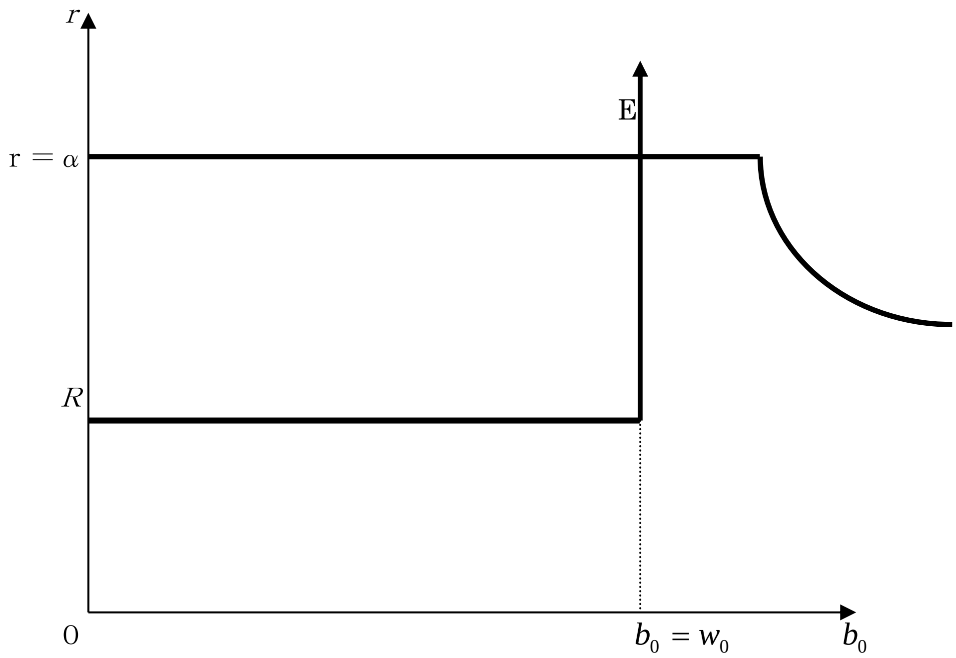
(Figure 3) The equilibrium in the case wherein the assets of enterprise are small(Case1)



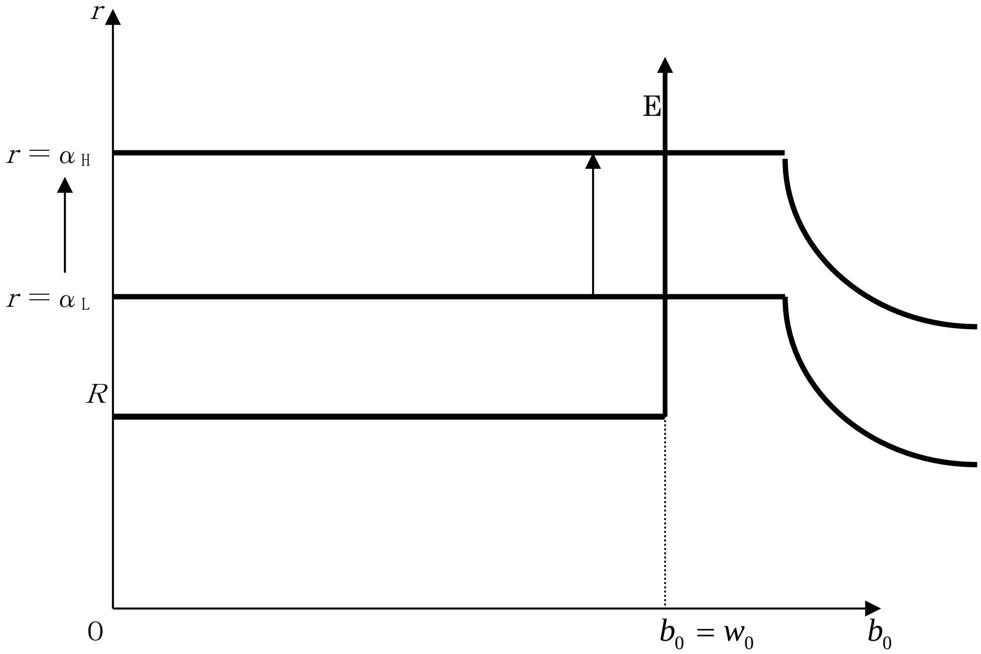
(Figure4) the equilibrium in the case wherein the assets of enterprise are abandoned (Case2)



