# The Optimal Combination of Corruption Reforms: Is a Comprehensive Approach a Good Idea?*

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**Abstract**

Earlier work on corruption reform often argues that a broad set of reforms should be simultaneously implemented in many different sectors. The purpose of this paper is to examine the validity of this argument by examining the complementarity or substitutability of anticorruption reforms in different sectors. The model rationalizes some frequently discussed interaction effects, and identifies some new interaction effects. These imply that in certain countries, it will be optimal to implement administrative reform alone; in other countries, it will be optimal to combine all reforms.

Key words: Big bang approach, gradualism, bureaucratic corruption, collusion, complementarity or substitutability of reforms, delegation.

JEL codes: D73, D78, D82, H57, L51 and O12.

# I. Introduction

During the 1990's many policy advisors (e.g., Sachs 1990, Lipton and Sachs 1990, and Murphy, Shleifer and Vishny 1992) recommended the "big bang" approach to transition in central and eastern European economies. In that view, carrying out a comprehensive set of reforms all at once works better than gradual reform. Since then, such a tendency to comprehensive reform has also influenced corruption reform within government sector in developing countries (e.g., Klitgaard 1995, Mookherjee 1998, and Rose-Ackerman 1999). For example, Mookherjee (1998) argues that incentive reform will be facilitated by legal reform, administrative reform and adjusting degree of autonomy. Although the argument is based on a premise that reforms in different sectors are complementary, little research has formally examined the interactions of the reforms. In this paper, we present a conceptual framework to answer the following questions: Under what conditions are anti-corruption reforms in different sectors complementary? Consequently, when is it desirable to carry out a broad set of reforms, as against reform in a single sector?

In section II, we present a model in which a government procures a good (e.g., a computer system, or an electricity generator) from a private sector, or alternatively regulates a price set by a natural monopoly. The firm has some private information about its productivity. The government employs a regulatory agency to reveal the firm's private information, while the firm can bribe the agency into hiding it. Thus, unless the government gives enough incentive payments to the agency, the agency will hide the firm's information (i.e., the agency will be corrupt).

In Section III, we examine the single and interaction effects of the following reform policies: Incentive reform (paying regulators on the basis of cost reports); Legal

reform (increasing the risk of corrupt deals, e.g., by increasing penalties for corruption or shifting burden of proof on defendants); Administrative reform (improving the agency's ability of investigation, e.g., by computerization, training or employing more auditors); Delegation (the regulatory agency is authorized to design pricing rules or procurement contract for the firm on behalf of the government).

An important feature of this model is that the government can revise the contract for the firm after receiving the agency's report, i.e., the government cannot precommit to its procurement contracts. This is in line with empirical evidence suggesting that such lack of commitment is a serious problem in many developing countries since the opportunity of future exploitation by governments inhibits private investment or incentives for cost reduction (for example, Levy and Spiller (1996)).

In our model, such a commitment problem discourages the government from blocking corruption by implementing incentive reform. Once the regulatory agency reveals the firm's private information, the government has an incentive to opportunistically revise the regulatory rule in order to appropriate the informational rents of the firm. This diminishes the firm's *ex ante* incentive to invest in cost reduction. The government can mitigate the commitment problem by tolerating corruption since corruption reduces information flow concerning the firm's effort for cost reduction to the government (Lambert-Mogiliansky, 1998).

We have three main results about interactions of reform policies. First, if delegation is not undertaken, then incentive reform is a substitute for administrative reform in that incentive reform reduces the welfare-improving effects of administrative reform. Since carrying out administrative reform increases the agency's information flow

to the government, the commitment problem becomes more severe. Thus, the government is less willing to undertake incentive reform if administrative reform is undertaken.

Second, delegation by itself decreases welfare and makes corruption rampant; however, delegation improves welfare and eradicates corruption if coupled with incentive reform. In our model, delegation eliminates the commitment problem perfectly since it robs the government of the opportunity of *ex post* opportunistic exploitation of the firm. However, it creates a different problem: the government loses control over the firm. Such loss of control over the firm is normally costly; in fact, carrying out delegation alone reduces welfare substantially in our model. However, the government can keep real control over the firm by designing a proper incentive contract for the agency. Thus, in our model, delegation improves welfare if coupled with incentive reform.

The result integrates seemingly inconsistent arguments in existing literature. Rose-Ackerman (1997), and Johnson, Kaufmann and Zoido-Lobaton (1998) argue that increasing the discretionary power of bureaucrats expands bureaucratic corruption. In contrast, some authors argue that delegation improves welfare if coupled with incentive reform (e.g., Kelman, 1994, and Das-Gupta and Mookherjee, 1998, Rose-Ackerman, 1999). For example, Kelman (1994) argues that procurement reforms in the U.S. are needed both to encourage discretion and improve incentives for good performance.

Third, if delegation is undertaken, then incentive reform is no longer a substitute for administrative reform. As we explained above, once delegation is undertaken, the commitment problem disappears, and thus, incentive reform does not reduce the welfare-enhancing effect of administrative reform. This result illustrates a problem of analyzing

interactions of reforms pair-wise since the interaction between administrative and incentive reform depends on whether delegation is carried out simultaneously.

Based on the interaction effects above, we examine how the optimal reform combination varies in response to a shift in a set of exogenous parameters, such as the costs of reform policies. The cost of settling a reform policy is often very expensive and time-consuming in developing countries. For example, to improve a legal system of a country, the government needs to train judges and lawyers, and replace bad laws with functional laws. These measures are very costly and time-consuming in developing countries (Hay, Shleifer and Vishny, 1996).

If the cost of delegation is very high but that of administrative reform is very low, then it is optimal to carry out administrative reform alone. Since administrative reform and incentive reform are substitutes if delegation is not undertaken, the government should implement administrative reform alone if the cost of administrative reform is very low.

On the other hand, if the cost of delegation is low, then it is optimal to combine all reforms in different sectors. Since incentive reform is no longer a substitute for administrative reform if delegation is undertaken, comprehensive reform is preferable in this setting. It follows, therefore, that the desirability of comprehensive *vis-à-vis* narrow reform is not universal: the optimal scope of reform efforts depends on the cost of implementing delegation and administrative reform.

Section IV contains a literature review. Section V concludes the paper with some remarks on the sequence of reform policies.

## II. The Model

The model is structured as a three-tier hierarchy consisting of a principal, a regulatory agency, and a firm. The principal could represent Congress issuing regulations regarding the firm's production project. The objective of the principal is to maximize expected welfare from the procurement through contracting with the regulatory agency and the firm. The firm has private information about efficiency in procuring a good. For the purpose of exposition, it is assumed that the firm has a simple zero-one production decision and that the principal finds it worthwhile to make the firm produce one unit. The regulatory agency is employed to investigate the firm's efficiency. We normalize the reservation utility of the regulatory agency and the firm to be zero and further assume that all agents are risk neutral. It is also assumed that there exists some mechanism (e.g. long-term relation) which makes the side-contract self-enforceable.

