

Bribery and Resource Allocation

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1. Introduction

In many macroeconomic model analysis, it is often assumed (mainly to avoid the aggregation problem) that economic agents are identical, and each of them does not take into account the consequences of his/her action on the other agents. However, our history suggests that the conflicts among economic agents have significant implications on the performance of an economy. For example, an economy consisting of agents with unanimous opinions may attain a better performance than an economy consisting of agents with conflicting opinions.¹⁾

Recently, Cole, Mailath and Postlewaite (1992) proposed an idea the “macrofoundation of microeconomics” by which they imply that an individual in a social context behaves differently from the one in isolation because of the interaction among individuals. A conflict over resources in an economy induces individuals to take the interaction among themselves into account when they come up with an allocation mechanism. Cole et. al. incorporated a nonmarket resource allocation mechanism with a standard market mechanism (price mechanism) and showed that such a model can generate multiple equilibria. They argued that economies which have the same structure may attain dif-

1) Parente (1990) observed that such countries like Spain and Burma showed drastic changes in economic growth before and after coup d’etat incidents.

ferent growth rates because of the multiplicity of equilibria.

The main objective of this paper is to analyze how the conflicts among economic agents and the allocation mechanisms through which the conflicts are resolved affect the performance of an economy.

In this paper, we analyze an economy consisting of two oligopoly firms and a government. The government owns a resource which is demanded by the firms as an input for production. There are two types of government with respect to the allocation of the resource. One is a *fair* government which allocates resources according to a fixed rule which is not affected by the actions taken by those who receive the resources. The other is a *rotten* government which allocates resources according to the relative size of bribes paid by economic agents which may be regarded as a resource allocation through auction market. The bribe activity is costly if it costs more than \$1 to raise \$1 bribe expenditure. The firms behave non-cooperatively. There are competitions between the firms in two aspects. First, they compete in the final good market as standard Cournot duopoly producers. Second, they compete over the input resource owned by the government.

Under these assumptions, it is easy to imagine that if the government is *rotten*, then the conflict between the firms over the input resource forces them to pay bribes which could have been spent for more productive purpose, and hence lower the performance of the economy. In other words, the firms are trapped in the prisoner's dilemma. Because of the non-cooperative behavior between the firms, zero bribe spending by each firm does not constitute a Cournot-Nash equilibrium. If one firm does not pay bribe, then the other firm has an incentive to pay bribe so that it can capture a significant portion of the input resource from the *rotten* government even if the amount of the

bribe is small.

From the view point of each firm, the bribe is a waste of resource. It merely lowers the profit of the firms. From the view point of the entire society, however, the bribe is not necessarily a waste if it costs \$1 to raise \$1 bribe. In such a case, the bribe is a pure transfer from the firms to the government like a lump-sum tax. Even if this is the case in the short-run, the bribe may cause a significant social loss in the long-run since the resources set aside for the bribe could have been used for more productive purpose.

This paper is organized as follows. In section 2, an one-period static model is analyzed where it will be shown that when the government is *rotten*, economic agents are forced to pay positive amount of bribes, compared to zero bribe spendings under the *fair* government, even though each of them knows that the bribe is a pure waste of resource. In section 3, the model is extended to an infinite horizon problem to analyze the long-run performance of the economy under the different types of government. The engine of growth of the economy is the R & D activities of the firms. Here again, the bribe spendings under the *rotten* government will lower the productive activities of firms and hence lower the long-run performance of the economy.

In section 4, concluding remarks for extending the model and future research will be discussed.