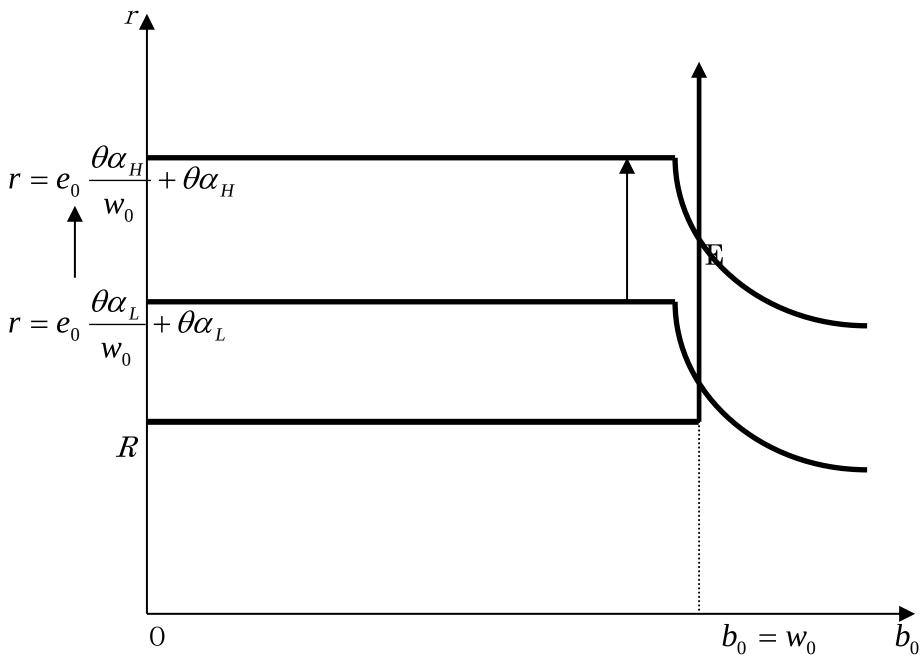
（Figure 5）the equilibrium when the constraint of credit does not mean(Case3)



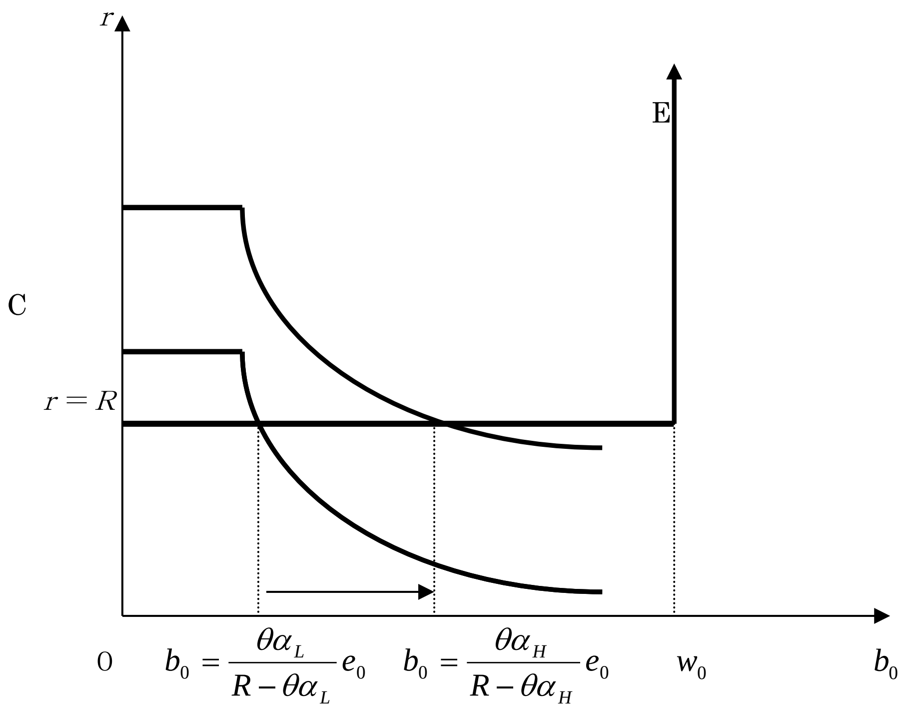
(Figure 6)　the effect of the rise of the productivity　α　when case 3 is satisfied in zero period



