NON-MONETARY AND INFORMAL COMPENSATION IN AGENCY SETTINGS

by

PATTARIN ADITHIPYANGKUL

B. Acc., Chulalongkorn University, 1996
M.Phil., The University of Cambridge, 1998

A THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS
FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

in

THE FACULTY OF GRADUATE STUDIES
(Business Administration)

THE UNIVERSITY OF BRITISH COLUMBIA

September 2005

Abstract

In the prior agency literature, the optimal compensation contracts generally specify cash payments that are functions of verifiable performance measures, which can be enforced by the courts. However, the compensation we observe in the real world often includes non-cash components like fringe benefits, gifts, etc. In addition, there are often unwritten (informal) contracts based on personal agreements between a boss and an employee, or between colleagues. These unwritten contracts are generally not enforced by the courts, but they can shape employees' expectations, and hence influence their behavior, as long as the agent believes there is positive probability the boss or colleague will abide by the agreement.

This dissertation examines the optimal composition and formality of compensation contracts in agency settings. Three assumptions which distinguish it from the prior agency literature based on cash compensation include (i) not all consumption goods are available from the market (the principal is the only source of some goods), (ii) the agent's productivity is affected by her consumption, and (iii) the principal have a cost advantage in providing some goods. The optimal contracts in different settings are derived. The characteristics of the optimal contract are determined by the characteristics of the good, and the characteristic of the principal's cost advantage (if any). If the agent has private, pre-contract information, the optimal contracts are also determined by the kind of private information the agent has.

To explain the use of informal contracts, this dissertation relaxes the assumption that all actions can be manipulated or controlled by a formal mechanism, like a written contract, an audit, etc. This dissertation considers an undesirable action that is beneficial to the agent but is costly to the principal, which cannot be deterred by a formal mechanism. Examples of this kind of action include strikes and employee litigation. An employee opportunistically exercises her rights under the labour law, and this cannot be deterred by a formal mechanism. This thesis shows that informal contracting may be able to deter these undesirable actions, so that the principal is better off leaving the contract unwritten.

Table of Contents

List of Tables

List of Figures

Acknowledgements

I would like to express my gratitude to my research supervisors, Professor Gerald Feltham and Professor Dan Simunic, for their most generous help and kindest support. I am also deeply indebted to their valuable guidance, comments and suggestions throughout the development of this dissertation. I also would like to gratefully thank Professor Gilles Chemla, my thesis committee member. I have benefited a great deal from his support and helpful comments. I would like to thank Professor Joy Begley, Professor Kin Lo, Professor Sandra Chamberlain, and Professor Amin Mawani very much for introducing me to different areas of accounting research. I would like to thank all other professors from whom I have taken courses. I am also very much indebted to the respondents and informants in my case studies. I am thankful for useful comments from the workshop participants at the University of British Columbia, Hong Kong University of Science and Technology, National University of Singapore, and Singapore Management University. C. K. Choi Fellowship in Business Administration, Faculty of Commerce International Graduate Tuition Scholarship, Dean Earle D. MacPhee Memorial Fellowship in Commerce and Business Administration, and Faculty of Graduate Studies International Graduate Tuition Scholarship are gratefully acknowledged. Finally, very special thanks go to my family for their warmest support throughout my Ph.D. programme at UBC.

Chapter 1: Introduction

The compensation decision is multi-dimensional. In addition to how much to offer and which performance measures to use (or which information system to implement), an employer must choose the composition of the pay – cash or non-cash (like fringe benefits). Furthermore, he must choose whether to offer a formal (written) contract, an informal contract, or a combination of the two. He must also choose the timing of the pay – immediate or deferred (e.g. retirement benefits)[1].

This dissertation examines the optimal composition and formality of compensation contracts in agency settings. In the term 'cash compensation,' I also include cash-equivalents like stocks. Non-cash compensation includes fringe benefits, an office, secretarial service, a gift, a party, etc. By 'formal compensation', I mean such pay as is specified in the employment contract, in the company's compensation policies, or in the company's charters. By 'informal compensation', I mean any cash or other resources employees receive or appropriate for personal use which are not specified in written agreements between employers and employees. For example, health benefits specified in compensation packages are formal compensation. The money an employer pays to an ill employee to assist her with the health care expenses on a case-by-case basis is informal compensation.

There is not much prior agency literature on non-monetary and informal compensation in mainstream accounting and compensation research.[2] Previous

---

[1] See Sundaram and Yermack (2005) for the description of the use of pensions and deferred compensation ("debt compensation") for CEOs in large US companies (Fortune 500 companies) from 1996-2002. The authors also consider the effect of the pension on the probability of CEO turnover, and the effect of the use of both debt and equity compensation on the firms' default risk.

[2] In economics, researchers study a somewhat related issue in the sharecropping literature. "Sharecropping (or Metayer System) is a form of land leasing in which a tenant and a landlord share the output of a farm as compensation for the managerial labor supplied by the former and the land capital supplied by the latter" (Braido, 2003: 1-2). A sharecropping setting is similar to the non-cash compensation setting considered here in the sense that the tenant (the agent) is also paid in terms of goods (the crop produced). However, in sharecropping models, the good (the crop) is generally treated the same way as cash in an analysis. The tenant's utility function is defined over her income, which is the sum of cash compensation and her share of the crop (measured in monetary unit). For example, $Y = w + \alpha Q$, where Y is the tenant's income, w is cash compensation, α is the fraction of output the tenant receives, and Q is the

theoretical and empirical accounting literature focuses almost exclusively on formal cash compensation, [3] even though non-cash and informal compensation can be significant parts of total compensation, both in terms of the amounts and in terms of their effects on employees' behavior. For example, in the military, non-cash compensation constitutes about 57% of total military compensation (Murray, 2004)[4]. Hashimoto (2000) finds that the proportion of (formal) non-monetary compensation (of the total (formal) compensation) across industries increased by 46.1% from 1966 to 1994. From casual observation, we observe the use of productive non-cash compensation, like an office, a secretary (who may often be asked to help with her boss's personal matters), a training program, a company car, a laptop computer, an insurance policy, meals, or uniforms. We also observe the use of non-productive non-cash compensation, like a paid leave, a subsidy for children's education, or a subsidy for accommodation.

As to informal compensation, due to the nature of the payment, little evidence has been compiled, and what exists is mostly in the form of case studies, rather than in empirical studies. While previous accounting research on informal compensation does not seem to exist, informal compensation has been a topic of interest to researchers in organizational behavior. Mars (1982), for instance, remarks that the total compensation from work consists of formal, legal rewards (e.g. wages, salaries, etc.), informal, legal rewards (e.g. tips, perks, etc.), and hidden economic rewards (e.g. pilfering, overcharged expenses, etc.) The hidden economic rewards "are usually allocated on an individual basis through an *individual contract* with a specific contract-maker – usually a first-line supervisor" (Mars, 1982:8). He reports the custom of an editor compensating a journalist informally for the quality of the articles submitted. The journalist handing in a better

---

output produced. Chapter two considers a more general utility function with respect to cash and goods. Also, it considers the case in which the consumption good paid to the agent as compensation leads to better production outcome. See Otsuka and Hayami (1988), Taslim (1992), and Braido (2003) for review of literature on sharecropping.

3 For recent reviews of prior literature on agency theory based on cash compensation, see Lambert (2001) which reviews theoretical work, and see Murphy (1998) and Ittner and Larcker (2001) which review empirical work.

4 Examples of the non-cash compensation paid include "subsidized goods and services that can be used immediately--such as medical care, groceries, housing, and child care ... other deferred benefits that service members receive after they leave active duty--including health care for retirees and veterans' benefits" (Murray, 2004: 1).

article can submit a more inflated expense list for reimbursement. Another vivid real-world case is reported by Zeitlin (1971).

> A close friend of mine, an accountant, told me of an experience he had recently when he audited the books of a corporation. It became apparent that the office manager was dipping into petty cash to the extent of about $2,000 a year. He reported this fact to the president. The president responded, "How much are we paying him?" "Ten thousand a year," replied the accountant. "Then keep quiet about it," said the president. "He's worth at least $15,000."
>
> Zeitlin (1971: 22)

In this case, the employer allows "theft" as part of compensation. Researchers in organizational behaviour (e.g., Greenberg and Scott (1996), Altheide et al (1978)) argue that employers pay informally rather than formally because this is a more flexible and timely way to reward an employee. Ditton (1977) notes that the use of illegal informal compensation gives the payer power over the payee. For example, after the employee has stolen, she is subject to future prosecution. Zeitlin (1971) finds that, in a setting where the job is boring, a manager allows employees to steal to increase their morale and "job" satisfaction.

The use of informal compensation seems inconsistent with the thought in classic agency theory. In prior models, the principal is usually better off if ex ante, he can commit to the contract he offers, to the way in which the private information reported by the agent will be used, to never renegotiate ex post, etc. This can be done more easily if a written contract is offered. Although there does not seem to be descriptive data on the use of informal compensation in the real world, from casual observations, informal compensation appears to be used extensively. In most organizations, a boss gives gifts on occasion to an employee, or a "star" employee is allowed some kinds of privileges.

This dissertation attempts to formally analyze the composition and the formality of compensation contracts. It attempts to answer the following questions: When will we observe the use of non-monetary compensation? What are the characteristics of the contract offered? Why do some firms prevent their employees from transferring non-cash compensation to others? Why do some companies offer a menu of contracts with different amounts of non-cash compensation? When will we expect to see the use of informal compensation? Chapters two and three examine the use of non-monetary compensation. Chapter four investigates the use of informal compensation. To augment economic analyses in chapters two to four, Appendice 1-3 provide short case studies of the use of non-cash and informal compensation in businesses in various industries in Thailand.

Chapter two starts with an agency model based on cash compensation similar to the one in prior literature. It then shows that the employer is indifferent whether to pay in terms of cash, in terms of goods, or in any combinations, when (i) all the goods are available from the market, (ii) the consumption of the goods does not affect the employee's productivity, and (iii) the employer does not have a cost advantage in providing the goods. Chapter two then relaxes these assumptions, and derives the optimal contracts in different settings. The outcome from production is contractible and is used as a performance measure.

Chapter two first considers the setting in which the principal is the only source of the good (i.e., the good is not available from the market). Examples of this kind of goods include on-the-job training, and workplace conditions. When the good is not productive, the non-cash compensation is paid based on the employee's preference. The good is provided so that the employer can reduce total compensation costs. When the good is productive, the good is provided to enhance the outcome from production, and to save compensation cost. The good is provided at the level where the marginal product to the principal plus the marginal benefit to the agent is equal to the marginal cost. Chapter two then considers the case in which the productive good is available from the market. Examples of this kind of productive goods include meals and health services. (There is no use providing a non-productive good which is available from the market, when the principal does not have a cost advantage, as discussed above.) Ideally, the employer wants the employee to consume at a level where the marginal benefit to both the principal and the agent is equal to the marginal cost. Unfortunately, when there is an external market for the good, the employee can buy and sell to undo the compensation bundles the employer offers. The employee will eventually consume at the level which equates the marginal benefit to herself with the marginal cost. There is therefore no use paying in terms of the good. The employer must increase cash bonuses to induce the desired consumption of the good. The bonus is to motivate both effort and consumption. Chapter two subsequently shows that if the employer can prevent the employee from selling the productive good in the market, he will provide the good.

Chapter two then considers the settings in which the principal has a cost advantage in providing a good. It shows that if the employer can buy the good at a cheaper price than the employee, the employer will provide the whole quantity the employee will consume. The employee consumes more than she would have if she had to buy the good from the market herself. If the principal can produce the good at the cheaper cost and the cost function is convex, the principal may provide the whole quantity the employee will consume, or may provide only part of it, depending on the degree of cost advantage.

To summarize, suppose that, in addition to the cost of the goods, the employer incurs administrative costs in providing non-cash compensation, but the administrative costs are sufficiently low, the model predicts that the employer will pay in terms of a good when the good (productive or not) is not available from the market, i.e., the employer is the only source of the good. In addition, the employer will pay in terms of the good if he has a cost advantage in providing the good. Finally, when the good is available from the market and there is no cost advantage, the employer will provide a good if the good is productive, and the employer can prevent the employee from selling the good in the market.

Chapter three discusses empirical studies of CEOs' perquisites, and where possible, compares empirical results with the theoretical predictions in chapter two. Subsequently, to explain the compensation practice in which a firm offers a menu of contracts to an employee, chapter three extends the analysis in chapter two to an adverse selection setting. Three kinds of private, pre-contract information are considered: the employee's productivity of effort, her preference for the good in consideration, and her productivity of the good. The analysis is simplified by assuming that the employer does not have a cost advantage, and the employee has single private information. A binary model with two types of employees is considered. The production outcome is contractible and is used as a performance measure. The main result is that what the employer will do to reduce the information rent is contingent on the kind of private information, and the market setting (i.e., whether the good is available from the market or not). To illustrate, if the private information is about the preference for the good, the good is productive, and the principal is the only source, a menu of contracts consists of contracts with different non-cash compensation, but the same incentive rates. If the private information is about the productivity of the good, and the good is not available from the market, a menu of contracts consists of contracts with different non-cash compensation, and different incentive rates. If the private information is about (i) the productivity of effort, (ii) the preference of the productive good and the good is available from the market, or (iii) the productivity of the good and the good is available from the market, then a menu of contracts consists of contracts with different incentive rates.

Chapter four analyzes another dimension of the compensation decision: the formality of compensation contracts. In prior agency models, the principal is usually better off with the ability to commit to the contract he offers. This seems to be true when all kinds of actions can be controlled or manipulated by a formal mechanism, like a formal compensation contract, or an audit. In reality, employees may be able to take undesirable actions that cannot be deterred by a formal mechanism. Examples of such an action include employee litigation and strikes. These are the cases in which employees opportunistically exercise their rights under the labor law. Chapter four considers the use of informal compensation to deter undesirable actions that cannot be deterred by formal mechanisms. Two characteristics of informal compensation are studied: the lack of written evidence that can be used in courts, and the power the employer obtains by "allowing" employees to take illegal informal compensation, e.g. through "theft".

Chapter four first examines the use of informal contracting to deter discrimination litigation, when subjective performance evaluation is used. Subjective performance measures can help mitigate myopic or window dressing behavior. However, a formal (written) compensation contract based on subjective evaluation also makes the firm susceptible to discrimination litigation, which is costly and is the most frequent employee litigation in the US (Doyle and Kleiner, 2002). Rather than offering a written contract which bases the pay on subjective performance evaluation, the employer can offer an unwitnessed oral contract, which specifies a discretionary bonus based on subjective evaluation. Because there is no evidence of the informal contract to show to the courts, the employee cannot sue her employer. However, there is a commitment problem. The employer may not pay her a bonus as promised. Whether formal or informal contracting is optimal depends on whether the commitment problem or the employee litigation problem is more severe.

Chapter four also considers the use of illegal informal compensation, like the allowed "theft" described above, to compromise the employee, and hence deter an undesirable action. If the employee accepts the illegal pay (i.e., steals), she is subject to future prosecution for theft. If the loss from prosecution to the employee is sufficiently large, the loss can deter the employee from taking an undesirable action. Chapter four derives the optimal contract, which will induce the employee to accept both the formal and (illegal) informal pay, and will deter an undesirable action.

The results from chapter four imply that one setting in which we may observe the use of informal contracts is the setting where the employee can take an undesirable action that cannot be manipulated by formal mechanisms.

Appendice 1 - 3 report the compensation practices of a sample of businesses in Thailand. The findings seem consistent with the theoretical predictions. Also, consistent with the prior findings in organizational behaviour, an executive pays informally both because the informal pay is more flexible, and because it helps him maintain power over his employees.

In summary, this dissertation formally examines two aspects of compensation decisions not extensively investigated in the past: the composition and the formality of the pay. It derives the optimal compensation contracts to achieve different goals (i.e., saving compensation costs, enhancing the production outcome, reducing information rent, deterring undesirable actions). It also provides real world evidence of the use of non-cash and informal compensation. It hopes to lead to future research on the issues, since very little is known, theoretically, empirically, or behaviorally.

Chapter 2: Non-monetary Compensation in Moral Hazard Settings

2.1 Introduction

This chapter formally analyses the use of non-cash compensation in moral hazard settings. Although there is little prior accounting literature on non-cash compensation, much prior theoretical and empirical research in macro-economics and labour economics studies different kinds of fringe benefits.[5] Prior literature in those fields discusses various benefits of using non-cash compensation: (i) an economy of scale from providing the non-cash compensation to a large number of employees, (ii) its productivity, and (iii) tax benefits (Rosen, 2000; Long and Scott; 1982, Rajan and Wulf, 2004). In addition, some perquisites paid to a manager (e.g., a corporate jet) may be provided because they convey a high social status to the payees (Rajan and Wulf, 2004). A recent empirical work on fringe benefits supports the arguments. Oyer (2004) considers employer-provided meals, child care services, and health and dental insurance. (He assumes no moral hazard problem.) Using data from the National Longitudinal Survey of Youth (NLSY) in the years 1986 -1994, 1996, 1998, and 2000, he finds that the probability that the employers provide those fringe benefits is increasing in the employers' cost advantages in providing the benefits (i.e., the employer is in the industry related to the goods provided, or the number of employees is large), and in the employees' preferences for the benefits. Although these findings seem to tell us why we observe the use of fringe benefits, they tell us nothing about the characteristics of the contracts we will observe.

In addition to the literature on non-cash compensation for employees at all levels in organizations mentioned above, there are a few empirical papers on the use of non-cash compensation for CEOs or high-level management. Discussion of the hypotheses and empirical work on CEO's perquisites is presented in chapter 3.

As to theoretical work on non-cash compensation in an agency framework, I know only of Marino and Zábojník (2004), who study the use of employee discounts and other forms of non-cash compensation in adverse selection models. Chapter three considers an adverse selection model with a moral hazard problem, and also further discusses the work of Marino and Zábojník (2004).

---

5 For a review of literature on fringe benefits, see Alpert and Woodbury (2000). For reviews of literature on sharecropping, see footnote two.

The prior work in the moral hazard literature which seems more related to this chapter is the paper by Banker, Datar, and Maindiratta (1988). While the classic agency literature assumes that the principal has preference only for cash (or for the production outcome measured in monetary terms), the authors consider a multi-attribute utility function for the principal. This is particularly applicable for not-for-profit organizations like hospitals. Alternatively, each attribute can be considered as cash flows from different time periods. The authors also consider a multi-attribute utility function for an agent. Instead of using a utility function which is additively separable in consumption and disutility of effort, the authors use a general utility function based on cash compensation and the agent's action.

This chapter extends prior research by formally examining the use of non-cash compensation in moral hazard settings. It first shows that the optimal contract when the principal can pay only in cash (as derived in the prior agency literature based on cash compensation) is identical to the optimal contract when the principal can also pay in terms of goods, when all three of the following are true: first, all the consumption goods are available from the market; second, the agent's consumption choice does not affect the production outcome; third, there is no cost advantage – the cost to the principal is equal to the cost to the agent. If any of the three conditions is not true, the principal may prefer to pay in terms of goods.

This chapter then derives the optimal contracts in the settings in which the employer is the only source of the goods, the employer has a cost advantage in providing the goods, or the goods are productive. It also answers the question "When will the principal prefer to include a specific good in the compensation bundle?"

This chapter shows that the principal will pay in terms of goods when (i) the good is not available from an external market, (ii) the principal has a cost advantage in providing the good, and (iii) the good is available from the market, and the principal has **no** cost advantage, but the good is productive and the principal can prevent the agent from selling the good in the market. Therefore, it is not always the case that the company will pay in terms of goods if the goods are productive, as hinted by prior literature.

The characteristics of the optimal contract are determined by the agent's preference, the productivity of the good, and whether the good is available from the market. When the principal is the only source of the good or he has a cost advantage, he provides the good to reduce compensation costs. When the good is productive, in some sense, the consumption of the good is similar to a productive action. If the principal is the only source of the good (i.e., the good is not available from the market), there is no moral hazard from consumption. The contract is designed to motivate effort. If there is an external market in which the agent can buy and sell freely, there is moral hazard related to consumption of the productive good, and the contract must be designed to motivate both proper effort and consumption.

This chapter is organized as follows. Section 2.2 describes a model. Section 2.3 considers a prior agency model based on only cash compensation. Section 2.4 considers the use of non-cash compensation when the principal is the only source of the non-productive goods. Section 2.5 investigates the use of productive non-cash compensation. Section 2.6 examines the use of non-cash compensation when the principal has a cost advantage in providing the goods. Section 2.7 summarizes the model implication. Section 2.8 concludes.

2.2 Model Description and Notation

This chapter considers a moral hazard setting in which the principal (P, later referred to as he) has a linear utility function with respect to cash. The agent (A, subsequently referred to as she) is strictly work-averse. At the beginning of the period, the principal offers a contract to the agent. The contract specifies the amounts of cash and non-cash compensation as functions of a performance measure. If the agent accepts the offer, she chooses an action a, which stochastically determines the benefit of her effort to the principal. The agent's action is not observable to the principal. If not properly motivated, the agent will not supply the costly effort.

Consumption goods

The important addition in this chapter relative to prior agency models is consideration of non-monetary compensation. Some kinds of non-cash compensation, e.g. an occasional gift, or a party, are simply consumption goods for an agent. Other kinds of non-cash compensation like food, health insurance, medical services, etc., have productive value. For example, to save cash for purchasing something else, an employee who does not have insurance coverage may not seek medical services until the illness is very serious. This disrupts the workflow and reduces the production outcome.

Assume that there are M productive goods and N non-productive goods. In this analysis, the productive goods are provided at the beginning of the period, and consumed during the period, whereas the non-productive goods are provided at the end of the period. Bonuses are based on reports made at the end of the period. Therefore, productive goods cannot be used to pay bonuses, whereas the non-productive goods can be used to pay bonuses.

The consumption of the productive goods is denoted by c_{0i}, $i = 1, \ldots, M$. For simplicity, assume no endowment, and assume that the agent does not produce any consumption goods herself. The consumption thus comes from two sources: from the principal in terms of compensation (wage), and from the exchange in the market. At the beginning of the period (time $t = 0$), the principal pays a productive non-cash wage w_{0i}, $i = 1, \ldots, M$. The agent then buys or sells the good in the market. Let m_{0i}, $i = 1, \ldots, M$, denote the purchase (if m_{0i} is positive), or the sale (if m_{0i} is negative) of a productive good. The agent's consumption of a productive good is thus $c_{0i} = w_{0i} + m_{0i}$. At the end of the period (time $t=1$), the principal pays cash and non-productive non-cash compensation, which are denoted by w_{10} and w_{1j}, $j = 1, \ldots, N$ respectively. The agent then exchanges goods in the market. Let m_{1j}, $j = 1, \ldots, N$, denote the purchase (if m_{1j} is positive) or the sale (if m_{1j} is negative) of a good. The agent's consumption of a non-productive good is $c_{1j} = w_{1j} + m_{1j}$. The vector of the agent's consumption is denoted by $\boldsymbol{c} = (\boldsymbol{c}_0, \boldsymbol{c}_1)'$, $\boldsymbol{c}_0 = \boldsymbol{w}_0 + \boldsymbol{m}_0$, $\boldsymbol{c}_1 = \boldsymbol{w}_1 + \boldsymbol{m}_1$. The principal's expected utility is denoted by $U^P(\boldsymbol{w}, a)$, $\boldsymbol{w} = (\boldsymbol{w}_0, \boldsymbol{w}_1)$.

Production Technology and Performance Measure

The benefit of the agent's effort to the principal (or the outcome) measured in monetary terms is denoted by x. In addition to the agent's action, the agent's consumption of productive goods affects the probability density function of x. Let $\phi(x | a, \boldsymbol{c}_0)$ denote the probability density function of the outcome x.

At the end of the period, a performance measure y is known. The performance measure is informative about the action and/or the consumption of productive non-cash compensation. Let $\phi(y | a, \boldsymbol{c}_0)$ and $\phi(x, y | a, \boldsymbol{c}_0)$ denote the probability density function of the measure y and the joint probability density function of the outcome x and the measure y respectively. The derivatives of the probability function with respect to the action and the consumption of a productive good i are represented by $\phi_k(y | a, \boldsymbol{c}_0)$ and $\phi_k(x, y | a, \boldsymbol{c}_0)$, $k = a, c_{0i}$ respectively.

The Agent's Preferences

The agent's utility function is denoted by $u^a(\boldsymbol{c}, a)$, $\boldsymbol{c} \geq \boldsymbol{0}$, $a \in A$. Assume that the cost of effort is separable from the utility from consumption:

(i) Additively separable: $u^a(\boldsymbol{c}, a) = u(\boldsymbol{c}) - v(a)$, or

(ii) Multiplicatively separable (exponential utility function): $u^a(\boldsymbol{c}, a) = K(a)u(\boldsymbol{c})$, $K(a) = exp[\kappa(a)]$, $u(\boldsymbol{c}) = -exp[-r\psi(c)]$.

Assume that $u(\boldsymbol{c})$ is concave in c_{0i}, $i = 1, \ldots, M$, and in c_{1j}, $j = 0, 1, \ldots, N$. The derivatives of the agent's utility with respect to the productive good i or the non-productive good j are represented by $u_{c_{0i}}(c)$ and $u_{c_{1j}}(c)$ respectively. Both an additive disutility of effort $v(a)$ and a multiplicative disutility $K(a)$ are convex, i.e., $v' > 0$, $v'' > 0$, $K' > 0$, and $K'' > 0$. Let $\underline{U}$ denote the agent's reservation utility. The agent's expected utility is denoted by $U^a(\boldsymbol{c}, a) \equiv E[u^a(\boldsymbol{c}, a)]$. Unless assumed otherwise, the principal knows the agent's preferences with respect to all consumption goods.

For the sake of simplicity, the analysis below uses the utility function with additive disutility of effort to illustrate the results in sections 2.3, 2.4, 2.5.1.1, and 2.5.2.1. (The results remain valid with a multiplicatively separable utility function.) In addition, a LEN model with a multiplicatively separable utility function is used occasionally to simplify the analysis of the cases in which the good is productive.

Cost of Non-cash Compensation

When the principal can produce a good himself (or can acquire the good from sources other than a perfect market), let k_{0i}, $i = 1, \ldots, M$, and k_{1j}, $j = 1, \ldots, N$, denote the cost functions of providing the productive and non-productive non-cash compensation to the agent respectively. Assume that k_{0i} and k_{1j} are weakly convex. Unless the principal's cost advantage is assumed, when there is a perfect market for consumption goods, both principal and the agent can buy and sell productive and non-productive goods in the market at the prices p_{0i}, $i = 1, \ldots, M$, and p_{1j}, $j = 1, \ldots, N$.

2.3 A Prior Agency Model

The prior agency literature is based only on cash compensation (for a review of classic agency models, see Christensen and Feltham, 2005), and researchers work with a utility function of cash $\hat{u}(c_{10})$. This utility function can be viewed as a derived function, based on the agent's utility for consumption goods and the optimal use of the cash to purchase consumption goods. All the consumption goods are purchased from the market by the agent, i.e., $\boldsymbol{c}_1 = \boldsymbol{m}_1$, $\boldsymbol{w}_1 = 0$.

At the end of the period, for a realized performance measure $y \in Y$, the agent is paid cash compensation, and she trades to maximize her utility. Her problem is as follows:

$$\hat{u}(c_{10}(y)) = \max_{(c_{11}(y),\ldots,c_{1N}(y))} u(c_{11}(y),\ldots,c_{1N}(y))$$

$$s.t. \quad (BC) \quad c_{10}(y) - \sum_{j=1}^{N} c_{1j}(y) p_{1j} \geq 0 \qquad (2.3.1)$$

Since u is increasing in c_{1j}, the budget constraint (2.3.1) is binding. Hence, we can rewrite c_{11} and derive an unconstrained problem as shown below.

$$c_{11}(y) = \frac{1}{p_{11}}\left(c_{10}(y) - c_{12}(y)p_{12} - c_{13}(y)p_{13} - \ldots - c_{1N}(y)p_{1N}\right).$$

$$\hat{u}(c_{10}(y)) = \max_{(c_{12}(y),\ldots,c_{1N}(y))} u\left(\frac{1}{p_{11}}(c_{10}(y) - c_{12}(y)p_{12} - \ldots - c_{1N}(y)p_{1N}), c_{12}(y),\ldots,c_{1N}(y)\right).$$

Assume that $u(\boldsymbol{c})$ is strictly concave in c_{1j}, $j = 0, 1, \ldots, N$. The optimal interior solution[6] obtained from the first-order conditions is identical to the solution to a classic consumer's consumption choice problem, i.e., for any realized performance measure $y \in Y$,

$$\frac{u_{c_{1j}}(c_1(y))}{u_{c_{1k}}(c_1(y))} = \frac{p_{1j}}{p_{1k}}, j,k = 1,\ldots,N, j \neq k. \qquad (2.3.2)$$

The marginal rate of substitution between any two consumption goods is equal to the price ratio.

With this derived utility for cash, it is assumed the agent obtains consumption goods from the market. The principal's optimization problem P2.3.1 is as follows (I assume additive disutility of effort for simplicity; the results are valid with exponential utility.):

6 If we assume $\left.\partial u(c(y)) \middle/ \partial c_{1j}(y)\right|_{c_{1j}=0} = \infty$, the solution will be interior.

$$\max_{c_{10},a} \quad U^p(c_{10},a) \equiv \int [x - c_{10}(y)]\phi(x,y \mid a)dxdy$$

$s.t.$

$$(PC) \quad \hat{U}^a(c_{10},a) \;\equiv\; \int \hat{u}(c_{10}(y))\,\phi(y \mid a)dy - v(a) \;\geq\; \underline{U} \qquad (2.3.3)$$

$$(AIC) \quad a \;=\; \arg\max_{\tilde{a}} \;\; \hat{U}^a(c_{10},\tilde{a}) \qquad (2.3.4)$$

The principal maximizes his payoff with respect to the agent's action and cash compensation. To induce the agent to accept the contract, the expected payoff to the agent must be no less than her reservation utility, as shown in the participation constraint (PC). Also, given the contract, the agent must not be better off choosing any other action than the one designated, as represented by the action incentive compatibility constraint (AIC).

Rather than paying cash, the principal can pay directly in terms of consumption goods which he acquires from the market. The principal's optimization problem P2.3.2 becomes

$$\max_{w_1,a} \quad U^p(w_1,a) \equiv \int [x - \sum_{j=1}^{N} w_{1j}(y)p_{1j})]\,\phi(x,y \mid a)dxdy$$

$s.t.$

$$(PC) \quad U^a(w_1 + m_1, a) \;\equiv\; \int u(w_1(y) + m_1(y))\,\phi(y \mid a)dy - v(a) \;\geq\; \underline{U} \qquad (2.3.5)$$

$$(IC) \quad (a, m_1(y)) \;=\; \arg\max_{\tilde{a},\tilde{m}_1(y)} \;\; U^a(w_1 + \tilde{m}_1, \tilde{a}) \qquad \forall y \in Y$$

$$s.t. \qquad (BC) \;\; \sum_{j=1}^{N} \tilde{m}_{1j}(y)p_{1j} \;\geq\; 0 \qquad (2.3.6)$$

There are many solutions to P2.3.2 which give equivalent payoffs to both the principal and the agent. To simplify the analysis, assume that the agent cannot buy or sell the goods in the market ($\boldsymbol{m} = \boldsymbol{0}$ is assumed). Then, (2.3.6) can be replaced with (2.3.7) below.

$$(AIC) \quad a \;=\; \arg\max_{\tilde{a}} \;\; U^a(c_1,\tilde{a}) \qquad (2.3.7)$$

It will be shown below that the agent will choose $\boldsymbol{m} = \boldsymbol{0}$, i.e., the solution to the problem with constraints (2.3.5) and (2.3.7) is identical to the solution to the problem with constraints (2.3.5) and (2.3.6). To simplify the analysis, assume that the agent's action choice can be characterized by the first-order condition with respect to her action –

$U_a^a(w_1 + m_1, a) \equiv \int u(w_1(y) + m_1(y))\ \phi_a(y \mid a)\, dy = 0$. The Lagrangian function is as follows:

$$L = \int [x - \sum_{j=1}^{N} w_{1j}(y) p_{1j}]\, \phi(x, y \mid a)\, dx\, dy + \lambda\, [\int u(w_1(y) + m_1(y))\ \phi(y \mid a)\, dy - v(a) - \underline{U}]$$

$$+ \mu\, [\int u(w_1(y) + m_1(y))\ \phi_a(y \mid a)\, dy - v'(a)] \qquad (2.3.8)$$

Differentiate the Lagrangian function with respect to $w_{1j}(y)$, which gives the following:

$$\frac{\phi(x, y \mid a)}{\phi(y \mid a)} \frac{p_{1j}}{u_{c_{1j}}(c_1(y))} = \lambda + \mu \frac{\phi_a(y \mid a)}{\phi(y \mid a)}.$$

Rearranging the terms yields (2.3.2), which characterizes the agent's optimal consumption bundle from a classic consumption choice problem in a perfect market. Thus, the optimal non-cash compensation is such that the agent has no incentive to trade in the market. The principal provides the bundle the agent wants most.

The problem P2.3.2 based on consumption goods is equivalent to the problem P2.3.1 based on cash compensation, which is found in prior agency literature. The crucial conditions for this equivalency are the assumptions that the source of all the consumption goods is the market, that the agent's consumption choice does **not** affect the production outcome, and that there is **no** cost advantage – the price to the principal is equal to the price to the agent. In other words, the principal is indifferent between paying only in cash and paying in terms of cash and non-productive goods which the agent can buy from the market at the same costs as the principal. If the principal incurs administrative costs (in addition to the costs of the goods) in providing the goods, he prefers not to pay in terms of goods. The non-cash compensation we observe in the real world thus will not include a non-productive good which the agent can readily purchase from the market at the same price as the principal.

This chapter extends the prior agency literature by relaxing the three assumptions. Section 2.4 examines the optimal contract when the principal is the only source of a non-productive good. Then section 2.5 considers the case in which the consumption of a good affects the outcome – section 2.5.1 assumes that the principal is the only source of the good, while section 2.5.2 assumes that the agent can buy or sell in a perfect external market. Section 2.6 examines the solution when the principal has a cost advantage in providing a good.

2.4 The Principal is the Only Source of Non-productive Consumption Goods

2.4.1 The Principal's Optimization Problem

The previous section characterizes the solution when all the consumption goods are not productive, and are available from the market. This section assumes that the principal can produce or acquire a non-productive good, and that the principal is the only source. Assume for now that there is no external market for the good to the agent or the principal. It is demonstrated later that the optimal contract in this no-market setting leaves the agent with no incentive to trade. Here, cash is included as one element in the agent's utility function; the utility for cash represents the derived utility from all the consumption goods not paid by the principal. The principal's problem is as follows.

$$\max_{w_1,a} \quad U^p(w_1,a) \equiv \int [x - w_{10}(y) - \sum_{j=1}^{N} k_{1j}(w_{1j}(y))]\, \phi(x,y \mid a)\,dx\,dy$$

$s.t.$

$$(PC) \quad U^a(w_1,a) \;\equiv\; \int u(w_1(y))\,\phi(y \mid a)\,dy - v(a) \;\geq\; \underline{U} \qquad (2.4.1.1)$$

$$(AIC) \quad a \;=\; \arg\max_{\tilde{a}} \quad U^a(w_1,\tilde{a}). \qquad (2.4.1.2)$$

I formulate the Lagrangian function similar to the one in section 2.3. Note that in this setting, $w_1(y) = c_1(y)$. The optimal interior solution is such that

$$\frac{u_{c_{1j}}(w_1(y))}{u_{c_{1k}}(w_1(y))} \;=\; \frac{k'_{1j}(w_{1j}(y))}{k'_{1k}(w_{1k}(y))},\ j,k = 1,\ldots,N,\ j \neq k. \qquad (2.4.1.3)$$

(See the derivation in the proof to proposition 2.1 in an appendix at the end of this chapter.) The optimal compensation is such that the marginal rate of substitution between a good and cash is equal to the marginal cost of that good. The marginal rate of substitution between two goods is equal to the marginal cost ratio. The consumption choice is efficient. Even if there is an external market where the agent can trade the consumption good she receives, she has no incentive to do so. The optimal solution and agent's consumption are identical whether the agent can trade the non-productive good in the market or not.

Proposition 2.1: Assume that the principal is the only source of non-productive goods. The optimal contract is such that the marginal rate of substitution between two non-productive goods in the bundle is equal to the ratio of the marginal costs.

Proof: See an appendix to chapter 2.

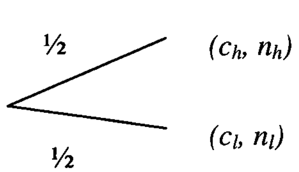
In fact, the characteristic of the optimal non-productive non-cash compensation is identical whether the principal also pays in terms of productive goods or not, as shown in section 2.5.1.1 below.

2.4.2 A Binary Example

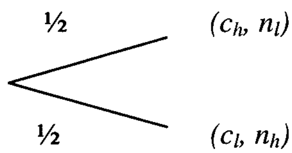
To illustrate the compensation decision, I consider a simple binary setting in which the compensation can be in terms of cash or another non-productive non-cash good, $a \in \{0, 1\}$, and $x \in \{x_L, x_H\}$, $x_H = x_L + \Delta x > x_L$. Assume that the principal wants to induce $a = 1$. If the agent chooses $a = 0$, then the outcome is x_L, i.e. $\phi(x_L|\ a = 0) = 1$. If the agent chooses $a = 1$, then the outcome realized is x_H with probability P, i.e. $\phi(x_L|a = 1) = 1 - P$ and $\phi(x_H|\ a = 1) = P$. Assume that $P \in (0, 1)$, i.e., that the outcome is an imperfect signal informing the principal of the agent's action. Let $\bar{x} = x_L + P\Delta x$. Assume that the outcome is the only performance measure available.

Consider the agent's utility function. I simplify the analysis by assuming an additively separable utility function. With a slight abuse of notation, let c represent cash, while n represent non-productive non-cash compensation the agent consumes. The agent's utility $u(c, n)$ is additively separable in c and n, i.e., $u(c, n) = u_c(c) + u_n(n)$, $u_c' > 0$, $u_c'' \leq 0$, $u_n' > 0$, and $u_n'' \leq 0$. (The utility from cash is hence a derived utility for all other consumption goods.) The main characteristic of this additively separable form is that c and n are additively independent (Keeney and Raiffa, 1993: Theorem 5.1), i.e., the agent is indifferent between the following two lotteries:

Lottery A:



Lottery B:



With a binary performance measure, the compensation consists of a fixed wage and a bonus. Let F_c denote the fixed cash wage; F_n denote the dollar amount spent on fixed non-cash wage; B_c denote the cash bonus; and B_n denote the dollar amount spent on non-cash bonus paid if $x = x_H$. The principal's objective function is thus

$$U^P(a, F, B) = x_L + P\Delta x - (1-P)[F_c + F_n] - P\,[F_c+B_c + F_n+B_n] \tag{2.4.2.1}$$

The optimal contract must be able to induce the agent to accept the contract and to choose $a = 1$ rather than $a = 0$, as represented by the participation constraint and the action incentive compatibility constraint below.

(PC) $(1\text{-}P)[u_c(F_c) + u_n(F_n)] + P\,[u_c(F_c+B_c) + u_n(F_n+B_n)] - v(a=1) \geq \underline{U}$.

(AIC) $(1\text{-}P)[u_c(F_c) + u_n(F_n)] + P\,[u_c(F_c+B_c) + u_n(F_n+B_n)] - v(a=1) \geq$

$u_c(F_c) + u_n(F_n) - v(a=0)$.

Note that since we assume an additively separable utility function, the utility function with respect to non-cash compensation and its cost function can be combined and written as a composite function based on the dollars spent on the good. In other words, from the utility function $u_n^q(n^q)$ and the cost function $k_n^q(n^q)$ defined in terms of the quantity of the good n^q, we can write a composite function $u_n(n) = u_n^q(k_n^{q\text{-}1}(n))$, where $k_n^{q\text{-}1}$ is an inverse of k_n^q and $n = k_n^q(n^q)$ is the dollar spent on the good. With this composite utility function, the principal basically decides how to spend each additional dollar to compensate the agent for her cost of effort – simply pay $\$1$ or use that $\$1$ to acquire the good to pay the agent, with (PC) and (AIC) specifying the amounts of fixed wage and bonus he needs to pay.

Since the principal's payoff is decreasing in the compensation paid to the agent, both constraints are binding. With (AIC) binding, we have $P[u_c(F_c+B_c)+u_n(F_n+B_n) - (u_c(F_c)+u_n(F_n))] = v(a=1) - v(a=0) = \Delta v$. Substitute the preceding into the participation constraint, we have $u_c(F_c)+ u_n(F_n) = \underline{U} + v(a=0)$. Let w_c denote the inverse of u_c, i.e., $w_c \equiv u_c^{-1}$. We can rewrite the two constraints as shown below:

$$F_c \quad = \quad w_c(\underline{U} + v(a=0) - u_n(F_n)) \tag{2.4.2.2}$$

$$F_c + B_c \quad = \quad w_c(\underline{U} + v(a=0) + \Delta v/P - u_n(F_n + B_n)) \tag{2.4.2.3}$$

Substitute (2.4.2.2) and (2.4.2.3) into (2.4.2.1) and solve for the solution. The interior solution is such that (2.4.1.3) is true, i.e.,

$$u_n'(F_n^*) = u_c'(F_c^*) \tag{2.4.2.4}$$

$$u_n'(F_n^* + B_n^*) = u_c'(F_c^*+B_c^*). \tag{2.4.2.5}$$

The optimal compensation contract depends on the slopes and concavity of u_c and u_n. The principal chooses to pay each additional $\$1$ where it creates greater utility to the agent. To illustrate, I show the optimal contracts in different settings below.