The firm exerts effort $e$, which, together with a productivity parameter $\beta$, determines cost $(\beta - e)$. We assume that the cost for the firm of exerting effort, $\psi(e)$, is an increasing, convex function with $\psi''' > 0$. The output belongs to the principal, who compensates the firm with a transfer, $t$. The firm can offer the regulatory agency an amount of bribes, $B$, so that the agency conceals its information. The firm's utility is

$$u_F = t - \psi(e) - B.$$

The regulatory agency observes a signal $\sigma$ imperfectly correlated with $\beta$. The agency receives a wage $w$ from the principal and a bribe $B$ from the firm. Its utility is

$$u_R = w + \frac{B}{1 + \lambda_B}.$$

$\lambda_B$ represents the extent to which the regulatory agency discounts the bribes paid by the firm. The principal receives a benefit, $S$, from the project and pays wages to two agents and pays the cost of the project, $(\beta - e)$. The principal's utility is the sum of producer, agency, and consumer surpluses. It is defined as:

$$W = S - (1+\lambda)(w + t + \beta - e) + u_F + u_R$$

$$= S - (1+\lambda)(\beta - e + \gamma(e)) - \lambda(u_F + u_R) - \frac{(1+\lambda)\lambda_B}{1+\lambda_B} B. \quad (1)$$

$\lambda (>0)$ represents a distortional tax system. Note that the sum of the agency's and the firm's rents is important for the principal, but the distribution is not. Note also that corruption in this model means collusion between the firm and the regulatory agency, where the firm bribes the agency into hiding the firm's type. Therefore, from now on, we will use 'collusion' instead of 'corruption'.

*Information Structure:* We assume that $\beta$ can take only two values, $\underline{\beta} < \overline{\beta}$. $\underline{\beta}$ obtains with probability $q$ and $\overline{\beta}$ with probability $(1-q)$. While $\beta$ and $e$ are private information of the firm, we will suppose that the cost of the project, $(\beta - e)$, is publicly observable and verifiable. The regulatory agency obtains a signal $\sigma$ imperfectly correlated with $\beta$. The signal has the following properties: (1) If the firm's type is $\beta$, the signal is $\beta$ or $\varnothing$ (nothing) for each $\beta$; (2) Prob $(\sigma = \beta) = \zeta$ for any $\beta$; (3) The signal is hard information: If $\sigma = \beta$, then the regulatory agency can report $\hat{\sigma} = \beta$ or $\varnothing$. If $\sigma = \varnothing$, then the regulatory agency can report $\hat{\sigma} = \varnothing$. That is, the regulatory agency can hide its information but cannot lie. Under this information structure, we have the following four states:

| State | Probability $x$ |
|---|---|
| $(i)$ $\beta = \overline{b}, \sigma = \overline{b}$ | $x_i = (1-q)\zeta$ |
| $(ii)$ $\beta = \underline{b}, \sigma = \underline{b}$ | $x_{ii} = q\zeta$ |
| $(iii)$ $\beta = \overline{b}, \sigma = \varnothing$ | $x_{iii} = (1-q)(1-\zeta)$ |
| $(iv)$ $\beta = \underline{b}, \sigma = \varnothing$ | $x_{iv} = q(1-\zeta)$ |

*Contracts:* The principal makes a take-it-or-leave-it offer to the firm and the regulatory agency. A contract for the firm is $\{t(\hat{\beta}, \hat{\sigma}), C(\hat{\beta}, \hat{\sigma})\}$; or equivalently, $\{e(\hat{\beta}, \hat{\sigma}), u_F(\hat{\beta}, \hat{\sigma})\}$. Also, a contract for the agency is $w(\hat{\beta}, \hat{\sigma})$; or equivalently, $u_R(\hat{\beta}, \hat{\sigma})$.

*Timing:* The timing is the same as Lambert-Mogiliansky (1998):

(0) All parties learn their information simultaneously: the principal learns the prior distribution of the firm's type, the agency and the firm observe a signal $\sigma$, and the firm learns its true type.

(1) The principal offers a menu of contracts to the agency and the firm.

(2) The firm and the agency agree on a side contract.

(3) The agency reports its information to the principal.

(4) The principal and the firm renegotiate.

(5) The firm reports its information to the principal. And the firm chooses effort.

(6) The cost is realized and transfers are distributed according to the contract with the principal and the side contract with the agency.

*Renegotiation in (4):* We assume that the principal still makes a take-it-or -leave-it offer to the firm when the principal renegotiates the contract with the firm after the agency's report. As Lambert-Mogiliansky (1998) argues, this assumption not only simplifies our

argument (we will have a unique equilibrium) but also corresponds to a more realistic sequence of moves: after the regulatory agency's investigation of the project, the principal designs a contract to the firm.

*Under symmetric information between the principal and the firm (the first best):* Suppose that the principal learns the firm's true type in stage (0). The principal does not have any incentive to employ the regulatory agency. The principal offers the firm the contract which does not give the firm any rents, $u_F = 0$, and lets it choose $e^*$ such that $\psi'(e^*) = 1$. Then, the expected welfare is

$$EW^* = q[S-(1+\lambda)(\underline{\beta}-e^*+\psi(e^*))]+(1-q)[S-(1+\lambda)(\overline{\beta}-e^*+\psi(e^*))].$$

**II.1.** ***Optimal Contracting without the regulatory agency***

In this section, we, for the moment, neglect the regulatory agency and we consider the case in which the principal regulates the firm directly. This is a typical principal-agent model under asymmetric information, studied by Laffont and Tirole (1993). Optimal regulation entails a tradeoff between efficiency and rent extraction: the incentives for an inefficient type are reduced to decrease the information rent of an efficient type. The optimal allocation, called the second best allocation in the following, is described in proposition 0. Note that $\underline{u}, \overline{u}, \underline{e}$ and $\overline{e}$ represent the efficient type's rents, the inefficient type's rents, the efficient type's effort and the inefficient type's effort, respectively.

*Proposition 0: In optimal contracting, the inefficient type does not receive any rents and chooses a lower level of efforts than under the first best,* $\overline{e}^s$*; on the other hand, the*

*efficient type receives positive rents,* $\Phi(\bar{e}^s)$ *, and chooses the first best level of effort,* $e^*$.

*Note that* $\bar{e}^s$ *is the solution of the problem,*

$$Max_{\bar{e}} EW^s(\bar{e},q) = q[S-(1+\lambda)(\underline{\beta}-e^*+\psi(e^*))-\lambda\Phi(\bar{e})]$$

$$+(1-q)[S-(1+\lambda)(\bar{\beta}-\bar{e}+\psi(\bar{e}))]$$

*where* $\Phi(e)=\psi(e)-\psi(e-\Delta\beta)$. *Then, the principal gets* $EW^s = EW^s(\bar{e}^s,q)$.

*Proof.* Laffont and Tirole (1993).

### II.2 *The optimal menu of contracts under full commitment*

Consider the case in which the principal employs the regulatory agency and can commit to the contracts offered at the outset (full commitment). Clearly, the opportunity to revise contracts after the agency's report plays no role. Thus, the structure considered here is a static game like Laffont and Tirole (1991)'s model, where the optimal collusion-proof menu of contracts achieves the optimal allocation. Thus, a collusion-proof menu of contracts maximizes social welfare in this model. As we shall show below, however, allowing collusion is as socially desirable as blocking collusion in a certain condition.

There is a tradeoff between blocking collusion and allowing collusion: blocking collusion eliminates the firm's informational rents since the regulatory agency reveals the firm's type; but it entails the regulatory agency's salary above bribes since the firm bribes the regulatory agency into hiding the firm's type. How much salary should the principal pay to block collusion? To keep its informational rents, the firm bribes the regulatory agency. Thus, it does not want to pay bribes above its informational rents, and so, the maximum amount of bribes is its informational rents. The regulatory agency may

discount the bribes paid by the firm because of punishment for bribery. Then, the principal can block collusion by paying the agency less salary than the informational rents. If the regulatory agency discounts the bribes from the firm, then the merit of blocking collusion (eliminating the informational rents) is larger than the cost of it (paying the regulatory agent's salary); thus, blocking collusion is more socially desirable than allowing collusion (Laffont and Tirole 1991). However, if the agency does not discount the bribes from the firm, the merit of blocking collusion is as much as the cost of it. Therefore, allowing collusion is as socially desirable as blocking collusion.

