Economic Analysis of Bureaucratic Corruption

DISSERTATION

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By

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1991
Dedicated To My Parents
And To The Memory Of My Grandmother
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TABLE OF CONTENTS

DEDICATION.................................................................ii
ACKNOWLEDGMENTS.........................................................iii
VITA...........................................................................iv
LIST OF FIGURES..............................................................vii

CHAPTER                                           PAGE
I.  INTRODUCTION............................................................1
II. LITERATURE SURVEY.......................................................7
III. THE PRODUCTION COST AND CORRUPTION......................15
IV. AGENTS' CORRUPTION IN THE MODIFIED NISKANEN MODEL.....22
    IV.1. The principal determines the output level and budget size
         based on the reported fixed costs and marginal costs........23
         a. Pareto-optimal output level and budget size..............24
         b. The principal has incomplete information about
            the fixed costs and marginal costs.......................25
            b.1. Output maximizing agency
            b.2. Discretionary budget maximizing agency
            b.3. Bribe-maximizing agency
         c. The principal has complete information about
            either fixed costs or variable costs......................34
            c.1. Fixed costs are public information
            c.2. Marginal costs are public information
IV.2. An agency reports constant average costs ..................................... 40
   a. The output maximizing agency .............................................. 42
   b. The discretionary budget maximizing agency .......................... 43
   c. Bribe-maximizing agency .................................................. 44

V. THE OPTIMIZATION OF THE CORRUPTION LEVEL .................................. 46

V.I. Homogeneous agents in the one sector model ................................. 48
   a. No-Corruption Equilibrium ............................................... 53
   b. Full-Corruption Equilibrium ............................................ 63

V.II. Heterogeneous agents in the one sector model ............................... 68
   a. Single contract .......................................................... 70
      a.1. No-Corruption Equilibrium
      a.2. Full-Corruption Equilibrium
      a.3. Partial-Corruption Equilibrium
   b. Self-selection contract .................................................. 81

V.III. Heterogeneous agents in the two sector model ............................. 89
   a. Short-run equilibrium in the two sector model ......................... 92
      a.1. No-corruption equilibrium in both sectors
      a.2. Partial-corruption equilibrium in both sectors
      a.3. Full-corruption equilibrium in both sectors
      a.4. No-corruption equilibrium in the private sector and
           partial-corruption equilibrium in the public sector
      a.5. Full-corruption equilibrium in the public sector and
           partial-corruption equilibrium in the private sector
      a.6. Full-corruption equilibrium in the public sector and
           no-corruption equilibrium in the private sector
   b. Long-run equilibrium in the two sector model .......................... 98

VI. ANECDOTAL EVIDENCES .......................................................... 104

VII. CONCLUSION ............................................................................... 113

LIST OF REFERENCES ......................................................................... 117

APPENDIX ......................................................................................... 121
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>FIGURES</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Equilibrium when the principal has incomplete information about the fixed costs and marginal costs</td>
<td>122</td>
</tr>
<tr>
<td>2. Equilibrium when fixed costs are public information</td>
<td>123</td>
</tr>
<tr>
<td>3. Equilibrium when marginal costs are public information</td>
<td>124</td>
</tr>
<tr>
<td>4. Interior solution of the no-corruption equilibrium</td>
<td>125</td>
</tr>
<tr>
<td>5. Corner solution of the no-corruption equilibrium</td>
<td>126</td>
</tr>
</tbody>
</table>
CHAPTER I
INTRODUCTION

Even though bribery plays an important role in resource allocation in many countries, especially in developing countries, economists have not paid a great deal of attention to this subject. Only after it was shown by Becker (1968) that economics can be a useful methodology in analyzing crime, has the analysis of corruption and bribes drawn attention from economists. Most of the literature, however, discussed a specific type of corruption, so that results from that literature pretty much depend on the specific role agents are playing. So we would like to build a model which is general in the sense that no specific type of corruption is introduced.

This research analyzes corruption of agents not only in the public sector as in other literature, but also in the private sector, which has not been discussed frequently in the context of corruption. I believe that there are two main reasons that corruption in the public sector has been more popular subject than that in the private sector. First, in political science corruption had been regarded as an important political problem by scholars long before economists attempted to analyze it. The main area of research in political science, of course, is the public sector. The dominance of the public sector in the discussion of corruption is no surprise since even
economists have focused on the government officials in analyzing corruption.

The second reason is that corruption by elected politicians (political corruption) is as important as corruption by agents employed by politicians (bureaucratic corruption) in the public sector whereas in the private sector the counterpart to the political corruption is not as important as agents' corruption. In actuality, political corruption sometimes becomes a bigger social issue than bureaucratic corruption and often appears in newspaper headline.

The fact that most scholars interested in corruption are investigating only the public sector makes it very hard to find the research that analyzes corruption in the private sector. Although corruption in the public sector draws more attention, it does not necessarily mean that corruption is absent in the private sector. If there is a certain level of corruption also in the private sector, it cannot be overlooked since the private sector generally has a greater share than the public sector in the economy. So, we do not confine the analysis to corruption within the public sector, and we try to derive a theory on corruption which can be applied in both sectors.

The analytical framework we employ in this research is the principal-agent model. In this framework, Banfield (1975) provides a proper definition of corruption, which is 'the knowing failure of agents to serve the interest of the principal for his own gain'. The definition which political scientists use such as "the practice of using the power of office for making private gain in breach of laws
and regulation nominally in force\textsuperscript{1} is not appropriate in this study since it is difficult to apply this definition to the private sector. In order to analyze corruption in the principal-agent framework, we need to specify characteristics of a principal and an agent. The existing principal-agent literature that focuses on the labor contract between the principal and agents in the private organization envisions the principal as the residual claimant who, monitoring the behavior of agents, offers a compensation structure to them to maximize the residual, namely profit. While this principal makes perfect sense in the private sector, it seems not appropriate to use this definition of principal in the public sector in which there is no residual claimant. Since corruption in both public sector and private sector is the subject in this study, it is necessary to define the principal so that we can use it in both sectors. The principal in this study is the one who has top monitoring authority in the organization. That is, the principal is the top monitor who cannot be monitored.\textsuperscript{2} According to this definition, a principal in the private sector would be the owner of a closely-held corporation or C.E.O. of an open corporation, and elected politicians in the public sector. Since our main interest in this study is the corruption of agents, we assume that there is no

\textsuperscript{1} From Andreski(1968).
\textsuperscript{2} A similar definition is found in Banfield(1975)
corruption of principals. Thus, we do not discuss political corruption in this study.³

As in all other principal-agent literature, asymmetric information plays a critical role throughout the study. For instance, if a principal is able to observe the corrupt activities of agents at no cost, then the imposition of a certain penalty on corrupt agents would be all we need in solving problems arising from corruption. It is not easy, however, for principals to observe exactly what agents are doing, especially when corruption is involved, because corrupt agents will try to cover up their corrupt activities. Within this principal-agent framework, we are going to investigate two primary subjects: the effect of corruption of agents on the output level of an organization and the principal's optimization of the corruption level. In the process of analyzing these two subjects, several interesting and relevant hypotheses will come out.

The next chapter reviews the existing economic literature on corruption. Although few economic studies analyze corruption, each contributes, in its own way, to our understanding of economic consequences of corruption. It would be, therefore, valuable as well as necessary to scrutinize assumptions each study makes in the specific type of corruption and examine results from those assumptions.

³ Corruption of principals in the public sector is well documented in Rose-Ackerman(1978).
The formal analysis of corruption starts in chapter III in which the effect of corruption on the cost function of an organization is analyzed. We will show that corruption increases costs of production in two different ways: on the input-side and on the output-side. The high costs of corruption become the basis for the following chapters.

In chapter IV, we focus on the public sector, but it should be kept in mind that the same analysis applies to the private sector as well since also in the private sector the information structure is asymmetric, and monitors (principal) and workers (agents) have different objectives. This chapter employs the Niskanen model in which the principal is 'passive' in a sense that he does not monitor the activities of agents. But we improve this model by showing that the institutional settings and informational structures are crucial in determining the output level and the budget size of an agency. In this improved model, it will be shown how corruption affects the output level of an organization, the budget size of an agency, and the welfare level of a principal.

If corruption of agents hurts the interest of the organization, which is assumed to coincide with that of the principal, the 'aggressive' principal has an incentive to monitor agents and impose penalties on corrupt agents. But monitoring agents and imposing penalties are not costless. As a result, a rational principal will look for the optimal set of monitoring and penalties. Chapter V deals with this optimization problem of the principal. The first section of this chapter analyzes the simplest case in which agents are
homogeneous and therefore only the moral hazard problem exists. In this section, we indicate that two different equilibria are possible in the optimum: no-corruption equilibrium and full-corruption equilibrium. Then, we will relax the homogeneity of agents assumption and introduce heterogeneous agents in the second section. Therefore, a principal faces not only the moral hazard problem but also the adverse selection problem. This extension adds another equilibrium in the optimum: partial-corruption equilibrium. Moreover, it has always been an interesting issue in the adverse selection problem to see what kind of a self-selecting contract is possible. This section will prove the existence of a self-selection contract and investigate the characteristics of this contract. The final section of chapter V will end the formal analysis by drawing some implications from the comparison between the public sector and private sector in the context of the optimization of corruption.

In chapter VI, we will show some anecdotal evidences from case studies on corruption to support the formal analysis from Chapter III to chapter V. Finally, Chapter VII concludes with implications of this research and some perspectives for future research.
CHAPTER II
LITERATURE SURVEY

Economic analyses of bribery and corruption stem from Becker's seminal paper (1968), where he analyzed illegal activities by introducing economic tools such as demand and supply. He showed that if apprehensions and conviction as well as punishments are costly, society should choose the optimal probability that an offense results in conviction and the optimal level of punishment to minimize the social loss in income from illegal activities. The optimal solutions derived are that the probability should be arbitrarily close to zero and the punishment sufficiently high. In deriving these solutions, he assumed that there was no constraint on the level of punishment. But if the punishment level cannot be high enough to counter incentives for criminal activities, Becker's solution loses its point, and monitoring becomes another viable solution. This is what Dickens, Katz, and Summers (1988) discussed in their employee crime model. They indicated that, although the size of bonds employees have to post in the employment contract can play the same role as the punishment in deterring crime, there are reasonable explanations for the constraint on the size of bonds which makes Becker's optimal solution infeasible. Those explanations are "liquidity constraints, firm moral hazard, legal restrictions on contracts, and social limits on bonding." In our
study, we follow them in assuming that the penalty level that a principal can impose is somewhat limited so that a positive level of monitoring could be optimal.

When illegal activities of an individual damage the organization in which he is employed, he can be removed from the job he is paid for with a positive probability. If this is the case, a relatively high compensation level acts just like a penalty or punishment in Becker's model since the difference between the compensation level from the present job and the alternative job can be interpreted as the opportunity costs of committing illegal activities. This idea was developed formally by Becker and Stigler (1974), who indicated that the compensation level of law enforcers should be at least as high as the expected income from bribery. Moreover, it was shown that the compensation level increases with the amount of bribes and decreases with the probability of detection.

Surprisingly, the argument by Becker and Stigler is not much different from the basic intuition of the efficiency-wage literatures, in which a wage rate higher than the equilibrium level can serve as a device to induce greater effort by agents.

Recently, Besley and McLaren (1990) extended the idea of Becker and Stigler by showing that high compensation to agents in the presence of corruption is not always optimal even though it deters

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corruption. He suggested that the optimal wage rate could be lower than the reservation wage rate if exogenously given monitoring is relatively effective.

Although Becker and Stigler mentioned the possibility of bribery in the law enforcement, extensive economic analysis on corruption began with works by Rose-Ackerman (1975, 1978), who developed the positive theory of corruption. She showed that the equilibrium size of bribes depends on the organization of private markets and the structure of government programs. In her model, both the gains to bribed officials and the profits to bribing private sellers are assumed to related to the level of bribery, the expected penalty level when they are caught, and moral costs of giving and receiving bribes. She discussed the incidence of corruption when a monopolistic bureau selects a best applicant for government needs. The first result is that there will be no corruption if government preferences are well defined and all products are identical. If products are differentiated, corrupt dealing becomes possible although there are well defined government preferences with which sellers should offer equally desirable quality-price combinations in order to be awarded a contract. In this case, she derived the various equilibrium bribery levels depending on the functional forms of the expected penalty and moral costs. When products differ and government preferences are vague, she predicts more corruption since firms can offer less desirable price-quality combinations and increase profits by corrupt dealings. The equilibrium bribery level in this case also depends on
the functional forms of the expected penalty to corrupt officials and firms, and moral costs. One of the interesting results she provided is that infinite bribes could be preferred by officials and sellers if both the penalty on the convicted firm is independent of the firm's revenue, which can be higher with bribes, and the penalty on officials is independent of bribery receipts.

After Rose-Ackerman observed the importance of the informational structure on government outputs in determining the equilibrium bribes, Cadot (1987) pointed out another important element of the informational structure when both bribees and bribers are heterogeneous. Corruption in his model arises when officials administrate a test to grant a valuable permit. With a possibility of denunciation, the wage income to officials is equivalent to the penalty if the denounced official is fired. This is not much different from the argument by Becker and Stigler. He derived equilibrium bribes under the different assumptions as to the information set of officials and candidates: perfect information, asymmetric information, and imperfect information on both sides. In the last case which is most important, he showed that the equilibrium bribes, derived from maximizing an an official's expected utility, increase with the discount rate and decrease with the wage rate and the degree of risk-aversion, while the effect of exogenously given job security has an ambiguous effect.

Although the general perception of corruption is mostly negative, some views in the literature maintained the view that corruption can enhance the efficiency of resource allocation. It was
argued by Kleinrock (1967) and Lui (1986) that corruption can increase the efficiency if the first-come first-served rule is used in allocating goods in the public sector and customers have different values of time. Kleinrock showed that bribing for a queue position is socially optimal if bribes offered are increasing with the value of time since the average value of time costs spent by the customers is minimized. Then, Lui proved that socially optimal bribing in the queue is consistent with the private optimization, and derived a bribery-maximizing service rate when a customer can decide not to join the queue. So, he indicated that bribery speeds up the system if the current service rate is lower than the bribery-maximizing service rate, and refuted Myrdal's hypothesis that corrupt officials may deliberately cause administrative delays to receive more bribes.

Similar efficiency-enhancing characteristics of corruption in a queueing system is argued by Rashid (1981), who investigated corruption in public utilities in LDC's where policy is oriented toward egalitarian. He showed that when more productive agents and less productive agents are given equal access to public utilities, for example the telephone system, bribes which can move more productive agents in front of the less productive in use of public utilities might bring efficiency gains.

We believe, however, that there are two aspects which should be noted when it is argued that bribery increases the efficiency of resource allocations. First, the efficiency gain of bribes is possible only when the existing mechanism for resource allocation such as the
first-come first-served rule is not operating efficiently. But there should be some reason for using this inefficient mechanism. For instance, distributive considerations could have a greater weight in social welfare than efficiency considerations. If this is the case, corruption could reduce welfare of the economy although increasing efficiency. Secondly, once a system of bribery becomes well-established, bribees start to pursue opportunities of bribes actively, and try to increase the amount that bribers are willing to pay. That is, extortion begins. Very slow service or sudden shutdown of telephone lines in busy times could be examples, and obviously these are inefficient.

Another efficiency effect of corruption was discussed by Beck and Maher (1986) and Lien (1987) in which the effect of corruption of contracting officials on resource allocation is analyzed. They showed that under the assumptions that every bidder participates in the bribery game and they have no moral costs of paying bribes, bribery is equivalent to the competitive bidding in that the most efficient supplier is chosen and the expected payoff of the winner is also the same as when firms negotiate privately with the government official for a government procurement contract. Beck and Maher noted that bribery is similar to competitive bidding in a government purchasing context in that the suppliers have incomplete information about the offers that other firms are making. Under the assumption that firms' information is modelled by the common distribution of gross profits, which are the predetermined contract invoice price minus the costs,
they derived the symmetric Nash equilibrium bribery strategy, and proved that both the equilibrium bribery strategy and the equilibrium bidding strategy provide the same expected payoffs. It is, therefore, shown that the bribery game has no efficiency loss in comparison with the competitive bidding procedures in that the same supplier wins the contract and pays same net-of-bribes prices to the government.

Lien extended the competitive bribery game to the asymmetric information case where the bribers do not know whether or not the official is corrupt. It was assumed that the corrupt official awards the contract on the base of bribery while the honest official awards the contract to the firm which has the lowest costs. He showed the existence of a Nash equilibrium in the competitive bribery game if the bribers have sufficiently close estimates of the probability that the official is corrupt. Then, the properties of this Nash equilibrium are indicated. First, he observed that it is always optimal for each firm to bribe if the firm has a positive probability that the official may be corrupt and the penalty is proportional to the bribes. A second property is that the firm which has higher estimates of the probability that the official is corrupt pays more bribes at the same realized cost level.