Both u_c and u_n are Linear

When both u_c and u_n are linear, we have a corner solution, in which the principal pays either in cash or in non-cash terms. Let $u_c(c) = c$ and $u_n(n) = \omega n$. With linear utilities, the solution depends on the slopes of u_c and u_n. When $\$1$ spent purchasing the non-cash for compensation has the value $\omega > 1$ to the agent, the principal is better off spending $\$1$ to acquire the good to pay the agent than simply paying her $\$1$. In other words, $F_c^* = B_c^* = 0$, $F_n^* = (\underline{U} + v(a=0))/\omega$, and $B_n^* = \Delta v/P\omega$. Otherwise, the principal pays only cash (i.e., $F_c^* = \underline{U} + v(a=0)$, $B_c^* = \Delta v/P$, and $F_n^* = B_n^* = 0$).

Either u_c or u_n is Linear

Consider the case in which the agent's utility with respect to cash u_c is linear while her utility with respect to non-cash compensation u_n is concave. (The analysis when u_c is concave while u_n is linear is similar.) Assume that $u_n'(0)= \infty$, which implies that it is optimal for the principal to pay at least some of the fixed wage in non-cash terms. Whether the principal will pay the whole fixed wage and bonus in terms of the good depends on the slope and concavity of u_n. If n^+ from $u(n^+) = \underline{U} + v(a=0)$ is such that $u_n'(n^+) \leq 1$, the optimal interior solution is as follows:

$$F_n^* \text{ such that } u_n'(F_n^*) = u_c'(F_c^*) = 1\,,\ B_n^{\$*} = 0,$$
$$F_c^* = \underline{U} + v(a=0) - u_n(F_n^*), \text{ and } B_c^* = \Delta v/P.$$

The fixed non-cash compensation F_n^* is chosen such that the marginal utility from the dollars spent on non-cash compensation is equal to the marginal utility from cash compensation. Paying a non-cash bonus is not optimal, since for $n > F_n^*$, the incremental benefit from $\$1$ paid to acquire the non-cash compensation is less than the incremental benefit from paying $\$1$ to the agent, due to the concavity of u_n. Similarly, the principal cannot improve his payoff by choosing $F_n < F_n^*$ and $B_n > 0$, due to the concavity of u_n.

Consider a case in which the slope of u_n at n^+ from $u(n^+) = \underline{U} + v(a=0)$ is greater than one, but the slope of u_n at n^{++} from $u(n^{++}) = \underline{U} + v(a=0) + \Delta v/P$ is less than one. With $u_n'(n^+) > 1$ but $u_n'(n^{++}) < 1$, the principal pays all the fixed wage and part of the bonus in terms of the good, i.e., F_n^* is chosen such that $u_n(F_n^*)= \underline{U} + v(a=0)$, and B_n^* is chosen such that $u_n'(F_n^*+B_n^*) = 1$. The principal also pays a cash bonus $B_c^* = \Delta v/P - [u_n(F_n^*+B_n^*) - u_n(F_n^*)]$.

If the marginal utility from non-cash is still higher than 1 even when he pays all compensation in terms of the good, he pays a fixed wage and a bonus only in terms of the good. In other words, if n^{++} from $u(n^{++}) = \underline{U} + v(a=0) + \Delta v/P$ is such that $u_n'(n^{++}) \geq 1$, the principal pays both a fixed wage and a bonus only in non-cash terms, i.e., F_n^* is such that $u_n(F_n^*) = \underline{U} + v(a=0)$, and B_n^* is such that $u_n(F_n^*+B_n^*) - u_n(F_n^*) = \Delta v/P$. This is a setting where u_n is very steep.

If the principal is limited to paying only cash compensation, his expected payoff with linear u_c is $\bar{x} - \underline{U} - v(a=1)$. When he has a facility to produce the good as well, his payoff increases to $\bar{x} - \underline{U} - v(a=1) + (1-P)[u_n(F_n^*) - F_n^*] + P[u_n(F_n^*+B_n^*) - F_n^* - B_n^*]$;[7] i.e., he can reduce the total compensation by the amount of the agent's consumption surplus from non-cash compensation, which is $[u_n(F_n^*) - F_n^*] + P[u_n(F_n^*+B_n^*) - u_n(F_n^*) - B_n^*]$.

Both u_c and u_n are Concave

When both the agent's utility with respect to cash u_c and her utility with respect to non-cash compensation u_n are strictly concave, the optimal solution is determined by the slopes and the concavity of u_c and u_n. To simplify the analysis, I assume that either $u_c'(m) > u_n'(m)$ for all $m \in R^+$ or vice versa - the two utility functions do not cross.

From (2.4.2.2) and (2.4.2.3), if the principal is limited to paying cash compensation, the total payoff to the agent when $x = x_L$ and when $x = x_H$ are $u_c(F_c^{**}) = \underline{U} + v(a=0)$ and $u_c(F_c^{**}+B_c^{**}) = \underline{U} + v(a=0) + \Delta v/P$ respectively. Now examine whether the principal can improve his payoff by paying non-cash compensation. Since the marginal utility from cash is diminishing, if the principal pays only in cash, the latter dollar is less and less valuable to the agent. The principal then may want to pay some in the good to benefit from the fact that for a small amount of the good, the marginal utility from non-cash compensation is still high.

When the slopes of u_c and u_n differ vastly, the principal pays either cash or non-cash compensation. Consider Figure 1a. The slope of u_c at $F_c^{**} + B_c^{**}$ for $u_c(F_c^{**} + B_c^{**}) = \underline{U} + v(a=0) + \Delta v/P$ is still greater than the slope of u_n at the origin, i.e., $u_c'(F_c^{**} + B_c^{**})$

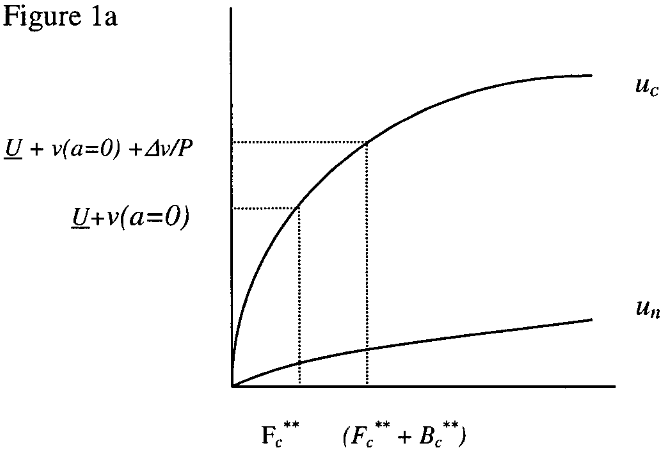
---

7 Assume that n is measured in terms of dollars spent on non-cash compensation. With linear u_c, (2.4.2.2) and (2.4.2.3) become $F_c = \underline{U} + v(a=0) - u_n(F_n)$, and $F_c + B_c = \underline{U} + v(a=0) + \Delta v/P - u_n(F_n + B_n)$. This implies $B_c = \Delta v/P - [u_n(F_n + B_n) - u_n(F_n)]$. Substitute F_c and B_c into the objective function, we have

$$\begin{aligned} U^P(a, F, B) &= x_L + P\Delta x - [F_c + F_n] - P[B_c + B_n] \\ &= x_L + P\Delta x - \underline{U} - v(a=1) + [u_n(F_n) - F_n] + P[u_n(F_n+B_n) - u_n(F_n) - B_n] \\ &= x_L + P\Delta x - \underline{U} - v(a=1) + (1-P)[u_n(F_n) - F_n] + P[u_n(F_n+B_n) - F_n - B_n]. \end{aligned}$$

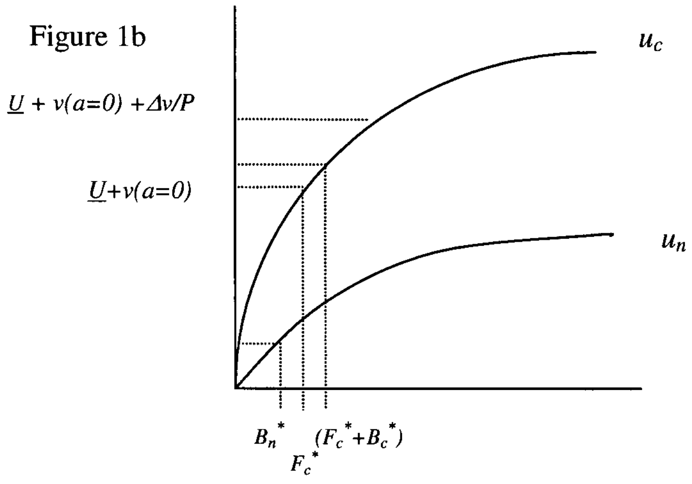
$> u_n'(0)$. In other words, the marginal benefit from spending money as cash compensation is higher than the marginal benefit from purchasing the non-cash to pay as compensation, even when the principal pays all the compensation in terms of cash. Therefore, the principal only pays in cash. The opposite is true when the slope of u_n is much higher than the slope of u_c.

Figure 1a



Consider Figure 1b. The slope of u_c at F_c^{**} for $u_c(F_c^{**}) = \underline{U} + v(a=0)$ is greater than the slope of u_n at the origin, but the slope of u_c at $(F_c^{**}+B_c^{**})$ for $u_c(F_c^{**}+B_c^{**}) = \underline{U} + v(a=0) + \Delta v/p$ is less than the slope of u_n at the origin, i.e., $u_c'(F_c^{**} + B_c^{**}) < u_n'(0)$, but $u_c'(F_c^{**}) > u_n'(0)$. Therefore, the principal pays a fixed wage only in cash, but pays both cash and non-cash bonuses. The optimal fixed cash wage F_c^*, the cash and non-cash bonuses (B_c^* and B_n^* respectively) are such that $u_n'(F_n^* + B_n^*) = u_c'(F_c^*+B_c^*)$ is true. Again, the opposite is true when the slope of u_n is much larger than the slope of u_c.

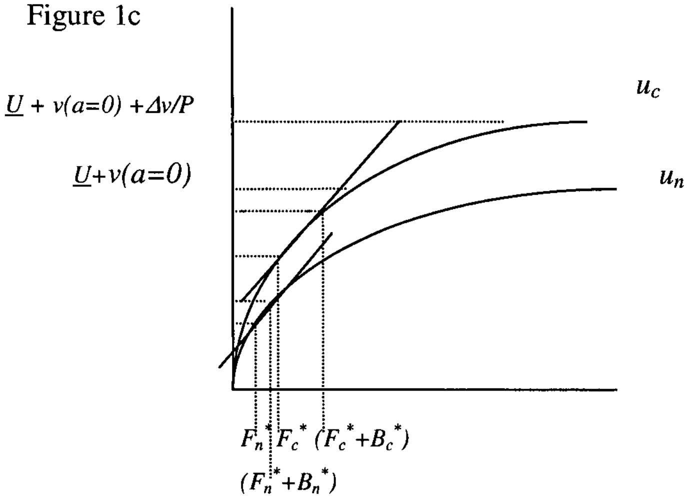
Figure 1b



Goods in consideration can be separated into necessity and non-necessity goods. By the word necessity goods, I mean the goods necessary for survival and for living a normal life in today's society. Examples of necessity goods include food, shelter, medical services, clothes, transportation, etc. The corner solutions above can be found in the settings in which (i) the good is a non-necessity good such that $u_n'(0)$ is finite (compared to $u_n'(0) = \infty$ for necessity goods), and the agent does not like the good very much (i.e., $u_n'(0)$ is not large); or (ii) the utility u_n is defined over the level of consumption beyond the survival level rather than the total consumption. The discussion above implies that when there are many goods to choose from, the principal chooses to pay in terms of the good which the agent likes more (i.e., the item with a large $u_n'(0)$) rather than the one she likes less.

When the slopes of u_c and u_n do not differ greatly (i.e., when $u_c'(F_c^{**}+B_c^{**}) < u_c'(F_c^{**}) < u_n'(0)$, for $u_c(F_c^{**}) = \underline{U} + v(a=0)$ and $u_c(F_c^{**}+B_c^{**}) = \underline{U} + v(a=0) + \Delta v/p$), we have an interior solution in which the principal pays fixed wages and bonuses both in cash and non-cash terms. The interior solution is characterized by the conditions $u_n'(F_n^*) = u_c'(F_c^*)$, and $u_n'(F_n^*+B_n^*) = u_c'(F_c^*+B_c^*)$. (See Figure 1c.) The optimal amounts of cash and non-cash compensation are determined by both the slopes and the degrees of concavity of the two utility functions, with the marginal utilities from a fixed cash wage and from a fixed non-cash wage being equal, and the marginal utility from $(F_c^*+B_c^*)$ equal to the marginal utility from $(F_n^* + B_n^*)$.

Figure 1c



To summarize the discussion in section 2.4.2, assume that the principal is the only source of a non-productive consumption good, and that the first derivative of the agent's utility with respect to the good $u_n'(0)$ is sufficiently large. The non-cash compensation provided is determined by the slope and concavity of the utility function u_n. The principal is better off paying non-cash compensation, because the agent's consumption surplus from the good enables him to reduce the total compensation costs. To illustrate, suppose that two firms are identical, except that Firm A can produce the good and is the only source of that good, while Firm B cannot. Also, assume that cash is the only form of payment other than the good. Firm A will offer lower cash compensation, accompanied by non-cash compensation. The total compensation cost to Firm A, which is the sum of cash compensation and the cost of the good, will be lower than the total compensation cost to Firm B, which is the amount of cash compensation Firm B pays.

2.5 The Consumption Goods are Productive

From real world observations (see Appendix 2 at the end of the dissertation), a majority of the consumption goods used in compensation are productive. Examples include food, an annual group trip to boost morale and cooperation between departments, gym facilities, and health benefits, and insurance coverage that keep employees in good physical and mental health. Some of the goods are not available from the market. Examples of these productive items include the workplace atmosphere and decoration, a secretary, a leave, and on-the-job training. Other goods, like food, are readily available from the market. With access to the market, the agent can supplement the consumption bundle provided by the principal. Below, I first consider a simple setting in which there is no external market of a productive good to the agent, i.e., ***m*** is exogenously limited to zero. Next I characterize the solution when the agent has access to a perfect market.

2.5.1 The Agent Has No Access to the Market

2.5.1.1 The Principal's Optimization Problem

The principal's optimization problem P2.5.1.1 is as shown below.

$$\max_{w,a} \quad U^p(w,a) \equiv \int [x - \sum_{i=1}^{M} k_{0i}(w_{0i}) - w_{10}(y) - \sum_{j=1}^{N} k_{1j}(w_{1j}(y))]\, \phi(x,y\,|\,a,w_0)\,dx\,dy$$

$s.t.$

$$(PC) \quad U^a(w,a) \;\; \equiv \;\; \int u(w_0, w_1(y))\, \phi(y\,|\,a,w_0)\,dy - v(a) \;\; \geq \;\; \underline{U}$$

$$(AIC) \quad a \;\; = \;\; \arg\max_{\hat{a}} \quad U^a(w,\hat{a})$$

To simplify the analysis, assume the agent's action choice can be characterized by the first-order condition with respect to her action below.

$$U_a^a(w,a) \;\; \equiv \;\; \int u(w_0, w_1(y))\, \phi_a(y\,|\,a,w_0)\,dy - v'(a) \;=0\,.$$

The Lagrangian function is as follows:

$$L \;\; = \;\; \int [x - \sum_{i=1}^{M} k_{0i}(w_{0i}) - w_{10}(y) - \sum_{j=1}^{N} k_{1j}(w_{1j}(y))]\, \phi(x,y\,|\,a,w_0)\,dx\,dy$$

$$+ \;\; \lambda\,[\int u(w_0, w_1(y))\, \phi(y\,|\,a,w_0)\,dy - v(a) - \underline{U}] + \mu\,[\int u(w_0, w_1(y))\, \phi_a(y\,|\,a,w_0)\,dy - v'(a)]$$

Consider the characterization of the optimal non-productive non-cash compensation. Differentiating the Lagrangian function with respect to $w_{1j}(y)$, and rearranging the terms shows the characteristic of an interior solution below.

$$\frac{\phi(x,y\,|\,a,w_0)}{\phi(y\,|\,a,w_0)} \frac{k_{1j}'(w_{1j}(y))}{u_{c_{1j}}(w_0, w_1(y))} \;=\; \lambda + \mu \frac{\phi_a(y\,|\,a,w_0)}{\phi(y\,|\,a,w_0)}.$$

The right hand side is identical for any $w_{1j}(y)$. Therefore, for a pair of non-productive goods, and for each signal $y \in Y$ and each action $a \in A$,

$$\frac{u_{c_{1j}}(w_0, w_1(y))}{u_{c_{1k}}(w_0, w_1(y))} \;\; = \;\; \frac{k_{1j}'(w_{1j}(y))}{k_{1k}'(w_{1k}(y))},\; j,k = 1,\ldots,N,\; j \neq k.$$

The optimal condition above is similar to that in the classical consumption choice problem, where the marginal rate of substitution between any two goods is equal to the ratio of the marginal costs (i.e., the price ratio when k_{1j} is linear).

The optimal productive non-cash compensation and action are characterized by the derivatives of the Lagrangian function with respect to w_{0i} and a below.

$$\frac{\partial L}{\partial w_{0i}} = -k_{0i}'(w_{0i}) + \lambda \int [u(w_0, w_1(y))\phi_{c_{0i}}(y \mid a, w_0) + u_{c_{0i}}(w_0, w_1(y))\phi(y \mid a, w_0)]dy$$

$$+ \mu \int [u(w_0, w_1(y))\, \phi_{ac_{01}}(y \mid a, w_0) + u_{c_{0i}}(w_0, w_1(y)\phi_a(y \mid a, w_0)]dy,$$

$$\frac{\partial L}{\partial a} = U_a^P(w,a) + \lambda U_a^a(w,a) + \mu U_{aa}^a(w,a) = 0,$$

where

$$U_a^P(w,a) \equiv \int [x - \sum_{i=1}^{M} k_{0i}(w_{0i}) - w_{10}(y) - \sum_{j=1}^{N} k_{1j}(w_{1j}(y))]\, \phi_a(x, y \mid a, w_0)\, dx\, dy,$$

$U_a^a(w,a) = 0$ is as defined above, and $U_{aa}^a(w,a) \equiv \int u(w_0, w_1(y))\phi_{aa}(y \mid a, w_0)dy - v''(a)$.

To obtain further results on the nature of compensation paid, a binary model similar to the one described previously in section 2.4.2 is considered in section 2.5.1.2. To investigate both the action and the productive compensation choice, a LEN framework is considered in section 2.5.1.3.

2.5.1.2 A Binary Example

Consider a binary setting with an additively separable utility function similar to the one in section 2.4.2. The difference is that in this section, the consumption of the productive good is assumed to affect the distribution of the outcome. As before, if the agent chooses $a = 0$, the outcome realized is low with probability one. If the agent chooses $a = 1$, the probability of the high outcome is concave in the consumption of the productive good, i.e., $P(n)$ is such that $P' > 0$, $P'' < 0$. The level of consumption of a productive good affects the productivity of the agent's effort. To simplify the analysis, I assume that $u_c(c) = c$, but $u_n(n)$ is concave. I repeat the analysis as in section 2.4.2. Consider the simple case in which $\underline{U} + v(a = 0)$ is large so that the principal does not pay a non-cash bonus (i.e., the case in which n^+ from $u(n^+) = \underline{U} + v(a=0)$ is such that $u_n'(n^+) \leq 1$). The interior solution for a non-cash wage is F_n^* such that $P'(F_n^*)\Delta x + u_n'(F_n^*) = 1 = u_c'(F_c^*) =$

$u_c'(F_c^*+B_c^*)$, $B_c^*=\Delta v/P(F_n^*)$. When the good is not productive, the fixed non-cash wage F_n^{**} is chosen such that $u_n'(F_n^{**}) = u_c'(F_c^{**}) = u_c'(F_c^{**}+B_c^{**}) = 1$. Therefore, $F_n^* > F_n^{**}$. The principal pays more of a good when it is productive than when it is not productive. When the good is not productive, an additional $\$1$ paid to acquire the good benefits the principal in terms of the agent's consumer surplus. When the good is productive, the principal has direct preference for the good, because the level of consumption affects the expected outcome (and hence the expected compensation). He pays more of the good to benefit from its productivity, in addition to the consumption surplus to the agent.

2.5.1.3 A LEN Model

This section focuses on the use of productive non-cash compensation and the action choice by the principal. The analysis is simplified by excluding non-productive non-cash compensation from the analysis. Also, for simplicity, I first consider only one productive consumption good. Cash compensation paid at the end of period is denoted by w_1; the productive non-cash compensation paid at the beginning of the period is denoted by w_0. When the agent cannot buy or sell non-cash compensation, $c_0 = w_0$. The price per unit of the productive good is represented by p_0.

Consider a LEN model with a risk neutral principal, and a work-averse agent with a multiplicatively separable, exponential utility function. The agent's degree of risk aversion is denoted by r. The agent' utility function is denoted by $u(c, a) = -exp\ [-r(c_1 + \zeta c_0^{1/2} - \kappa(a)]$, where c_i, $i = 1, 0$ represents the agent's consumption, ζ is the preference parameter, and $\kappa(a)$ represents the agent's cost of effort. For simplicity, assume that $\kappa(a) = \frac{1}{2} a^2$. The agent's reservation utility is denoted by $\underline{U}$. Assume that $\underline{U} = -1$, i.e., the reservation utility in terms of certainty equivalent is zero.

The outcome from production x is normally distributed with mean $b_0\, c_0^{1/2} + b_1\, a$, and variance σ_x^2, i.e., $x = b_0\, c_0^{1/2} + b_1\, a + \varepsilon_x$, $\varepsilon_x \sim N\,(0, \sigma_x^2)$. The outcome is informative about both the agent's action and consumption of a productive good. Assume that the outcome is the only performance measure available.

Note that square-root benefit functions $\zeta c_0^{1/2}$ and $b_0 c_0^{1/2}$ with linear cost functions, rather than linear benefits with a quadratic cost function, are used here. Analytically the two are equivalent. The former is more appropriate in a perfect market setting in which the prices are constant. A linear benefit function with a quadratic cost function is not a must for LEN simplification. But we need the random component of the compensation (which is cash compensation in this setting) to be additive in the performance measures.

The agent's cash compensation w_1 is restricted to be linear in x so that the compensation is normally distributed. The fixed component is denoted by f, while the variable component is denoted by vx, i.e., $w_1 = f + v\,x$.

With the assumptions of a linear contract, exponential utility, and normally-distributed performance measure, the agent's expected utility $U^a(c, a)$ when there is no external market of the productive good can be written as

$$U(c, a) = -\exp[-r\,CE(v, f, a, w_0)],$$

$$CE(v, f, a, w_0) = f + v\,[b_0\,w_0^{1/2} + b_1\,a] + \zeta\,w_0^{1/2} - ½\,r\,v^2\sigma_x^2 - ½\,a^2.$$

This section assumes that m_0 is exogenously limited to zero. (Therefore, $c_0 = w_0$.) The agent's only choice is her action. Since maximizing the expected utility with respect to the agent's action is equivalent to maximizing the certainty equivalent with respect to her action, the agent' incentive compatibility constraint can be expressed as the first-order condition based on her certainty equivalent as follows:

(AIC) $CE_a\,(v, f, a, w_0) = b_1\,v - a = 0.$ (2.5.1.1)

With $\underline{U} = -1$, the participation constraint can be written as

(PC) $f = -v[b_0\,w_0^{1/2} + b_1\,a] - \zeta\,w_0^{1/2} + ½\,r\,v^2\,\sigma_x^2 + ½\,a^2$ (2.5.1.2)

The principal's maximization problem is as shown below.

$$\max_{f,v,a,w_0} \quad U^P(w_0,a) \equiv b_0 w_0^{1/2} + b_1 a - f - v[b_0 w_0^{1/2} + b_1 a] - p_0\,w_0$$

subject to (2.5.1.1) and (2.5.1.2).

Substitute $a = b_1 v$, and the value of f from (PC) into the objective function. The unconstrained optimization problem is

$$\max_{v,w_0} \quad U^P(w,a) \equiv b_0 w_0^{1/2} + b_1^2 v + \zeta w_0^{1/2} - \frac{1}{2} r v^2 \sigma_x^2 - \frac{1}{2}(b_1 v)^2 - p_0 w_0$$

Differentiating the principal's payoff with respect to v and w_0 gives the following solution and principal's maximized payoff in the no-market setting.

$$v^{NM} = \frac{b_1^2}{b_1^2 + r\sigma_x^2},$$

$$a^{NM} = b_1 v^{NM},$$

$$w_0^{NM} = \left(\frac{b_0 + \zeta}{2p_0}\right)^2, \text{ and}$$

$$U^P(w_0^{NM}, a^{NM}) = \frac{1}{2} b_1^2 v^{NM} + \frac{(b_0 + \zeta)^2}{4p_0}.$$

Note that v^{NM} and a^{NM} are independent of b_0, ζ or p_0. They only depend on the benefit of the effort to the principal as represented by b_1, and by the degree of risk aversion and the noise in the performance measure. This is identical to the results in the prior LEN models (Christensen and Feltham, 2005), and this is based on the production technology with the outcome additively separable in the agent's action and consumption of the good, and on the agent's utility function which exhibits no wealth effects.

In choosing w_0, note that increasing c_0 increases $E[x|a, c_0]$ and also reduces f when $\zeta > 0$. In other words, the principal benefits from both the productivity of the good and the agent's consumption surplus, which helps reduce the compensation cost. Therefore, the optimal level of productive consumption good provided is higher than the level where the marginal cost is equal to the marginal product to the principal. To an outsider, this may seem to represent an agency problem (excessive perk problem). Further discussion on the issue of perks and agency costs can be found in chapter three.

Now, suppose that the principal does not yet have the production technology to produce the good. Consider how much the principal will pay for the production technology in a single-period setting. If the principal decides not to use non-cash compensation or w_0 is exogenously limited to zero, the value of v and a is as shown above, but the principal's payoff is lower by the amount of $(b_0 + \zeta)^2/4p_0 > 0$. Therefore, when the agent cannot trade the compensation she receives, the principal wants to provide productive non-cash compensation when either b_0 or $\zeta > 0$. Also, the maximum amount the principal is willing to pay for the production facility is the incremental payoff from using the good to compensate the agent: $(b_0 + \zeta)^2/4p_0$.

Multiple Productive Goods

Suppose that there are M productive goods. The outcome function and agent's certainty equivalent are

$$x = \sum_{i=1}^{M} b_{0i} w_{0i}^{1/2} + b_1 a + \varepsilon_x, \quad \varepsilon_x \sim N(0, \sigma_x^2)$$

$$CE(v, f, a, w_0) = f + v[\sum_{i=1}^{M} b_{0i} w_{0i}^{1/2} + b_1 a] + \sum_{i=1}^{M} \zeta_i w_{0i}^{1/2} - \tfrac{1}{2} r v^2 \sigma_x^2 - \tfrac{1}{2} a^2$$

Solving for the solution in this no-market setting yields the optimal incentive rate and action identical to the ones in a single productive good setting (i.e., v^{NM} and a^{NM} are independent of the number of the goods). When the agent can trade freely in an external market, the optimal incentive rate (and hence the effort induced) increases when the number of goods in consideration increases (given that $b_{0i} > 0$ for all i), as shown below. The optimal non-cash wage in this no-market setting is as follows:

$$w_{0i}^{NM} = \left(\frac{b_{0i} + \zeta_i}{2p_{0i}}\right)^2.$$

2.5.2 Perfect External Market for Productive and Non-productive Goods

2.5.2.1 The Principal's Optimization Problem

When there is a perfect external market where the agent can trade the consumption goods, the agent can consume any bundle she likes. The principal can choose to pay any consumption bundle as a function of the performance measure; however, the final consumption choice is the one that maximizes the agent's payoff. The incentive compatibility constraint now includes two elements, the action and the agent's trades. Note that in the problem below, $\boldsymbol{c_0} = \boldsymbol{w_0} + \boldsymbol{m_0}$ and $\boldsymbol{c_1}(y) = \boldsymbol{w_1}(y) + \boldsymbol{m_1}(y)$.

$$\max_{w,a} \quad U^P(w,a) \equiv \int [x - \sum_{i=1}^{M} p_{0i}w_{0i} - w_{10}(y) - \sum_{j=1}^{N} p_{1j}w_{1j}(y)]\, \phi(x, y \mid a, w_0 + m_0)\, dx\, dy$$

$s.t.$

$$(PC) \quad U^a(c,a) \;\equiv\; \int u(w_0 + m_0, w_1(y) + m_1(y))\, \phi(y \mid a, w_0 + m_0)\, dy - v(a) \;\geq\; \underline{U}$$

$$(IC) \quad (a,m) \;=\; \arg\max_{\tilde{a},\tilde{m}} \; U^a(w + \tilde{m}, \tilde{a}).$$

$$s.t. \quad w_{10}(y) - \sum_{i=1}^{M} m_{0i}p_{0i} - \sum_{j-1}^{N} m_{1j}(y)p_{1j} \;\geq\; 0 \;\forall\; y \in Y$$

Consider the agent's ex ante maximization problem. Substituting $c_{10}(y) = w_{10}(y) - [\Sigma\, p_{0i}m_{0i} + \Sigma\, p_{1j}m_{1j}(y)]$ into the agent's objective function gives the following unconstrained problem:

$$\max_{(a, m_0, m_1(y))} \int u(w_0 + m_0, w_{10}(y) - \sum_{i=1}^{M} m_{0i}p_{0i} - \sum_{j=1}^{N} m_{1j}(y)p_{1j},$$
$$w_{11}(y) + m_{11}(y), \ldots, w_{1n}(y) + m_{1N}(y))\phi(y \mid a, w_0 + m_0)dy - v(a)$$

Assume that the optimal interior solution is characterized by the first-order conditions with respect to action and trades. Differentiating the agent's objective function with respect to $m_{1j}(y)$ yields

$$\frac{u_{c_{1j}}(c_0, c_1(y))}{u_{c_{10}}(c_0, c_1(y))} = \frac{p_{1j}}{1}, j = 1,...,N.$$

The optimal consumption choice for non-productive goods is thus identical to the solution to the classic consumer's consumption choice problem, i.e., for any realized performance measure $y \in Y$,

$$\frac{u_{c_{1j}}(c_0, c_1(y))}{u_{c_{1k}}(c_0, c_1(y))} = \frac{p_{1j}}{p_{1k}}, j,k = 1,...,N, j \neq k. \qquad (2.5.2.1)$$

The consumption choice for non-productive goods above is also optimal ex post.

Now, consider the agent's consumption choice of productive goods. Differentiating the agent's objective function by m_{0i} gives the following first order condition. The agent will buy or sell the productive goods such that the expected marginal benefit from the consumption of the productive good (which includes the improvement on the performance measure and the utility from consuming more of the productive good) is equal to the expected cost (the expected marginal utility from cash multiplied by the price of the good), i.e.,

$$\int [u(c_0, c_1(y))\phi_{c_{0i}}(y \mid a, c_0) + u_{c_{0i}}(c_0, c_1(y))\phi(y \mid a, c_0)]dy$$

$$= \quad p_{0i} \int u_{c_{10}}(c_0, c_1(y))\, \phi(y \mid a, c_0)\, dy. \qquad (2.5.2.2)$$

The choice of c_0 reflects direct preferences and indirect preferences due to compensation contract incentives.

When the agent has no access to an external market for consumption goods, as shown in section 2.5.1, the principal chooses the consumption bundle for the agent such that the first-order condition below is true.

$$\lambda \int [u(c_0, c_1(y))\phi_{c_{0i}}(y \mid a, c_0) + u_{c_{0i}}(c_0, c_1(y))\phi(y \mid a, c_0)]dy$$

$$+ \mu \int [u(c_0, c_1(y))\, \phi_{ac_{01}}(y \mid a, c_0) + u_{c_{0i}}(c_0, c_1(y)\phi_a(y \mid a, c_0)]dy = p_{0i}. \qquad (2.5.2.3)$$

From (2.5.2.2) and (2.5.2.3), one can see that in general the consumption choices are different when the agent has and does not have access to an external market. Compare the setting when the agent has no access to the market with the setting when she can trade the goods. When the agent has no access to the market, the consumption is chosen such that the "marginal product" to the principal plus the marginal utility to the agent is equal to the marginal cost of the good (see the binary example). The agent's ability to trade generally makes the principal worse off. When the agent has access to a perfect market, she will sell some of the productive good to make the marginal benefit from its direct effect on her utility and its indirect effect on the distribution of her compensation (rather than the distribution of the principal's outcome) equal to her "marginal cost". (See the left-hand side and the right-hand side of (2.5.2.2) respectively.) Additionally, in the analysis in section 2.5.1.3 above, I simplify the analysis by using a simple outcome function – the outcome is additively separable in the agent's action and consumption. With a more complicated outcome function, we may face the problem of the agent trading to undo the incentive risk the principal puts in the compensation to induce the designated action.

A special case in which the principal is not worse off for the agent's ability to trade productive goods is the setting in which $u_{c_{10}}(c_0, c_1(y))=1$. With $u_{c_{10}}(c_0, c_1(y))=1$, the principal can sell the firm to the agent to make the agent the residual claimant; this eliminates the moral hazard problem with respect to both action and consumption.

To obtain further results on the optimal compensation and action choice when the agent is risk averse with respect to cash, I again consider a LEN framework below.

2.5.2.2 A LEN Model with a Perfect Market

Assume that the agent can buy and sell freely in an external perfect market. The agent who receives w_0 can sell or purchase the good at price p_0. The net amount of cash received/paid is $p_0 m_0$.

The agent's total payoff is $f + vx + \zeta c_0^{1/2} - p_0 m_0$, where $c_0 = w_0 + m_0$. Her certainty equivalent is thus

$$CE(v, f, a, c_0) = f + v[(b_0 c_0^{1/2} + b_1 a] - p_0 m_0 + \zeta c_0^{1/2} - ½\ r v^2 \sigma_x^2 - ½\, a^2$$

The agent's optimal choice of action and consumption of the productive good can be represented by the following incentive compatibility constraints.

$$\text{(AIC)}\quad CE_a(v, f, a, c_0) = b_1 v - a = 0. \tag{2.5.2.4}$$

$$\text{(CIC)}\quad CE_{m_0}(v, f, a, c_0) = (b_0 v + \zeta)/[2 (w_0 + m_0)^{1/2}] - p_0 = 0. \tag{2.5.2.5}$$

With $\underline{U} = -1$, the participation constraint can be written as

$$\text{(PC)} \quad f = -v\,[b_0 c_0^{1/2} + b_1 a] + p_0 m_0 - \zeta c_0^{1/2} + \tfrac{1}{2} r v^2 \sigma_x^2 + \tfrac{1}{2} a^2 \qquad (2.5.2.6)$$

The principal maximization problem is as follows:

$$\max_{f,v,a,w_0} \; U^P(w,a) \equiv b_0 c_0^{1/2} + b_1 a - f - v[b_0 c_0^{1/2} + b_1 a] - p_0 w_0$$

subject to (2.5.2.4), (2.5.2.5), and (2.5.2.6).

From (2.5.2.4), $a = b_1 v$. From (2.5.2.5), $m_0 = [(b_0 v + \zeta)/2p_0]^2 - w_0$. For whatever amount of productive good provided, the agent's consumption of the productive good is thus $c_0 = m_0 + w_0 = [(b_0 v + \zeta)/2p_0]^2$. Therefore, when the market is perfect, there is no additional benefit for the principal from providing the productive non-cash compensation (rather than having the agent purchase the good from the market). The principal's payoff is independent of the amount of productive non-cash compensation paid. In this setting, it is as if the principal exogenously could not pay in terms of the productive good.

Substituting $a = b_1 v$, $m_0 = [(b_0 v + \zeta)/2p_0]^2 - w_0$, and the value of f from (PC) into the objective function yields the following unconstrained optimization problem

$$\begin{aligned}
\max_{v,w_0} U^P(w,a) &= b_0\left(\frac{vb_0+\zeta}{2p_0}\right) + b_1^2 v - p_0\left(\frac{vb_0+\zeta}{2p_0}\right)^2 + \zeta\left(\frac{vb_0+\zeta}{2p_0}\right) - \frac{1}{2} r v^2 \sigma_x^2 - \frac{1}{2}(b_1 v)^2 \\
&= (b_0+\zeta)\left(\frac{vb_0+\zeta}{2p_0}\right) - p_0\left(\frac{vb_0+\zeta}{2p_0}\right)^2 + b_1^2 v - \frac{1}{2} r v^2 \sigma_x^2 - \frac{1}{2}(b_1 v)^2
\end{aligned}$$

Differentiating the principal's payoff with respect to v shows the following solution and the principal's maximized payoff in the perfect-market setting.

$$\begin{aligned}
v^{PM} &= \frac{b_1^2 + b_0^2/2p_0}{b_1^2 + r\sigma_x^2 + b_0^2/2p_0} > v^{NM}, \\
a^{PM} &= b_1 v^{PM} > a^{NM}, \\
\textit{any } w_0^{PM} &\geq 0, \text{ and}
\end{aligned}$$

$$U^P(w_0^{PM}, a^{PM}) = \frac{1}{2}\left(b_1^2 + \frac{b_0^2}{2p_0}\right)v^{PM} - \frac{b_0^2}{2p_0} v^{PM}\left(1 - \frac{v^{PM}}{2}\right) + (b_0+\zeta)\frac{(b_0 v^{PM}+\zeta)}{2p_0} - \frac{(b_0 v^{PM}+\zeta)^2}{4p_0},$$

where $c_0^{PM} = [(b_0 v^{PM} + \zeta)/2p_0]^2$.

The incentive rate v^{PM} is now a function of b_1, r, and σ_x^2, as in the prior LEN models. In addition, v^{PM} is a function of b_0 and p_0. This is because the principal uses v^{PM} not only to induce the productive effort, but also to induce a desired level of consumption. The incentive rate v^{PM} is increasing in b_0 but decreasing in p_0.

Comparison of the No-market and Perfect-market Settings

Proposition 2.2: Assume a LEN framework and assume that the good considered is productive. Also, assume that the outcome is contractible and is the only performance measure. The incentive rate when the agent has no access to the market is lower than when the agent can buy or sell in a perfect market.

Proof: $v^{PM} - v^{NM} = \dfrac{r\sigma_x^2(b_0^2/2p_0)}{(b_1^2 + r\sigma_x^2)(b_1^2 + r\sigma_x^2 + b_0^2/2p_0)} > 0.$

Recall that the interior solution in the no-market setting is such that $a^{NM} = b_1 v^{NM}$, $v^{NM} = \dfrac{b_1^2}{b_1^2 + r\sigma_x^2}$, and $w_0^{NM} = \left(\dfrac{b_0 + \zeta}{2p_0}\right)^2$. As the good is more productive, the good is more desirable to the agent, and the cost is lower, the principal provides more of the good.

This section assumes instead that the good is available from a perfect market. It is shown above that the principal does not strictly prefer to provide the good (because the agent can buy or sell freely to undo the compensation bundle offered). To motivate the agent to consume more to improve the production outcome, the principal uses more cash incentive (e.g., larger bonus or higher commission rate). Compared with the setting with no external market, the pay-performance sensitivity in the perfect-market setting is higher. This is to induce the agent to internalize the benefit of the productive consumption good to the principal, as discussed above. As the good is more productive and its price is lower, the principal uses greater cash incentive to motivate greater consumption. However, even with higher pay-performance sensitivity, the level of consumption of the productive good here is still lower than that in the no-market setting, i.e., $c_0^{PM} < w_0^{NM}$. The principal also induces higher effort from the agent (intuitively to compensate for the lower consumption of the productive goods.)

The Agent's Ability to Trade and the Principal's Payoff

Recall the discussion at the end of section 2.5.2.1. A special case in which the principal is not worse off for the agent's ability to trade productive goods is the setting in which $u_{c_{10}}(c_0, c_1(y)) = 1$, i.e., the agent is "risk neutral" with respect to cash so that the principal can "sell" the firm to the agent to solve the hidden action and "hidden consumption" problems. The LEN model implies a similar point.

