Essays on Information Structures and Managerial Incentive Problems

Graduate School of Systems and Information Engineering

University of Tsukuba

July 2014

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Declaration of Authorship

I, Michiko Ogaku, declare that this thesis titled, 'Essays on Information Structures and Managerial Incentive Problems' and the work presented in it are my own. I confirm that:

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- Where I have consulted the published work of others, this is always clearly attributed.
- Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work.
- I have acknowledged all main sources of help.
- Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself.

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Abstract

Doctoral Program in Social Systems and Managament
Graduate School of Systems and Information Engineering

Doctor of Philosophy in Economics

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This dissertation analyses the relationship between information and the designs of managerial incentive contracts and aims at a better understanding of moral hazard.

The designs of managerial incentive contracts differ from one country to another. Such differences might reflect the characteristics of various managerial labour markets. This is because managerial labour markets indicate the value of managers as human capital and that can be characterised by local information. In this dissertation, the differences in information are characterised by the structure of signals on which the values are assessed. This structure is referred to as the information structure.

Understanding the moral hazard associated with manager behaviour is important because diffuse security holders are vulnerable to managerial opportunism. This dissertation shows that the distortion of information in each labour market creates differences in the costs of moral hazard, thus influencing differences in structures of executive compensation across countries. The implications that either highly incentivised or fixed compensation contract designs might be a consequence of strong corporate governance shed light on heterogenity in moral hazard created by the separation of security ownership and control.

Acknowledgements

This dissertation would not have been completed without the help of many people. In particular, I would like to thank

Ryuichiro Ishikawa for his assistance throughout the program, and for patiently commenting on the earlier version of Chapter 1 and the priceless learning experience during my time at SSM;

Eizo Akiyama for accepting to be my formal adviser at SSM;

Kyota Eguchi for his insightful discussions of the issues in the early chapters, which motivated further writing;

Naoki Watanabe for his insights on microeconomics, and for his helpful comments on the contributions of Chapter 2;

Stephen J. Turnbull for his comments on my description of Japanese governance, and for reading an early version of this thesis that many were unwilling to read;

Yukihiko Okada for his occasional conversations and encouragement;

Noboru Ogura for his comments on my survey of management accounting, and for his support during my time at GSSM and

Hua Xu for his initial help with a research plan and for his encouragement to write a paper and submit it to a journal.

The financial support from the Ishii Memorial Securities Research Promotion Foundation is gratefully acknowledged.

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To my husband Satoru and to my son Masato

Chapter 1

Introduction

1.1 Information structures and managerial incentives

This dissertation addresses the relationship between information and the designs of managerial incentive contracts across countries. It also aims to better understand the moral hazard associated with the separation of security ownership and control.

The managerial incentive contract designs differ among countries. Such differences might reflect the characteristics of various managerial labour markets because these markets indicate the value of managers as human capital and that can be characterised by local information. These indications depend, for example, on the success or failure of the firm or the negotiations with the firm's stakeholders. The former is an example of global information and the latter can be an example of either global or local information. In this dissertation, the differences in information are characterised by the structure of signals on which the marketable values of managers are assessed. This structure is referred to as the information structure.

The managerial compensation contract is designed to address moral hazard. Here, the moral hazard of interest arises when a firm's decision-making remains the exclusive province of managers, who are not the firm's security holders. Understanding such moral hazard is undoubtedly important. The recognition of this problem, known as moral hazard, and in this case associated with the separation of security ownership and control, potentially infinitely impacts financial markets because diffuse security ownership can potentially infinitely allow for risk sharing.

One challenge to understanding the moral hazard associated with the separation of security ownership and control is that the classical principal-agent theory fails to identify risk bearers and contract designers. In the theory, a principal controls an agent's unobservable behaviour with the contract that the principal designs. Diffuse security holders are principals who do not control an agent's unobservable behaviour with a contract of their design.

Arguably, such a situation requires a third party dedicated to the task of controlling moral hazard. In a relationship between firm managers and shareholders, corporate law attributes this responsibility to the board of directors chosen by shareholders. However, the board of directors is a principal that does not always act as a residual risk bearer and a diffuse shareholder's voting rights are not enough to privately control the third party. Fama [16] attributed this to the rational expectations of managers created by competition inside and outside the markets for managers. In other words, managerial labour markets are viewed as third parties acting as proxies for the security market.

Fama's ideas were formalised by Holmström [26] and Gibbons and Murphy [20].[1] These studies do not prove the viability of separation of security ownership and control. However, they open fruitful avenues for a complete understanding of the associated moral hazard. The studies consider the risk bearer to be a contract designer, but with the agent perfectly informed of any outside job opportunities. Although unintended, it is possible to characterise moral hazard as dependent on labour markets as the third parties, and that observation inspires the current study.

[1] Fama's idea results in building models that correspond closely to efficiency wage models of unemployment. During the late 1970s, economists had been in the search of a coherent explanation as to why the labour market does not clear when excess supply of labour leads to involuntary unemployment. Solow [53] provides an explanation for sticky wages with a model in which a labour market is monopolistic and an employer has some choice of wages. With an assumption of a competitive labour market, Calvo [8] and Shapiro and Stiglitz [50] explain involuntary unemployment by introducing a model in which good workers are paid fixed wages, which are higher than the market clearing price. The latter model and career concern models, advocated by Fama [16], have common features in their mechanisms to induce efforts.

The rise in US executive compensation since 1980s, especially in the form of stock options, has been controversial. This rise significantly altered the structure of US executive compensation and the relative importance of fixed payments against contingent payments.[2] One concern is that executive pay in the US, which is much higher than that in other countries, signals the failure of corporate governance, and this possibility has stimulated considerable empirical[3] and theoretical[4] research. However, scant attention has been given to the fact that many cases in other countries are yet to be examined.

This dissertation proposes two possible interpretations of the arguments from the aspect of differences in labour markets and their information structures. First, the relative importance of fixed payments against contingent payments will be robust (fragile) if the pricing of the market value of human capital of managers is driven by signals of which contractual provisions are infinitely costly (costless) to enforce. Second, earnings management, which is often viewed as self-serving behaviour, will not deteriorate shareholder values if everyone believes that earnings management is undoubtedly present because contracts are based on signals easily inflated by managers. Such signals make other signals less effective; consequently, the relative importance of fixed payments against contingent payments will remain weak.

The relative importance of fixed payments in Japanese firms represents a stark contrast to that in US firms. Apparently, the Japanese labour market does not attribute firm performance to top management to a similar extent as does the US labour market. This interpretative process accords well with the observation that Japanese management

[2] Hall and Liebman [23] document that, between 1980 and 1994, the level of CEO compensation increased by over 200% at the mean and that most of this increase was in the form of stock options.

[3] Healy [24] postulates that executives rewarded earnings-based bonuses exercise discretion in the choices of accounting procedures that increase their compensation. Bergstresser and Philippon [5] provide empirical evidence that firms with CEOs whose overall compensation is more sensitive to the firms' prices display higher levels of earnings management. Klein [36] documents that firms with audit committees comprised of less than a majority of independent directors experience higher levels of earnings management.

[4] Some theoretical work attributes the increase in CEO compensation to the change in the securities market. Holmström and Kaplan [27] argue that the leveraged buyouts — takeovers accelerated in early 1980s that were characterised by the heavy use of leverage — were associated with significant changes in corporate governance, including executive compensation. Gabaix and Landier [19] provide a model in which US CEO compensation is proportional to firm size in market equilibrium, and conclude that the leap in US CEO compensation is an efficient response to the surge in the market value of firms, while others attribute this to the change in product market. Cuñat and Guadalupe [13] investigate the influence of foreign competition in product markets and document that foreign competition increases the sensitivity of pay to performance in US CEO compensation.

seeks broad participation in decision-making and defers final decisions until consensus is reached among affected managers and departments (see Lincoln et al. [39]).

This dissertation is a step towards a more complete understanding of the moral hazard created by the separation of security ownership and control.

1.2 Chapter Overviews

This dissertation is comprised of three theoretical models, which are explored in later chapters. An outline of each model is as follows:

Overview of Chapter 2

The first model, described in Chapter 2, is an N-period optimal compensation model. The model extends the logic of Gibbons and Murphy [20] by incorporating multi-signals into their single-signal model. The structure of signals is defined by those on which contractual provisions are infinitely costless to enforce, that is, contractible signals, and by those on which contractual provisions are infinitely costly to enforce, that is, non-contractible signals. The model explains why the structure of executive compensation varies greatly across countries. Moreover, the model provides a simple counter-example of the supposition that firms should be transparent to market participants as much as possible.

In the optimal compensation model, the agent focuses excessively on one signal that reflects his effort more easily than the other. If a contractible signal is distorted in the sense that it overstates the constructive outcome provided by the agent, then either a contractible or a non-contractible signal can be the focal point, and the dichotomy between contractible and non-contractible signals becomes instrumental in showing the design for the optimal contract.

The main contribution of Chapter 2 is that the model allows for an explanation of the cross-country differences in the structure of executive compensation. In a country observing a large portion of performance pay in executive compensation, the labour market mainly attributes firm performance to the top management, and non-contractible signals receive less attention. A secondary contribution is to find an example that counters the myth of transparency. An excess of implicit incentives to improve their marketable value of human capital makes a disincentives contract optimal for managers with many remaining years of service, and where outcomes may not be improved by improving transparency via the enforcement of more detailed corporate reporting.

The limits of the model are, first, that the model uses the property of linear functions that enables a closed-form solution while making something important unobservable. Second, the model supposes a perfectly competitive labour market which faces obvious difficulty of explaining why internal labour markets are economically viable. The former and latter limits are relaxed in the second and third models, respectively.

Overview of Chapter 3

The second model, addressed in Chapter 3, is the single-period optimal compensation model not restricted to linear functions. The purpose of this generalisation is, first, to examine the robustness of the findings from the first model in Chapter 2, and second, to compare the criteria for information systems (performance evaluation systems) in a standard agency framework with those for information structures in the current study. As in Chapter 2, a key feature of the model is the dichotomy between contractible and non-contractible signals.

The model provides a general threshold that indicates whether incentive contracts will hold their primary condition, wherein a higher signal realisation always implies a higher reward. Furthermore, Chapter 3 shows that the model's threshold can be compared to the criteria for information system rankings in a standard principal-agent model. The informativeness criterion introduced by Holmström [25], for example, states that additional information should be used in contracts until sufficient statistics are obtained. Chapter 3 demonstrates, however, that this is not the case when considering a perfectly competitive labour market and non-contractible signals.

Overview of Chapter 4

The final model, described in Chapter 4, is a two-period optimal compensation model. In contrast to the aforementioned models, the final model compares the shareholder values[5] of two firms whose governance and information structures are entirely different from each other, and assumes that labour markets are imperfectly competitive. In one firm, any contingent pay scheme not normally used, along with non-contractible signals, plays an essential role in the assessment of individual performance. This assessment is subjective in the sense that the non-contractible signals are only observed in the internal labour market. Meantime in the other firm, optimal contracts are chosen, but non-contractible signals are not observed. Consequently, they use only contractible signals for pricing their managers' contributions. The comparison indicates a counter-intuitive effect in which the difference in the information structure can lead the former firm to outperform the latter one, so long as competition in the labour market is not ignored.

The firms in Chapter 4 illustrate the stylised descriptions of Japanese and US firms. However, despite its rudimentary model, Chapter 4 may provide some lessons for policy debates concerning financial regulations aimed at making Japanese firms more transparent: the implementation of performance contingent pay schemes, for example, is not always beneficial for shareholders under the Japanese systems of governance.

With the above-mentioned three models, this dissertation shows that distortion of information in each labour market creates differences in the costs of moral hazard, a factor behind the difference in the structure of executive compensation across countries. The implications that either highly incentivised or fixed compensation contract designs might be a consequence of strong corporate governance shed light on heterogenity in moral hazard created by the separation of security ownership and control.

[5] The stakeholder values are equally important, but are beyond the scope of Chapter 4 .

Chapter 2

Managerial Incentive Problems: A Role of Multi-Signals

2.1 Introduction

This chapter provides an executive compensation model and studies the effect of information on the cost of moral hazard arising from the relationship between a corporate executive and his or her shareholders. The information is comprised of contractible and non-contractible signals, both being imperfectly correlated with the executive's inputs (unknown talent and unobservable effort) that cannot be tied with his or her compensation contracts.

The model finds that the distortion of information in each labour market accounts for a large part of the difference in the structures of executive compensation between markets. Moreover, the model indicates a policy debate on the role of information in financial regulations by showing a counter-example for the widespread assumption that firms should be as transparent as possible to market participants.

In the model, the signal that is more responsive to executive effort than another signal invites extensive attention. The attracting signal is either contractible or non-contractible when the executive labour market is competitive. The chapter extends previous studies (Fama [16]; Holmström [26]; Gibbons and Murphy [20]; Sabac [47]) by introducing a multi-signal information structure into a reputational principal-agent relationship in a perfectly competitive labour market. This allows for a direct analysis of the effect of the information structure on the structures of executive compensation.

The main contribution of this chapter is that the model allows for a simple and intuitive explanation for cross-country differences in the structures of executive compensation. Information structures vary from market to market, shaping different structures of executive compensation across markets. A larger proportion of performance-related pay in executive compensation implies that firm performance (contractible) is mainly attributed to the top manamement, and non-contractible signals receive less attention in the labour market.

A secondary contribution of this chapter is to address some policy debates concerning the role of information in financial regulations. There is a widespread supposition that firms should be as transparent as possible to market participants. As a result, not only financial information (contractible) but also non-financial information (non-contractible in many cases) is seriously considered as mandated corporate reporting.[1] The proposed model allows for evaluating the effect of corporate transparency that plays a double-edged role. Scholarship on career concerns suggests that increased transparency is undesirable, first, because more information about the agent's talent can have a negative impact on implicit incentives in the form of career concerns (see Holmström [26]; Crémer [12]; Dewatripont et al. [15]), and second, because more information about the agent's talent can discourage the agent to use private signals (see Prat [44]). This study complements these theories by indicating a different rationale for opacity. When implicit incentives are so strong that the optimal incentive scheme is monotone decreasing, less noise of information about the agent's talent and action (providing a positive impact on implicit incentives) is undesirable because the principal desires to provide the agent with disincentives.

This chapter is primarily related to the literature on career concerns, with the main departure addressing the role of multi-signals (a mixture of contractible and non-contractible signals). The idea that a manager's concerns about his or her reputation in

[1] The European Commission proposed disclosure of non-financial and diversity information by large corporations on April 3, 2013.

the labour market might solve the problem of moral hazard was first introduced by Fama [16]. Holmström [26] provides a simple model to analyse the nature of career concerns, but the only information he considers is non-contractible outputs. Gibbons and Murphy [20] introduce explicit incentive contracts and manager retirement dates into the Fama-Holmstrom model, but the only information they consider is contractible outputs. More recent work considers the role of information. Sabac [47] provides a career concern model in which outputs are not observable, and therefore, imperfect performance signals are taken as a proxy, but they are all contractible. Kaarbøe and Olsen's work [32] is technically closest to this chapter. They study the role of distorted performance signals in the presence of career concerns. While they introduce, as this chapter does, a mixture of contractible and non-contractible signals, they focus on the effect of the distortion of multi-tasks rather than on multi-signals.