Although the positive analyses of corruption sometimes shows efficiency-enhancing characteristics, normative analyses provide results showing that corruption is socially harmful. Basically, the normative analysis on corruption rests on the idea that rent-seeking, namely bribe-seeking, activities lead to the waste of resources.
First, Johnson (1975) focused on the behavior of the corrupt government and explains the socially harmful effects of corruption. In his model, the corrupt government maximizes the gain from corruption subject to a self-imposed constraint and an externally imposed constraint. The latter constraint includes the legal costs of corruption and the competitive cost of corruption. The competitive cost of corruption is the reduction in the probabilities of being the government in the future as a result of corruption. He indicated the incentives for government to change the externally imposed constraint by spending some of its resources in order to make it difficult and costly to produce and transmit the information about corruption to the legal system and voters.

Another normative analysis was done by Billman and Katz (1987) who set the model where real resources are wasted in activities of being in the position to receive bribes.
CHAPTER III
THE PRODUCTION COST AND CORRUPTION

The principal-agent framework has proved to be useful in the analysis of public good provision. We could make the reasonable assumption that an elected politician (principal) and a bureaucrat (agent) have not only different utility functions but also asymmetric information about the cost function of public goods, just like the owner and the manager of the firm in the private sector. Moreover, it seems that the agency problem could be more serious in the public sector because the principal cannot claim the monetary residuals from the provision of public goods, and therefore he cannot use the optimal sharing rule of the residuals to give an incentive to the agent to maximize the net benefit of the provision of the public good. That is, both the allocation and production inefficiency of the bureaucratic provision of the public good can be considered as the agency costs, and corruption on the part of the agents is included in the agency costs as well.

The fact that the principal has incomplete information about the cost function of the public good makes it possible for an agent to extract bribes although those bribes would increase the costs of public goods.

In order to see how the cost function is related to the bribes,
we introduce two types of corruptions: input-side corruption and output-side corruption.

In input-side corruption, an individual or a private firm that supplies input in the production of the public good pays bribes to an agent to get a favor. Corruption in the government procurement process is a good example of input-side corruption. Output-side corruption is completely different from input-side corruption in that bribes are paid in the process of supplying the public good. Police corruption can be an example of output-side corruption.

Consider how the cost function of the public good is related to bribes in input-side corruption. Basically, corruption can affect two decisions made by an agent; from whom to demand and how much to demand. It is assumed that a clean agent demands the optimal amount of input from the most efficient input supplier, who bids the lowest input prices. Now, corruption distorts both decisions of the agents. The literature on corruption usually focuses on the effects of corruption in the first decision making process. Beck and Maher (1986) showed an isomorphism between bribery and competitive bidding in that the most efficient supplier is awarded a contract. But their result is based on the very restricted assumptions of competitive bribery and no moral costs of corruption. Rose-Ackerman (1975) indicated that the different moral costs of the suppliers prevent the most efficient supplier from winning a contract.

When bribes take the form of kickbacks out of revenue, we observe the typical case where corruption distorts the first decision
making process of an agent. Generally, the contract price will be higher by at least as much as the amount of bribes. More formally, the cost function (C) is

\[(\text{III.1})\quad C = z_c(X, \xi_c, \xi_1 \ldots \xi_n) + \sum_{i=1}^{n} z_i(X, \xi_c, \xi_1 \ldots \xi_n).\]

where \(\xi_i\) : input price
\(z_i\) : input demand.

In the cost function (III.1), subscript \(c\) denotes the input price paid to a corrupt firm and the input demand from the corrupt firm. Therefore, in the case of kickbacks,

\[(\text{III.2})\quad \xi_c = \xi'_c + R,\]

Where \(\xi'_c\) = payment to a corrupt supplier excluding kickbacks
\(R\) = bribery level (kickbacks).

Generally,

\[(\text{III.3})\quad \xi'_c \geq \xi^e_c\]

Where \(\xi^e_c\) = input price from the most efficient supplier
Then from (III.1),

\[(III.4) \quad \frac{\partial C}{\partial R} = (\frac{\partial \xi_c}{\partial R})z_c > 0.\]

In the derivation of (III.4), it is assumed that \(\frac{\partial z_c}{\partial R} = \frac{\partial z_1}{\partial R} = 0,
which means that bribery does not change input demand.

Another form of input-side corruption occurs when \(\frac{\partial z_c}{\partial R} > 0\).

That is, corruption distorts the second decision making process of an agent. Compared to the many discussions on the first case of distortion by corruption, the second case of distortion has not drawn much attention from researchers. Suppose that a corrupt agent is induced to demand more input \((z_c)\) from the corrupt firm than the cost minimizing level. Then, the cost function is

\[(III.5) \quad C = \xi_c z_c (X, \xi_c, \xi_1 ... \xi_n, R) + \xi_1 z_1 (X, \xi_c, \xi_1 ... \xi_n)\]

where \(z_c(...R) > z^*\)

and \(z^*\): the cost minimizing input demand.

Therefore,

\[(III.6) \quad \ell_c/L_1 = (\partial f/\partial z_1)/(\partial f/\partial z_c)\]

where \(X = f(\quad z_c, z_1 ... z_n)\).
This indicates that the cost will be higher with bribes because the cost minimization condition is not satisfied. That is,

\[(III.7) \quad C(\ldots R) > C^*\]

where \(C^*\): the cost of the clean agent

Of course, it is possible that both cases of the input-side corruption occur simultaneously. Then, the cost increasing effects of bribes will be stronger.

We are able to observe a realistic example of this input-side corruption. Department of Defense produces the national defense which is a public good, and jet fighters are among the many inputs that are used to produce national defense. Usually, officials of the Department of Defense procure jet fighters from the private sector. The first type of input-side corruption is that the government official pays an inflated invoice price to the corrupt firm, which kicks back a portion of the invoice price to the official. The second type is that a private supplier bribes an official to procure more jet fighters than the cost minimizing level, and therefore the cost of producing the same level of national defense will be higher.

Whereas input side corruption increases the costs of producing a public good directly, output side corruption affects the costs in an indirect way. The literature on the principal-agent problem provides us with a suitable model where we can analyze the effect of the output-side corruption on the cost function of the public good. It is
assumed in those models that the output level depends on not only the input level and technology but also the activities or effort levels of agents. It is also assumed that the principal has incomplete information about the effort levels the agents are making. These principal-agent problems are equally applied to the public sector in which unobservable efforts of agents are derived from agents' utility maximization subject to a reward structure which includes bribes.

In order to look at the relationship between costs and efforts, we represent the output level as a function of both the input level and the efforts level.

\[(III.8) \quad X = f(z^*, e^*), \frac{\partial f}{\partial z} > 0 \text{ and } \frac{\partial f}{\partial e} > 0\]

where \(z^*\); cost minimizing input level
\(e^*\); utility maximizing efforts level.

Then,

\[(III.9) \quad dX = f_z dz^* + f_e de^* \]

From \(dX = 0\),

\[(III.10) \quad \frac{dz^*}{de^*} = -\frac{f_e}{f_z} < 0,\]

\[(III.11) \quad \frac{\partial C}{\partial e^*} = \xi(dz^*/de^*) < 0.\]
So, if the efforts of an agent are related to the bribes he can extract, we expect that corruption can affect the costs of public good. When an agency is running coercive programs, bribes have a negative relationship with efforts (Rose-Ackerman; 1978). Then, bureaucrats decrease their efforts in order to receive more bribes. For example, if the anti-pollution regulatory agency that produces 'clean air' as a public good is not detecting a violating firm which bribes its agent, then the output level of the public good is decreasing with same level of inputs used. Another example of this type is police corruption in which the crime prevention is decreasing due to bribes because the corrupt police are not carrying out their efforts to arrest the criminals who pay the bribes. Accordingly, the cost function is

\[(III.12) \quad C = C (X, e), \text{ and } e = e(R).\]

If \(e'(R) < 0\),

\[(III.13) \quad \frac{\partial C}{\partial R} > 0 \text{ from (III.11).}\]

From (III.2), (III.5), and (III.7),

\[(III.14) \quad C = C (X, R), \text{ and } \frac{\partial C}{\partial R} > 0.\]

That is, the cost is increasing with the level of bribery.
CHAPTER IV

AGENTS' CORRUPTION IN THE MODIFIED NISKANEN MODEL

After Niskanen (1971) emphasized the monopoly power of a agency in the supply of public goods, many public sector economists have acknowledged the importance of the behavior of the agency. Migue and Belanger (1974) provided a model in which it is assumed that agents get utility from the discretionary budget as well as the output level. They concluded that the output level of agencies does not exceed the Pareto efficient level as much as Niskanen has shown even though the budget of a agency is always too large. Another criticism on Niskanen’s theory was by Breton and Vintrobé (1975) who emphasized the role of the control devices politicians can use to monitor the behavior of agencies.

Whereas the traditional bureaucratic approach argues that the lack of monitoring activities of the politicians indicates the independence of the bureau, Weingast (1984) and Weingast and Moran (1985) suggested that this lack of explicit monitoring activities indicate the smooth working of the politician’s implicit control over bureaus. They supported their argument with empirical tests on the behavior of the regulatory agencies.

In order to overcome some criticisms of the Niskanen model, we envision two different institutional settings. In the Niskanen model,
a sponsor (principal) is assumed to be completely passive in a sense that a agency decides output level and the budget size and makes an all-or-nothing offer to the principal. Several papers criticized this unrealistic assumption, and proposed more realistic models which consider the interactions between a principal and an agency (Moene (1986), Chan and Westelman (1988)). In our first institutional setting, an agency reports fixed costs and marginal costs to a principal. Then, the principal decides the level of public good provision and the budget size. Mumy and No (1989) and Moene (1986) used similar setting to ours, but Moene employed partial equilibrium analysis and Mumy and No assumed a quasilinear utility function on the part of a principal. In both models, therefore, reported fixed costs do not affect the output decision of the principal. In our model, the general equilibrium framework is used and no specific utility form is assumed.

In our second setting, the principal decides the output level and grants the budget according to the constant average cost reported by the agency. In the complete information, this institution is Pareto inferior if there are fixed costs. But, since the essence of the Niskanen model is incomplete information, we can draw interesting implications from this setting.

IV.1. The Principal Determines the Output Level and the Budget Size Based on the Reported Fixed Cost and Marginal Cost
a. The Pareto-Optimal Output Level and the Budget Size

First, we derive Pareto-optimal outcomes which are used as a benchmark. These outcomes can be derived when the principal is fully informed about the true cost function.

The principal's optimization problem is as follows.

\[
\begin{align*}
\text{(IV.1) } & \text{ Max } U = U( X, Z ), \\
& \text{ s.t. } a + bX + Z = I, \\
& \quad X \geq 0, \\
& \text{ where } U = \text{ utility function of the sponsor,} \\
& \quad X = \text{ a public good,} \\
& \quad Z = \text{ the private numeraire good,} \\
& \quad a = \text{ true fixed costs,} \\
& \quad b = \text{ true marginal costs,} \\
& \quad I = \text{ income.}
\end{align*}
\]

From the f.o.c.,

\[
\begin{align*}
\text{(IV.2a) } & U'_X - \lambda b \leq 0, \text{ and } X(U'_X - \lambda b) = 0, \\
\text{(IV.2a) } & U'_Z - \lambda = 0, \\
\text{(IV.2c) } & I - a - bX - Z = 0.
\end{align*}
\]

The interior solution is given by the followings.
(IV.3) \[ x^* = x^*(b, I-a), \]
\[ z^* = z^*(b, I-a). \]

And the corner solutions are

(IV.4) \[ x^* = 0, \]
\[ z^* = I, \]

if and only if \( u_x / u_z \leq b \), or \( a > I - E(b, U(0,I)) \), where \( E \) is the minimized expenditure function subject to \( U(0,I) \).

Two conditions for the corner solutions should be kept in mind because these are upper bounds when an agency reports fixed costs and marginal costs. The first condition is not unusual since we get a similar condition in consumer theory in basic microeconomic theory, but the second one is unique to this model.

In figure 1, point \( p \) denotes the Pareto-optimal outcome, and \( U^* \) is the highest utility level in the perfect information case.

b. The Principal Has Incomplete Information about the Fixed and Marginal Costs

In this section, it is assumed that an agency knows the utility function of the principal while the latter does not know the true cost function of the agency. Then the principal’s optimization problem is given by
\[(IV.5) \quad \max_{X', Z} U = U(X, Z) \]
\[\text{s.t. } a' + b'X + Z = I,\]
where \(a'\) = reported fixed costs,
\(b'\) = reported marginal costs.

From the f.o.c.,

\[(IV.6a) \quad \frac{U_x}{U_z} = b',\]
\[(IV.6b) \quad a' + b'X + Z = I.\]

Then the solutions are followings.

\[(IV.7) \quad X' = X'(b', I-a'),\]
\[Z' = Z'(b', I-a').\]

The next step is to derive \(a'\) and \(b'\) from the agency's optimization, where we need to specify the utility function of the agency and the constraints the agency faces. With respect to the utility function, we assume three types of the agencies: the output-maximizer, the discretionary budget-maximizer, and the bribe-maximizer. The agency faces two constraints. The first is given by the conditions for corner solutions in the preceding section, since the agency does not exist if no output is demanded by the principal. The second is that the budget given by the principal should cover the true costs.
b.1. The Output Maximizing Agency

First, the formally described output maximizer's optimization problem is

\[(IV.8) \quad \max_{a', b'} \quad X = X(b', I-a'),\]

s.t. \[V(b', I-a') \geq \bar{V},\]
\[a' + b'X' \geq a + bX,\]

where \(V\) = indirect utility function,
\[\bar{V} =\] utility level when \(X=0\) and \(Z=1\).

From the Kuhn-Tucker Necessary Condition (K-T.N.C.):

\[(IV.9a) \quad 2X/\partial a' + \lambda_1 V/\partial a' + \lambda_2 (1 + b'2X/\partial a' - b2X/\partial a') = 0,\]
\[(IV.9b) \quad 2X/\partial b' + \lambda_1 V/\partial b' + \lambda_2 (X + b'2X/\partial b' - b2X/\partial b') = 0,\]
\[(IV.9c) \quad V - \bar{V} \geq 0, \quad \lambda_1 \geq 0, \text{ and } \lambda_2 (V - \bar{V}) = 0,\]
\[(IV.9d) \quad (a' + b'X') - (a + bX) \geq 0, \quad \lambda_2 \geq 0,\]

and \[\lambda_2 ((a' + b'X') - (a + bX)) = 0.\]

From the above K-T.N.C., the equilibrium reported fixed cost \(a^o\) and marginal cost \(b^o\) of the output maximizing agency are
derived, and $X^o = X^o(b^o, I-a^o)$ from (IV.7) where superscript o stands for the optimal value of the output maximizing agency.

From (IV.9a) and (IV. 9b), $\lambda_2$ is positive, and therefore $a^o+b^oX^o$ is equal to $a+bX^o$ from (IV. 9d). In order to derive equilibrium $a^o$ and $b^o$, we can use Roy's Identity that $(\partial V/\partial b^o)/(\partial V/\partial a^o) = X^o$. After some calculations,

(IV.10) \[ b^o = b - 1/\lambda_2, \]

(IV.11) \[ a^o = a + (1/\lambda_2)X^o. \]

The characteristics of the solutions can be easily shown in Figure 1, where the point o denotes the equilibrium point of the output maximizer. First, $U(X^o, Z^o) = U(0, I)$, and $a^o+b^oX^o = a+bX^o$. These results imply that the principal's utility level from the public good provision is the same as that from no public good provision, but there is no production inefficiency because the budget of the agency is equal to the minimized costs. These implications are similar to those from the original Niskanen model.

Next, note that $a^o > a$, and $b^o < b$. That is, the output maximizing agency reports higher fixed costs and lower marginal costs than the true costs. Of course, $X^o > X^*$, and $Z^o < Z^*$. Therefore, it is proposed that, if the agency is an output maximizer and the principal
has incomplete information about the cost function, too much public
good is provided and the utility level of the principal does not
increase with the public good provision even if the principal decides
the output level and the budget size.

In some cases, it is possible that no fixed input is needed in
the production of the public good and the principal knows this fact.
Therefore, the agency cannot report positive fixed costs which means
that $a^o = 0$. In this case, we have interesting results on $b^o, x^o,$ and
$U(x^o, z^o)$. From (IV.9b), if $\partial x^o / \partial b^o < 0$, then $\lambda_2 > 0$. This implies that
$b^o = b$. That is, if the principal's demand for the public good
decreases with the reported marginal costs, the output maximizing
agency reports the true marginal costs. Also, $x^o = x^*$, and $z^o = z^*$. So,
we have Pareto-optimal results.