2. One-period Problem

The setup of the model is described as follows. There are two non-cooperative oligopoly firms, firm 1 and firm 2, and a government. The government owns an input resource v , and allocates it between the two firms as v_1 for firm 1 and v_2 for firm 2. The govern-

ment is either one of two types, *fair* or *rotten*. The *fair* government allocates v equally to each firm. On the other hand, the *rotten* government determines the amounts of v_1 and v_2 according to the relative size of bribes x_1 and x_2 , paid by firm 1 and firm 2, respectively. Notationally, for $i=1, 2$,

$$v_i = \begin{cases} \frac{1}{2}v, & \text{if the government is fair} \\ \frac{x_i}{x_1+x_2}v, & \text{if the government is rotten.} \end{cases}$$

Given the setup described above, the situation can be modeled as a two-stage game. Stage 1; firm 1 and firm 2 choose the amount of bribes, x_1 and x_2 . Stage 2; the government allocates v as v_1 for firm 1 and v_2 for firm 2. Then, firm 1 (2) combines v_1 (v_2) with labor l_1 (l_2) to produce output q_1 (q_2) and sells it in an oligopoly market to earn profit π_1 (π_2) which is defined as

$$\pi_i = p(q_1, q_2)q_i(l_i, v_i) - wl_i - c_i(x_i), \quad i=1, 2,$$

where $p(q_1, q_2)$ is the (inverse) market demand function, $q_i(l_i, v_i)$ is firm i 's production function, w is wage and $c_i(x_i)$ is firm i 's bribe cost function. Complete information and simultaneous moves are assumed. Each firm knows whether the government is *fair* or *rotten*. Each firm does not observe the other firm's choice of bribe and labor.

The structure of the model indicates that the optimal level of bribe is zero if the government is *fair*. On the other hand, if the government is *rotten*, the firms may be forced to pay positive bribe even if they know that the bribe is unproductive, that their profit will be smaller because of the bribe cost.

For a numerical exposition, the functional forms are specified as follows²⁾.

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$$p(q_1, q_2) = \frac{m}{\sqrt{q_1 q_2}} \quad (1)$$

$$q_i = l_i^\alpha v_i^{1-\alpha}, \quad 0 < \alpha < 1, \quad i=1, 2 \quad (2)$$

$$c_i(x_i) = \frac{1}{2} c x_i^2, \quad i=1, 2 \quad (3)$$

Equation (3) implies a convex (increasing) bribe cost. If the bribe is a pure transfer from the firms to the government, then the bribe cost function is simply expressed as

$$c_i(x_i) = x_i, \quad i=1, 2. \quad (3)'$$

In this case, a bribe is much like a lump-sum tax. Shleifer and Vishny (1993) pointed out the similarity and the difference between bribery and taxation. They argued that despite their similarity, bribes are more distortionary than taxes because of the efforts by corrupt bureaucrats to avoid detection. I employ specification (3) in the hope that it will capture such a property of bribes.

For simplicity, firms are assumed to be identical, i. e.,

$$\alpha_1 = \alpha_2 \equiv \alpha$$

$$c_1 = c_2 \equiv c.$$

Then, the profit function is simplified as

$$\pi_i = m (l_i / l_j)^{\alpha/2} - w l_i - \frac{1}{2} c x_i^2, \quad i, j=1, 2, \quad i \neq j \quad (4)$$

2) Equation (1) seems odd since one price is quoted for q_1 and q_2 even though they are not perfect substitutes from the view point of consumers. However, in a symmetric equilibrium on which we will focus in section 2 and section 3, equation (1) and a linear (inverse) demand function such as

$$p(q_1, q_2) = 2m / (q_1 + q_2) \quad (1)'$$

can yield exactly the same outcome. The point is that in the specifications (1) and (1)', the price level depends on the average of q_1 and q_2 ; the geometric average $(q_1 \cdot q_2)^{1/2}$ in (1) and the arithmetic average $(q_1 + q_2) / 2$ in (1)'. Though specification (1)' seems more natural than (1), we will use (1) since the consumers' surplus, the area below demand function, for the social welfare analysis can not be defined for (1)'.