The rest of this chapter is organised as follows. Section 2.2 introduces the career concern model. Section 2.3 studies the role of information in determining compensation structures. Section 2.4 studies the effect of transparency in the reputational principal-agent relationship. Section 2.5 provides a conclusion.

2.2 Model

Two-Period Model

Consider a two-period reputational agency model in a competitive labour market, where the agent with unknown talent[2] $\theta \sim N(0, \sigma_\theta^2)$ privately takes actions $a_t \in A \subset \mathbb{R}$, $t = 1, 2$. The outcome from the agent's talent and effort in period t are not observable; hence they are not contractible.[3] Let x_t be

$$x_t = \theta + ba_t + \tau_t, \ t = 1, 2,$$

[2] Holmström [26] assumes that θ is unknown to everybody so that there is symmetric information at the start of the first period, in order to focus on moral hazard. This study also makes that assumption.

[3] The principal cannot use the outcome for contracts. This assumption is commonly used in the literature on performance measures (Holmström and Milgrom [29]; Feltham and Xie [17]; Kaarbøe and Olsen [32]; Sabac [47]).

where $b \in (0, \infty)$ represents the marginal impact of the agent's effort on the outcomes and $\tau_t \sim N(0, \sigma_\tau^2)$ denote a random state of nature.

Observables are a set of signals y_t and z_t. Let y_t and z_t be

$$y_t = \theta + ma_t + \varepsilon_t,$$
$$z_t = \theta + pa_t + \nu_t, \ t = 1, 2,$$

where $m \in (0, \infty)$ and $p \in (0, \infty)$ denote the marginal impact of the agent's effort on the contractible and non-contractible signals, respectively, and $\varepsilon_t \sim N(0, \sigma_\varepsilon^2)$ and $\nu_t \sim N(0, \sigma_\nu^2)$ represent errors in assessment of the agent's performance. Suppose θ, τ_t, ε_t and ν_t are independent with each other. This chapter assumes that y_t are observable and contractible, and z_t are observable but not contractible. Examples of y_t are firms' financial reports or stock price. The market (prospective employers) can offer a contract which depends on y_t. On the other hand, examples of z_t are the firm's policy on environmental, social and employee-related matters. Contracts are not contingent on z_t, but the agent makes efforts for raising z_t because the public information z_t might impinge his reputation in the labour market. Every participant is risk neutral and an expected utility maximiser. The agent has the following utility function:

$$U_A = w_1 + w_2 - c(a_1) - c(a_2),$$

where w_t denotes the compensation contract offered in period t, $c(a_t)$ represents the agent's private cost in period t. For simplification, this chapter assumes that the optimal contract is linear and the agent's private cost is quadratic:

$$w_t(y_t) = \alpha_t + \beta_t y_t, \ c(a_t) = \frac{1}{2}a_t^2, \ t = 1, 2,$$

where $\alpha_t, \beta_t \in \mathbb{R}, t = 1, 2.$[4]

The timing of the two-period model begins when the prospective employers simultaneously offer the first-period compensation contract w_1. The agent chooses the most

[4]Justification of the restriction to linear contracts in a similar model can be seen in Holmström and Milgrom [28].

attractive contract and decides the effort level. At the end of the first period, all parties observe the outcome y_1 and the non-contractible measure z_1. At the start of the second period, the firm and the market simultaneously offer the agent w_2. The agent is free to choose the most attractive contract again.

Consider the agent's choice of the optimal second-period action a_2. Given compensation contracts and cost function, the agent's expected utility is given by

$$E\left[\alpha_1 + \beta_1 y_1 + \alpha_2 + \beta_2 y_2 - \frac{1}{2}a_1^2 - \frac{1}{2}a_2^2\right],$$

where y_1 and z_1 are predetermined. The agent's problem reduces to

$$\max_{a_2} E[\beta_2 y_2 | y_1, z_1] - \frac{1}{2}a_2^2.$$

The agent selects

$$a_2^* = \beta_2 m. \tag{2.1}$$

In the competitive labour market, all the prospective employers are wage takers and the contract that the agent accepts for the second period must earn zero expected profit. Thus, α_2 is given by

$$\begin{aligned} \alpha_2(\beta_2) &= E\left\{x_2 | y_1, z_1\right\} - \beta_2 E\left\{y_2 | y_1, z_1\right\} \\ &= (1-\beta_2)E[\theta | y_1, z_1] + \big(\frac{b}{m} - \beta_2\big) m a_2. \end{aligned} \tag{2.2}$$

A conjecture of a_1 is required to determine the agent's expected talent conditional on the first-period outcome, $E[\theta | y_1, z_1]$. Let the conjecture be $\hat{a}_1$, which is correct in equilibrium. Applying the well-known formulas for the normal distribution, the agent's expected talent conditional on the first-period outcome from the prospective employers' perspective, $\mu_c = E\{\theta | y_1, z_1, \hat{a}_1\}$, is given by

$$\mu_c = \rho_y(y_1 - E[y_1 | \hat{a}_1]) + \rho_z(z_1 - E[z_1 | \hat{a}_1]),$$

where

$$\rho_y = \frac{\sigma_\theta^2 \sigma_\nu^2}{\sigma_\theta^2 \sigma_\nu^2 + \sigma_\varepsilon^2 \sigma_\theta^2 + \sigma_\varepsilon^2 \sigma_\nu^2} \text{ and } \rho_z = \frac{\sigma_\theta^2 \sigma_\varepsilon^2}{\sigma_\theta^2 \sigma_\nu^2 + \sigma_\varepsilon^2 \sigma_\theta^2 + \sigma_\varepsilon^2 \sigma_\nu^2}.$$

The prospective employers compete, resulting in the optimal β_2 maximising the agent's objective function:

$$E[w_2|y_1, z_1] - \frac{1}{2}a_2^2$$

and the optimal incentive rate β_2^* is given by

$$\beta_2^* = \frac{b}{m}. \tag{2.3}$$

Given the second-period compensation corresponds to the optimal second-period incentive β_2^*, the agent's first period problem to choose a_1 reduces to

$$\max_{a_1} E[\beta_1 y_1 + \alpha_1 + \alpha_2] - \frac{1}{2}a_1^2,$$

and the agent's optimal action is given by

$$a_1^* = \tilde{\beta}_1 m + \beta_z p, \tag{2.4}$$

where $\tilde{\beta}_1 = \beta_1 + \beta_y$, $\beta_y = (1 - \beta_2^*)\rho_y$ and $\beta_z = (1 - \beta_2^*)\rho_z$. $\beta_1 m$ is explicit incentive, while $\beta_y m$ and $\beta_z p$ are implicit incentives that come from the effects of y_1 and z_1 on the second-period fixed payment. So far the market's conjecture about the agent's first-period action choice $\hat{a}_1$ is supposed to be given. In equilibrium, the conjecture which must be correct is given by

$$\hat{a}_1 = a_1^*(\beta_1).$$

Note that the agent knows that he cannot fool the market in equilibrium. However, he does not deviate from $a_1^*(\beta_1)$ because the deviation works against his reputation. The logic is that of a signalling game, such as that described by Spence [54]. The equilibrium concept is perfect Bayesian equilibrium.

The first period prospective employers' problem is considered in a manner similar to the second period. In the competitive labour market, the first-period fixed payment α_1 must satisfy

$$\alpha_1(\beta_1) = E[x_1] - \beta_1 E[y_1], \tag{2.5}$$

and the prospective employers compete, resulting in the optimal effective incentive rate $\tilde{\beta}_1 = (\beta_1 + \beta_y)m$ maximising the agent's objective function:

$$E[w_1 + w_2] - \frac{1}{2}a_1^2 - \frac{1}{2}a_2^2$$

and the optimal incentive rate β_1^* is given by

$$\beta_1^* = \frac{b}{m} - \beta_y - \beta_z \frac{p}{m}. \tag{2.6}$$

Characteristics of this two-period model are summarised as follows. First, the explicit incentive rate is increasing, i.e. $\beta_1^* < \beta_2^*$. This result is consistent with Gibbons and Murphy [20] and generalised in the N-period model. Second, the optimal effective incentive rate is constant, i.e. $\tilde{\beta}_1 = \tilde{\beta}_2 = \frac{b}{m}$. Third, the first-best action $a_1^* = a_2^* = b$ is induced in equilibrium. Finally, $\frac{b}{m} < 1$ must hold in order to examine implicit incentives from career concerns. This performance measure's scaling distortion is necessary because this study assumes that the agent is risk neutral and as a result, the first-best action is induced in equilibrium. Gibbons and Murphy [20] assumed risk aversion so that optimal contracts do not completely eliminate career concerns. This study assumes that $\frac{b}{m} < 1$ throughout the rest of this chapter.

N-Period Model

In the N-period model, the agent's optimal action choice satisfies

$$a_t^* = \frac{\partial E_{t-1}\Big[\sum_{k=t}^{N} \gamma^{k-t} w_k\Big]}{\partial a_t}, \tag{2.7}$$

where $E_{t-1}[\cdot] = E[\cdot|y_1, \dots, y_{t-1}, z_1, \dots, z_{t-1}]$, $\gamma \in (0,\ 1]$ is the discount rate. When setting β_t, the principal's problem to induce the optimal period t action is given by

$$\max_{\beta_t} \hat{E}_{t-1}\Big[\sum_{k=t}^{N} \gamma^{k-t}\big(x_k - \frac{1}{2}a_k^2\big)\Big], \tag{2.8}$$

where $\hat{E}[\cdot]$ is the expectation from the perspective of the principal. Note that the above problem is implicitly incorporates the zero-profit constraint:

$$\hat{E}_{t-1}\Big[\sum_{k=t}^{N} w_k\Big] = \hat{E}_{t-1}\Big[\sum_{k=t}^{N} x_k\Big] \quad for\ t = 1, \dots, N. \tag{2.9}$$

The following proposition characterises the optimal contract for the N-period model.

Proposition 1. *The actions induced by the optimal contract and the optimal incentives are given by the following recursive relations:*

$$a_t^* = b\ for\ t = 1, \dots, N, \tag{2.10}$$

$$\beta_N^* = \frac{b}{m}, \tag{2.11}$$

$$\beta_t^* = \frac{b}{m} - \sum_{k=t+1}^{N} \gamma^{k-t}(1 - \beta_k^*)Cov_{k-1}\big(y_k, z_k\big)\left(\frac{1}{\sigma_\varepsilon^2} + \frac{1}{\sigma_\nu^2}\frac{p}{m}\right) \tag{2.12}$$

$$for\ t = 1, \dots, N-1,$$

where $Cov_t(\cdot,\cdot)$ *is the conditional covariance given history* $(y_1, \dots, y_t, z_1, \dots, z_t)$.

All proofs are in the Appendix.

2.3 Optimal compensation structures

This study addresses the questions on the role of information in optimal compensation structures. In order to isolate the effects of multi-signal information structures from those of single-signal ones, this study first derives the properties of the optimal incentives that hold in both information structures: the optimal incentives are monotonic.

Proposition 2. *Suppose* $\frac{b}{m} < 1$. *The optimal incentive rates exhibit the property:* $\beta_t^* < \beta_{t+1}^*$ *for all* $t < N$.

Proposition 2 is consistent with the result of Gibbons and Murphy [20]. As mentioned in the Introduction, the model of Gibbons and Murphy [20] focuses only on a contractible signal in each period. Proposition 2 guarantees that the optimal incentives also exhibit monotonicity in the information structures in which both contractible and non-contractible signals are observable in each period. The optimal incentives' monotonicity implies that implicit incentives are a declining sequence because the optimal effective incentives are constant. The mechanisms causing implicit incentives to diminish are, first, that the uncertainty over the agent's talent is eliminated as the conditional variances, $Var_{t-1}(\theta)$, converge in the limit to zero, and second, that the agent does not expect any reputational benefit in the future after the retirement date. These effects and limits of career concerns are supported by empirical evidence (Gibbons and Murphy [20]; Chevalier and Ellison [9]).

Here, it is important to consider incentive contracts. What information structure sustains career concerns incentives for a longer period? In other words, what information structure reduces the cost of moral hazard? A relevant way to pose the question is to consider the second term on the right-hand side of (2.12):

$$\beta_t^{imp} = \sum_{k=t+1}^{N} \gamma^{k-t}(1-\beta_k^*)Cov_{k-1}(y_k, z_k)\left(\frac{1}{\sigma_\varepsilon^2} + \frac{1}{\sigma_\nu^2}\frac{p}{m}\right), \tag{2.13}$$

which represents the implicit incentive from career concerns in period t. In other words, it is a discount rate of the cost of moral hazard. From (2.13), this study notes the following comparative statics features of the N-period model:

- Suppose the precisions $\frac{1}{\sigma_\varepsilon^2}$ and $\frac{1}{\sigma_\nu^2}$ are fixed; then, β_t^{imp} is increasing in $Cov_{k-1}(y_k, z_k)$ for $k \geq t+1$.
- β_t^{imp} is increasing in $\frac{p}{m}$.

The interpretation given to $Cov_{k-1}(y_k, z_k)$ was the conditional covariance of financial reports y_k and non-financial reports z_k, given the history of reports, $y_1, \ldots, y_{k-1}$ and $z_1, \ldots, z_{k-1}$; hence this result implies that if both financial and non-financial reports are required, and if they will significantly correlate, then implicit incentives from career concerns are sustained for a longer period. One of factors that makes the conditional covariance $Cov_{k-1}(y_k, z_k)$ higher is the opaque information about the agent's talent θ. More precisely,

- $Cov_{k-1}(y_k, z_k)$ is decreasing in $\frac{1}{\sigma_\theta^2}$.

More interesting is the comparative statics β_t^{imp} with respect to $\frac{p}{m}$. Variables p and m represent the marginal impact of effort on the non-contractible and contractible signals, respectively. A larger $\frac{p}{m}$ implies that the non-contractible signals are more responsive to efforts than the contractible signals. Such an information structure sustains the career concerns effect for a longer period. Conversely, the lower $\frac{p}{m}$ diminishes career concerns at an earlier period.

Figure 2.1 illustrates this comparative statics effect. The fact is that the longer that career concerns are sustained, the deeper the drop of optimal incentives in early years. This can be detrimental in practice, because arguably, the optimal incentives should be positive. This issue is discussed further in the next section.

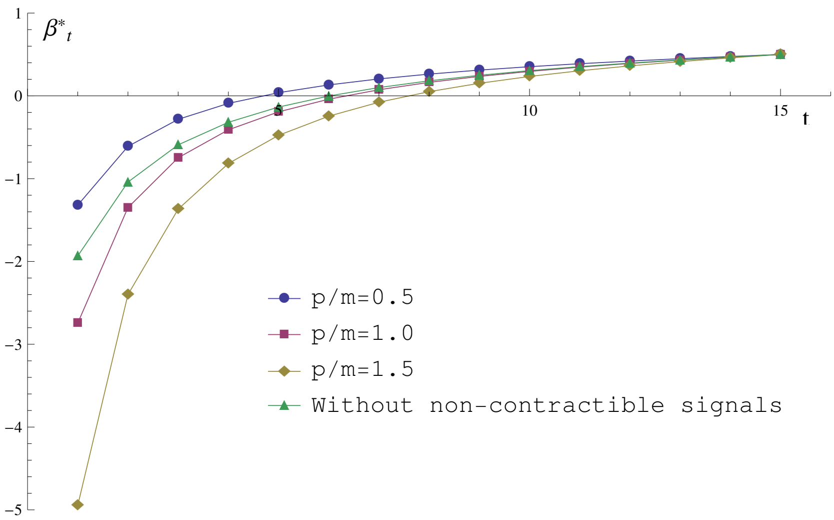


FIGURE 2.1: Optimal explicit incentives: $N = 15,\ \gamma = 0.95,\ \frac{b}{m} = 0.5,\ \sigma_\varepsilon^2 = \sigma_\nu^2 = \sigma_\theta^2$.