### II.2.1 *The optimal collusion-proof menu of contracts under full commitment*

The allocation achieved by the optimal collusion-proof menu of contracts, which is derived by Laffont and Tirole (1991), is the following.

| State | Report | Probability | Effort | $u_F$ | $u_R$ | $u_F + u_R$ | $B$ |
|---|---|---|---|---|---|---|---|
| $(i)\beta = \bar{\beta}, \sigma = \bar{\beta}$ | $\hat{\sigma} = \bar{\beta}, \hat{\beta} = \bar{\beta}$ | $(1-q)\zeta$ | $e^*$ | 0 | 0 | 0 | 0 |
| $(ii)\beta = \underline{\beta}, \sigma = \underline{\beta}$ | $\hat{\sigma} = \underline{\beta}, \hat{\beta} = \underline{\beta}$ | $q\zeta$ | $e^*$ | 0 | $\frac{\Phi(\bar{e}^n)}{1+\lambda_B}$ | $\frac{\Phi(\bar{e}^n)}{1+\lambda_B}$ | 0 |
| $(iii)\beta = \bar{\beta}, \sigma = \varnothing$ | $\hat{\sigma} = \varnothing, \hat{\beta} = \bar{\beta}$ | $(1-q)(1-\zeta)$ | $\bar{e}^n$ | 0 | 0 | 0 | 0 |
| $(iv)\beta = \underline{\beta}, \sigma = \varnothing$ | $\hat{\sigma} = \varnothing, \hat{\beta} = \underline{\beta}$ | $q(1-\zeta)$ | $e^*$ | $\Phi(\bar{e}^n)$ | 0 | $\Phi(\bar{e}^n)$ | 0 |

$$\bar{e}^n(\lambda_B) = \arg\max_{\bar{e}} \{\zeta EW^* - q\zeta\lambda\Phi(\bar{e})/(1+\lambda_B) + (1-\zeta)EW^s(\bar{e}, q)\} \qquad (3)$$

We denote the expected welfare by

$$EW^n(\lambda_B) = \zeta EW^* - q\zeta\lambda\Phi(\bar{e}^n(\lambda_B))/(1+\lambda_B) + (1-\zeta)EW^s(\bar{e}^n(\lambda_B), q) \qquad (4)$$

In (iii) and (iv), where the regulatory agency does not know the firm's type, the principal offers a menu of contracts similar to the second best one, $\{(\bar{e},0),(e^*,\Phi(\bar{e}))\}$, and achieves $EW(\bar{e},q)$. The informational rents affect the regulatory agency's salary necessary to block collusion: 0 in (i) and $\Phi(\bar{e})/(1+l_B)$ in (ii). Since she knows the firm's type in (i) and (ii), the principal obtains the expected welfare level under symmetric information $(EW^*)$ except for the social cost of paying the agency the salary $l\Phi(\bar{e})/(1+l_B)$. The important point to note is that when deciding the level of $\bar{e}$, the principal considers the effects on the agency's salary in (ii) as well as on the firm's informational rents $\Phi(\bar{e})$ in (iv). It causes $\bar{e}^n(l_B)$ to be smaller than $\bar{e}^s$.

From the envelop theorem, it is obvious that $EW^n(l_B)$ is decreasing in $l_B$, that is, if the regulatory agency discounts the bribes from the firm more, then the social welfare from the optimal collusion-proof menu increases. This is because the principal can block collusion by less salary to the regulatory agency.

### II.2.2 *The optimal menu with a non-incentive contract for the regulatory agency*

We characterize the optimal menu conditional on non-incentive contracts with the regulatory agency. It is obvious that if the principal does not choose any incentive contracts, then the principal does not have any incentive to pay the agency more than his reservation wage. Thus, we focus on a non-incentive contract: the principal does not pay any positive salary to the regulatory agency irrespective of his report. If the regulatory agency knows the firm is efficient ($s = \underline{b}$), then the firm can block $\hat{s} = \underline{b}$ by bribing to the regulatory agency ($B \geq 0$). On the other hand, if the regulatory agency knows the

firm is inefficient ($\sigma = \overline{\beta}$), then the regulatory agency reports $\hat{\sigma} = \overline{\beta}$ because the firm does not have any incentive to block this report. Thus, the principal does not know the firm's type in the cases of (ii), (iii) and (iv). As a result, in (ii), (iii) and (iv), the principal offers the second best type of contracts under the simple principal-agent problem: $(\overline{e}, \overline{u}) = (\overline{e}, 0)$ and $(\underline{e}, \underline{u}) = (e^*, \Phi(\overline{e}))$. The amount of bribes depends on the bargaining power of the agency and the firm. We assume that the firm bribes a share of the informational rents $k \in [0,1]$ to the regulatory agency. Under this assumption, the agency receives $k\Phi(\overline{e})/(1+\lambda_B)$ by hiding the information that the firm is efficient. Then we will have the following allocation:

| State | Report | Effort | $u_F$ | $u_R$ | $B$ |
|---|---|---|---|---|---|
| $(i)\,\beta = \overline{\beta}, \sigma = \overline{\beta}$ | $\hat{\sigma} = \overline{\beta}, \hat{\beta} = \overline{\beta}$ | e* | 0 | 0 | 0 |
| $(ii)\,\beta = \underline{\beta}, \sigma = \underline{\beta}$ | $\hat{s} = \varnothing, \hat{\beta} = \underline{\beta}$ | e* | $(1-k)\Phi(\overline{e})$ | $\frac{k}{1+\lambda_B}\Phi(\overline{e})$ | $k\Phi(\overline{e})$ |
| $(iii)\,\beta = \overline{\beta}, \sigma = \varnothing$ | $\hat{s} = \varnothing, \hat{\beta} = \overline{\beta}$ | $\overline{e}$ | 0 | 0 | 0 |
| $(iv)\,\beta = \underline{\beta}, \sigma = \varnothing$ | $\hat{s} = \varnothing, \hat{\beta} = \underline{\beta}$ | e* | $\Phi(\overline{e})$ | 0 | 0 |

The optimal level of $\overline{e}^c(\lambda_B, k)$ is the solution of the problem:

$$Max_e[\rho EW^* - q\rho\left\{\lambda + \frac{\lambda_B k}{1+\lambda_B}\right\}\Phi(\overline{e}) + (1-\rho)EW^s(\overline{e}, q)] \qquad (5)$$

The second term represents the social costs in state (ii) from informational rents and bribery. In state (ii), the principal gives the firm an amount of informational rents, $\Phi(\overline{e})$.

The firm pays $k\Phi(\bar{e})$ to the regulatory agency as bribes. $\lambda\Phi(\bar{e})$ represents the social costs of the informational rents. $\frac{\lambda_B k}{1+\lambda_B}\Phi(\bar{e})$ represents the transaction cost of bribery.

We denote the expected welfare by

$$EW^c(\lambda_B, k) = \theta EW^* - q\theta\left\{\lambda + \frac{\lambda_B k}{1+\lambda_B}\right\}\Phi(\bar{e}^c(\lambda_B, k)) + (1-\theta)EW^s(\bar{e}^c(\lambda_B, k), q) \qquad (6)$$

From envelope theorem, $EW^c(\lambda_B, k)$ is decreasing in $\lambda_B$ and $k$, that is, if the transaction cost of bribery increases or if the regulatory agency has more bargaining power in negotiation for collusion, then allowing collusion gets more costly.