If the action is contractible (i.e., no hidden action), the solution in the no-market setting is $v^{NM} = 0$, $a^{NM} = b_1$, and $w_0^{NM} = \left(\frac{b_0 + \zeta}{2p_0}\right)^2$. The principal does not need to put incentive in the compensation to induce the desired action, and he can choose any consumption level he likes. The principal's expected payoff is the first-best payoff, i.e., $U^P(w, a) = \frac{1}{2}b_1^2 + (b_0 + \zeta)^2/4p_0$. In contrast, the solution in the perfect market setting is $a^{PM} = b_1$, $v^{PM} = \frac{b_0^2/2p_0}{r\sigma_x^2 + b_0^2/2p_0}$, and $c_0^{PM} = [(b_0 v^{PM} + \zeta)/2p_0]^2$. With no moral hazard, the incentive in the compensation is to induce only the desired level of consumption. As the agent's degree of risk aversion r and the noise in performance measure σ_x^2 is closer to zero, the principal's payoff in the perfect market setting rises closer to the first-best payoff in the no-market setting.

Multiple Productive Goods

Suppose that there are M productive goods. The outcome function and agent's certainty equivalent are as follows:

$$x = \sum_{i=1}^{M} b_{0i} w_{0i}^{1/2} + b_1 a + \varepsilon_x, \quad \varepsilon_x \sim N(0, \sigma_x^2),$$

$$CE(v, f, a, w_0) = f + v[\sum_{i=1}^{M} b_{0i} c_{0i}^{1/2} + b_1 a] + \sum_{i=1}^{M} \zeta_i c_{0i}^{1/2} - \tfrac{1}{2} r v^2 \sigma_x^2 - \tfrac{1}{2} a^2 - \sum_{i=1}^{M} p_{0i} m_{0i}$$

The optimal solution is

$$v^{PM} = \frac{b_1^2 + \sum_{i=1}^{M} [b_{0i}^2/2p_{0i}]}{b_1^2 + r\sigma_x^2 + \sum_{i=1}^{M} [b_{0i}^2/2p_{0i}]} > v^{NM},$$

$$a^{PM} = b_1 v^{PM} > a^{NM}, \text{ and}$$

$$c_{0i}^{PM} = \left(\frac{v^{PM} b_{0i} + \zeta_i}{2p_{0i}}\right)^2.$$

If $b_{0i} > 0$ for all i, $\sum_{i=1}^{M} [b_{0i}^2/2p_{0i}]$ increases as the number of productive goods increases. This results in a larger incentive rate as well because

$$\frac{\partial v^{PM}}{\partial \sum_{i=1}^{M}[b_{0i}^2/2p_{0i}]} = \frac{r\sigma_x^2}{[b_1^2 + r\sigma_x^2 + \sum_{i=1}^{M}[b_{0i}^2/2p_{0i}]]^2} > 0.$$

Compare with a single productive good setting, in a multiple productive good setting, $b_0/2p_0$ is replaced by $\sum_{i=1}^{M}[b_{0i}^2/2p_{0i}]$. It is as if we could work with a single "combined" productive good. A more complicated outcome function and the agent's utility function should lead to more interesting results and insights.

The analysis above implies that, if a particular job involves a greater number of productive goods for which there is a perfect market, the principal uses larger cash incentive (i.e., a higher incentive rate). To illustrate, consider a fashion model. The productivity of a model depends much on her looks, which in turn depends on her consumption of healthy food, good-quality toiletry, good moisturizers and make-up, and sufficient personal training at a gym, etc. All these goods and services are available from the market and they can be sold. For example, the modeling agency can pay in terms of premium moisturizers, but the model can return them to a department store for full refund, if the department store does not require a receipt. The theoretical result implies that we will observe much use of cash incentive in a model's compensation contract, rather than a fixed salary.

2.5.2.3 A LEN Model Where the Agent Can Buy But Cannot Sell (Limited Market)

Assume that m_0 is exogenously limited to be weakly positive. I refer to this as a limited market setting. From Section 2.5.2.2, with a perfect market, the agent optimally chooses to consume $c_0^{PM} = [(b_0 v^{PM} + \zeta)/2p_0]^2$.

In section 2.5.1, with no external market, the principal provides $w_0^{NM} = [(b_0+\zeta)/2p_0]^2$ which is greater than c_0^{PM} (note that $v^{PM} \in (0,1)$). Therefore, if the principal pays $w_0^{NM} = [(b_0+\zeta)/2p_0]^2$, the agent wants to sell some of her goods, if she can.

If the principal can prevent the agent from selling the productive non-cash compensation [or if there are market frictions (e.g., transaction costs) such that the agent prefers not to trade], the optimal solution in this limited market setting is similar to the one assuming no external market. Simply limiting the agent from selling is adequate to prevent trading if the principal wants to use non-cash compensation to boost the productive outcome.

Proposition 2.3: Assume that the agent has access to a perfect market, and assume that the agent is paid the optimal no-market compensation bundle. The agent will sell some of the productive good. The principal is better off if he can prevent the agent from selling the productive good.

Proof: See the discussion above.

As discussed above, given that the principal does not have a cost advantage, he prefers to pay in terms of a good when the good is not available from the market, since he can reduce the total compensation cost. The principal does not prefer to pay in terms of goods, either productive or non-productive, which are available from the perfect market. (In case of a productive good, this is because the agent can trade to undo the bundle he pays. In case of a non-productive good, this is because there is no benefit from paying in terms of the good anyway.)

Suppose that the productive good is available from the market. Proposition 2.3 implies that, given no cost advantages, if the principal can prevent the agent from selling the productive goods in the market so that he becomes the only source, the principal will do so. If he can preclude the sales, he will pay in terms of the productive goods.

Therefore, in the real world, given that the principal has no cost advantages in providing the good, if we observe that the principal provides a productive good which is available from the market, we should also observe that the principal prevents the agent from selling that good. For example, meals are usually allowed to be consumed only on premise. In-house medical services are allowed only for employees themselves.

2.5.2.4 A LEN Model When the Outcome is Not Contractible

In the LEN model above, I assume that the outcome is the only performance measure. In this section, I assume that the outcome is not contractible. The principal must contract with the agent based on the performance measure y instead. Suppose that the outcome from production x is normally distributed with mean $b_{0x}c_0^{1/2} + b_{1x}a$, and variance σ_x^2, i.e., $x = b_{0x}c_0^{1/2} + b_{1x}a + \varepsilon_x$, $\varepsilon_x \sim N(0, \sigma_x^2)$. Assume that measure y is normally distributed with mean $b_{0y}c_0^{1/2} + b_{1y}a$, and variance σ_y^2, i.e., $y = b_{0y}c_0^{1/2} + b_{1y}a + \varepsilon_y$, $\varepsilon_y \sim N(0, \sigma_y^2)$.

I repeat the analysis similar to the one above. (See the derivation of the solution in the appendix to this chapter.) The optimal contract in the no-market setting is as shown below:

$$v^{NM,y} = \frac{b_{1x}b_{1y}}{b_{1y}^2 + r\sigma_y^2},$$

$$a^{NM,y} = b_{1y}v^{NM,y}, \text{ and}$$

$$w_0^{NM,y} = \left(\frac{b_{0x} + \zeta}{2p_0}\right)^2,$$

The incentive rate $v^{NM,y}$ is decreasing in σ^2_y. It is increasing in b_{1y} if $r\sigma^2_y > b_{1y}^2$ (see the proof to proposition 2.4 in the appendix to this chapter). The agent's consumption is efficient, i.e., it maximizes total welfare.

The optimal contract in the perfect-market setting is as follows:

$$v^{PM,y} = \frac{b_{1x}b_{1y} + b_{0x}b_{0y}/2p_0}{b_{1y}^2 + r\sigma_y^2 + b_{0y}^2/2p_0},$$

$$a^{PM,y} = b_{1y}v^{PM,y}, \text{ and}$$

$$c_0^{PM,y} = \left(\frac{v^{PM,y}b_{0y} + \zeta}{2p_0}\right)^2.$$

The incentive rate $v^{PM,y}$ is decreasing in σ^2_y. It may be increasing or decreasing in b_{0y} and b_{1y}, depending on the value of all the exogenous variables.

The results on the derivatives of incentive rates above are summarized in Proposition 2.4 below.

Proposition 2.4: Assume that the outcome from production is not contractible. When the agent has no access to an external market of a productive good, the incentive rate $v^{NM,y}$ is decreasing in σ^2_y, and is independent of b_{0y}. It may be increasing or decreasing in b_{1y}. When the agent has access to a perfect market, the incentive rate $v^{PM,y}$ is decreasing in σ^2_y, but it may be increasing or decreasing in b_{0y} and b_{1y}.

Proof: See an appendix to this chapter.

To show a real world example in which the incentive rate may be decreasing in b_{0y}, consider an advertising firm in which the long-term profit or the real firm's value is not contractible. Clients' feedback is available for contracting. A copywriter can improve the firm's profit by working very hard to create a great advertisement, which will also lead to good feedback. Nonetheless, she can also work not as hard, but instead spend more resources to entertain the clients to obtain good feedback. Entertainment may help retain the clients, but not as much as good work. If the client's feedback is influenced a great deal by the copywriter's "pampering," the firm may find it optimal not to depend much on the clients' feedback to compensate the copywriter.

The situation described above is similar to window dressing in Feltham and Xie (1994). In Feltham and Xie (1994), the performance measure is dependent on two actions, a productive action and a non-productive action. In that setting, because payment to the agent is based on such a performance measure, the agent has an incentive to boost the performance measure by taking the non-productive action. This is costly to the principal since he also needs to compensate the agent for the cost of the non-productive action. The principal chooses a lower incentive rate (and hence induces less productive effort) when the performance measure is also dependent on the non-productive action.

Here, the principal wants to induce a productive action, and the consumption of a productive good. A specific level of consumption is desirable. When the outcome is contractible and can be used as a ("perfectly congruent") performance measure, the principal's concern is that the agent will consume too little. In a perfect market setting in which he cannot control the agent's consumption, he thus optimally chooses a higher incentive rate than he does when the agent cannot trade. The perfect-market incentive rate is increasing in b_{0x}. On the other hand, when the outcome is not contractible (so that he has to use another performance measure), his concern also includes the case in which the agent consumes too much to boost the performance measure. Therefore, the incentive rate may be decreasing in b_{0y}.

Measure of "Congruity"

Consider the ratios of the action and the consumption of productive good when x is contractible and when x is not contractible below.

$$\frac{a^{PM}}{c_0^{PM}} = \frac{b_{1x}v^{PM}}{[(b_{0x}v^{PM}+\zeta)/2p_0]^2},$$

$$\frac{a^{PM,y}}{c_0^{PM,y}} = \frac{b_{1y}v^{PM,y}}{[(b_{0y}v^{PM,y}+\zeta)/2p_0]^2}.$$

The allocation of resources on the action and the productive good is not simply represented by the ratio b_{1y}/b_{0y}. Even when the outcome function is additively separable in the action and the consumption of the productive good, the difference in allocation when x is contractible and when the contract is based on y can not be learned by simply comparing b_{1x}/b_{0x} with b_{1y}/b_{0y}. The measure of congruity in a productive good setting should be defined taking the agent's utility function (and possibly the price of the productive good) into consideration (in addition to the outcome function). The difficulty is that different utility functions and outcome functions potentially result in different measures of "congruence". The definition of "congruity" and the derivation of the measure of "congruity" in the productive good setting are left to future research.

Greater Use of Incentive in the Perfect-market Setting?

Consider the setting in which the outcome from production is contractible. It has been shown that the incentive rate (and hence the intensity of effort induced) when the agent has access to the market is larger than when the agent has no access to the market.

Here, in contrast, when the outcome from production is not contractible, the incentive rate when the agent has access to the market can be higher or lower than when she has no access to the market. Note that

$$\text{Sign } [v^{PM,y} - v^{NM,y}] = \text{Sign } [b_{0x}\,(b_{1y}^{\ 2} + r\sigma_y^{\ 2}) - b_{0y}b_{1x}b_{1y}].$$

Therefore, $v^{PM,y} > v^{NM,y}$ when

$$b_{0x}/b_{0y} > b_{1x}b_{1y}/\,(b_{1y}^{\ 2} + r\sigma_y^{\ 2}).$$

The prior result that the principal uses more incentive in the perfect-market setting than in the no-market setting may not be true, when the principal has to use a performance measure other than the outcome from production (i.e., when, in addition to the intensity of consumption, the allocation of resources between the productive good and the productive effort is an issue).

In the analysis above with an outcome additively separable in the action and the consumption of a productive good, it seems that one way to view a productive good is to view it as one action with the "cost" equal to its total price net of the agent's utility from consumption. Future research may consider a more complicated outcome and the agent's utility functions to better understand the interaction between the agent's consumption and action choice.

2.6 The Principal with a Cost Advantage

This section explores the effects of the principal's cost advantage on the optimal non-cash compensation. This section first considers a setting in which the principal can purchase a good at a wholesale price, which is lower than a retail price. Next, this section considers the setting in which the principal can produce the good himself. The convex production cost function is such that the marginal cost is lower than the retail price, if the firm produces less than the cutoff quantity.

2.6.1 Linear Cost function

Assume that the agent can purchase goods at retail market prices, which are represented by p_{0i}^r and p_{1j}^r, $i = 1, \ldots, N, j = 1, \ldots, M$. The principal, on the other hand, can purchase at the wholesale price p_{0i}^w and p_{1j}^w. The price differences $d_{0i} = p_{0i}^r - p_{0i}^w$ and $d_{1i} = p_{1j}^r - p_{1j}^w$ represent the saving of promotion, distribution, and order-processing costs. (For example, it is cheaper to deliver a big lot of a good to the principal than to deliver small quantities to each individual customer. The seller can also save promotional costs to attract the individual retail customers to buy their products.) If the agent wants to sell the goods in the market, she also incurs promotion, distribution, order-processing costs. Therefore, the net amount of cash (the net "selling price") she receives from selling a good in a perfect market is $p_{0i}^w = p_{0i}^r - d_{0i}$ or $p_{1j}^w = p_{1j}^r - d_{1i}$. Assume that the amount of cash the agent needs to pay to buy is greater than the amount of cash she receives from selling a good in the market, i.e., $p_{0i}^w < p_{0i}^r$ or $p_{1j}^w < p_{1j}^r$.

2.6.1.1 Non-productive Goods

In section 2.3, I show that if the agent has to purchase the non-productive good from the market herself, the agent's consumption choice is such that

$$\frac{u_{c_{1j}}(c_0, c_1(y))}{u_{c_{10}}(c_0, c_1(y))} = \frac{p_{1j}^r}{1}, j = 1, \ldots, N. \tag{2.6.1.1}$$

In section 2.5.2, I demonstrate that in the no-market setting, the principal's choice of non-productive non-cash compensation is such that

$$\frac{u_{c_{1j}}(c_0^{NM}, c_1^{NM}(y))}{u_{c_{10}}(c_0^{NM}, c_1^{NM}(y))} = \frac{p_{1j}^w}{1}, j = 1, \ldots, N. \tag{2.6.1.2}$$

With $p_{1j}^w < p_{1j}^r$, the no-market bundle provides more non-productive good than the amount the agent would have consumed if she had to buy the good from the market herself. If the cost advantage is greater (i.e., p_{1j}^w is smaller), then the principal provides more of the good. The question is thus whether the agent wants to trade if she is given the no-market bundle characterized by (2.6.1.2).

For conciseness, let $u(c_0, c_1(y); \delta)$ denote the agent utility from buying (selling) δ units of the good given the current bundle $(c_0, c_1(y))$, i.e.,

$$u(c_0, c_1(y)); \delta) = u(c_0, c_{10} - p_{1j}\delta, c_{11}(y), \ldots, c_{1j}(y) + \delta, \ldots, c_{1N}(y)),$$

where $p_{1j} = p_{1j}^r$ for $\delta > 0$ and $p_{1j} = p_{1j}^w$ for $\delta < 0$.

Consider the agent's marginal utility from buying (selling) δ units of the good below:

$$\frac{\partial u(c_0, c_1(y); \delta)}{\partial \delta} = \begin{cases} -p_{1j}^r u_{c_{10}}(c_0, c_1(y)) + u_{c_{1j}}(c_0, c_1(y)), & \textit{for } \delta > 0, \\ p_{1j}^w u_{c_{10}}(c_0, c_1(y)) - u_{c_{1j}}(c_0, c_1(y)), & \textit{for } \delta < 0. \end{cases}$$

Using $p_{1j}^w\ u_{c10}(c_0^{NM},\ c_1^{NM}(y)) = u_{c1j}(c_0^{NM},\ c_1^{NM}(y))$, the derivative of the agent's utility with respect to δ at the no-market bundle is

$$\left.\frac{\partial u(c_0, c_1(y); \delta)}{\partial \delta}\right|_{C^{NM}} = \begin{cases} (p_{1j}^w - p_{1j}^r) u_{c_{10}}(c_0^{NM}, c_1^{NM}(y)) < 0, & \textit{for } \delta > 0, \\ 0, & \textit{for } \delta < 0. \end{cases}$$

Given the no-market bundle, the agent is thus indifferent between selling and not selling the non-productive good. With $p_{1j}^w < p_{1j}^r$, the agent does not want to buy more non-productive good. Hence, there is no benefit to the principal from preventing the agent from selling the non-productive good.

Proposition 2.5: Assume that the price of the non-productive good to the principal (which is equal to the net cash the agent receives from selling a unit of the good) is less than the retail price the agent pays to buy additional units of the non-productive good. The optimal compensation is characterized by (2.6.1.2). The agent consumes more than she would have if she had to purchase the good herself.

Proof: See the discussion above.

The analysis in the previous section shows that when the good is not productive, there is a perfect market for the good, and the principal does not have a cost advantage, then the principal does not prefer to provide the good. Here, with a cost advantage, the principal prefers to provide the good. Therefore, if we observe a firm providing a non-productive good, which is available from the market to the employees, we should also find that the firm has cost advantages in providing that good. The larger the cost advantage, the more of the good is provided. The employees consume more than they would if they had to purchase the good from the market themselves. Also, the firm does not prevent the employees from selling the non-productive good.

2.6.1.2 Productive Goods

To simplify the analysis, consider a LEN model. If the agent has no access to the market (say, she is on a very remote island), the consumption choice is such that the marginal product to the principal plus the marginal utility to the agent is equal to the marginal cost to the principal, which is p_0^w, i.e., $w_0^{NM} = [(b_0 + \zeta)/2p_0^w]^2$. Now, when the agent has access to the market, she can buy at the price p_0^r, but can sell at the net price $p_0^w < p_0^r$. I first show that, given the no-market contract, the agent has no incentive to buy more, but she wants to sell. Then I discuss the optimal contract when the agent has access to the market.

With $p_0 = p_0^r$ if she buys and $p_0 = p_0^w$ if she sells, the agent's payoff is

$$CE(v, f, a, c_0) \quad = \quad f + v[(b_0\, c_0^{1/2} + b_1\, a] - p_0\, m_0 + \zeta\, c_0^{1/2} - ½\; r\, v^2\, \sigma_x^2 - ½\, a^2.$$

Given the no-market bundle, if she buys δ units more, the incremental payoff derived using the Taylor approximation is negative as shown below. (Note that $v^{NM} \in (0, 1)$).

$$\Delta CE\,(\delta) \quad \approx \quad \delta\,(v^{NM} b_0 + \zeta)/[2(w_0^{NM})^{1/2}] \; - p_0^r\,\delta$$

$$= \quad \delta\left[\frac{v^{NM} b_0 + \zeta}{b_0 + \zeta} p_0^w - p_0^r\right] \; < \; 0\;.$$

If she sells δ units, the incremental payoff derived using the Taylor approximation is positive, i.e.,

$$\Delta CE\,(\delta) \quad \approx \quad p_0^w\,\delta \text{ - } \delta\,(v^{NM} b_0 + \zeta)/[2(w_0^{NM})^{1/2}]$$

$$= \quad \delta\, p_0^w\left[1 - \frac{v^{NM} b_0 + \zeta}{b_0 + \zeta}\right] \; > \; 0\;.$$

Therefore, with the no-market contract, the agent does not want to buy but wants to sell. This implies that the principal wants to prevent the agent from selling the good in the market if he can do so at a sufficiently low cost.

Now consider the optimal solution when the principal has a cost advantage. Assume for now that the agent cannot buy, i.e., m_0 must be non-positive. Her payoff is thus

$$CE(v, f, a, c_0) \qquad = \; f + v[(b_0\, c_0^{1/2} + b_1\, a] + p_0^w\, m_0 + \zeta\, c_0^{1/2} - ½\; r\, v^2\, \sigma_x^2 - ½\, a^2.$$

Differentiating the certainty equivalent with respect to a gives the agent's action choice $a^{PM,C} = b_1 v$. Differentiating the certainty equivalent with respect to m_0 gives the agent's consumption choice below

$$c_0^{PM,C} = \left(\frac{v\, b_0 + \zeta}{2 p_0^w} \right)^2 . \tag{2.6.1.3}$$

Since the principal and the agent can sell the good to the market at the same net price, there is no benefit for the principal to use the agent as a distribution channel, i.e., there is no benefit from giving the agent more goods than she wants so that she later sells the excess to the market. But the principal can buy the good at a cheaper price. It is hence optimal for the principal to supply all the good the agent wants. The principal supplies the good equal to $c_0^{PM,C}$ above and the agent will have no incentive to sell. The level of consumption is such that the marginal benefit to the agent (the marginal utility from the consumption of the good plus the marginal benefit from a better distribution of the performance measure) is equal to the cost to the principal, rather than the retail price. As p_0^w decreases, $c_0^{PM,C}$ increases. (The derivative of $c_0^{PM,C}$ with respect to p_0^w is negative.)

Substitute (2.6.1.3) into the objective function and solve for the optimal incentive rate. The solution is as follows:

$$v^{PM,C} = \frac{b_1^2 + b_0^2 / 2p_0^w}{b_1^2 + r\sigma_x^2 + b_0^2 / 2p_0^w} \tag{2.6.1.4}$$

Note that $v^{PM,C}$ is increasing in b_0 but is decreasing in p_0^w. In other words, the smaller the price to the principal p_0^w, the larger the consumption, and the larger the incentive rate.

Previously I assumed when deriving the solution that the agent cannot buy the good from the market. Now, I show that the agent does not want to buy given ($v^{PM,C}$, $c_0^{PM,C}$). With the non-cash wage equal to (2.6.1.3), if the agent buys δ units more, the incremental payoff derived by the Taylor approximation is negative as shown below. (Note that $v^{PM,C} \in (0, 1)$).

$$\begin{aligned} \Delta CE(\delta) &\approx \delta(v^{PM,C} b_0 + \zeta)/[2(w_0^{PM,C})^{1/2}] - p_0^r \delta \\ &= \delta\left[\frac{v^{PM,C} b_0 + \zeta}{b_0 + \zeta} p_0^w - p_0^r \right] < 0 . \end{aligned}$$

Therefore the agent does not want to buy more of the productive good.

Proposition 2.6: Assume that the price of the productive good to the principal is less than the retail market price the agent needs to pay to buy additional units of the productive good. The optimal productive non-cash wage $w_0^{PM,C} = c_0^{PM,C}$ is as defined in (2.6.1.3). It leaves the agent with no incentive to buy or sell. The agent consumes more than she would have if she had to purchase the good from the market herself. The smaller the price to the principal p_0^w, the more of the good the principal provides.

Proof: See the discussion above.

From section 2.4.2, the optimal contract in the perfect market setting with no cost advantage is $v^{PM} = \dfrac{b_1^2 + b_0^2/2p_0}{b_1^2 + r\sigma_x^2 + b_0^2/2p_0}$, $a^{PM} = b_1 v^{PM}$, and any $w_0^{PM} \geq 0$. The principal is indifferent whether to pay productive non-cash wage or to let the agent purchase the good from the market. Here, when the principal has a cost advantage, the incentive rate is similar to the one when there is no cost advantage (except p_0 is replaced by p_0^w). But the principal prefers to provide the good to benefit from the cost advantage.

Again, the principal wants to prevent the agent from selling in a perfect market if he can do so at a sufficiently low cost. But even if he cannot, he will still provide the good if there is a cost advantage.

2.6.2 Convex Production Function

Consider a setting in which the principal can produce a good at a marginal cost lower than the market price up to a cutoff quantity. The principal benefits from his cost advantage if he pays in terms of the good up to the cutoff quantity. The agent may purchase an additional amount she wants from the market. Examples include an airline allowing its employees some free flights, or a hotel group permitting its employees to stay in the hotel in another location for a specific number of nights annually. It is cheaper for the airline or the hotel to provide services to its employees only up to the levels where it does not lose revenue from its customers from doing so.

2.6.2.1 Non-productive Good

Assume that the production function of a non-productive good q_{1j} is convex, i.e., $q_{1j}'$and $q_{1j}'' > 0$. Let Q_{1j} denote the cutoff level of production where the marginal production cost is equal to the market retail price, i.e., $q_{1j}'(Q_{1j}) = p_{1j}^r$. Beyond the cutoff level, the principal is better off buying the good from the market rather than producing it himself. The cost function of the good to the principal is thus

$$k_{1j}(n) = q_{1j}(n) + p_{1j}^r \max\{0, (n - Q_{1j})\},\ n \geq 0.$$

Assume that the agent can also buy the good at the retail price p_{1j}^r. Assume that the principal and the agent can sell at the price net of transaction cost of p_{1j}^s.

Consider the setting where the agent has access to the market. The agent's consumption choice is such that (2.6.1.1) is true; i.e.,

$$\frac{u_{c_{1j}}(c_0, c_1(y))}{u_{c_{10}}(c_0, c_1(y))} = \frac{p_{1j}^r}{1}, j = 1, \ldots, N. \tag{2.6.1.1}$$

Section 2.5.2 demonstrates that in the no-market setting, the principal's choice of non-productive non-cash compensation is such that

$$\frac{u_{c_{1j}}(c_0{}^{NM}, c_1{}^{NM}(y))}{u_{c_{10}}(c_0{}^{NM}, c_1{}^{NM}(y))} = \frac{k'_{1j}(c_{1j}{}^{NM}(y))}{1}, j = 1, \ldots, N. \tag{2.6.2.1}$$

The Cost Advantage is not Substantial

If the non-cash wage in the no-market setting is such that (2.6.2.1) is true at $c_{1j}^{NM}(y) \geq Q_{1j}$ (i.e., at $k'_{1j}(c_{1j}^{NM}(y)) = p_{1j}^r$), then the agent has no incentive to trade since the no-market bundle provided is the one she will buy herself. The optimal consumption is thus characterized by (2.6.1.1). The agent consumes the same amount she would have consumed if she has to purchase the good from the market herself.

This is the setting in which the cost advantage is not very substantial. In other words, let $c_{ij}^*(y)$ denote the agent's consumption choice when she can trade freely, as characterized by (2.6.1.1). This is the setting in which the marginal cost of producing $c_{ij}^*(y)$ is greater than the retail price, i.e., $q_{1j}'(c_{ij}^*(y)) > p_{1j}^r$. The principal produces the good to utilize all the cost saving potential (i.e., he produces the cutoff quantity Q_{1j}). After producing the cutoff quantity, the principal is indifferent between buying the rest from the market to pay the agent or giving cash and letting the agent buy it herself. We thus can also have an interior solution where the principal provides part of the total consumption, and the agent purchases some from the market, rather than the corner solution where the principal provides the whole amount, as in the linear-cost setting.

The Cost Advantage is Substantial

Consider the case in which the non-cash wage in the no-market setting is such that (2.6.2.1) is true at $c_{1j}^{NM}(y) < Q_{1j}$ (i.e., at $k'_{1j}(c_{1j}^{NM}(y)) < p_{1j}^r$). The no-market non-cash wage $w_{1j}^{NM}(y) = c_{1j}^{NM}(y)$ is larger than the quantity the agent will purchase from the market herself. Given the no-market contract, the agent has no incentive to buy, but may have incentive to sell, as demonstrated below.

As before, let $u(c_0, c_1(y); \delta)$ denote the agent utility from buying (selling) δ units of the good given that current bundle $(c_0, c_1(y))$, i.e.,

$$u(c_0, c_1(y)); \delta) = u(c_0, c_{10} - p_{1j}\delta, c_{11}(y), \ldots, c_{1j}(y) + \delta, \ldots, c_{1N}(y)),$$

where $p_{1j} = p_{1j}^r$ for $\delta > 0$ and $p_{1j} = p_{1j}^w$ for $\delta < 0$.

The agent's marginal utility from buying (selling) δ units of the good is

$$\frac{\partial u(c_0, c_1(y); \delta)}{\partial \delta} = \begin{cases} -p_{1j}^r u_{c_{10}}(c_0, c_1(y)) + u_{c_{1j}}(c_0, c_1(y)), & for \ \delta > 0, \\ p_{1j}^s u_{c_{10}}(c_0, c_1(y)) - u_{c_{1j}}(c_0, c_1(y)), & for \ \delta < 0. \end{cases}$$

Using $k'_{1j}(c_{1j}^{NM}(y))\ u_{c10}(c_0^{NM}, c_1^{NM}(y)) = u_{c1j}(c_0^{NM}, c_1^{NM}(y))$, the derivative of the agent's utility with respect to δ at the no-market bundle is

$$\left.\frac{\partial u(c_0, c_1(y); \delta)}{\partial \delta}\right|_{C^{NM}} = \begin{cases} [-p_{1j}^r + k'_{1j}(c_{1j}^{NM}(y))] u_{c_{10}}(c_0^{NM}, c_1^{NM}(y)), & for \ \delta > 0, \\ [p_{1j}^s - k'_{1j}(c_{1j}^{NM}(y))] u_{c_{10}}(c_0^{NM}, c_1^{NM}(y)), & for \ \delta < 0. \end{cases}$$

When $\delta > 0$, $p_{1j} = p_{1j}^r \geq k'_{1j}(c_{1j}^{NM}(y))$; the agent is worse off from buying more. When $\delta < 0$, $p_{1j} = p_{1j}^s$. The agent may or may not want to sell. Firstly, if $p_{1j}^s < k'_{1j}(c_{1j}^{NM}(y)) < p_{1j}^r$, the agent is worse off if she sells. The agent hence has no incentive to trade at all. The optimal contract is characterized by (2.6.2.1). (The contract is the same whether the agent has access to the market or not.)

In contrast, if $p_{1j}^r > p_{1j}^s > k'_{1j}(c_{1j}^{NM}(y))$, then the agent has an incentive to sell. Since her selling price is p_{1j}^s, not p_{1j}^r, the agent sells to achieve the bundle such that

$$\frac{u_{c_{1j}}(c_0, c_1(y))}{u_{c_{10}}(c_0, c_1(y))} = \frac{p_{1j}^s}{1}, j = 1, \ldots, N. \tag{2.6.2.2}$$

Consider the optimal contract when $p_{1j}^s > k'_{1j}(c_{1j}^{NM}(y))$. Because the cost to the principal is lower than the cost to the agent, it is optimal for the principal to supply the whole quantity the agent wants to consume. Also, the principal cannot improve his payoff by providing more of the good than the agent wants. (To illustrate, note that both the principal and the agent can sell the good at the same price of p_{1j}^s. There is then no benefit from paying the agent more than she wants, since she will sell the excess to the market at the same price the principal can sell. The principal can provide the quantity the agent will consume, so that she will not buy or sell later. He then can sell the excess good to the market himself. Alternatively, he can provide more of the good than wanted, so that the agent eventually sells it for cash. Anticipating the agent's sales, he reduces the agent's cash compensation accordingly. The principal is indifferent between the two alternatives.) The optimal contract is thus characterized by (2.6.2.2).

To sum up, in the setting where the cost advantage is sufficiently large, when the contract characterized by (2.6.2.1) is such that $p_{1j}^s \leq k'_{1j}(c_{1j}^{NM}(y))$, the optimal contract is characterized by (2.6.2.1). Otherwise, the optimal contract is characterized by (2.6.2.2).

In either case, the agent consumes more than she would have if she had to purchase the goods from the market herself. The non-cash compensation is such that the agent has no incentive to trade.

2.6.2.2 Productive Good

To simplify the analysis, I consider a LEN model. Let q denote the convex production function of a productive good (i.e., q' and $q'' > 0$), and let Q denote the cutoff level of production where the marginal production cost is equal to the market retail price, i.e., $q'(Q) = p_0^r$. The cost function of the good to the principal is represented by

$$k_0(n) = q(n) + p_0^r \max\{0, (n - Q)\}, \; n \geq 0.$$

Because the cost to the principal is less than the cost to the agent up to the cutoff level, it is optimal for the principal to provide the entire amount of optimal consumption (to be derived below), if it is no more than the cutoff level. If the agent's optimal consumption is such that she consumes more than the cutoff level, the principal is indifferent whether to buy the portion beyond the cutoff level himself, or to give the agent the cash so that she can buy it from the market.

Consider the setting in which the agent has no access to the market. Replace p_0 with $k_0(n)$ in the principal's problem in section 2.5.1.3, and redo the analysis. The optimal non-cash wage is such that the marginal product to the principal plus the marginal utility to the agent is equal to the marginal cost to the principal, which is $k'_0(n)$; i.e., w_0^{NM} is characterized by $(b_0 + \zeta)/[2(w_0^{NM})^{1/2}] = k'_0(w_0^{NM})$. Note that $k'_0(n) \leq p_0^r$ for all $n \geq 0$.

When the agent has access to the market, she can buy at the price p_0^r, but can sell at the net price $p_0^s < p_0^r$. I first show that, given the no-market contract, the agent has no incentive to buy more, but she wants to sell. Then I discuss the optimal contract when the agent has access to the market.

With $p_0 = p_0^r$ if she buys and $p_0 = p_0^s$ if she sells, the agent's payoff is

$$CE(v, f, a, c_0) \;=\; f + v[(b_0 c_0^{1/2} + b_1 a] - p_0 m_0 + \zeta c_0^{1/2} - ½\, r v^2 \sigma_x^2 - ½\, a^2.$$

If she buys δ units more, the incremental payoff derived using the Taylor approximation is negative as shown below. (Note that $v^{NM} \in (0, 1)$ and that $(b_0 + \zeta)/[2(w_0^{NM})^{1/2}] = k'_0(w_0^{NM})$).

$$\Delta CE(\delta) \;\approx\; \delta(v^{NM} b_0 + \zeta)/[2(w_0^{NM})^{1/2}] \; - p_0^r \delta$$

$$= \delta\left[\frac{v^{NM}b_0+\zeta}{b_0+\zeta}k_0'(w_0^{NM})-p_0^r\right] \le 0 .$$

If she sells δ units, the incremental payoff derived using the Taylor approximation may be positive, i.e.,

$$\Delta CE(\delta) \approx p_0^s\,\delta - \delta(v^{NM}b_0+\zeta)/[2(w_0^{NM})^{1/2}]$$

$$= \delta\left[p_0^s-\frac{v^{NM}b_0+\zeta}{b_0+\zeta}k'(w_0^{NM})\right].$$

Therefore, with the no-market contract, the agent does not want to buy, but may want to sell if the selling price is adequately high, i.e., if $\left[p_0^s-\frac{v^{NM}b_0+\zeta}{b_0+\zeta}k'(w_0^{NM})\right]>0$.

When the selling price is sufficiently low so that, given the no-market bundle, the agent does not want trade at all (i.e., $\left[p_0^s-\frac{v^{NM}b_0+\zeta}{b_0+\zeta}k'(w_0^{NM})\right]\le 0$), the optimal non-cash compensation is w_0^{NM} characterized by

$$(b_0+\zeta)/[2(w_0^{NM})^{1/2}] = k_0'(w_0^{NM}). \tag{2.6.2.3}$$

The setting with a sufficiently low selling price is in some sense similar to the limit-market setting. There is market friction which prevents the agent from selling the good to the market. If the selling price is equal to the retail price, the agent will want to sell. (Note that $\left[p_0^r-\frac{v^{NM}b_0+\zeta}{b_0+\zeta}k'(w_0^{NM})\right]>0$). The solution is then as described below.

Next, consider the optimal solution when $\left[p_0^s-\frac{v^{NM}b_0+\zeta}{b_0+\zeta}k'(w_0^{NM})\right]>0$. Given the no-market bundle, the agent wants to sell. She wants to sell to consume the bundle

$$c_0 = \left(\frac{v\ b_0+\zeta}{2p_0^s}\right)^2, \tag{2.6.2.4}$$

which is derived by differentiating her certainty equivalent with respect to m_0. Since both the principal and the agent can sell in the market at the same price, there is no benefit from paying the agent more than she wants. She will subsequently sell the excess in the market. The optimal consumption is thus characterized by (2.6.2.4). Substitute (2.6.2.4) into the objective function and solve for the optimal incentive rate. The solution is as follows:

$$v^{PM,C} = \frac{b_1^2 + b_0^2/2p_0^s}{b_1^2 + r\sigma_x^2 + b_0^2/2p_0^s} \tag{2.6.2.5}$$

The results above are based on a model with only one productive good. Future research may consider the setting in which there are multiple productive goods, some of which the principal can purchase at a lower price from the market, some of which the principal can produce at a marginal cost less than the market price.

2.7 Summary of the Model Implication

Assume that in addition to the cost of the good, the principal incurs additional administrative costs in providing non-cash compensation, and that the administrative costs are sufficiently low. In addition, the principal incurs a sufficiently small cost if he wants to prevent the agent from selling the good in the market. Table 2.1 lists the setting in which researchers can expect to see the use of non-cash compensation.

Table 2.1 When Will the Principal Prefer to Provide a Good as Compensation?

	No Market	Perfect Market	Limited Market*
No cost advantage			
Non-productive good	√	X	X
Productive good	√	X	√
Cost advantage			
Non-productive good	N/A	√	√
Productive good	N/A	√	√

* In a limited market setting, the agent can buy but cannot sell.

2.8 Concluding Remarks

This chapter demonstrates that there is no benefit from paying in terms of non-cash compensation, when (i) the non-cash items are not productive, (ii) the agent can buy them from the market, and (iii) the principal does not have a cost advantage in providing such goods. Given that there is no administrative cost from providing the goods, the principal is indifferent whether to pay in terms of cash, in terms of non-productive goods, or the combination of cash and non-productive goods. The agent's consumption decision does not affect the action the principal induces. This is not the case when the principal is the only source of a good, when the goods are productive, or when the principal has a cost advantage in buying a large quantity of the goods, or in producing the good.

Firstly, when the principal is the only source of the non-productive good, and the agent's marginal utility from the good is sufficiently high, the principal can reduce the compensation cost by paying in terms of the good. He can act as a monopolist and profit from the agent's consumption surplus. Since the principal has no direct preference with respect to the agent's consumption of the good, he pays the bundle the agent likes most in order to maximize the total of his welfare and the agent's welfare (the agent does not want to buy or sell even when she can.)

If the good is not productive, and the principal has a cost advantage in providing the good, the principal pays in terms of the good to exploit the cost advantage.

When the good is productive, the optimal compensation and action are determined by both the agent's preference and the productivity of the good. The principal wants the agent to consume the bundle which maximizes total welfare, rather than just the agent's welfare. I consider a LEN framework with a simple production technology – the outcome is additively separable in the agent's effort and the consumption of the productive good. The production outcome is used as a contractible performance measure. If the agent has no access to the market, the principal provides the non-cash compensation which maximizes total welfare, which is more than the agent would have purchased if she had an access to the market. The incentive risk in compensation is imposed only to motivate the desired intensity of effort. On the other hand, if the agent can buy or sell in a perfect market, she can consume any bundle she likes. Simply paying the agent the desired bundle is not sufficient to induce the desired level of consumption of the productive good. A greater incentive rate must be imposed to motivate both the intensity of effort and the consumption of the productive good. Even with this greater incentive rate, the level of consumption of the productive good is still lower than when the agent has no access to the market. (Note that since the no-market contract leaves the agent with no incentive to buy, it is sufficient for the principal to prevent the agent from selling to achieve the same payoff as if the agent had no access to the market.) With a cost advantage, the principal generally provides an even greater quantity of the good to exploit the advantage.

The analysis above offers a basic insight into the characteristics of the optimal compensation portfolio and action choice when the principal is the only source of a good, when he has a cost advantage in providing the good, or when the good is productive. In addition, it thereby predicts the characteristics of the good which will be included in a compensation bundle (i.e., whether the agent can buy or sell the good, whether the principal has a cost advantage in providing the good, and whether the good is productive). However, it does not answer the question: "Why do we observe a firm offering a menu of different compensation bundles from which an employee can choose?" Chapter three investigates this question. Chapter three also discusses the literature on the use of perquisites for CEOs.

Implicitly assumed is that the principal can offer an individually-designed contract to each agent. In reality, the agents have different preferences, and transaction costs often preclude individual contracting. There is thus room for future research on the optimal contract in a multi-agent setting in which the agents have different preferences. One possible direction is to explore the use of informal non-cash compensation paid to an individual employee to supplement the formal non-cash compensation paid to many employees. (Chapter four considers the use of informal compensation in a single-agent setting to deter undesirable actions. It does not specifically consider non-cash informal compensation.) Also, the analysis assumes a rather simple production technology for tractability. The analysis from the LEN models shows that the results from a model with a single productive good are not much different from a model with multiple productive goods. Future research may attempt to consider a more complicated production technology, where the action and the consumption choices are more closely related. The differences between a single productive good setting and a multiple productive good setting may be more pronounced in such a model. Finally, the analysis above answers a general question of how the compensation portfolio is influenced by the characteristics of the good in consideration, its cost functions, and the market setting. Interesting specific questions remain unexplored. For example, why some companies pay a cash subsidy for housing or child education rather than simply paying cash.