2.4 Transparency

This study now turns to another set of questions regarding comparative statics and examines some implications on the role of information transparency in influencing optimal incentives. In addressing this issue, this study hopes to highlight the importance of preventing the optimal incentives from becoming negative. As mentioned in Section 2.3, if the optimal incentives must be positive, then firms cannot make managers stop working hard in the early years. This is a detriment that is difficult to control, and leads to a comparison between optimal incentives and the accuracy of information. From (2.12), the following comparative statics features are obtained.

Lemma 1.

- *If* $\frac{p}{m} \leq 1$, *then* β_t^* *is decreasing in* $\frac{1}{\sigma_\varepsilon^2}$.
- *If* $\frac{p}{m} \geq 1$, *then* β_t^* *is decreasing in* $\frac{1}{\sigma_\nu^2}$.

The interpritation is that if financial reports are more (less) responsive to effort than non-financial reports, then the more accurate are financial (non-financial) reports, the larger negative are the optimal incentives in early years. In other words, information that is relatively responsive to effort should be opaque when firms assign tasks to managers who have many remaining years.

2.5 Conclusion

Moral hazard problems created by the separation of security ownership and control have played an influential role in shaping the debate over accounting abuses. Simultaneously, however, our understanding of moral hazard — in other words, that of the problem of managerial incentives — is far from clear. It would be wrong to generate too simplistic a conclusion about the provision of incentives. However, to the extent that career motives can be considered, this study suggests that the information in which a mixture of contractible and non-contractible signals is observable can provide counter-intuitive effects. It may open new avenues for empirical research. For instance, in the area of cross-country differences in the extent of pay-for-performance for top management, this study implies that it is important to consider what information can be attributed to executives other than firm performance. The extent to which the labour market attributes firm performance to top management depends on the degree to which the managers have power over the firm's decisions, and that degree varies greatly across countries.

Despite the limitations of the model, however, this study may provide some implications for the debates on financial regulations. A striking result is an example, furnished by the theory, to counter the myth that firms should be as transparent as possible to market participants. After all, the normative implication provides a lesson: placing all emphasis on the shareholders' perspective does not always lead to efficiency. Opaque information may be preferable for both shareholders and managers who have many remaining years.

Appendix

To keep the notation simple, let $\delta_t = \theta + \varepsilon_t$, $\eta_t = \theta + \nu_t$ and $\kappa_t = \theta + \tau_t$. Let H^y_{kt} and H^z_{kt} be the impact of observed contractible and non-contractible signal history at date t on conditional expectations of period k contractible signal with components $H^y_{kt} = (H^{y1}_{kt}, \ldots, H^{yt}_{kt})$ and $H^z_{kt} = (H^{z1}_{kt}, \ldots, H^{zt}_{kt})$, respectively, i.e. $E_t[\delta_k] = H^y_{kt}(\delta_1, \ldots, \delta_t)^T + H^z_{kt}(\eta_1, \ldots, \eta_t)^T$. Similarly, Let L^y_{kt} and L^z_{kt} be the impact of observed contractible and non-contractible signal history at date t on conditional expectations of period k outcome with components $L^y_{kt} = (L^{y1}_{kt}, \ldots, L^{yt}_{kt})$ and $L^z_{kt} = (L^{z1}_{kt}, \ldots, L^{zt}_{kt})$, respectively, i.e. $E_t[\kappa_k] = L^y_{kt}(\delta_1, \ldots, \delta_t)^T + L^z_{kt}(\eta_1, \ldots, \eta_t)^T$. Note that $H^y_{kt} = L^y_{kt}$ and $H^z_{kt} = L^z_{kt}$ for all k and t. Thus, only H^y_{kt} and H^z_{kt} are used in the proof of Proposition 1.

The following lemma is a special case of Lemma 1 of Sabac [47] and is used in the proof of Proposition 1.

Lemma 1. *If the contract w_t satisfies the participation constraint in (2.9), then*

$$w_t = \hat{E}_{t-1}[x_t] + \beta_t(y_t - \hat{E}_{t-1}[y_t]). \tag{2.14}$$

The proof can be seen in Sabac [47].

Proof of Proposition 1.

Consider the agent's optimal action a_t^* for period t. Substituting (2.14) in Lemma 1 into (2.7), a_t^* can be rewritten as

$$a_t^* = \frac{\partial E_{t-1}\left[\sum_{k=t}^{N} \gamma^{k-t}\Big(\hat{E}_{t-1}[x_t] + \beta_t(y_t - \hat{E}_{t-1}[y_t])\Big)\right]}{\partial a_t},$$

and one obtains the following equation:

$$a_t^* = \sum_{k=t}^{N} \gamma^{k-t}(1-\beta_k)\big(H^{yt}_{k\ k-1} m + H^{zt}_{k\ k-1} p\big) + m\beta_t.$$

Substituting the above equation into (2.8), the optimal incentives are given by

$$\beta_t^* = \frac{b}{m} - \sum_{k=t+1}^{N} \gamma^{k-t}(1-\beta_k)\left(H^{yt}_{k\ k-1} + H^{zt}_{k\ k-1}\frac{p}{m}\right). \tag{2.15}$$

Now it is shown that for $k \geq 2$,

$$\begin{aligned} E_{k-1}[\delta_k] = {} & \frac{\sigma_\theta^2\sigma_\nu^2}{(k-1)\sigma_\theta^2(\sigma_\nu^2+\sigma_\varepsilon^2)+\sigma_\varepsilon^2\sigma_\nu^2}(\delta_1+\cdots+\delta_{k-1}) \\ & + \frac{\sigma_\theta^2\sigma_\varepsilon^2}{(k-1)\sigma_\theta^2(\sigma_\nu^2+\sigma_\varepsilon^2)+\sigma_\varepsilon^2\sigma_\nu^2}(\eta_1+\cdots+\eta_{k-1}). \end{aligned} \tag{2.16}$$

Note that (2.16) determines for $1 \leq t \leq k-1$,

$$H^{yt}_{k\ k-1} = \frac{\sigma_\theta^2\sigma_\nu^2}{(k-1)\sigma_\theta^2(\sigma_\nu^2+\sigma_\varepsilon^2)+\sigma_\varepsilon^2\sigma_\nu^2} \quad \textit{and} \quad H^{zt}_{k\ k-1} = \frac{\sigma_\theta^2\sigma_\varepsilon^2}{(k-1)\sigma_\theta^2(\sigma_\nu^2+\sigma_\varepsilon^2)+\sigma_\varepsilon^2\sigma_\nu^2}.$$

The proof is by induction on k. Let ζ_k be the normalised random variable:

$$\zeta_k = \begin{pmatrix} \frac{\delta_k - E_{k-1}[\delta_k]}{\sqrt{Var_{k-1}(\delta_k)}} \\ \frac{1}{\sqrt{1-\rho^2}}\left(\frac{\eta_k - E_{k-1}[\eta_k]}{\sqrt{Var_{k-1}(\eta_k)}} - \rho\frac{\delta_k - E_{k-1}[\delta_k]}{\sqrt{Var_{k-1}(\delta_k)}}\right) \end{pmatrix},$$

where $\rho = \frac{Cov(\delta_k - E_{k-1}[\delta_k], \eta_k - E_{k-1}[\eta_k])}{\sqrt{Var(\delta_k - E_{k-1}[\delta_k]) Var(\eta_k - E_{k-1}[\eta_k])}}$. Since ζ_k is independent of $\delta_1, \ldots, \delta_{k-1}$, the conditional expectation of δ_{k+1} can be written as

$$
\begin{aligned}
E_k[\delta_{k+1}] &= E_{k-1}[\delta_{k+1}] + Cov(\delta_{k+1}, \zeta_k)\zeta_k \\
&= E_{k-1}[\delta_k] + Cov(\delta_{k+1}, \zeta_k)\zeta_k. \qquad (2.17)
\end{aligned}
$$

For $k = 2$, (2.16) follows from

$$
E_1[\delta_2] = \frac{\sigma_\theta^2 \sigma_\nu^2}{\sigma_\theta^2 \sigma_\nu^2 + \sigma_\theta^2 \sigma_\varepsilon^2 + \sigma_\varepsilon^2 \sigma_\nu^2} \delta_1 + \frac{\sigma_\theta^2 \sigma_\varepsilon^2}{\sigma_\theta^2 \sigma_\nu^2 + \sigma_\theta^2 \sigma_\varepsilon^2 + \sigma_\varepsilon^2 \sigma_\nu^2} \eta_1.
$$

Suppose that (2.16) holds for k. Then,

$$
\begin{aligned}
\delta_k - E_{k-1}[\delta_k] = \theta + \varepsilon_k &- \frac{\sigma_\theta^2 \sigma_\nu^2}{(k-1)\sigma_\theta^2(\sigma_\nu^2 + \sigma_\varepsilon^2) + \sigma_\varepsilon^2 \sigma_\nu^2} \big((k-1)\theta + \varepsilon_1 + \cdots + \varepsilon_{k-1}\big) \\
&- \frac{\sigma_\theta^2 \sigma_\varepsilon^2}{(k-1)\sigma_\theta^2(\sigma_\nu^2 + \sigma_\varepsilon^2) + \sigma_\varepsilon^2 \sigma_\nu^2} \big((k-1)\theta + \nu_1 + \cdots + \nu_{k-1}\big). \qquad (2.18)
\end{aligned}
$$

From (2.17), it follows that

$$
\begin{aligned}
E_k[\delta_{k+1}] &= E_{k-1}[\delta_k] + Cov(\delta_{k+1}, \zeta_k)\zeta_k \\
&= E_{k-1}[\delta_k] + \frac{\sigma_\theta^2 \sigma_\nu^2}{k\sigma_\theta^2(\sigma_\nu^2 + \sigma_\varepsilon^2) + \sigma_\varepsilon^2 \sigma_\nu^2} (\delta_k - E_{k-1}[\delta_k]) \\
&\qquad + \frac{\sigma_\theta^2 \sigma_\varepsilon^2}{k\sigma_\theta^2(\sigma_\nu^2 + \sigma_\varepsilon^2) + \sigma_\varepsilon^2 \sigma_\nu^2} (\eta_k - E_{k-1}[\eta_k]) \\
&= \frac{\sigma_\theta^2 \sigma_\nu^2}{k\sigma_\theta^2(\sigma_\nu^2 + \sigma_\varepsilon^2) + \sigma_\varepsilon^2 \sigma_\nu^2} (\delta_1 + \cdots + \delta_k) \\
&\qquad + \frac{\sigma_\theta^2 \sigma_\varepsilon^2}{k\sigma_\theta^2(\sigma_\nu^2 + \sigma_\varepsilon^2) + \sigma_\varepsilon^2 \sigma_\nu^2} (\eta_1 + \cdots + \eta_k).
\end{aligned}
$$

The last equation is because $E_{k-1}[\delta_k] = E_{k-1}[\eta_k]$. This proves the induction hypothesis (2.16). Thus, β_t^* in (2.15) is given by

$$
\beta_t^* = \frac{b}{m} - \sum_{k=t+1}^{N} \gamma^{k-t}(1 - \beta_k^*) Cov(\delta_k - E_{k-1}[\delta_k], \eta_k - E_{k-1}[\eta_k]) \left(\frac{1}{\sigma_\varepsilon^2} + \frac{1}{\sigma_\nu^2} \frac{p}{m} \right). \qquad (2.19)
$$

The last equation proves (2.12) in Proposition 1.

Considering the participation constraint in (2.9), the agent's optimal action in (2.7) can be rewritten as

$$a_t^* = \frac{\partial E_{t-1}\Big[\sum_{k=t}^{N} \gamma^{k-t} x_k\Big]}{\partial a_t},$$

and this proves (2.10) in Proposition 1 and completes the proof of Proposition 1. □

Proof of Proposition 2.

It is shown that for $k = 1, \ldots, N-1$,

$$\beta^*_{N-k} \leq \beta^*_{N-k+1} - \gamma^k (1 - \frac{b}{m}) \frac{\sigma_\theta^2 \sigma_\nu^2 + \sigma_\theta^2 \sigma_\varepsilon^2 \frac{p}{m}}{(N-1)\sigma_\theta^2(\sigma_\varepsilon^2 + \sigma_\nu^2) + \sigma_\varepsilon^2 \sigma_\nu^2}. \tag{2.20}$$

The proof is by induction on k. For $k = 1$, from (2.19) one obtains

$$\beta^*_{N-1} = \beta^*_N - \gamma(1 - \frac{b}{m}) \frac{\sigma_\theta^2 \sigma_\nu^2 + \sigma_\theta^2 \sigma_\varepsilon^2 \frac{p}{m}}{(N-1)\sigma_\theta^2(\sigma_\varepsilon^2 + \sigma_\nu^2) + \sigma_\varepsilon^2 \sigma_\nu^2}.$$

Suppose the induction hypothesis (2.20) holds for $k-1$. From (2.19), β^*_{N-k} is given by

$$\begin{aligned} \beta^*_{N-k} = \frac{b}{m} - \gamma^k (1 - \beta^*_N) &\frac{\sigma_\theta^2 \sigma_\nu^2 + \sigma_\theta^2 \sigma_\varepsilon^2 \frac{p}{m}}{(N-1)\sigma_\theta^2(\sigma_\varepsilon^2 + \sigma_\nu^2) + \sigma_\varepsilon^2 \sigma_\nu^2} \\ &- \sum_{i=N-k+1}^{N-1} \gamma^{i-(N-k)} (1 - \beta^*_i) \frac{\sigma_\theta^2 \sigma_\nu^2 + \sigma_\theta^2 \sigma_\varepsilon^2 \frac{p}{m}}{(i-1)\sigma_\theta^2(\sigma_\varepsilon^2 + \sigma_\nu^2) + \sigma_\varepsilon^2 \sigma_\nu^2}. \end{aligned}$$

Let $A_i = -(1 - \beta^*_i) \frac{\sigma_\theta^2 \sigma_\nu^2 + \sigma_\theta^2 \sigma_\varepsilon^2 \frac{p}{m}}{(i-1)\sigma_\theta^2(\sigma_\varepsilon^2 + \sigma_\nu^2) + \sigma_\varepsilon^2 \sigma_\nu^2}$. $A_i < A_{i+1}$ holds for $i = N-k+1, \ldots, N-1$, one obtains

$$\begin{aligned} \beta_{N-k} &= \frac{b}{m} - \gamma^k (1 - \beta^*_N) \frac{\sigma_\theta^2 \sigma_\nu^2 + \sigma_\theta^2 \sigma_\varepsilon^2 \frac{p}{m}}{(N-1)\sigma_\theta^2(\sigma_\varepsilon^2 + \sigma_\nu^2) + \sigma_\varepsilon^2 \sigma_\nu^2} + \sum_{i=N-k+1}^{N-1} \gamma^{i-(N-k)} A_i \\ &< \frac{b}{m} - \gamma^k (1 - \beta^*_N) \frac{\sigma_\theta^2 \sigma_\nu^2 + \sigma_\theta^2 \sigma_\varepsilon^2 \frac{p}{m}}{(N-1)\sigma_\theta^2(\sigma_\varepsilon^2 + \sigma_\nu^2) + \sigma_\varepsilon^2 \sigma_\nu^2} + \sum_{i=N-k+2}^{N} \gamma^{i-(N-k+1)} A_i \\ &= \beta^*_{N-k+1} - \gamma^k (1 - \beta^*_N) \frac{\sigma_\theta^2 \sigma_\nu^2 + \sigma_\theta^2 \sigma_\varepsilon^2 \frac{p}{m}}{(N-1)\sigma_\theta^2(\sigma_\varepsilon^2 + \sigma_\nu^2) + \sigma_\varepsilon^2 \sigma_\nu^2}. \end{aligned}$$

Hence, (2.20) holds for $k = 1, \ldots, N-1$. Since $\frac{b}{m} < 1$ from the assumption, this proves Proposition 2. □

Chapter 3

Moral hazard and preference for fixed payments

3.1 Introduction

In a principal-agent relationship after contracting, hidden action and hidden information play a major role in causing moral hazard, while opaque information about an agent's unknown talent can be an important factor in the reduction of moral hazard, if one considers the effects of career concerns, wherein, for example, an agent works hard without any incentive scheme, anticipating better job opportunities in the future. However, these effects have received scant attention from studies on the ranking of information systems for designing contracts. This chapter proposes a model in which there are principal-agent (incentive) problems and in which a principal can contextualise an agent's career concerns in a general distribution formulation, so as to examine the role of information structure in a manner parallel to prior work on the ranking of information systems.