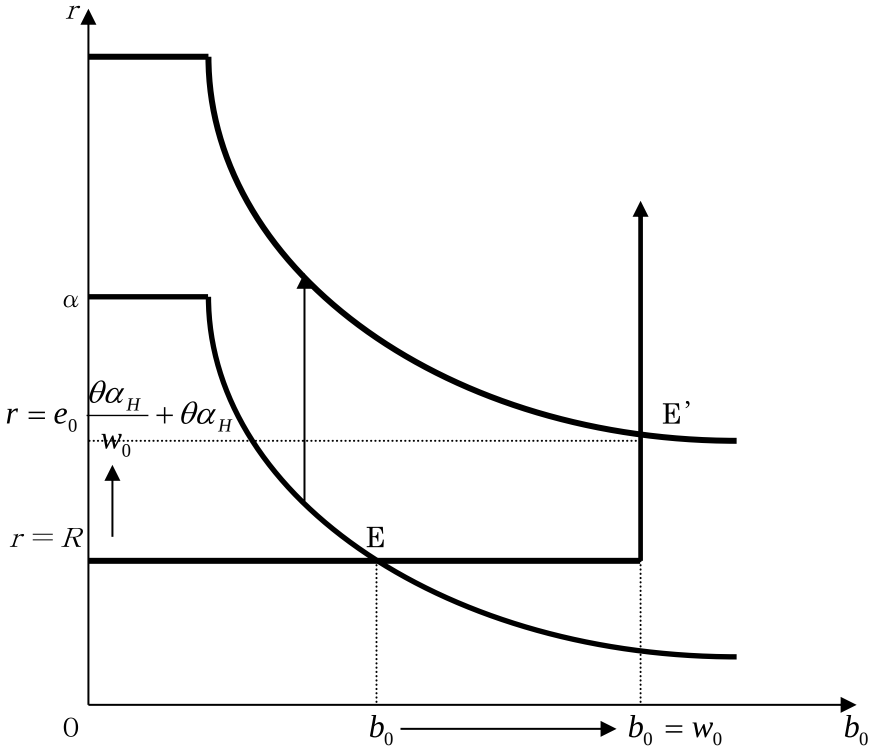
(Figure 7) the effect of the rise of the productivity α when case 2 is satisfied in zero period