Appendix to Chapter 2

2A.1 Proofs to Propositions

Proof to Proposition 2.1

The Lagrangian function is as follows:

$$L \;=\; \int[x-w_{10}(y)-\sum_{j=1}^{N}k_{1j}(w_{1j}(y))]\,\phi(x,y\,|\,a)\,dx\,dy \;+\lambda\,[\int u(w_1(y))\,\phi(y\,|\,a)\,dy-v(a)-\underline{U}]$$

$$+\;\mu\,[\int u(w_1(y))\,\phi_a(y\,|\,a)\,dy-v'(a)].$$

Differentiate the Lagrangian function with respect to $w_{1j}(y)$ gives the following:

$$\frac{\phi(x,y\,|\,a)}{\phi(y\,|\,a)}\frac{k'_{1j}(w_{1j}(y))}{u_{c_{1j}}(w_1(y))} \;=\; \lambda+\mu\frac{\phi_a(y\,|\,a)}{\phi(y\,|\,a)} \;=\; \frac{\phi(x,y\,|\,a)}{\phi(y\,|\,a)}\frac{k'_{1k}(w_{1k}(y))}{u_{c_{1k}}(w_1(y))}.$$

Rearranging the terms yields (2.4.1.3).

Proof to Proposition 2.4

For the first part of the proposition, consider the first derivatives of $v^{NM,y}$ below:

$$\frac{\partial v^{NM,y}}{\partial b_{1y}} \;=\; \frac{b_{1x}[r\sigma_y^2-b_{1y}^2]}{(b_{1y}^2+r\sigma_y^2)^2},$$

$$\frac{\partial v^{NM,y}}{\partial \sigma_y^2} \;=\; -\frac{b_{1x}b_{1y}r}{(b_{1y}^2+r\sigma_y^2)^2}<0, \text{ and}$$

$$\frac{\partial v^{NM,y}}{\partial b_{0y}} = 0.$$

The sign of the derivative with respect to b_{1y} is not definitive.

The first derivatives of $v^{PM,y}$ are as follows:

$$\frac{\partial v^{PM,y}}{\partial \sigma_y^2} \;=\; -r\frac{[b_{1x}b_{1y}+(b_{0x}b_{0y}/2p_0)]}{(b_{1y}^2+r\sigma_y^2+b_{0y}^2/2p_0)^2}<0,$$

$$\frac{\partial v^{PM,y}}{\partial b_{0y}} \;=\; \frac{(b_{1y}^2+r\sigma_y^2)(b_{0x}/2p_0)-(b_{0x}b_{0y}^2/4p_0^2)-(b_{0y}b_{1x}b_{1y}/p_0)}{(b_{1y}^2+r\sigma_y^2+b_{0y}^2/2p_0)^2}, \text{ and}$$

$$\frac{\partial v^{PM,y}}{\partial b_{1y}} \;=\; \frac{b_{1x}[r\sigma_y^2+(b_{0y}^2/2p_0)-b_{1y}^2]-(b_{0x}b_{0y}b_{1y}/p_0)}{(b_{1y}^2+r\sigma_y^2+b_{0y}^2/2p_0)^2}.$$

The signs of the derivatives with respect to b_{0y} and b_{1y} are not definitive.

2A.2 Derivation of The Solution from Section 2.5.2.4

2A.2.1 The Agent Has No Access to Market

In this section, I assume that m_0 is exogenously limited to zero. (Therefore, $c_0 = w_0$.) The agent's only choice is her action. The agent's certainty equivalent is thus

$$CE(v, f, a, w_0) = f + v\,[b_{0y}\, w_0^{1/2} + b_{1y}\, a] + \zeta\, w_0^{1/2} - ½\, r\, v^2\sigma_y^2 - ½\, a^2.$$

The agent' incentive compatibility constraint can be expressed as the first-order condition based on her certainty equivalent as follows:

$$\text{(AIC)}\quad CE_a\,(v, f, a, w_0) = b_{1y}\, v - a = 0.$$

With $\underline{U} = -1$, the participation constraint can be written as

$$\text{(PC)}\quad f = -\,v[b_{0y}\, w_0^{1/2} + b_{1y}\, a] - \zeta\, w_0^{1/2} + ½\, r\, v^2\sigma_y^2 + ½\, a^2$$

The principal's maximization problem is as shown below.

$$\max_{f, v, a, w_0} \quad U^P(w_0, a) \equiv b_{0x} w_0^{1/2} + b_{1x} a - f - v[b_{0y} w_0^{1/2} + b_{1y} a] - p_0\, w_0$$

subject to (PC), (AIC).

Substitute $a = b_{1y}v$, and the value of f from (PC) into the objective function. The unconstrained optimization problem is

$$\max_{v, w_0} \quad U^P(w, a) \equiv b_{0x} w_0^{1/2} + b_{1x} b_{1y} v + \zeta w_0^{1/2} - \frac{1}{2} r v^2 \sigma_y^2 - \frac{1}{2}(b_{1y} v)^2 - p_0 w_0$$

Differentiating the principal's payoff with respect to v and w_0 gives the following solution and principal's maximized payoff in the no-market setting:

$$v^{NM,y} = \frac{b_{1x} b_{1y}}{b_{1y}^2 + r\sigma_y^2},$$

$$a^{NM,y} = b_{1y} v^{NM,y}, \text{ and}$$

$$w_0^{NM,y} = \left(\frac{b_{0x} + \zeta}{2 p_0}\right)^2,$$

2A.2.2 The Agent Can Trade in A Perfect Market

Assume that the agent can buy and sell freely in an external perfect market at price p_0. The net amount of cash received/paid is $p_0 m_0$.

The agent's total payoff is $f + vy + \zeta(c_0)^{1/2} - p_0 m_0$, where $c_0 = w_0 + m_0$. Her certainty equivalent is thus

$$CE(v, f, a, c_0) = f + v[b_{0y}\, c_0^{1/2} + b_{1y}\, a] - p_0\, m_0 + \zeta\, c_0^{1/2} - ½\, r\, v^2\sigma_y^2 - ½\, a^2$$

The agent's optimal choice of action and consumption of the productive good can be represented by the following incentive compatibility constraints.

(AIC) $CE_a(v, f, a, c_0) = b_{1y} v - a = 0.$

(CIC) $CE_{m_0}(v, f, a, c_0) = (b_{0y} v + \zeta)/[2(w_0 + m_0)^{1/2}] - p_0 = 0.$

With $\underline{U} = -1$, the participation constraint can be written as

(PC) $f = -v[b_{0y}c_0^{1/2} + b_{1y} a] + p_0 m_0 - \zeta c_0^{1/2} + \frac{1}{2} r v^2 \sigma_y^2 + \frac{1}{2} a^2$

The principal maximization problem is as follows:

$$\max_{f,v,a,w_0} U^P(w,a) \equiv b_{0x}c_0^{1/2} + b_{1x}a - f - v[b_{0y}c_0^{1/2} + b_{1y}a] - p_0 w_0$$

subject to (PC), (AIC), (CIC).

From (AIC), $a = b_{1y}v$. From (CIC), $m_0 = [(b_{0y} v + \zeta)/2p_0]^2 - w_0$. For whatever amount of productive good provided, the agent's consumption of the productive good is thus $c_0 = m_0 + w_0 = [(b_{0y} v + \zeta)/2p_0]^2$. Hence, in the perfect-market setting, there is no benefit for the principal to supply the productive non-cash compensation, when he has no cost advantage.

Substituting $a = b_{1y}v$, $c_0 = m_0 = [(b_{0y} v + \zeta)/2p_0]^2 - w_0$, and the value of f from (PC) into the objective function yields the following unconstrained optimization problem

$$\max_{v,w_0} U^P(w,a) = b_{0x}\left(\frac{vb_{0y}+\zeta}{2p_0}\right) + b_{1x}b_{1y}v - p_0\left(\frac{vb_{0y}+\zeta}{2p_0}\right)^2 + \zeta\left(\frac{vb_{0y}+\zeta}{2p_0}\right) - \frac{1}{2}rv^2\sigma_y^2 - \frac{1}{2}(b_{1y}v)^2$$

$$= (b_{0x}+\zeta)\left(\frac{vb_{0y}+\zeta}{2p_0}\right) - p_0\left(\frac{vb_{0y}+\zeta}{2p_0}\right)^2 + b_{1x}b_{1y}v - \frac{1}{2}rv^2\sigma_y^2 - \frac{1}{2}(b_{1y}v)^2$$

Differentiating the principal's payoff with respect to v shows the following solution in the perfect-market setting:

$$v^{PM,y} = \frac{b_{1x}b_{1y} + b_{0x}b_{0y}/2p_0}{b_{1y}^2 + r\sigma_y^2 + b_{0y}^2/2p_0},$$

$$a^{PM,y} = b_{1y}v^{PM,y}, \text{ and}$$

$$c_0^{PM,y} = \left(\frac{v^{PM}b_{0y}+\zeta}{2p_0}\right)^2.$$

Chapter 3: Other Issues on Non-monetary Compensation

3.1 Introduction

Chapter two discusses the characteristics of cash and non-cash compensation for employees in all levels of organizations. This chapter considers empirical evidence on the use of non-cash compensation for executives, and extends the analysis in chapter two to a setting with private information. Section 3.2 discusses empirical work on the use of non-cash compensation in CEOs' employment contracts. It provides examples of the use of non-cash compensation in the real world, and where possible, compares empirical results with the theoretical predictions in chapter two. Deviation from the theory exists. However, it should be noted that not all forms of compensation are included in the CEOs' employment contracts. For example, executive's loans, which will be forgiven in the future, conditioned on satisfactory performance, and leniency in reimbursement policy are forms of compensation usually not included in an employment contract. The empirical results based on items written in an employment contract may not give a whole picture of the real world practices.

Section 3.3 extends the analysis in chapter two to an adverse selection setting. The motivation is to explain the compensation practice in which a firm offers a menu of contracts to employees. This section derives the optimal contract when the agent has private pre-contract information about her preference, about the productivity of the good, or about her productivity of effort. This analysis considers both the setting in which the principal is the only source of the goods, and the setting in which there is an external market for the goods. The analysis is simplified by assuming that the principal does not have a cost advantage, and the agent has single private information. A binary model with two types of agent is considered. The main results are as follows. As in a classic adverse selection model, the agent with the highest preference for the good or with the highest productivity (either from the good or from her effort) is induced to consume and work (i.e., expend efforts) efficiently. She receives rent from her private information. The principal wants to reduce the information rent to maximize his payoff. The way in which the principal reduces the rent is contingent on the kinds of private information the agent has. In addition, it is also dependent on whether principal is the only source of the goods (the no market setting), or there is an external perfect market for the goods (the perfect market setting).

In the no market setting, when the private information is about the agent's productivity of effort, the high type's rent is increasing in the low productivity type's level of effort. The low type's effort is thus reduced to lower the rent paid to the more productive type. When the private information is about the agent's preference for a good, the rent is increasing in the low preference type's consumption of the good. The principal reduces the rent by decreasing the low type's consumption. When the private information is about the productivity of the good, the more productive type earns rent from additional compensation she receives when she expends the same level of effort as the low productivity type. Her rent is increasing in both the low type's incentive rate and consumption of the good. Therefore, the principal adjusts both the low type's consumption and incentive rate to reduce the rent.

When there is an external market of the good, the principal's only choice variable is the incentive rate. Therefore, he reduces the high type's rent through the low type's incentive rate, whether he actually wants to reduce the low type's effort, the consumption, or the incentive rate itself.

To summarize, if the private information is about the preference for the good, the good is productive, and the principal is the only source, a menu of contracts consists of contracts with different quantities of non-cash compensation, but the same incentive rates. If the private information is about the productivity of the good, and the principal is the only source of the good, a menu of contracts consists of contracts with different quantities of non-cash compensation, and different incentive rates. If the private information is about (i) the productivity of effort, (ii) the preference of the productive good and the good is available from the market, or (iii) the productivity of the good and the good is available from the market, a menu of contracts consists of contracts with different incentive rates. Note that the prediction is based on the assumption that the principal does not have a cost advantage, and the agent has only one piece of private information.

This chapter is organized as follows. Section 3.2 discusses empirical work on the use of non-cash compensation for CEOs. Section 3.3 derives the optimal contract when the agent's preference for the good is not known to the principal. Section 3.4 shows and compares the optimal contracts when the agent's private information is about the productivity of the effort or of the good, with the case discussed in section 3.3. Section 3.5 concludes.

3.2 The Hypotheses and Empirical Evidence on CEO's Perquisites

The purpose of the analysis in chapter 2 is to derive the characteristic of optimal compensation when there are benefits to the firms from paying in terms of goods, i.e., the firm is the only source of the goods or has a cost advantage in providing the goods, or the goods are productive in the sense that the consumption affects the outcome from production. It addresses employee's compensation in general rather than focusing on top-level management. This section discusses the prior literature on management's non-cash compensation and some recent empirical work.

3.2.1 Description of CEO's Perquisites

Schwab and Thomas (2004) obtain CEOs' employment contracts from the Corporate Library, which is "an information clearing house formed in 1999 by Nell Minow and Robert Monks. They complied their data base by contacting every company in the S&P 500, the S&P Midcap 400, and the S&P Small Cap 600, and asking them to provide a copy of their CEO's employment contract." (p. 14). Although the main interest of their paper is on the legal characteristics of the CEO's employment contract, they also report data on the perquisites included in the contracts. The more common perquisites included in the employment contracts are summarized in their Table 11, which is slightly adjusted and presented below.

Table 3.1 Perquisites Mentioned in CEOs' Contracts

Type of Perquisite	Number of Contracts	% of All Contracts
Apartment	8	2.13
Personal use of company aircraft	27	7.20
Company car or car allowance	144	38.40
Country/Social club membership	92	24.53
Loan of any kind	26	6.93
Company paid travel for the CEO's spouse	20	5.33
Supplemental retirement plans, pension, or financial counseling benefits	217	57.87
Total	375	

Yermack (2005) gathers data on CEO's personal uses of the company aircraft in 237 of Fortune 500 firms from 1993 – 2002, as disclosed in annual proxy statements filed to SEC. He finds a similar result. The more common perquisites (reported according to their frequencies) are personal use of company aircraft (15.9%), financial counselling (9.2%), company car and local transportation (6.4%), country club dues (2.2%), medical care exceeding the company's plan (1.6%), and personal or home security (0.3%).

In Rajan and Wulf (2004), the data come from a confidential survey on more than 300 traded firms in US. The survey is conducted by a leading consulting firm, Hewitt Associates. The more common perks, grouped by types, include company plane (66%), chauffer service (38%), company car (56%), country club membership (47%), lunch club membership (48%), health club membership (17%), financial counseling (70%), tax preparation (65%), and estate planning (59%).

In the studies above, the relative values of cash and non-cash compensation are not derived, possibly due to the difficulties in valuing non-cash compensation. Also, SEC (Security and Exchange Commission) only demands the disclosure of perquisites worth more than a specific value. Not all non-cash compensation used is disclosed. As Rajan and Wulf (2004) mention in footnote 2 on p. 2, "compliance [with SEC's disclosure rule] and perquisite valuation vary across firms. For example, AIG discloses no costs of perks provided to management, stating that they are a business expense that facilitates the performance of management responsibilities ...".

3.2.2 CEO's Perquisites as An Agency Cost or A Part of the Optimal Contract

There seems to be two perspectives on CEO's perquisites. Jensen and Meckling (1976) consider perks an agency cost. Perks exhibit the manager's misappropriation of wealth from the shareholders, which possibly results from weak corporate governance. Fama (1980), in contrast, argues that manager's wage can be adjusted, ex ante or ex post, to account for manager's consumption of perks. Thus, it can be beneficial for the company with a cost advantage to pay in terms of goods, and reduce the manager's cash and other compensation accordingly. Fama's view is more consistent with the views of researchers in labour economic or macro-economic, and with the analysis in chapter two. Some recent empirical work tests the validity of the two hypotheses.

Yermack (2005) uses the data on CEO's personal use of a company airplane to test Fama's and Jensen and Meckling's competing hypotheses. He finds that a CEO who belongs to a golf club that is located far away from the company's headquarters (and hence who has greater preference for a corporate jet) is approximately twice as likely to have a personal use of the company plane as part of compensation. This seems to support the idea that the principal considers the agent's preference when designing a contract. A business use of a corporate jet is considered a productive good which is consumed during the period. A personal use will be provided to an agent who has preference for it (e.g., who wants to play golf in a remote club), and the value of the personal use for that CEO must be larger than additional costs to the company. Chapter two predicts that cash or other components of compensation should be reduced accordingly by the amount of the agent's surplus from the consumption of the good. Yermack, nonetheless, reports in Table I that the firms which allow personal use of the plane pay their CEOs higher salaries (note that he does not control for the firms' sizes or other variables that may be proxies for the manager's reservation utility). It is possible that the reduction is done through other components of pay.

Yermack (2005) also finds negative abnormal stock returns when the firms he studies first disclosed the CEO's personal use of a company aircraft in an event study. Moreover, he finds the annual stock returns are significantly negatively correlated with a dummy variable whether the firms allow the CEO's personal aircraft use and disclose it in the proxy statements. He notices that "After the CEO aircraft perk is first disclosed, firms' [accounting] operating performance does not change significantly. However, disclosing companies are more likely to take extraordinary accounting writeoffs and are also more likely to report quarterly earnings per share significantly below analyst estimates" (p. 4). He considers this finding possible evidence of management's shirking or a strategic disclosure of bad news: "This data about writeoffs, quarterly earnings, and falling stock performance is consistent with various theories of managerial shirking in the presence of lavish perks, but it also may result from a disclosure strategy in which managers conceals bad news from shareholders until after they acquire access to lucrative fringe benefits" (p. 4).

Whether the use of perquisites represents an agency cost remains an empirical question. However, the important thing Yermack does is introduce another kind of productive good not covered in chapter two. Chapter two assumes that the costs of the goods are additively separable. Yermack provides information about an interesting type of non-cash compensation whose cost is not separable. The business use of an airplane is a productive good, while the personal use is a non-productive good. The costs of both goods (i.e., maintenance costs, parking costs, fuel costs, driver's salary, etc.), however, are naturally not separable.

When the cost of each good is separable, the binary models in sections 2.4.2 and 2.5.2.1 suggest that the principal buys (or produces) the good to pay to the agent when the sum of the productive benefit to the employer (if any) and the value to the agent is greater than the cost. Now, consider the case of a corporate plane for both business and personal uses. This is the case of one productive good and one non-productive good with non-separable costs. The nature of the compensation decisions is different, depending on whether it is a decision to buy a plane (or to initiate a trip), or a decision to allow personal uses. For the decision whether to buy a plane, the plane will be purchased when the productive value to the principal plus the value to the agent is greater than the cost. Otherwise the purchase of the plane is suboptimal. Given that the company already has a plane, however, the decision whether to allow personal uses is a "marginal cost" decision, rather than an "average cost" decision. The good will be provided only when the value to the agent is greater than the marginal cost, not the average cost. Other components of the compensation then will be reduced accordingly so that the total compensation cost decreases. For example, consider the case in which an executive needs to fly from New York to Seattle for a business meeting. A trip from New York to Seattle is productive, while a side trip from Seattle to a golf course in California is non-productive. Whether the personal use of the plane from Seattle to a golf course will be granted does not depend on the total cost of the trip from New York to California, but on the cost of the trip from Seattle to California. The personal use of the plane exhibits the setting where the fixed/sunk cost is high but the marginal cost is low. And the personal use may not always represent an agency cost even when the average cost seems larger than the average benefit to the agent.

While Yermack (2005) argues that the evidence seems to support Jensen and Meckling's hypotheses, Rajan and Wulf (2004)'s findings support Fama's (and labour economists') view that firms use non-cash compensation to enhance their welfares. Consistent with Yermack (2005), they find that the firms which pay more cash compensation tend to pay more perquisites, even after controlling for firm size, industry, year, and market-to-book ratio. I conjecture that the agent's consumption surplus from the goods provided may be deducted through components of compensation other than cash, possibly through the non-cash components not disclosed to SEC.

Rajan and Wulf also find evidence supporting the beneficial use of perks due to their productivity. A company plane is more productive when the company's headquarters are located in a county with a smaller population, or in a location remote from a large, convenient airport, and when the firms' operations are more geographically dispersed. They find that such a company is more likely to have a company aircraft. (Note that they do not separate between business and personal uses of the plane.)

Their evidence also seems to support a tax saving hypothesis. They find the use of a company car, country club memberships, and financial counseling are positively associated with the highest marginal state income tax rate in the state in which the headquarters are located. Additionally, the use of corporate plane is more likely in a firm with more organizational hierarchies, supporting a view that some kinds of perks enhance a payee's social status.

Whether Fama or Jensen and Meckling are correct about the CEOs' perquisites we observe in the real world remains an interesting empirical question. The importance of non-cash compensation is undeniable, even when the focus of the study is cash compensation. Consider a recent study in accounting by Lee, Matolcsy, and Wells (2004). Lee, Matolcsy, and Wells study the (cash) compensation-performance relation for State Dominated Enterprises (SDE) and Non-State Dominated Enterprises (NSDE) in China. They find no difference in accounting performance measures, which are tied to monetary compensation, between SDE and NSDE, and no difference in the monetary pay-performance relation. They also find that the level of monetary compensation is lower for SDE. (Intuitively, if one considers only cash compensation, one would expect that, with other things being equal, the firm that pays less should have worse performance.) The authors anticipate that the amount of non-cash fixed compensation paid is higher for SDE, while the amounts of cash bonuses are similar for SDE and NSDE. (Note that the data on non-cash compensation is not available.) This possibly explains why they do not find a difference in measured performance, despite the lower cash pay for SDE.

To sum up, this section discusses some empirical evidence and hypotheses of CEO's perquisites. It suggests that the use of perquisites can be optimal. Also, it suggests that different kinds of goods may require different analyses. A multi-period model where a good paid as a bonus can be used in many periods will enhance our understanding of compensation practice in the real world.

3.3 Non-Monetary Compensation in A Setting with Both Moral Hazard and Adverse Selection Problems

To the best of my knowledge, there is only one prior work on the use of non-cash compensation in an adverse selection setting. Marino and Zábojník (2004) study the use of employee discounts and other forms of non-cash compensation in adverse selection models. The agent's utility function is assumed to be additively separable in cash ("a numeraire good representing all other goods") and in a good in consideration. They first formulate a model in which a monopolist-employer determines the optimal prices to charge his employees and other customers. There are two types of customers; one type has greater preference for the firm's product. The monopolist-employer wants to hire an employee from a pool of customers. Assume that the pool is large so that the employer can choose which type to hire. Marino and Zábojník (2004) find that it is optimal to charge the employee at marginal cost to induce the employee to purchase as much as possible, and then extract the surplus the employee receives by decreasing the amount of cash salary. Since a customer with high preference has a larger surplus the employer can extract, it is optimal to hire her. The principal then designs a contract to induce only the high-preference type to participate. There is price discrimination: the price charged to outside customers is higher than the price charged to employees. Subsequently, the authors assume the employees represent an insignificant fraction of the market and treat the price charged to the market as exogenous. They consider the use of employee discount and perks in a setting where there are, again, two types of workers, high-preference and low-preference, and the principal wants to hire both types. In addition to their preferences, the two types also have different reservation utilities. The reservation utility is correlated with the agent's preference. Marino and Zábojník show that the optimal bundle is determined by the agent's preference, the correlation between the agent's preference and the reservation utility, and the cost function of the good.

Marino and Zábojník (2004) do not explicitly model the agent's consumption choice problem when she can trade in a market, nor do they formally consider the productivity of non-cash compensation. (The authors give examples of a productive good, but they do not formally investigate the effects of the consumption of the good on the outcome.) Also, there is no moral hazard problem. This section considers instead a setting in which the good is productive, and the principal does not know either the agent's preference or her action. It also explicitly examines the agent's consumption choice problem. The analysis is simplified by considering only one productive good, and if the good is available from the market, by assuming that there is no cost advantage.

3.3.1 The Principal is the Only Source of A Productive Good

Assume that there are two types of agents – the L-type with low preference parameter ζ_L and the H-type with high preference parameter ζ_H, $\zeta_H = \zeta_L + \Delta\zeta$, $\Delta\zeta > 0$. The type is known to the agent before she accepts the contract, but is unknown to the principal. Let ρ_L and $\rho_H = 1 - \rho_L$ denote the principal's prior probability that the agent has low and high preference parameter respectively. At the beginning of the period, the principal offers a menu of contracts to the agent. Let (f_i, v_i, w_{0i}, a_i) represent the contract for type-i agent. The type-i agent's certainty equivalent is represented by

$$CE(v, f, a|\zeta_i) = f + v\,[b_0\,(w_0)^{1/2} + b_1\,a] + \zeta_i(w_0)^{1/2} - \tfrac{1}{2}\; r\,v^2\sigma_x^2 - \tfrac{1}{2}\,a^2, i = L, H.$$

With $\underline{U} = -1$, the participation constraint can be written as

$$(\text{PC})_i \quad f_i = -\,v_i[b_0(\,w_{0i})^{1/2} + b_1\,a_i] - \zeta_i(w_{0i})^{1/2} + \tfrac{1}{2}\; r\,v_i^2\,\sigma_x^2 + \tfrac{1}{2}\,a_i^2,\; i = L, H.$$

When the agent has private, pre-contract information, she has incentive to misreport if it is profitable. There are many solutions to an adverse selection problem. The prior mechanism design literature shows that when there are no limits on communication and the set of feasible contracts, no side contracting, and no commitment problem, an optimal contract can be found in the set of contracts that induce the agent to reveal her type truthfully (Laffont and Martimort, 2002, Christensen and Feltham, 2005). Thus, I limit myself to the solution which induces the agent to reveal her true type.

For the agent to reveal the truth, the type-i agent must be better off choosing the type-i contract and the designated action than (i) choosing type-i contract and any other action, (ii) choosing type-j contract and any other action. For the latter case, it is necessary to consider only the action which maximizes the payoff of the type-i agent who chooses type-j contract. (If the outcome function is more complicated, the incentive compatibility constraints may be more complicated, and there may be more incentive compatibility constraints to consider.)

Consider the type-i agent's action which maximizes her payoff given that she chooses type-i contract. The agent's action choice is derived from the first-order condition with respect to her certainty equivalent:

$$CE_a\,(v, f, a|\zeta_i) = b_1\,v - a = 0. \qquad (3.3.1.1)$$

Note that the action choice here is independent of the agent's preference parameter. But it is dependent on the contract the agent chooses (i.e., on v). This results from an outcome function which is additively separable in effort and the consumption of a productive good. Let a_i denote the action the principal wants the type-i agent to take. The incentive compatibility constraints that ensure the type-i agent does not want to choose a type-i contract and then take any other action are represented by

$$(IC)_{1i} \qquad a_i = b_1 v_i\,,\ i = L, H.$$

From the first-order condition (3.3.1.1), if the agent chooses the L-type (H-type)'s contract, then her optimal action is $b_1 v_L\,(b_1 v_H)$; whatever her type is. Therefore, to ensure the type-i agent does not want to choose a type-j contract and take other actions, the incentive compatibility (truth-telling) constraints $(IC)_{2i}$ below must be satisfied.

$$(IC)_{2i} \qquad f_i + v_i[b_0(w_{0i})^{1/2} + b_1 a_i] + \zeta_i(w_{0i})^{1/2} - \tfrac{1}{2}\, r\, v_i^2\sigma_x^2 - \tfrac{1}{2}\, a_i^2 \geq$$

$$f_j + v_j[b_0(w_{0j})^{1/2} + b_1 a_j] + \zeta_i(w_{0j})^{1/2} - \tfrac{1}{2}\, r\, v_j^2\sigma_x^2 - \tfrac{1}{2}\, a_j^2\,, \quad i, j = L, H, i \neq j.$$

The principal's maximization problem is as shown below.

$$\max_{\substack{f_L, v_L, a_L,\\ f_H, v_H, a_H}} U^P(w,a) = \rho_L\{b_0(w_{0L})^{1/2} + b_1 a_L - f_L - v_L[b_0(w_{0L})^{1/2} + b_1 a_L] - p_0\, w_{0L}\}$$

$$+\rho_H\{b_0(w_{0H})^{1/2} + b_1 a_H - f_H - v_H[b_0(w_{0H})^{1/2} + b_1 a_H] - p_0 w_{0H}\}$$

subject to $(PC)_i$, $(IC)_{1i}$, $(IC)_{2i}$, i = L, H.

In this setting $(IC)_{1L}$ and $(IC)_{1H}$ are binding. As in the prior adverse selection literature, only the H-type's truth-telling constraint and the L-type's participation constraint are binding. With $\underline{U} = -1$ and $(PC)_L$ binding, from $(IC)_{2H}$, we must have

$$f_H + v_H[b_0(w_{0H})^{1/2} + b_1 a_H] + \zeta_H(w_{0H})^{1/2} - \tfrac{1}{2}\, r v_H^2\sigma_x^2 - \tfrac{1}{2}\, a_H^2 \geq$$

$$f_L + v_L[b_0(w_{0L})^{1/2} + b_1 a_L] + \zeta_H(w_{0L})^{1/2} - \tfrac{1}{2}\, r\, v_L^2\sigma_x^2 - \tfrac{1}{2}\, a_L^2$$

$$= CE(v_L, f_L, a_L|\zeta_L) + \Delta\zeta(w_{0L})^{1/2}$$

$$= 0 + \Delta\zeta(w_{0L})^{1/2}.$$

By choosing the L-type contract, the H-type agent receives the rent of $\Delta\zeta\,(w_{0L})^{1/2} \geq 0$ (and hence $(PC)_H$ is satisfied). The rent is increasing in w_{0L}. With this amount of rent, $(IC)_{2L}$ is satisfied when $w_{0L} \leq w_{0H}$, which is true, as shown in the solution below.

Substitute f_L from $(PC)_L$, f_H from $(IC)_{2H}$, and a_i from $(IC)_{1i}$ into the objective function, and solve for the solution. The interior solution in the no market setting is as follows:

$$v_i^{NM} = \frac{b_1^2}{b_1^2 + r\sigma_x^2},$$
$$a_i^{NM} = b_1 v_i^{NM}, i = L, H,$$

$$w_{0L}^{NM} = \left(\frac{b_0 + \zeta_L - \frac{\rho_H}{\rho_L}\Delta\zeta}{2p_0} \right)^2,$$

$$w_{0H}^{NM} = \left(\frac{b_0 + \zeta_H}{2p_0} \right)^2.$$

The principal induces the same action for both types. (Again, this is because the outcome is additively separable in the action and consumption of productive good.) The rent is minimized directly through the choice of non-cash wages. The H-type receives an efficient amount of non-cash good (the H-type's consumption is identical to that when the type is known). The L-type's consumption is, however, less than an efficient level to minimize the rent paid to the H-type. The principal's payoff is

$$U^p(w_0^{NM}, a^{NM}) = \rho_L \left(\frac{1}{2} b_1^2 v_L^{NM} + \frac{1}{4}\frac{(b_0 + \zeta_L)^2}{p_0} - \frac{1}{4p_0}\left(\frac{\rho_H}{\rho_L}\Delta\zeta \right)^2 \right)$$
$$+\rho_H \left(\frac{1}{2} b_1^2 v_H^{NM} + \frac{1}{4}\frac{(b_0 + \zeta_H)^2}{p_0} - \Delta\zeta\sqrt{w_{0L}} \right).$$

The principal's payoff is equal to his payoff if the type is known, minus the expected loss from inefficient choice of consumption for the L-type, and minus the expected rent paid to the H-type.

When the probability of the high type and the difference in preference are sufficient large, $w_{0L}^{NM} = 0$. The principal provides the good to only the high type.

Consider a special case in which $b_0 = 0$, i.e., the good is non-productive. The high type consumes efficiently, while the low type consumes less than the efficient level, i.e., the interior solution is $w_{0H}^{NM} = \left(\frac{\zeta_H}{2p_0} \right)^2$ and $w_{0L}^{NM} = \left(\frac{\zeta_L - \frac{\rho_H}{\rho_L}\Delta\zeta}{2p_0} \right)^2$.

Given limited empirical evidence on the use of non-cash compensation, it is difficult to provide an example of a menu of contracts offered by the principal. One possible example is a university which offers an assistant professor a cash salary with two forms of housing benefits: a two-bedroom on-campus apartment, or a subsidy for housing. This can possibly be explained by an assistant professor's private information about her valuation of a living space. Some like living in a larger unit, while others do not mind living in a compact unit (since she spends most of the time outside it anyway). But the assistant professor's preference is not known to the university. The result above suggests that when the probability of the high-preference type and the difference in the valuation are sufficiently large, it is optimal to provide an on-campus apartment only to the high type. Suppose the high-type wants a two-bedroom unit. In this example, we observe the provision of either a two-bedroom unit or a cash subsidy, nothing in between like a one-bedroom unit or a studio.

3.3.2 The Agent Can Buy and Sell Productive Goods

Section 2.5.2.2 shows that, with a perfect market and with no cost advantage, there is no benefit from providing a non-cash wage to the agent. Therefore, I simplify the analysis below by limiting w_0 to zero, i.e., $c_0 = m_0$. The agent's consumption comes entirely from the market.

The type-i agent's certainty equivalent is represented by

$$CE(v, f, a|\zeta_i) = f + v\,[b_0(c_0)^{1/2} + b_1 a] + \zeta_i(c_0)^{1/2} - \tfrac{1}{2}\, r\, v^2\sigma_x^2 - \tfrac{1}{2}\, a^2 - p_0 c_0\,, i = L, H.$$

With $\underline{U} = -1$, the participation constraint can be written as

$$(\mathrm{PC})_i \quad f_i = -v_i[b_0(c_{0i})^{1/2} + b_1\, a_i] - \zeta_i(c_{0i})^{1/2} + \tfrac{1}{2}\; r\, v_i^2\sigma_x^2 + \tfrac{1}{2}\, a_i^2 + p_0 c_{0i}$$

Consider the agent's incentive. The type-revealing contract must be such that the type-i agent is better off choosing the type-i contract, and the designated action and consumption than (i) choosing type-i contract and any other action and consumption, or (ii) choosing type-j contract and any other action and consumption. In the latter case, it is necessary to consider only the action and consumption which maximize the payoff of the type-i agent who chooses type-j contract. Let a_i and c_{0i} denote the action and consumption the principal wants the type-i agent to choose.

Consider the type-i agent's action which maximizes her payoff given that she chooses type-i contract. The agent's action choice is such that:

$$CE_a\,(v, f, a|\zeta_i) = b_1\, v - a = 0. \tag{3.3.2.1}$$

Again the action choice here is independent of the agent's preference parameter, but is dependent on the contract the agent chooses, i.e., on v, because an outcome function is additively separable in the effort and the consumption of productive good. From the first-order condition (3.3.2.1), if the agent chooses the L-type (H-type)'s contract, then her optimal action is $b_1 v_L (b_1 v_H)$; whether she is L- or H-type.

The agent's consumption choice is derived by differentiating her certainty equivalent by c_0.

$$CE_{c_0}(v, f, a|\zeta_i) \;=\; (b_0\, v + \zeta_i)/2(\, c_0)^{1/2} - p_0 \;=\; 0. \qquad (3.3.2.2)$$

Rearranging the terms gives $c_{0i}^{\,*} = \left(\dfrac{b_0 v + \zeta_i}{2p_0}\right)^2$. The agent's consumption choice depends on both the contract chosen (i.e., on v), and on the agent preference parameter ζ_i. If the type-i chooses type-i contract, her optimal consumption is $c_{0i} = \left(\dfrac{b_0 v_i + \zeta_i}{2p_0}\right)^2$. If the type-i chooses type-j contract, her optimal consumption is $c_{0i}^{\,**} = \left(\dfrac{b_0 v_j + \zeta_i}{2p_0}\right)^2$.

The incentive compatibility constraints that the type-i agent does not want to choose a type-i contract with any other action and consumption choice are represented by

$$(\mathrm{IC})_{1i} \qquad a_i = b_1 v_i\,,\ i = L, H,$$

$$(\mathrm{IC})_{2i} \qquad c_{0i} = \left(\frac{b_0 v_i + \zeta_i}{2p_0}\right)^2,\ i = L, H.$$

The incentive compatibility (truth-telling) constraints that ensure the type-i agent does not want to choose a type-j contract with any other action and consumption choice (which maximizes her utility given the type-j contract) are as follows:

$$(\mathrm{IC})_{3i} \qquad f_i \;+\; v_i[b_0(c_{0i})^{1/2} + b_1\, a_i] + \zeta_i(c_{0i})^{1/2} - \tfrac{1}{2}\; r\, v_i^2\sigma_x^2 - \tfrac{1}{2}\, a_i^2 - p_0\, c_{0i} \;\;\geq$$
$$f_j \;+\; v_j[b_0(c_{0i}^{\,**})^{1/2} + b_1 a_j] + \zeta_i(c_{0i}^{\,**})^{1/2} - \tfrac{1}{2}\, r\, v_j^2\sigma_x^2 - \tfrac{1}{2}\, a_j^2 - p_0\, c_{0i}^{\,**}, \quad i, j = L, H,\ i \neq j.$$

The principal's maximization problem is as shown below.

$$\max_{\substack{f_L, v_L, a_L,\\ f_H, v_H, a_H}} \; U^P(c,a) \;=\; \rho_L\{b_0(c_{0L})^{1/2} + b_1 a_L - f_L - v_L[b_0(c_{0L})^{1/2} + b_1 a_L]\}$$
$$+\rho_H\{b_0(c_{0H})^{1/2} + b_1 a_H - f_H - v_H[b_0(c_{0H})^{1/2} + b_1 a_H]\}$$

subject to $(\mathrm{PC})_i$, $(\mathrm{IC})_{1i}$, $(\mathrm{IC})_{2i}$, $(\mathrm{IC})_{3i}$ i = L, H.

In this perfect-market setting, $(\mathrm{PC})_L$, $(\mathrm{IC})_{1i}$, $(\mathrm{IC})_{2i}$, and $(\mathrm{IC})_{3H}$ are binding. From $(\mathrm{PC})_L$ and $(\mathrm{IC})_{3H}$ binding, we have[8]

---

[8] Note that $(c_{0H}^{\,**})^{1/2} = (c_{0L})^{1/2} + \Delta\zeta/2p_0$ and $c_{0H}^{\,**} = c_{0L} + [(c_{0L})^{1/2}\Delta\zeta]/p_0 + (\Delta\zeta)^2/(4p_0^2)$. Substituting these into $CE(v_L, f_L, a_L|\zeta_H) = [f_L \;+\; v_L[b_0(c_{0H}^{\,**})^{1/2} + b_1\, a_L] + \zeta_H(c_{0H}^{\,**})^{1/2} - \tfrac{1}{2}\; r\, v_L^2\sigma_x^2 - \tfrac{1}{2}\, a_L^2 - p_0 c_{0H}^{\,**}]$ gives the high-type's rent shown in (3.3.2.3).

$$f_H + v_H[b_0(c_{OH})^{1/2} + b_1 a_H] + \zeta_H(c_{OH})^{1/2} - ½\, r\, v_H^2\sigma_x^2 - ½\, a_H^2 - p_0 c_{OH}$$
$$= f_L + v_L[b_0(c_{OH}^{**})^{1/2} + b_1 a_L] + \zeta_H(c_{OH}^{**})^{1/2} - ½\, r\, v_L^2\sigma_x^2 - ½\, a_L^2 - p_0 c_{OH}^{**}$$
$$= CE(v_L, f_L, a_L|\zeta_L) + (v_L b_0 + \zeta_H)[(c_{OH}^{**})^{½} - (c_{OL})^{½}] + \Delta\zeta(c_{OL})^{½} - p_0[c_{OH}^{**} - c_{OL}]$$
$$= 0 + \Delta\zeta\,(c_{OL})^{1/2} + \Delta\zeta^2/4p_0 \qquad (3.3.2.3)$$

The H-type agent receives the rent of $\Delta\zeta\,(c_{OL})^{1/2} + \Delta\zeta^2/4p_0 \geq 0$. (The constraint $(PC)_H$ is thus satisfied). The rent is increasing in c_{OL}, which is increasing in v_L. With this amount of rent, $(IC)_{3L}$ is satisfied when $v_L < v_H$, which is true, as shown in the solution below.

Substitute f_L from $(PC)_L$, f_H from the (3.3.2.3), c_{0i} from $(IC)_{2i}$, and a_i from $(IC)_{1i}$ into the objective function, and solve for the solution. The solution in the no market setting is as follows:

$$v_H^{PM} = \frac{b_1^2 + b_0^2/2p_0}{b_1^2 + r\sigma_x^2 + b_0^2/2p_0} \quad > \quad v_H^{NM},$$
$$a_H^{PM} = b_1 v_H^{PM} \quad > \quad a_H^{NM},$$
$$v_L^{PM} = \frac{b_1^2 + \dfrac{b_0^2}{2p_0} - \dfrac{b_0}{2p_0}\dfrac{\rho_H}{\rho_L}\Delta\zeta}{b_1^2 + r\sigma_x^2 + b_0^2/2p_0},$$
$$a_L^{PM} = b_1 v_L^{PM},$$
$$m_{0i}^{PM} = \left(\frac{b_0 v_i + \zeta_i}{2p_0}\right)^2, \text{ and}$$
$$w_{0i}^{PM} = 0, i = L, H.$$

The incentive rate for the H-type is identical to when there is no pre-contract private information. Also, as when the type is known, the incentive rate and the action for the H-type in the perfect market setting are higher than those in the no market setting.