In the model, the agent has unknown talent and privately takes an action. His hidden talent and action are learned through two imperfect, mutually observable signals: one is contractible and the other is non-contractible. The competitive labour market prices the value of the agent's human capital accordingly. Among them, the contractible signal can also be used for designing incentive schemes by prospective employers in the market.

The model provides a general threshold level of information structure, where the optimal incentive scheme always violates the condition for it to be non-decreasing, that is, a higher contractible signal realisation may not always imply higher compensation. The threshold indicates that even when incentive schemes are monotone non-decreasing in the contractible signal in a standard principal-agent model, it can be monotone decreasing in this model. Moreover, this chapter finds that Kim's [35] mean preserving spread (MPS) criterion, which is used for ranking information systems in terms of relative efficiency in a standard principal-agent model, can be applied to testing the monotonicity of incentive schemes in this model; however, this is only valid for a subclass of information structures that this chapter considers.

In this general distribution formulation, the conditional probability density function of the contractible signal, given the observed non-contractible signal, does not always hold the monotone likelihood ratio property (MLRP) — the property wherein higher signals represent good news, even though each signal individually holds the property and tells whether the optimal incentive scheme, on the basis of the contractible signal, can be monotone non-decreasing. The chapter generalises Gibbons and Murphy [20] and extends Dewatripont et al. [15] by drawing a general form of an agent's marginal implicit incentives from Dewatripont et al. [15] and building a principal's problem in the context of Gibbons and Murphy [20].

The central inequation in this chapter (inequation (3.8), the threshold mentioned above) is expressed in a comparison of covariances of each signal's likelihood ratio and the agent's output. The expression allows us to solve for the relationship with Kim's MPS criterion. Considering that the non-contractible signal is a candidate for observables used for designing an incentive scheme, if the information system of a non-contractible signal is more efficient than that of a contractible signal (in the sense of Kim's MPS criterion), then the optimal incentive scheme cannot be monotone non-decreasing. This condition is sufficient but not necessary for the central inequation in this chapter, which also implies that an efficient information system in a standard principal-agent model can violate the conditions for the incentive scheme to be progressive in this model.

It is important to explain how this chapter relates to prior work. This chapter is based on Gibbons and Murphy [20] in spirit. Just as Gibbons and Murphy [20] consider incentive schemes and career concern effects concurrently in a normal distribution formulation, this model represents a hybrid of those considerations in a general distribution formulation.[1] Implicit incentives that an agent makes efforts without formal incentive schemes were first recognised by Fama [16], formalised by Holmström [26] and generalised by Dewatripont et al. [15]. Dewatripont et al. [15] demonstrate that information structures on career concerns can be analogously compared to the rankings of information systems in a standard principal-agent model. The present study begins by mixing general career concerns, principal-agent problems and a first-order approach to solving the problems.

The subject of ranking information systems was first addressed by Blackwell [6]. It was introduced as a decision-maker's (statistician) ranking of experiments (sampling procedures). Gjesdal [21] analyses it as a problem of information system choice in a principal-agent problem. He shows that Blackwell's ranking is sufficient but not necessary for many principal-agent problems.[2] Holmström [25] independently proposes the informativeness criterion, which plays a leading part in information system rankings for a principal-agent problem. In essence, the informativeness criterion means that additional information should be used for designing incentive schemes until sufficient statistics are obtained, because at this point, further information does not add any news that will affect the agent's action. More recently, introducing his MPS criterion, Kim [35] has extended Holmstöm's informativeness criterion, which supposes inclusive information systems[3] by also making it available for ranking noninclusive information systems.[4] This chapter offers new insights into the literature by showing that non-contractible information might invalidate the ranking of information systems on the basis of prior work.

---

[1]Gibbons and Murphy [20] first show how incentive contracts are influenced by career concerns using the Normal-Exponential (CARA-Gaussian) model restricting linear contracts. The CARA Gaussian model, which considers both incentive contracts and career concerns, is utilised in Meyer and Vickers [41], Kaarbøe and Olsen [32], Sabac [46, 47] and Ogaku [43].

[2] Gjesdal [21] shows that Blackwell's ranking might be invalid when the agent's risk preferences depend on his actions.

[3]Inclusive information systems can be described as a vector x and a subvector $T(x)$, which are obtained by deleting some components of x.

[4]Kim [35] proves that Holmström's informativeness criterion and the MPS criterion are equivalent when the ranking is conducted between inclusive information systems.

Sufficient conditions for the incentive schemes to be non-decreasing have been investigated intensively in a standard principal-agent paradigm Grossman and Hart [22]; Rogerson [45]; Sinclair-Desgagné [52]). Grossman and Hart [22] and Rogerson [45] show that if MLRP and concavity of distribution function condition (CDFC) hold, then a second-best optimal incentive scheme satisfies the monotonicity constraint when the signal space is one dimensional. With regard to that condition in a multidimensional signal space, Sinclair-Desgagné [52] confirm that MLRP and generalised CDFE in multi-dimensional space are sufficient conditions. This chapter assumes MLRP but not CDFC; however, what makes the monotonicity invalid is non-contractible information's relative efficiency in developing a reputation in the market.

The basic model is advanced in Section 3.2. Section 3.3 presents the threshold for incentive schemes violating non-decreasing monotonicity. Section 3.4 shows how the central inequation (3.8) relates to Kim's MPS criterion. Section 3.5 provides a conclusion.

3.2 Basic Model

Consider a single-period principal-agent relationship in the competitive labour market, where a risk-averse agent with unknown talent $\theta \in \mathbb{R}$ privately takes an action $a \in A = [0, \bar{a}]$. The agent's talent and action will be learned by a set of variables $x = (y, z) \in X \subset \mathbb{R}^2$, which becomes commonly observable without cost. This chapter assumes that y is contractible, while z is not. Supposing the agent is a firm manager, examples of y are the firm's earnings and share prices. Thus, the market (prospective employers) can design the agent's incentive scheme, s, as a function of y. On the other hand, examples of z are things that are (infinitely) costly to enforce in those contractual provisions: non-financial information on social, environmental and employee matters of the firm; press reports on leadership; and the initiative or charisma of the manager, for example.

The agent is induced to raise the non-contractible signal z as well as the contractible signal y by assuming that he cares about his reputation in the market. Let the reputation be represented by the market's equilibrium expectation of the agent's talent after he/she observes the full statistic $x = (y, z)$. Let $a^* \in A$ be an equilibrium action, then the reputation is written as $t = E[\theta|x, a^*]$.

The information structure is represented by a density function $f(\theta, x|a)$, parametrised by the agent's action. The problem is whether the incentive scheme s defined in the information structure f is monotone non-decreasing.

The analysis begins by imposing the following assumptions.

Assumption 1: The agent has the following utility function:

$$U(w) - V(a), \quad U' > 0, \quad U'' < 0, \quad V' > 0, \quad V'' > 0,$$

where $w = s + t$ is the aggregation of the incentive scheme s and the reputation t, and V denotes a measure of the agent's disutility of effort.

Assumption 2: $f(\theta, x|a)$ is positive and twice continuously differentiable, and respective marginal densities are

$$\begin{aligned} h(y, \theta|a) &= \int f(\theta, x|a)dz, \\ l(z, \theta|a) &= \int f(\theta, x|a)dy, \\ \hat{f}(x|a) &= \int f(x, \theta|a)d\theta, \\ \hat{h}(y|a) &= \int \hat{f}(x|a)dz, \ \textit{and} \\ \hat{l}(z|a) &= \int \hat{f}(x|a)dy, \end{aligned}$$

where h, l, $\hat{h}$ and $\hat{l}$ are strict MLRP.

Assumption 3: The reputation $t(x) = E[\theta|x, a^*]$ is additively separable in y and z, i.e. $t(x) = A(y) + B(z)$, and strictly increasing in y and z.[5] Let $\tilde{s}(y) = s(y) + A(y)$.

[5]Some examples of random variables that satisfy Assumption 3 are as follows. Suppose θ, y and z are all normally distributed. Then, $t(x)$ is a linear function of y and z. Suppose y and z are positively correlated with θ. Then, $t(x)$ is strictly increasing in y and z.

Note that $\tilde{s}(y)$ in Assumption 3 is the agent's overall reward from the contractible variable y and is used in the prospective employers' problem explained below because the prospective employers cannot control the non-contractible signal z by definition.

In the competitive labour market, the prospective employers are supposed to be wage takers, i.e. they compete, resulting in the optimal reward $\tilde{s}(y)$ maximising the agent's expected utility. The optimal $\tilde{s}$ is a solution of the problem:

$$\max_{\tilde{s},a} \int (U(w) - V(a))\, \hat{f}(x|a)dx \tag{3.1}$$

subject to

$$\int \Big(y + \int \theta \frac{f(x,\theta|a^*)}{\hat{f}(x|a^*)} d\theta - w \Big) \hat{f}(x|a)dx = 0 \quad and \tag{3.2}$$

and

$$\int U(w)\hat{f}_a dx = V'(a), \tag{3.3}$$

where (3.2) reflects the restriction that the contract must earn zero expected profit for the principal. In other words, this is the participation constraint for the agent; the principal must offer the agent the expected reward w at least as high as the agent's expected outcome y and talent $t = E[\theta|x, a^*] = \int \theta \frac{f(x,\theta|a^*)}{\hat{f}(x|a^*)} d\theta$. Also, (3.3) represents the incentive constraint. Let the agent's expected utility $M(a) \equiv \int (U(w) - V(a))\, \hat{f}(x|a)dx$. Here, (3.3) is a relaxed constraint of $a \in \arg\max_{\hat{a}\in A} M(\hat{a})$, and this approach is called the first-order approach.[6] Also, (3.3) represents a stationary point for the agent, i.e. $M'(a) = 0$. In order to guarantee that the point be the agent's optimal action choice, it is supposed that $M(a)$ is strictly concave, i.e. $M''(a) < 0$ for all $a \in A$. Consider the Lagrangian form obtained by assigning undetermined multipliers λ and μ to (3.2) and (3.3):

$$\begin{aligned} L(\tilde{s}, a) = &\int (U(w) - V(a))\, \hat{f}(x|a)dx \\ &+ \lambda \int \Big(y + \int \theta \frac{f(x,\theta|a^*)}{\hat{f}(x|a^*)} d\theta - w \Big) \hat{f}(x|a)dx + \mu \Big(\int U(w)\hat{f}_a dx - V'(a) \Big). \end{aligned}$$

[6]Grossman and Hart [22], Rogerson [45] and Sinclair-Desgagné [52] show that MLRP and CDFC are sufficient for the validity of the first-order approach.

Differentiating with respect to the scalar a and the function w,[7] one obtains the first-order conditions as follows:

$$\frac{\partial L}{\partial a} = M'(a) + \lambda \int \Big(y + \int \theta \frac{f(x,\theta|a^*)}{\hat{f}(x|a^*)} d\theta - w \Big) \hat{f}_a(x|a)dx + \mu M''(a) = 0,$$

i.e.

$$\mu = -\lambda M''(a)^{-1} \int \Big(y + \int \theta \frac{f(x,\theta|a^*)}{\hat{f}(x|a^*)} d\theta - w \Big) \hat{f}_a(x|a)dx, \tag{3.4}$$

and

$$\frac{\partial L}{\partial \tilde{s}} = U'(w)\hat{f} - \lambda \hat{f} + \mu U'(w)\hat{f}_a = 0,$$

i.e.

$$\frac{\lambda}{U'(w)} = \left(1 + \mu \frac{\hat{f}_a}{\hat{f}} \right). \tag{3.5}$$

Substituting the equilibrium effort $a = a^*$, μ in (3.4) can be written as

$$\mu = -\lambda M''(a^*)^{-1} \left(cov(y, \frac{\hat{h}_a}{\hat{h}}) - cov(s(y), \frac{\hat{h}_a}{\hat{h}}) \right). \tag{3.6}$$

3.3 Monotonicity of optimal incentive schemes

Let $s_f(y)$ be the optimal incentive scheme that depends on the information structure f and satisfies (3.4) and (3.5).

Observation 1. If $\mu > 0$ and $\frac{\partial}{\partial y}\left(\frac{\hat{f}_a}{\hat{f}}\right) \geq 0$, then

$$w_y \geq 0 \quad \forall y$$

and the equation is satisfied only if $\frac{\partial}{\partial y}\left(\frac{\hat{f}_a}{\hat{f}}\right) = 0$ is satisfied.

[7] A variation method is used with regard to w.

Proof. Differentiating (3.5) with respect to y, one obtains the following.

$$-\lambda \frac{U''}{(U')^2} w_y = \mu \frac{\partial}{\partial y}\left(\frac{\hat{f}_a}{\hat{f}}\right). \tag{3.7}$$

Let the first-best reward when the agent's incentive constraint in (3.3) is not considered be w_λ. w_λ must satisfy $\lambda = U'(w_\lambda)$. Since $U' > 0$ from Assumption 1, $\lambda > 0$ must be satisfied. With Assumption 1, Assumption 2 and $\lambda > 0$, (3.7) implies $w_y \geq 0$ and the equation is satisfied only if $\frac{\partial}{\partial y}\left(\frac{\hat{f}_a}{\hat{f}}\right) = 0$ is satisfied. □

Proposition 1. Suppose Assumption 1 holds. Then, any μ satisfying (3.3) and (3.5) is positive.