if the government is *fair*, and

$$\pi_i = m(l_i/l_j)^{\alpha/2}(x_i/x_j)^{(1-\alpha)/2} - wl_i - \frac{1}{2}cx_i^2, \quad i, j=1, 2, \quad i \neq j \quad (5)$$

if the government is *rotten*. The Cournot-Nash equilibrium outcomes under each type of the government are calculated as follows. If the government is *fair*, then

$$l_1^* = l_2^* \equiv l^* = \frac{m\alpha}{2w} \quad (6)$$

$$x_1^* = x_2^* \equiv x^* = 0 \quad (7)$$

$$q_1^* = q_2^* \equiv q^* = (l^*)^\alpha (v/2)^{1-\alpha} = \left(\frac{m\alpha}{2w}\right)^\alpha \left(\frac{v}{2}\right)^{1-\alpha} \quad (8)$$

$$p^* = \frac{m}{(q_1^*)^{1/2}(q_2^*)^{1/2}} = \frac{m}{q^*} = \frac{m}{\left(\frac{m\alpha}{2w}\right)^\alpha \left(\frac{v}{2}\right)^{1-\alpha}} \quad (9)$$

$$\pi_1^* = \pi_2^* \equiv \pi^* = p^*q^* = wl^* - \frac{1}{2}c(x^*)^2 = m\left(1 - \frac{\alpha}{2}\right) \quad (10)$$

where the superscript “*” on the variables indicates the solution under the *fair* government. If the government is *rotten*, then

$$l_1^{**} = l_2^{**} \equiv l^{**} = l^* \quad (11)$$

$$x_1^{**} = x_2^{**} \equiv x^{**} = \left(\frac{m(1-\alpha)}{2c}\right)^{1/2} \quad (12)$$

$$q_1^{**} = q_2^{**} \equiv q^{**} = q^* \quad (13)$$

$$p^{**} = p^* \quad (14)$$

$$\pi_1^{**} = \pi_2^{**} \equiv \pi^{**} = \pi^* - \frac{m(1-\alpha)}{4} = m\left(\frac{3-\alpha}{4}\right) < \pi^* \quad (15)$$

where the superscript “**” on the variables indicates the solution under the *rotten* government.

The comparison of outcomes under the different types of government reveals that the level of labor input and output are the same for both

cases, however, the profit is smaller for the outcome under the *rotten* government because of the bribe cost accrued from positive bribes. By the symmetry of the firms the amount of input, v_1 and v_2 , allocated to each firm are the same ($v/2$) regardless of the types of government (therefore, labor input and output are the same, too). However, in the outcome under the *rotten* government, both firms are forced to pay positive bribes even though they are pure waste. Suppose $v_1=v_2=v/2$ when $x_1=x_2=0$ if the government is *rotten*. Obviously, $x_1=x_2=0$ does not constitute a Nash equilibrium. Each firm has an incentive to pay a (small) amount of bribe so that it can capture the entire v . In other words, sticking on zero bribe is dangerous for each firm. One firm gets zero input from the government, zero output and, thus, zero profit if the other firm pays some positive bribe however small it is.

From (15), the loss in profit under the *rotten* government positively depends on the intensity of v in production. That is, larger the value of $1-\alpha$, larger the loss in profit, $m(1-\alpha)/4$.

What are the implications of these results for social welfare?

Define the social welfare as the sum of consumers' surplus, producers' profits and the bribes paid to the government, i. e.,

$$W \equiv CS + [\pi_1 + \pi_2] + [x_1 + x_2] \tag{16}$$

where

$$CS \equiv \int_0^{q_1} \int_0^{q_2} p(q_1, q_2) dq_1 dq_2 - pq_1 q_2.$$

Remember that producers 1 and 2 produce the same amount, $q_1=q_2$, under the *fair* government and the *rotten* government. Therefore, the consumers' surplus is the same, too, regardless of the types of government. With the functional forms chosen here, it can be shown that $CS=3m \cdot (q_1 \cdot q_2)^{1/2}$. Then, from (7), (8) and (10),

$$W = 3mq^* + 2\pi^* \equiv W_f \tag{17}$$

if the government is *fair*, and from (12), (13) and (15),

$$W = 3mq^* + 2\left[\pi^* - \frac{m(1-\alpha)}{4}\right] + 2\left[\frac{m(1-\alpha)}{2c}\right]^{1/2} \equiv W_r \quad (18)$$

if the government is *rotten*. Subtract (17) from (18) to have

$$W_r - W_f = 2\left\{\left[\frac{m(1-\alpha)}{2c}\right]^{1/2} - \frac{1-\alpha}{4}\right\}. \quad (19)$$