When there is no external market for an agent, the rent is minimized directly through the consumption choice (i.e., through the non-cash wage paid to the L-type). When there is a perfect external market, the rent is minimized instead through the incentive rate. The incentive rate for the L-type is adjusted downward to reduce the rent paid to the H-type. When the type is known, the incentive rate is higher in the perfect market setting than the no market setting. This is to induce the agent to consume more to increase the outcome to the principal. Here, the L-type incentive rate in the perfect market setting can be either higher or lower than that in the no market setting, depending on the values of the exogenous variables. This is because the incentive rate is adjusted downward to minimize the information rent paid to the H-type.

$$\text{Sign of } [v_L^{PM} - v_L^{NM}] = \text{Sign of } [r\sigma_x^2 b_0 - \Delta\zeta(r\sigma_x^2 + b_1^2)\rho_H/\rho_L].$$

Therefore, $v_L^{PM} > v_L^{NM}$ is true when $\Delta\zeta$ and/or ρ_H are sufficiently small.

The principal's payoff is

$$U^p(c_0^{PM}, a^{PM}) = \rho_L\left((b_0 + \zeta_L)\sqrt{c_{0L}^{PM}} + b_1 a_L^{PM} - p_0 c_{0L}^{PM} - \frac{1}{2}(a_L^{PM})^2 - \frac{1}{2}r\sigma_x^2(v_L^{PM})^2\right)$$

$$+\rho_H\left((b_0 + \zeta_H)\sqrt{c_{0H}^{PM}} + b_1 a_H^{PM} - p_0 c_{0H}^{PM} - \frac{1}{2}(a_H^{PM})^2 - \frac{1}{2}r\sigma_x^2(v_H^{PM})^2 - \frac{\Delta\zeta^2}{4p_0} - \Delta\zeta\sqrt{c_{0L}^{PM}}\right).$$

3.3.3 The Agent Can Buy But Cannot Sell (Limited Market)

From Section 3.3.2, with perfect market, the agent optimally chooses to consume $c_{0i}^{PM} = [(b_0 v_i^{PM} + \zeta_i)/2p_0]^2$. From section 3.3.1, with no external market to the agent, the principal provides $w_{0i}^{NM} = [(b_0+\zeta_i)/2p_0]^2$, which is greater than c_{0i}^{PM} (note that $v_i^{PM} \in (0,1)$). Therefore, if the principal pays $w_{0i}^{NM} = [(b_0+\zeta_i)/2p_0]^2$, the agent wants to sell some of her goods if she can.

Similar to the setting where the type is known, simply preventing the agent from selling the productive goods is adequate for the principal to be able to achieve the payoff exactly as if he can forbid the agent to trade.

3.4 Comparison of Different Private Information

This section considers and compares the optimal contracts in the no market setting and in the perfect market setting, when the agent's private information is (i) her preferences, (ii) the productivity of her effort, and (iii) the productivity of the productive good. (To give an example of the case the agent has private information about the productivity of the good, consider an agent who knows how much more productive she will be with a sophisticated personal computer.) The optimal contract when there is no private information, and the optimal contracts with different private information are discussed below. The derivation of the solutions is similar to the one described above in section 3.3. The results are similar to before. The low-type agent receives no rent, while the high-type agent receives rent increasing in the difference between the two types. The high type produces and consumes efficiently (i.e., her effort and consumption are identical to those when there is no private information), whatever the private information is. The rent paid to the high type is reduced by decreasing the low type's induced effort, consumption, or incentive rate. The optimal contracts for the high type and the rents are shown in Tables 3.2 and 3.3 respectively. The optimal contracts for the low type are shown in Table 3.4. (Note that the optimal non-cash wages for the perfect market setting are not shown in the tables below. It has been shown in chapter two that when the agent can buy and sell, it does not matter how much of the good is paid as compensation. The agent can buy and sell to consume the bundle she wants. So, let $w_0^{PM} = 0$ and $c_0^{PM} = m_0^{PM}$.)

Table 3.2 The Optimal Contracts for the High Type

Private Information	No-Market Setting	Perfect-Market Setting
Any	$a_H^{NM} = b_{1H} v_H^{NM}$ $v_H^{NM} = \dfrac{b_{1H}^2}{b_{1H}^2 + r\sigma_x^2}$ $w_{0H}^{NM} = \left(\dfrac{b_{0H} + \zeta_H}{2p_0}\right)^2$	$a_H^{PM} = b_{1H} v_H^{PM}$ $v_H^{PM} = \dfrac{b_{1H}^2 + b_{0H}^2 / 2p_0}{b_{1H}^2 + r\sigma_x^2 + b_{0H}^2 / 2p_0}$ $m_{0H}^{PM} = \left(\dfrac{b_{0H} v_H + \zeta_H}{2p_0}\right)^2$

Consider the high type's rent derived from the incentive compatibility constraints for the high type in Table 3.3 below. With different private information, and different market settings, the rents are increasing in different variables. And this determines the low type's contract, which is shown in Table 3.4 below.

When the private information is about the productivity of effort, the rent is increasing in the low type's effort, and hence is increasing in the incentive rate v_L.[9] When the private information is about the agent's preference, the rent is increasing in the consumption of the low type (i.e., w_{0L} in the no market setting, and m_{0L} in the perfect

[9] From the first-order condition, the optimal action for type-i agent is $a = vb_{1i}$. Given the L-type contract, the optimal action for the H-type is $a_H^{**} = v_L b_{1H}$. First, consider the no-market setting. The truth-telling incentive compatibility for the high-type is as follows. (Note that the L-type's participation constraint binding implies $CE(v_L, f_L, a_L|\zeta_L) = 0$.)

$$f_H + v_H[b_0(w_{0H})^{1/2} + b_{1H}a_H] + \zeta(w_{0H})^{1/2} - ½ r v_H^2\sigma_x^2 - ½ a_H^2 \geq$$
$$f_L + v_L[b_0(w_{0L})^{1/2} + b_{1H}a_H^{**}] + \zeta(w_{0L})^{1/2} - ½ r v_L^2\sigma_x^2 - ½ (a_H^{**})^2$$
$$= CE(v_L, f_L, a_L|\zeta_L) + \frac{1}{2}v_L^2(b_{1H}^2 - b_{1L}^2) = 0 + \frac{1}{2}v_L^2(b_{1H}^2 - b_{1L}^2).$$

With the above incentive compatibility binding, the H-type's rent is $\frac{1}{2}v_L^2(b_{1H}^2 - b_{1L}^2)$, as shown in Table 3.3. Since the private information is not related to the good, the H-type rent is equal whether the agent has access to the market or not.

market setting). When the private information is about the productivity of the good, the rent is increasing in both the low type's incentive rate v_L and in her consumption w_{0L} in the no market setting,[10] but is increasing in the incentive rate in the perfect market setting.[11]

Table 3.3 The High Type's Rent

Private Info.	No-Market Setting	Perfect-Market Setting
Productivity of effort: b_1	$\frac{1}{2}v_L^2(b_{1H}^2 - b_{1L}^2)$	$\frac{1}{2}v_L^2(b_{1H}^2 - b_{1L}^2)$
Agent's preference: ζ	$\Delta\zeta\,(w_{0L})^{1/2}$	$\Delta\zeta\,(m_{0L})^{1/2} + \Delta\zeta^2/4p_0$
Productivity of good: b_0	$\Delta b_0\, v_L\,(w_{0L})^{1/2}$, where $\Delta b_0 = b_{0H} - b_{0L}$	$v_L \frac{\Delta b_0}{4p_0}[v_L(2b_{0L} + \Delta b_0) + 2\zeta]$

---

10 From the first-order condition, the optimal action for type-i agent is $a = vb_1$, which is dependent on the contract chosen. Given that the L-type contract is chosen, the optimal action for the H-type is $v_L b_1 = a_L$. The incentive compatibility for the high-type is as follows. (Again, the L-type's participation constraint binding implies $CE(v_L, f_L, a_L|\zeta_L) = 0$.)

$$f_H + v_H[b_{0H}(w_{0H})^{1/2} + b_1 a_H] + \zeta(w_{0H})^{1/2} - \tfrac{1}{2} r v_H^2\sigma_x^2 - \tfrac{1}{2} a_H^2 \geq$$
$$f_L + v_L[b_{0H}(w_{0L})^{1/2} + b_1 a_L] + \zeta(w_{0L})^{1/2} - \tfrac{1}{2}\, r v_L^2\sigma_x^2 - \tfrac{1}{2} a_L^2$$
$$= CE(v_L, f_L, a_L|\zeta_L) + v_L\Delta b_0(w_{0L})^{1/2} = 0 + v_L\Delta b_0(w_{0L})^{1/2}.$$

With the above incentive compatibility binding, the H-type's rent is $v_L\Delta b_0(w_{0L})^{1/2}$, which is increasing in both the incentive rate and the consumption of the low type, as shown in Table 3.3.

11 From the first-order condition with respect to a, the optimal action for type-i agent is $a = vb_1$, which is dependent on the contract chosen. Given that the L-type contract is chosen, the optimal action for the H-type is $v_L b_1 = a_L$. From the first-order condition with respect to m_0, the optimal consumption for a type-i agent is $m_0 = \left(\frac{b_{0i}v + \zeta}{2p_0}\right)^2$. The optimal consumption for the H-type who chooses the L-type contract is thus $m_{0H}^{**} = \left(\frac{b_{0H}v_L + \zeta}{2p_0}\right)^2$. To derive the H-type's rent, consider the incentive compatibility for the high-type shown below.

$$f_H + v_H[b_{0H}(m_{0H})^{1/2} + b_1 a_H] + \zeta(m_{0H})^{1/2} - \tfrac{1}{2} r v_H^2\sigma_x^2 - \tfrac{1}{2} a_H^2 - p_0 m_{0H} \geq$$
$$f_L + v_L[b_{0H}(m_{0H}^{**})^{1/2} + b_1 a_L] + \zeta(m_{0H}^{**})^{1/2} - \tfrac{1}{2}\, r v_L^2\sigma_x^2 - \tfrac{1}{2} a_L^2 - p_0 m_{0H}^{**}$$
$$= CE(v_L, f_L, a_L|\zeta_L) + (b_{0H}v_L + \zeta)(m_{0H}^{**})^{1/2} - p_0 m_{0H}^{**} - [(b_{0L}v_L + \zeta)m_{0L}^{1/2} - p_0 m_{0L}]$$

Rearranging the terms give the H-type's rent of $v_L \frac{\Delta b_0}{4p_0}[v_L(2b_{0L} + \Delta b_0) + 2\zeta]$, as shown in Table 3.3.

Table 3.4 The Optimal Contracts for the Low Type

Private Info.	No-Market Setting	Perfect-Market Setting
No private information (Chapter 2)	$a_L^{NM} = b_1 v_L^{NM}$ $v_L^{NM} = \frac{b_1^2}{b_1^2 + r\sigma_x^2}$ $w_{0L}^{NM} = \left(\frac{b_0 + \zeta}{2p_0}\right)^2$	$a_L^{PM} = b_1 v_L^{PM}$ $v_L^{PM} = \frac{b_1^2 + b_0^2/2p_0}{b_1^2 + r\sigma_x^2 + b_0^2/2p_0}$ $m_{0L}^{PM} = \left(\frac{b_0 v_L^{PM} + \zeta}{2p_0}\right)^2$
Productivity of effort: b_1	$a_L^{NM} = b_{1L} v_L^{NM}$ $v_L^{NM} = \frac{b_{1L}^2}{b_{1L}^2 + r\sigma_x^2 + \frac{\rho_H}{\rho_L}(b_{1H}^2 - b_{1L}^2)}$ $w_{0L}^{NM} = \left(\frac{b_0 + \zeta}{2p_0}\right)^2$	$a_L^{PM} = b_{1L} v_L^{PM}$ $v_L^{PM} = \frac{b_{1L}^2 + b_0^2/2p_0}{b_{1L}^2 + r\sigma_x^2 + \frac{b_0^2}{2p_0} + \frac{\rho_H}{\rho_L}(b_{1H}^2 - b_{1L}^2)}$ $m_{0L}^{PM} = \left(\frac{b_0 v_{0L}^{PM} + \zeta}{2p_0}\right)^2$
Agent's preference: ζ	$a_L^{NM} = b_1 v_L^{NM}$ $v_L^{NM} = \frac{b_1^2}{b_1^2 + r\sigma_x^2}$ $w_{0L}^{NM} = \max\{\hat{w}_{0L}, 0\}$ $\hat{w}_{0L} = \left(\frac{b_0 + \zeta_L - \frac{\rho_H}{\rho_L}\Delta\zeta}{2p_0}\right)^2$	$a_L^{PM} = b_1 v_L^{PM}$ $v_L^{PM} = \max\{\hat{v}_L^{PM}, 0\}$ $\hat{v}_L^{PM} = \frac{b_1^2 + \frac{b_0^2}{2p_0} - \frac{b_0}{2p_0}\frac{\rho_H}{\rho_L}\Delta\zeta}{b_1^2 + r\sigma_x^2 + b_0^2/2p_0}$ $m_{0L}^{PM} = \left(\frac{b_0 v_L^{PM} + \zeta_L}{2p_0}\right)^2$
Productivity of good: b_0	$a_L^{NM} = b_1 v_L^{NM}$ $v_L^{NM} = \max\{v_L^*, 0\}$ $v_L^* = \left(\frac{b_1^2 - \frac{\rho_H}{\rho_L}\Delta b_0 \sqrt{w_{0L}^{NM}}}{b_1^2 + r\sigma_x^2}\right)$ $w_{0L}^{NM} = \max\{w_{0L}^*, 0\}$ $w_{0L}^* = \left(\frac{b_{0L} + \zeta - \frac{\rho_H}{\rho_L}\Delta b_0 v_L^{PM}}{2p_0}\right)^2$	$a_L^{PM} = b_1 v_L^{PM}$ $v_L^{PM} = \max\{v_L^{**}, 0\}$ $v_L^{**} = \frac{b_1^2 + \frac{b_{0L}^2}{2p_0} - \frac{\rho_H}{\rho_L}\frac{\Delta b_0}{2p_0}\zeta}{b_1^2 + r\sigma_x^2 + \frac{b_{0L}^2}{2p_0} + \frac{\rho_H}{\rho_L}\frac{z}{2p_0}}$, $z = \Delta b_0(2b_{0L} + \Delta b_0)$ $m_{0L}^{PM} = \left(\frac{b_{0L} v_L^{PM} + \zeta}{2p_0}\right)^2$

Productivity of Effort is Private Information

Consider the setting in which the principal does not know the productivity of the agent's effort. Prior adverse selection models show that the high type's rent is increasing the low type's effort. If the high type claims to be a low type, she can expend less effort to achieve the same level of expected outcome as the low type. The compensation adequate to cover the cost of effort and risk premium for the low type gives her rent. Since the cost of effort is convex, the larger the low type's effort, the higher the high type's rent. The low type's effort is increasing in v_L. The principal therefore decreases v_L to reduce the rent (both in the no market and the perfect market settings). Note that the incentive rate for the low type in the perfect-market setting v_L^{PM} is still higher than v_L^{NM} in the no-market setting to induce the desired level of consumption.[12] Also, since the benefit from the agent's effort is additively separable from the productivity and the consumption of the good, the rent is independent of the consumption of the good. The rent is equal whether the agent has access to the external market or not. When there is no market, the consumption is not affected by the private information about the productivity of effort. When there is an external market, the principal reduces the incentive rate because he wants to reduce the low type's effort. However, this has a side effect of reducing the consumption as well.

Note that we do not have a corner solution in which the low-type is offered only a fixed wage (i.e., the low-type incentive rate is equal to zero) when the private information is about the agent's productivity of effort. However, if the private information is about the good, we have a corner solution (in which the low-type incentive rate or the low-type non-cash wage is equal to zero) when the difference between the two types is sufficiently large, as discussed below.

Preference is Private Information

Consider the setting where the private information is about the agent's preference. When there is **no** external market to the agent, if the high type chooses the low-type contract, she benefits more from the good than the low type does. But the principal reduces other components of compensation only by the amount of the benefit of the good to the low

---

12 In this setting,

$$v_L^{PM} - v_L^{NM} = \frac{1}{b_{1L}^2 + r\sigma_x^2 + \dfrac{b_0^2}{2p_0} + \dfrac{\rho_H}{\rho_L}(b_{1H}^2 - b_{1L}^2)} \cdot \frac{(b_0^2/2p_0)[r\sigma_x^2 + (b_{1H}^2 - b_{1L}^2)\rho_H/\rho_L]}{b_{1L}^2 + r\sigma_x^2 + \dfrac{\rho_H}{\rho_L}(b_{1H}^2 - b_{1L}^2)} > 0.$$

type. She earns rent and the rent is increasing in the non-cash wage paid to the low-preference type. The principal reduces the rent by decreasing the non-cash wage for the low-preference type. If the probability of the high type and the difference between the two types are sufficiently large, the principal provides the good only for the high type.

Consider the perfect market setting. If the high type chooses the low-type contract, she benefits more from the good than the low type if she chooses the low-type's consumption m_{0L}. However, when she chooses the low type's contract, her optimal consumption is not m_{0L}, but is $\left(\frac{b_0 v_L + \zeta_H}{2p_0}\right)^2$ (because of her higher preference). This higher consumption leads to more expected variable cash compensation and more utility from the good, but also incurs a higher cost of the good. But the principal "reimburses" only the amount $p_0 m_{0L}$ to the agent who chooses the low type contract. Therefore, the high type's rent becomes

$$(b_0 v_L + \zeta_H)\left(\frac{b_0 v_L + \zeta_H}{2p_0}\right) - p_0\left(\frac{b_0 v_L + \zeta_H}{2p_0}\right)^2 - [(b_0 v_L + \zeta_L)m_{0L}{}^{1/2} - p_0 m_{0L}]$$

$$= \Delta\zeta(m_{0L})^{1/2} + \Delta\zeta^2/4p_0.$$

Whether there is an external market or not, the rent is increasing in the low type's consumption. The principal wants to reduce the low type's consumption to reduce this rent. Consider the no-market setting. When $\Delta\zeta$, which is the difference between the preferences of the two types, and the probability of the high type ρ_H are sufficiently large, the low-type is offered only cash compensation (i.e., $w_{0L}{}^{NM} = 0$).

When there is an external market, the principal cannot control the agent's consumption directly. He has to decrease incentive rate v_L in order to reduce the low type's consumption. The side effect is the reduction in the low type's effort. The principal optimally decreases v_L to the point where the marginal reduction in rent is equal to the marginal loss from the less-than-efficient effort and consumption choice. When $\Delta\zeta$, which is the difference between the preferences of the two types, and the probability of the high type ρ_H are sufficiently large, we have a corner solution in which the low-type is offered only a fixed cash wage (i.e., the low-type incentive rate is equal to zero).

Productivity of the Good is Private Information

Consider the setting in which the agent's productivity of the good is private information. When there is **no** external market to the agent, the principal decreases the rent by decreasing both w_{OL} and v_L. To understand why this is the case, note that if the high type chooses the low type's contract, she optimally chooses the effort $a^+ = b_1 v_L = a_L$. The low type who expends effort a_L will receives the expected cash compensation of $f_L + v_L(b_{OL}w_{OL}^{1/2} + b_1 a_L)$. The high type, however, receives $f_L + v_L(b_{OH}w_{OL}^{1/2} + b_1 a_L)$ (but she incurs the same cost of effort and risk premium as the low type). If she expends the low type's effort, she gains more expected outcome, and hence more variable cash compensation above the reservation wage. This extra compensation, which is $\Delta b_0 \, v_L \, (w_{OL})^{1/2}$, is increasing in the incentive rate, and in the expected outcome, which is increasing in the consumption of the good. Therefore, the principal wants to reduce both the incentive rate and the non-cash consumption to decrease the rent paid to the high type.

The interior solution is $(v_L^*, w_{OL}^*, v_H^{NM}, w_H^{NM})$. Consider the functional forms of the incentive rate v_L^* and the non-cash wage w_{OL}^*. The incentive rate and the non-cash wage must be no less than zero. Therefore, an interior solution is such that the incentive rate v_L^* and the non-cash wage w_{OL}^* are less than those when there is no private information. This is because the principal wants to reduce both the incentive rate and the non-cash wage for the low type to reduce the rent. However, reducing v_L has a side effect of reducing the low type's effort.

Consider a corner solution. Recall from Table 3.3 that the amount of high type's rent is $\Delta b_0 \, v_L(w_{OL})^{1/2}$. With either v_L or w_{OL} equal to zero, the high type earns no rent. The principal may find it optimal to eliminate all the rent by choosing either v_L or w_{OL} equal to zero, and enhancing the low-type outcome through either w_{OL} or v_L respectively. If the low-type's productivity of the good b_{OL} is small, but the difference in productivity of the good Δb_0 is large so that $w_{OL}^* < 0$, the principal chooses not to provide the good to the low type at all. The principal chooses to enhance the low-type outcome through productive effort by setting the low-type incentive rate equal to the rate when there is no private information. In contrast, if the difference in productivity of the good Δb_0 is small, but the productivity of the good for the low type b_{OL} is large so that w_{OL}^* is sufficiently large, the principal offers $v_L^{NM} = 0$. He chooses to increase the low-type outcome through the consumption of the productive good (which he can control perfectly), rather than by motivating effort through cash compensation. This result is based on the crucial assumption that the outcome function is additively separable in the consumption of good and effort.

Consider the setting in which there is an external market. If the high type chooses the low type's contract, she optimally chooses the effort $a^+ = b_1 v_L = a_L$. The low type who expends effort a_L will receives the expected cash compensation of $f_L + v_L(b_{0L} m_{0L}^{1/2} + b_1 a_L)$. The high type, however, receives $f_L + v_L(b_{0H} m_{0L}^{1/2} + b_1 a_L)$ (but she incurs the same cost of effort and risk premium as the low type). However, if she chooses the low type's contract, her optimal consumption is not $m_{0L} = \left(\frac{b_{0L} v_L + \zeta}{2p_0}\right)^2$, but is $\left(\frac{b_{0H} v_L + \zeta}{2p_0}\right)^2 > m_{0L}$, which will give a higher utility from the good, a higher outcome, and hence a higher variable cash compensation (but she will also incur higher cost of the good). Also, the principal will "reimburse" the low type agent only the amount $p_0 m_{0L}$ for the cost of the productive good. Therefore, the amount of rent becomes

$$(b_{0H} v_L + \zeta)\left(\frac{b_{0H} v_L + \zeta}{2p_0}\right) - p_0\left(\frac{b_{0H} v_L + \zeta}{2p_0}\right)^2 - [(b_{0L} v_L + \zeta) m_{0L}^{1/2} - p_0 m_{0L}]$$

$$= \quad v_L \frac{\Delta b_0}{4p_0}[v_L(2b_{0L} + \Delta b_0) + 2\zeta].$$

The rent is increasing in the incentive rate v_L. The principal reduces the rent by decreasing v_L, which also leads to lower low-type consumption and effort.

When Δb_0, which is the difference between the preferences of the two types, and the probability of the high type ρ_H are sufficiently large, we have a corner solution in which the low-type incentive rate is zero. In addition, we also have a corner solution when the agent's preference parameter ζ is sufficiently large. This is the setting in which the agent has intrinsic motivation to consume a lot of the productive good, which also increases the principal's production outcome.

No-market vs Perfect-market Settings

Compare the no market setting with the perfect market setting. When there is **no** external market to the agent, the principal's choice variables include both the consumption of good (i.e., the non-cash wage) and the incentive rate. If the rent is increasing in the low type's consumption (i.e., when the private information is about the agent's preference or the productivity of the good), the rent is reduced directly through the low type's non-cash wage. If the rent is increasing in the effort of the low type (i.e., when the private information is about the productivity of effort), or in the incentive rate itself (i.e., when the productivity of the good is not known), the rent is decreased directly through an incentive rate.

When there is a perfect external market for the good, the agent can consume any bundle she likes. It does not matter how much of the good the principal provides. The principal has only one choice variable, v. Whether he wants to decrease consumption, effort, (or of course the incentive rate itself), he reduces the incentive rate. The functional forms of m_{0L}, which is the low type's consumption of good, are similar for all three cases of different private information. However, the consumption is actually not identical, since the incentive rates are different when there is no private information, when the private information is about the preference, about the productivity of effort, or about the productivity of good.

The results in section 3.4 are summarized below.

Proposition 3.1: Whether the agent can buy or sell the good in the market or not, and whether the private information is about the preference, about the productivity of effort, or about the productivity of good, the high type produces and consumes efficiently.

Proof: See Table 3.2.

Proposition 3.2: Assume that the principal is the only source of the productive good.

(i) When the private pre-contract information is about the productivity of effort, the high type's rent is reduced through the incentive rate for the low type.

(ii) When the private pre-contract information is about the agent's preference for the good, the high type's rent is reduced directly through the low type's non-cash wage.

(iii) When the private pre-contract information is about the productivity of the good, the high type's rent is reduced through both the low type's non-cash wage and incentive rate.

(iv) The reduction is larger as the probability of the high type and the difference between the two types increase.

Proof: See Table 3.4.

Proposition 3.3: Assume that the agent can buy or sell the productive good in the market. Whether the private pre-contract information is about the agent's productivity of effort, the preference for the good, or the productivity of the good, the high type's rent is reduced through the incentive rate for the low type. The reduction is larger as the probability of the high type and the difference between the two types increase.

Proof: See Table 3.4.

Model Implication

The results from the analysis above can be summarized below.

Table 3.5 Model Implication

Private Information	No Market	Perfect Market
No Private information	A single contract offered.	A single contract offered.
Private information (No cost advantage)		
Non-productive good		
Productivity of Effort	Different incentive rates.	Different incentive rates.
Preference	Different non-cash wages.	Same contract (No good provided).*
Productive good		
Productivity of Effort	Different incentive rates.	Different incentive rates.
Preference	Different non-cash wages.	Different incentive rates.
Productivity of Good	Different incentive rates and non-cash wages.	Different incentive rates.

* It has been shown in chapter two that, when the principal has no cost advantage, he does not prefer to provide a non-productive good which is available from the market as compensation.

Assume there is no cost advantage. If the private information is about the preference for the good, the good is productive, and the principal is the only source, a menu of contracts consists of contracts with different quantities of non-cash compensation, but the same incentive rate. If the private information is about the productivity of the good, and the good is not available from the market, a menu of contracts consists of contracts with different quantities of non-cash compensation, and different incentive rates. If the private information is about (i) the productivity of effort, (ii) the preference of the productive good and the good is available from the market, or

(ii) the productivity of the good and the good is available from the market, then a menu of contracts consists of contracts with different incentive rates.

Recall the results from chapter 2 in Table 2.1: When will the principal provide a good as compensation? Assume that there is no cost advantage. The principal pays non-cash compensation when he is the only source of the good. This chapter shows that this may not be true for all employees if the employee has private information about her preference or about the productivity of the good. If the probability of the high type and the difference between the two types are sufficiently large, the principal provides the good only for the high type. He does not provide the good for a low type. (In other words, a menu consists of one contract offering only cash and another offering both goods and cash. The low type will choose the one which pays only in cash.)

In addition, if the private information is about the agent's productivity of effort, we do not have a corner solution in which the low-type incentive rate is equal to zero. Therefore, if a menu of contracts consists of one contract offering only a fixed salary, and another contract offering a fixed salary and a bonus, then this results from the private information about the preference or the productivity of the good.

Caveats

The model above assumes single private information, and assumes no cost advantage. In reality, the agent may have multiple private information. Also, the principal may have a cost advantage in providing the good. The settings with multiple private information and with cost advantages are left for future research.

3.5 Concluding Remarks

Chapter two examines the optimal use of non-monetary compensation in moral hazard settings. Chapter three discusses empirical work on CEOs' perquisites, and examines the setting where the agent has private, pre-contract information. The optimal contracts derived in chapters two and three are based on the assumption that there is no cost of writing a contract. Some goods like health insurance, medical examinations, annual leaves, etc., are required by law, and thus are often included in a written contract. Some goods can be easily described and hence incur low contracting costs. Examples include a subsidy for accommodation or child's education, etc. Other goods like employee's training and education, an annual group trip, other social activities, workplace conditions, gym facilities, etc., are more difficult to specify. The written (formal) contracts we observe in the real world reflect the benefit of including a good in the bundle, the costs of the goods, and the contracting costs. They are often incomplete. In general, an employer includes cash compensation, and omits some of the non-cash items which are more difficult to describe from the written contracts. When the promise to provide a good is simply verbal, there is a chance that the employer will renege after the agent has accepted the contract. The agent thus discounts the non-cash pay which is not specified in the written contract according to her belief about the principal's honesty.

Prior literature on implicit or informal contract has studied the sufficient conditions for a non-written part of the contract to be self-enforceable (i.e., for the employees to rationally expect that the employer will pay the informal compensation). Chapter four examines the use of informal compensation to deter undesirable actions which cannot be deterred by a formal mechanism. However, it does not specifically consider informal non-cash compensation. Future research which examines the use of non-cash compensation when contracting is costly will definitely help explain written contracts we observe in the real world.

Chapter 4: Informal Compensation and Labour Disputes

4.1 Introduction

This chapter examines another dimension of the compensation decision: formal vs informal. In particular, it considers the use of informal compensation to deter undesirable actions, which cannot be deterred by a formal mechanism. Examples of these actions include various kinds of employee litigation, strikes, etc. Employees are protected by the labor law, and employers cannot penalize the employees who exercise their rights under the law.

When an undesirable action cannot be deterred by any formal mechanism, one way the principal can reduce the loss from such an action is to decrease the agent's wage by the amount of the gain to the agent. Section 4.3 shows that when there is no private, pre-contract information, wage reduction is as good as being able to deter an undesirable action at no cost when (i) the agent is risk neutral, (ii) the agent has unlimited liability, and (iii) the gain to the agent is equal to the loss to the principal. This chapter considers settings in which one of the three is not true, and the principal is worse off with an undesirable action.

This chapter examines the use of informal compensation to deter employee's undesirable action. This is based on two special characteristics of the informal pay: (i) it is not written so that there is no evidence of the informal contract, and (ii) illegal informal pay gives the payers influence or power over the payees, and this power can be used to deter undesirable actions.

Sections 4.5-4.8 first examine the benefit of informal contracting in deterring employee litigation. In particular, it considers the use of legal informal pay in the setting in which a performance measure is observable to both the principal and the agent, but is not verifiable to the courts (i.e., a setting with a subjective performance measure). Consider a formal incentive contract (i.e., a written contract specifying a discretionary bonus based on a subjective performance measure), which cannot be enforced by the court because the performance measure is not verifiable. Ex post, after the action is taken, the principal has incentive to renege by not paying a bonus. There is a principal's commitment problem. Prior literature on implicit contracts (contracts not enforceable by the courts) derives the conditions under which the contract based on a non-verifiable performance measure is self-enforcing. The incentive problem on the principal's side is investigated. In reality, the agent can act opportunistically as well. When the agent is not paid a bonus because the realized performance measure is not good, she can sue the principal, claiming discrimination in performance evaluation. The principal cannot defend himself very effectively, since he has no evidence to show the courts that the agent is actually not paid a bonus due to inadequate performance.

In the US, employee litigation has become a real problem for employers. According to Doyle and Kleiner (2002), the punitive damages awarded to plaintiffs are on average $2,875,000, and the incidence frequency is increasing. The most frequent lawsuits are those related to discrimination. Webster (1988) argues that the firm's employee-evaluation practice is commonly used to prove discrimination. The more subjective and ambiguous the evaluation, the more likely the firm will lose the case.

Instead of deriving the sufficient conditions for a self-enforceable contract in an infinite-horizon setting, this chapter considers a game with incomplete information, as introduced by Kreps and Wilson (1982). The focus is to study the characteristics of the optimal contract when there are both the principal's commitment problem and the employee litigation problem.

Rather than offering a formal (written) contract based on a subjective performance measure, the principal can offer an informal (unwritten) incentive contract. Using an informal contract can prevent discrimination suits, since there is no evidence of such a contract. However the principal may renege, and there is no way the agent can penalize the reneging principal. With a formal, written contract, the principal incurs the loss from litigation problem since the agent can sue him for discrimination. However, the commitment problem is less severe, since the agent can sue to gain something to offset her cost of effort, if the principal reneges. Whether the optimal contract is formal or informal thus depends on whether the commitment problem or the litigation problem is more severe.

This chapter then examines the use of illegal informal compensation to deter undesirable actions. Illegal informal compensation, such as allowed "theft" gives the employer power to compromise the agent if she takes undesirable actions the principal would like to deter. When the lower bound on compensation is sufficiently low, and there is no private, pre-contract information, a proper mix of formal and informal compensation can deter the agent's opportunistic behavior. Note that in this setting, commitment is not a real problem, i.e., the principal intrinsically wants to pay informally even when the courts cannot force him to do so (as long as the amount of pay is not larger than the loss from an undesirable action to the principal), because he wants to obtain power to compromise an employee.

To sum up, this chapter considers the use of informal compensation to mitigate an undesirable action problem. It considers two kinds of informal compensation: legal and illegal pay. It focuses on two features of informal compensation: (i) informal contracting leaves no evidence to be used in the courts, and (ii) illegal informal compensation can be used to compromise employees. This chapter is organized as follows. Section 4.2 discusses the definition and prior evidence on informal compensation. Section 4.3 examines the use of formal compensation when the agent can take an undesirable action. Sections 4.4–4.8 address the use of a legal informal contract to deter discrimination litigation. Section 4.4 briefly reviews the prior literature on the use of implicit/informal contract in a no-litigation setting. Section 4.5 describes the model. Sections 4.6 and 4.7 derive the optimal formal and informal contracts respectively. Section 4.8 compares formal and informal contracting. Section 4.9 considers the use of illegal informal compensation to deter an undesirable action like strikes. Section 4.10 concludes.

4.2 Definition and Evidence of Informal Compensation

4.2.1 Definition of Informal Compensation

Informal contracting or informal compensation means different things in different papers. For example, in Battigalli and Maggie (2004), a formal contract is the one externally enforced, but an informal contract is a self-enforcing contract. By this definition, the use of a subjective bonus (i.e., a bonus based on a non-verifiable performance measure) is considered an informal contract, even when the agreement to pay discretionary bonuses is written in an employment contract. Zenger, Lazzarini, and Poppo (2001) offer a different definition.

> We define formal institutions as rules that are readily observable through written documents or rules that are determined and executed through formal position, such as authority or ownership. Formal institutions, thus, include explicit incentives, contractual terms, and firm boundaries as defined by equity positions. We define informal institutions, in turn, as rules based on implicit understandings, being in most part socially derived and therefore not accessible through written documents or necessarily sanctioned through formal position. Thus, informal institutions include norms, routines, and political processes.
>
> Zenger, Lazzarini, and Poppo, 2001: 2

In this chapter, informal compensation includes any form of payment (monetary or non-monetary) that is not included in formal compensation practices, as written in an employment contract, a company's charter, or any other recorded agreements. Examples of informal pay include a superior allowing an employee to take defective goods, scrap raw materials, overstocked items, obsolete items, etc., for personal consumption; allowing an employee to take a "sick" leave when the workload is minimal; allowing an employee to travel business class or first class, or to stay in a luxurious hotel rather than cost-saving airfare and accommodation, etc. The informal compensation paid to employees is usually dependent on the work context. A waiter working in a restaurant, for example, may be informally allowed to consume some food in the kitchen or to take leftovers home; while a manufacturing worker may be able to take some tools home for personal use.

4.2.2 Evidence of Informal Compensation

The empirical evidence or case studies on informal compensation in accounting are very limited. However, there are some case studies in organizational behavior (Greenberg and Scott, 1996). Researchers describe a controlled theft system, where a certain employee is occasionally allowed to "steal" a certain amount of a certain item as part of her compensation. In a supermarket, those working on late-night shifts can consume food or beverage while working; this is considered additional compensation for undesirable working conditions (Greenberg and Scott, 1996).

In explaining theft or fraud, the most important theory in organizational behavior (which is adopted by accounting authors– see, for example, Wells (1997)) seems to be the so-called triangle model of fraud. According to this theory, fraud occurrence is determined by three factors: an employee's motives; her attitudes; and the opportunity to perpetrate fraud. The motives include greed (which is assumed to be the only motive in the economics literature); personal financial difficulties; and other psychological factors such as job dissatisfaction, the feeling of being treated unfairly and the desire to retaliate, etc. Once the employee has a motive to commit fraud, whether she really does so is determined by her attitude toward fraud (i.e., her levels of honesty, risk aversion, possible guilt over fraud, etc.), and by whether the opportunities to perpetrate fraud exist (i.e., whether the internal control is effective or not). This theory explains from the employee's perspective whether fraud will occur. It delineates how the employee's attitudes and the situational factors (e.g. whether the employee gets compensated fairly and whether the internal audit is effective) affect her decision to perpetrate fraud. From an employer's perspective, the economics literature usually explains the choice of control as a cost-benefit analysis. With costless control, an employer wants to implement the perfect control to deter all fraud incidents. When control is costly, he optimally chooses less than perfect control because perfect control is too expensive, compared with the benefit. Consequently, fraud seems to result from costly, imperfect control.

Evidence from organizational behavior (e.g. Mars (1982) and Greenberg and Scott (1996)) seems to hint that some of the fraud incidents we observe may be virtual fraud, which is allowed as a way to pay employees informally, rather than the unwanted fraud which occurs because the perfect control is too costly. Even when perfect control is costless, an employer may not implement perfect control to deter all fraud because he wants to pay the agent informally. Note that, in addition to being a more timely and flexible way to compensate employees, as asserted in prior literature (Greenberg and Scott, 1996), informal compensation is tax-free for employees, but the expenses incurred from the informal pay are usually tax-deductible for employers. However, the tax effects are not discussed here.

4.2.3 Special Issues on Informal Compensation

This section discusses two special issues of informal compensation: different kinds of the pay and the characteristics of a control system to allow the informal payment. From existing evidence on informal compensation, there seems to be two kinds of informal compensation: legal and illegal. Examples of legal informal compensation include a boss paying for a birthday gift or a party for a certain employee. Some types of illegal informal compensation seem outright illegal, e.g. controlled "theft" discussed above. Other types may not be so obviously illegal. For example, consider the "abuse" of an expense account. It can be difficult to define "abuse" if the company does not have thorough reimbursement policies.

For formal compensation, we generally focus on the amount of pay. With informal compensation, in addition to the amount, an employer also needs to decide whether he wants to pay legal or illegal informal compensation. If the objective of the informal pay is to gain power over the agent, as discussed further in section 4.9, the business uses illegal informal pay like allowed "theft." By accepting the pay, the employee is subject to being prosecuted for "theft. The threat of prosecution can be used to deter undesirable actions.

In addition, the employer must decide how the pay can be transferred to the agent. This is simple in cases of legal pay like a monetary or non-monetary gift. For other forms of informal pay, like allowed "theft" or "abuse" of expense accounts, control is an issue. The control system in an organization must be designed to allow for informal pay. By the word "allow", I mean the firm chooses not to implement an adequate control system to protect certain organizational resources "at risk". The control is weak enough to facilitate the permitted asset appropriation, but strong enough to prevent unwanted misappropriation. Consider the example of a journalist and inflated expense accounts in Mars (1982) discussed earlier in chapter one. With a weak policy as to what and how much is allowed for reimbursement, the editor has some leeway to compensate the journalist for good work. However, the business can prevent the unwanted abuse of the expense account by requiring management's authorization for a large reimbursement. To change the amount of informal pay, the employer adjusts the control system accordingly. When controlled "thefts" are used as a way to informally compensate the employees, the control is weaker somewhere but stronger elsewhere. In other words, even when perfect control is costless, a firm may choose to implement less than perfect control to allow illegal informal compensation.

Section 4.9 considers the use of illegal informal compensation. It assumes that any level of control to prevent and to detect unwanted theft is possible at no cost. For example, if the bakery owner wants to allow his employee to "steal" one loaf of bread each day, section 4.9 assumes that he has an efficient control system which allows just one loaf per employee per day. In reality, control may not be that efficient. This possibly explains why there has been no real world example where an employer allows employees to steal cash, gold, or diamonds. It seems more difficult to prevent unwanted thefts of those small items with big values, and the losses from unwanted thefts of these items can be enormous.

This section defines and provides evidence of informal compensation. Section 4.3 considers a setting with an undesirable action which cannot be deterred by a formal mechanism. It shows that, if limited to formal contracting, the principal is worse off with such an action when the agent is risk averse or has limited liability, or the gain from the action to the agent is less than the loss to the principal. Sections 4.5-4.8 consider the use of legal informal compensation in a setting with a discrimination lawsuit. Section 4.9 considers the use of illegal informal compensation to deter employee resistance, and other kinds of litigation like wrongful termination suits and harassment suits.