The proof is in the Appendix.

Observation 1 and Proposition 1 immediately provide the following corollary.

Corollary 1. $s_f(y)$ violates non-decreasing monotonicity if the contractible signal y is noninformative in the sense of Holmström [25], i.e. there exists function $m : X \to \mathbb{R}$ such that for all (z, a), the density $\hat{f}$ can be factorised according to

$$\hat{f}(x|a) = m(y, z)\hat{l}(z|a).$$

Proof. The equality

$$\hat{f}(x|a) = m(y, z)\hat{l}(z|a)$$

implies

$$\frac{\hat{f}_a}{\hat{f}} = \frac{\hat{l}_a}{\hat{l}}.$$

Thus, one has

$$\frac{\partial}{\partial y}\left(\frac{\hat{f}_a}{\hat{f}}\right) = 0.$$

From the above equation, Observation 1 and Proposition 1, one has $w_y = 0$. From Assumption 3, $s_f(y)' < 0$ is implied. □

The proof of Corollary 1 demonstrates that Holmström's [25] informativeness criterion does not consider the case of $w_y < 0$. That is, an additional signal y is informative as long as it conveys information about an optimal reward/penalty on the basis of y. Thus, the converse of Corollary 1 is false.

Corollary 1 is straightforward: when contractible signals are uninformative, their information systems do not hold a condition in which the incentive schemes are non-decreasing. The following proposition provides the threshold that $s_f(y)$ fails to hold non-decreasing monotonicity.

Proposition 2. $s_f(y)$ violates non-decreasing monotonicity if

$$cov(\frac{\hat{l}_a}{\hat{l}}, y) \geq cov(\frac{\hat{h}_a}{\hat{h}}, y). \tag{3.8}$$

The proof is in the Appendix.

Corollary 2. The converse of Proposition 2 is false.

Proof. Suppose $w_y = 0$. Then $s_f(y)' = \frac{\partial}{\partial y} E[\theta | x, a^*]$. From Assumption 3, $s_f(y)' > 0$. □

The central inequation (3.8) means that the conditional probability density function of the contractible signal y, given the observed non-contractible signal z, does not hold the MLRP, although the probability density function of y, $\hat{h}$, independently holds the property. In other words, this applies when y is good news about the agent's effort but bad news if z is observed beforehand. The central inequation (3.8) can be used for testing whether the incentive schemes of information systems can be monotone non-decreasing, that is, whether fixed payments are preferable.

Example 1. Let signals be

$$y = \theta + pa + \varepsilon, \quad y \sim N(\bar{\theta} + pa, \sigma_\theta^2 + \sigma_\varepsilon^2), \quad p \in (0, 1)$$
$$z = \theta + a + \nu, \quad z \sim N(\bar{\theta} + a, \sigma_\theta^2 + \sigma_\nu^2).$$

Then, covariances are given by

$$cov\left(\frac{\hat{l}_a(z|\hat{a})}{\hat{l}(z|\hat{a})}, y\right) = \frac{\sigma_\theta^2}{\sigma_\theta^2 + \sigma_\nu^2}$$
$$cov\left(y, \frac{\hat{h}_a(y|\hat{a})}{\hat{h}(y|\hat{a})}\right) = p,$$

and w_y is given by

$$w_y = \frac{cov\big(y, \frac{\hat{h}_a(y|\hat{a})}{\hat{h}(y|\hat{a})}\big) - cov\big(\frac{\hat{l}_a(z|\hat{a})}{\hat{l}(z|\hat{a})}, y\big)}{Var(y|z,a)}.$$

The sign of w_y can be positive and negative depending on the covariance relation of likelihood ratios. The fact that normal distributions do not obey CDFC implies that the monotonicity of incentive schemes in this model is independent of CDFC.

The central inequation in (3.8) in Example 1 is written as

$$p \leq \frac{\sigma_\theta^2}{\sigma_\theta^2 + \sigma_\nu^2}\ (< 1),$$

where p denotes the marginal impact of the agent's action on y, σ_θ^2 is the variance of the agent's talent and σ_ν^2 is the variance of z's noise term. It implies that (3.8) holds when z is more responsive to the agent's action than y, i.e. $1 > p$, and both signals convey opaque information about the agent's talent, but z's noise term is small.

3.4 Relationship with MPS Criterion

Next, this section shows how the central inequation in (3.8) relates to Kim's MPS criterion. For completeness, this section restates Kim's result:

MPS Criterion: Assuming that the first-order approach is valid,[8] the information system $\hat{l}$ is more efficient than $\hat{h}$ at $a = \hat{a}$ if the random variable $\frac{\hat{l}_a(z|\hat{a})}{\hat{l}(z|\hat{a})}$ is a mean

[8]This section interprets the assumption of the validity of the first-order approach as the validity in terms of $\hat{l}$ and $\hat{h}$, separately.

preserving spread of $\frac{\hat{h}_a(y|\hat{a})}{\hat{h}(y|\hat{a})}$. That is,

$$\int^{y} L_l^a(t)dt \geq \int^{y} L_h^a(t)dt \quad for \quad all \quad y \in \mathbb{R} \tag{3.9}$$

with the strict inequality holding for some range of $y \in \mathbb{R}$ with positive measure, where L_l^a and L_h^a are the cumulative distribution function of $\frac{\hat{l}_a(z|\hat{a})}{\hat{l}(z|\hat{a})}$ and $\frac{\hat{h}_a(y|\hat{a})}{\hat{h}(y|\hat{a})}$, respectively.

Interestingly, (3.9) implies that $\{\frac{h_a}{h}, \frac{l_a}{l}\}$ can be seen as a martingale. This section refers to a purely technical result from the literature on stochastic orders.

Lemma 1. [Shaked and Shanthikumar [49], Theorem 3.A.1 and Theorem 3.A.4]

$$(3.9) \text{ holds} \Leftrightarrow \frac{\hat{h}_a(y|\hat{a})}{\hat{h}(y|\hat{a})} \leq_{\text{cx}} \frac{\hat{l}_a(z|\hat{a})}{\hat{l}(z|\hat{a})} \Rightarrow \left\{ \frac{\hat{h}_a(y|\hat{a})}{\hat{h}(y|\hat{a})}, \frac{\hat{l}_a(z|\hat{a})}{\hat{l}(z|\hat{a})} \right\} \text{ is a martingale,}$$

that is

$$\frac{\hat{h}_a(y|\hat{a})}{\hat{h}(y|\hat{a})} = E\left[\frac{\hat{l}_a(z|\hat{a})}{\hat{l}(z|\hat{a})} \middle| y \right]. \tag{3.10}$$

Proof of Lemma 1 is found in Shaked and Shanthikumar [49].[9]

Kim's MPS criterion is originally used for ranking information systems for incentive schemes, and $\hat{l}$ is the probability density function of the non-contractible signal z, but following corollary temporally considers $\hat{l}$ as if a candidate of information systems for incentive schemes, in order to compare $\hat{l}$ and $\hat{h}$ in terms of their relative efficiency in overall incentive problems.

Corollary 3. If information system $\hat{l}$ is more efficient than $\hat{h}$ in the sense of Kim's MPS criterion, then $s_f(y)$ violates non-decreasing monotonicity.

[9] Dewatripont et al. [15] and Shaked and Shanthikumar [49] document that the MPS criterion is necessary and sufficient for the martingale property. This section uses only the sufficiency condition.

Proof.

$$
\begin{aligned}
cov\left(\frac{\hat{l}_a(z|\hat{a})}{\hat{l}(z|\hat{a})}, y\right) &= \int\int y\frac{\hat{l}_a(z|\hat{a})}{\hat{l}(z|\hat{a})} f(y,z)dydz \\
&= \int\int y\frac{\hat{l}_a(z|\hat{a})}{\hat{l}(z|\hat{a})} k(z|y)h(y)dydz \\
&= \int yh(y)\int \frac{\hat{l}_a(z|\hat{a})}{\hat{l}(z|\hat{a})} k(z|y)dzdy \\
&= cov\left(y, E\left[\frac{\hat{l}_a(z|\hat{a})}{\hat{l}(z|\hat{a})}\middle| y\right]\right) \\
&= cov\left(y, \frac{\hat{h}_a(y|\hat{a})}{\hat{h}(y|\hat{a})}\right) \ (\because \text{ Lemma 1.})
\end{aligned}
$$

From Proposition 2, $s_f(y)$ violates non-decreasing monotonicity. □

Corollary 4. The converse of Corollary 3 is false.

Proof. Suppose $cov\left(y, \frac{\hat{l}_a(z|\hat{a})}{\hat{l}(z|\hat{a})}\right) > cov\left(y, \frac{\hat{h}_a(y|\hat{a})}{\hat{h}(y|\hat{a})}\right)$. From the proof of Corollary 3, it implies information system $\hat{l}$ is not more efficient than $\hat{h}$ in the sense of MPS criterion. □

In words, Corollary 3 and 4 indicate that Kim's MPS criterion is sufficient but not necessary for the central inequation in (3.8). This implies that if there exists $\hat{l}$ that is more efficient than $\hat{h}$, $\hat{h}$ can no longer be an information system that holds a primary condition in which incentive schemes are monotone non-decreasing. Moreover, even if $\hat{h}$ is more efficient than $\hat{l}$ in Kim's MPS criterion, $\hat{h}$ is not an information system that holds the incentive scheme's non-decreasing monotonicity when (3.8) holds.

3.5 Conclusion

This chapter has shown that efficient information systems can fail to hold their primary condition in which incentive schemes are monotone non-decreasing in a principal-agent relationship, considering the assistance of a labour market. Because the agent will devote himself to raising one signal that is more responsive to his action than the other, if the non-contractible signal excessively invites the agent's attention, then optimal incentive schemes, on the basis of the contractible signal, are not monotone non-decreasing.

One important implication from this chapter is that the efficiency of an information system may depend on non-contractible signals. In extreme circumstances, non-contractible signals might invalidate rankings of information systems for a standard agency paradigm.

The principal-agent theory has been developed by departing from theories of market forces. More recent work, however, handles a situation in which both incentive problems and market forces are considered. This chapter provides new insight into the literature on ranking information systems in a principal-agent model and shows that such hybridisation opens up new avenues for the research on moral hazard.

For brevity, this chapter has restricted the above analysis to the case where each signal (contractible and non-contractible) is defined in terms of scalar random variables satisfying MLRP. However, this chapter's results can be generalised so as to consider situations in which vector random variables are suitable.

Appendix

Proof of Proposition 1.

Proof. The proof is similar to Lemma 1 of Jewitt [30]. Substituting (3.5) into (3.3), one obtains

$$\int U(w)\Big(\frac{\lambda}{U'(w)} - 1\Big)\hat{f}dx = \mu V'(a). \tag{3.11}$$

Using the fact that $E\left[\frac{\hat{f}_a}{\hat{f}}\right] = 0$, (3.5) gives

$$E\Big[\frac{\lambda}{U'(w)}\Big] = 1. \tag{3.12}$$

(3.12) implies that the covariance of $U(w)$ and $\frac{\lambda}{U'(w)}$ is equal to $\mu V'(a)$. Since one knows that $\lambda > 0$ from (3.5), $U(w)$ and $\frac{\lambda}{U'(w)}$ are monotone increasing and their covariance is positive. Since $V'(a)$ is positive, one knows that $\mu > 0$. □

Proof of Proposition 2.

Proof. $\hat{f}(x|a)$ can be rewritten as

$$\begin{aligned}\hat{f}(x|a) &= m(y|z,a)\hat{l}(z|a),\\ &= k(z|y,a)\hat{h}(y|a),\end{aligned}$$

where $m(y|z,a)$ is a density function of y conditioned by (z,a), and $k(z|y,a)$ is a density function of z conditioned by (y,a). Since

$$\frac{\partial}{\partial y}\left(\frac{\hat{f}_a}{\hat{f}}\right) = \frac{\partial}{\partial y}\left(\frac{m_a}{m}\right),$$

and from Observation 1 and Proposition 1 one knows that $\frac{\partial}{\partial y}\left(\frac{m_a}{m}\right)$ and w_y are of the same sign. $\frac{m_a}{m}$ can be written as

$$\frac{m_a}{m} = \frac{k_a}{k} + \frac{\hat{h}_a}{\hat{h}} - \frac{\hat{l}_a}{\hat{l}}.$$

Note that $cov(\frac{k_a}{k}, y) = 0$. Thus,

$$cov(\frac{m_a}{m}, y) = cov(\frac{\hat{h}_a}{\hat{h}}, y) - cov(\frac{\hat{l}_a}{\hat{l}}, y).$$

If $cov(\frac{\hat{l}_a}{\hat{l}}, y) \geq cov(\frac{\hat{h}_a}{\hat{h}}, y)$ holds, the above equation tells that $\frac{m_a}{m}$ is negatively correlated with y and $\frac{\partial}{\partial y}\left(\frac{m_a}{m}\right) > 0$ have to be denied. Hence, $s_f(y)$ violates non-decreasing monotonicity. □

Chapter 4

Would Shareholders in Firms with Japanese Governance Mechanisms Benefit from the Use of Annual Incentive Plans?

> The recent dismissal of the British chief executive of Olympus has once again drawn the attention of European media to peculiarities in corporate governance in Japan. Accounting practices and lack of transparency have aroused particular concern. (Cortazzi [11], pg. 15)

4.1 Introduction

This chapter studies the economic consequences of the choice of two different types of executive compensation contracts and examines whether shareholders in firms with Japanese governance mechanisms would benefit from the use of annual incentive plans.

This article is based on my paper, Ogaku [42], "Would shareholders in firms with Japanese governance mechanisms benefit from the use of annual incentive plans," *Journal of Management Accounting, Japan*, Supplement 2.

Japanese governance mechanisms are usually characterized as bank- and relationship-oriented, while Anglo-Saxon governance mechanisms are perceived as market-oriented. There are pros and cons of Japanese governance mechanisms. According to some observers, Japanese governance mechanisms give internal management autonomy, and management's degree of freedom from bank control has a close positive correlation with the level of corporate profit (e.g., Aoki [1]). In contrast, others view the lack of transparency as one of the major obstacles to investment (e.g., Schulz [48]; Jones [31]). Obviously, the internal management autonomy is a double-edged blade. As Jones [31, pg. 12] comments,

> ...[it may result in] corporate decisions that are incomprehensible to outsiders. This tendency can sometimes manifest itself in a course of systematic lying to outside shareholders through falsified accounts or other deliberate misinformation. ...Corporate scandals like Olympus are thus seized upon as yet another example of bad "Japanese-style" management systems.

Implementation of performance-based compensation contracts is expected to provide a major improvement in transparency. Currently, performance-based compensation is exempted from Japanese corporate taxation by Corporate Tax Act No. 34. Until this act was passed, the Japanese executive compensation system was starkly different from those of western counterparts. Even a reasonable allowance for salaries, which is tax deductible under Section 162 of the U.S. Internal Revenue Code, for instance, was not allowed as a deduction under Japanese corporate tax law. The amendment made the Japanese executive compensation system more easily understandable to people in western countries and allowed tax deductibility of performance-based compensation, regular period compensation (e.g., salary), and pre-determined compensation.[1] It is fair to say that performance-based compensation is exempted from corporate taxation in order to encourage firms to change their discretionary bonus contract practice to a performance-based one that appears more market-oriented.