Depending on the parameter values, this can be either positive or negative. Particularly, it is likely to have $W_r > W_f$ if c is small, i. e., the social welfare can be larger under the *rotten* government than that under the *fair* government. However, such an outcome is due to the specification of the cost function (3). The bribes, x_1 and x_2 , are transfers from the producers to the government. That is, in the economy as a whole, the government also participates in production activities together with the producers. When the government is *rotten*, output is $x_1 + x_2$, the bribe income to the government, and input (cost) is $c_1(x_1) + c_2(x_2)$, the bribe costs accrue to the producers. Therefore, the net output is

$$[x_1 + x_2] - [c_1(x_1) + c_2(x_2)] = 2\left\{\left[\frac{m(1-\alpha)}{2c}\right]^{1/2} - \frac{(1-\alpha)}{4}\right\} \quad (20)$$

which is equal to (19). If the government is *fair*, then the output is zero (zero bribe income to the government), and the input is also zero (zero bribe costs for the producers). Since the producers produce the same amount, $q_1 = q_2$, under the two different types of government, the only difference between the economy under the *fair* government and that under the *rotten* government is the net output, (20). Since the bribe cost function is convex in the amount of the bribe, $[x_1 + x_2] > [c_1(x_1) + c_2(x_2)]$ implies that to raise a \$1 bribe, it costs less than \$1 when the total bribe $x_1 + x_2$ is not large. Therefore, as we discussed before, if the bribe is much like a lump-sum tax, i. e., $c(x) = x$ (equa-

tion (3)'), then equation (20) implies that the social welfare under the *rotten* government is the same as that under the *fair* government.

3. Infinite-horizon Problem

The basic structure of the model is almost the same as that of the one-period model. However, to account for the long-run effect of the bribery, we take the Schumpeterian point of view. That is, the R & D activities of entrepreneurs generate the growth of firms. At any moment t , an entrepreneur has one unit of factor endowment (time) which will be divided into three different types of activities; $x(t)$ for bribery if necessary, $z(t)$ for direct production, and $1-x(t)-z(t)$ for R & D. The production function of firm i (entrepreneur i) is specified as

$$q_i(t) = A_i(t) z_i(t)^{\alpha_i} v_i(t)^{1-\alpha_i}, \quad 0 < \alpha_i < 1, \quad i=1, 2$$

where $A_i(t)$ is a technology measure which evolves as

$$\dot{A}_i = \delta_i A_i(t) (1-x_i(t)-z_i(t)), \quad \delta_i > 0, \quad i=1, 2$$

and $v_i(t)$ is the amount of input factor given by the government to firm i according to the rule

$$v_i(t) = \begin{cases} \frac{1}{2}v(t), & \text{if the government is fair} \\ \frac{x_i(t)}{x_1(t)+x_2(t)}v(t), & \text{if the government is rotten.} \end{cases}$$

Exogenous growth rate μ is assumed for $v(t)$, i. e.,

$$v(t) = v(0) \cdot e^{\mu t}.$$

The specification of demand function is the same as before, i. e.,³⁾

$$p(t) = \frac{m}{\sqrt{q_1(t)q_2(t)}}. \tag{21}$$

Given the structure of the model described above, entrepreneur i ,

3) As we mentioned before, a different specification $p(t) = 2m / (q_1(t) + q_2(t))$ generates the same outcome as (21) does in a symmetric equilibrium.