What if $\partial x^o / \partial b^o > 0$? This case is similar to the Giffen good in
the consumer theory. If the principal's demand for the public good
increases with the reported marginal costs, $b^o$ is higher than $b$, and
$x^o$ is greater than $x^*$.

b.2. The Discretionary Budget Maximizing Agency

The discretionary budget is defined as the budget granted by the
principal less the true costs. Then the equilibrium outcomes are
derived from the following optimization problem.
\[(IV.12) \quad \max_{a', b', (a' + b'X)} - (a + bX), \]
\[
\text{s.t. } V(b', I - a') \geq \bar{V},
\]
\[
a' + b'X \geq a + bX.
\]

From the Kuhn-Tucker Necessary Condition,

\[(IV.13a) \quad 1 + b' \partial X / \partial a' - b \partial X / \partial a' \lambda_1 + \lambda_2 \partial V / \partial a' = 0,\]

\[(IV.13b) \quad \chi + b' \partial X / \partial b' - b \partial X / \partial b' + \lambda_1 \partial V / \partial b' + \lambda_2 \partial X (\chi + b' \partial X / \partial b' - b \partial X / \partial b') = 0,\]

\[(IV.13c) \quad V(b', I - a') - \bar{V} \geq 0, \lambda_1 \geq 0, \text{ and } \lambda_1 (V - \bar{V}) = 0,\]

\[(IV.13d) \quad (a' + b'X) - (a + bX) \geq 0, \lambda_2 \geq 0, \text{ and } \lambda_2 ((a' + b'X) - (a + bX)) = 0.\]

We denote equilibrium values in the discretionary budget-maximizing agency case with a superscript d. Since the agency tries to maximize the discretionary budget, \(a^d + b^dX^d\) is greater than \(a + bX^d\), and \(\lambda_2 = 0\) from \((IV.13d)\). Then, \((IV.13a)\), \((IV.13b)\), and Roy's Identity indicate that \(b^0\) is equal to \(b\). That is, the discretionary budget maximizing agency reports true marginal costs to the principal. And \(a^0\) is higher than \(a\) in order to have a greater budget. But the agency cannot report infinitely high fixed costs because of the constraint \((IV.13c)\). This implies that the specific value of \(a^d\) is determined by \((IV.13c)\).
Next, what are the output level $X^d(b^d, I - a^d)$ and the budget size $a^d + b^d X^d$? The conventional bureaucratic model provides the result that the discretionary maximizing agency's output level is the Pareto optimal level and the budget size is greater than the true minimum costs for the Pareto-optimal output level. But this result does not always hold in a general equilibrium framework like ours. Consider the usual case where both $X$ and $Z$ are normal goods. In this case, $X^d$ is less than $X^*$ since $a^d$ is greater than $a$. Moreover, because $Z^d$ is less than $Z^*$, $a^d + b^d X^d$ is greater than $a + bX^*$. Point $d$ in Figure 1 represents this case.

If $X$ is an inferior good and $Z$ is a normal good, $X^d > X^*$ and $a^d + b^d X^d > a + bX^*$. Therefore, only when $X$ is neither a normal good nor an inferior good, the result of the conventional model holds. If $Z$ is an inferior good, $a^d + b^d X^d < a + bX^*$.

As in the preceding section, consider the case where there is no fixed cost. In this case, $\lambda_1$ is zero because the first constraint is not binding. The reason for this is that, if the agency reports such a high marginal cost that $V(b^d, I) = \overline{V}$, then $X^d$ will be zero and this is not what the agency wants to have. Given this condition, (IV.13b) becomes

$$X^d + b^d a^d / 2b^d - b^d X^d / 2b^d = 0.$$
Then we have the following equilibrium condition:

\[(IV.14) \quad b^d = b - x^d (\partial x^d / \partial b^d)^{-1}.\]

This implies that the reported marginal cost is higher than the true marginal cost as long as the output level demanded by the principal decreases with the reported marginal cost.

\[b.3. \text{The Bribe-Maximizing Bureaucracy}\]

Given the fact that corruption increases the cost of producing public goods, we need to specify two kinds of corruption, of which one increases fixed costs and the other increases the variable costs. So we define $R_f$ as the bribery level which increases fixed costs and $R_v$ as the bribery level which increases variable costs. Then the cost function becomes

\[(IV.15) \quad C(X, R) = a(R_f) + b(R_v)X, \text{ and } \partial a / \partial R_f > 0, \partial b / \partial R_v > 0,\]

where $R$ (total bribes collected) = $R_f + R_v$.

The optimization problem of the bribe-maximizing agency is as follows:

\[(IV.16) \quad \max_{R, a', b'} R = R_f + R_v,\]

\[\text{s.t. } V(b', I - a') \geq \bar{V},\]
\[ a' + b'X \geq a(R_f) + b(R_v)X. \]

From the Kuhn-Tucker Necessary Condition,

(IV.17a) \[ 1 - \lambda_2 (\partial a/\partial R_f) + (\partial b/\partial R_v)X = 0, \]

(IV.17b) \[ \lambda_1 \partial a/a' + \lambda_2 (1 + b \partial X/a' - b(R_v) \partial X/a') = 0, \]

(IV.17c) \[ \lambda_1 \partial b/b' + \lambda_2 (X + b' \partial X/b' - b(R_v) \partial X/b') = 0, \]

(IV.17d) \[ \nu (b', I-a') - \bar{V} \geq 0, \lambda_1 \geq 0, \text{ and } \lambda_1 (\nu - \bar{V}) = 0, \]

(IV.17e) \[ (a' + b'X) - (a(R_f) + b(R_v)X \geq 0, \lambda_2 > 0, \]

and \[ \lambda_2 (a' + bX - a(R_f) - b(R_v)X) = 0. \]

In this section, superscript c denotes the equilibrium value in the bribe-maximizing agency case. From (IV.17a), \( \lambda_2 > 0 \). Therefore, \( a^c + b^cX^c = a(R_f) + b(R_v)X^c \) from (IV.17e). Next, (IV.17b), (IV.17c), and Roy's Identity show that \( b^c \) is equal to \( b(R_v) \). Since the second constraint is binding, \( a^c \) is also equal to \( a(R_f) \). Finally, from (IV.17b) or (IV.17c), \( \lambda_1 > 0 \) which implies that \( \nu = \bar{V} \).

As we did in the previous sections, we can show the equilibrium point by using a diagram (Figure 1), where point c denotes the equilibrium point of a corrupt agency. That is, the corrupt agency
reports higher fixed costs and marginal costs than true fixed and marginal costs, and the output level is almost surely lower than the Pareto-optimal level because of the substitution effect as well as the income effect.

Now, we are ready to demonstrate interesting comparisons among the output-maximizing agency, the discretionary budget-maximizing agency, and the bribe-maximizing agency. We claim that

\[(IV.18)\quad b^c > b^d = b > b^o,\]
\[(IV.19)\quad a^o > a^d > a^c > a,\]
\[(IV.20)\quad x^o > x^d > x^c,\]
\[(IV.21)\quad B^o > B^d > B^c,\]

where \(B\) = the budget size of the agency.

c. The Principal Has Complete Information About Either Fixed Costs or Variable Costs

The assumption that the principal knows true fixed costs or variable costs of the agency provides some interesting implications from both the positive and the normative point of view. Positively, it would explain why agencies that are producing different public goods behave differently. In our analysis, the focus is on the fact that some agencies produce public goods, the fixed costs of which are easy
to observe and some produces the public good whose variable costs are easy to observe. Depending on the type of public goods agencies produce, different behavior of the agency is expected.

If the principal could acquire perfect information about fixed costs and variable costs, the resulting welfare level will be the first-best level. But it is costly to acquire perfect information. With scarce resources, the principal has to decide which is more welfare-improving, monitoring fixed costs or variable costs. As a matter of fact, in some cases that we analyze below, monitoring only fixed costs is enough to achieve the first-best welfare level.

c.1. Fixed Costs are Public Information

If the principal knows true fixed costs, the reported fixed costs of the agency should be equal to the true fixed costs, which means that $a^o = a^d = a^c = a$. Therefore, we do not need to consider (IV.9a) (IV.13a) and (IV.17a) in each type of agency, since the remaining K-T.N.C.'s provide the equilibrium conditions in this section.

First, for the output-maximizing agency, $\lambda_2$ is positive from (IV.9b), and (IV.9d) is binding. Then, $b^o = b$ because $a^o = a$. This indicates that the output-maximizing agency reports the true marginal cost and the output level is the Pareto-optimal level. In Figure 2, point p is the equilibrium point of the output-maximizing agency.
Secondly, for the discretionary budget-maximizing agency, (IV.13b) is not binding and $\lambda_2$ is zero. And $b^d$ is higher than $b$ from (IV.13d). The next question is whether or not (IV.13c) is binding. The answer depends on the utility function of the principal. To draw more specific results, we represent (IV.13b) in the different way.

\[(IV.13b') -z/a'b' - b(\Delta x/a'b') + \lambda_1(\Delta v/a'b') = 0,\]

because $x + b'(\Delta x/a'b') = -z/a'b'$ from the budget constraint of the principal. In (IV.13b'), if $z/a'b' < -b(\Delta x/a'b')$, $\lambda_1$ should be positive and (IV.13c) is binding which implies that the principal's welfare is not increased from the public good provision. An interesting implication is that, if the public good and the private good are complements, monitoring fixed costs does not increase the welfare level. In Figure 2, the equilibrium of the discretionary budget-maximizer is described by point $d$ in the case of not-binding constraint. The equilibrium of the binding constraint case coincides with that of the bribe-maximizer, which we analyze below.

Finally, consider the characteristics of the equilibrium when the agency is corrupt. If the principal has perfect informations about fixed costs, the agency cannot extract bribes from fixed input, and therefore $R_f$ does not exist. Then, (IV.17a) becomes
(IV.17a') \( 1 - \lambda_2 (\partial b / \partial R_v) X^c = 0. \)

From above condition, \( \lambda_2 > 0 \), which means that \( b^c = b(R_v) > b \) from (IV.17e). To see whether (IV.17d) is binding, we rewrite (IV.17c) as the following:

(IV.17c') \( \lambda_1 \partial v / \partial b^c + \lambda_2 x^c = 0. \)

The above condition indicates that \( \lambda_1 \) is positive, and (IV.17d) is binding. So, if the agency is corrupt, monitoring fixed costs does not increase the welfare level as long as bribes can be extracted from variable inputs. Point \( c \) in Figure 2 represents the equilibrium of this case.

In summary, if the principal knows true fixed costs,

(IV.22) \( b^c \geq b^d > b^o = b \),
(IV.23) \( x^* = x^o > x^d \geq x^c \),
(IV.24) \( u^* = u^o > u^d \geq u^c = \bar{u} \).

c.2. Marginal Costs are Public Information

If the principal knows true marginal costs, the agency cannot report marginal costs different from the true marginal costs, which
implies that \( b^0 \cdot b^d = b^c = b \). Then, we need not consider (IV.9b) (IV.13b) and (IV.17b) in the agency's optimization problems, since the reported fixed costs are the only choice variable for the agency.

If the agency is an output maximizer, from (IV.9a),

\[(IV.9a') \exists x^0/\partial a^0 + \lambda_1 \partial v/\partial a^0 + \lambda_2 = 0.\]

In the above condition, if \( \exists x^0/\partial a^0 < 0, \lambda_2 > 0 \). That is, if the public good is a normal good, the constraint (IV.9d) is binding, and therefore \( a^0 = a \). In this case, the output level is the Pareto-optimal level, and point p in Figure 3 is the equilibrium.

If the public good that the agency is producing is an inferior good, \( a^0 \) will be higher than true fixed costs and \( x^0 \) will be greater than \( x^* \). In this case, \( \lambda_1 \) is positive which means that \( V(b, I-a^0) = \bar{v} \) from which \( a^0 \) can be derived. As a matter of fact, the equilibrium conditions of the inferior good case are the same as those in the case of the discretionary budget-maximizer analyzed below.

If the agency is a discretionary budget-maximizer, from (IV.13a),

\[(IV.13a') 1 + \lambda_1 \partial v/\partial a' = 0.\]
Then \( \lambda_1 \) is positive, and consequently \( V(b, 1-a^d) = \bar{V} \). In this case,

\[ x^d < x^* \] if the public good is a normal good, and \( x^d > x^* \) if it is an inferior good. In both cases monitoring the marginal costs of the discretionary budget maximizing agency does not increase the welfare level. In Figure 3, point d shows the equilibrium of the discretionary budget-maximizer when the public good is a normal good.

Finally, consider the case where the agency is corrupt. Since the principal knows the true marginal costs, \( R_v = 0 \). Then, from (IV.17a) and (IV.17c), it is easily shown that \( \lambda_1 > 0 \) and \( \lambda_2 > 0 \). Therefore,

\[ a^c = a(R_f) \text{ and } V(b, 1-a^c) = \bar{V}. \]

Note that \( x^c = x^d \).

In summary, when the public good is a normal good,

\[
\begin{align*}
(IV.25) \quad & a^c = a^d > a^o = a, \\
(IV.26) \quad & x^c = x^d < x^o = x^*, \\
(IV.27) \quad & \bar{U} = u^c = u^d < u^o = U^*. 
\end{align*}
\]

When the public good is an inferior good,

\[
\begin{align*}
(IV.28) \quad & a^c = a^d = a^o > a, \\
(IV.29) \quad & x^c = x^d = x^o > x^*, \\
(IV.30) \quad & \bar{U} = u^c = u^d = u^o < U^*. 
\end{align*}
\]
IV.2. An Agency Reports Constant Average Costs

In the preceding section, we analyzed the institutional setting where the agency reports the fixed costs and marginal costs information from which the principal determines the output level and the budget size. In that setting, the welfare level of the principal does not increase with the provision of the public good if the principal has incomplete information about both fixed costs and marginal costs. In this section, we propose another institutional setting which is better in that the welfare level of the principal is improved without monitoring the cost function. In this setting, the agency reports the constant average cost and the principal determines the output level and the budget size.

As in the previous section, it is assumed that both fixed input and variable input are needed to produce a public good (X). Although we assume constant marginal costs, the true average costs is not constant as long as there are fixed costs. This indicates that the output level cannot be Pareto-optimal if the agency should report the constant average cost.

In order to derive the public good level and the resulting welfare level in this setting, the first step we should take is to analyze the principal's optimization problem:

\[(IV.31) \quad \max_{X,Z} U(X, Z),\]
s.t. \[ I = Z + \sigma X, \]
\[ X \geq 0, \]

where \( \sigma \) = the reported average cost from the agency.

From the Kuhn-Tucker Necessary Condition,

\[
\text{(IV.32a)} \quad \frac{U_X}{U_Z} \leq \sigma, \text{ and } X(\frac{U_X}{U_Z} - \sigma) = 0,
\]

\[
\text{(IV.32b)} \quad I = Z + \sigma X.
\]

Therefore, the equilibrium levels of \( X \) and \( Z \) demanded by the principal are a function of \( \sigma \). Since we assume that the agency has complete information about the principal's utility function and the principal decides how much of the public good to produce, what the agency does is to determine \( \sigma \) to maximize its own utility subject to (IV.32a) and (IV.32b) as well as the feasibility constraints. From (IV.32a), if \( \frac{U_X}{U_Z} < \sigma, X = 0 \) which means that no agency is necessary. In other words, the agency must report \( \sigma \) that is not higher than \( \frac{U_X}{U_Z} \) where \( X = 0 \) and \( Z = I \). That is, the upper bound for \( \sigma \) is the slope of the indifference curve when only private goods are demanded. Therefore, the agency will report \( \sigma \) which is lower than \( \bar{\sigma} \) to ensure its existence. This is the condition to make this setting worthwhile to analyze since, as long as \( \sigma > \bar{\sigma} \), \( V(\sigma, I) > V \), which implies that the utility level with both public good and private good is higher than
that with no public good. So we do not need the constraint, \( V \geq \bar{V} \), in the optimization problem of the agency. With respect to the utility function of the agency, we assume three types of agencies just as in the preceding section.

**a. The Output-Maximizing Agency**

The output-maximizing agency’s problem is as follows.

\[
\text{(IV.33) } \max_\sigma X(\sigma) \\
\text{s.t. } \sigma X(\sigma) \geq a + bX(\sigma)
\]

From the Kuhn-Tucker Necessary Condition,

\[
\text{(IV.34a) } \frac{\partial X}{\partial \sigma} + \lambda(X + \sigma \frac{\partial X}{\partial \sigma} - b \frac{\partial X}{\partial \sigma}) = 0,
\]

\[
\text{(IV.34b) } \sigma X - a - bX \geq 0, \lambda \geq 0, \text{ and } \lambda(\sigma X - a - bX) = 0.
\]

From (IV.34a), \( \lambda > 0 \) if \( \frac{\partial X}{\partial \sigma} < 0 \), which is true except in a very special case. Then, \( \sigma^o X^o = a + bX^o \) from (IV.34b), which shows

\[
\text{(IV.35) } \sigma^o = b + a/X^o.
\]
The reported average cost is higher than the true marginal cost as long as there exist fixed costs.

b. The Discretionary Budget-Maximizing Agency

The discretionary budget-maximizing agency's problem is as follows.

\[(IV.36) \quad \max_{\sigma} \sigma X(\sigma) - a - bX(\sigma),\]
\[\text{s.t. } \sigma X - a - bX \geq 0.\]

From the Kuhn-Tucker Necessary Condition,

\[(IV.37a) \quad X + \sigma \frac{\partial X}{\partial \sigma} - b \frac{\partial X}{\partial \sigma} + \lambda (X + \sigma \frac{\partial X}{\partial \sigma} - b \frac{\partial X}{\partial \sigma}) = 0,\]
\[(IV.37b) \quad \sigma X - a - bX \geq 0, \lambda \geq 0, \text{ and } \lambda (\sigma X - a - bX) = 0.\]

If it is possible to have the positive discretionary budget, \(\lambda = 0\) from (IV.37b). Then, \(X + \sigma \frac{\partial X}{\partial \sigma} - b \frac{\partial X}{\partial \sigma} = 0\) from (IV.37a), which shows

\[(IV.38) \quad \sigma^d = b - X^d (\frac{\partial X^d}{\partial \sigma^d})^{-1}.\]

Therefore, \(\sigma^d\) is higher than \(b\). Thus, (IV.38) can be rewritten as the following:
\[(IV.39) \quad \sigma^d = b(\eta^d/1+\eta^d),\]

where \( \eta \) = the elasticity of demand for the public good w.r.t. \( \sigma \).