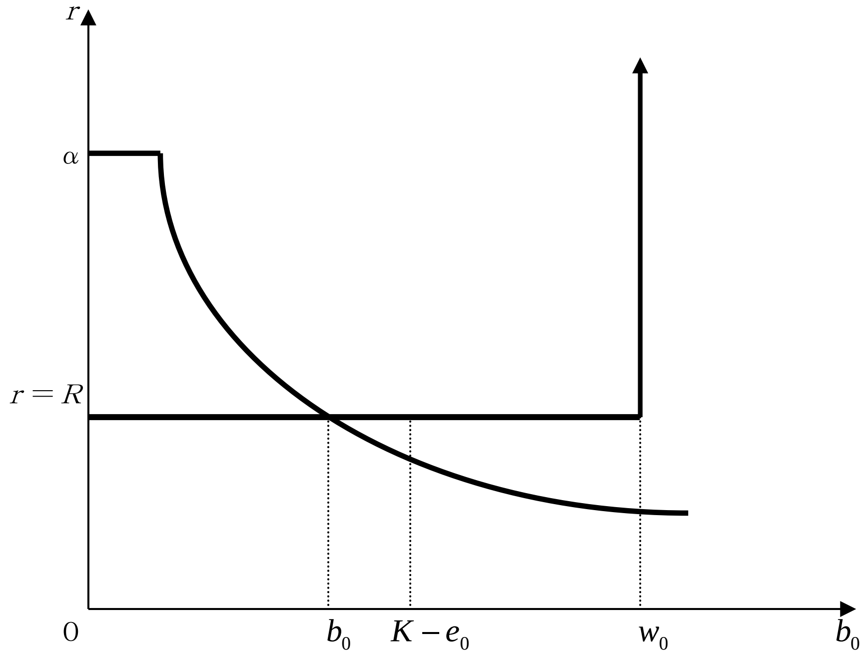
(Figure8) the effect of the rise of the productivity α when Case 1 is satisfied in zero period but efficiency does not attain in one period(Case 1-1)



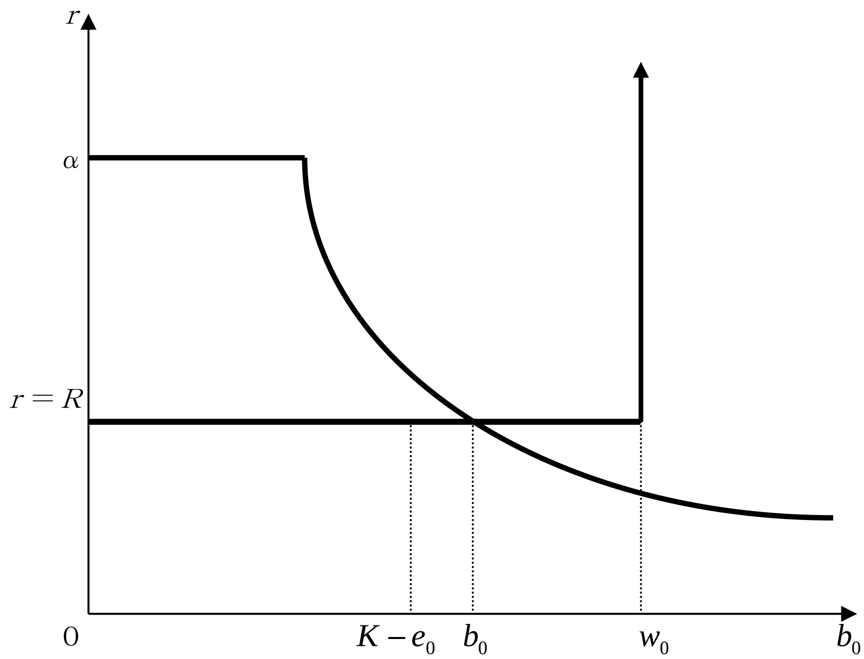
(Figure9) the effect of the rise of the productivity α when Case 1 is satisfied in zero period but efficiency attain in one period(Case 1-2)