### II.2.3. *Comparison*

From equations (3) and (5), we find that those equations are the same except for the second term implying a social cost. If $\lambda_B$ is positive, the second term of (5) is smaller than that of (3) given $\bar{e}$. If $\lambda_B$ is zero, then both of them have the same values. Thus, we have the following proposition.

*Proposition 1: Under full commitment, allowing collusion by issuing the non-incentive contract to the regulatory agency is socially optimal if the transaction cost of bribery is equal to zero. On the other hand, if the transaction cost of bribery is positive, then blocking collusion strictly dominates allowing collusion.*

If the cost of bribe is positive, it makes collusion more difficult; therefore, collusion-proof menu of contracts becomes less costly (since the principal can decrease the salary to the regulatory agency in the state (ii)), while the menu of contracts with a non-incentive contract gets more costly. Figure 1 summarizes the results above.

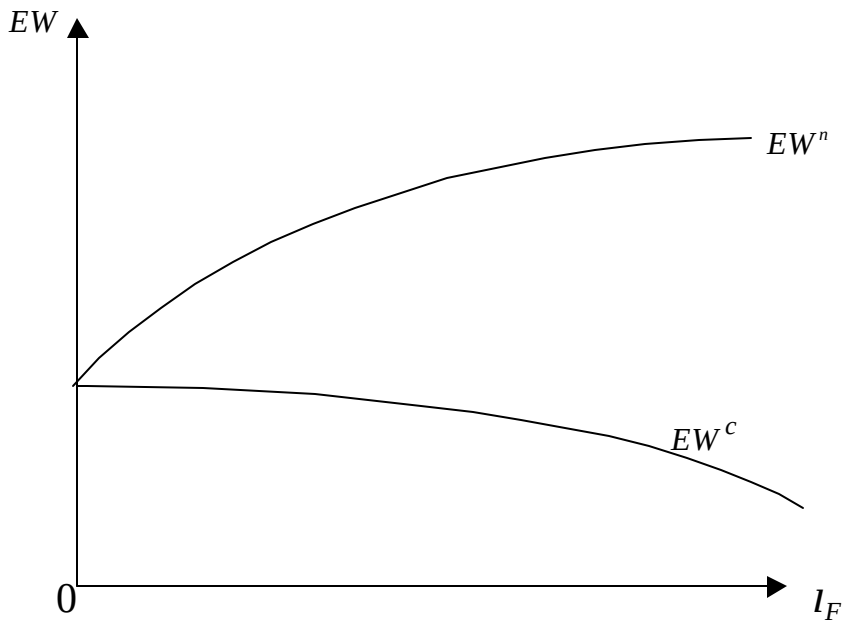


**Figure 1**.

### II.3. *Contracting under lack of commitment*

We consider the case in which the principal cannot commit to the contracts offered at the outset. If the principal knows that the original contract with the firm is no longer optimal after the regulatory agency's report, the principal will revise it. Thus, the contract for the firm must be optimal after the agency's report. This requirement may shrink the set of feasible contracts, and thus, prevent the principal from maximizing welfare ex ante. Then, tolerating corruption may be optimal since it reduces the information flow from the agency and mitigates the requirements. In the following, we will characterize the optimal allocations heuristically rather than rigorously. See Lambert-Mogiliansky (1998) or Yoshida (1999) for the rigorous proofs.

#### II.3.1. *The optimal collusion-proof menu of contracts under lack of commitment*

We construct the optimal collusion-proof menu of contracts under lack of commitment. First find the optimal contract for the firm conditional on the information revised after the regulatory agency's report. If the agency does not report anything ($\hat{s} = \varnothing$), the asymmetric information between the principal and the firm remains. If the principal believes that collusion is blocked, $\hat{s} = \varnothing$ implies that the agency does not know the firm's type, that is, the possible state should be (iii) or (iv). Thus, the optimal menu for the firm after $\hat{s} = \varnothing$ is the same as the second best menu, $\{(e^*, \Phi(\bar{e}^s)), (\bar{e}^s, 0)\}$ (see proposition 0). In other words, the principal does not consider the effect of $\bar{e}$ in state (iii) on the regulatory agency's salary in state (ii), unlike in section II.2.1. If the agency reports the firm's type ($\hat{s} = \beta$), the asymmetric information disappears; thus, the principal offers the first best contract: $(e^*, 0)$ for both types. Next consider the contracts between the principal and the regulatory agency. The informational rents of the efficient type are $\Phi(\bar{e}^s)$, so is the maximum amount of the bribes. Thus, the principal must pay the agency $\Phi(\bar{e}^s)/(1+\lambda_B)$ to let the agency report $\hat{s} = \underline{\beta}$. To let the agency report $\hat{s} = \bar{\beta}$, the principal does not have to pay positive rents. The allocation under the optimal collusion-proof menu of contracts is as follows:

| State | Probability | Effort | $u_F$ | $u_R$ | $u_F + u_R$ | $t_F$ |
|---|---|---|---|---|---|---|
| $(i)\beta = \bar{\beta}, s = \bar{\beta}$ | $(1-q)\zeta$ | $e^*$ | 0 | 0 | 0 | 0 |
| $(ii)\beta = \underline{\beta}, s = \underline{\beta}$ | $q\zeta$ | $e^*$ | 0 | $\frac{\Phi(\bar{e}^s)}{1+\lambda_B}$ | $\frac{\Phi(\bar{e}^s)}{1+\lambda_B}$ | 0 |
| $(iii)\beta = \bar{\beta}, s = \varnothing$ | $(1-q)(1-\zeta)$ | $\bar{e}^s$ | 0 | 0 | 0 | 0 |
| $(iv)\beta = \underline{\beta}, s = \varnothing$ | $q(1-\zeta)$ | $e^*$ | $\Phi(\bar{e}^s)$ | 0 | $\Phi(\bar{e}^s)$ | 0 |

Then the principal will receive

$$EW_L^n(\lambda_B) = \zeta EW^* - q\zeta\Phi(\bar{e}^s)/(1+\lambda_B) + (1-\zeta)EW^s(\bar{e}^s, q) \qquad (7)$$

We know the cost of lack of commitment by comparing equation (7) with (3) and (4). Even though the effort level of the inefficient type in (iv) affects the regulatory agency's salary in (ii), the principal must neglect this effect under lack of commitment. Since $\bar{e}^s \neq \bar{e}^n$, $EW_L^n(\lambda_B) < EW^n(\lambda_B)$.

### II.3.2. *The optimal menu with a non-incentive contract for the regulatory agency*

We construct the optimal menu with a non-incentive contract under lack of commitment. Here, we will show that the menu described in Section II.2.2 is still feasible under lack of commitment. When the principal allows the regulatory agency to collude with the firm, $\hat{\sigma} = \varnothing$ implies $\sigma = \varnothing$ or $\underline{\beta}$. As in Section II.2.2, the principal cannot distinguish the case (ii), (iii) and (iv). Thus, after $\hat{\sigma} = \varnothing$, the principal does not have any incentive to change the menu of contracts with collusion described in Section II.2.2. It is also obvious that the principal does not have any incentive to change it after other reports of the agency. Therefore, the principal obtains the same level of social welfare under lack of commitment as under full commitment. Letting the maximum level of social welfare be $EW_L^c$, $EW_L^C = EW^C$. From these results, we have the following proposition.

*Proposition 2 (Lambert-Mogiliansky 1998): If the principal lacks commitment to the contracts offered at the outset and if the transaction cost of bribery is zero ($\lambda_B = 0$), then allowing collusion is more socially desirable than blocking collusion, that is,* $EW_L^C = EW^C > EW_L^n(0)$.