[1] Extra compensation qualifies as performance-based or pre-determined compensation if it was paid on the basis of performance measures that appear in a firm's financial reporting or if it was declared to the tax office before the execution of a contract.

Somewhat ironically, discretionary bonuses continued to be used considerably after the introduction of the current terms of Corporate Tax Act No. 34. According to the Tokyo Stock Exchange (TSE), 87.1% of TSE-listed companies responded that they have initiatives to offer incentives (Tokyo Stock Exchange [55]). Performance-based compensation was introduced in 19.7% of the TSE-listed companies, and stock option plans and "others" were introduced in 31.4% and 45.2% of the TSE-listed companies, respectively. Out of 1,038 companies that selected "others", 50.4% referred to either "remuneration" or "bonus" in their supplementary explanation of initiatives. This suggests that each year, several firms revised the salary component of their executive compensation on the basis of the performance of the previous period, although some of the salary component may be regarded as a discretionary bonus.

Several Japanese firms continue using an opaque bonus contract practice, contrary to what authorities might have expected. However, Japanese firms have typically used rank hierarchy as a primary incentive device (Aoki [1]). Therefore, rewards might not be paid on the basis of performance measures, but instead are paid on the basis of rank (Shirai and Inoue [51]). Thus, it is not obvious that a performance-based contract improves Japanese executives' work incentives. In other words, it is not known whether a performance-based contract reduces moral hazard problems in Japanese governance mechanisms because these mechanisms may already motivate executives to work hard.

The empirical evidence on the impact of the firms' choice of executive compensation contract is ambiguous. Kaplan [33] studies top executive compensation and its relationship with firm performance in the largest Japanese and U.S. companies, and finds that the relationship between executive compensation and performance in Japan and the U.S. are statistically similar, although the corporate governance mechanisms in those countries are considered significantly different from each other. These results are supported by Kato [34] and Basu et al. [4]. They identify that CEOs of keiretsu members earn less than those of independent firms, and keiretsu could play a role as an effective Japanese governance mechanism. On the other hand, Core et al. [10] find that U.S. firms with weaker governance mechanisms had greater agency problems. Finally, Basu et al. [4] find that Japanese firms with weaker governance mechanisms, in particular firms with higher insider ownership, have greater agency problems.

Motivated by the mixed empirical findings, this chapter theoretically studies the consequences of the choice of two different types of executive compensation contracts. The analysis is based on a career concerns model in which compensation contracts are subject to renegotiation; compensation is paid on the basis of the agent's earnings report (e.g., a performance-based contract) or a non-verifiable measure within the firm (e.g., a conventional implicit contract). Career concerns were first formalized by Holmström [26]. Gibbons and Murphy [20] and Meyer and Vickers [41] develop dynamic models with explicit contracts based on the career concerns model of Holmström [26] and enable analyses of the interplay between implicit dynamic incentives and explicit incentives. Kaarbøe and Olsen [32] extend the work of Meyer and Vickers [41] by adding distorted performance measures based on the multi-task agency model of Feltham and Xie [17]. Kaarbøe and Olsen [32] come closest to this chapter's models; however, this chapter takes a different approach when modeling distorted performance measures. Instead of using the weights given to a performance measure as a degree of distortion, this chapter uses biases that the agent can introduce into his earnings report in order to inflate his performance evaluation. This chapter follows the work of Fischer and Verrecchia [18] when modeling the agent's biased reporting.

This chapter also relates to the literature on relational contracts (e.g., Bull [7]; Baker et al. [2]; Levin [38]; MacLeod [40]). For example, Baker et al. [2] consider subjective performance measures in implicit contracts and their model is similar in spirit to the one in this chapter; however, the contract they consider is one in which a worker anticipates that the employer could renege on a promise if their contract is implicit, and they focus on the role of trust in enforcing implicit contracts. This chapter assumes that Japanese firms' discretionary bonus contracts are driven by career concerns as compared to trust.

In the first of two main results, this chapter shows that the conventional implicit contract can dominate the performance-based contract if the agent's bargaining power is moderate and the non-verifiable measure within the firm is sufficiently informative, making it unlikely that the agent's earnings report will trigger renegotiation for the second-period compensation contract. On the other hand, the second result shows that the performance-based contract is optimal if the non-verifiable measure is not sufficiently informative and the agent's bargaining power is considerably strong. One interpretation of these results complements Aoki's [1, pg. 12] description of the way in which rank hierarchy works as an incentive:

> The existence of a credible threat of discharge when the employee does not meet the criteria for continual promotion plays an important role in enabling the rank hierarchy to operate as an effective incentive to curb shirking. A discharge in mid-career may point to some negative attributes of the discharged so that he or she may not be able to gain equivalent rank outside, when information about him or her is not perfect.

In these terms, the main results show that explicit contracts are not required when executives have concerns that they may not be able to gain equivalent rank outside and when information about them is not verifiable outside.

The remainder of this chapter is organized as follows: Section 4.2 explains the model assumptions and derives the optimal contract in equilibrium. Section 4.3 theoretically addresses whether the shareholders in Japanese firms would benefit from the use of annual incentive plans. Section 4.4 provides the conclusion.

4.2 Model

4.2.1 Model Assumptions

Consider a two-period agency model with a risk neutral board of directors (the principal) and a risk neutral and effort averse manager (the agent), who run the business on behalf of the shareholders (the owner). Although shareholders are not active players, the chapter assumes their presence. This is in order to emphasize the fact that non-verifiable measures, which play an important role in this analysis, are observed only by the contracting parties.

The key feature of this analysis is the consideration of two types of executive compensation contracts: conventional implicit contracts and performance-based contracts. At $t = 0$, the principal selects one of these two types of contracts and provides a take-it-or-leave-it offer. The initial contract commits both parties to stay in the relationship for two periods, but does not preclude the possibility that the principal may reset the terms of the contract, and in turn, the agent may terminate the employment relationship in the case of a breakdown in renegotiation for the second period contract.However, to ease exposition, once selected (and accepted by the agent), it is assumed that the form of contract is not allowed to change for two periods. However, the parameters may change.

Figure 4.1 presents the timeline. At $t = 0$, a compensation contract is signed between the principal and the agent. During the first period, the agent's effort a_1 generates stochastic cash flow v_1. The realized value of the cash flow is not directly observable to anybody except the agent. After observing v_1, the agent provides his earnings report r_1, which is potentially distorted by his bias b_1. In addition to the agent's earnings report, the contracting parties (but not the shareholders) may observe the non-verifiable measure s_1, which is useful for subjective assessments of the agent's contribution to the value of the cash flow. At $t = 1$ the principal and the agent renegotiate the second-period contract w_2. The sequence of events is repeated in the second period except that at the end of period two, no further contract negotiation takes place. At that point, shareholders consume the residual income.

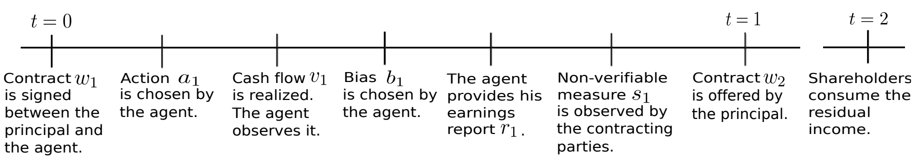


FIGURE 4.1: Timeline

In the conventional implicit contract, compensation $\bar{w}_t$ is assumed to consist of only fixed payments, and the agent is motivated to work hard by career concerns. The principal uses information about the agent's current performance $\boldsymbol{x}_t = (r_t, s_t)'$ to update her beliefs about the agent's ability, where $\boldsymbol{x}_t$ is a column vector composed of the earnings report r_t and the non-verifiable measure s_t. s_t is the realization of the random variable $\tilde{s}_t$ which is given by

$$\tilde{s}_t = a_t + \tilde{\eta} + \tilde{\zeta}_t,$$

where $a_t \in \mathbb{R}$ denotes the agent's effort in period t. The agent's effort is not observable by the principal (and shareholders). $\tilde{\eta}$ and $\tilde{\zeta}_t$ are two independent normally distributed random variables. It is assumed that $\tilde{\eta}$ has mean $E[\tilde{\eta}] > 0$ and variance σ_η^2 and $\tilde{\zeta}_t$ has mean zero and variance σ_ζ^2. $\tilde{\eta}$ represents a manager's unknown ability, which is related to the agent's contribution. $\tilde{\zeta}_t$ represents errors in the assessment of the agent's contribution. The realized s_t is common knowledge to the contracting parties, but not verifiable to a third party. This assumption corresponds closely with the Japanese firms' discretionary bonus contract practice in which the salary component in executive compensation is revised on the basis of a subjective assessment (from shareholders' perspective) in the previous period. On the other hand, in the performance-based contract, compensation w_t^{per} is assumed to be composed of fixed payments and variable (earnings-report-based) payments.

$$w_t^{per} = \bar{\alpha}_t + \beta_t r_t, \tag{4.1}$$

where $\bar{\alpha}_t \geq 0$ is the fixed payment for period t and $\beta_t > 0$ is an incentive coefficient for period t. This assumption corresponds exactly with performance-based compensation in Corporate Tax Act No. 34. It is assumed that the non-verifiable measure is not available when the performance-based contract is selected, and information available for the principal to update her beliefs is $\boldsymbol{x}_t = r_t$.

The firm's cash flow in each period results from the agent's effort and ability and a random factor. The firm's cash flow in period t is given by the following expression:

$$v_t = a_t + \eta + \varepsilon_t,$$

where η is the agent's actual, unknown ability, ε_t is the realization of a normally distributed random variable $\tilde{\varepsilon}_t$ with mean zero and variance σ_ε^2. $\tilde{\varepsilon}_t$ denotes the impact of uncontrollable events on a firm's cash flow. Let $\tilde{\varepsilon}_t$ be independent of $\tilde{\eta}$ and of $\tilde{\zeta}_t$. The realization of the cash flow in each period v_t is not directly observable to anybody except the agent until the end of the second period; however, the functional form of $\tilde{v}_t$ and the distributions of noise and the agent's ability are common knowledge.

Observing the realization of the cash flow, the agent provides an earnings report to the principal (and shareholders). The earnings report for period t is potentially biased, as follows:

$$r_t = v_t + b_t,$$

where $b_t \in \mathbb{R}$ represents the bias introduced by the agent into the earnings report. b_t is not directly observed by the principal (and shareholders).

The agent is risk neutral and effort averse. It is assumed that exerting effort (both constructive and destructive, i.e., a_t and b_t) causes the agent to incur a private cost of $c(a_t, b_t)$. The cost function is given by

$$c(a_t, b_t) = \frac{a_t^2}{2} + \frac{c \cdot b_t^2}{2}.$$

c is a known positive parameter and denotes the marginal impact of effort for providing a biased report on the agent's private cost. To reduce the number of parameters, the marginal impact of productive effort a_t is assumed to be 1. When period t compensation is offered as w_t, the agent's objective function is given as

$$CE = E[\tilde{w}_1 + \tilde{w}_2] - c(a_1, b_1) - c(a_2, b_2). \tag{4.2}$$

Compensation w_t may be a random variable when it depends on performance measures that include random variables. The principal is risk-neutral, and her objective function can be stated as

$$E[\tilde{v}_1 + \tilde{v}_2] - E[\tilde{w}_1 + \tilde{w}_2]. \tag{4.3}$$

In order to make a contract, the principal considers two types of constraints. The first type consists of the incentive constraints: the agent will choose a_t and b_t to maximize his expected utility. The second type consists of participation constraints: the principal must offer the agent expected utility at least as high as the agent's reservation wage. Following Meyer and Vickers [41], the agent's reservation wage depends on the total expected surplus. Let the total expected surplus at the start of the contract be Π:

$$\Pi = E[\tilde{v}_1 + \tilde{v}_2] - c(a_1, b_1) - c(a_2, b_2). \tag{4.4}$$

If the agent's bargaining power is $B \in (0,\ 1)$, his reservation wage is $B\Pi$ and the first-period participation constraint is given by

$$CE \geq B\Pi. \tag{4.5}$$

Throughout the chapter it is assumed that the principal commits to satisfying the agent's participation constraints not only at the initial contract but also at the time of renegotiation.[2]

Setting the participation constraint in (4.5) as an equality[3], the principal's objective function in (4.3) can be simplified as follows:

$$E[\tilde{v}_1 + \tilde{v}_2] - c(a_1, b_1) - c(a_2, b_2) - B\Pi = (1 - B)\Pi. \tag{4.6}$$

Note that $(1 - B)$ is always positive.

4.2.2 Conventional Implicit Contracts

This section presents the model's solution assuming that the conventional implicit contract is selected. The modeling is based on the career concerns model of Holmström [26]. First, the optimal contract in the second period is characterized.

[2] As Meyer and Vickers [41] point out in their footnote 9, models along the lines of the career concerns literature with a participation constraint of this form need to recognize the possibility that (i) if the agent ' s expected productivity after the first period is extremely low, his efficient choice at that point is to change firms, and (ii) the agent may initially plan to leave after the end of the first period (take-the-money-and-run strategy). However, these possibilities are negligible as long as his ex ante expected outputs at the first-period firm are sufficiently larger than those at other firms, or the agent is to receive a sufficiently large lump-sum payment in the second period for remaining with his first-period firm. For example, the first-period fixed payment may be paid at the beginning of the second period.

[3] The equality is satisfied under the optimal contract. Because the principal initiates a negotiation, she will set compensation w_t at the lowest level at which the agent is willing to accept the contract, i.e., $CE = B\Pi$. On the other hand, when $CE = B\Pi$ is satisfied, the participation constraints and the agent's outside opportunities give him the same level of expected utility. Because it is a take-it-or-leave-it offer and this chapter supposes that the agent will not choose outside opportunities that give the same expected utility as the principal's offer, the agent will accept the principal's offer.

At the start of the second period the principal maximizes her share of the total amount of second-period expected surplus:

$$(1-B)\Pi_2 = (1-B)\left\{E[\tilde{v}_2|\boldsymbol{x}_1] - c(\hat{a}_2, \hat{b}_2)\right\}, \tag{4.7}$$

subject to the following two constraints:

$$\begin{aligned} a_2, b_2 &\in \arg\max_{a_2', b_2'}\{E[\tilde{w}_2|\boldsymbol{x}_1] - c(a_2', b_2')\}, && (4.8)\\ E[\tilde{w}_2|\boldsymbol{x}_1] - c(a_2, b_2) &\geq B\Pi_2, && (4.9) \end{aligned}$$

where $\hat{a}_t$ and $\hat{b}_t$ are the principal's belief about the equilibrium amount of effort and bias, respectively. The constraint in (4.8) is the incentive constraint and the constraint in (4.9) is the agent's participation constraint.