$i=1, 2$, chooses $\{x_i(t), z_i(t); t \geq 0\}$ to solve

$$\max \int_0^{\infty} p(t) q_i(t) e^{-\rho t} dt$$

subject to

$$\dot{A}_i = \delta_i A_i(t) (1 - x_i(t) - z_i(t)), \quad t > 0$$

$A_i(0)$ is given, and

$$\{x_j(t), z_j(t); t \geq 0\} \text{ is given, } j \neq i.$$

For simplicity, these two firms are assumed to be identical, i. e.,

$$\alpha_1 = \alpha_2 \equiv \alpha$$

$$\delta_1 = \delta_2 \equiv \delta$$

$$A_1(0) = A_2(0) \equiv A(0).$$

Then, the Hamiltonian for the problem under the different types of government is given by

$$H_i(z_i, x_i, A_i, \lambda_i) = m(A_i/A_j)^{1/2} (z_i/z_j)^{\alpha/2} + \lambda_i \delta A_i (1 - x_i - z_i), \quad i=1, 2, \quad i \neq j$$

if the government is *fair*, and

$$H_i(z_i, x_i, A_i, \varphi_i) = m(A_i/A_j)^{1/2} (z_i/z_j)^{\alpha/2} (x_i/x_j)^{(1-\alpha)/2} + \varphi_i \delta A_i (1 - x_i - z_i), \quad i=1, 2, \quad i \neq j$$

if the government is *rotten*.

It can be shown by straightforward calculations that the steady-state symmetric Nash equilibrium outcomes are; if the government is *fair*, then

$$z = \alpha \rho / \delta \tag{22}$$

$$x = 0 \tag{23}$$

$$\dot{A}/A = \delta - \alpha \rho \tag{24}$$

$$\dot{q}/q = (\delta - \alpha \rho) + (1 - \alpha) \mu \equiv g_F \tag{25}$$

$$q(t) = q(0) \exp[(\delta - \alpha \rho) + (1 - \alpha) \mu] t \tag{26}$$

$$q(0) = A(0) \left(\frac{\alpha \rho}{\delta} \right)^\alpha \left(\frac{v(0)}{2} \right)^{1-\alpha}, \tag{27}$$

and if the government is *rotten*, then

$$z = \alpha \rho / \delta \quad (28)$$

$$x = (1 - \alpha) \rho / \delta \quad (29)$$

$$\dot{A}/A = \delta - \rho \quad (30)$$

$$\dot{q}/q = (\delta - \rho) + (1 - \alpha) \mu \equiv g_R \quad (31)$$

$$q(t) = q(0) \exp[(\delta - \rho) + (1 - \alpha) \mu t] \quad (32)$$

and $q(0)$ is the same as (27).

The comparison of outcomes under the different types of government reveals several features. The choice of z is the same for both cases because of the symmetric nature of the equilibrium. Regardless of the types of government, each firm receives $(1/2)v(t)$ so the optimal combination of $z(t)$ with $(1/2)v(t)$ is the same for both cases. However, if the government is *rotten*, then each firm is forced to pay unproductive bribe which will reduce the level of R & D activities, as well as the rate of technological progress, \dot{A}/A . The difference in the growth rate of the output under the different types of government is

$$g_F - g_R = (1 - \alpha) \rho$$

which is the same as the difference in the rate of technological progress. Higher the intensity of $v(t)$ in production, $1 - \alpha$, larger the difference in growth rate.

Murphy, Shleifer and Vishny (1993) discussed about the effect of private rent-seeking and public rent-seeking on innovation activities and everyday production activities. They pointed out that the public rent-seeking is more harmful on innovation activities than on production “since innovators need government-supplied goods such as permits, licenses, import quotas, and so on.” (p. 412) In our model, the public rent-seeking hurts innovation activities because of the competition between the firms over the input resource owned by the government. Each firm is forced to spend the time for bribe activities in

such a way that the time spent for R & D activities decreases more than the time spent for production activities does. Ehrlich and Lui's (1992) model has a property similar to ours such that an individual tries to obtain a political power through the accumulation of *political capital* which is the source of bribe income if he/she has more political power than the others in a society. In an identical agents framework, every individual ends up with the same level of nonzero political capital investment which could have been used for more productive purpose.