*Proof. From the above argument, we have* $EW^c = EW^n(0)$ *and* $EW^n(\lambda_B) > EW_L^n(\lambda_B)$.

*Thus,* $EW^c > EW_L^n(0)$ *. QED.*

As in Section II.2.2, blocking collusion is less costly if the regulatory agency discounts the bribes from the firm more, i.e., $\lambda_B$ increases.

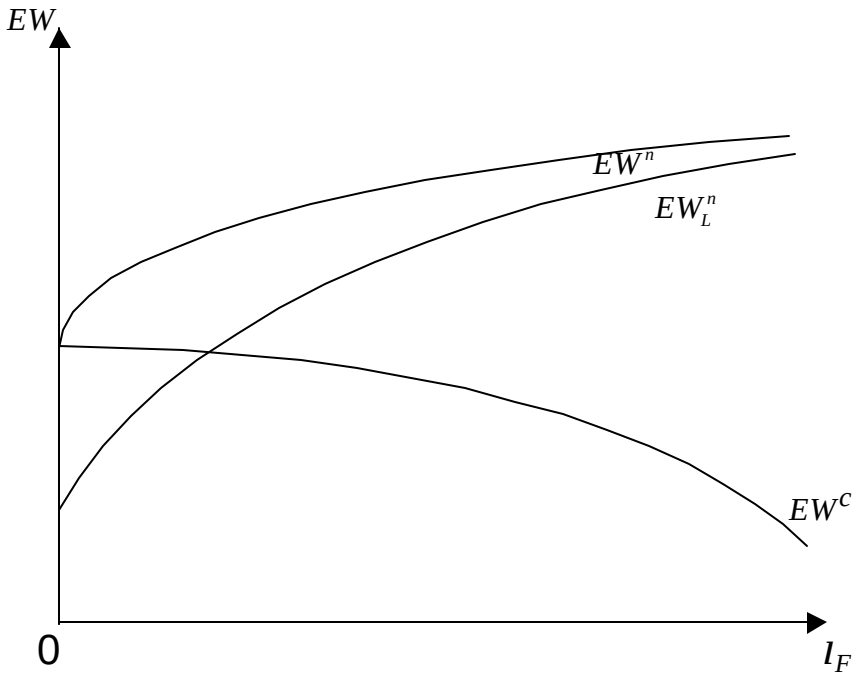


**Figure 2**.

*Corollary 2: If the transaction cost of bribe is sufficiently small, allowing collusion is more socially desirable than blocking collusion.*

*Proof. It is obvious from Figure 2.*

Therefore, under lack of commitment, collusion happens if the transaction cost of bribe is sufficiently small.

***II.3.3. The comparative static***

We examine the comparative static of some parameters in our model. For the moment, we neglect the cost of changing those parameter values.

(i) Increasing $\lambda_B$: As Figure 2 illustrates, both $EW^n$ and $EW_L^n$ are increasing in $\lambda_B$, while $EW^c$ is decreasing in $\lambda_B$.

(ii) Increasing $\zeta$: We examine the effects of increasing $\zeta$ on $EW^n$ and $EW_L^n$. When collusion is blocked, increasing $\zeta$ improves expected welfare since the agency is more likely to reveal the firm's type. This holds under limited commitment as well as under full commitment.

Even though collusion is tolerated, increasing $\zeta$ still expands expected welfare because it improves the principal's information in the following two senses. First, the principal will learn without payment that the firm is inefficient if the regulatory agency knows it. Second, the principal receives an imperfect signal of the efficient firm even though the agency reports nothing. Since the regulatory agency colludes only with the efficient firm, the firm is more likely to be efficient after $\hat{\sigma} = \varnothing$ than under the prior information of the principal. The more frequently the regulatory agency learns the firm's type ($\zeta$ increases), the better signal the report $\hat{\sigma} = \varnothing$ becomes. Thus, improving the quality of the regulatory agency increases expected welfare. Lemma 1 shows that this reasoning is correct.

*Lemma 1: Improving the quality of the regulatory agency raises the expected social welfare achieved by the menu of contracts with collusion, that is,* $\partial EW^C / \partial \zeta > 0$.

*Proof. See appendix.*

After all, increasing $z$ improves expected welfare in any case. The following lemma implies that if collusion is an equilibrium outcome, the welfare-enhancing effect of increasing $z$ is larger in allowing collusion than in blocking collusion.

*Lemma 2: If* $EW^c \geq EW_L^n$, *then* $\frac{\partial EW^c}{\partial z} > \frac{\partial EW_L^n}{\partial z} > 0$[1].

*Proof. See appendix.*

The following lemma shows that increasing $z$ is in favor of tolerating collusion.

*Lemma 3: Let* $\bar{l}_B(l_B^0, z)$ *be such that* $EW^c(l_B^0, z) = EW_L^n(\bar{l}_B, z)$. *Then,* $\partial \bar{l}_B / \partial z > 0$.

*(See figure 3.)*

*Proof. It follows from lemma 2.*

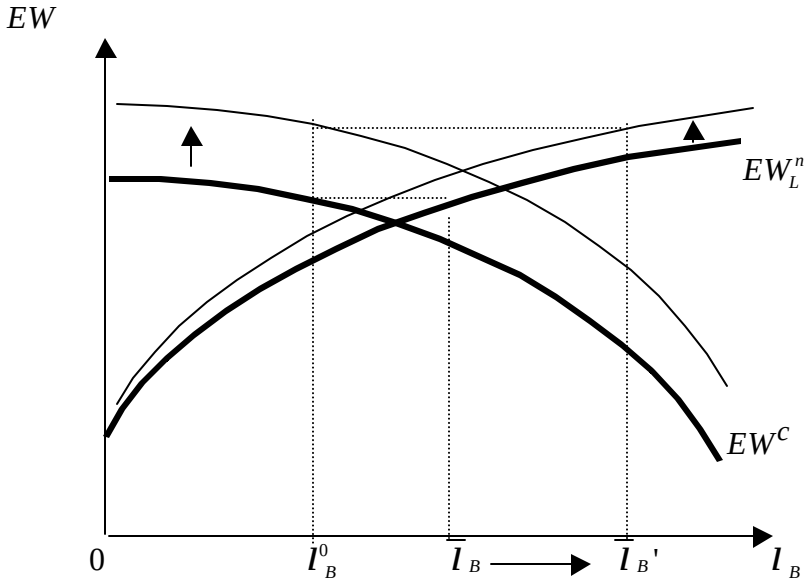


**Figure 3**.

Figure 3 implies the following: The current transaction cost of bribery is $l_B^0$ and the principal prefers allowing collusion currently. The principal prefers blocking collusion if the transaction cost rises by more than ($\bar{l}_B - l_B^0$). On the other hand, if $z$ increases, the

principal prefers blocking collusion only if the transaction cost of bribery increases by more than ( $\overline{l}_B' - l_B^0$ ). In this sense, increasing $z$ is in favor of tolerating collusion.

## III. Institutional reform

Using the above results, we next examine the effects of several reform policies on expected social welfare in the case that allowing collusion is socially more desirable than blocking it. We consider the following reform policies. (i) Delegation (denoted by **D**): the regulatory agency is authorized to design pricing rules or procurement contract for the firm on behalf of the government. After delegation, the principal designs only contracts for the agency and the agency designs contracts for the firm. (ii) Incentive reform (denoted by **I**): The principal offers incentive contracts to the regulatory agency to block collusion. (iii) Administrative reform (denoted by **A**): The principal improves the regulatory agency's ability of investigation (i.e., increasing $z$ ) by computerization, training or employing more auditors. (iv) Legal reform (denoted by **L**): The principal increases the transaction cost of bribery (i.e., increasing $l_B$) by increasing penalties for corruption or shifting burden of proof on defendants..