From (IV.39), note that \( \eta^d < -1 \) in equilibrium.

Now, it would be interesting to compare \( \sigma^o \) and \( \sigma^d \). From (IV.34b) and (IV.37b), \((\sigma^d - b)X^d > (\sigma^o - b)X^o\). Since \( X^o > X^d \), \( \sigma^d > \sigma^o \).

c. The Bribe-Maximizing Agency

The bribe-maximizing agency solves the following problem. 

\[(IV.40) \quad \max \_{R^f, R^v} \quad R = R^f + R^v, \]

s.t. \( \sigma X \geq a(R^f) + b(R^v)X \).

From the Kuhn-Tucker Necessary Condition,

\[(IV.41a) \quad 1 + \lambda(a' + b'X) = 0, \]
\[(IV.41b) \quad \lambda(X + \sigma X/\sigma - b(R^v)X/\sigma) = 0, \]
\[(IV.41c) \quad \sigma X - a(R^f) - b(R^v)X \geq 0, \lambda \geq 0, \text{ and } \lambda(a\sigma - a(R^f) - b(R^v)X) = 0. \]

From (IV.41a), \( \lambda > 0 \). Therefore, \( \sigma X^C = a(R^f) + b(R^v)X^C \) which gives
(IV.42) \( \sigma^c = b(R_v) + a(R_x)/X^c. \)

From (IV.35) and (IV.32), \( \sigma^c > \sigma^d \) since \( a(R_x^f) > a \) and \( b(R_v) > b \). This indicates that \( X^c < X^o \). Next, from (IV.31b), \( X^c + \sigma^c \partial X^c/\partial \sigma - b(R_v) \partial X^c/\partial \sigma = 0 \) which provides

(IV.43) \( \sigma^c = b(R_v) - X^c (\partial X^c/\partial \sigma)^{-1}. \)

By using the elasticity form,

(IV.44) \( \sigma^c = b(R_v)(\eta^c/1+\eta^c). \)

From (IV.39) and (IV.44), the sufficient condition for \( \sigma^c > \sigma^d \) is that \( \eta^c > b/b(R_v) \eta^d \). So, if the marginal cost is increasing with corruption, it is likely that the corrupt agency reports higher average costs than the clean agency, and not only the public good level but also the welfare level is lower if the agency is corrupt.
CHAPTER V

THE OPTIMIZATION OF THE CORRUPTION LEVEL

In the previous chapter, we showed that corruption of agents has a negative effect on the welfare of the principal. Therefore, if a principal were able to observe the activities of an agent perfectly at no cost, he would remove any corrupt agents and hire only incorrupt agents. Then, it turns out that in this case he need not remove any agents since no agent would be corrupt if he knew that the principal has perfect information. But this simple solution is not plausible in the real world in which getting perfect information is not costless. Now a principal faces the decision about the quantity of resources to be spent to control corruption of agents and consequently how much corruption is optimal. Of course, this decision depends on how expensive it is to control corruption. Basically, there are two anti-corruption measures which a principal can use to control corruption of agents. These include monitoring the corrupt activities of agents and/or giving incentives (higher wage rate) to agents not to be corrupt. In essence, this chapter focuses on the optimizing behavior of a principal who confronts corruption of agents, and seeks for answers about how to control corruption and how much corruption to allow. If there is no possibility for corruption, the answer is zero monitoring and the reservation wage rate. Moreover, a principal will
demand the employment level which equates the value of marginal product of labor to the reservation wage rate.

Since it is costly to prevent corruption of agents, minimizing corruption is not always the best policy. This simple idea could have very important implications on the current understanding of agents' corruption. Many case studies on corruption provide the stylized fact that LDC's are experiencing more serious bureaucratic corruption than developed countries. Those studies argue that the low compensation level to public officials is a key reason for the large scale of bureaucratic corruption, and suggest that the compensation level for public officials be raised to decrease bureaucratic corruption. This argument is based on the observation that countries with less bureaucratic corruption offer a relatively good compensation level for public officials. But our research will provide a completely different argument. Intuitively, raising the wage rate of agents might not be the optimal policy if some positive level of corruption is optimal.

We begin our analysis from the simplest case which considers homogeneous agents and the single sector. Although the adverse selection problem does not exist in this section due to the homogeneity of agents, the moral hazard problem still exists, and it gives rise to agency costs of corruption. After that, we generalize the analysis to the case of heterogeneous agents and a two sector model where the adverse selection problem and the moral hazard problem exist simultaneously. Throughout the analysis, we assume that both
principal and agents are risk-neutral, and therefore the optimal risk-sharing problem is not discussed. Another assumption is that the utility of agents depends only on the income level which implies that the shirking decision of agents is not considered.

V. I. Homogeneous Agents in the One Sector Model.

When an agent decides whether to be corrupt or not, his decision is based on the comparison of the utility levels from being corrupt and from remaining clean. Whereas a clean agent is paid a constant wage ($v$) with certainty, a corrupt agent gets paid an uncertain income as long as the corrupt agent can be detected and fired with positive probabilities. That is to say the corrupt agent gets expected utility ($EU^C$) which is assumed below:

**Assumption V.1**

$$EU^C = (1-u)U(v+b) + \alpha(1-\beta)U(w) + \alpha\beta uU(\tilde{w}) + \alpha\beta(1-u)U(\tilde{w}) - \alpha\gamma U(\tilde{p}),$$

where $U(\cdot)$: utility function,

$\alpha$: the probability of being caught,

$\beta$: the probability of being fired when an agent is caught for corruption,

$\gamma$: the probability of being convicted when an agent is caught for corruption,
\( P \): the monetary penalty,
\( b \): bribes,

\( \tilde{\omega} \): the reservation wage rate,

\( \hat{\omega} \): the wage rate to the agent who fired with corruption and get new job,

\( u \): the unemployment rate,

\( \delta \): the preference for corrupt income.

In this expected utility, it is assumed that the agents caught and fired for being corrupt get paid \( \tilde{\omega} \) when they are unemployed, and the agents who are caught for corruption can not be corrupt again. Moreover, when an agent gets a new job after fired, his compensation \( \hat{\omega} \) is assumed to be lower than the \( \omega \) from the old job. That is,

\[
(V.1) \quad \hat{\omega} = \omega - f \quad \text{and} \quad f > 0,
\]

where \( f \) is the reduction of compensation due to the personal history of corruption.
One unusual parameter in this definition is $\delta$ which represents the preferences for bribes. It is assumed that $\delta$ is positive and less than 1.5

Finally, we need assumptions on the information structure. In this section, it is assumed that a principal has perfect information on both $\delta$ and $b$, and accordingly on $\text{Eu}^C$. Since these perfect information assumptions are apparently restrictive, we will relax these assumptions later. In the next section, agents are heterogeneous with respect to $\delta$, and the principal has imperfect information on $\delta$. This brings the adverse selection problem to the sponsor's optimization problem. Also, it will be shown that the uncertainty of $b$ provides the same implications as the uncertainty of $\delta$ does.

With the assumption that agents are income maximizers, they become corrupt if $\text{Eu}^C > v$, but clean if $\text{Eu}^C < v$. They would be indifferent between being corrupt and clean if $\text{Eu}^C = v$. But we assume that agents remain clean in this case. Since we are discussing the homogeneous agent case in this section, every agent has the same $\delta$, and consequently all have the same $\text{Eu}^C$.

---

5. Note that $\delta$ can be greater than 1 if the marginal utility of $b$ is greater than the marginal utility of $v$. But it is more likely that the marginal utility of $v$ is greater than the marginal utility of $b$. The moral costs of corruption that Rose-Ackerman (1975) suggested could be one explanation for this smaller marginal utility of corruption.
But, with the assumption that agents are risk-neutral, we do not need to compare utility levels since the expected utility from corruption is equivalent to the utility of expected corrupt income \((w^c)\). Therefore,

\[
V^c = U(w^c),
\]

and 
\[
v^c = (1-\alpha)w + \alpha w^c + (1-\alpha)\delta b - \alpha(1-u)f - \gamma P.
\]

From \(v^c\), it would not be difficult to note that this corruption model is another case where the efficiency wage model could be applied. Since Leibenstein (1957) introduced the possibility that the productivity of labor is positively related to the wage rate, several other reasons for the wage-productivity hypothesis have come out. Those include the labor turnover, incentive effects, morale effects, quality effects, and recruitment effects. The basic results of those models are that the productivity is positively related to the wage rate and the unemployment rate but negatively related to the alternative income. If corruption decreases productivity of agents, this corruption model would provide the same results as the efficiency wage model since they become corrupt more likely with low \(w\) and \(u\), and high \(\tilde{w}\). The most important hypothesis of the efficiency wage model is that the wage rate is higher than the market clearing level and there exists excess supply in the labor market. In fact, a later section of this paper provides the same hypothesis.
Before solving the principal's optimization problem, we need to specify the cost function. The cost per agent is \( w + M \) where \( M \) is the expenditure for monitoring activities, and we assume that the probability of detection increases with \( M \) at a decreasing rate. Thus,

\[
(V.3) \quad \alpha = \alpha(M, t), \quad \alpha_M > 0, \quad \alpha_M < 0, \quad \alpha_t > 0,
\]

where \( t \) is a shift parameter.

Actually, \( t \) can be interpreted as the productivity parameter in the monitoring activities of the sponsor. That is, when \( t \) is increasing due to better technology of monitoring, \( \alpha \) becomes greater even with the same \( M \). For the simplicity of calculation, we assume a special functional form of \( \alpha \),

\[
(V.4) \quad \alpha(M, t) = \alpha(tM).
\]

Now, let us consider the principal's optimization problem. First, we have to specify the objectives of the principal. In the private sector, it is an accepted assumption that a principal (owner) of a firm tries to maximize profits. As to the objective function of a principal in the public sector (politician), the popular assumption is that he tries to maximize the probability of reelection. Once we accept this assumption, we should clarify what the probability of reelection depends on. In this study, we assume that the probability of reelection is positively related to the net benefit from the
production of goods and services by the government. Therefore, the objective function in our model is the total revenue in the private sector or the total benefit in the public sector minus total costs of the production. The choice variables at a principal's disposal are the employment level, the wage rate, and monitoring expenditures.

In previous chapters, we indicated that corruption of agents usually hurts the interest of a principal. But it is not costless for the principal to get rid of all corruption when the principal has imperfect information about who is corrupt. With agents' identical preference for corruption, the principal is able to keep all agents from being corrupt only by paying monetary incentives and monitoring. If it is too costly to keep all the agents clean, it would be better for the principal to let all the agents be corrupt and do nothing against corruption. That is to say, there are two possible equilibria: a full-corruption equilibrium and a no-corruption equilibrium. A rational principal, of course, will choose the equilibrium which provides greater profits or net benefits. The following analyses will show the principal's optimal decisions in each equilibrium. After these analyses, we will discuss what determines the principal's decision about which equilibrium to choose.

a. No-Corruption Equilibrium

In the no-corruption equilibrium, a principal pays the legal compensation ($w$) which is not less than the expected income from
corruption when he chooses the appropriate employment level \((L)\), the wage rate \((w)\), and monitoring spending \((M)\) to maximize the profit or net benefit. Describing this problem formally,

\[
\begin{align*}
(V.5a) \quad \max_{w, M, L} & \quad F(L) - (w + M)L, \\
\text{s.t.} & \quad w \geq \bar{w} - \left(\frac{1-u}{u}\right)f + \frac{(1-u)\delta b}{\alpha\beta u} - \frac{\gamma P}{\beta u}, \\
(V.5c) \quad & \quad v \geq \bar{v}.
\end{align*}
\]

In the objective function, \(F(L)\) is interpreted as the total revenue in the private sector and the total benefit to constituents in the public sector, and we assume that \(F' > 0\) and \(F'' < 0\). For the first constraint, a principal has to set the wage rate and monitoring spending to make the expected income from corruption be not greater than the wage rate to prevent corruption. The reason for second constraint is that nobody wants to be hired if the wage rate is lower than the reservation wage rate.

The Lagrange function \((\Phi)\) of \((V.5)\) is

\[
(V.6) \quad \Phi = F(L) - (w + M)L + \lambda_1 (w - \bar{w} + \left(\frac{1-u}{u}\right)f + \frac{\gamma P}{\beta u} - \frac{(1-u)\delta b}{\alpha\beta u}) + \lambda_2 (w - \bar{w})
\]

where \(\lambda_1\) and \(\lambda_2\) are Lagrangian multipliers.
The necessary conditions for this problem are as follows:

(V.7a) \( \frac{\partial \pi}{\partial L} = F' - (w + M) = 0, \)
(V.7b) \( \frac{\partial \pi}{\partial w} = -L + \lambda_1 + \lambda_2 = 0, \)
(V.7c) \( \frac{\partial \pi}{\partial M} = -L + \lambda_1 \left( \frac{t \alpha' \delta b}{\alpha \beta u} \right) = 0, \)
(V.7d) \( \frac{\partial \pi}{\partial \lambda_1} = v - \tilde{w} + \left( \frac{1-u}{u} \right) \xi + \frac{\gamma p}{\beta u} - \frac{(1-\alpha) \delta b}{\alpha \beta u} \geq 0, \lambda_1 \geq 0, \)
and \( \left( \frac{\partial \pi}{\partial \lambda_1} \right) \lambda_1 = 0, \)
(V.7e) \( \frac{\partial \pi}{\partial \lambda_2} = v - \tilde{w} \geq 0, \lambda_2 \geq 0, \) and \( \left( \frac{\partial \pi}{\partial \lambda_2} \right) \lambda_2 = 0. \)

Before deriving the equilibrium \( L, w \) and \( \alpha \) from (V.7), it would be interesting to see what happens if the principal can control \( P \). If imposing \( P \) is not costly, the equilibrium \( w \) is \( \tilde{w} \), and the equilibrium \( \alpha \) is \( \alpha_{\text{min}} \), which is the probability of detection when \( M = 0 \) since the sponsor is able to keep all agents from corruption by imposing a very heavy penalty without any help from monetary incentives and monitoring activities. The optimal \( P \) derived from the no-corruption condition is that

6. Dickens, Katz, Lang, and Summers (1989) employed similar assumption to simplify the proofs.
\[(V.8) \quad P \geq \frac{(1-\alpha_{\text{min}})\delta b}{\alpha_{\text{min}}^\gamma} - \beta \gamma (1-u)f.\]

These solutions are basically the same as that suggested by Becker (1968) who argued that the optimal probability of detection should be as low as possible and the optimal fine should be arbitrarily large if it is costly to detect crimes. Also, Dickens, et al. (1989) provide similar results in the employee crime model where employees post bonds. As they pointed out, however, casual observation of the real world indicates that there are substantial expenditures on monitoring activities, and therefore the above solutions fail to explain the real world. The most important reason for this failure is the legal restriction on the penalty which states that the penalty could not be far in excess of the actual damages, which is \( b \) in our model.\(^7\) So, in our model, it is assumed that \( P \) is exogenously given to the principal, and it is assumed that

\[(V.9) \quad P < \frac{(1-\alpha_{\text{min}})\delta b}{\alpha_{\text{min}}^\gamma} - \beta \gamma (1-u)f.\]

\(^7\) This legal restriction on penalty is one of the four reasons suggested by Dickens, et al. to explain the limitation on bonds.
With an exogenous $P$, the equilibrium $L^*_n$, $V^*_n$ and $M^*_n$ are derived from (V.7) where the subscript $n$ represents the no-corruption equilibrium. In fact, both interior and corner solutions are possible in this model.

First, interior solutions are derived from following equations:

\[
(V.10a) \quad V^*_n = \bar{V} + \frac{[1-\alpha(tM^*_n)] \delta_b}{\alpha(tM^*_n) \delta u} - \frac{\gamma p}{\delta u} - \left(\frac{1-u}{u}\right) f,
\]

\[
(V.10b) \quad \alpha^2(tM^*_n) \delta u = \tau \alpha(tM^*_n) \delta b,
\]

\[
(V.10c) \quad F'(L^*_n) = V^*_n + M^*_n.
\]

Second, the corner solutions are given by:

\[
(V.11a) \quad V^*_n = \bar{V},
\]

\[
(V.11b) \quad M^*_n = \frac{1}{\tau} \alpha^{-1} \left( \frac{\delta_b}{\gamma P + \delta b + \beta(1-u)f} \right),
\]

\[
(V.11c) \quad F'(L^*_n) = V^*_n + M^*_n.
\]

Figure 4 shows the interior solutions, and Figure 5 shows the corner solutions.