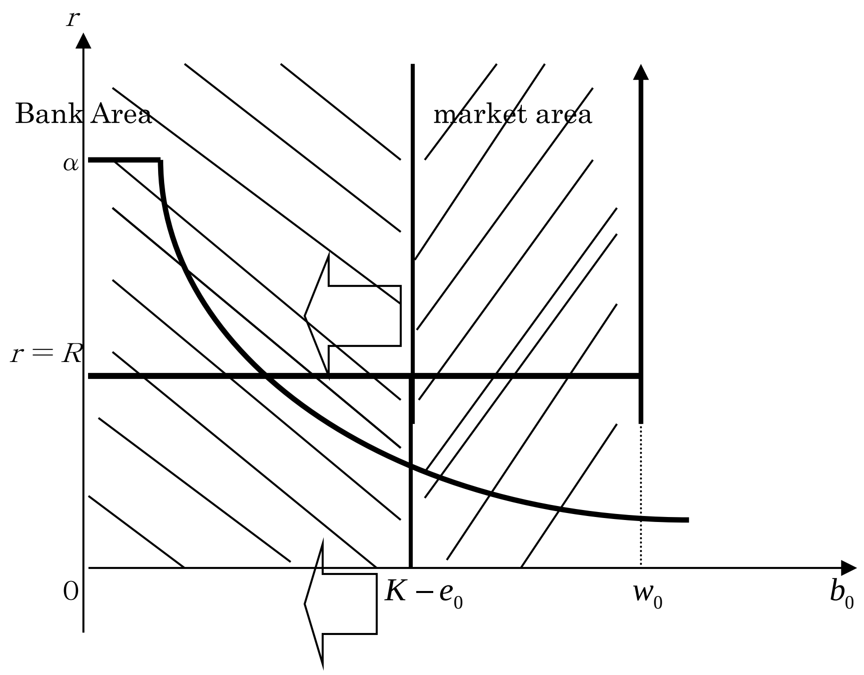
(Figure10) enterprise do not have the needed credit for the occurrence of complementary in the first period



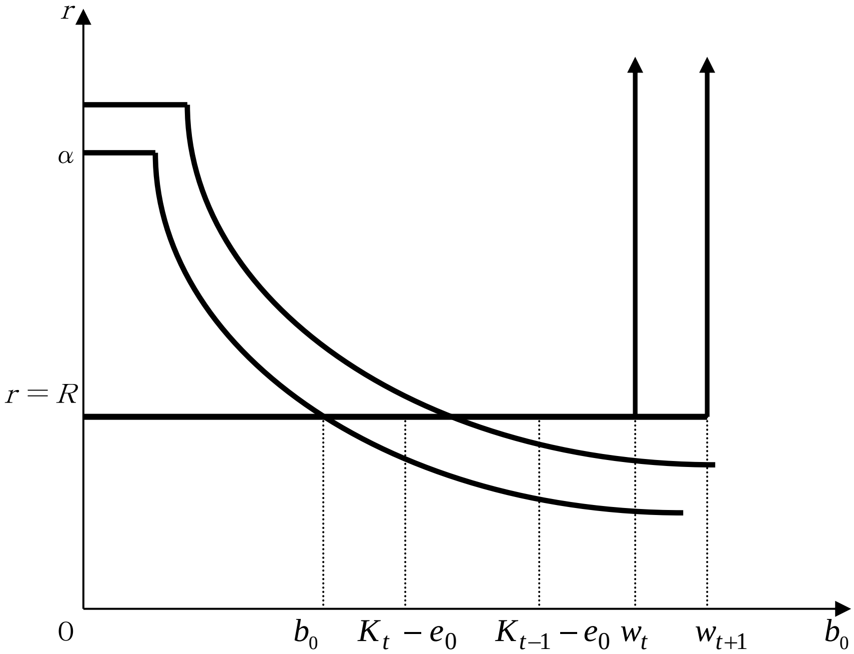
(Figure11) in the case that enterprise have the needed credit for the occurrence of complementary in the first period