At any moment, each producer's revenue is a constant, m , on the balanced growth path regardless of the types of government since the rate at which output increases and the rate at which price decreases are the same. Therefore, each producer earns the same discounted sum of revenue (which is equal to profit in our example)

$$\int_0^{\infty} m e^{-\rho t} dt = m/\rho$$

regardless of the types of government.

Following the same procedure we made at the end of section 2, the welfare implication of these results will be analyzed as follows. Define the instantaneous social welfare at time t as

$$W(t) \equiv CS(t) + [\pi_1(t) + \pi_2(t)] + [x_1(t) + x_2(t)] \quad (33)$$

where

$$CS(t) \equiv \int_0^{q_1(t)} \int_0^{q_2(t)} p(q_1, q_2) dq_1 dq_2 \\ - p(q_1(t), q_2(t)) q_1(t) q_2(t)$$

and

$$\pi_i(t) \equiv p(q_1(t), q_2(t)) q_i(t).$$

Notice that in the definition of social welfare for the one-period static model analysis (equation (16)), all the variables, CS , π_1 , π_2 , x_1 and x_2 are monetary measures, however, in definition (33), to CS , π_1 , π_2

which are monetary measures, x_1 and x_2 which are the time spent for bribe activities are added. Therefore, equation (33) may be regarded as an index for social welfare rather than a measure in which some specific unit of account is used.

From (23), (25) and (26),

$$W(t) = 3mq(0) \exp(g_F t) + 2m = W_F(t)$$

if the government is *fair*, and from (29), (31) and (32),

$$W(t) = 3mq(0) \exp(g_R t) + 2m + 2 \left[\frac{(1-\alpha)\rho}{\delta} \right] \equiv W_R(t)$$

if the government is *rotten*. Then, the social welfare is defined as

$$\Sigma_i(T) \equiv \int_0^T W_i(t) \exp(-r_g t) dt, \quad i = F, R,$$

where r_g is the social discount rate. Then, it can be shown that

$$\begin{aligned} & \Sigma_F(T) - \Sigma_R(T) \\ &= \int_0^T W_F(t) \exp(-r_g t) dt - \int_0^T W_R(t) \exp(-r_g t) dt \\ &= 3mq(0) \int_0^T \{ \exp[(g_F - r_g)t] - \exp[(g_R - r_g)t] \} dt \\ & \qquad \qquad \qquad - 2 \left[\frac{(1-\alpha)\rho}{\delta} \right] \frac{1 - \exp(-r_g T)}{r_g}. \end{aligned}$$

If $g_F > g_R > r_g$, then it is clear that

$$\Sigma_F(T) - \Sigma_R(T) \rightarrow \infty$$

as $T \rightarrow \infty$.

We can imagine two cases in which the social welfare under the *rotten* government exceeds that under the *fair* government. The first case is that the government heavily discounts the future such that $r_g > g_F > g_R$. Then, even if $T \rightarrow \infty$, we obtain

$$\begin{aligned} & \Sigma_F(T) - \Sigma_R(T) \\ & \rightarrow 3mq(0) \left[\frac{g_F - g_R}{(r_g - g_F)(r_g - g_R)} \right] - \frac{2}{r_g} \left[\frac{(1-\alpha)\rho}{\delta} \right] \end{aligned}$$

$$= 3mA(0) \left[\frac{\alpha \rho}{\delta} \right]^\alpha \left[\frac{v(0)}{2} \right]^{1-\alpha} \frac{(1-\alpha)\rho}{(r_g - g_F)(r_g - g_R)} \frac{2}{r_g} \left[\frac{(1-\alpha)\rho}{\delta} \right].$$