A few interesting implications follow (V.8) and (V.9). First, $V^*$ is higher than $\bar{V}$ if the interior solutions are achieved. That is,
agents are paid more than the reservation wage rate since the wage
premium \((\bar{w} - \tilde{w})\) is

\[
(V.12) \quad \frac{(1 - \alpha(tM_n^*))\delta b}{\alpha(tM_n^*)\beta u} - \frac{\gamma^*}{\beta u} - \frac{(1 - u)}{u} f.
\]

Assumption \((V.9)\) guarantees that this wage premium is positive since
\(\alpha(tM_n^*)\) is greater than \(\alpha_{\min}\). This positive wage premium explains why
this corruption model is one extension of the efficiency wage model. It is, however, also true that there is no wage premium if the
monitoring activities are effective enough to satisfy the condition
that \(\alpha^2(tM_n^*)\beta u < \tau\alpha'(tM_n^*)\delta b\). This is when the corner solutions are
achieved.

Second, \(M_n^*\) does not depend on \(\tilde{w}, P, \gamma,\) and \(f\) in the interior
solutions. That is, the principal is responding to the changes in \(\tilde{w},
P, \gamma,\) and \(f\) by changing only \(w^*\). Another implication is that \(\alpha(tM_n^*)\) is
less than one. In other words, the perfect detection can not be
optimal no matter how effective the monitoring activities are.

Now, we need to show the comparative statics results on \(M_n^*, w_n^*,\)
and \(L_n^*\). First, when the model provides the interior solutions, the
following results on $M_n^*$ are derived. Let $A$ denote $(t^{2\alpha'} \delta b - 2t\alpha' \delta u)$. Then $A < 0$ since $\alpha' > 0$ and $\alpha'' < 0$.

(V.13a) \[ \frac{dM_n^*}{d\beta} = \frac{\alpha^2 u}{A} < 0, \]

(V.13b) \[ \frac{dM_n^*}{d\delta} = \frac{-t\alpha' b}{A} > 0, \]

(V.13c) \[ \frac{dM_n^*}{db} = \frac{-t\alpha' \delta}{A} > 0, \]

(V.13d) \[ \frac{dM_n^*}{du} = \frac{\alpha^2 \beta}{A} < 0, \]

(V.13e) \[ \frac{dM_n^*}{dt} = \frac{M}{t} < 0. \]

For the remaining exogenous variables,

(V.14) \[ \frac{dM_n^*}{d\bar{w}} = \frac{dM_n^*}{dP} = \frac{dM_n^*}{d\gamma} = \frac{dM_n^*}{df} = 0. \]

Proposition V.1

With assumptions V.1 and (V.3), $M_n^*$ is increasing with $\delta$ and $b$, and decreasing with $\beta$, $u$, and $t$. And the changes in $\bar{w}$, $P$, $\gamma$, and $f$ do not affect $M_n^*$.

The comparative statics results on $\bar{w}^*$ are derived from (V.10a).
(V.15a) \[ \frac{dv_n^*}{d\vec{w}} = 1 > 0, \]

(V.15b) \[ \frac{dv_n^*}{dy} = -(P/\beta u) < 0, \]

(V.15c) \[ \frac{dv_n^*}{dP} = -(\gamma/\beta u) < 0, \]

(V.15d) \[ \frac{dv_n^*}{df} = -1/u + 1 < 0. \]

When \( \beta, u, \delta, b, \) and \( t \) are changing, the effects on \( v_n^* \) are more complicated since the changes in those variables affect \( M_n^* \), which affects \( v_n^* \).

(V.16a) \[ \frac{dv_n^*}{d\beta} = - \frac{dM_n^*}{d\beta} - \frac{(1-\alpha)\delta b}{\alpha u^2} + \frac{\gamma P}{u^2}, \]

(V.16b) \[ \frac{dv_n^*}{du} = - \frac{dM_n^*}{du} - \frac{(1-\alpha)\delta b}{\alpha u^2} + \frac{\gamma P}{u^2} + \frac{1}{u^2} f, \]

(V.16c) \[ \frac{dv_n^*}{d\delta} = - \frac{dM_n^*}{d\delta} + \frac{(1-\alpha)b}{\alpha u}, \]

(V.16d) \[ \frac{dv_n^*}{db} = - \frac{dM_n^*}{db} + \frac{(1-\alpha)\delta}{\alpha u}, \]

(V.16e) \[ \frac{dv_n^*}{dt} = - \frac{dM_n^*}{dt} - \frac{M_n^*\alpha' \delta b}{\alpha u^2}. \]
All signs of (V.16a) – (V.16e) are ambiguous. These results are somewhat surprising since it would be intuitively expected that increases in $\beta$ and $\mu$ or decreases in $\delta$ and $\delta$ will decrease the incentives for corruption, and consequently decrease $w_n^*$. But this expectation is not correct in that it does not consider that the changes in $M_n^*$ which come from the changes in those variables will affect $w_n^*$.

Proposition V.2

With assumptions V.1 and (V.3), $w_n^*$ is increasing with $\bar{w}$ and decreasing with $\gamma$, $F$, and $f$, but it is indeterminate whether it is increasing with $\beta$, $u$, $\delta$, $b$, and $t$.

Next, let us consider the comparative statics results on $L_n^*$.

\[(V.17) \quad \frac{dL_n^*}{dI} = F', R^{-1}(\frac{dM_n^*}{dI} + \frac{dw_n^*}{dI}),\]

where $I = \bar{w}$, $\gamma$, $F$, $f$, $\beta$, $u$, $\delta$, $b$, $t$.

From (V.13a) – (V.16e),
(V.18a) \[ \frac{dL^*_n}{d\tilde{w}} < 0, \]

(V.18b) \[ \frac{dL^*_n}{d\gamma} > 0, \]

(V.18c) \[ \frac{dL^*_n}{dp} > 0, \]

(V.18d) \[ \frac{dL^*_n}{df} > 0, \]

(V.18e) \[ \frac{dL^*_n}{d\beta} = F''r^{-1} \left( \frac{\gamma F}{u\beta^2} - \frac{(1-\alpha)\delta b}{\alpha \beta u^2} \right) > 0 \]

from (V.9),

(V.18f) \[ \frac{dL^*_n}{du} = F''r^{-1} \left( \frac{\gamma F}{u^2} + \frac{1}{u^2} - \frac{(1-\alpha)\delta b}{\alpha \beta u^2} \right) > 0 \]

from (V.9),

(V.18g) \[ \frac{dL^*_n}{d\delta} = F''r^{-1} \left( \frac{(1-\alpha)b}{\alpha \beta u} \right) < 0, \]

(V.18h) \[ \frac{dL^*_n}{db} = F''r^{-1} \left( \frac{(1-\alpha)\delta}{\alpha \beta u} \right) < 0, \]

(V.18i) \[ \frac{dL^*_n}{dt} = F''r^{-1} \left( - \frac{\alpha \gamma \delta b}{\alpha^2 \beta u} \right) > 0. \]

**Proposition V.3**
With assumptions V.1, (V.3), and (V.9), \( L^*_n \) is increasing with \( \gamma \), \( P, f, \beta, u, t \), and decreasing with \( \bar{w}, \delta, b \).

b. **Full-Corruption Equilibrium**

Since it is not costless to prevent all corruption of agents, it could be optimal for a principal to let all agents be corrupt if corruption does not hurt the interest of the principal a lot. In order to indicate how much corruption is bad to the interest of the principal, we need to introduce a new variable (\( \Omega \)) which we call the productivity of corrupt agents. Then, the total revenue or the total benefit is denoted as \( F(\Omega L) \). \( \Omega \) is, of course, assumed to be less than one, which is assumed to be the productivity of clean agents. The objective function a principal faces in full-corruption equilibrium is

\[
(V.19) \quad \text{Max}_{L, \Omega, M} \quad F(\Omega L) - (w + M) L.
\]

Although the objective function is similar to that in the no-corruption equilibrium, the constraint is quite different between the two equilibria. First, it is obvious that the no-corruption constraint is not applied in the full-corruption equilibrium. Second, the labor supply constraint is that the expected income from corruption should not be less than the reservation wage rate. Another difference we
should note is that the expected income from corruption in the full-
corruption equilibrium will not coincide with that in the no-
corruption equilibrium.

In the no-corruption equilibrium, the interior solutions
provided that \( w > \tilde{w} > \bar{w} \). This inequality implies that the agent who is
captured for corruption do want to keep the job, and, if fired, he tries
to get another job even though he cannot be corrupt again. So, we have
(V.2). But if \( \tilde{w} > w > \bar{w} \), which is the case in the full-corruption
equilibrium, the behavior of agents will change when they are caught
for being corrupt. That is, they do not prefer being employed after
they are caught since they cannot get income from corruption.
Therefore, the labor supply constraint is

\[
(V.20) \quad w^c = (1-\alpha)(w+\delta b) + \alpha\bar{w} - \alpha\gamma P \geq \bar{w}.
\]

From (V.19) and (V.20), the Lagrangian Function (\( \Phi \)) is

\[
(V.21) \quad \Phi = \mathcal{P}(\Omega L) - (w+M)L + \lambda((1-\alpha)(w+\delta b) + \alpha\bar{w} - \alpha\gamma P - \bar{w}).
\]

The necessary conditions are followings:

\[
(V.22a) \quad \partial \Phi / \partial L = \Omega \bar{r} - (w+M) = 0,
(V.22b) \quad \partial \Phi / \partial w = -L + \lambda(1-\alpha) = 0,
(V.22c) \quad \partial \Phi / \partial M = -L + \lambda(-t\alpha'(w+\delta b) + t\alpha'\bar{w} - t\alpha'\gamma P) \leq 0, M \geq 0,
\]
and \( \lambda(\partial \theta / \partial \lambda) = 0 \),

\[(V.22d) \quad \partial \theta / \partial \lambda = (1 - \alpha)(v + \delta b) + \alpha \tilde{w} - \alpha \gamma P - \tilde{w} \geq 0, \lambda \geq 0, \]

and \( \lambda(\partial \theta / \partial \gamma) = 0 \).

From (V.22b), \( \lambda > 0 \). Therefore, \( \partial \theta / \partial \lambda = 0 \) and \( \partial \theta / \partial \gamma < 0 \) in (V.22d) and (V.22c). Then, the optimal wage rate \( (v^*_f) \) and monitoring spending \( (m^*_f) \) are

\[(V.23) \quad v^*_f = \tilde{w} - \delta b + \left( \frac{\alpha_{\min}}{1 - \alpha_{\min}} \right) \gamma P, \]

\[(V.24) \quad m^*_f = 0. \]

With (V.23) and (V.24), the optimal employment level \( (L^*_f) \) is

\[(V.25) \quad L^*_f = \frac{1}{\tilde{w}} - Py^{-1}(\tilde{w} - \delta b + \left( \frac{\alpha_{\min}}{1 - \alpha_{\min}} \right) \gamma P). \]

In (V.23), \( v^*_f - \tilde{w} < 0 \) with assumption (V.9). That is to say the wage rate a principal pays is actually lower than the reservation wage rate if the penalty is not very heavy. And, not surprisingly, the principal does not spend any resources on monitoring activities at all in the full-corruption equilibrium. The question about which
equilibrium employs more agents does not have a definite answer since the productivity of agents and costs of hiring agents are higher in the no-corruption equilibrium, and vice versa.

Now, let's discuss comparative statics results on $\nu^*_T$ and $L^*_T$.

(V.26a) \[ \frac{d\nu^*_T}{d\tilde{\nu}} = 1 > 0, \]

(V.26b) \[ \frac{d\nu^*_T}{d\gamma} = \left( \frac{\alpha_{\min}}{1-\alpha_{\min}} \right) P > 0, \]

(V.26c) \[ \frac{d\nu^*_T}{d\beta} = \left( \frac{\alpha_{\min}}{1-\alpha_{\min}} \right) \gamma > 0, \]

(V.26d) \[ \frac{d\nu^*_T}{d\delta} = -b < 0, \]

(V.26e) \[ \frac{d\nu^*_T}{d\beta} = -\delta < 0, \]

(V.27) \[ \frac{dL^*_T}{d\Omega} = (\Omega^F)^{-1} \frac{d\nu^*_T}{d\Omega}, \]

where $i = \tilde{\nu}, P, \gamma, \delta, b$.

So, the sign of $\frac{dL^*_T}{d\Omega}$ is the opposite of that of $\frac{d\nu^*_T}{d\Omega}$ where $i = \tilde{\nu}, P, \gamma, \delta, b$. It is also true that the change in the productivity of agents affects $L^*_T$:

(V.28) \[ \frac{dL^*_T}{d\Omega} = -\frac{F'}{OLP^F}, > 0. \]
Proposition V.5

In the no-corruption equilibrium, the equilibrium wage rate is increasing with $\bar{\omega}$, $\gamma$, and $P$, and decreasing with $\delta$ and $b$. On the other hand, the equilibrium employment level is increasing with $\delta$, $b$, and $\Omega$, and decreasing with $\bar{\omega}$, $\gamma$, and $P$.

Considering that both the no-corruption equilibrium and the full-corruption equilibrium are possible, the principal faces the eventual problem about which equilibrium to choose. In order to solve this problem, we need the net profit or net benefit in each equilibrium, $\Pi_n$ and $\Pi_f$ respectively:

\[(V.29a) \quad \Pi_n = F(L_n^*) - (w_n^* + M_n^*) L_n^*,\]

\[(V.29b) \quad \Pi_f = F(QL_f^*) - w_f^* L_f^*.\]

If $\Pi_n > \Pi_f$, the no-corruption equilibrium will be attained with $L_n^*$, $w_n^*$, and $M_n^*$. On the other hand, the principal will go for the full-corruption equilibrium with $L_f^*$ and $w_f^*$ if $\Pi_f > \Pi_n$. Then, it would be interesting to investigate how the exogenous variables affect the principal's decision about which equilibrium to choose. Intuitively, we believe that the lower productivity of corrupt agents and the lower costs of preventing corruption will lead to the higher probability of
choosing the no-corruption equilibrium. This intuition proved to be true in the following proposition.

**Proposition V.6**

Given assumptions (V.1), (V.3), (V.9), and income maximizing and risk-neutral agents, \( K = \Pi_n - \Pi_f \) is increasing with \( \gamma, \psi, f, \beta, u, \) and \( t, \) and decreasing with \( \delta, b, \) and \( \Omega. \)

**Proof**

From (V.15a)-(V.15d), (V.16a)-(V.16e), and (V.26a)-(V.26e),

\[
\frac{\partial K}{\partial \gamma} = \frac{\partial \Pi_n}{\partial \gamma} - \frac{\partial \Pi_f}{\partial \gamma} = -(d_{n\gamma}^* + d_{n\gamma}^* L_n^* + (d_{f\gamma}^*/d\gamma)L_f^* > 0.
\]

In the same way as above, it can be shown that

\( \frac{\partial K}{\partial \psi} > 0, \frac{\partial K}{\partial f} > 0, \frac{\partial K}{\partial \beta} > 0, \frac{\partial K}{\partial u} > 0, \frac{\partial K}{\partial t} > 0, \frac{\partial K}{\partial \delta} < 0, \) and \( \frac{\partial K}{\partial b} < 0. \)

And \( \frac{\partial K}{\partial \omega} = -L_f^* F' < 0. \)

The effect of \( \bar{w} \) on \( K \) is ambiguous since \( \frac{\partial K}{\partial \bar{w}} = L_f^* - L_n^* \) which has an ambiguous sign.

**V. II. Heterogeneous Agents in the One Sector Model**
Although the previous section is quite simple and somewhat unrealistic, it provides some insights into the optimal decision-making when corruption exists, and helps us to build a more general and realistic model in this section. The first extension is to relax the assumption that agents have identical preferences for corruption and accordingly that they make the same decision on whether to be corrupt or not when they face the same compensation level and monitoring intensities. This is apparently a too restrictive assumption since it is true that some agents become corrupt and others do not even if they are under the same contract. So, this section introduces two types of agents: high-$\delta$ ($\delta_h$) agents and low-$\delta$ ($\delta_l$) agents. Let $\theta$ be the proportion of $\delta_h$-agent in the total labor force, and we assume that the principal knows $\theta$.

From (V1), $\partial w^c / \partial \delta > 0$ which implies that agents with $\delta_h$ have a higher probability of being corrupt than agents with $\delta_l$ when they are given the same $v$ and $\alpha$. Of course, it is assumed that the principal cannot observe which $\delta$ a specific agent has. Such imperfect information on the characteristics of agents presents the principal with a well-known adverse selection problem. Therefore, the principal has to solve not only the moral hazard problem but also the adverse selection problem when he determines $v$ and $\alpha$ in the contract. In the previous section, there was either a no-corruption or a full-corruption equilibrium. But when agents have different attitudes toward corruption, it could be the case that the principal's surplus
is maximized by preventing corruption of only some portion of agents. Another interesting issue in the case of heterogeneous agents is the existence of self-selection contracts. So, we would like to see whether the self-selection contract, if exists, is more efficient than the single contract.

First section deals with equilibrium without a self-selection contract. That is, the sponsor uses only a single contract when he maximizes profits or net benefits. In the second section, we introduce the possibility of a self-selection contract, and investigate the characteristics of that contract.

a. Single Contract

In the previous section, we showed that two different equilibria, the no-corruption equilibrium and the full-corruption equilibrium, are possible when all the agents are same. In this section, the heterogeneity of agents brings another equilibrium: the partial-corruption equilibrium. In this equilibrium, the principal sets the wage rate and monitoring spending to prevent corruption of only $\delta_1$-agents and lets $\delta_h$-agents be corrupt. Of course, the principal will choose the equilibrium that provides the greatest profits or net benefits among the three equilibria.