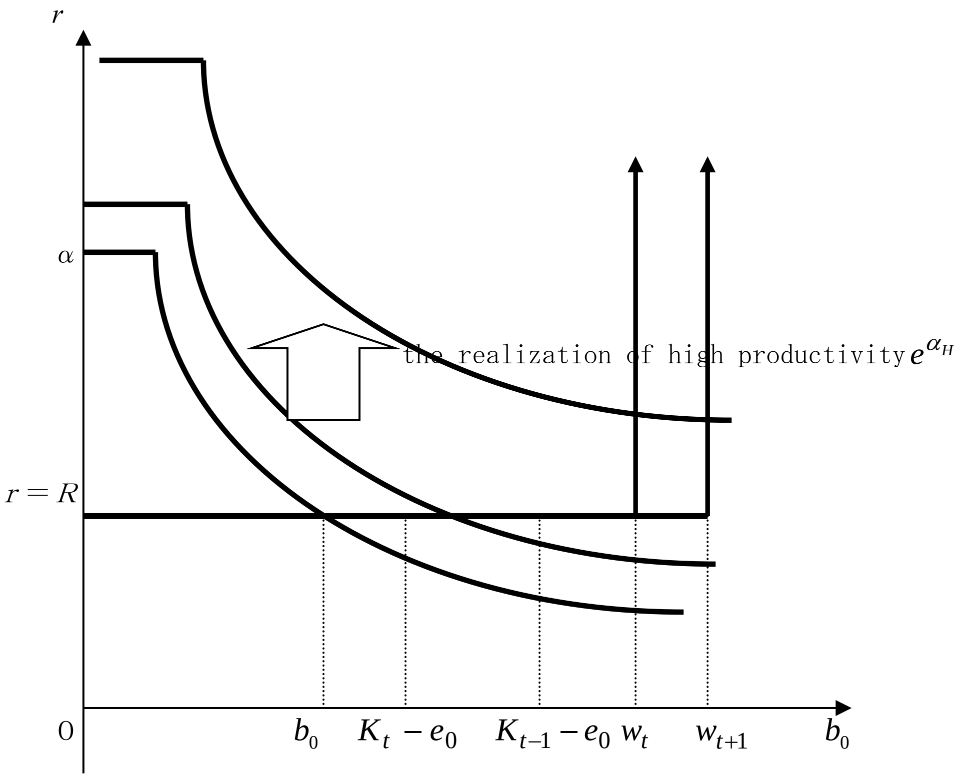
(Figure12) Get funds mobilized through from market to the operation of bank



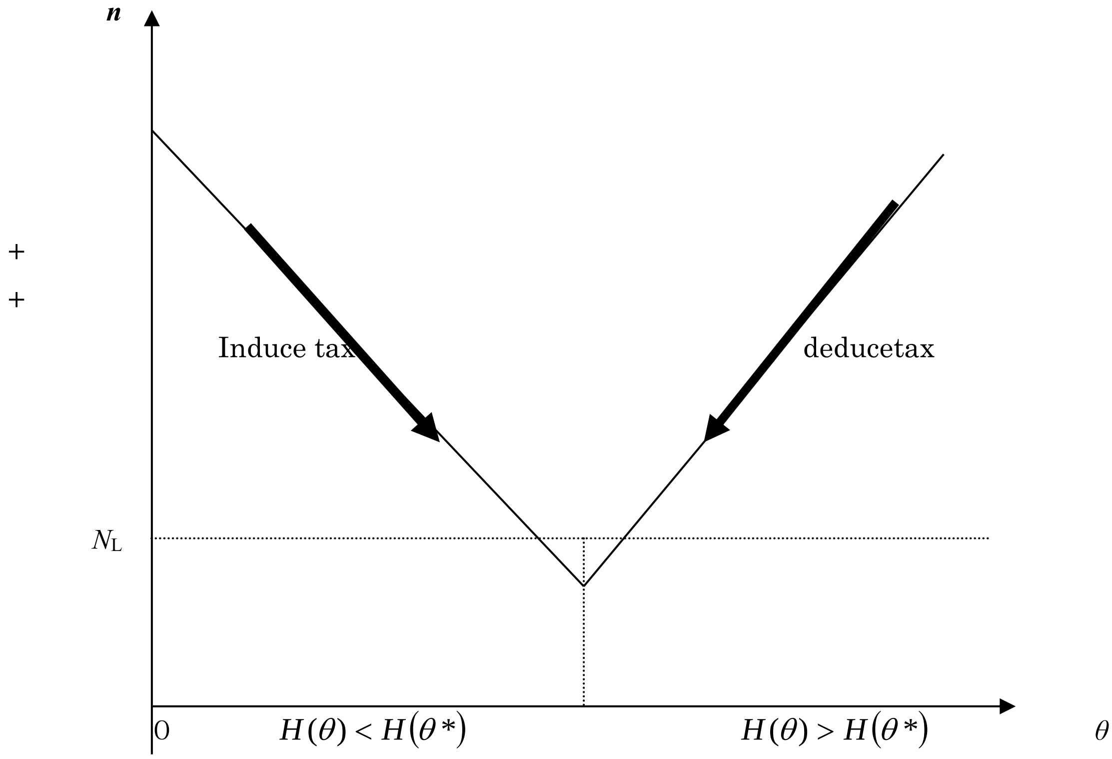
(Figure13) notice that in the latter part of our article notice demand curve of enterprise ,supply curve of enterprise and the needed invest level $\underline{K}$ move as the rise of the productivity