Therefore, depending on the parameter values, it is possible to have $\Sigma_F(T) < \Sigma_R(T)$. The second case is that the government is myopic, i. e., T is small. Define $T = T^*$ such that

$$\Sigma_F(T^*) = \Sigma_R(T^*).$$

Then for $T < T^*$,

$$\Sigma_F(T) < \Sigma_R(T)$$

and for $T > T^*$,

$$\Sigma_F(T) > \Sigma_R(T) \quad (\text{see figure 1}).^4)$$

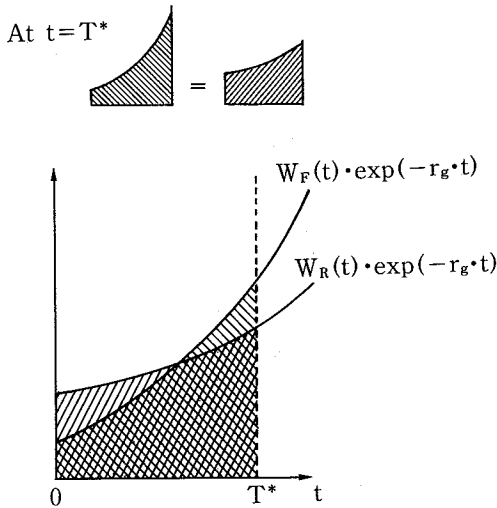


Figure 1

4) It is equivalent to say

$$\Sigma_F(T^*) - \Sigma_R(T^*) = 0$$

and

$$\begin{aligned} & \frac{d}{dT} \Big|_{T=T^*} \Sigma_F(T) - \frac{d}{dT} \Big|_{T=T^*} \Sigma_R(T) \\ &= W_F(T^*) \exp(-r_g T^*) - W_R(T^*) \exp(-r_g T^*) > 0. \end{aligned}$$

However, as discussed in the welfare analysis of the one-period model, if the bribe is a pure transfer from the firms to the *rotten* government, i. e., $c(x) = x$, then for any time horizon the social welfare under the *rotten* government can not be larger than that under the *fair* government.

4. Conclusion

Even though the analysis is limited to a partial equilibrium, our model reveals some insights about the performance of an economy in which an interdependence among economic agents about their actions and outcomes exists.

The two oligopoly firms are caught in the prisoner's dilemma when the government is *rotten*. Each firm is forced to pay a positive bribe even if the firm knows that the bribe is a waste since zero bribe does not constitute a Nash equilibrium. If the firms behave cooperatively, then they would have agreed not to pay bribe (or, small but the same amount of bribe) to the *rotten* government, and still gotten the one-half of the input resource for each of them. However, under the non-cooperative assumption, given the other firm's action, zero bribe, one firm has an incentive to deviate from zero bribe so that it can capture all the government owned input factor. Such properties are carried over to an infinite horizon problem. When the government is *rotten*, part of resource, which could have been used for R & D activities, is set aside for bribe activity which leads to a decrease in the output growth.

From the view point of a single firm, bribe is a waste. However, from the view point of the entire society, it is not necessarily a waste. The bribe is a transfer from the firms, which incur the bribe cost, to the government. If the cost is not very large, then the difference between the social welfare under the *fair* government and that

under the *rotten* government is not large in the short-run. However, in the long-run, the decrease in the level of R & D activities, due to the bribe paid to the *rotten* government, results in a large loss because of the lower output growth rate.

One may suggest several ways to extend this model. In this paper, we assumed for analytical simplicity that the two oligopoly firms are identical, which enables us to focus on the symmetric equilibrium. However, asymmetric characteristics of firms (such as the asymmetry in productivity, the asymmetry in information, etc.) may have a significant implication for the market structure and the role of government, especially in the long-run. Dasgupta and Stiglitz's (1988) argument will be a reference to this way of extension. Since our model is of a partial equilibrium, one may also want to extend the model to a general equilibrium framework. In this way of extension, we are able to analyze the role of imperfect competition and economic policy in an endogenous growth model by comparing the outcomes with those obtained under the perfect competition assumption. The references to this way of extension may be found in the research of monopolistic competition literature; Akerlof and Yellen (1985), Mankiw (1985) and Blanchard and Kiyotaki (1987).

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