As in the previous section, what the principal has to do is to find the optimal compensation level ($w^*$), monitoring activities
(M(\alpha^*)), and employment level (L^*). If the principal has perfect information on the types of the agents, the previous section provides us with all we need. That is, the principal optimizes for each type of agent and presents the optimal compensation level and monitoring activities for each group, and there will be no corruption or full corruption in the equilibrium. However, it is assumed that the principal has the imperfect information on \delta, and consequently the optimization problem becomes more complex.

First, we are going to derive the no-corruption and full-corruption equilibria. This derivation is almost identical to what we did in the previous section. Then, the discussion of the partial-corruption equilibrium will follow.

a.1. No-Corruption Equilibrium

In the no-corruption equilibrium, the sponsor tries to find the optimal \( v, M, \) and \( L \) that maximize the profits or net benefits accruing to him.

\[
\underset{w,M,L}{\text{Max}} \quad F(L) - (v + M)L,
\]

s.t. \( v \geq \bar{w} - \frac{\gamma_D}{\beta U} + \frac{(1-\alpha)\delta b}{\alpha \beta U} - \frac{(1-u)}{u} f, \)

\( v \geq \bar{w}. \)
The first constraint indicates that \( w \) and \( H \) should be set to make \( w \geq v^C \) for \( \delta_h \)-agents. If \( w \geq v^C \) for \( \delta_h \)-agents, then it is definitely true that \( w \geq v^C \) for \( \delta_1 \)-agents. Thus, \( \delta_1 \)-agents have no incentive to be corrupt, either. The previous section showed that both interior and corner solutions are possible in this problem. Since the corner solutions are not very interesting, we focus on the interior solutions.

In order to derive the optimal no-corruption wage rate \( (v^*_n) \), monitoring spending \( (M^*_n) \), employment level \( (L^*_n) \), we use the following Lagrange function:

\[
(V.31) \quad \Phi = F(L) - (w+H)L + \lambda_1 (w - \bar{w}) + \left( \frac{1-u}{u} \right) f + \frac{\gamma p}{\beta u} - \frac{(1-\alpha) \delta_h b}{\alpha \beta u} \\
+ \lambda_2 (w - \bar{w}).
\]

From this Lagrange function, we have necessary conditions which are identical to \((V.7a) - (V.7e)\) except that \( \delta_h \) is inserted instead of \( \delta \).

Then we get the following three equations from which \( v^*_n \), \( M^*_n \), and \( L^*_n \) are derived:

\[
(V.32a) \quad v^*_n = \bar{v} + \frac{(1-\alpha(TH^*_n)) \delta_h b}{\alpha(TH^*_n) \beta u} - \frac{\gamma p}{\beta u} - \left( \frac{1-u}{u} \right) f,
\]
(V.32b) \( \alpha^2(tM^*_n)bu = t\alpha'(tM^*_n)\delta_h b, \)

(V.32c) \( F'(L^*_n) = \nu^*_n + M^*_n. \)

Note that neither \( \nu^*_n \) nor \( \alpha^*_n \) depends on \( \delta_1 \). That is, in the no-corruption equilibrium, the preference of the less corruptible agents does not matter in determining the optimal compensation and monitoring activities. Another interesting point is that \( \delta_1 \)-agents get benefit from the existence of \( \delta_h \)-agents since they are compensated more than enough to keep them from being corrupt.

a.2. Full-Corruption Equilibrium

Another possible equilibrium is the full-corruption equilibrium where the sponsor spends nothing on monitoring activities, pays low wage rate, and lets every agent be corrupt. The optimization problem in this equilibrium is as follows:

(V.33) \[
\max_{L,W,H} F(\omega L) - (w + M)L,
\]

s.t. \( (1-\alpha)(w + \delta_h b) + \alpha \bar{w} - \alpha \gamma F \geq \bar{w}, \)

\( M \geq 0. \)

The Lagrange function is as follows:
\[ (V.34) \quad \Phi = F(\Omega L) - (\psi + M)L + \lambda(1-\alpha)(\psi + \delta^* b) + \alpha \bar{w} - \alpha \gamma P - \bar{w}. \]

The same necessary conditions as \((V.22a) - (V.22d)\) come out from \((V.34)\) with \(\delta^*\) instead of \(\delta\). Then, the optimal wage rate \((\psi^*_f)\), monitoring spending \((M^*_f)\), and the employment level \((L^*_f)\) in this equilibrium are as follows:

\[ (V.35a) \quad \psi^*_f = \bar{w} - \delta^*_h b + \left(\frac{\alpha_{\min}}{1-\alpha_{\min}}\right) \gamma P, \]

\[ (V.35b) \quad M^*_f = 0, \]

\[ (V.35c) \quad L^*_f = \frac{1}{\bar{w}} P^{-1} [\bar{w} - \delta^*_h b + \left(\frac{\alpha_{\min}}{1-\alpha_{\min}}\right) \gamma P]. \]

With \(\psi^*_f\) and \(M^*_f\), the expected income for \(\delta^*_h\)-agents is the reservation wage rate. But \(\delta^*_l\)-agents have expected income from corruption which is less than \(\bar{w}\) since

\[ (V.36) \quad \psi^c(\delta^*_l) = \bar{w} - (1-\alpha_{\min})(\delta^*_h - \delta^*_l) b < \bar{w}. \]

Therefore, in the full-corruption equilibrium, only more corruptible agents are hired.
a.3. Partial-Corruption Equilibrium

In the partial-corruption equilibrium, the sponsor sets the optimal wage rate \( w^*_p \), monitoring spending \( M^*_p \), and the employment level \( L^*_p \) which make only \( \delta_1 \)-agents not be corrupt. Intuitively, this equilibrium will be preferred to the no-corruption equilibrium when the proportion of \( \delta_h \)-agents is small and when it is very costly to prevent \( \delta_h \)-agents' corruption. The following problem provides \( w^*_p \), \( M^*_p \), and \( L^*_p \):

\[
\max_{w, M, L} \quad P((1-\theta)L + \theta \omega L) - (w + M)L,
\]

s.t. \( w \geq \bar{w} - \frac{\gamma P}{\beta u} + \frac{(1-\alpha(tM))\delta_1b}{\alpha(tM)\beta u} \frac{1}{u} - \left(1 - \frac{1}{u}\right)f, \)

\( w \geq \bar{w}. \)

The Lagrange function of this problem is given by:

\[
\Phi = P((1-\theta)L + \theta \omega L) - (w + M) + \lambda_1\left[w - \bar{w} + \frac{\gamma P}{\beta u} + \frac{(1-\alpha(tM))\delta_1b}{\alpha(tM)\beta u} \frac{1}{u} - \left(1 - \frac{1}{u}\right)f\right] + \lambda_2(w - \bar{w}).
\]
The necessary conditions are the same as (V.7a) - (V.7e) except that $\delta_1$ is used instead of $\delta$ and $F'$ is changed to $[(1-\Theta)\Theta\Omega]F'$. Then, the interior solutions of the partial-corruption equilibrium are derived from the following equations:

$$(V.39a) \quad w_p^* = \bar{w} + \frac{(1-\alpha(tM_p^*))\delta_1 b}{\alpha(tM_p^*)\beta u} - \frac{\gamma p}{\beta u} - \left(\frac{1-u}{u}\right)f,$$

$$(V.39b) \quad \alpha(tM_p^*)\beta u = \tau e'(tM_p^*)\delta_1 b,$$

$$(V.39c) \quad F'(L_p^*) = \frac{w_p^* + M_p^*}{(1-\Theta)\Theta\Omega}.$$ 

Under $w_p^*$ and $M_p^*$, $\delta_1$-agents prefer being remain clean, but $\delta_h$-agents are not given enough incentives and monitoring not to be corrupt. Both $w_p^*$ and $M_p^*$ depend on the same exogenous variables as $w_n^*$ and $M_n^*$ except for $\delta_h$. In fact, what affects $w_p^*$ and $M_p^*$ in the partial-corruption equilibrium is not $\delta_h$ but $\delta_1$.

Since each equilibrium provides different optimal compensation levels, monitoring activities, and employment level, it will be interesting to compare these among the possible three equilibria. First, as to the optimal wage rate, note that

$$(V.40a) \quad w_n^* > w_f^* \text{ and } w_p^* > w_f^*.$$
But from (V.16c), it is ambiguous which equilibrium has a higher wage rate between the no corruption equilibrium and the partial corruption equilibrium.

Next, we have unambiguous result about the optimal monitoring.

\[(V.40b) \quad M_n^* > M_p^* > M_f^* = 0.\]

The strong monitoring in the no-corruption equilibrium are needed to keep all agents from being corrupt, and this is not surprising results at all. A somewhat surprising result comes from the comparison among the optimal employment levels in three equilibria. From (V.32c), (V.35c), and (V.39c), it is ambiguous which equilibrium provides the greatest employment level since \( \Omega \) is assumed to be less than one, although

\[(V.40c) \quad w_n^* + M_n^* > w_p^* + M_p^* > w_f^* + M_f^*.\]

After he derives the optimal compensation level, monitoring activities, and employment level for each equilibrium, the principal should decide which equilibrium to choose among \((w_n^*, M_n^*, L_n^*)\), \((w_p^*, M_p^*, L_p^*)\), and \((w_f^*, M_f^*, L_f^*)\). The rational principal will choose the equilibrium which provides him with the greatest profits or net benefits. The decision about which equilibrium to choose depends on
the exogenous variables of the model. Although we are unable to tell which equilibrium will be chosen unless the specific values of exogenous variables are given, we can show how that decision is affected by changes in the exogenous variables.

**Proposition V.7**

When agents have different preferences for corrupt income, assuming (V.1), (V.3), and (V.9), the probability that a principal chooses either the no corruption equilibrium or the partial corruption equilibrium over the full corruption equilibrium is increasing with $b$ and $Q$, and decreasing with $\gamma$, $P$, $f$, $\beta$, $u$, $t$, and $\theta$.

**Proof**

Same as the proof of proposition V.6

So far in this section, we have shown that the principal has to decide which equilibrium to choose among $(w_n^*, M_n^*, L_n^*)$, $(w_p^*, M_p^*, L_p^*)$, and $(w_t^*, M_t^*, L_t^*)$ if he has imperfect information both on who is corrupt and who is more corruptible. Thus, this model indicates that no corruption is not always preferred to a positive level of corruption. In other words, if a decision-maker tries to remove any corruption without considering the exogenous variables, his policies
could be misleading. This is what Banfield (1975) pointed out when he described optimizing corruption.

Another implication of this model is that it could explain why the corruption level in some countries is much higher than that in other countries. First, a high bureaucratic corruption level in LDC's could be optimal. One of the important results in this model is that the partial-corruption equilibrium could produce a greater net surplus than the no-corruption equilibrium depending on values of some exogenous variables. As a matter of fact, it is believed that $b$ is higher and $\tau$ and $\beta$ are lower in LDC's, and consequently it is more likely that partial corruption is optimal from (V.27). There is some evidence on the high $b$ as well as the low $\tau$ and $\beta$ in LDC's. First, it is generally true that LDC's impose substantial governmental restrictions on the economy which result in lots of rents which public officials can exploit. In other words, there are many opportunities for bureaucratic corruption in LDC's. This implies that $b$ is higher in LDC's than in developed countries.

Secondly, in LDC's where the civil service system is a patronage system and the political leader has a dictatorship, $\beta$ is usually low since public officials who have political support will not be easily fired even in the case of being caught for corruption.

Finally, the relatively well developed personnel systems of the civil service in developed countries have developed much better techniques and technology of monitoring and supervising employees than LDC's where modern personnel systems are now developing. That is, the
level of \( t \) in LDC's is lower than that in developed countries. All these differences in \( b, \beta, \) and \( t \) contribute to making the full-corruption equilibrium more likely to be optimal in LDC's than the no-corruption equilibrium.

Next, consider the role of compensation to public officials in bureaucratic corruption. From (V.27), if the full-corruption equilibrium is optimal in LDC's, then the compensation level should be lower than that in countries where the partial-corruption equilibrium or the no-corruption equilibrium optimal. Therefore, it is not correct policy to increase the compensation level to public officials to reduce bureaucratic corruption in LDC's. Apparently, the corruption level will be reduced if the compensation level is increased. But this entails more costs than benefits. Then, one may ask how to reduce corruption. The answer lies in the exogenous variables. If a country wants to reduce corruption, it must change the exogenous variables, if possible, to make the no-corruption equilibrium optimal. That is, if a country can increase \( t, \beta, P, \) and \( \gamma, \) and decrease \( V, \) then the higher compensation level and stronger monitoring activities will be optimal. As a result, corruption will be reduced.

As shown above, several interesting implications come forward when the uncertainty of \( \delta \) is introduced. Another informational problem the sponsor would face is the uncertainty of \( b \) since it cannot be denied that the amount of bribes is usually kept secret in the corrupt transaction. In fact, there are two sorts of uncertainty of \( b \) we can think of. First, a principal does not know the amount of \( b \) although \( b \)
is the same to every agents. This implies that $w^c$ is the same to all agents. In other words, if $w^c(w, b) > w$, all the agents are corrupt, and, if $w^c(w, b) < w$, all the agents remain clean. If the corrupt activities of agents decrease the productivity ($\Omega$) of agents, the principal can infer $w^c$ by choosing $w$ and $\alpha$ and observing the output level. Then, this case becomes the homogeneous agent case in the previous section, and there will be no corruption or full corruption in the equilibrium.

A second more interesting and realistic case would be one where agents are facing different levels of $b$ which are unknown to a principal. In other words, it is possible that some agents are corrupt and others are not depending on $w^c(w, b)$ and $v$. In order to derive the equilibrium and draw implications in this case, we should solve the optimization problem of the principal as we did previously. But we already have all we need since the effect of the uncertainty of $\delta$ on $w^c$ is exactly same as the effect of the uncertainty of $b$ on $w^c$. Therefore, all results we showed in the case of an uncertain $\delta$ are equally true in the case of an uncertain $b$.

b. Self-Selection Contract

When a principal has imperfect information on the characteristics of agents, which is $\delta$ in this model, he can use a self-selection contract, if one exists, in which different agents are
choosing different contracts and consequently reveal their unknown characteristics. For example, if workers are different according to the expected tenure at a firm, an entry fee can be used as the self-selection contract (Salop and Salop, 1976), and if workers have different productivities that are unknown to employers, a test can be useful in revealing productivities (Guash and Weiss, 1981). In this section, we will investigate if a self-selection contract exists such that agents with different s's choose different contracts. In order to simplify the analysis we change the assumption on the expected income from corruption:

Assumption (V.1')

\[ w^C = (1-\alpha(tM))(w + \delta b) + \alpha(tM)\bar{w}. \]

Also, we assume that a principal can devise two different contracts: \((w', M')\) and \((w'', M'')\). With these assumptions, we provide the following proposition.

Proposition V.8

1) A self-selection contract exists only in the partial-corruption equilibrium.

2) A properly designed self-selection contract dominates the single contract in the partial-corruption equilibrium.

Proof:
1) Suppose that in order to achieve the no-corruption equilibrium a principal offers \((v', M')\) and \((w'', M'')\) such as

\[
(1-\alpha(tM'))(w'+\delta_h b) + \alpha(tM')\tilde{v} = w',
\]

and \([1-\alpha(tM'')](w''+\delta_1 b) + \alpha(tM'') = w''\).

Then, both type of agents will choose the same contract with the greater \(w\) between the two contracts. Therefore, the self-selection contract does not exist in the no-corruption equilibrium.

Next, suppose that in order to achieve the full-corruption equilibrium a principal offers \((v', M')\) and \((w'', M'')\) such as

\[
(1-\alpha(tM'))(w'+\delta_h b) + \alpha(tM')\tilde{w} = \tilde{w},
\]

and \([1-\alpha(tM'')](w''+\delta_1 b) + \alpha(tM'')\tilde{w} = \tilde{w}\).

Then, both types of agents will choose \((w'', M'')\) since \(w'' > w'\). Therefore, a self-selection contract does not exist in the full-corruption equilibrium, either.

Finally, in the partial-corruption equilibrium, the following six conditions define the set of a self-selection contract:

1. \( (1-\alpha(tM'))(w'+\delta_h b) + \alpha(tM')\tilde{v} > w' \),
2. \( (1-\alpha(tM'))(w'+\delta_h b) + \alpha(tM')\tilde{v} > [1-\alpha(tM'')](w''+\delta_1 b) + \alpha(tM'')\tilde{w} \),
3. \( (1-\alpha(tM'))(w'+\delta_h b) + \alpha(tM')\tilde{w} > w'' \),
4. \( w'' > (1-\alpha(tM''))(w''+\delta_1 b) + \alpha(tM'')\tilde{w} \),
(5) \( w'' \geq (1 - \alpha(tM'))(w' + \delta_1 b) + \alpha(tM')\overline{w}, \)

(6) \( v'' > v'. \)

The first three conditions imply that \( \delta_h \)-agents prefer \((w', M')\) to \((w'', M'')\), thus becoming corrupt whereas the last three conditions imply that \( \delta_1 \)-agents prefer \((w'', M'')\) to \((w', M')\), thus remaining clean. In order to prove the nonemptyness of the set of a self-selection contract, let \( v' = \overline{v} - A, M' = 0 \) and \( v'' = \overline{v} + B, M'' = C \) where \( A, B, C \) are positive. If we can prove that there exist \( A, B, C \) which satisfy (1) through (6), then the existence of a self-selection contract is proved.