### III.1. *The individual effects of the reform policies*

The current situation (collusion is an equilibrium outcome) is represented in figure 4. Since allowing collusion is optimal, $EW^C$ is larger than $EW_L^n$. When the principal allows collusion, the principal uses a non-incentive contract for the regulatory agency. In this figure, incentive reform represents the movement from $EW^C$ to $EW_L^n$. Thus, it is

[1] Laffont and N'Guessan (1999) also gets a similar result in a different model.

obvious that, if allowing collusion is optimal, it is not desirable to carry out only incentive reform. Before considering the other policies' effects, we must note that both $EW^C$ and $EW_L^n$ do not include the costs of reform policies, (**D**), (**A**) and (**L**). For the moment, we neglect the effects of those costs.

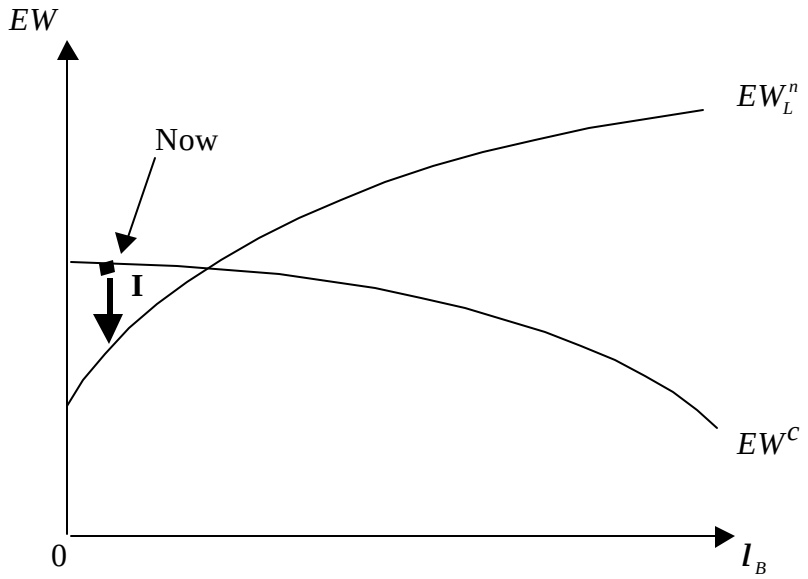


**Figure 4**

(i) Delegation

If the principal carries out delegation without combining any other reform policy, the result is disastrous. Since the principal offers a non-incentive contract to the regulatory agency, the agency is interested only in the income from bribery. Thus, the agency maximizes the rents of the firm, which means an infinite amount of transfer from the principal to the firm. Consequently, undertaking only delegation increases bribes and decreases social welfare substantially.

(ii) Administrative reform $(\Delta z > 0)$

As we discussed in II.3.3, undertaking only administrative reform raises expected social welfare.

(iii) Legal reform ($\Delta l_F > 0$)

As we discussed in II, carrying out only legal reform reduces expected welfare.

### III.2. *The interaction effects of reform policies*

(i) Delegation & Incentive reform

Delegation by itself decreases welfare and makes corruption rampant; however, delegation improves welfare and eradicates corruption if coupled with incentive reform. In our model, delegation eliminates the commitment problem perfectly since it robs the government of the opportunity of *ex post* opportunistic exploitation of the firm. However, it creates a different problem: the government loses control over the firm. Such loss of control over the firm is normally costly; in fact, carrying out delegation alone reduces welfare substantially in our model. However, the government can keep real control over the firm by designing a proper incentive contract for the agency. Thus, in our model, delegation improves welfare if coupled with incentive reform. The proposition 3 shows this result.

*Proposition 3: The principal attains the optimal level of expected social welfare under full commitment $EW^C$ by carrying out the combination of delegation and incentive reform.*

*Proof. See appendix*

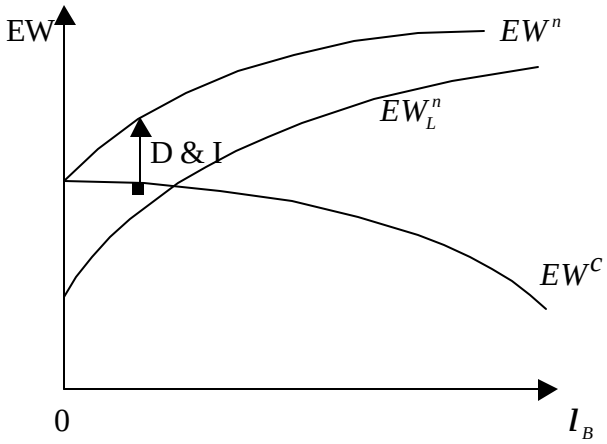


**Figure 5**

(ii) Incentive reform & Legal reform

Though each of incentive reform and legal reform deteriorates social welfare, the combination of them may improve the social situation (see figure 6). As we argued above, blocking collusion requires a higher salary for the regulatory agency in order to let him reject bribery. Since legal reform makes the income from bribes less favorable, the principal can block collusion with a less salary to the regulatory agency. This is why legal reform has a positive interaction effect with incentive reform. But, the incentive reform by itself decreases social welfare, and so, the combination improves social welfare only if legal reform increases the transaction cost of bribery drastically.

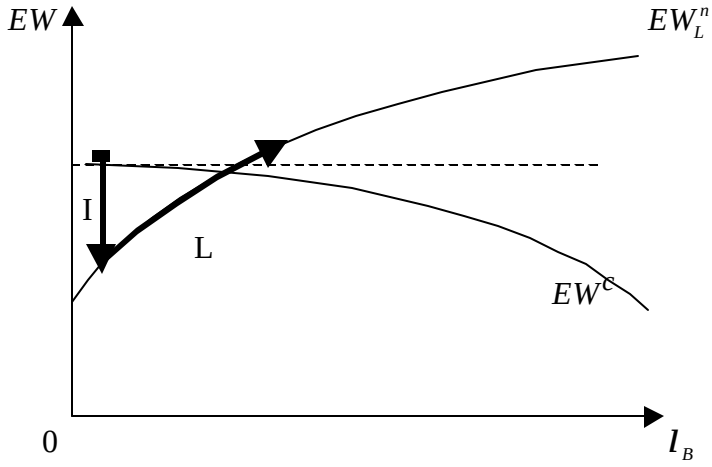


**Figure 6**

(iii) Administrative reform & Incentive reform

As we discussed in II.3.3, administrative reform improves social situations when collusion is blocked as well as when collusion is allowed. But, incentive reform deteriorates the welfare-enhancing effect. Thus, the principal always prefers only administrative reform to combining them with incentive reform (see figure 7).