4.3 Formal Compensation and Labour Disputes

This section investigates a setting where, in addition to a productive action, the employee may have a chance to take an "undesirable" action that is beneficial to the employee but is costly to the employer. In particular, this section considers labour disputes like strikes and employee litigation. An employee is protected by the labor laws, and the employer cannot offer a contract which imposes a fine on the employee who exercises her rights under the law. (The employer can offer a formal contract which offers a bonus to an employee who has not sued or gone on strike. However, after the bonus is paid, there is nothing to stop the employee from taking an undesirable action anyway.) These undesirable actions cannot be deterred by a formal mechanism like a formal compensation contract.

When the undesirable action cannot be deterred by formal mechanisms, the firm can minimize the loss from an undesirable action by decreasing the wage by the amount of the expected gain the agent will receive. Ex post, the agent takes an undesirable action if nature determines that she has a chance to do so. Assume that the principal is risk neutral, and there is no private, pre-contract information. This wage reduction is as good as being able to deter the undesirable action at no cost only when the agent is risk neutral and has unlimited liability, plus the expected gain to the agent is equal to the loss to the principal, as shown below.

<u>A Benchmark Case with no Undesirable Action Problem</u>

Consider a simple setting with no moral hazard problem. There is only a single action: a productive action, which is observable. The principal hires the agent to produce the outcome x, where x denote the outcome which maximizes the principal's payoff. To produce x, the agent incurs an additive disutility of effort v.[13] Let w denote the wage paid to the agent, and $u^a(w,v) = u(w) - v$ denote the agent's utility. Assume $u(w)$ is weakly concave. The agent's reservation utility is denoted by $\underline{U}$. To induce the agent to accept the contract, a fixed wage must be such that

(PC)^a $$u(w) - v \geq \underline{U}. \qquad (4.3.1)$$

[13] Let $x(a)$ denote a concave outcome function and $v(a)$ denote an additively separable convex disutility of effort, where $a > 0$ is the level of effort. The outcome $x = x(a^*)$ and the disutility of effort $v = v(a^*)$ are such that $x'(a^*) = v'(a^*)$.

Let W denote the inverse of u, i.e., $W \equiv u^{-1}$. The optimal wage and the principal's payoff are as follows:

$$w^{FB} = W(\underline{U} + v),$$
$$U^P(w^{FB}) = x - w^{FB} = x - W(\underline{U} + v).$$

An equivalent contract is a sales contract in which the principal sells the firm to the agent. However, to examine labor dispute problems, assume that the principal cannot sell the firm to the agent.

A Formal Contract with an Undesirable Action Problem

Now, suppose that there are two actions: a productive action, which is observable, and an undesirable action which cannot be deterred by formal mechanisms. After production, the agent may have a chance to take an undesirable action with probability ϕ^u. Let g^u denote the gain to the agent while l^u denote the loss to the principal.[14] Assume that the expected gain is no more than the agent's reservation utility, i.e., $g^u < \underline{U}$. (If the expected gain from an undesirable action is larger than the agent's reservation utility, the agent will work for the principal even for free or for a negative payment, just to have a chance to take an undesirable action later on. This is not a very realistic case, and therefore is ruled out.)

With $l^u > 0$, the principal's payoff is

$$U^P(w) = x - w - \phi^u l^u. \tag{4.3.2}$$

It will be illustrated below that the principal is worse off with an undesirable action when the agent is risk averse, when the lower bound on compensation is sufficiently large, and when the agent's gain from such an action is less than the loss to the principal.

First, consider the effects of the agent's risk preference and the bound on compensation. To rule out the effects of differential payoffs from an undesirable action, suppose that $g^u = l^u$. Ideally, the principal wants to reduce the fixed wage paid to the agent by the amount $\phi^u g^u$, but he may not be able to do so since he also needs to induce the agent to accept the contract. The participation constraint is as follows:

---

14 In reality, the expected gain from the undesirable action to the agent, the expected loss to the principal, and the probability that the agent can take an undesirable action can be dependent on the agent's productive action. In section 4.6, the probability that the agent can take an undesirable action (i.e. sue the principal for discrimination) is determined by the productive action. However, note that the effects of productive action on the payoffs from an undesirable action or on the probability the agent can take such an action are not analyzed here.

(PC)[a] $\phi^u\, u(w+ g^u) + (1 - \phi^u)\, u(w) - v \ \geq \underline{U}.$ (4.3.3)

Let w^* denote the fixed wage which makes (4.3.3) binding.

If the agent is risk neutral and there is no lower bound on compensation, $w^* = \underline{U} + v - \phi^u g^u$. The principal's payoff is equal to the first-best payoff with no opportunistic behavior problem, i.e.,

$$U^P(w^*) = x - w^* - \phi^u l^u \ = x - (\underline{U} + v). \tag{4.3.4}$$

If there is a lower bound on compensation $\underline{w}$, and $w^* = \underline{U} + v - \phi^u g^u \ < \underline{w}$, the principal is worse off with the agent's ability to act opportunistically since he has to pay the rent of $\underline{w}$ - w^* to the agent.

Now, consider the setting in which the agent is risk averse and $g^u = l^u$. With (4.3.3) binding and Jensen's inequality,

$$\phi^u\, u(w^*+ g^u) + (1 - \phi^u)\, u(w^*) \ = \ \underline{U} + v \ < u(w^*+ \phi^u g^u). \tag{4.3.5}$$

Appling the wage function to the latter parts of (4.3.5) yields

$$W(\underline{U} + v) \ < \ w^* + \phi^u g^u.$$

Therefore, the principal's payoff is

$$\begin{aligned} U^P(w^*) \quad &= \quad x - [w^* + \phi^u g^u] \\ &< \quad x - W(\underline{U} + v). \end{aligned}$$

The principal is worse off with the agent's undesirable action when the agent is risk averse, even when the gain to the agent is equal to the loss to the principal.

Now, consider the effect of the differential payoffs from an undesirable action. Consider the principal's payoff in (4.3.2). When the agent is risk neutral, with $w^* = \underline{U} + v - \phi^u g^u$, his payoff becomes

$$U^P(w^*) = x - w^* - \phi^u l^u \ = x - (\underline{U} + v) + \phi^u(g^u - l^u).$$

Given that the agent is risk neutral and has unlimited liability, if $g^u > l^u$, the principal is even better off with the agent's ability to take this "undesirable" action. However, if $g^u < l^u$, the principal is still worse off even after this strategic wage reduction. This is also true when the agent is risk averse, or the lower bound on compensation is sufficiently large.

Proposition 4.1: Assume that there is no private, pre-contract information, and the agent's productive action does not affect the payoffs from an undesirable action, or the chance that the agent can take the action. Also, the principal can only offer a formal, written contract, and the undesirable action cannot be deterred by formal mechanisms. The principal is not worse off with an undesirable action, if

(i) the agent is risk neutral and has unlimited liability, and

(ii) the gain to the agent from the harmful action is no less than the loss to the principal.

Proof: See the analysis above.

When a formal, written contract cannot solve an undesirable action problem, an informal contract may be able to do so. This chapter considers two kinds of informal compensation: legal and illegal. Sections 4.4-4.8 consider the use of legal informal compensation in a setting where the only performance measure available is not verifiable to the courts. When a subjective performance measure is used and is specified in a written contract, the agent can sue the principal for discrimination in performance evaluation. When the litigation loss to the principal is larger than the gain to the agent, the agent is risk averse, or the lower bound on compensation is sufficiently large, the principal is worse off with employee litigation. The key feature of an informal contract is that there is no evidence of the contract to be opportunistically used by the agent. If the principal officially offers a fixed salary and informally agrees to pay a bonus based on a subjective performance measure, the agent cannot sue. Section 4.4 first reviews prior economic literature on informal/implicit contract in a no-litigation setting. Sections 4.5-4.8 consider an employee litigation problem, and analyze and compare formal and informal contracting.

In sections 4.5-4.8, the main focus is on one characteristic of informal compensation – the lack of evidence of the informal contract, which is useful when the principal wants to avoid employee litigation. Section 4.9 introduces another kind of informal pay: illegal informal compensation. The key feature of illegal informal pay is that it can be used to compromise the agent, and hence to deter undesirable actions like strikes, wrongful termination suits, etc.

4.4 Implicit Contract With No Employee Litigation

This section reviews prior literature on the use of informal contracts when there is no employee litigation. Prior literature on implicit contracts (contracts not enforceable by the courts) seems to focus on the principal's commitment problem. Much effort has been done to derive the conditions in which an implicit contract is self-enforcing. See, for example, Bull (1983), Bull (1987), MacLeod and Malcomson (1989).[15] More recent work examines a more general issue. Levin (2002), for example, considers the use of

[15] Rosen (1985) extensively reviews earlier literature on implicit contracts.

bilateral implicit contracts (where the firm contracts with each individual employee) and a multilateral implicit contract (where the firm offers the same contract to many employees). A multilateral implicit contract is more difficult to change and hence performs better in a static environment where future changes are unlikely.

The analysis of implicit contracts in moral hazard settings seems to concentrate on the use of subjective performance measure (or the use of discretionary bonus). In the setting with non-verifiable performance measures, the moral hazard is double-sided. The agent may shirk, and the principal may renege by not paying the bonus as promised.[16] There are two ways in which the use of non-verifiable information in contracting can be sustained: by considering an infinitely repeated game (as in the literature on cartel agreements) or by assuming the agent is not certain about the principal's type (as in Kreps and Wilson (1982)). Baker, Gibbons, and Murphy (1994) consider a super game between an employer and an employee. There are both objective (verifiable) and subjective performance measures. Although not verifiable, the subjective performance measure is observable to both the principal and the agent. The agent can punish the reneging principal with a trigger strategy, i.e., she refuses to participate in a subjective bonus plan forever if the principal reneges. After reneging, the principal can use only the objective measure for contracting. The authors show that a bonus based on the subjective measure cannot be sustained when the discount rate is sufficiently high, or the noise in the objective measure is sufficiently low. In other settings, the principal optimally uses both subjective and objective bonuses. However, as the noise in the objective measure decreases, the sustainable subjective bonus decreases.

MacLeod (2003) ignores the reneging problem (i.e., he assumes the contract based on a subjective measure is self-enforcing), and considers a setting where the principal and the agent each observe a private signal of performance.[17] The two signals may be correlated. If the agent thinks she is not compensated fairly, she can undertake an unproductive action which is costly to the principal. MacLeod finds that the compensation is dependent only on the principal's signal, but the optimal contract does depend on the correlation between the principal's and the agent's signals. When the correlation is closer to perfect, the contract is closer to the contract the principal offers

[16] In addition to the reneging problem, Predergast and Topel (1993) discuss (without a formal analysis) other possible problems like bias (intentional or unintentional) and favoritism.

[17] His work is very much related to Prendergast and Topel (1996)'s work on favoritism in subjective performance evaluation.

when the measure is verifiable. (Note that the author assumes that the implicit contract is self-enforcing.) When there is no correlation, the principal pays the same bonus to all but a very bad signal, since he wants to avoid the costly conflict with the agent. This results in a low-power incentive plan.

Instead of considering a super game or a game with incomplete information about the principal's type, Baiman and Rajan (1995) consider a single-period, multi-agent model in which the principal can commit to a bonus pool based on verifiable measures. The allocation of the pool to individual agents is based on a subjective measure observed by the principal. Assume there is no renegotiation and no collusion between the principal and an agent, or between the principal and a subset of agents. Once committed to the pool amount through a formal contract, the principal does not renege. Baiman and Rajan show that the principal is strictly better off when the subjective measure can be used in an implicit contract.

Sections 4.5 - 4.8 extend the prior literature by considering the subjective evaluation setting with a litigation problem. If a formal contract based on subjective evaluation is used, the principal is subject to future litigation. However, if a firm contracts with the agent informally, there is no evidence of the promise to pay the bonus. The agent cannot sue the principal. Intuitively, one would expect that employers may want to avoid the lawsuit by offering an informal contract rather than a formal contract. But in the real world, we do observe the use of subjective evaluation in a formal compensation contract. The choice of a formal or an informal contract is a tradeoff between the possibly higher loss from the commitment problem if an informal contract is used, and the loss from litigation problem if a formal contract is used. The sufficient conditions for an informal contract are derived in section 4.8.

4.5 Model Description

Consider an agency model in which the performance measure (i.e., the outcome from production) is observable by both the principal and the agent, but is not verifiable to the courts. Also, assume that there is no other informative signal about the agent's effort.

For simplicity, this chapter excludes non-cash compensation, and considers a binary setting similar to the one in section 2.4.2. To summarize, $a \in \{0, 1\}$, and $x \in \{x_L, x_H\}$, $x_H = x_L + \Delta x > x_L$. If the agent chooses $a = 0$, then the outcome is x_L, i.e. $\phi(x_L|\, a = 0) = 1$. If the agent chooses $a = 1$, then the outcome realized is x_H with probability P, i.e.

$\phi(x_L|a = 1) = 1 - P$ and $\phi(x_H|\ a = 1) = P$. Assume that $P \in (0, 1)$ so that the outcome is an imperfect signal informing the principal of the agent's action. Let $\bar{x} = x_L + P\Delta x$. Assume that the outcome is the only performance measure available. Additionally, unless assumed otherwise, $P\Delta x$ is sufficiently large so that the principal wants to induce $a = 1$.

The agent's utility function is denoted by $u^a(c, a) = u(c) - v(a)$, where $c \in R^+$ is cash compensation, and $v(a)$ denotes the cost of effort. Let $\Delta v = v(a=1) - v(a=0)$. The fixed compensation is represented by F, the bonus paid when the high outcome is realized is denoted by B, and the agent's reservation utility is represented by $\underline{U}$. The agent's expected utility is denoted by $U^a(a) \equiv E[u(c)|a] - v(a)$.

To simplify the analysis further, I assume that the agent is risk neutral. However, to examine labor dispute problems, assume that the principal cannot sell the firm to the agent. Also, at the end of the period after the action is taken, the principal's strategy is limited to either paying the amount of bonus specified or not paying at all.

Consider the use of formal compensation when the performance evaluation is subjective. The formal compensation contract is a written contract between the principal and the agent which bases the compensation on the subjectively-evaluated outcome. After the agent has chosen the desired level of effort $a = 1$ and the high outcome is realized, the principal may renege by not paying the promised bonus. Thus, we have a commitment problem on the principal's side. On the other hand, the agent may have an incentive to shirk (and receive the low outcome and thus no bonus) and then sue the principal for discrimination in performance evaluation. The principal cannot prove to the courts that the bonus is not paid because the outcome realized is low, not because of discrimination. The firm may have deep pockets so that the agent finds it is worthwhile to sue the firm. Also, the firm may accommodate the agent's demand, because the litigation may ruin its reputation in a capital or a labour market. Therefore, there are two problems accompanying the use of a formal contract: the principal's commitment problem and the litigation problem.[18]

Next, consider the use of informal compensation. By "informal contract", I mean the principal offers a formal contract specifying a fixed wage, and offers an informal incentive contract specifying a bonus based on the subjective performance measure. Example of an informal incentive contract includes a non-witnessed verbal promise to

---

[18] Note that the expected loss from litigation per employee does not need to be large to make employee litigation a significant problem, since the firm may hire a large number of employees.

pay a bonus based on the outcome. There is no evidence of the informal incentive contract available to present to outsiders. The informal incentive contract is based on the expectation (or the "trust") between the principal and the agent. Examples include a manager promising to give a gift to a secretary if her performance is satisfactory to him; or to allow a secretary to take a "sick" leave from time to time, knowing that the secretary is not sick, etc. Because there is no evidence, an informal incentive contract generally cannot be enforced by the courts. The principal may renege. On the other hand, if the agent is not satisfied with the performance evaluation, she cannot sue the principal for discrimination. Therefore, with an informal contract, there is no litigation problem, but the principal's commitment problem still exists. (For instance, the courts cannot force a manager to give a gift to his subordinate.)

Rather than considering a super game between the principal and the agent, I consider a game with incomplete information. Assume that there are two types of principals: honest and dishonest. If the honest principal reneges by not paying the bonus when the outcome is high, he suffers from guilt so that his payoff becomes $-\infty$. Thus, the honest principal will never renege. The dishonest type, in contrast, incurs no guilt at all. However, if the dishonest principal is indifferent between paying or not paying a bonus ex post, assume that he will pay. At the time he offers a contract, the principal knows whether he is honest or not. But the agent does not know his type. The agent believes that the principal is honest with a prior probability h_0 and is dishonest with a prior probability $1- h_0$. Let h_1 denote the agent's updated belief about the principal's honesty, after she observes the contract offered. (If it is optimal for the dishonest principal to imitate the honest principal (i.e., they offer the same contract), then $h_0 = h_1$). Let h_2 denote the agent's updated belief after she receives or does not receive the bonus at the end of the period. The honest and dishonest principals' payoffs are denoted by $U^{PH}(a, F, B| h_1)$ and $U^{PD}(a, F, B| h_1)$ respectively. Unless the contract offered is such that both the honest and the dishonest principals will pay a bonus, the agent's expected payoff is dependent on h_1, which is the agent's updated belief about the principal's type after she observes the contract offered.

Section 4.6 investigates the use of a formal contract when the performance measure is not verifiable, and the agent can sue the principal. Section 4.7 considers the use of an informal contract. Section 4.8 compares the formal and informal contracts.

4.6 Formal Contract with Employee Litigation

This section examines the use of formal contracting in the setting in which the performance measure (the outcome) is observable by both the principal and the agent but is not verifiable to the third party. The principal offers a written compensation contract, based on subjective performance evaluation. The bonus based on this subjective performance measure is susceptible to reneging. On the other hand, when the bad outcome is realized and she should not be paid a bonus, the agent can sue the principal for discrimination in performance evaluation. In this setting, both the principal's commitment problem and the litigation problem exist. It will be shown that the agent's opportunity to sue helps mitigate the commitment problem, compared with when an informal contract is used. However, if the gain from litigation to the agent less than the loss to the principal, or the lower bound on compensation is sufficiently large, the principal cannot eliminate all the loss from litigation by reducing the fixed wage paid to the agent. The principal incurs a deadweight loss from litigation.

To summarize, there are three problems in this formal contracting setting: a moral hazard problem, a litigation problem, and a commitment problem.

4.6.1 The Benchmark Case: The Outcome is Verifiable

Consider a benchmark case where the performance measure (the outcome) is verifiable. Therefore, there is no commitment or litigation problem. Assume also that $P\Delta x$ is sufficiently large so that the principal wants to induce $a = 1$. Since the agent is risk neutral, the principal achieves the first-best payoff. To induce the agent to accept the contract, her payoff must be no less than her reservation utility. To motivate the agent to choose $a = 1$, her payoff from doing so must be no less than that from shirking. In other words, the participation and incentive compatibility constraints below must be satisfied.

$$(PC^a) \qquad U^a(a=1) \equiv F + PB - v(a=1) \geq \underline{U} \qquad (4.6.1.1)$$

$$(IC^a) \qquad U^a(a=1) \geq U^a(a=0) \equiv F - v(a=0). \qquad (4.6.1.2)$$

The principal's optimization problem is as follows:

$$\underset{F,B}{Max} \quad U^P(F,B,a=1) \equiv \bar{x} - [F + PB]$$

subject to (4.6.1.1) and (4.6.1.2)

From (4.6.1.2), we must have $B \geq \Delta v/P$ to motivate $a = 1$. From (4.6.1.1), we must have $F \geq \underline{U}^a + v(a=1) - PB$ to induce the agent to accept the contract. Since the agent is risk-neutral, there are multiple solutions. The solutions and the principal's payoff are

$$\begin{aligned} \text{any } B^{FB} &\geq \Delta v/P, \\ F^{FB} &= \underline{U} + v(a=1) - PB^{FB}, \\ U^P(F^{FB}, B^{FB}, a=1) &= \bar{x} - [\underline{U} + v(a=1)]. \end{aligned}$$

4.6.2 Employee Litigation when The Agent Has Unlimited Liability

Now, assume that the agent can sue the principal if she is not paid a bonus, whether she has chosen $a = 0$ or $a = 1$. Also, assume that the agent has unlimited liability, and there is no lower bound on the compensation. Let G^0 and G^1 denote the expected gain from the discrimination lawsuit to the agent from suing the principal, and L^0 and L^1 denote the loss to the principal, when the agent has chosen $a = 0$ and $a = 1$ respectively. Suppose that the expected gain from the lawsuit is higher if the agent has chosen $a = 1$, i.e., $G^1 = G^0 + \Delta G > G^0$. Similarly, assume that $L^1 > L^0$. To rule out an unrealistic case where the principal wants the agent to sue, assume that $G^1 < L^1$ and $G^0 < L^0$. Note that if the expected gain from the lawsuit to the agent is positive, she will always sue if she is not paid the bonus. The principal cannot prevent the lawsuit.

Assume that $P\Delta x > \Delta v/h_1$ so that the honest principal wants to induce $a = 1$, even when the dishonest principal offers a contract identical to his contract (so that the principal's type remains unknown to the agent after she observes the contract offered).

The game G1 between the principal and the agent is presented below. To simplify the game, assume that G^0 and G^1 are positive. The agent chooses to sue if the bonus is not paid, as a dominant strategy.[19] The last stage of the game where the agent decides whether to sue is omitted in the game tree. Furthermore, assume that after the outcome is realized, the principal chooses whether or not to pay the bonus specified in the formal contract (paying only part of it is not an option). Note that if the bonus paid is lower than the amount agreed upon, the agent still can sue the principal for discrimination.

---

[19] To illustrate, if she chooses $a = 1$ and then sues when the bonus is not paid, her payoff is $F + Ph_1B + P(1 - h_1)G^1 + (1-P)G^1 - v(a=1)$, which is strictly higher than the amount $F + Ph_1B - v(a=1)$ she receives if she does not sue. If she chooses $a = 0$ and sues when no bonus is paid, her payoff is $F + G^0 - v(a = 0)$, which is again strictly higher than the amount $F - v(a = 0)$ if she does not sue.

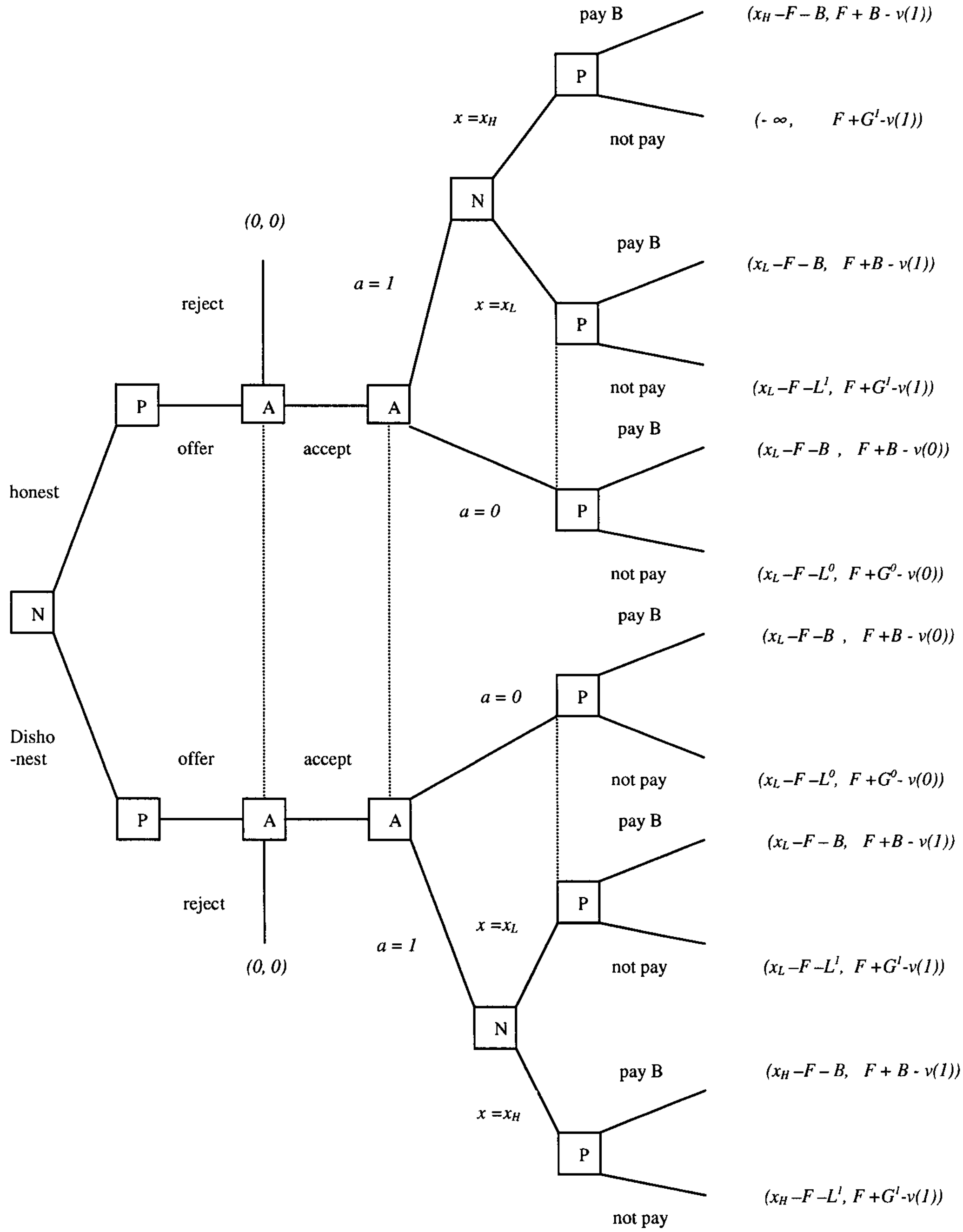


Figure 4.1: A Game with Subjective Evaluation and Discrimination Litigation

To induce $a = 1$, it must be the case that, ex post, the principal will not pay the bonus to avoid the lawsuit when $x = x_L$. If the principal always pays the bonus, the agent prefers to choose $a = 0$. The incentive compatibility constraint for the principal below must be satisfied.

$$(\text{IC}^P) \qquad x_L - F - L^1 \geq x_L - F - B \qquad (4.6.2.1)$$

From (4.6.2.1), if the bonus offered is less than the loss from litigation, ex post the principal prefers to pay a bonus for the low outcome in order to avoid litigation. Hence, to induce the principal to pay the bonus only for the high outcome, the bonus B must be in the set $[L^1, \infty)$. With the bonus $B \geq L^1$, ex post, the honest principal will pay a bonus only for a high outcome. With $B > L^1$, the dishonest principal will not pay a bonus at all. If the bonus offered is equal to the loss from litigation ($B = L^1$), ex post the dishonest principal is indifferent whether to pay or not. Assume for simplicity that he will pay when the outcome realized is high, but will not pay when the outcome realized is low, and that the agent anticipates both types will pay the bonus when the outcome is high.

In addition to the principal's incentive compatibility constraint, the bonus must be sufficiently large to induce the agent to choose $a = 1$ rather than $a = 0$. The agent's payoff from choosing $a = 1$ depends on her expectation whether the principal will pay a bonus or not. Whether the dishonest principal will pay a bonus or not depends on whether the bonus is greater than the litigation loss to the principal L^1. If $B = L^1$, the dishonest principal has no incentive to renege. If $B > L^1$, the dishonest principal will renege. To derive the solution, the honest principal can first check whether the bonus $B = L^1$ which can deter reneging is sufficiently large to induce $a = 1$. If that is the case, then $B = L^1$ is the optimal bonus. Otherwise, he has to incur the loss from the commitment problem.

4.6.2.1 A Bonus Sufficiently Large to Induce $a = 1$ Deters Reneging

Consider the honest principal's reaction to the commitment problem. If he chooses the bonus B equal to L^1, which is the litigation loss (given that $a = 1$ has been chosen), he knows the dishonest principal has no incentive to renege so that there is no loss from commitment problem. However, the bonus $B = L^1$ may not be sufficient to motivate the agent to choose $a = 1$. With employee litigation, it becomes more difficult to induce $a = 1$, since the agent's other option is to choose $a = 0$, and then sue the principal at the end of the period. Simply paying the expected bonus equal to the cost of effort can no longer induce $a = 1$.

With $B = L^1$, the agent anticipates that both types will pay a bonus. If she chooses $a = 1$, and then sues when the outcome is low and the bonus is not paid, then her payoff is $F + PB + (1 - P)G^1 - v(a = 1)$. If the agent chooses $a = 0$, and then sues, her payoff is $F + G^0 - v(a = 0)$. Therefore, the agent will choose $a = 1$ when

(IC^a) $$F + PB + (1 - P)G^1 - v(a = 1) \geq F + G^0 - v(a = 0), \text{ or}$$

$$B \geq G^1 + (\Delta v - \Delta G)/P. \quad (4.6.2.2)$$

If the bonus $B = L^1$ satisfies the above incentive compatibility constraint (4.6.2.2), then the honest principal can offer a bonus $B = L^1$, and incurs no loss from the commitment problem. The fixed wage must satisfy the participation constraint, i.e.,

$$F + PB + (1 - P)G^1 - v(a = 1) \geq \underline{U}. \quad (4.6.2.3)$$

The honest principal's optimal solution is

$$B^{F*} = L^1,$$

$$F^{F*} = \underline{U} + v(a=1) - (1 - P)G^1 - PL^1, \text{ and}$$

$$U^{PH}(F^{F*}, B^{F*}, a = 1 | h_1) = \bar{x} - F^{F*} - PB^{F*} - (1-P)L^1$$

$$= \bar{x} - \underline{U} - v(a = 1) - (1 - P)(L^1 - G^1). \quad (4.6.2.4)$$

The honest principal's payoff is equal to the first-best payoff, minus the expected loss from litigation. With a probability $(1 - P)$, the low outcome is produced and the agent sues. The principal incurs the loss of $(L^1 - G^1)$. Commitment is not a problem in this setting. Therefore, the principal's payoff is independent of h_1, which is the principal's conjecture about the agent's belief about the principal's type after she observes the contract offered. Note that if $L^1 = G^1$, the principal achieves the first-best payoff.

In this setting, there is only one optimal solution to the honest principal's problem above. I therefore assign the following off-equilibrium belief to the agent. If the agent observes the contract other than the optimal contract for the honest type (F^*, B^*), then the agent believes that the principal cannot be honest, i.e., Pr(honest| $(F, B) \neq (F^*, B^*)$) = 0. In other words, the agent believes that if the contract offered is not (F^*, B^*), then the principal is dishonest. I also assign the same off-equilibrium belief in the next subsection where $L^1 < G^1 + (\Delta v - \Delta G)/P$ below.

The dishonest principal's payoff from offering an identical contract to the honest principal's contract is

$$U^{PD}(F^{F*}, B^{F*}, a = 1 | h_1) = U^{PH}(F^{F*}, B^{F*}, a = 1 | h_1).$$

The dishonest principal cannot improve his payoff by offering a different contract. The different contracts can be classified into three sets: contracts which offer $B > L^1$, contracts which offer $B < L^0$, and contracts which offer $L^0 \leq B < L^1$.

Consider a contract which offers $B > L^1$. If the dishonest principal offers a different contract with $B^{F+} > L^1$ and F that makes (PC[a]) binding (which reveals his type), the agent anticipates no bonus. When the agent anticipates no bonus, her payoff if she chooses $a = 0$ (and then sues) is $F + G^0 - v(a=0)$. If she chooses $a = 1$ (and then sues), her payoff is $F + G^1 - v(a=1)$. Hence, the agent will choose $a = 1$ if the additional cost of effort sufficiently increases the future gain from litigation, i.e., $\Delta v \leq \Delta G$. If $\Delta v > \Delta G$, the agent will not choose $a = 1$. The dishonest principal cannot induce a desired action. If $\Delta v \leq \Delta G$, the agent will choose $a = 1$. This is the setting in which the agent has intrinsic motivation to choose $a = 1$. The additional cost from choosing $a = 1$, which is Δv, is less than the benefit from an increase in the gain from lawsuit, which is ΔG. She wants to choose $a = 1$ even when she anticipates no bonus. However, the dishonest principal must pay a fixed wage of $\underline{U} + v(a=1) - G^1$ to induce the agent to accept the contract. His payoff from offering $(F^{F+} = \underline{U} + v(a=1) - G^1, B^{F+} > L^1)$ is less than the payoff from offering an identical contract to the honest principal's contract, i.e.,

$$U^{PD}(F^{F+}, B^{F+}, a = 1 | h_1 = 0) = \bar{x} - F^{F+} - L^1$$
$$= \bar{x} - \underline{U} - v(a=1) - (L^1 - G^1).$$

He is not better off with the contract $(F^{F+} = \underline{U} + v(a=1) - G^1, B^{F+} > L^1)$.

Consider a contract which offers $B < L^0$. If the dishonest principal offers a different contract with $B < L^0$, the agent anticipates that the principal will pay a bonus even when $x = x_L$ so that she cannot sue. She thus will choose $a = 0$.

Consider a contract with $L^0 \leq B < L^1$. If the principal anticipates that the agent has chosen $a = 1$, he will always pay a bonus for all values of outcome since $B < L^1$. However, anticipating that the principal will always pay a bonus, the agent will choose $a = 0$, which is inconsistent with the principal's belief. If the principal anticipates that the agent has chosen $a = 0$, he will not pay a bonus at all because $B > L^0$. If $\Delta v > \Delta G$, without a bonus, the agent will choose $a = 0$. If $\Delta v \leq \Delta G$, the agent will choose $a = 1$, which is inconsistent with the principal's belief.

Therefore, in this setting where a bonus sufficiently large to induce $a = 1$ deters reneging (i.e., $B^{F*} = L^1 \geq G^1 + (\Delta v - \Delta G)/P$), both types offer (F^{F*}, B^{F*}) and both types pay the bonus. The honest principal incurs no loss from the commitment problem.

4.6.2.2 A Bonus Sufficiently Large to Induce $a = 1$ Does Not Deter Reneging

Now assume that the bonus $B = L^1$ cannot induce $a = 1$, i.e, $L^1 < G^1 + (\Delta v - \Delta G)/P$. To induce $a = 1$, the principal must pay $B > L^1$. With $B > L^1$, the dishonest principal will not pay a bonus, while the honest principal will pay a bonus only when the outcome is high.

Assume for now that the dishonest principal offers a contract identical to the honest principal's contract (which is true, as discussed below) so that the agent does not know the principal's type, i.e., $h_0 = h_1$.

As before, to induce $a = 1$, it must be the case that, ex post, the principal will not pay the bonus to avoid the lawsuit when $x = x_L$. With $B > L^1$, the incentive compatibility constraint for the principal (4.6.2.1) is satisfied.

Consider the agent's incentive. With positive G^0 and G^1, ex post, she will always sue if she can. With $B > L^1$, the agent anticipates that the dishonest principal will not pay a bonus. The agent's payoff from choosing $a = 1$ and then suing if no bonus is paid is

$$U^a(F, B, a=1|h_1) \equiv F + Ph_1B + [P(1-h_1) + (1-P)]G^1 - v(a=1).$$

The payoff $U^a(F, B, a=1|h_1)$ must be no less than the payoff she receives if she chooses $a = 0$ and then sues, i.e.,

(IC^a) $F + Ph_1B + [P(1-h_1) + (1-P)]G^1 - v(a=1) \geq F + G^0 - v(a=0)$, or

$$Ph_1B \geq Ph_1G^1 + \Delta v - \Delta G \qquad (4.6.2.5)$$

To induce the agent to accept the contract, it must be such that

(PC^a) $$F + Ph_1B + [P(1-h_1) + (1-P)]G^1 - v(a=1) \geq \underline{U}. \qquad (4.6.2.7)$$

The honest principal's problem is thus

$$\underset{F,B}{Max} \quad U^{PH}(F,B,a=1|h_1) \equiv \bar{x} - [F + PB + (1-P)L^1]$$

subject to (4.6.2.1), (4.6.2.5), and (4.6.2.7).

Consider the first-best solution in section 4.6.1. Since the agent is risk neutral, there are multiple solutions, and the bonus can be any amount no less than $\Delta v/P$. Here, the agent is risk neutral but we have a single solution. To understand this, consider a case where the dishonest principal offers an identical contract and the bonus offered is greater than the loss from litigation L^1. In this setting, $h_0 = h_1$; and with $B > L^1$, the dishonest principal will not pay a bonus ex post. With the participation constraint binding,

$$\begin{aligned} F &= \underline{U} + v(a=1) - Ph_1B - [P(1-h_1) + (1-P)]G^1 \\ &= \underline{U} + v(a=1) - Ph_1B - (1-Ph_1)G^1. \end{aligned}$$

Substituting the value of F into the honest principal's objective function gives

$$U^{PH}(F, B, a=1|h_1) = \bar{x} - F - PB - (1-P)L^1$$
$$= \bar{x} - \underline{U} - v(a=1) - PB(1-h_1) + G^1(1-Ph_1) - (1-P)L^1.$$

The honest principal's payoff is decreasing in B for $B > L^1$ because of the commitment problem. The honest principal optimally chooses the smallest bonus possible to save compensation costs. The optimal bonus is hence the one which makes the agent's incentive compatibility constraint (4.6.2.5) binding, which will also satisfy the principal's incentive compatibility constraint (4.6.2.1) (because this is the setting in which $L^1 < G^1 + (\Delta v - \Delta G)/P$). The optimal solution and principal's payoff are as follows:

$$B^{F**} = G^1 + (\Delta v - \Delta G)/Ph_1,$$
$$F^{F**} = \underline{U} + v(a=0) - G^0, \text{ and}$$

$$U^{PH}(F^{F**}, B^{F**}, a=1|h_1) = \bar{x} - \underline{U} - v(a=1) - (\Delta v - \Delta G)(\frac{1}{h_1} - 1) - (1-P)(L^1 - G^1). \quad (4.6.2.8)$$

The honest principal's payoff is equal to the first-best payoff, minus the expected loss from the commitment problem of $(\Delta v - \Delta G)(\frac{1}{h_1} - 1)$, and the expected loss from the litigation problem of $(1 - P)(L^1 - G^1)$. With probability P, the high outcome is realized, and the principal has to pay an incremental bonus above the first-best bonus of $\frac{1}{P}(\Delta v - \Delta G)(\frac{1}{h_1} - 1)$. With probability $(1-P)$, the low outcome is realized, and the agent sues. The principal incurs a loss from litigation $(L^1 - G^1)$, which results from the difference in the payoffs from litigation to the agent and to the principal.

Consider a special case in which $L^1 = G^1$. As discussed in proposition 4.1, if $L^1 = G^1$, then litigation is not a problem (because we assume that the agent is risk neutral, has unlimited liability, and has no private information). The principal only needs to deal with the commitment problem. The honest principal's payoff is higher than when the agent cannot sue in section 4.7 (to be discussed below). The agent's ability to sue in some sense helps punish the dishonest principal. It ensures that the agent will earn something if she chooses $a = 1$, even when the bonus is not paid.

The dishonest principal's payoff if he offers an identical contract (F^{F**}, B^{F**}), but does not pay a bonus ex post (because $B^{F**} > L^1$), is as follows:

$$U^{PD}(F^{F**}, B^{F**}, a = 1|h_1) = \bar{x} - F^{F**} - L^1$$
$$= \bar{x} - \underline{U} - v(a=0) - \Delta G - (L^1 - G^1) \quad (4.6.2.9)$$

$$= U^{PH}(F^{F**}, B^{F**}, a = 1|h_1) + \frac{1}{h_1}(\Delta v - \Delta G) - P(L^1 - G^1)$$

$$> U^{PH}(F^{F**}, B^{F**}, a = 1|h_1).$$[20]

The dishonest principal's payoff is greater than the honest principal's payoff.

Note that the dishonest principal has no incentive to offer a different contract to reveal his type. The reasoning is similar to the one in section 4.6.2.1 above.

To summarize, when the bonus $B = L^1$, which deters reneging, is sufficiently large to induce $a = 1$ (i.e., $L^1 \geq G^1 + (\Delta v - \Delta G)/P$), the principal offers the contract $(F^{F*}, B^{F*} = L^1)$. Both types will pay a bonus for the high outcome. When the bonus $B = L^1$ does not induce $a = 1$ (i.e., $L^1 < G^1 + (\Delta v - \Delta G)/P$), the principal offers $(F^{F**}, B^{F**} = G^1 + (\Delta v - \Delta G)/Ph_1)$. The dishonest principal will not pay a bonus, and the honest principal incurs the loss from the commitment problem.