(Figure14) in the latter part of our article the case of high production means the case that supply curve become to cross demand curve at axis of supply curve



（Figure15）policy about distribution between enterprise and stockholder



If $H(\theta) > H(\theta *)$,policy should fix minus tax or subsidies against distribution from enterprise to enterprise in order to induce distribution,while if $H(\theta) < H(\theta *)$, policy should fix tax against distribution from enterprise to enterprise in order to deduce distribution,

East Japan		
complex	Kawasaki	
main Oil Firm	JapanOil	
main OilChemistry Firm	Showa Denkou	
main Bank	Fuji	
correlation coeffient between lending to oil and lending to oil chemitry (First during)	0.5	1972-1986
correlation coeffient between lending to oil and lending to oil chemitry (Second during)	0.01	1988-1999

East Japan		
complex	Kawasaki	
main Oil Firm	Showa Oil	
main OilChemistry Firm	Mitsybishi Chemical	
main Bank	Mitsubishi	
correlation coeffient between lending to oil and lending to oil chemitry (First during)	0.68	1972-1986
correlation coeffient between lending to oil and lending to oil chemitry (Second during)	0.27	1986-1992

Kawasaki
Nihon Oil
Mitsui Chemical
Mitsui

0.46 1972-1986

0.78 1986-1992
]

Kawasaki
Nihon Oil
Asahikasei
Daiichi

0.7 1972-1985

0.64 1987-1991

Goi
Cosmo Oil
Ube Industries
Sanwa

0.62 1972-1986

0.9 1987-1992

West Japan

complex	Mizushima	
main Oil Firm	Cosmo Oil	
main OilChemistry Firm	AsahiKasei	
main Bank	Sumitomo	
correlation coeffient between lending to oil and lending to oil chemitry (First during)	0.89	1972-1986
correlation coeffient between lending to oil and lending to oil chemitry (Second during)	0.87	1987-1992

complex	Mizushima	
main Oil Firm	Mitsubishi Oil	
main OilChemistry Firm	Asahi Kasei	
main Bank	Sumitomo	
correlation coeffient between lending to oil and lending to oil chemitry (First during)	0.78	1972-1986
correlation coeffient between lending to oil and lending to oil chemitry (Second during)	0.31	1987-1992

Mizushima
Mitsubishi Oil
MitsubishiChemical
Mitsubishi

0.6	1072-1986
0.17	1987-1992

Iwakuni
Kouwa Oil
Mitsui Chemical
Mitsui Chemical

0.69	1972-1987
0.52	1987-2002