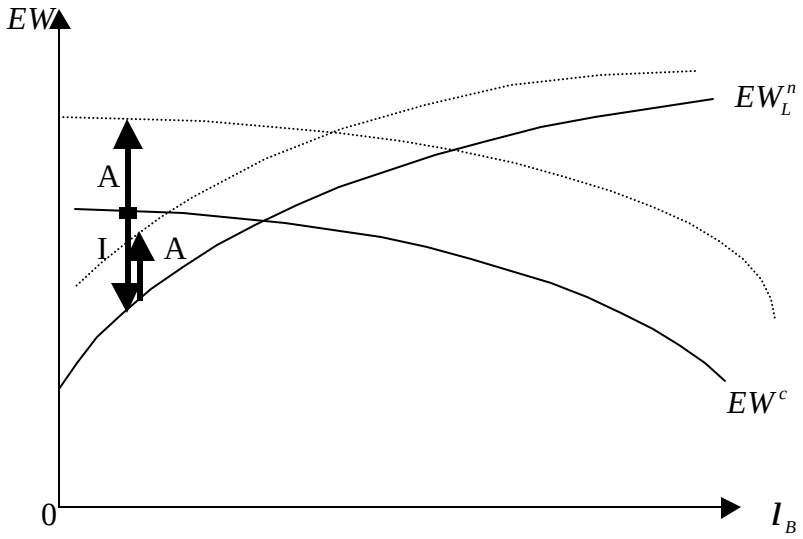


**Figure 7**

(iv) Administrative reform & Legal reform

As Figure 8 shows, the principal prefers administrative reform alone to combining it with legal reform.

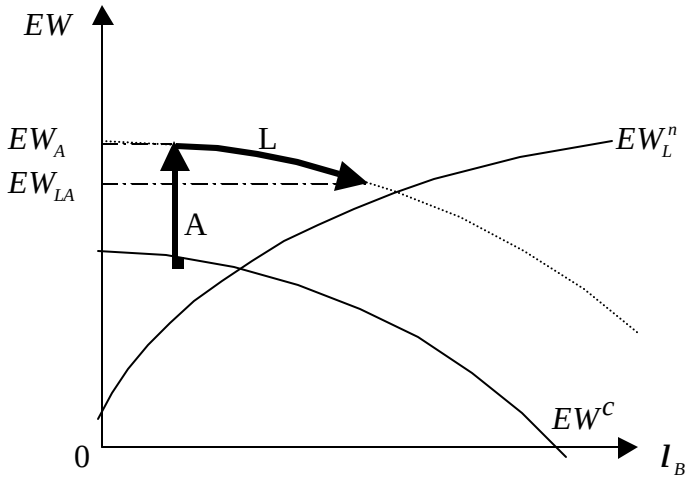


**Figure 8**

(v) Administrative reform, Incentive reform & Legal reform

If the principal combines legal reform further, the combination may increase social welfare because legal reform is complementary to incentive reform. Lemma 3 implies that if the principal chooses larger-scale administrative reform, the principal is more reluctant to combine them with incentive and legal reform. In other words, the larger-scale administrative reform is favorable to undertaking administrative reform alone.

(vi) Administrative reform, Incentive reform, Legal reform & Delegation

If the principal combine delegation furthermore, then the negative interaction between administrative and incentive reform disappears. The combination of them pushes up social welfare drastically. (See figure 9.)

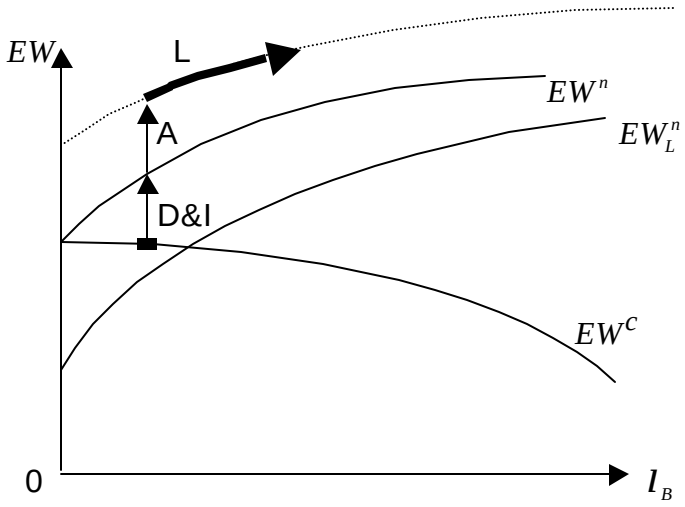


**Figure 9**

**III.3.** ***The optimal combination of institutional reform policies***

Thus far, we did not consider the costs of delegation, administrative reform and legal reform. Needless to say, when governments design institutional reform policies, they must take those costs into account. In particular, if they do not have enough resources for reform policies, it is essential. We next consider those costs explicitly and then derive the optimal reform policy (or combination).

The net effect of a reform policy (combination) i can be written as $\Delta NEW_i = \Delta EW_i(\Delta l_B, \Delta z) - C_D - C_L(\Delta l_B) - C_A(\Delta z)$, where $\Delta EW_i$ denotes the gross effect of the policy, and $C_j$ denotes the cost of reform policy j. The gross effects of some policies $\Delta EW_i$ have been already analyzed in III.1 and III.2. $C_D$ is assumed to be nonnegative. $C_L$ (and also $C_A$) continuously increases with $\Delta l_B$ ($\Delta z$) for $\Delta l_B > 0$ ($\Delta z > 0$) at an increasing rate $C_L'' > 0$ ($C_A'' > 0$), and satisfies $C_L(0) = 0$ ($C_A(0) = 0$) and $\lim_{\Delta l_B \to 0} C_L'(\Delta l_B) = 0$ $\left( \lim_{\Delta z \to 0} C_L'(\Delta z) = 0 \right)$.

Note that incentive reform and delegation are discrete choice, while legal reform and administrative reform are continuous choice. When we say legal reform (administrative reform) is combined, it means $\Delta l_B > 0$ (or $\Delta z > 0$). The point we wish to stress is that our concern in this section is not to find the optimal degree of legal reform or administrative reform, but to find whether they should be combined or not. More precisely, we compare any degree of $\Delta l_B > 0$ (or $\Delta z > 0$) with $\Delta l_B = 0$ (or $\Delta z = 0$). If $\Delta l_B = 0$ (or $\Delta z = 0$) achieves more welfare than any degree of $\Delta l_B > 0$ (or $\Delta z > 0$), we shall say that it is better not to combine legal reform (or administrative reform).

(i) The case if delegation is too costly to be undertaken ( $C_D = \infty$ )

In this case, the principal can choose **I**, **L**, **A** or combinations of them. We describe the net effects of several reform policies as follows:

| Reform policy i | $\Delta NEW_i$ |
|---|---|
| **I**,**L** & **A** | $\Delta NEW_{ILA} = \Delta EW_{ILA}(\Delta l_B, \Delta z) - C_L(\Delta l_B) - C_A(\Delta z)$ |
| **I** & **L** | $\Delta NEW_{IL} = \Delta EW_{IL}(\Delta l_B, 0) - C_L(\Delta l_B)$ |
| **A** | $\Delta NEW_A = \Delta EW_A(0, \Delta z) - C_A(\Delta z)$ |
| **A** & **I** | $\Delta NEW_{AI} = \Delta EW_{AI}(0, \Delta z) - C_A(\Delta z)$ |
| **A** & **L** | $\Delta NEW_{AL} = \Delta EW_{AL}(\Delta l_B, \Delta z) - C_L(\Delta l_B) - C_A(\Delta z)$ |

Note that using the results in III.2, III.3 and the figures, we can characterize $\Delta EW_i$ easily.

*Lemma 4:* $\Delta EW_A(0, \Delta z)$ *is larger than* $\Delta EW_{AI}(0, \Delta z)$ *and* $\Delta EW_{AL}(\Delta l_B, \Delta z)$ *for* $\Delta l_B > 0, \Delta z > 0$.

*Proof. From lemma 3, it is obvious that* $\Delta EW_A(0, \Delta z) > \Delta EW_{AI}(0, \Delta z)$. *It is also obvious from figure 8 that* $\Delta EW_A(0, \Delta z) > \Delta EW_{AL}(\Delta l_B, \Delta z)$. *Q.E.D.*

Proposition 4 immediately follows lemma 4.