4.6.3 Employee Litigation When The Agent Has Limited Liability

Let $\underline{F}$ denote the lower bound on the compensation. In addition to the agent's participation constraint and incentive compatibility constraint, the optimal compensation must also satisfy the following consumption feasibility constraints

$$F \geq \underline{F} \tag{4.6.3.1}$$

$$F + B \geq \underline{F}. \tag{4.6.3.2}$$

<u>4.6.3.1 A Bonus Sufficiently Large to Induce $a = 1$ Deters Reneging</u>

With no lower bound on compensation, the optimal solution, and the principal's payoff are as shown below.

$$B^{F*} = L^1,$$

$$F^{F*} = \underline{U} + v(a=1) - (1 - P)G^1 - PL^1, \text{ and}$$

$$U^{PH}(F^{F*}, B^{F*}, a = 1|\ h_1) = U^{PD}(F^{F*}, B^{F*}, a = 1|\ h_1)$$

$$= \bar{x} - \underline{U} - v(a = 1) - (1 - P)(L^1 - G^1), \tag{4.6.2.4}$$

If $F^{F*} \geq \underline{F}$, then the principal can use the contract (F^{F*}, B^{F*}) defined above and can achieve the payoff (4.6.2.4). In contrast, if $F^{F*} < \underline{F}$, the principal incurs the loss from litigation, which is $\underline{F} - F^{F*}$. This is because the principal must increase the fixed wage to the lower bound $\underline{F}$, but he cannot decrease the bonus accordingly without destroying the agent's incentive to choose $a = 1$. The bonus B^{F*} is already the lowest one which induces

[20] Note that this is the case where $L^1 < G^1 + (\Delta v - \Delta G)/P$, i.e., $(\Delta v - \Delta G)/h_1 > (\Delta v - \Delta G) > P(L^1 - G^1)$.

$a = 1$. With a lower bonus, the principal's incentive compatibility constraint is not satisfied. With a lower bound, the optimal contract is therefore ($F^{FL} = \underline{F} > F^{F*}$, $B^{F*} = L^1$).

The principal's payoff is, again, independent of h_1:

$$U^{PH}(F^{FL}, B^{F*}, a = 1|\, h_1) = U^{PD}(F^{FL}, B^{F*}, a = 1|\, h_1)$$

$$= \bar{x} - F^{FL} - PB^{F*} - (1\text{-}P)L^1 - F^{F*} + F^{F*}$$

$$= \bar{x} - \underline{U} - v(a=1) - (1 - P)(L^1 - G^1) - (\underline{F} - F^{F*}).$$

4.6.3.2 A Bonus Sufficiently Large to Induce $a = 1$ Does Not Deter Reneging

When there is no lower bound on compensation, the solution and the principal's payoff are as follows:

$$B^{F**} = G^1 + (\Delta v - \Delta G)/Ph_1,$$

$$F^{F**} = \underline{U} + v(a{=}0) - G^0, \text{ and}$$

$$U^{PH}(F^{F**}, B^{F**}, a{=}1|h_1) = \bar{x} - \underline{U} - v(a=1) - (\Delta v - \Delta G)(\frac{1}{h_1} - 1) - (1 - P)(L^1 - G^1). \quad (4.6.2.8)$$

$$U^{PD}(F^{F**}, B^{F**}, a = 1|h_1) = \bar{x} - \underline{U} - v(a=0) - \Delta G - (L^1 - G^1) \quad (4.6.2.9)$$

If $F^{F**} \geq \underline{F}$, then the principal can use the contract (F^{F**}, B^{F**}) defined above and can achieve the payoff (4.6.2.8) or (4.6.2.9). If $F^{F**} < \underline{F}$, the principal must pay rent, which is $\underline{F} - F^{F**}$. Again this is because the principal must increase the fixed wage to $\underline{F}$, but he cannot decrease the bonus accordingly. With $B < B^{F**}$, the agent's incentive compatibility constraint is not satisfied.

With a lower bound, the optimal formal contract is ($F^{FL} = \underline{F} > F^{F**}$, $B^{F**} = L^1$). The honest and dishonest principals' payoffs are

$$U^{PH}(F^{FL}, B^{F**}, a{=}1|h_1) = U^{PH}(F^{F**}, B^{F**}, a{=}1|h_1) - (\underline{F} - F^{F**}), \text{ and}$$

$$U^{PD}(F^{FL}, B^{F**}, a = 1|h_1) = U^{PD}(F^{F**}, B^{F**}, a = 1|h_1) - (\underline{F} - F^{F**}).$$

4.7 Informal Contract with Employee Litigation

Although illegal informal compensation can be used in this setting to deter discrimination litigation, the purpose of sections 4.5-4.8 is to examine the lack-of-evidence feature of informal contracting, rather than the agent-compromising feature of illegal informal pay. Therefore, to simplify the analysis and to focus of the lack-of-evidence characteristic of informal pay, assume that the principal can only use legal informal compensation.

Consider the setting in which the performance measure is not verifiable to the court, but the incentive contract is informal (i.e., the principal offers a formal contract specifying a fixed wage, and then agrees informally to pay the agent a bonus for a high outcome.) Since there is no evidence of the informal incentive contract, the agent cannot sue the principal for discrimination in performance evaluation.[21] (In fact, this section derives the optimal contract when there is no employee litigation, either because the agent is exogenously assumed to be unable to sue, or because the principal uses an informal contract to avoid litigation.) Also, assume that $P\Delta x$ is sufficiently large that both types want to induce $a = 1$.[22] Given that the agent cannot sue, the honest principal will pay the promised bonus if the high outcome is realized, but the dishonest one will not pay.

Consider the principal's problem when he wants to induce $a = 1$. Assume for now that the dishonest principal finds it optimal to offer a contract that is identical to the honest principal's contract (and hence $h_1 = h_0$). Anticipating that the honest type will honour the contract and the dishonest type will renege, the agent will choose $a = 1$ if the following is satisfied:

(IC^a) $$F + P\, h_1 B - v(a=1) \geq F - v(a = 0). \tag{4.7.1}$$

To induce the agent to accept the contract, the fixed wage F is chosen to satisfy the agent's participation constraint (PC^a):

(PC^a) $$F + P\, h_1 B - v(a=1) \geq \underline{U}. \tag{4.7.2}$$

The honest principal's problem is as shown below:

$$\underset{F,B}{Max} \quad U^{PH}(F,B,a=1\,|\,h_1) \equiv \bar{x} - [F + PB]$$

subject to (4.7.1) and (4.7.2),

where h_1 is the principal's conjecture with respect to the agent's belief that the principal is honest.

In the benchmark case in section 4.6.1, the optimal bonus for both honest and dishonest principal is any $B^* \geq \Delta v/P$. Here, we have a single solution. This is because the honest principal's payoff is decreasing in the bonus. To see this, note that with the

21 There is also another psychological benefit of contracting informally. Since the informal contract is generally not known to the other organizational members, the manager can avoid the charge of favoritism in performance evaluation.

22 To be precise, assume that $P\Delta x > \Delta v/h_1$.

participation constraint binding, $F = \underline{U} + v(a=1) - Ph_1B$. Substitute this into the objective function, the honest principal's payoff is

$$U^{PH}(F, B, a=1 | h_1) = \bar{x} - F - PB = \bar{x} - \underline{U} - v(a=1) - PB(1-h_1).$$

The honest principal's payoff is decreasing in the amount of bonus, because of the existence of a dishonest principal. Therefore, the optimal bonus is the minimal B that satisfies (4.7.1), i.e., $B^I = \Delta v/Ph_1$. The optimal informal contract the honest type offers and his payoff are

$$B^I = \Delta v/Ph_1,$$

$$F^I = \underline{U} + v(a=0),$$

$$U^{PH}(F^I, B^I, a = 1 | h_1) = \bar{x} - \underline{U} - v(a=0) - \frac{\Delta v}{h_1}$$

$$= \bar{x} - \underline{U} - v(a=1) - \Delta v(\frac{1}{h_1} - 1).$$

The honest principal's payoff is equal to the first-best payoff when the performance measure is verifiable, minus the loss due to the commitment problem. His payoff is decreasing in h_1. The optimal contract for the honest principal is the only solution, since (F^I, B^I) is the least costly contract to induce $a = 1$. The honest principal will not offer another contract if $h_1 > 0$.

Notice that with an **informal** contract, the loss from the commitment problem is $\Delta v(\frac{1}{h_1} - 1)$. With a **formal** contract, the honest principal incurs no loss from the commitment problem if the bonus $B = L^1$, which deters reneging, is sufficiently large to induce $a = 1$. Even when the bonus which induces $a = 1$ is larger than L^1, the loss from the commitment problem is $(\Delta v - \Delta G)(\frac{1}{h_1} - 1)$, which is lower than the loss the honest principal incurs from an informal contract. The agent's opportunity to sue helps discipline the dishonest principal, and hence helps mitigate the commitment problem.

Consider the dishonest principal's problem. If the dishonest principal offers a different informal contract, he reveals his type. The agent expects that the bonus will not be paid and thus will not expend effort. The dishonest principal then cannot induce $a = 1$. Therefore, the dishonest type optimally offers an identical informal contract. (However, he will not pay a bonus ex post.) His expected payoff is higher than the first-best payoff, i.e.,

$$U^{PD}(F^I, B^I, a = 1 | h_I) = \bar{x} - F^I = \bar{x} - \underline{U} - v(a=0).$$

If the principal is limited to informal contracting, the optimal informal contract for both types is (B^I, F^I). (Therefore, the agent still does not know the principal's type after she observes the contract offered.) The agent will accept the contract and choose $a = 1$. She cannot sue the principal if the bonus is not paid.

The analysis of formal and informal contracting in a two-period setting is shown in an appendix to this chapter. The results are similar to those in the classic reputation model. Given that the future gain is sufficiently large, the dishonest principal prefers to pay a bonus at the end of period one in order to build reputation of being honest, which will help him induce $a = 1$ in period two. He sacrifices an immediate gain of reneging today for a greater future gain. It is in his self-interest to act "honestly." Reputation can make the informal contract and the formal contract based on a non-verifiable measure self-enforceable in earlier periods, as long as the agent believes that in the last period, there is positive probability that the contract will be honored. The honest principal therefore may incur no loss from the commitment problem in period one. (The honest principal does not prefer to pay a bonus sufficiently large to induce the dishonest principal to renege, i.e., to reveal his type, at the end of the first period, as discussed in an appendix to this chapter.) In the last period, since there is no more future gain, the dishonest principal will renege. The optimal contracts are different in the last period and the earlier periods.

4.8 The Sufficient Conditions for an Informal Contract

4.8.1 The Agent Has Unlimited Liability

The principal's payoffs with a formal and an informal contract when the agent has unlimited liability are summarized below.

Table 4.1 The Principal's Payoff and Optimal Formal and Informal Contracts to Induce $a = 1$, When the Agent Has Unlimited Liability

	Honest Principal's Payoff	Dishonest Principal's Payoff
Formal Contract		
$L^1 \geq G^1 + (\Delta v - \Delta G)/P$	$\bar{x} - \underline{U} - v(a=1)$ $- (1 - P)(L^1 - G^1)$	$\bar{x} - \underline{U} + v(a=1)$ $- (1 - P)(L^1 - G^1)$
$L^1 < G^1 + (\Delta v - \Delta G)/P$	$\bar{x} - \underline{U} - v(a=1)$ $-(\Delta v - \Delta G)(\frac{1}{h_1} - 1)$ $- (1 - P)(L^1 - G^1)$	$\bar{x} - \underline{U} - v(a=0) - \Delta G$ $- (L^1 - G^1)$
Informal Contract	$\bar{x} - \underline{U} - v(a=1) - \Delta v(\frac{1}{h_1} - 1)$	$\bar{x} - \underline{U} + v(a=0)$
	The Contract Both Types Offer	
Formal Contract		
$L^1 \geq G^1 + (\Delta v - \Delta G)/P$	$F^{F*} = \underline{U} + v(a=1) - (1 - P)G^1 - PL^1$; $B^{F*} = L^1$	
$L^1 < G^1 + (\Delta v - \Delta G)/P$	$F^{F**} = \underline{U} + v(a=0) - G^0$; $B^{F**} = G^1 + (\Delta v - \Delta G)/Ph_1$	
Informal Contract	$F^I = \underline{U} + v(a=0)$; $B^I = \Delta v/Ph_1$	

4.8.1.1 A Bonus Sufficiently Large to Induce $a = 1$ Deters Reneging

Consider the setting in which the bonus $B = L^1$, which deters reneging, also induces $a = 1$ (i.e., $L^1 \geq G^1 + (\Delta v - \Delta G)/P$). With a formal contract, the principal incurs no loss from the commitment problem, but still incurs the loss from litigation. With an informal contract, the principal incurs the loss from commitment problem, but no loss from litigation. The honest principal prefers an informal contract when the loss from litigation is greater than the loss from the commitment problem, i.e,

$$U^{PH}(F^I, B^I, a = 1 | h_1) > U^{PH}(F^{F*}, B^{F*}, a = 1 | h_1), \text{ or}$$

$$-\Delta v(\frac{1}{h_1} - 1) > -(1 - P)(L^1 - G^1). \qquad (4.8.1.1)$$

The honest principal prefers an informal contract when the commitment problem is less severe, i.e., the incremental bonus he has to pay with an informal contract, which is $\Delta v(\frac{1}{h_1} - 1)$, is small, while the expected loss from the undesirable action problem , which is $(1 - P)(L^1 - G^1)$, is large.

Section 4.6 (4.7) assumes that both the honest and dishonest principal are limited to formal (informal) contracting and derives the optimal formal (informal) contract. This section allows the principal to choose between the two contracting schemes. Given that the dishonest principal will choose the same contracting scheme, the sufficient conditions for the honest principal to prefer informal contracting are as derived above. Now consider whether the dishonest principal has an incentive to use a different contracting scheme (i.e., whether the dishonest principal will offer an informal contract when the honest principal offers a formal contract and vice versa).

Suppose the honest principal chooses a formal contract (F^{F*}, B^{F*}) over an informal contract (F^I, B^I). A dishonest principal who offers an informal contract (which reveals his type) cannot induce $a = 1$. It was shown above in section 4.6 that he does not prefer any other formal contract to (F^{F*}, B^{F*}). So, he offers the same contract as the honest principal's contract.

In contrast, suppose that the honest principal chooses an informal contract (F^I, B^I). The dishonest principal who offers any other informal contract cannot induce $a = 1$, since the agent will knows his type. He is not better off offering a formal contract either. In this setting, the honest principal's payoff from offering a formal contract (F^{F*}, B^{F*}) is equal to the dishonest principal's payoff from (F^{F*}, B^{F*}). If the honest principal chooses an informal contract, this implies that the formal contract (F^{F*}, B^{F*}) gives the dishonest principal less payoff than the informal contract as well. Also, it has been shown that the dishonest principal does not prefer another formal contract to (F^{F*}, B^{F*}).

4.8.1.2 A Bonus Sufficiently Large to Induce $a = 1$ Does Not Deter Reneging

Consider the setting in which the bonus $B = L^1$, which deters reneging, is not sufficient large to induce $a = 1$ (i.e., $L^1 < G^1 + (\Delta v - \Delta G)/P$). The honest principal incurs a loss from commitment problem, whether he uses a formal or an informal contract. However, the loss is smaller with a formal contract because the agent can sue to discipline the dishonest principal. The honest principal thus compares the greater loss from commitment problem he incurs with an informal contract with the loss from litigation problem. He prefers an informal contract when

$$U^{PH}(F^I, B^I, a = 1 | h_1) > U^{PH}(F^{F**}, B^{F**}, a = 1 | h_1), \text{ or}$$

$$-\Delta v(\frac{1}{h_1} - 1) > -(\Delta v - \Delta G)(\frac{1}{h_1} - 1) - (1 - P)(L^1 - G^1), \text{ or}$$

$$(1 - P)(L^1 - G^1) > \Delta G(\frac{1}{h_1} - 1) \qquad (4.8.1.2)$$

In other words, the honest principal prefers an informal contract when (i) the chance to sue cannot help solve the commitment problem much (i.e., ΔG is small but h_1 is large), and (ii) the undesirable action problem is more severe (i.e., $L^1 - G^1$ is large).

The dishonest principal has no incentive to offer a different contract. If the honest principal prefers a formal contract (F^{F**}, B^{F**}), the dishonest principal cannot induce $a = 1$ with an informal contract. On the other hand, if the honest principal prefers an informal contract (F^I, B^I), the dishonest principal who offers a formal contract reveals his type and he cannot induce $a = 1$ with any formal contracts.[23]

Proposition 4.2: Assume that the agent is risk-neutral and has unlimited liability. There is no lower bound on compensation. Assume that the performance measure is observable to both the principal and the agent but is not verifiable, and the agent can sue the principal for discrimination in performance evaluation.

(i) When $L^1 \geq G^1 + (\Delta v - \Delta G)/P$, the principal prefers informal contracting if (4.8.1.1) is satisfied.

(ii) When $L^1 < G^1 + (\Delta v - \Delta G)/P$, the principal prefers informal contracting if (4.8.1.2) is satisfied.

Proof: See the discussion above.

<u>A Special Case with $L^1 = G^1$</u>

Consider a special case in which $L^1 = G^1$. If $L^1 = G^1$, the principal's payoff from formal contracting is always no less than the payoff from informal contracting. (With $\Delta G > 0$, the principal's payoff from formal contracting is greater than the payoff from informal contracting.)

[23] A formal contract with $B > L^1$ cannot induce $a = 1$, because the agent's incentive compatibility constraint (4.6.2.5) is not satisfied. (Note that in this setting, $L^1 < G^1 + (\Delta v - \Delta G)/P$. And this implies $\Delta v > \Delta G$.) With a formal contract offering $B < L^0$, the principal will pay a bonus for all outcomes, and the agent prefers $a = 0$. Consider a formal contract with $L^0 \leq B < L^1$. If the principal anticipates that the agent has chosen $a = 1$, he will always pay a bonus for all values of outcome, since $B < L^1$. However, anticipating that the principal will always pay a bonus, the agent will choose $a = 0$, which is inconsistent with the principal's belief. If the principal anticipates that the agent has chosen $a = 0$, he will not pay a bonus at all because $B > L^0$. Without a bonus, the agent will choose $a = 0$.

Recall the result from proposition 1, when the agent is risk neutral and has unlimited liability, and the gain to the agent is equal to the loss to the principal, the principal can solve the undesirable action problem and achieve the first-best payoff by reducing the fixed wage by the amount of expected gain to the agent. Therefore, in this setting with $L^1 = G^1$, the major problem is the principal's commitment problem, not the undesirable action problem. With the commitment problem, it is more difficult to induce the agent to take the designated action. The optimal contract aims to solve the commitment problem rather than the litigation problem. With an informal contract, if the principal is dishonest and does not pay, the agent cannot do anything to improve her payoff. With a formal contract, the agent's ability to sue implies she still can gain something if the outcome realized is high and the principal does not pay. This helps motivate her to choose $a = 1$. The honest principal is now better off if he offers a formal contract rather than an informal contract. The dishonest principal cannot improve his payoff by offering a different contract. If $L^1 > G^1$, then the principal has to design a contract to solve both the commitment and undesirable action problems. With a sufficiently large litigation cost, the principal prefers informal contracting.

4.8.2 The Agent Has Limited Liability

When the lower bound on compensation is sufficiently large, the principal cannot simply reduce the fixed wage by the amount of expected gain to the agent to mitigate the undesirable action problem. Therefore, the optimal contract is designed to solve both the commitment and litigation problems. Whether an informal or a formal contract is optimal depends on whether the litigation problem or the commitment problem is more severe.

Assume that consumption feasibility constraint (4.6.3.1) is binding, i.e., $F = \underline{F}$. The principal's payoffs with a formal and an informal contract when the agent has limited liability are summarized below.

Table 4.2 The Principal's Payoff and Optimal Formal and Informal Contracts to Induce $a = 1$, When the Agent Has Limited Liability

	Honest Principal's Payoff	Dishonest Principal's Payoff
Formal Contract		
$L^1 \geq G^1 + (\Delta v - \Delta G)/P$	$\bar{x} - \underline{U} - v(a=1)$ $- (1 - P)(L^1 - G^1)$ $- [\underline{F} - F^{F*}]$, where $F^{F*} = \underline{U} + v(a=1) - (1-P)G^1 - PL^1$	$\bar{x} - \underline{U} - v(a=1)$ $- (1 - P)(L^1 - G^1)$ $- [\underline{F} - F^{F*}]$, where $F^{F*} = \underline{U} + v(a=1) - (1-P)G^1 - PL^1$
$L^1 < G^1 + (\Delta v - \Delta G)/P$	$\bar{x} - \underline{U} - v(a=1)$ $- (\Delta v - \Delta G)(\frac{1}{h_1} - 1)$ $- (1 - P)(L^1 - G^1)$ $- [\underline{F} - F^{F**}]$, where $F^{F**} = \underline{U} + v(a=0) - G^0$	$\bar{x} - \underline{U} - v(a=0) - \Delta G$ $- (L^1 - G^1)$ $- [\underline{F} - F^{F**}]$, where $F^{F**} = \underline{U} + v(a=0) - G^0$
Informal Contract	$\bar{x} - \underline{U} - v(a=1) - \Delta v(\frac{1}{h_1} - 1)$	$\bar{x} - \underline{U} + v(a=0)$
	The Contract Both Types Offer	
Formal Contract		
$L^1 \geq G^1 + (\Delta v - \Delta G)/P$	$F^{FL} = \underline{F}$; $B^{F*} = L^1$	
$L^1 < G^1 + (\Delta v - \Delta G)/P$	$F^{FL} = \underline{F}$; $B^{F**} = G^1 + (\Delta v - \Delta G)/Ph_1$	
Informal Contract	$F^I = \underline{U} + v(a=0)$; $B^I = \Delta v/Ph_1$	

Notice that this section is different from section 4.8.1 in that when the lower bound is sufficiently large, the principal's payoff from formal contracting is decreased by the amount $[\underline{F} - F^{F*}]$ or - $[\underline{F} - F^{F**}]$. Repeating a similar analysis to the one in section 4.8.1 gives the following results.

Consider the setting where the bonus $B = L^1$, which deters reneging, induces $a = 1$ (i.e., $L^1 \geq G^1 + (\Delta v - \Delta G)/P$). There is no commitment problem with formal contracting. With $F^{F*} < \underline{F}$, the principal incurs the rent from the lower bound on compensation of $\underline{F} - F^{F*}$, in addition to the loss from the differential payoffs from litigation. With an informal contract, a commitment problem exists, and the honest principal's payoff is increasing in the agent's assessed probability that the principal is honest, but is decreasing in Δv. The honest principal has to pay an additional $\Delta v(\frac{1}{h_1}-1)$ above the first-best bonus to induce $a = 1$. Therefore, as the undesirable action problem becomes more severe (i.e., $\underline{F}$ and L^1 increase), and as the commitment problem becomes less significant (i.e., $h_1 = h_0$ increases but Δv decreases), the honest principal prefers an informal contract. Formally, the honest principal prefers an informal contract when

$$- \Delta v(\frac{1}{h_1}-1) \;>\; -(1 - P)(L^1 - G^1) - [\underline{F} - (\underline{U} + v(a=1) - (1-P)G^1 - PL^1)]\text{ , or}$$

$$\underline{F} - \underline{U} - v(a=0) + L^1 \;>\; \Delta v\frac{1}{h_1}. \qquad (4.8.2.1)$$

The dishonest principal will not offer a different contract as discussed above.

Consider the setting in which the bonus $B = L^1$, which deters reneging, cannot induce $a = 1$ (i.e., $L^1 < G^1 + (\Delta v - \Delta G)/P$). With an informal contract, the principal can eliminate the rent from an undesirable action. However, he has to pay an additional bonus of $\Delta v(\frac{1}{h_1}-1)$ above the first-best bonus to induce the agent to choose $a = 1$, because of the commitment problem. This additional cost is decreasing in h_1. Consider a formal contract. Compared with an informal contract, the principal can reduce (through the agent's opportunity to sue) the loss from the commitment problem by $\Delta G(\frac{1}{h_1}-1)$.

However, the principals must incur the losses from an undesirable action: the loss from differential payoff of $(1 - P)(L^1 - G^1)$ and the rent from the lower bound on compensation of $[\underline{F} - (\underline{U} + v(a=0) - G^0)]$. The principal thus prefers an informal contract when the loss from the undesirable action is sufficiently large (i.e., L^1, G^0 and $\underline{F}$ are sufficiently large). Formally, the honest principal prefers an informal contract when

$$- \Delta v(\frac{1}{h_1}-1) > -(\Delta v-\Delta G)(\frac{1}{h_1}-1) - (1 - P)(L^1 - G^1) - [\underline{F} - (\underline{U} + v(a=0) - G^0)]\text{, or}$$

$$(1 - P)L^1 + PG^0 + [\underline{F} - (\underline{U} + v(a=0))] \;>\; \Delta G(\frac{1}{h_1}-P) \qquad (4.8.2.2)$$

Proposition 4.3: Assume that the agent is risk-neutral and has limited liability. There is a lower bound on compensation such that the consumption feasibility constraint (4.6.3.1) is binding. Assume that the performance measure is observable to both the principal and the agent but is not verifiable, and the agent can sue the principal for discrimination in evaluation.

(i) When $L^1 \geq G^1 + (\Delta v - \Delta G)/P$, the principal prefers informal contracting if (4.8.2.1) is satisfied.

(ii) When $L^1 < G^1 + (\Delta v - \Delta G)/P$, the principal prefers informal contracting if (4.8.2.2) is satisfied.

Proof: See the analysis above.

The analysis above assumes that that the agent is risk neutral. Ceteris paribus, if the agent is risk averse, I anticipate that a contracting scheme which requires a smaller bonus to induce $a = 1$ should be more preferable as the agent becomes more risk averse.

Sections 4.5-4.8 have shown that the employer contracts informally to solve the discrimination litigation problem when the difference in the gain to the agent and the loss to the principal, and the lower bound on compensation are large (i.e., when the litigation problem is more severe compared with the commitment problem).

This implies that ceteris paribus formal subjective performance evaluation is more likely in a large company. A large firm usually has its own legal department. If sued, the firm most likely will incur only small additional legal costs, apart from the expected redemption to the employee. In this case, the loss from litigation to the principal should be close to the gain to the agent. Conversely, if a small firm with no legal department is sued, the firm has to incur costs to find and to hire a lawyer. The loss to the principal will likely be much larger than the gain to the agent.

Consider the rent from the lower bound on compensation. The rent from the litigation problem decreases as $\underline{U}$ increases. This implies that formal subjective performance evaluation is more likely used for a high-level employee than a low-level employee, assuming that the reservation utility of a high-level employee is larger than a low-level employee.

4.9 Illegal Informal Compensation and the Agent's Undesirable Action

This section considers a setting identical to the one in section 4.3. The agent can take an undesirable action, and this action cannot be deterred by a formal mechanism. Assume that there is no private, pre-contract information, and the agent's productive action does not affect the expected gain or loss from an undesirable action. Proposition 4.1 in section

4.3 shows that the principal is worse off with the agent's opportunistic behavior when one of the following is true.

(i) The agent is risk averse.

(ii) The lower bound on compensation is sufficiently large.

(iii) The expected gain to the agent is less than the expected loss to the principal.

All three are likely in the real world. People are risk averse. There are minimum wage requirements in many countries. And there are many situations in which the harmful actions cost the firm much more than they economically benefit the employees. Consider, for example, an employee who wants a pay raise. Knowing that she alone does not have adequate bargaining power, she may decide to initiate strike. If the strike is successful, the firm has to give raises to all employees. Clearly, ex post the firm may prefer to give that particular employee a raise rather than to let her arrange the strike. However, even after the payment, there is no guarantee the employee will not initiate strike to gain more. Also, the act of increasing a wage to a particular employee without a clear reason may itself lead to other employees' resistance.

This section introduces a special kind of informal compensation: illegal informal compensation. Rather than using formal compensation, the employer can use illegal informal compensation to create leverage against the agent. For example, he can intentionally implement a weak control system to allow the agent to steal some organizational resources. After the agent has accepted the informal pay (i.e., has "stolen"), she is subject to prosecution. (The prosecution is against theft, not against an undesirable action.) If the agent initiates strike, the principal can prosecute her in return. If the loss from prosecution is sufficiently large, the agent will not initiate strike. Prior case studies of controlled thefts seem to concentrate in the manufacturing industry. Possibly, the illegal informal compensation is paid to a potentially "problematic" employee as a precautionary measure to prevent strikes or other unproductive behavior.

Consider an example of an informal contract specifying illegal pay. From prior case studies, this informal contract comes in a form of a boss or a supervisor implicitly hinting to an employee that it is OK to "steal" something as part of compensation.

> For example, an employee is told that the rate of wages is low, but this statement is accompanied by some sort of a figurative or a real wink.[58] Perhaps, he is told that he can purchase products at "give away" (wink) prices. Or, that there are always "cheap" (wink), "spare" (wink), or "extra" (wink) goods to be had. Perhaps he is told, like I was at the Wellbread Bakery, that "they" would see that

I didn't "go short" (wink) or "lose out" (wink) when I complained that the wages were low. Everybody else, I was told,[59] was able to "make a bit on the side" (wink), or, "have their little perks" (wink), or, "take the odd loaf" (wink). With the meta-communicative wink the employer is able to craftily say something specific about the actual statements he has made.

Ditton, 1977: 48

This section shows that the use of illegal informal compensation helps the principal achieves the payoff as if the agent cannot take an undesirable action, even when the agent is risk averse, and/or the gain to the agent is less than the loss to the principal.

Consider a simple setting with **no** moral hazard problem identical to the one in section 4.3. The principal hires the agent to produce x, at a cost of effort v. Assume that the gain from opportunistic behavior to the agent is less than the loss to the principal, i.e., $g^u < l^u$. From section 4.3, when the agent is risk neutral, the principal's payoff from formal contracting is

$$U^P(w^*) = x - [\underline{U} + v] - \phi^u(l^u - g^u),$$

where w^* is such that $\phi^u\, u(w^* + g^u) + (1 - \phi^u)\, u(w^*) - v = \underline{U}$.

Because the loss to the principal is greater than the gain to the agent, the principal is worse off with the undesirable action. Ex post, the principal would prefer to pay g^u to the agent, rather than having the agent take the harmful action. However, he needs to find a way to stop the agent from taking the undesirable action after she has received g^u. One way to do so is to use illegal informal compensation to compromise the agent. After the agent takes the pay (e.g. "steals" some organizational resources or "abuses" the reimbursement system), she is subject to disciplinary actions such as prosecution against the "theft" or "abuse". The threat of prosecution can prevent the agent from acting opportunistically.

Consider a game G2 between the principal and the agent below. At the beginning of the period, the principal offers a formal contract specifying a formal wage, and also an informal contract specifying an informal wage. Let w^F denote a formal wage, while w^I denote an illegal informal wage. Let $\underline{w}$ denote the lower bound on compensation. For conciseness of the game tree, assume for now that the principal can commit to informal pay. (Since the principal wants the agent to take the illegal informal pay to compromise her, commitment is not a problem in this setting, as long as the amount of the pay is no larger than the loss from the harmful action.)

Subsequently, the agent chooses whether to reject the employment contract, to accept only formal compensation, or to accept both formal and informal compensation. Then nature determines whether the agent has a chance to act opportunistically. For simplicity and conciseness, call the undesirable action "strike". The agent then decides whether to go on strike.

Later, if the agent had accepted the illegal informal pay, the principal has a choice whether to prosecute the agent against "theft". Let κ^P denote the cost of prosecution to the principal (net of any possible redemption from the agent). Assume that the principal is vengeful. If the agent has gone on strike, the principal gains satisfaction from prosecuting the agent. Let g^P denote the satisfaction from revenge. His net payoff from prosecution if the agent has gone on strike is therefore g^P - κ^P. However, if the agent has not gone on strike and the principal prosecutes, the principal only incurs the cost κ^P. If prosecuted, the agent incurs the loss from being prosecuted l^P, independent of whether she has gone on strike or not. Assume for now that g^P, κ^P, and l^P are constants, rather than functions.

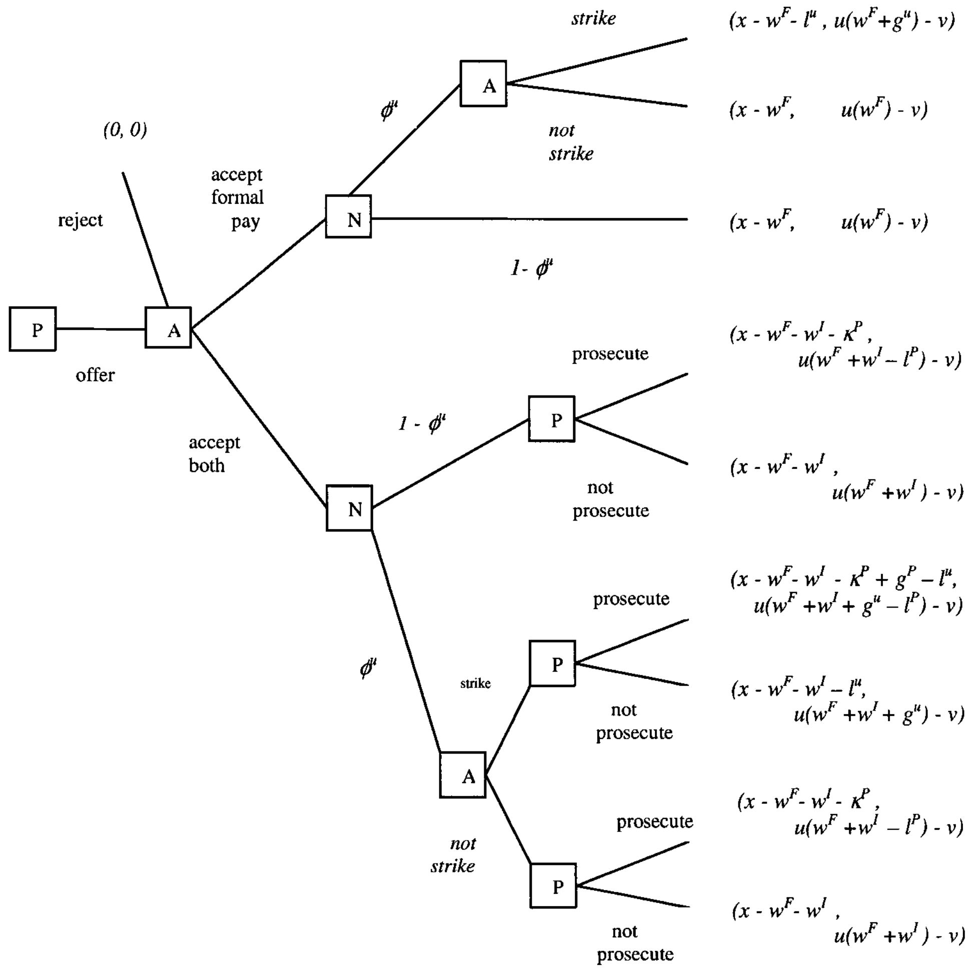


Figure 4.2: A Game with Employee's Undesirable action

Consider the subgame after the agent has chosen to accept both formal and informal pay. The principal wants (not prosecute, not strike) to be the only outcome of the game. It must be such that (i) if the agent does not go on strike, the principal will not prosecute, and (ii) if the agent goes on strike, the principal will prosecute. In other words, it must be such that (i) $\kappa^P > 0$, and (ii) $g^P > \kappa^P$.

To prevent the agent from going on strike after she accepts the informal pay, it must be such that the loss from prosecution is less than the gain from going on strike, i.e., $g^u < l^P$.

Now relax the assumption that the principal can commit to the informal pay. For the principal to ex post want to pay w^I, it must be such that the informal pay is less than the expected loss from the harmful action, i.e.,

$$(IC)^P \qquad w^I \leq l^u. \qquad (4.9.1)$$

Finally the principal needs to induce the agent to accept the contract, and to accept both formal and informal compensation. With $g^u < l^P$ and $0 < \kappa^P < g^P$, the agent does not want to go on strike after she accepts the informal pay, and she anticipates the principal will not prosecute her if she does not go on strike. Assume for now that the agent is risk neutral. Her payoff if she accepts the informal pay is thus $w^F + w^I - v$. If she does not accept the informal pay, the principal cannot prosecute her. Her payoff from a formal wage plus an expected gain from going on strike is $w^F + \phi^u g^u - v$. To induce her to accept both formal and informal pay, it must be such that

$$(IC)^a \qquad w^F + w^I - v \geq w^F + \phi^u g^u - v. \qquad (4.9.2)$$

In addition, the payoff from accepting both formal and informal pay must be greater than her reservation utility, i.e.,

$$(PC)^a \qquad w^F + w^I - v \geq \underline{U}. \qquad (4.9.3)$$

Assume that there is no lower bound on compensation, i.e., $\underline{w} = -\infty$. With $g^u < l^P$ and $0 < \kappa^P < g^P$, the solution is any amount of informal pay which satisfies (4.9.1) and (4.9.2), and the amount of formal pay which makes (4.9.3) binding, i.e.,

$$w^{F*} = \underline{U} + v - w^{I*},$$

$$\text{any } w^{I*} \text{ such that } \phi^u g^u \leq w^{I*} \leq l^u.$$

The principal's payoff is equal to the first-best payoff, i.e.,

$$U^P(w^{F*}, w^{I*}) \quad = \quad x - [\underline{U} + v].$$

Now consider the case the agent is risk averse. The incentive compatibility and participation constraints are as follows.

$$(IC)^a \qquad u(w^F + w^I) - v \geq (1 - \phi^u)\, u(w^F) + \phi^u\, u(w^F + g^u) - v. \qquad (4.9.4)$$

$$(PC)^a \qquad u(w^F + w^I) - v \geq \underline{U}. \qquad (4.9.5)$$

With $g^u < l^P$ and $0 < \kappa^P < g^P$, there are again multiple solutions, i.e.,

$$w^{F*} = W(\underline{U} + v) - w^{I*},$$

$$\text{any } w^{I*} \text{ which satisfies (4.9.1) and (4.9.4).}$$

One of the optimal solutions is w^{F*} such that (4.9.5) is binding, and $w^{I*} = \phi^u g^u$. To show that this solution satisfies (4.9.4), note that with (4.9.5) binding, we have $w^{F*} = W(\underline{U} + v) - w^{I*}$. With $w^{I*} = \phi^u g^u$, $w^{F*} = W(\underline{U} + v) - \phi^u g^u$. From Jensen's inequality,

$$\begin{aligned}(1 - \phi^u)\, u(w^{F*}) + \phi^u\, u(w^{F*} + g^u) &< u(w^{F*} + \phi^u g^u) \\ &= \underline{U} + v = u(w^{F*} + w^{I*}).\end{aligned}$$

The principal's payoff is equivalent to the payoff when the agent exogenously cannot take a harmful action, i.e.,

$$U^P(w^{F*}, w^{I*}) = x - (w^{F*} + w^{I*}) = x - W(\underline{U} + v).$$

Proposition 4.4: Assume that there is no private, pre-contract information, the agent is risk averse but has unlimited liability. The agent can take an undesirable action to harm the principal in the future, and this undesirable action cannot be deterred by a formal mechanism. Assume that the gain to the agent from the harmful action is less than the loss to the principal.

(i) The principal can achieve the first-best payoff by paying an illegal informal wage when $g^u < l^P$, and $0 < \kappa^P < g^P$.

(ii) The optimal solution is $w^{F*} = W(\underline{U} + v) - w^{I*}$, and any w^{I*} which satisfies (4.9.1) and (4.9.4).

Proof: See the analysis above.

If there is a lower bound on compensation, and the lower bound is sufficiently large, the principal still has to pay rent due to the agent's ability to take undesirable actions. Illegal informal compensation, however, cannot eliminate this rent. To illustrate, let w^{I**} denote the minimum w^I which satisfies (4.9.1) and (4.9.4). If $w^{F*} = W(\underline{U} + v) - w^{I**} < \underline{w}$, the optimal solution is $(w^F = \underline{w}, w^{I**})$. The principal must increase a formal wage to the lower bound. However, he cannot reduce the informal wage accordingly to make the agent's participation constraint binding. If he offers any $w^I < w^{I**}$, the agent will not accept informal compensation since she is better off accepting only formal pay and then going on strike.

Assume that a large firm is more likely to have its own legal department, so that the gain to the agent g^u is close to the loss to the principal l^u. The analysis implies that it is **less** likely that a researcher will observe the use of illegal informal pay to deter undesirable actions in a large firm.

A Forgiving Principal

The analysis above assumes that the principal is vengeful, in the sense that he incurs utility from prosecuting the agent who has gone on strike. The model above can be enriched by assuming the principal can be either forgiving or vengeful. The forgiving principal incurs no additional utility from prosecuting the agent, and hence he will not prosecute the agent in a single-period setting. In a multi-period setting, he may want to prosecute the agent in earlier periods to build reputation of being vengeful, so that he can deter strikes with illegal informal pay in future periods. A two-period model with a risk neutral agent will be discussed only briefly here.

Suppose that the principal's type is not known to the agent, but the agent believes that the principal is vengeful with probability ϕ^v. Assume that the gain from revenge is large so that the vengeful principal will prosecute if the agent has gone on strike in both periods. If the agent has accepted informal pay, she will go on strike if the gain is greater than the expected loss from prosecution, i.e., $g^u - \phi^v l^P > 0$. Therefore, if $g^u - \phi^v l^P > 0$, the illegal informal pay cannot deter strike, and will not be used. To rule out such a setting, assume instead that $g^u - \phi^v l^P < 0$.