From the principal's perspective, the total surplus Π_2 can be rewritten as

$$\Pi_2^{con} = E[\tilde{v}_2] + \rho_{r1}^d(r_1 - E[\tilde{r}_1|\hat{a}_1, \hat{b}_1]) + \rho_{s1}(s_1 - E[\tilde{s}_1|\hat{a}_1]) - c(\hat{a}_2, \hat{b}_2). \tag{4.10}$$

ρ_{r1}^d reflects the marginal impact of the first-period earnings report r_1 on the principal's belief about the second-period cash flow. Similarly, ρ_{s1} reflects the marginal impact of the first-period non-verifiable measure s_1 on the principal's belief about the second-period cash flow. The exact expressions for the regression coefficients ρ_{r1}^d and ρ_{s1} are contained in Appendix A. It is noted that $\rho_{r1}^d, \rho_{s1} \in (0,\ 1)$ and $\rho_{r1}^d + \rho_{s1} < 1$.

To determine the agent's optimal effort choice, recall that compensation $\tilde{w}_2$ in (4.8) is defined as a fixed payment. Because the agent's efforts do not impact compensation, his optimal effort choice is $a_2 = b_2 = 0$.

Considering the agent's bargaining power, the principal offers a contract to satisfy the participation constraint. Setting (4.9) as an equality and substituting $a_2 = b_2 = 0$, $\bar{w}_2$ is given by

$$\bar{w}_2^{con}(\boldsymbol{x}_1) = BE[\tilde{v}_2|\boldsymbol{x}_1]. \tag{4.11}$$

The symbol "*con*" is used to denote that it is satisfied in the optimal conventional implicit contract. Note that the second-period contract $\bar{w}_2^{con}(\boldsymbol{x}_1)$ in (4.11) depends on

$\boldsymbol{x}_1 = (r_1, s_1)'$. This comes from the fact that the principal updates her belief about the agent's ability $\tilde{\eta}$ by observing $\boldsymbol{x}_1$. Thus, $\bar{w}_2^{con}(\boldsymbol{x}_1)$ gives an implicit incentive to the agent in the first period, i.e., career concerns are present in the first period. Recall that $\bar{w}_2^{con}(\boldsymbol{x}_1)$ does not give any incentive to the agent in the second period, i.e., $a_2 = b_2 = 0$. Thus, both the earnings report and the non-verifiable measure are used to provide only implicit incentives in the conventional implicit contract.

The first-period problem is solved in a similar manner. The principal's problem at $t = 0$ is to maximize her objective function in (4.6) subject to the participation constraint in (4.5) and the incentive constraint

$$a_1, b_1 \in \arg\max_{a_1', b_1'} \{CE\}. \tag{4.12}$$

Because the second-period compensation $\bar{w}_2^{con}(\boldsymbol{x}_1)$ in (4.11) depends on $\boldsymbol{x}_1 = (r_1, s_1)'$, the agent has an incentive to exert effort in the first period to increase $\bar{w}_2^{con}(\boldsymbol{x}_1)$. Thus, the agent's incentive constraint can be rewritten as

$$a_1, b_1 \in \arg\max_{a_1', b_1'} \{\bar{w}_2^{con}(\boldsymbol{x}_1) - c(a_1', b_1')\},$$

for which the solution is

$$a_1^{con} = B(\rho_{r1}^d + \rho_{s1}), \tag{4.13}$$

$$b_1^{con} = \frac{1}{c} B \rho_{r1}^d. \tag{4.14}$$

Setting (4.5) as an equality, $\bar{w}_1$ is given by

$$\bar{w}_1^{con} = B\left(a_1^{con} + E[\eta]\right) + (1 - B)c(a_1^{con}, b_1^{con}). \tag{4.15}$$

Substituting compensations in (4.11) and (4.15) and the agent's induced efforts, the total expected surplus for the conventional implicit contract Π^{con} is given by

$$\Pi^{con} = -\frac{1}{2}\left[(\rho_{r1}^d + \rho_{s1})^2 + \frac{1}{c}(\rho_{r1}^d)^2\right] B^2 + (\rho_{r1}^d + \rho_{s1})B + 2E[\tilde{\eta}].$$

Π^{con} is used in Section 4.3 when the principal compares her share of the total expected surplus for each type of contract.

4.2.3 Performance-based contracts

In this section, the optimal contract for the performance-based contract is derived. The modeling is based on dynamic models with explicit contracts developed by prior literature (e.g., Baker et al. [2]; Meyer and Vickers [41]; Kaarbøe and Olsen [32]). Similar to the aforementioned conventional implicit contract, the principal maximizes her objective function in (4.7) subject to constraints in (4.8) and (4.9) at $t = 1$. From (4.7) and the fact that the information available for the principal is now $\boldsymbol{x}_1 = r_1$, the total expected surplus Π_2 from principal's perspective can be written as

$$\Pi_2^{per} \quad = \quad E[\tilde{v}_2] + \rho_{r1}(r_1 - E[\tilde{r}_1|\hat{a}_1, \hat{b}_1]) - c(\hat{a}_2, \hat{b}_2). \tag{4.16}$$

The symbol "*per*" is used to denote that it is satisfied in the optimal performance-based contract. ρ_{r1} reflects the marginal impact of the first-period earnings report on the principal' belief about the second-period cash flow. Note that the regression coefficient ρ_{r1} is different from ρ_{r1}^d which was given in the aforementioned conventional implicit contract. For the principal the first-period earnings report in the performance-based contract is the sole source of information about the agent's efforts and ability. In contrast, in the conventional implicit contract the principal can use not only the first-period earnings report, but also the first-period non-verifiable measure. Thus, the impacts of the first-period earnings report ρ_{r1} in the performance-based contract are bigger than ρ_{r1}^d in the conventional implicit contract for the principal. The exact expression is contained in Appendix A.

For determining the agent's optimal effort choice, first consider the expectation of his compensation at $t = 1$. For the contract defined in (4.1), it is given by

$$E[\tilde{w}_2|\boldsymbol{x}_1] = \bar{\alpha}_2 + \beta_2 \left\{E[\tilde{v}_2|\boldsymbol{x}_1] + b_2\right\} - c(a_2, b_2). \tag{4.17}$$

Substituting (4.17) in the constraint in (4.8), the agent's optimal effort choice is given by

$$a_2^{per} = \beta_2, \tag{4.18}$$

$$b_2^{per} = \frac{1}{c}\beta_2. \tag{4.19}$$

Maximizing (4.7) with respect to β_2 and considering the agent's induced efforts in (4.18) and (4.19), the incentive weight of the optimal contract at $t = 1$ is given by

$$\beta_2^* = \frac{c}{c+1}. \tag{4.20}$$

The fixed component of the agent's compensation $\bar{\alpha}_2$ is determined in a manner that satisfies the constraint in (4.9). This is given by

$$\bar{\alpha}_2^*(\boldsymbol{x}_1) = (B - \beta_2^*)E[\tilde{v}_2|\boldsymbol{x}_1] - \frac{1}{c}(\beta_2^*)^2 + (1-B)\left[\frac{1}{2}(\beta_2^*)^2 + \frac{1}{2c}(\beta_2^*)^2\right].$$

Therefore, the second-period wage contract offered to the agent is

$$w_2^{per}(\boldsymbol{x}_1) = \bar{\alpha}_2^*(\boldsymbol{x}_1) + \beta_2^* r_2. \tag{4.21}$$

Note that the second-period fixed payment $\bar{\alpha}_2^*(\boldsymbol{x}_1)$ in (4.21) depends on the first-period earnings report r_1. However, the optimal second-period incentive payment $\beta_2^* r_2$ in (4.21) does not depend on r_1, because it is an explicit contract based on the second-period earnings report r_2.

Next, consider the first-period problem. The principal's problem at $t = 0$ is to maximize her objective function (4.6) subject to the constraints in (4.12) and (4.5). Recall that the agent's second-period fixed payment $\bar{\alpha}_2^*(\boldsymbol{x}_1)$ in (4.21) depends on his first-period earnings report r_1. Thus, the incentive constraint in (4.12) can be written as

$$a_1, b_1 \in \arg\max_{a_1', b_1'} \{E[\beta_1 \tilde{r}_1] + E[\bar{\alpha}_2^*(\boldsymbol{x}_1)] - c(a_1', b_1')\}, \tag{4.22}$$

for which the solution is

$$a_1^{per} = \beta_1 + \mu_{r1}, \tag{4.23}$$

$$b_1^{per} = \frac{1}{c}(\beta_1 + \mu_{r1}), \tag{4.24}$$

where $\mu_{r1} = (B - \beta_2^*)\rho_{r1}$ is the implicit incentive to increase the second-period fixed payment. The sign of μ_{r1} is ambiguous. It is positive when $B > \frac{c}{1+c}$ and negative when $B < \frac{c}{1+c}$.

Considering the agent's optimal effort choice and maximizing (4.6) with respect to $\check{\beta}_1$, $\check{\beta}_1 = \beta_1 + \mu_{r1}$, the incentive weight of the optimal contract at $t = 0$ is given by

$$\check{\beta}_1^* = \begin{cases} \frac{c}{1+c} & B < B_F, \\ \mu_{r1} & B > B_F, \end{cases} \tag{4.25}$$

where $B_F = \frac{c(1+\rho_{r1})}{(1+c)\rho_{r1}}$. Note that the incentive weight of the performance-based contract in (4.1) is defined as positive, i.e., $\beta_1 > 0$. Perhaps when $\check{\beta}_1^* = \mu_{r1}$ is satisfied, the contract can be defined as a semi-performance-based contract because it provides a direct incentive only in the second period. Thus, B_F is the threshold above which the semi-performance-based contract has to be offered instead of the performance-based contract.

Setting (4.5) as an equality and considering the agent's optimal action choice and the optimal incentive weights, the first-period fixed payment is given by

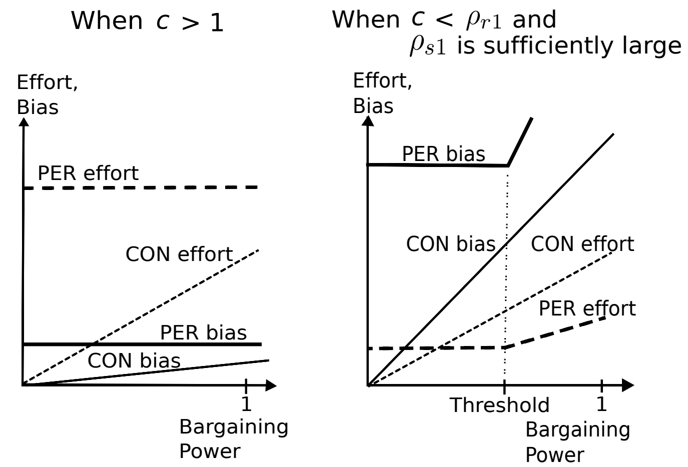
$$\bar{\alpha}_1^* = (B - \check{\beta}_1^*)E[\tilde{v}_1] + (1 - B)c(\check{\beta}_1^*, \frac{1}{c}\check{\beta}_1^*) - \beta_1(\frac{1}{c}\check{\beta}_1^*) - \mu_{r1}E[\tilde{r}_1]. \tag{4.26}$$

Note that a long-term linear contract in which the fixed payment is $\alpha_1 + (\alpha_2 - \mu_{r1}r_1)$ and the incentive coefficient for r_t is always $\frac{c}{1+c}$ would be a renegotiation-proof contract.

The total expected surplus for the performance-based contract Π^{per} and that for the semi-performance-based contract Π_F^{per} are given by

$$\begin{aligned}\Pi^{per} &= \frac{c}{1+c} + 2E[\tilde{\eta}],\\ \Pi_F^{per} &= -\frac{1+c}{2c}\left[\left(\frac{c}{1+c}\right)^2 + \mu_{r1}^2\right] + \frac{c}{1+c} + \mu_{r1} + 2E[\tilde{\eta}].\end{aligned}$$

Note that $\Pi^{per} \geq \Pi_F^{per}$ is satisfied (and the equation is satisfied when $B = B_F$). Recall that Π^{per} is computed to be the optimal total surplus.



PER effort indicates the sum of the first- and the second- period effort in the performance-based contract and CON effort denotes that in the conventional implicit contract. While PER bias represents the sum of the first- and the second- period bias in the performance-based contract and CON bias indicates that in the conventional implicit contract.

FIGURE 4.2: Agent's induced actions

Figure 4.2 shows the agent's induced actions in equilibrium. For example, PER (CON) effort indicates the sum of the first- and the second- period effort of the performance-based contract (the conventional implicit contract). The x-axis measures the bargaining power scale. When c is larger than one, the agent's cost of introducing bias is higher than that of exerting productive effort. Thus, the line of induced effort is always above the line of induced bias in each contract. In this case, the effort exerted in the performance-based contract is always higher than that in the conventional contract.

On the other hand, when c is less than ρ_{r1} and ρ_{s1} is sufficiently large, i.e., the non-verifiable measure is sufficiently informative, the agent's preference for effort and bias is completely opposite in each contract. Importantly, when c is less than ρ_{r1} and ρ_{s1} is sufficiently large, the bias of the performance-based contract is always higher than that of the conventional implicit contract, and in some interval, the effort of the conventional implicit contract is higher than that of performance-based contract.

4.3 Choice of the Type of Contracts

In this section, the optimal choice of the type of contract is derived. At the start of period 1, the principal compares her share of the total expected surplus for each type. The following proposition summarizes the results.

Proposition 4.1. *Suppose* $\sigma_{\zeta}^2 = k\sigma_{\varepsilon}^2$, $k > 0$.

(*i*) *For* $c \geq 1$, *the performance-based contract is optimal.*

(*ii*) *For* $c < 1$, $k^{con}(c)$ *exists such that* $k^{con}(c)$ *is a decreasing function in* c *and*

- *For* $k > k^{con}(c)$, *the performance-based contract is optimal over* $B \in (0,\ 1)$ *if* $c > \rho_{r1}$, *and over* $B \in (0,\ B_F)$ *if* $c < \rho_{r1}$;
- *For* $k < k^{con}(c)$, $c^{con} \in (0,\ 1)$, B^{con} *and* B^{exp}, $0 < B^{con} < B^{exp}$, *exists such that for* $c < c^{con}$ *the conventional implicit contract is optimal over* $B \in (B^{con},\ B^{exp})$ *if* $B^{exp} \leq \min(B_F,\ 1)$, *and over* $B \in (B^{con},\ \min(B^{exp},\ 1))$ *if* $B^{exp} > \min(B_F,\ 1)$.

All proofs are in Appendix B.

The intuition behind these results is straightforward. When the private cost of introducing bias into an earnings report is higher than that of exerting productive effort for the agent, i.e., $c \geq 1$, the performance-based contract in which the performance measure serves as an incentive to work hard dominates the conventional implicit contract. Furthermore, even though introducing bias into an earnings report is an easier choice for the agent, i.e., $c < 1$, when the non-verifiable measure is not informative enough, i.e., $k > k^{con}$, the performance-based contract is still the optimal choice for the principal. On the other hand, when reporting with bias is an easier choice for the agent, i.e., $c < 1$, and the non-verifiable measure is sufficiently informative so that the agent's earnings report does not consider renegotiation for the next compensation contract, i.e., $k < k^{con}(c)$, the conventional implicit contract could dominate its counterpart. Note that the coefficient k in $\sigma_\zeta^2 = k\sigma_\varepsilon^2$ could be a measure of relative informativeness. A lower coefficient k reflects a superior non-verifiable measure's relative informativeness to the earnings report. Recall that the shareholders observe only the agent's earnings report. It can be said that when the non-verifiable measure works well the agent works hard despite the fact that his contribution is assessed with an opaque decision process from the shareholders' perspective, which is often observed in Japanese management mechanisms. These results correspond to the empirical evidence provided by Kaplan [33] , Kato [34], and Basu et al. [4]. These studies report that a relationship-oriented governance mechanism works as well as a market-oriented governance mechanism. Arguably, non-verifiable measures in relationship-oriented governance mechanisms are sufficiently informative because they provide common consent, which can be interpreted as that in which a non-verifiable measure would play an important role in relationship-oriented mechanisms.