From (3),

(3') \( (1 - \alpha_{\min})\delta_h b - (1 - \alpha_{\min})A > B. \)

And from (5),

(5') \( (1 - \alpha_{\min})\delta_1 b - (1 - \alpha_{\min})A \leq B. \)

Then, there exist positive \( A \) and \( B \) that satisfy (3') and (5') since \( \delta_h > \delta_1 \).

Moreover, when (3') and (5') are satisfied, (1) and (6) are also satisfied.
Next, from (2),

\[(2') \quad \alpha(tC) > 1 - (1 - \alpha_{min}) \frac{\delta_h b - A}{\delta_h b + B} \cdot \]

And from (4),

\[(4') \quad \alpha(tC) \geq \frac{\delta_1 b}{\delta_1 b + B} \cdot \]

Then, there exists C that satisfies \((2')\) and \((4')\) subject to A, B which satisfy \((3')\) and \((5')\).

2) Let \((w', M')\) be the single contract in the partial-corruption equilibrium. Then total costs are \((w' + M')L\). The total costs from a self-selection contract is \((w' + M')\delta_0L + (w'' + M'')(1-\theta)L\). That is, a principal can produce the same output at lower cost if he uses the self-selection contract in the partial-corruption equilibrium.

The above proposition indicates that a principal will use the self-selection contract if he can. Then it is necessary to derive the optimal self-selection contract. The design of the optimal contract is based on the cost minimization consideration of a principal. That is to say he will choose A, B, and C in the set of the intersection of
(1) through (6) to minimize the costs of the contract. In this cost minimization problem, the whole set of intersection is redundant as a constraint set. First we will find the subset of this intersection which is proper to the cost minimization problem. From (3'), and (5'),

\[(7) \quad (1 - \alpha_{\text{min}}) \delta_1 b - (1 - \alpha_{\text{min}}) A \leq B < (1 - \alpha_{\text{min}}) \delta_1 b - (1 - \alpha_{\text{min}}) A.\]

In this set, the proper set to the cost minimization is

\[(8) \quad (1 - \alpha_{\text{min}}) \delta_1 b - (1 - \alpha_{\text{min}}) A = B,\]

since the costs of contract is increasing with A and B.

Next, the intersection set of (2') and (4') is

\[(9) \quad \alpha(tc) \geq 1 - \frac{B}{\delta_1 b + B}.\]

Then the proper set for constraint of cost minimization problem is

\[(10) \quad \alpha(tc) = 1 - \frac{B}{\delta_1 b + B},\]

since the costs of contract is increasing with C.

With (8) and (10), we are ready to derive the optimal contract from the following optimization problem:
\[(V.41) \quad \min_{A, B, \delta_1, \delta_2} \quad \Theta(\bar{w} - A) + (1-\Theta)(\bar{w} + B + C),\]
\[\text{s.t.} \quad B = (1 - \alpha_{\text{min}})\delta_1 b - (1 - \alpha_{\text{min}})A,\]
\[\alpha(tC) = 1 - \frac{B}{\delta_1 b + B}.\]

Then the Lagrangian function \(\Phi\) is

\[(V.45) \quad \Phi = \Theta(\bar{w} - A) + (1-\Theta)(\bar{w} + B + C) + \lambda_1 \left(B - (1-\alpha_{\text{min}})\delta_1 b + (1-\alpha_{\text{min}})A\right) + \lambda_2 \{\alpha(tC) - \frac{\delta_1 b}{\delta_1 b + B}\}.\]

The necessary conditions are

\[(V.46a) \quad \frac{\partial \Phi}{\partial A} = -\Theta + \lambda_1 (1 - \alpha_{\text{min}}) = 0,\]
\[(V.46b) \quad \frac{\partial \Phi}{\partial B} = (1-\Theta) + \lambda_1 - \lambda_2 \frac{\delta_1 b}{(\delta_1 b + B)^2} = 0,\]
\[(V.46c) \quad \frac{\partial \Phi}{\partial C} = (1-\Theta) + \lambda_2 t\alpha^2 = 0,\]
\[(V.46d) \quad \frac{\partial \Phi}{\partial \lambda_1} = B - (1-\alpha_{\text{min}})\delta_1 b + (1-\alpha_{\text{min}})A = 0,\]
\[(V.46e) \quad \frac{\partial \Phi}{\partial \lambda_2} = \alpha(tC) - \frac{\delta_1 b}{\delta_1 b + B} = 0.\]

From (V.46a) through (V.46e),
(V.47a) \[ A = \{1 - \frac{1 - \alpha}{\alpha(1-\alpha_{\text{min}})}\} \delta_1 b, \]

(V.47b) \[ B = \left(\frac{1 - \alpha}{\alpha}\right) \delta_1 b, \]

(V.47c) \[ \frac{\alpha(tC)^2}{t\alpha(tC)} = \left[ \frac{\theta}{(1-\theta)(1-\alpha_{\text{min}})} + 1 \right] \delta_1 b. \]

Note that (V.47a), (V.47b), and (V.47c) determine the optimal A, B, C and consequently the optimal contract. In this contract, \( \theta \) plays an important role whereas \( \theta \) does not affect the optimal value in the pooling contract of the partial-corruption equilibrium. For example, if \( \theta \) is increasing, \( A \) and \( C \) is increasing and \( B \) is decreasing.

**Proposition V.9**

In the optimal self-selection contract, the proportion of the more corrupt agents is positively related to the intensity of monitoring the less corrupt agents and negatively related to the wage rate of both the more corrupt and the less corrupt.

It would be interesting to compare the optimal values between the pooling contract and the separating contract. Under the new assumption about the expected income from corruption, Assumption (V.1'), the pooling contract of the partial-corruption equilibrium is given by the following conditions:
\[ w^*_p = \bar{w} + \frac{(1-\alpha(tM^*_p))}{\alpha(tM^*_p)} \delta_1 b, \]

\[ \frac{\alpha(tM^*_p)^2}{t\alpha'(tM^*_p)} = \delta_1 b. \]

First, by comparing (V.47c) with (V.39b'), C is greater than \( M^*_p \).

**Proposition V.10**

1) The optimal self-selection contract offers more monitoring for the less corrupt than the single contract in the partial corruption equilibrium does, but the same monitoring for the more corrupt as the single contract in the full corruption equilibrium does.

2) The optimal self-selection contract offers a higher wage rate for the less corrupt than the single contract in the partial-corruption equilibrium does, and also offers a higher wage rate for the more corrupt than the single contract in the full-corruption equilibrium does.

**V. III. Heterogeneous Agents in the Two Sector Model**

The analyses in the previous sections are basically partial equilibrium analyses since we deal with the optimization problem in one sector. So, the final extension is to build a two-sector model.
This extension makes it possible to analyze two interesting questions; the externality on the decision-making of sponsors between the sectors and the separation of the agents according to their δ-type between the sectors.

It is true that most of the literature on corruption focuses on corruption of government officials without discussing corruption in the private sector. But corruption also exists in the private sector. The reason that the public sector had been exclusively discussed in the literature probably comes from the common belief that corruption is more prevalent and serious in the public sector. In fact, Banfield (1975) argued that the institutional aspects of the government sector provide more incidence of corruption than the private sector. No theoretical analysis, however, has been attempted to prove or disprove this argument. So, we like to show whether this argument can be validated or not in this two sector model.

In order for the two sector model to make sense, the private sector and the public sector should be different. If two sectors are same in the sense that the principals of both sectors choose the same w*, h*, and l*, then the one sector model above is enough for our discussion. So, we make assumptions which make differences between the
private sector and public sector. These assumptions are that $\beta$ and $t$ are lower in the public sector than the private sector. That is, $t_p > t_g$ and $\beta_p > \beta_g$ where the subscripts $g$ and $p$ represent the public sector and the private sector. The assumption of the lower $\beta$ in the public sector is based on the fact that the civil service regulation, of which the objective is to protect agents from being controlled by political influences, makes it hard to demote or dismiss agents even for nonpolitical reasons. Empirically, Allen (1989) showed the higher level of public sector job security by looking at differences in the layoff rate between the public sector and the private sector regardless of the union status.

As to the lower $t$ in the public sector, we could draw three different justifications from the existing literature. First, when Stigler (1962) explained the reason for the positive relationship between pay rates and firms’ size, he pointed out the fact that a bigger firm has disadvantages in the hiring process in judging the quality of workers. This argument can support the relative disadvantages in the monitoring activities in the public sector since governments are among the biggest organizations. Secondly, Niskanen

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8. The fact that the principals have different goals in the private sector and in the public sector does not make difference in this model since maximizing the net surplus ($\Pi$) in this model is goal of the principals in both sectors. As long as $\Pi$ is maximized, what $\Pi$ really is does not matter in determining the optimal compensation, the monitoring activities, and the employment level.
(1975) noted the publicness of monitoring activities within the legislature, and indicated that the monitoring activities were inefficiently low due to the free-rider problem. Finally, Banfield's (1975) explanation for the lower t in the public sector was grounded on the observation that in the public sector the central control system is absent and monitoring activities are fragmented.

If dismissing agents is not easy and monitoring agents is not effective, it could be argued that more corruption will result. In fact, this argument was proposed by Banfield, who concluded that there is more corruption in the public sector. Our model shows that this argument holds only in the short-run in which agents do not move between sectors. But there is another important aspect we should consider in the two sector model. Since workers can change jobs between sectors, it should be expected that different compensation levels between sectors will bring certain adjustments in the labor market in the long run. We show that the above argument does not hold in the long run. Before we explore the details of long-run equilibrium, we begin with the discussion of the short-run equilibrium.

a. Short-run Equilibrium in the Two Sector Model

First of all, the definition of the short-run equilibrium is that the principal's optimization problem is based on the fixed θ. In
other words, workers cannot change jobs between sectors in the short-run even though the compensation levels between sectors are different in the short-run.

The derivation of the short-run equilibrium is straightforward since a principal in one sector does not need to be concerned with what a principal in the other sector is doing. Therefore, the results in one sector model can be easily extended to this short-run equilibrium. In order to simplify the analysis without losing its main point, we slightly modify the assumption. We assume that there are two types of agents: the corruptible and the incorruptible. That is, it is assumed that $\delta_i = 0$, which implies that incorruptible agents are remaining clean without any monetary incentives and monitoring activities.

From the one sector model, we know that each sector has three possible equilibria. This implies that in the two sector model nine different equilibria pairs could be imagined. But since the public sector has higher costs of preventing corruption due to the assumptions on $t_g$, $t_p$, $\beta_g$, and $\beta_p$, the following three pairs of equilibria are excluded from feasible equilibrium set: the full-corruption in the private sector and the partial corruption in the public sector, the full-corruption in the private sector and the no-corruption in the public sector, and the partial-corruption in the private sector and the no-corruption in the public sector. In the remaining six pairs of equilibria, we will compare the optimized values between sectors.
a.1. No-Corruption Equilibrium in Both Sectors

First, consider the case where the principals in both sector choose the no-corruption equilibrium, \((w^*_n, M^*_n, L^*_n)\) and \((w^*_g, M^*_g, L^*_g)\), where \(p\) and \(g\) in the second subscript stand for the private sector and the public sector respectively. From the previous section, it was shown that both \(dw^*_n/dt\) and \(dw^*_n/d\beta\) are ambiguous. Therefore, it is not obvious which sector provides the higher compensation level. Unlike \(w^*\), we have the unambiguous result that

\[(V.48) \quad M^*_n < M^*_g,\]

since \(dM^*_n/d\beta < 0\) and \(dM^*_n/dt < 0\). That is, more expenditures on monitoring are expected in the public sector if both sectors choose the no-corruption equilibrium.

a.2. Partial-Corruption Equilibrium in Both Sectors

Second, when both sectors choose the partial-corruption equilibrium, the optimal \(w\) and \(M\) in the public sector and the private sector are
(V.49) \( w^*_g = w^*_p = \bar{w} \)
\[ M^*_g = M^*_p = 0. \]

That is, both sectors are paying the same reservation wage rate to all agents. Moreover, there are no expenditures on monitoring activities in both sectors. Now, we assume that the probability of detection is zero when there are no monitoring expenditures.

Then, from (V.2) and (V.49),

(V.50) \( \nu^c_g = \nu^c_p = \bar{w} + \delta b. \)

This equality states that the expected income from corruption is the same in both sectors.

a.3. Full-Corruption Equilibrium in Both Sectors

In the full-corruption equilibrium, the principals do not monitor agents' activities and pay the wage rate which equates the expected income from corruption to the reservation wage rate. That is,

(V.51) \( w^*_g = w^*_p = \bar{w} - \delta b, \)
\[ M^*_g = M^*_p = 0. \]

Then,
(V.52) $v^c_n = v^c_p = \bar{v}$.

That is, the expected income from corruption is the same in both sectors.

a.4. No-Corruption Equilibrium in the Private Sector and Partial-Corruption Equilibrium in the Public Sector

When the private sector chooses the no-corruption equilibrium and the public sector chooses the partial-corruption equilibrium, $(v^*_n, M^*_n)$ is the optimal set in the private sector and $(\bar{v}, 0)$ in the public sector. Comparing the optimal values in the public sector with those in the private sector,

(V.53) $v^*_n > v^*_p = \bar{v}$, and $M^*_n > M^*_p = 0$.

That is, the probability of detection is higher in the private sector and clean agents are compensated more in the private sector. In the private sector, both the corruptible and the incorruptible are paid $v^*_n$. Of course, no corruption occurs in the private sector since enough monetary incentives are given and monitoring expenditures are undertaken.
In order to see which sector provides more income to the corruptible agents, we have to derive the expected income from corruption in the public sector \( w^c_g \) and compare \( w^c_g \) with \( w^*_np \). In fact, the result of the comparison is that

\[
(V.54) \quad w^c_g > w^*_np.
\]

This can be proved by the fact that the no-corruption set in the public sector does not include \( (w^*_np, H^*_np) \). That is, the wage rate should be higher than \( w^*_np \) to keep the corruptible agents from being corrupt in the public sector when \( H=H^*_np \). In fact, \( H^*_ng < H^*_np \) since there is zero monitoring in the public sector. Therefore, the expected income from corruption in the public sector is greater than the wage rate in the private sector. This is an important inequality we will discuss later.

a.5. Full-Corruption Equilibrium in the Public Sector and Partial-Corruption Equilibrium in the Private Sector.

When the full-corruption equilibrium is chosen in the public sector and the partial-corruption equilibrium in the private sector, the monitoring expenditures are zero in both sectors, but the private sector pays the higher wage rate. Therefore,
(V.55) \[ m_{ig}^* = m_{pp}^* = 0, \]
\[ w_{ig}^* = \bar{w} - \delta_b < w_{pp}^* = \bar{v}. \]

And the expected income from corruption is also higher in the private sector. That is,

(V.56) \[ w_{ig}^c = \bar{w} < w_{pp}^c = \bar{w} + \delta_b. \]

a.6. Full-Corruption Equilibrium in the Public Sector and No-Corruption Equilibrium in the Private Sector.

Since there is no corruption in the private sector, both the corruptible and the incorruptible get the same income, which is \( w_{np}^* \).

But in the public sector only the corruptible are hired and they get the income from corruption. Of course, the wage rate is higher in the private sector. That is,

(V.57) \[ w_{ig}^c = \bar{w} < w_{np}^*, \]
\[ m_{np}^* > m_{np}^* = 0. \]

b. Long-run Equilibrium in the Two Sector Model
Although the short-run equilibrium analysis gives us some idea about how the different sectors are responding to the existence of corruptible agents, the possibility that agents can move between sectors makes it necessary to see what the labor markets of the two sectors look like in the long-run in which agents have no incentives to change sectors. One interesting result of the short-run equilibrium analysis is that the wage rate as well as the expected income from corruption could be different between sectors in some cases. But, in the long-run, it should be expected that agents could move to the sector which pays more as long as there are no costs of changing jobs. Since we are assuming that changing a job imposes no costs to agents, θ in each sector could change whenever the wage rates and/or the expected income levels from corruption are different between sectors.

Since we assume that agents are income maximizers, the compensation levels should be equalized to remove any incentive for agents to change sectors. From the previous section, we have six different pairs of short-run equilibria. We are going to derive long-run equilibria from these short-run equilibria.

First, when both sectors choose either the partial-corruption equilibrium or full-corruption equilibrium, the wage rate as well as the expected income from corruption is the same in both sectors. Therefore, there is no incentive for agents to change sectors. In other words, these short-run equilibria are sustainable in the long-run.
Next, consider the no-corruption equilibrium in the short-run in both sectors. In this case, there is no corrupt income because there is no corruption. Then, all agents including the incorruptible and the corruptible are looking for a job in the sector which pays the higher wage rate. Therefore, $\theta$ in both sectors will not change, and importantly these short-run equilibria are also sustained in the long-run. Although $\theta$ is not changing, the probability of getting a job in each sector will change. If $w^{*}_{ng} > w^{*}_{np}$, the public sector will attract all of the agents. So the probability of getting a job in the public sector will fall, and the probability in the private sector will rise. This change in the probability will bring about long-run equilibrium even though the wage rates are different in the two sectors. The long-run equilibrium condition is following:

\begin{equation}
(u_g w^{*}_{ng} = u_p w^{*}_{np},)
\end{equation}

where $u_g$ and $u_p$ represent the probability of getting hired in the public sector and the private sector respectively.