*Proposition 4: The principal prefers* ***A*** *to* ***AI*** *and* ***AL***.

The following proposition is also derived easily.

*Proposition 5: The principal prefers **ILA** to **IL**.*

*Proof. See appendix.*

Finally, we would like to know which policy (combination) is better, **ILA** or **A**. **ILA** has more flexibility than **A** because the principal can control the level of transaction cost of bribery also in **ILA**. But, as we explained in III.2 (v), the larger-scale administrative reform is more favorable to **A** than **ILA**. Thus, if the cost of administrative reform becomes cheaper and the larger $\Delta z$ becomes affordable, then the principal is more likely to carry out **A** alone. Proposition 6 is the summary of the above argument.

*Proposition 6: Suppose that delegation is too costly to execute. Then either **ILA** or **A** is the optimal reform policy (combination). The smaller the cost of administrative reform, the principal is more likely to carry out **A alone**, and then, collusion is more likely to remain.*

(ii) The case if delegation is affordable ( $C_D < \infty$ )

We next examine the case if delegation is not too costly to execute. The principal can choose the optimal reform policy (combination) in all combinations of {**D**, **I**, **L**, **A**}. Proposition 4 and 5 imply that we do not have to consider the following policy combinations: **IL**, **AI**, **AL**. We do not also have to consider any policy combination of delegation without incentive reform. Delegation is disastrous because the agency maximizes the income from bribes if it is not combined with incentive reform. These arguments lead us to focus on the following five reform policy combinations:

| Reform policy i | $\Delta NEW_i$ |
|---|---|
| **I**,**L** & **A** | $\Delta NEW_{ILA} = \Delta EW_{ILA}(\Delta l_B, \Delta z) - C_L(\Delta l_B) - C_A(\Delta z)$ |
| **A** | $\Delta NEW_A = \Delta EW_A(0, \Delta z) - C_A(\Delta z)$ |
| **D**,**I**,**L** & **A** | $\Delta NEW_{DILA} = \Delta EW_{DILA}(\Delta l_B, \Delta z) - C_D - C_L(\Delta l_B) - C_A(\Delta z)$ |
| **D**,**I** & **L** | $\Delta NEW_{DIL} = \Delta EW_{DIL}(\Delta l_B, 0) - C_D - C_L(\Delta l_B)$ |
| **D & I** | $\Delta NEW_{DI} = \Delta EW_{DI}(0,0) - C_D$ |

*Proposition 7: The principal prefers **DILA** to **DIL** and **DI**.*

*Proof: See appendix.*

We next compare **DILA** with **A** and **ILA**. $\Delta NEW_{DILA}$ is decreasing in the cost of delegation $C_D$ while both $\Delta NEW_A$ and $\Delta NEW_{ILA}$ do not depend on it. Thus, the principal prefers A and ILA to DILA if the cost of delegation $C_D$ is extremely high. Now we consider the case if the cost of delegation $C_D$ is equal to zero. We then have the following proposition:

*Proposition 8: If the cost of delegation is sufficiently small, **DILA** is the optimal reform policy combination.*

*Proof. See Appendix*

## IV. The related literature

Our paper belongs to the literature on optimal corruption (or collusion), which shows the merits of tolerating corruption. Rose-Ackerman (1978), Mookherjee and Png (1995) and Mookherjee (1998) discuss a hypothesis, "grease-the-wheels-of-bureaucracy", that bribery increases bureaucrats' incentives to work. However, Rose-Ackerman (1999: p226) argues that "the possibility that payoffs may sometimes motivate officials to work

more efficiently suggests that in particular cases illegal bribes might be converted into legal incentive pay schemes." Mookherjee and Png (1995) shows that if bribes do serve a valid resource allocation function, they should be legalized since the principal can give bureaucrats the same level of incentives to work through wages as through bribery. This is a result of revelation principal: every type of agent truthfully reveals his or her privately-known characteristics under an optimal menu of contract (Kofman and Lawrree 1996).

There are two ways to obtain optimal corruption even if the principal can design contracts with bureaucrats. One way is to assume the existence of honest bureaucrats, who never accept bribery (e.g., Besley and MacLaren, 1993 or Kofman and Lawrree 1996, and Laffont and N'Guessan 1999). The principal can get information from honest bureaucrats for free, while she must pay dishonest ones enough salaries to reveal their information. Thus, if there are few dishonest bureaucrats, it is optimal to pay lower salaries even if they let dishonest bureaucrats be corrupt. The other way is to assume the principal's lack of commitment to her contracts (e.g., Strauz 1997 and Lambert-Mogiliansky 1998). Our model is a variant of Lambert-Mogiliansky (1998).

In this paper, we have shown that if collusion is an equilibrium outcome, then delegation to the regulatory agency may prevent collusion between the agency and the firm. This result is closely related to Felli (1996)'s result: larger delegation prevents collusion between agents. There are, however, two main differences between our result and his one. First, collusion is not optimal even if the principal chooses a lower degree of delegation in his model, while it is in our model. Second, the definition of delegation is different: delegation means in his model that the principal expands the massage space of

the agency; it means in our model that the principal gives the agency authority over contracting with the firm.

Our paper is also closely related to the recent work on organizational design. If the Revelation Principle holds, delegation does not give the principal any extra merit. Melumad, Mookherjee and Reichelstein (1997) and Laffont and Martimort (1997) have shown that delegation has real value if we assume limited communication or incomplete contracts between the principal and the agents. On the other hand, we have shown, like Melumad and Mookherjee (1989), that delegation has real value if the principal lacks commitment to her contracts.

## V. Concluding Remarks

The contribution of this paper is to present a conceptual framework to examine the interaction effects of reform policies against bureaucratic corruption. This framework has enabled us to analyze the view that bureaucratic corruption is best combated by using comprehensive reform. Our results suggest that comprehensive reform may not be a good idea in certain circumstances. In fact, if the cost of delegation is high and that of administrative reform is low, then governments should carry out administrative reform alone. On the other hand, if the cost of delegation is low enough, then comprehensive reform is better.

Our results have several implications for the optimal sequence of reforms. In particular, it is risky to choose a "big bang approach" in the presence of uncertainty concerning the outcome of reforms even though it is optimal under perfect certainty. If incentive reform does not work effectively, implementing delegation only reduces

welfare. To avoid this risk, it is better to carry out the incentive reform first, and then to carry out delegation if they turn out to be effective; otherwise not. In this sense, our results are favorable to Dewatripont and Roland (1997): strong complementarity of reform policies may give an additional advantage to gradualism (sequencing reform policies).

There is another important implication concerning policy dynamics. If delegation is too costly to be undertaken, once the principal implements administrative reform alone, she will be more likely to implement them alone in the future (lemma 3). This result can account for the persistence and deepening of corruption in some societies over time, even though they continue to develop. We can find some examples in eastern Asia, such as Japan or Korea. At the same time, other societies may embark on incentive and legal reform early on and thus pursue a different "rule of law" path along which corruption is eradicated early on. It may be the case of Great Britain or the USA.

We have assumed throughout that the principal maximizes expected welfare and can design incentive contracts for the regulatory agency. However, in reality, the principal may be unable to design incentive contracts because of lack of reliable performance measure (Ades and DiTella 1997, Rose-Ackerman 1999). Or, she may not maximize welfare because she is irrational or corrupt (political corruption). An interesting extension of this paper is to model those factors explicitly, and to examine those effects on optimal reform combinations.

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