However, it is not the case if the agent's bargaining power B is in the range $(0,\ B^{con}] \cup (B^{exp}, \min(B_F,\ 1))$. In particular, when the agent's bargaining power is considerably strong, i.e., $B \in (B^{exp},\ \min(B_F,\ 1))$, the conventional implicit contract allows the agent to provide a biased earnings report and get excess compensation as compared to the performance-based contract. The following corollary shows that inequality $B^{exp} < \min(B_F,\ 1)$ is satisfied and a non-empty set $(B^{exp},\ \min(B_F,\ 1))$, in which the performance-based contract is optimal, exists.

Corollary 4.2. *Suppose $c < \rho_{r1}$ and $k < k^{con}$. If k is sufficiently close to $k^{con}(c)$, $\rho^{exp} \in (0,\ 1]$ exists such that for $\rho_{r1} < \rho^{exp}$, $B^{exp} < B^F < 1$ is satisfied and the performance-based contract is optimal over $B \in (B^{exp},\ B_F)$.*

In other words, when the non-verifiable measure in the conventional implicit contract is relatively uninformative and when the marginal impact of the earnings report in the performance-based contract ρ_{r1} is weaker, i.e., $\rho_{r1} < \rho^{exp}$, the performance-based contract can dominate the conventional implicit contract depending on the strength of the agent's bargaining power. The results imply a scenario: the conventional implicit contract may be chosen by managers who have strong bargaining power as compared to the board of directors, although a performance-based contract could be optimal for their firms. This scenario is consistent with Basu et al. [4], who find that top Japanese executives earn more in firms with higher insider ownership.

Figure 4.3 characterizes the case where the assumptions of Corollary 4.2 and $c < c^{con}$ are satisfied.

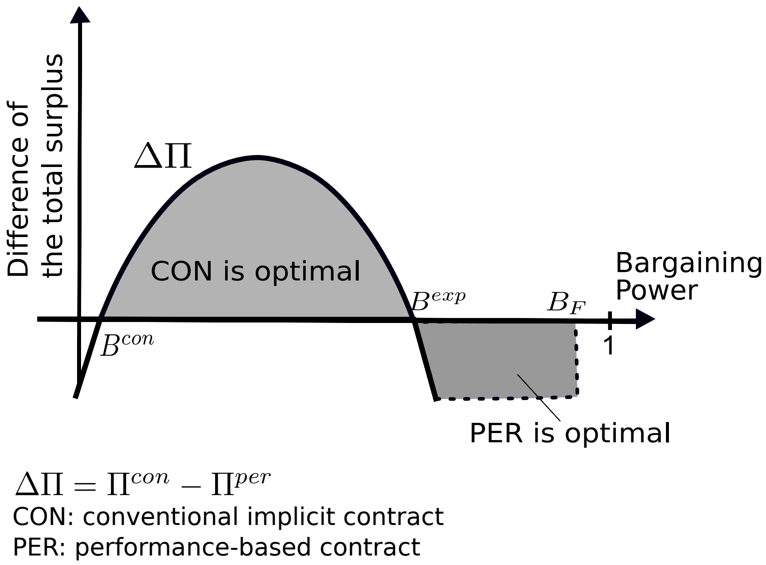


FIGURE 4.3: Difference of the total surplus

4.3.1 Empirical Implications

On the basis of the aforementioned results, implications for empirical compensation research can be discussed. First, the firms' executive compensation policy (e.g., how directors are paid) is may not serve as a useful test in identifying profitable firms. A change in the pay policy from discretionary to performance-based bonus contract practice is not expected to have a positive relationship with firm performance. This prediction is consistent with Kubo [37], who analyzes whether a firm's method of paying its directors matters, although the current study does not agree with his conclusion that executive compensation is not designed to motivate executives to work towards increasing shareholder value. Second, the combination of the firms' executive compensation policy and ownership structure is likely to be associated with the level of executive compensation.

If firms with higher insider ownership continue to use a conventional contract, they may experience higher agency costs.

4.4 Conclusion

This chapter studies the consequences of the choice of two types of executive compensation contracts. The analysis is based on a two-period agency model in which compensation contracts are subject to renegotiation; compensation is paid on the basis of the agent's earnings report (e.g., a performance-based contract) or a non-verifiable measure within the firm (e.g., a conventional implicit contract). The analysis shows that assessment of the agent's contribution based on an earnings report creates incentives for providing a biased report; these incentives could significantly distort the structure of the optimal-compensation contract. The effect makes the conventional implicit contract optimal if the non-verifiable measure within the firm is sufficiently informative and the agent's bargaining power is moderate. In contrast, if the non-verifiable measure is not sufficiently informative and the agent has strong bargaining power, the conventional implicit contract motivates the agent to provide a biased report and the performance-based contract becomes optimal.

These results imply two different scenarios. First, Japanese firms use the conventional implicit contract because top executives in those firms are motivated to work hard by subjective assessments of their contribution to firm value, though it can be seen as an opaque decision process by shareholders. Second, the conventional implicit contract is chosen by top executives who have strong bargaining power as compared to the board of directors, although their non-verifiable measures are relatively uninformative and so a performance-based contract could be optimal for their firms. Therefore, the shareholders in firm with Japanese governance mechanisms would not always benefit from the use of annual incentive plans.

As long as the Japanese governance mechanisms are working well, implementation of a performance-based compensation contract may give excessive rewards to executives who are already motivated to work hard. A performance-based compensation contract would not be what improves firms' transparency but it seems to work well in firms that already have a transparent governance mechanism.

Although this chapter has applied classic agency theory, which is built upon the assumption that there is a conflict of interest between a principal and an agent, it is easy to imagine analyses relaxing the assumption. For example, further insights on performance-based measures under various control mechanisms can be generated by introducing a goal congruent agent.[4]

APPENDIX A

Regression Coefficients

The covariance matrix $(\tilde{v}_2, \tilde{r}_1, \tilde{s}_1)$ is

$$\begin{pmatrix} \sigma_\eta^2 + \sigma_\varepsilon^2 & \sigma_\eta^2 & \sigma_\eta^2 \\ \sigma_\eta^2 & \sigma_\eta^2 + \sigma_\varepsilon^2 & \sigma_\eta^2 \\ \sigma_\eta^2 & \sigma_\eta^2 & \sigma_\eta^2 + \sigma_\zeta^2 \end{pmatrix}.$$

By applying well-known formulas for multivariate normal distributions (e.g., DeGroot [14]),

$$\begin{aligned} \rho_{r1}^d &= \frac{\sigma_\eta^2 \sigma_\zeta^2}{\sigma_\eta^2 \sigma_\zeta^2 + \sigma_\varepsilon^2 \sigma_\eta^2 + \sigma_\varepsilon^2 \sigma_\zeta^2}, \\ \rho_{s1} &= \frac{\sigma_\eta^2 \sigma_\varepsilon^2}{\sigma_\eta^2 \sigma_\zeta^2 + \sigma_\varepsilon^2 \sigma_\eta^2 + \sigma_\varepsilon^2 \sigma_\zeta^2}, \\ \rho_{r1} &= \frac{\sigma_\eta^2}{\sigma_\eta^2 + \sigma_\varepsilon^2}. \end{aligned}$$

[4] For example, this kind of analysis is conducted by Banker et al. [3]. They integrate agency theory and organizational control theory and study three types of control: outcome based control; behavior-based control; and clan control.

APPENDIX B

Proof of Proposition 4.1

Let $\Delta\Pi = \Pi^{con} - \Pi^{per}$ and $\Delta\Pi_F = \Pi^{con} - \Pi_F^{per}$. Recall that $(1 - B)$ is positive. Hence $(1 - B)\Delta\Pi$ and $\Delta\Pi$ have the same sign, and $(1 - B)\Delta\Pi_F$ and $\Delta\Pi_F$ also have the same sign, $\Delta\Pi$ and $\Delta\Pi_F$ can be taken as the principal's measure of the optimal type of contract. To examine the sign of $\Delta\Pi$, the discriminant of $\Delta\Pi$ is evaluated. From $\sigma_\zeta^2 = k\sigma_\varepsilon^2$, ρ_{r1}^d can be written as $\rho_{r1}^d = k\rho_{s1}$. Substituting the expression, $\Delta\Pi$ can be rewritten as

$$\Delta\Pi = -\frac{1}{2}\left[(1+k)^2 + \frac{1}{c}k^2\right]\rho_{s1}^2 B^2 + (1+k)\rho_{s1}B - \frac{c}{1+c}.$$

The discriminant of $\Delta\Pi$ is given by

$$D = \frac{\rho_{s1}^2}{1+c}\left[(1-c)(1+k)^2 - 2k^2\right].$$

(i) For $c \geq 1$. Because the discriminant of $\Delta\Pi$ is negative, i.e., $D < 0$, $\Delta\Pi$ has no real roots. Because the coefficient of B^2 in $\Delta\Pi$ is negative, $\Delta\Pi$ is the parabola that opens downwards. Thus, the sign of $\Delta\Pi$ is negative for all B. Further, for $c > 1$, $B_F > 1$ over all $\rho_{r1} \in (0,\ 1)$. Therefore, the performance-based contract is optimal over all $B \in (0,\ 1)$.

(ii) For $c < 1$. To determine the sign of the discriminant of $\Delta\Pi$, denote $\psi(k) = (1 - c)(1 + k)^2 - 2k^2$. The discriminant of $\psi(k)$ is given by $8(1 - c) > 0$. Thus, $\psi(k)$ has two real roots. Because the coefficient of k^2 in $\psi(k)$ is negative, $\psi(k)$ is a parabola that opens downwards. The roots are given by

$$\frac{1-c-\sqrt{2(1-c)}}{1+c},\ and,\ \frac{1-c+\sqrt{2(1-c)}}{1+c}.$$

Let $k^{con} = \frac{1-c+\sqrt{2(1-c)}}{1+c}$. Note that k^{con} is a decreasing in c. Because the sign of $\frac{1-c-\sqrt{2(1-c)}}{1+c}$ is negative and that of k^{con} is positive, $\psi(k) > 0$ for $k \in [0,\ k^{con})$ and $\psi(k) < 0$ for $k > k^{con}$ is known.

For $k > k^{con}$. The discriminant of $\Delta\Pi$ is negative, i.e., $D < 0$. Thus, $\Delta\Pi < 0$ over all $B \in (0,\ 1)$. Taking account of the fact that if $c < \rho_{r1}$ the performance-based contract is unfeasible over $B \in [B_F,\ 1)$, it can be said that the performance-based contract is optimal, over $B \in (0,\ 1)$ if $c > \rho_{r1}$, and over $B \in (0,\ B_F)$ if $c < \rho_{r1}$.

For $k < k^{con}$. Because the discriminant of $\Delta\Pi$ is positive, $\Delta\Pi$ has two real roots. These roots are given by

$$\frac{(1+k) - \sqrt{\frac{1}{1+c}\left[(1-c)(1+k)^2 - 2k^2\right]}}{\left[(1+k)^2 + \frac{1}{c}k^2\right]\rho_{s1}},\ and,\ \frac{(1+k) + \sqrt{\frac{1}{1+c}\left[(1-c)(1+k)^2 - 2k^2\right]}}{\left[(1+k)^2 + \frac{1}{c}k^2\right]\rho_{s1}}.$$

Let $B^{con} = \frac{(1+k)-\sqrt{\frac{1}{1+c}\left[(1-c)(1+k)^2-2k^2\right]}}{\left[(1+k)^2+\frac{1}{c}k^2\right]\rho_{s1}}$ and $B^{exp} = \frac{(1+k)+\sqrt{\frac{1}{1+c}\left[(1-c)(1+k)^2-2k^2\right]}}{\left[(1+k)^2+\frac{1}{c}k^2\right]\rho_{s1}}$. One knows that $\Delta\Pi > 0$ over $B \in (B^{con}, B^{exp})$. The fact that $\Delta\Pi(0)$ is negative implies that $B^{con} > 0$ and $B^{exp} > 0$. Because the limit of B^{con} as c approaches zero is zero, $c^{con} \in (0,\ 1)$ exists such that for $c < c^{con}$, $B^{con} < 1$ is satisfied. Recall that $\Delta\Pi_F \geq \Delta\Pi$ for all B. If $B^{exp} > B_F$ and $\Delta\Pi > 0$ over $B \in (B^{con}, B^{exp})$, $\Delta\Pi_F > 0$ is satisfied over $B \in (B_F, B^{exp})$. Thus, the conventional implicit contract is optimal, over $B \in (B^{con},\ B^{exp})$ if $B^{exp} \leq \min(B_F,\ 1)$, and over $B \in (B^{con},\ \min(B^{exp},\ 1))$ if $B^{exp} > \min(B_F,\ 1)$. This completes the proof of Proposition 4.1.

Proof of Corollary 4.2

Let the vertex of $\Delta\Pi$ be $(B_v,\ \Delta\Pi(B_v))$. Because $\Delta\Pi(k)$ is continuous, the roots of $\Delta\Pi$ can be made to be as close to B_v as desired by making k sufficiently close to k^{con}. Thus, when $B_v < B_F$ is satisfied, inequality $B_v < B^{exp} < B_F$ can be derived by making k sufficiently close to k^{con}. Consider now when inequality $B_v < B_F$ is satisfied. Inequality $B_v < B_F$ can be rewritten as $\left[(1+\frac{1}{c})B_v - 1\right] < \frac{1}{\rho_{r1}}$. Denote $\psi(c,k) = \left(1+\frac{1}{c}\right)B_v - 1$. When $k = k^{con}$, $\psi(c, k^{con}) > 0$ is satisfied. Suppose c is fixed somewhere in $(0,\ \rho_{r1})$. Because $\psi(c,k)$ is a continuous function, for any number $\varepsilon > 0$, some number $\delta > 0$ exists such that for all k, $|k - k^{con}| < \delta \Rightarrow |\psi(c,k) - \psi(c,k^{con})| < \varepsilon$. Thus, $\psi(c,k) > 0$ in the neighbourhood $U = \{(c,k)||k - k^{con}| < \delta, c \in (0,\ \rho_{r1})\}$. Let $\rho^{exp} = \min\{\frac{1}{\psi(c,k)}, 1\}$, $(c,k) \in U$. If $\rho_{r1} < \rho^{exp}$, $\psi(c,k) < \frac{1}{\rho^{exp}} < \frac{1}{\rho_{r1}}$. This indicates that $B_v < B_F$ is satisfied over $(c,k) \in U$. From the proof of Proposition 1,

$\Delta\Pi < 0$ over $B \in (B^{exp}, B_F]$. Therefore, the performance-based contract is optimal over $B \in (B^{exp}, B_F)$. This completes the proof of Corollary 4.2.

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