This condition implies that $u_g < u_p$ if $w^{*}_{ng} > w^{*}_{np}$, and vice versa. Another implication is that we do not have separation by $\delta$ in this long-run equilibrium.

So far, we have shown that when both sectors choose the same equilibria in the short run, these will be sustained also in the long
run. From now on, consider the cases where different equilibria are chosen in each sector.

First, we would like to specify the long-run equilibrium when the partial-corruption equilibrium in the public sector and the no-corruption equilibrium in the private sector are optimal in the short-run. The inequalities (V.53) and (V.54) indicate that the incorruptible will prefer the private sector while the corruptible will prefer the public sector. So, in the long-run, jobs in the public sector will be filled by the corruptible with the incorruptible getting jobs in the private sector. This implies a drastic increase in $\theta_g$ and decrease in $\theta_p$, and consequently the short-run equilibrium is not sustained in the long-run. It is true that the likelihood that a sponsor chooses the no-corruption equilibrium is increasing with $\theta$. So, continuing change in $\theta$ makes both the public sector and the private sector change the equilibrium from the partial-corruption equilibrium to the no-corruption equilibrium in the public sector and from the no-corruption equilibrium to the partial-corruption equilibrium in the private sector. Then, the crucial determinant of the long-run equilibrium is which sector changes the equilibrium before the other does since we have already shown that the no-corruption equilibrium in both sectors and the partial-corruption equilibrium in both sectors are sustainable in the long-run. First, consider the long-run equilibrium when the public sector changes equilibrium from the partial-corruption equilibrium to the no-corruption equilibrium due to the increase in $\theta_g$, but the private
sector keeps the no-corruption equilibrium even though \( \Theta_p \) is decreasing, once the public sector attains the no-corruption equilibrium. Then, \( \Theta_g \) and \( \Theta_p \) do not change any more because, as shown previously, \( \Theta \) is stable when both sectors have no-corruption equilibria. And (V.58) becomes the long-run equilibrium condition.

What happens if the private sector changes equilibrium before the public sector does? In this case, we have different long-run equilibria which are the partial-corruption equilibria in both sectors. Then, in the long-run, the wage rate as well as the expected income from corruption will be the same in both sectors.

Next, consider the long-run equilibrium when the partial-corruption equilibrium in the private sector and the full-corruption equilibrium in the public sector are chosen. From (V.55) and (V.56), both the wage rate and the expected income from corruption are higher in the private sector. Then, both the corruptible and the incorruptible will look for a job in the private sector. This makes \( U_p \) less than one. Therefore, the expected income for the incorruptible will be less than the reservation wage rate. So, the incorruptible do not want to get a job in the private sector, which implies that \( \Theta_p = 1 \) and \( \Theta_g = 1 \). Then, the optimal equilibrium in the private sector becomes the no-corruption equilibrium or the full corruption equilibrium. And the long-run equilibrium condition is
Finally, we investigate the long-run equilibrium when the public sector chooses the full-corruption equilibrium and the private sector chooses the no-corruption equilibrium. From (V.59), we know that the incorruptible are employed only in the private sector in the short-run and the corruptible prefer being employed in the private sector. Then, in the long-run, $\theta_p$ will increase. But once the no-corruption equilibrium is attained, the proportion of the corruptible does not matter. So, in the long-run equilibrium, there will be no corruption in the private sector and full corruption in the public sector and the long-run equilibrium condition is

(V.60) \[ U_p^* w_{np}^* = w^c_p = \bar{w} . \]

In summary, in the long-run equilibrium, either both sectors achieve the same equilibrium or the private sector achieves the no-corruption equilibrium and the public sector achieves the full-corruption equilibrium.
CHAPTER VI
ANECDOTAL EVIDENCE

In this chapter, we present some anecdotal evidence taken from existing case studies on corruption in various countries to show the relevance of our model in explaining the real world. In order to achieve this goal, consider two separate issues. First, we will focus on case studies discussing how the different exogenous variables lead to different levels of corruption, and see whether the results are consistent with what our model predicts. Proposition V.7 of Chapter V predicts that the corruption level is positively related to the amount of bribes and the relative productivity of corrupt agents, and negatively to the conviction rate, the legal penalty, disadvantage from a personal history of corruption, job security, the unemployment rate, the monitoring technology, and the proportion of corrupt agents. The second issue we are concerned with is whether a specific policy carried out in case by case to control corrupt activities of agents is consistent with what our model suggests. As many case studies showed that some policies were successful and others were not in reducing the corruption level, our model will shed light on the reasons for the success or failure of policies.

We start with the effect of the size of bribes facing agents on the corruption level. Before 1954 Philippine citizenship for the
Chinese community there had low value, and there was small demand for it. Consequently, it was not difficult to obtain through the mandatory market system, and the cost of obtaining it in the legal way was relatively low. But in 1954 the Philippine legislature passed the Retail Trade Nationalization Act which prevented foreigners from opening new business and handing over their existing businesses to their children. Suddenly, Philippine citizenship became much more valuable and demand for it increased dramatically. Moreover, it became extremely difficult to obtain it in the legal way. This situation raised the willingness to pay for it even in an illegal way. So the size of bribes was increased. As a result, the high level of corruption of these officials were observed. 9

A similar situation happened in Zambia where economic reforms were introduced by the government between 1968 and 1971 to exclude non-citizens from participating in specific economic sectors. This reform led to a high premium on Zambian citizenship to those who were supposed to lose their businesses or wanted to take over such industries. Consequently, two Permanent Secretaries were prosecuted for the alleged sale of citizenship to resident expatriates. 10

Another variable to which the optimized corruption level is positively related is the relative productivity of corrupt agents. If

corrupt agents produce output almost as much as clean agents, our model expects that not many resources will be spent on depressing corruption. In West Africa, Patients have to pay bribes to doctors and nurses if they want to get proper services. However, the tasks of doctors and nurses were so overwhelming that, even if they worked very hard without corruption, the output level would not increase a lot. In this case, the high level of corruption could be a result of optimizing behavior.

The relationship between the corruption level and the severity of punishment for corrupt activities is well exemplified in the African Farming Improvement Funds scandal of 1970 in Zambia. In November 1970, the president of Zambia suspended a number of officials for appropriation of the African Farming Improvement Funds. These officials included two Cabinet members, two Ministers of State, a Permanent Secretary, a divisional policy commander, and two provincial agricultural officers. But after some investigations the president reinstated all those suspended except one Cabinet member. This implies that no serious penalty was imposed on corrupt officials. Therefore, it is not surprising that a 1979 report indicated that there still existed the broad misuse of funds among public officials.

If an agent is not removed from the job for some reason even if he is known to be corrupt, this also leads to a high corruption level of agents. In the context of our model, a high $\beta$ will result in high corruption level although the corruption level is optimized. In countries with the spoils system in politics, public officials usually enjoy a high level of job security. In those countries, even when an official is caught for corruption, he will probably return to his job if he has a strong party affiliation. Therefore, the high level of bureaucratic corruption should be a natural result of the spoils system.

The example taken from the case study of Zambia clearly shows the consequences of the spoils system. Another example can be found in Indonesia where the spoils system was introduced into the bureaucracy in the early years of the Republic.\textsuperscript{13} The observation by Palmier is that "loyalty to the party exonerated such faults as proved corruption." Most of the investigations and attempted prosecutions of corruption of high-level officials failed, and this caused widespread corruption.

Our model predicts that when it is difficult and therefore costly to observe the activities of agents, the corruption level should be higher. In actuality, this prediction proved valid in many case studies on corruption involving tax departments and police.

\textsuperscript{13} Leslie Palmier(1983) provided this example from "Bureaucratic corruption and its remedies" in Corruption, Michael Clarke, ed.
departments. It has been acknowledged that tax corruption and police corruption are serious problems in many countries. The particularly high level of corruption in tax departments and police departments is related to the difficulties in monitoring since it is not easy to observe the activities of tax officials and policemen. In other words, these officials have monopoly power over the information. For example, the job of tax officials is to find information which are necessary for assessing the amount of tax on a specific person or firm. When they get this information, they have monopoly power which can lead to private bargaining with those who owe the tax but have not paid yet. Of course, the accused taxpayers are willing to pay bribes if the amount of tax assessed is greater than bribes.

In the case of police corruption, a policeman usually gets sole possession of information about a violation when he catches the violator. This can lead to private and of course illegal bargaining between the policeman and the violator. This informational problem in police corruption exists in the private sector as well. A case study on corruption in the private security sector revealed the fact that the information problem is crucial in corruption even in the private sector.15

Until now, we have focused on which variable affects the corruption level. From now on, we will examine the case studies\textsuperscript{16} which cover various policies used for combatting corruption.

The Philippines' Bureau of Internal Revenue was well known for its corruption by tax officials who were collecting and embezzling tax money, accepting bribes for lower assessments, and extorting money from taxpayers by threatening them with higher assessments than true ones. In 1975, a new commissioner took charge of this department, and introduced several anti-corruption measures which turned out to be very successful. His policy has three major components: effective use of an incentives system, better information gathering, and quick and strong punishment of corrupt officials, especially high-level officials. The following statement of the new commissioner summarizes the first component of his policy: "We needed a system to reward efficiency. Before, inefficient people could get promotions through gifts. But even though I could not change the pay scale, I could give them rewards through promotions and transfers... I introduced a system based on the amount of assessments an examiner had made, how many of his assessments were held, the amounts actually collected...{"17} Our model does not discuss the construction of such an incentive system. We leave this subject for further research.

\textsuperscript{16} For more complete studies, see Robert Klitgaard (1988).
\textsuperscript{17} From page 48 and 49 of \textit{Controlling Corruption} by Robert Klitgaard.
The second component of his policy is to collect information about corrupt activities of tax officials. Although information gathered is directly used to discover corrupt agents, a more important effect of collecting information is to increase the agents' expected probabilities of detection of corrupt activities. Thus, the expected income from corruption in the context of our model is decreased since α is increasing. The deterrence effect of better information through the change in expected probability of detection was emphasized by the commissioner himself: "More than what they actually accomplished through these reviews was the impact on other examiners of the possibility that their work would be subjected to review. They work harder and better as a result." 18

The last component of the anti-corruption policy of the new commissioner is about penalizing the corrupt. In terms of our model, he attempted to change γ, P, and β. Although he obtained some convictions on criminal charges of corrupt officials, it was not easy to get convictions for all cases since it was beyond his jurisdiction. Instead, he used dismissals to penalize the corrupt. In a relatively short time, thirty-four officials were dismissed. That is, he increased β.

Another successful story of an anti-corruption program can be found in Hong Kong where the Independent Commission Against

18. From page 53 in Controlling Corruption.
Corruption (ICAC) was set up in 1973 to combat widespread corruption in the Royal Hong Kong Police. From the beginning, ICAC was given sweeping powers not only to search and seize any suspect without need of a warrant but also require any person to provide any information that the commissioner thought necessary. That is to say, the cost of gathering information was reduced.

The ICAC was organized into three departments: the Operations Department, the Corruption Prevention Department, and the Community Relations Department. The primary objective of the Operations Department was to increase agents' expected probability of detection. This Department had two branches: the General Target branch and the Personal Target branch. The former branch dealt with the investigations and prosecutions of corruption in all areas and at all levels. On the other hand, the latter branch scrutinized the finances of officials who seemed to have living standards they could not afford with their regular income.

The Corruption Prevention Department concentrated on changes in working procedures in government agencies to get rid of incentives for corruption. One official of the department stated the role of the Corruption Prevention Department: "The objective is to eliminate or, simplify wherever possible or desirable, enforceable laws, cumbersome
procedures, vague and ineffectual practices conducive to corruption."19

The Community Relations Department was set up to gather information from the public and to change the public attitude toward corruption. This department ran a program which made it easy for local citizens to report information about corruption on the one hand, and developed higher moral, social, and ethical standards in society on the other hand. Thus, this department attempted to decrease which is the preference for corruption. All the programs which the ICAC carried out are consistent with what our model suggests to decrease the level of corruption. Eventually, the police department in Hong Kong became one of the cleanest departments in Asia.

19. From page 111 in Controlling Corruption.
CHAPTER VII
CONCLUSION

When a principal has imperfect information on agents' activities or their characteristics, he should expect 'agency costs' from either moral hazard or adverse selection problems. The starting point of this study is the recognition that corruption of agents is one instance of agency costs, and it could be analyzed in the context of the principal-agent problem. As in other literature on agency costs, we need to answer two basic questions about what effect corruption of agents has on the interest of a principal and how the principal reacts to the corruption of agents.

The first question was discussed in chapter III and chapter IV, where we employed the Niskanen model to show the effects of agents' corruption on the output level, the budget size of agency, and the welfare level of the principal. Although we keep the basic idea of the Niskanen model, which introduced the inefficiency of the self-interested agents, we improve a few drawbacks of the model that were pointed out by previous studies. We identified the precise nature of the interaction between the principal and agents in the general equilibrium framework, while the original Niskanen model assumed in the partial equilibrium framework that agents decide both the output level and the budget size and make an all-or-nothing offer. Moreover,
we indicated that asymmetric information about the cost function is the very source of the inefficiency in production by agents. This asymmetric information also brings the possibility of agents' corruption since we showed that corruption of agents increases the production costs on the input side and/or output side.

We presumed three types of agents regarding their objective: the output-maximizing agency, the discretionary budget-maximizing agency, and the bribe-maximizing agency. It has been shown that each agency behaves differently in the specific informational structure. The main proposition of these chapters is that in any informational setting, the bribe-maximizing agency is producing the output level no greater than that of other types of agency, and it is never preferred to other types of agency by the principal. Note that this proposition is quite general since we do not make any assumption about the specific type of the corrupt dealing.

The second question about how the principal reacts to the agents' corruption is the subject of chapter V, where the principal is given the authority to monitor agents and dismiss the agents caught for corruption as well as set the wage rate for agents. Under the assumption that agents become corrupt only when the expected income from corruption is greater than non-corrupt income, the principal is supposed to attempt to get the optimal level of corruption by spending the optimal amount of resources on monitoring and setting the optimal wage rate. We started with the simplest one sector model in which agents are homogeneous with respect to their preference for corrupt
income. One surprising result in this chapter is that full corruption could be better than no corruption for the principal, depending on exogenous variables which affect the expected income from corruption. For instance, the harder it is to dismiss the corrupt, the more likely it is that full corruption is preferred by the principal. As to the optimal wage rate, it is higher than the reservation wage rate when the interior solution of the no-corruption equilibrium is chosen by the principal, and lower when the full-corruption equilibrium is chosen. Therefore, it was shown that the efficiency wage argument is true only when the no-corruption equilibrium is attained.

When we extended the model to heterogeneous agents, we obtained another equilibrium which let some portion of agents be corrupt. We called this equilibrium as the partial-corruption equilibrium. It was proved that the optimal wage rate of the partial-corruption equilibrium is higher than the reservation wage rate unless the corner solution is attained. Additionally, we explored the possibility of the self-selection contract as in many studies on the adverse selection problem. In actuality, we proved the existence of the self-selection contract by which the principal can separate the less corruptible from the more corruptible, and also showed the dominance of the self-selection contract over the single contract in the partial-corruption equilibrium. Moreover, it was proved that the optimal self-selection contract offers a higher wage rate and more monitoring for the less corruptible, compared with the single contract in the partial-corruption equilibrium.
Then, a two sector model was discussed to investigate the question whether the public sector or the private sector has more corruption. We obtained the somewhat surprising result that both sectors have the same optimal corruption level in the long run even though the different values of the exogenous variables make it more difficult to prevent corruption in either sector.

Certainly, our study does not explain everything about economic aspects of corruption although the findings here significantly help our understandings of the economic consequences of agents' corruption. In concluding this study, we leave a couple of questions which we hope future research can answer. First, a more systematic investigation on corruption of a principal is necessary, especially in the public sector. Casual observation indicates that agents' corruption flourishes when the principal is also corrupt. However, it is uncertain whether the principal's corruption encourages agents' corruption or agents' corruption gives rise to the principal's corruption. Second, it would be interesting to find out the optimal structure of an organization in the presence of corruption. Is multi-layer supervising is better than single-layer supervision in fighting agents' corruption?
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117


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APPENDIX
Figure 1. Equilibrium when the principal has incomplete information about the fixed costs and marginal costs
Figure 2. Equilibrium when fixed costs are public information
Figure 3. Equilibrium when marginal costs are public information.
Figure 4. Interior solution of the no-corruption equilibrium
\[ v = \bar{v} - \left[ \frac{(1-u)}{u} \right] + \left[ \frac{((1-\alpha)\delta u/\alpha\beta u)}{\gamma u} \right] - \frac{\gamma}{\beta u} \]

\[ \frac{1}{\xi^{\alpha-1}} \left( \frac{\delta b}{\gamma F + \delta b + \beta(1-u)\xi} \right) \]

Figure 5. Corner solution of the no-corruption equilibrium