At the beginning of period one, the forgiving type has no incentive to offer a different contract to reveal his type. The question is whether the forgiving principal wants to prosecute to mimic the vengeful type at the end of period. If he does not prosecute, his type is revealed. In period two, the agent anticipates no prosecution. Informal compensation cannot deter strikes. The forgiving principal has to use instead a formal contract derived in section 4.3, and incur the loss from strikes of $\phi^u(l^u - g^u)$. If he incurs the cost κ^P to prosecute the agent, he still can use illegal informal compensation to deter an undesirable action, and achieves the first-best payoff in period two. Therefore, the forgiving principal will prosecute when $\kappa^P < \phi^u(l^u - g^u)$. With $\kappa^P < \phi^u(l^u - g^u)$, the agent anticipates that both types will prosecute, therefore, after she accepts an informal pay, she will not go on strike if $g^u < l^P$.

<u>Effects of the Control, and the Amount and the Illegality of the Pay</u>

The analysis above assumes that κ^P, and l^P are constants, rather than functions. In reality, the principal can manipulate the cost of prosecution to himself and the loss to the agent. Consider the cost of prosecution (net of possible redemption from the agent). The principal wants the cost of prosecution such that $0 < \kappa^P < g^P$, so that ex post he will prosecute if the agent has gone on strike, but will not do so if the agent has not gone on strike. The prosecution cost is possibly decreasing in the control's ability to produce evidence to incriminate the agent, and in the amount of an illegal informal wage. The principal wants an adequate control to make sure κ^P is sufficiently low (i.e., $\kappa^P < g^P$). However, the control cannot be too good since the principal wants the prosecution cost net of redemption from the agent to be positive, i.e., $\kappa^P > 0$. For example, if the principal installs surveillance cameras everywhere, he can easily and perfectly produce evidence to convict the agent at no additional cost. Suppose that the redemption the principal will receive from the agent is positive, then the principal actually gains some money from prosecuting the agent, i.e., $\kappa^P < 0$. The desired equilibrium (not strike, not prosecute) cannot be obtained.

Consider the effect of informal pay (or the amount of allowed "theft") on κ^P. If the pay is larger, it is likely that the redemption for theft will be larger. The prosecution cost (net of the agent's redemption) will then be smaller.

Therefore, when the principal uses illegal informal compensation to deter undesirable actions, there is an upper bound on the amount of informal compensation. The amount of informal pay cannot be too large so that the principal wants to prosecute the agent ex post no matter whether the agent has taken an undesirable action or not, or wants to renege by not paying informal compensation after the agent accepts the contract (i.e. it cannot be too large so that $\kappa^P < 0$ or $w^I > l^u$). This possibly explains why we do not observe the principal paying only in terms of illegal informal pay, despite its tax benefits.

Consider the loss from prosecution to the agent. The principal wants the gain from going on strike to be less than the loss from prosecution (i.e., $g^u < l^P$) to deter strikes. The loss from prosecution to the agent includes both monetary and non-monetary loss, like reputation loss, disutility from shame and difficulties in finding a new job. This loss is potentially increasing in the amount of an informal wage. (The larger the amount the agent has stolen, the larger the amount of redemption to be paid to the principal, the more likely the prosecution receives public attention.) It also seems to be increasing as the informal pay seems more obviously illegal. For example, compare theft with abuse of expense accounts. The loss from being prosecuted, especially the psychic cost from shame, is larger for stealing. Theft seems outright immoral, while it can be difficult to define an abuse of expense accounts when the reimbursement regulation is lenient. Finally, as the control is better at producing evidence to convict the agent, the expected loss from prosecution is larger.

The discussion above suggests that the control decision is not just a simple cost-benefit analysis. The principal may intentionally impose weak control on a specific organizational resource to facilitate "theft" of that item, but strong control on other resources to prevent unwanted appropriation of valuable organizational resources. Also, the control decision is not just about prevention and detection of errors or fraud. The principal needs to determine the degree to which the control system can produce convincing evidence for successfully convicting the "thieving" employees, if this becomes necessary.

Caveats

The analysis in this section assumes that any level of prevention and detection of unwanted theft is available to the principal at no cost. In other words, the principal can completely control the amount of "theft". In reality, control is costly and is imperfect in preventing and detecting theft. The difficulty and costs of control are different for various organizational resources. I anticipate that, for informal compensation, the principal chooses an item for which the potential damage from unwanted theft is small.

Additionally, this section assumes there is no cost for using illegal informal compensation. In practice, public companies may incur costs from using illegal informal compensation. Investors and other outside stakeholders may not fully understand the optimality of the use of informal pay and hence may interpret the informal pay as an agency cost. This can lead to reputation losses (and possibly litigation) if the use of informal compensation becomes publicly known. The cost of using informal compensation may be larger in certain industries where a reputation for being honest and transparent is important in attracting the customers. Examples include the banking and auditing industries. If these costs exist, the principal pays illegal informal compensation only when the gain outweighs the expected cost.

4.10 Concluding Remarks

This chapter considers settings in which the agent can take an undesirable action which is beneficial to herself but costly to the principal. Such an action cannot be deterred by a formal mechanism. It is shown that the principal is worse off with such an action when the agent is risk averse, the lower bound on compensation is sufficiently large, and the gain from such an action to the agent is less than the loss to the principal.

Sections 4.5-4.8 consider the use of informal contracting to deter discrimination litigation. The advantage of informal contracting is that there is no evidence of the contract for the agent to misuse in the future. However, since there is no evidence of the informal contract, the principal's commitment problem exists. Whether the principal will use informal contracting depends on whether a commitment problem or an employee litigation problem is more severe.

Section 4.9 introduces illegal informal compensation, like allowed "theft", which can be used to compromise the agent. By accepting informal pay, the agent is subject to future prosecution against theft. If the loss from prosecution to the agent is sufficiently large, informal compensation can deter an undesirable action.

In the litigation model in section 4.5-4.8, the relations between a productive action and the payoffs from an undesirable action, and the probability that the agent can take such an action, are simple. A thorough study which examines more complicated relations and their effects on the optimal contracts may help us better understand the labour dispute phenomena in the real world.

Also, this chapter is mainly about the use of informal compensation to deter an undesirable action. Future research may consider the setting where informal compensation is used to induce a desirable action, the setting where the principal pays informally because it is more flexible or because it is tax-exempt, etc.

Appendix to Chapter 4: Formal and Informal Contracting in A Two-Period Setting

The analysis in sections 4.6-4.7 examines the use of formal and informal contracting in a single-period setting. This appendix considers instead a two-period setting. Assume that the periods are independent, and that there is no discounting between the two periods for both the principal and the agent. The objective is to derive sufficient conditions for the dishonest principal to find it optimal to pay a bonus at the end of the first period so that his type remains unknown in the second period. It will be shown that the dishonest principal will pay the bonus at the end of the first period if the amount of future gain (from the ability to induce $a = 1$) is sufficiently large. Also, if the amount of $P\Delta x$ is sufficiently large so that the principal wants to induce $a = 1$ when the outcome is verifiable, there is no commitment problem in period one if an informal contract is used.

4A.1 Formal Contract with Employee Litigation

To simplify the analysis, assume that the principal cannot fire an agent who sues him for discrimination (otherwise he may be sued for wrongful termination as well), and that the agent will stay with the principal even after she sued the principal in period one. (Or equivalently, once the principal reneged, his type is known to all employees in the labour market. A new agent hired also knows his type.) Also, assume that there is no lower bound on compensation

The setting in which a bonus that is sufficiently large to induce $a = 1$ deters reneging in each period (i.e., the setting in which $L^1 \geq G^1 + (\Delta v - \Delta G)/P$), is not considered here since there is no commitment problem. The optimal contract in each period is as derived in section 2.6.2.1,

Now, consider a setting in which $L^1 < G^1 + (\Delta v - \Delta G)/P$. Section 4.6.2.2 shows that in a single-period setting, the dishonest principal will not pay the bonus, and the honest principal incurs the loss from the commitment problem. In a two-period setting, the dishonest principal may have an incentive to pay the bonus at the end of the first period, and the honest principal thus may not incur the loss from the commitment problem in period one. (But he still incurs the loss in period two since the type remains unknown in period two, and the dishonest principal will renege in the last period.)

Consider the period-two subgame. At the beginning of the second period, the contract the honest principal offers is determined by whether the type is known to the agent at the beginning of period two. If the type is still unknown (either because the period-one outcome is low, or the period-one outcome is high but the agent anticipates both types will pay the bonus), the honest principal optimally offers the contract (F^{F**}, B^{F**}) derived in section 4.6.2.2. The dishonest principal will offer the same contract, as discussed previously. If the type is known (because the bonus is paid for the high period-one outcome, and the agent anticipates only the honest principal will pay the bonus), the honest principal can offer the contract $(F^{F+} = U + v(a=1) - (1\text{-}P)G^1 - PB^{F+}, B^{F+} = G^1 + (\Delta v\text{-}\Delta G)/P)$, and achieve the payoff $\bar{x} - \underline{U} - v(a=1)\text{-}(1\text{-}P)(L^1 - G^1)$.[24] The honest principal incurs no loss from the commitment problem in the second period since his type is known to the agent. On the other hand, after his type is revealed, the dishonest principal cannot induce $a = 1$ in period two.[25] He instead has to offer $F^{F++} = U = v(a=0)$ to induce the agent to accept the contract and choose $a = 0$. His payoff is only $x_L - F^{F++} = x_L - \underline{U}$ $- v(a=0)$.

Consider the honest principal's problem at the beginning of the first period. Note that, as discussed in section 4.6.2, to induce $a = 1$, the bonus must satisfy the following.

(i) $B \geq L^1$ to satisfy the principal's incentive compatibility constraint.

---

24 Knowing that the principal is honest, the agent anticipates that the bonus will be paid for the high outcome. Her payoff from choosing $a = 1$ is thus $F + PB + (1 - P)G^1 - v(a=1)$. Her payoff from choosing $a = 0$ is $F + G^0 - v(a=0)$. Therefore, to induce $a = 1$, the bonus must be greater than $G^1 + (\Delta v - \Delta G)/P$. To induce the agent to accept the contract, the fixed wage must be such that $F + PB + (1\text{-}P)G^1 - v(a=1) \geq \underline{U}$. Thus, one of the optimal solutions is $(F^{F+} = \underline{U} + v(a=1) - (1\text{-}P)G^1 - PB^{F+}, B^{F+} = G^1 + (\Delta v - \Delta G)/P)$. The honest principal's payoff is $\bar{x} - F^{F+} - PB^{F+} - (1\text{-}P)L^1 = \bar{x} - \underline{U} - v(a = 1) - (1\text{-}P)(L^1 - G^1)$.

25 Once the agent knows the principal is dishonest, in period two, any contract he offers which pays $B > L^1$ cannot induce the agent to choose $a = 1$, since the agent anticipates that the bonus will not be paid. Any contract which offers $B < L^0$ cannot induce $a = 1$ either, since the agent knows the bonus will always be paid and she is better off choosing $a = 0$. Any contract which offers $L^0 < B < L^1$ cannot induce $a = 1$ as well. If the principal anticipates that the agent has chosen $a = 1$, he will always pay a bonus for all values of outcome. However, anticipating the principal will always pay a bonus, the agent will choose $a = 0$. On the other hand, if the principal anticipates that the agent has chosen $a = 0$, he will not pay a bonus at all. Anticipating the principal will not pay a bonus, the agent will choose $a = 0$. This is because $L^1 < G^1 + (\Delta v - \Delta G)/P$ and the assumption that $L^1 > G^1$ implies that $(\Delta v - \Delta G) > 0$. The agent does not have intrinsic motivation to choose $a = 1$ to boost the gain from litigation.

(ii) Given that the agent anticipates both types will pay the bonus for x_H at the end of the first period, $B \geq G^1 + (\Delta v - \Delta G)/P$ to satisfy the agent's incentive compatibility constraint (4.6.2.2). Let $B^{a1} = G^1 + (\Delta v - \Delta G)/P$ denote the smallest bonus which still induces $a = 1$ when the agent anticipates that the dishonest principal will not renege at the end of period one.

(iii) Given that the agent anticipates that the dishonest principal will renege at the end of the first period, $B \geq G^1 + (\Delta v - \Delta G)/Ph_1$ to satisfy the agent's incentive compatibility constraint (4.6.2.5). Let $B^{a2} = G^1 + (\Delta v - \Delta G)/Ph_1$ denote the smallest bonus which induces $a = 1$ when the agent anticipates that the dishonest principal will renege at the end of period one.

What is new in the two-period setting is that the dishonest principal may have incentive to pay a bonus at the end of the first period to conceal his type. If he has not reneged, his type is still unknown, and the optimal contract in period two is (F^{F**}, B^{F**}), as derived in section 4.6.2.2. If he offers the same contract as the honest principal (i.e., (F^{F**}, B^{F**})), but he does not pay the bonus, his payoff from is $\bar{x} - \underline{U} - v(a=0) - \Delta G$ - $(L^1 - G^1)$. In contrast, if the dishonest principal has reneged, the agent knows his type. He cannot induce $a = 1$ in period two. He instead has to offer $F^{F++} = U = v(a=0)$ to induce the agent to accept the contract and choose $a = 0$. His payoff is only $x_L - F^{F++} = x_L - \underline{U} - v(a=0)$, which is less than the payoff he receives if his type is still unknown. Therefore, the dishonest principal will pay a period-one bonus B_1 if the immediate gain from reneging (which is equal to the bonus offered in period one) is less than the future gain, i.e.,

$$B_1 \leq \bar{x} - \underline{U} - v(a=0) - \Delta G - (L^1 - G^1) - [x_L - \underline{U} - v(a=0)], \text{ or}$$

$$B_1 \leq P\Delta x - L^1 + G^0. \tag{4A.2.1}$$

Let B^d denote the largest bonus which deters reneging at the end of the first period, i.e., $B^d = P\Delta x - L^1 + G^0$.

Case 1: $B^d = P\Delta x - L^1 + G^0 < B^{a1} = G^1 + (\Delta v - \Delta G)/P$

If the largest bonus which deters reneging at the end of the first period is too small to induce $a = 1$ (i.e., $B^d = P\Delta x - L^1 + G^0 < B^{a1} = G^1 + (\Delta v - \Delta G)/P$), the honest principal cannot deter reneging at the end of period one. In period one, he (and the agent) anticipates that the dishonest principal will not pay a bonus at the end of the period. Since his payoff is decreasing in the amount of bonus he offers, he optimally offering the smallest bonus which induces $a = 1$. The optimal contract is thus (F^{F**}, B^{F**}). The honest principal's and the dishonest principal's payoffs in period one are (4.6.2.8) and (4.6.2.9) respectively.

At the beginning of the first period, the dishonest principal will offer the same contract as the honest principal. At the end of the first period, the dishonest principal will renege if the outcome is high. If the period-one outcome is high, the honest principal incurs no loss from the commitment problem in the second period. As discussed above, he offers (F^{F+}, B^{F+}) and obtains $\bar{x} - \underline{U} - v(a=1) - (1-P)(L^1 - G^1)$. The dishonest principal offers a fixed wage to induce $a = 0$. However, if the first-period outcome is low, the principal's type is still unknown to the agent. The agent's assessed probability of the principal being honest is still equal to h_1 at the beginning of the second period. The optimal contract is thus (F^{F**}, B^{F**}) derived in section 4.6.2.2. The honest principal's and the dishonest principal's payoffs in period two are (4.6.2.8) and (4.6.2.9) respectively.

Case 2: $B^d = P\Delta x - L^1 + G^0 \geq B^{a1} = G^1 + (\Delta v - \Delta G)/P)$

Now consider the case the largest bonus which deters reneging at the end of the first period is sufficiently large to induce $a = 1$ (i.e., $B^d = P\Delta x - L^1 + G^0 \geq B^{a1} = G^1 + (\Delta v - \Delta G)/P)$). The honest principal has two choices. He can offer a contract which deters reneging at the end of the first period. This way, he incurs **no** loss from the commitment problem in the first period, but he incurs the loss in the second period. Alternatively, he can offer a contract which induces the dishonest principal to renege at the end of the first period. This way, he incurs the loss from the commitment problem in the first period, but possibly incurs no loss in the second period.

It is demonstrated below that he is better off if he deters reneging in the first period when he can. This is because, by deterring reneging in period one, he incurs the loss from the commitment problem only in period two. However, by offering an additional bonus sufficiently large to induce the dishonest type to renege at the end of period one, he can separate himself only if the period-one outcome is high. In other words, with probability $(1-P)$, he will incur the loss from the commitment problem in both periods, rather than in just one period.

Consider the first option: deter reneging in the first period. The honest principal can offer the bonus B^{a1}, and the fixed wage $F^{a1} = \underline{U} + v(a=1) - (1-P)G^1 - PB^{a1}$, which satisfies $F + PB + (1-P)G^1 - v(a=1) \geq \underline{U}$. In the second period, he offers the contract

(F^{F**}, B^{F**}) derived in section 4.6.2.2. The honest principal incurs the loss from litigation only in the second period. Note that in the second period the type is still unknown, and the agent's assessed probability of the honest type at the beginning of the second period is still equal to h_1. Since the dishonest principal will offer the identical contract, the agent's assessed probability of the honest type after she observes the period-two contract (F^{F**}, B^{F**}) is still equal to h_1. The honest principal's total payoff is

$$U^{PH}(F^{a1},B^{a1}, F^{F**},B^{F**}, a=(1,1)) = 2[\bar{x}-\underline{U}-v(a=1)-(1-P)(L^1-G^1)] - (\Delta v-\Delta G)(\frac{1}{h_1}-1).$$

Consider the second option. To induce the dishonest principal to renege at the end of the first period, he must offer the bonus $B > B^d$. Note that his payoff is decreasing in the amount of bonus he offers, when the agent anticipates the dishonest principal will renege. Let $B^{d\varepsilon} = B^d + \varepsilon$, $\varepsilon > 0$ and $\varepsilon \to 0$ denote the "smallest" bonus sufficiently large to induce reneging in the first period. To induce the agent to choose $a = 1$, he must offer the bonus $B > B^{a2}$. Note that in this setting, $B^d \geq B^{a1} = G^1 + (\Delta v - \Delta G)/P$, but it is possible that $B^d < B^{a2} = G^1 + (\Delta v - \Delta G)/Ph_1$. The cost-minimizing bonus which induces reneging and $a = 1$ is thus the bonus $B^{***} = max\{B^{d\varepsilon}, B^{a2}\}$. In the first period, the honest principal offers a fixed wage $F^{***} = \underline{U} + v(a=1) - Ph_1B^{***} - (1-Ph_1)G^1$, which satisfies the participation constraint. With this contract (F^{***}, B^{***}), he receives the following period-one payoff.

$$\begin{aligned} U_1^{PH}(F^{***},B^{***}, a=1) &= \bar{x} - F^{***} - PB^{***} - (1-P)L^1 \\ &= \bar{x}-\underline{U}-v(a=1)-(1-P)(L^1-G^1)-P(1-h_1)(B^{***}-G^1). \end{aligned}$$

If the period-one outcome realized is high, with the bonus B^{***}, the dishonest principal will renege. If the period-one outcome is low, the honest principal cannot separate himself from the dishonest type.

Therefore, ex ante, with probability $(1-P)$, in period two, the honest principal still has to offer (F^{F**}, B^{F**}), and incurs the loss from the commitment problem (i.e., the period-two payoff is $\bar{x}-\underline{U}-v(a=1)-(1-P)(L^1-G^1)-(\Delta v-\Delta G)(\frac{1}{h_1}-1)$). With probability P, the type is revealed so that he can offer (F^{F+},B^{F+}), and obtain $\bar{x}-\underline{U}-v(a=1)-(1-P)(L^1-G^1)$ in period two. His ex ante total expected payoff is thus

$$\begin{aligned} &U^{PH}(F^{***},B^{***}; F^{F**}, B^{F**}; F^{F+},B^{F+}; (a=1, 1)) \\ &= 2[\bar{x}-\underline{U}-v(a=1)-(1-P)(L^1-G^1)] - P(1-h_1)(B^{***}-G^1) - (1-P)(\Delta v-\Delta G)(\frac{1}{h_1}-1). \end{aligned}$$

The principal's payoff from option one is greater than the payoff from option two when

$$U^{PH}(F^{a1}, B^{a1}, F^{F**}, B^{F**}, a=(1,1)) > U^{PH}(F^{***}, B^{***}; F^{F**}, B^{F**}; F_2^{F+}, B_2^{F+}; (a=1, 1),$$

$$-(\Delta v-\Delta G)(\frac{1}{h_1}-1) > -P(1-h_1)(B^* - G^1) - (1-P)(\Delta v-\Delta G)(\frac{1}{h_1}-1),$$

$$P(1-h_1)(B^* - G^1) > P(\Delta v-\Delta G)(\frac{1}{h_1}-1),$$

$$max\{B^{d\varepsilon}, B^{a2}\} - G^1 > (\Delta v - \Delta G)/h_1, \text{ or}$$

$$max\{B^{d\varepsilon} - G^1, (\Delta v - \Delta G)/Ph_1\} > (\Delta v - \Delta G)/h_1. \qquad (4A.1.2)$$

Since (4A.1.2) is always true, the honest principal prefers to deter reneging in the first period, and incur the loss from the commitment problem only in the second period, rather than to induce the dishonest principal to renege in the first period.

4A.2 Informal Contract with Employee Litigation

Consider the period-two subgame. The contract the dishonest principal offers depends on whether he has revealed his type by reneging at the end of the first period or not. If the dishonest principal has reneged, he can no longer induce $a = 1$ in period two. He can only offer a fixed wage sufficiently large to induce the agent to accept the contract, which is $F^{I+} = \underline{U} + v(a=0)$. His payoff is $x_L - F^{I+} = x_L - \underline{U} - v(a=0)$.

Now, suppose instead that the dishonest principal has paid the bonus at the end of the first period and the agent anticipates that both types will pay. At the beginning of the second period, the agent does not know the principal's type. As discussed in section 4.7, the dishonest principal has no incentive to offer a different contract to reveal his type so that both types will offer the same contract in period two. Thus, when she observes the contract offered in period two, the agent's assessed probability of the honest type is still equal to h_1. The optimal contract the honest and dishonest principals offer is as derived in section 4.7, which is $(F^I = \underline{U} + v(a=0), B^I = \Delta v/Ph_1)$. The dishonest principal payoff is $\bar{x} - F^I = \bar{x} - \underline{U} - v(a=0)$, which is higher than $x_L - \underline{U} - v(a=0)$ he receives if he has reneged.

Consider the period-one game, and the honest principal's reaction to the commitment problem. As in the formal contracting setting, he may be able to deter reneging in the first period. Now consider the set of the bonuses which deters reneging at the end of the first period. At the end of period one, if the high outcome is realized, the dishonest principal compares the immediate gain from reneging (which is equal to the bonus B offered in period one) with the future gain from paying a bonus to conceal his type, which is $P\Delta x = \bar{x} - \underline{U} - v(a=0)$ - $[x_L - \underline{U} - v(a=0)]$. The dishonest principal will pay the bonus when

$$B \leq P\Delta x. \tag{4A.2.1}$$

Let $B^D = P\Delta x$ denote the largest bonus which deters reneging at the end of the first period.

Suppose the agent anticipates that both types will pay a bonus at the end of period one. Her period-one payoff from choosing $a = 1$ is $F + PB - v(a = 1)$. If the agent chooses $a = 0$, her payoff is $F - v(a = 0)$. Therefore, the agent will choose $a = 1$ when

(IC[a]) $$F + PB - v(a = 1) \geq F - v(a = 0), \text{ or}$$

$$B \geq \Delta v/P. \tag{4A.2.2}$$

Let B^A denote the smallest bonus which is sufficiently large to induce $a = 1$, given that the agent anticipates both types will pay the bonus for the high outcome.

Therefore, if the bonus $B^D = P\Delta x \geq B^A = \Delta v/P$, then the bonus $B^A = \Delta v/P$, which is sufficiently large to induce $a = 1$, deters reneging. The honest principal can offer a contract with $B^A = \Delta v/P$, and a fixed wage $F^A = \underline{U} + v(a=0)$, which satisfies the participation constraint. He incurs no loss from the commitment problem. His period-one payoff is the first-best payoff.

Note that $\Delta v/P < P\Delta x$ is a sufficient condition for the principal to prefer to induce $a = 1$ rather than $a = 0$ when the outcome is verifiable. When the outcome is not verifiable, $\Delta v/Ph_1 < P\Delta x$ is a sufficient condition for the honest principal to prefer to induce $a = 1$ rather than $a = 0$, given that the dishonest principal offers an identical contract to the honest principal's contract, and the agent anticipates the dishonest principal will renege. Note that previously we assume that the honest principal wants to induce $a = 1$. This implies the dishonest principal will pay the bonus $B^A = \Delta v/P < \Delta v/Ph_1 < P\Delta x$ at the end of the first period, and there is no loss from the commitment problem in the first period.

As in the formal contracting scheme, the honest principal can also offer a bonus $B^{D\varepsilon} = P\Delta x + \varepsilon > B^D$ to induce the dishonest principal to renege at the end of the first period (if the outcome is high). However, it is not certain that the type will be revealed (i.e., the period-one outcome may be low). He may end up incurring the loss from the commitment problem in both periods. Given that the honest principal wants to induce $a = 1$ even when the agent anticipates the dishonest principal will renege (i.e., $\Delta v/Ph_1 <$

$P\Delta x$), the honest principal prefers to deter reneging in the first period, rather than to try to separate himself from the dishonest type.

The optimal period-one contract for both types is thus ($F^A = \underline{U} + v(a=0)$, $B^A = \Delta v/P$). Both types pay the bonus when the outcome is high. The optimal contract for period two is as derived in section 4.7, which is ($F^I = \underline{U} + v(a=0)$, $B^I = \Delta v/Ph_I$). The honest principal will pay the bonus when the outcome is high, while the dishonest principal will not.

4A.3 Comparison of Formal and Informal Contracting

To consider the use of discretionary bonus, assume that $P\Delta x > \Delta v/Ph_I > \Delta v/P$ so that the principal wants to induce $a = 1$. With $P\Delta x > \Delta v/P$, the dishonest principal will pay the bonus in period one if the informal contract (F^A, B^A) is offered. This implies that the principal will incur the loss from the commitment problem only in the last period. With formal contracting, when the bonus $B = L^1$, which deters reneging, is sufficient large to induce $a = 1$, the principal incurs no loss from the commitment problem at all, but incurs the loss from litigation in each period. If the litigation problem is sufficiently severe, the principal prefers informal contracting. On the other hand, if the bonus $B = L^1$ does not induce $a = 1$, the principal may or may not incur the loss from the commitment problem in earlier periods, depending on whether the future gain is larger than the immediate gain from reneging. However, the principal incurs the loss from litigation in every period. Again, if the litigation problem is sufficiently severe, the principal prefers informal contracting.

Chapter 5: Conclusion

This dissertation studies two important aspects of compensation decisions: the composition and formality of compensation. Chapter two examines the use of non-cash compensation in a moral hazard setting. It has been demonstrated that there is no difference paying in terms of cash or in terms of goods when (i) all goods are available from the market, (ii) the principal has no cost advantage in providing the goods, and (iii) the consumption of the goods does not affect the agent's productivity. When any of the above is not true, the optimal compensation contracts are different when the principal exogenously can and cannot pay in terms of goods. If the principal is the only source of the goods, he optimally provides the goods, and reduces cash compensation accordingly. The principal is better off paying non-cash compensation, because the agent's consumption surplus from the goods enables him to reduce the total compensation costs.

When the principal has a cost advantage in providing a particular good, he also optimally provides the good and reduces cash compensation accordingly, rather than having the agent buy it from the market herself. In these two cases, the principal provides the good to reduce total compensation costs. On the other hand, when the good is productive, the principal wants to control the agent's consumption of the good to achieve the desired level of production outcome. If he is the only source of the good, he controls the agent's consumption by providing the good as part of compensation. When the good is available from the market, the agent consumes to maximize her own welfare, rather than the total welfare. If she is not properly motivated, she consumes less than the amount the principal desires. The principal manipulates the agent's consumption by including proper incentive in cash compensation (or other goods for which he is the only source). To increase the agent's consumption, a higher incentive rate is used. Chapter two also discusses the use of a productive good for "window dressing" activities.

Chapter three discusses empirical research on the use of non-cash compensation for executives. There seems to be little empirical work on non-cash compensation in agency settings in accounting, finance, or microeconomics. The studies appear to focus on testing the competing hypotheses on CEOs' perquisites: the agency cost hypothesis and the optimal contract hypothesis. Empirical results are inconclusive, possibly because the data used in the studies are not complete. This emphasizes the importance of further theoretical and empirical studies on other issues related to the composition of the pay.

Chapter three also investigates the use of non-cash compensation in an adverse selection model. It considers three kinds of private, pre-contract information: the agent's preference for non-cash compensation, the productivity of non-cash compensation, and the productivity of the agent's effort. It demonstrates that the principal's optimal way to reduce information rent is contingent on the kind of private information the agent has. And if the private information is related to non-cash compensation, the principal reacts differently when the agent can and cannot buy or sell the good in the market.

The analysis in chapter two and three can be beneficially extended in many directions, e.g. a multi-agent model, a multi-period model, an adverse selection model with multiple private information, an analysis of contracting costs for non-cash compensation, and an analysis to discover differences in non-cash compensation used for executives and ordinary employees.

Chapter four considers another aspect of compensation: formal vs informal. Prior agency literature mostly considers productive and non-productive actions which can be manipulated or controlled by formal mechanisms, like a written compensation contract or an audit. Chapter four instead considers a non-productive action which is beneficial to the agent but is costly to the principal, and cannot be deterred formally. Chapter four illustrates that informal compensation can be used to solve labor dispute problems, like employee litigation or strikes.

We do not know much about informal compensation, which seems to be extensively used in the real world (at least in terms of gifts). We may leave contracts unwritten because of high contract writing costs, or because we want to deter undesirable actions. However, there may be other motives for informal contracting not yet examined. We do not know how frequently and how extensively informal compensation is used in the real world. We do not know whether informal compensation is more often paid in terms of goods or of cash and why, whether it is used more for low-level employees or executives, etc. For illegal informal compensation, we do not how a company selects which organizational resources to pay informally, and how the firm limits "theft" to a desired level. We do not know what happens in a multi-agent setting. To obtain better insights into informal compensation, much more future theoretical, empirical, and behavioral research needs to be done.

In addition to further studies on non-cash and informal compensation, future research on another dimension of compensation, immediate vs deferred compensation, will lead to better understanding of the compensation practices in the real world.

References

Alpert, William T. and Stephen A. Woodbury. 2000. *Employee Benefits and Labor Markets in Canada and the United States.* Kalamazoo, Michigan: W.E. Upjohn Institute for Employment Research.

Altheide, David L, Patricia A. Adler, Peter Adler, and Duane A. Altheide. 1978. The Social Meanings of Employee Theft. In J. M. Johnson and J. D. Douglas (Eds.), *Crime at the Top: Deviance in Business and The Professions*, Philadelphia: J. B. Lippincott.

Baiman, Stanley, and Madhav V. Rajan. 1995. The Informational Advantages of Discretionary Bonus Schemes. *Accounting Review* 70(4): 557-579.

Baker, George, Robert Gibbons, and Kevin J. Murphy. 1994. Subjective Performance Measures in Optimal Incentive Contracts. *Quarterly Journal of Economics* 109: 1125-1156.

Banker, Rajiv D., Srikant M. Datar, and Ajay Maindiratta. 1988. Unobservable Outcomes and Multiattribute Preferences in the Evaluation of Managerial Performance. *Contemporary Accounting Research* 5(1): 96-124.

Battigalli, Pierpaolo, and Giovani Maggi. 2004. Costly Contracting in a Long-term Relationship. *Unpublished Working Paper* (Boccini University).

Braido, Luis H. B. 2003. Insurance and Incentives in Sharecropping. *CESIFO Working Paper.*

Bull, Clive. 1983. Implicit Contracts in the Absence of Enforcement and Risk Aversion. *American Economic Review* 73(4): 658-671.

Bull, Clive. 1987. The Existence of Self-enforcing Implicit Contracts. *Quarterly Journal of Economics* 102(1): 147-159.

Christensen, Peter O., and Gerald A. Feltham. 2005. *Economics of Accounting, Volume II: Performance Evaluation.* Boston: Kluwer Academic Pulishers.

Ditton, Jason. 1977. Perks, Pilferage, and the Fiddle: The Historical Structure of Invisible Wages. *Theory and Society* 4(1): 39-71.

Doyle, Tanya, and Brian H. Kleiner. 2002. Issues in Employment Litigation. *Managerial Law* 44(1-2): 151-155.

Fama, Eugene F. 1980. Agency Problems and the Theory of the Firms. *Journal of Political Economy* 88 (2): 288-307.

Feltham, Gerald A., and Jim Xie. 1994. Performance Measure Congruity and Diversity in Multi-task Principal/Agent Relations. *Accounting Review* 69: 429-453.

Greenberg, Jerald and Kimberly S. Scott. 1996. Why Do Workers Bite the Hands that Feed Them? Employee Theft as a Social Exchange Process. *Research in Organizational Behavior: An Annual Series of Analytical Essays and Critical Reviews*, 18: 111-156.

Hashimoto, Masanori. 2000. Fringe Benefits and Employment. In William T. Alpert and Stephen A. Woodbury (Eds.), *Employee Benefits and Labor Markets in Canada and the United States*, Kalamazoo, Michigan: W.E. Upjohn Institute for Employment Research.

Ittner, Christopher D., and David F. Larcker. 2001. Assessing Empirical Research in Managerial Accounting: A Value-Based Management Perspective. *Journal of Accounting and Economics* 32(1-3): 349-410.

Jensen, Michael C., and William H. Meckling. 1976. Theory of the Firm: Managerial Behavior, Agency Costs, and Ownership Structure. *Journal of Financial Economics* 3(4): 305-360.

Keeney, Ralph L., and Howard Raiffa. 1993. *Decisions with Multiple Objectives: Preferences and Value Tradeoffs.* Cambridge, UK: Cambridge University Press.

Kreps, David M., and Robert Wilson. 1982. Reputation and Imperfect Information. *Journal of Economic Theory* 27: 253-279.

Laffont, Jean-Jacques and David Martimort. 2002. *The Theory of Incentives: The Principal-Agent Model.* Princeton University Press.

Lambert, Richard A. 2001. Contracting Theory and Accounting. *Journal of Accounting and Economics* 32 (1-3): 3-87.

Lee, Gerald, Zoltan Matolcsy, and Peter Wells. 2004. The Compensation-Performance Relation in China for State Dominated Enterprises and Non-State Dominated Enterprises. *Unpublished Working Paper* (University of Technology, Sydney, Australia).

Levin, Jonathan. 2002. Multilateral Contracting and the Employment Relationship. *Quarterly Journal of Economics* 117(3): 1075-1103.

Long, James E., and Frank A. Scott. 1982. The Income Tax and Nonwage Compensation. *Review of Economics and Statistics* 64(2): 211-219.

MacLeod, W. Bentley, and James M. Malcomson. 1989. Implicit Contracts, Incentive Compatibility, and Involuntary Unemployment. *Econometrica* 57(2): 447-480.

MacLeod, W. Bentley. 2003. Optimal Contracting with Subjective Evaluation. *American Economic Review* 93(1): 216-240.

Marino, Anthony M., and Ján Zábojník. 2004. Optimal Pricing of Employee Discounts and Benefits: A Rent Extraction View. *Unpublished Working Paper* (University of Southern California).

Mars, Gerald. 1982. *Cheats at Work: An Anthropology of Workplace Crime*. London: George Allen & Unwin Ltd.

Murphy, Kevin J. 1998. Executive compensation. *Unpublished Working Paper* (University of Southern California).

Murray, Carla Tighe. 2004. Military Compensation: Balancing Cash and Non-cash Benefits. *Economic and Budget Issue Brief: A series of issue summaries from the Congressional Budget Office*. January 16. (Available at http://www.cbo.gov/showdoc.cfm?index=4978&sequence=0).

Otsuka, Keijiro, and Yujiro Hayami. 1988. Theories of Share Tenancy: A Critical Survey. *Economic Development and Cultural Change* 37(1): 31-68.

Oyer, Paul. 2004. Salary or Benefits? *Unpublished Working Paper* (Stanford University).

Prendergast, Canice, and Robert H. Topel. 1993. Discretion and Bias in Performance Evaluation. *European Economic Review* 37(2-3): 355-365.

Prendergast, Canice, and Robert H. Topel. 1996. Favoritism in Organizations. *Journal of Political Economy* 104(5): 958-978.

Rajan, Raghuram, and Julie Wulf. 2004. Are Perks Purely Managerial Excess? *Journal of Financial Economics,* fourthcoming.

Rosen, Sherwin. 1985. Implicit Contracts: A Survey. *Journal of Economic Literature* 23(3): 1144-1175.

Rosen, Sherwin. 2000. Does the Composition of Pay Matter? In William T. Alpert and Stephen A. Woodbury (Eds.), *Employee Benefits and Labor Markets in Canada and the United States*, Kalamazoo, Michigan: W.E. Upjohn Institute for Employment Research.

Schwab, Stewart J., and Randall S. Thomas. 2004. What do CEOs bargain for?: An Empirical Study of Key Legal Components of CEO Employment Contracts. *Unpublished Working Paper* (Vanderbilt University and Cornell Law School).

Sundaram, Rangarajan K., and David L. Yermack. 2005. Pay Me Later: Inside Debt and Its Role in Managerial Compensation. *Unpublished Working Paper* (New York University).

Taslim, M. A. 1992. A Survey of Theories of Cropshare Tenancy. *Economic Record* 68(202): 254-275.

Webster, George D. 1988. The Law of Employee Evaluations. *Association of Management* 40(5): 118-119.

Wells, Joseph T. 1997. *Occupational Fraud and Abuse*. Texas: Obsidian Publishing Company, Inc.

Yermack, David. 2005. Flights of Fancy: Corporate Jets, CEO Perquisites, and Inferior Shareholder Returns. *Unpublished Working Paper* (New York University).

Zeitlin, Lawrence R. 1971. A Little Larceny Can Do a Lot For Employee Morale. *Psychology Today* June: 22-26, 64.

Zenger, Todd R., Sergio G. Lazzarini, and Laura Poppo. 2001. Informal and Formal Organization in New Institutional Economics. *Unpublished Working Paper* (Washington University).

Appendix 1: Description of Data Collected and Firms Studied

1.1 Data Collected

I use questionnaires, email correspondence, in-person interviews, and phone interviews to gather data on the use of non-cash and informal compensation in the real world. The questionnaire consists of 6 parts. It first explains the definitions and gives examples of non-cash and informal compensation. The first part of the questionnaire asks for the background information of the respondents and the businesses. The second and third parts are about the use of formal compensation for core workers and temporary workers (if any), respectively. The fourth and the fifth parts are about the use of informal compensation for core workers and temporary workers (if any) respectively. The sixth part explores the use of objective and subjective performance measures, and their relations to formal and informal compensation used.

Since the use of non-cash and informal compensation is sensitive information, the businesses included in this study are ones with which the author has personal contact in Thailand. This sample selection method, though it potentially provides more truthful and in-depth information, may not provide a good representative picture of the compensation practices of businesses in general. I try to overcome this problem by including in this study firms from a variety of industries and of various sizes. The Thai business sample includes two pharmaceutical manufacturers, a hotel, an audit firm, an auto parts manufacturer, a freighter, an agrochemical manufacturer, and a sugar exporter. All of these are private enterprises, except the agrochemical manufacturer. The two pharmaceutical manufacturers and the hotel are family businesses. The automobile parts manufacturer is affiliated with a car manufacturer in Japan. The audit firm is a small business with two auditor-partners. The sugar exporter is a private company founded by a group of local sugar producers in order to export their products. The freighter is a Thai branch of a US company offering global supply chain services. The agrochemical manufacturer is a public company traded in Thailand Stock Exchange. The company's main operations include the importation, formulation and distribution of pesticides.

Replies from the hotel and the freighter are in English. Replies from the sugar exporter, the auditor, the agrochemical manufacturer, and one pharmaceutical company (T. Man Pharma Partnership Ltd.) are in Thai. Replies from the auto parts manufacturer and another pharmaceutical company (Thaipharmed 1942 Co. Ltd.) are mixed. When the replies in English are quoted, they are shown exactly as the originals, except for minor correction of grammatical errors and word choices.

1.2 Description of Firms Studied

Company Name	No. of Employees	Total Assets (2003)*	ROA (2003)	Description of Business	Respondent
T. Man Pharma Partnership Ltd.	289	B 116M	0.09 (EBIT used)	Pharmaceutical manufacturer	Production manager
Thaipharmed 1942 Co. Ltd.	144	B 23.12M	NA	Pharmaceutical manufacturer	Production manager & personnel manager
Auto Parts Co. Ltd.	636	B 1,495M	0.1665	Automobile parts manufacturer	Advisor
Narai Hotel	588	B 900M	0.1222	Hotel (three-star)	Internal auditor
Auditor Ltd.	4	B 4.8M	0.005	Audit firm	Auditor-partner
Freighter Co. Ltd.	132	B 114.1M	0.343	UPS company	Financial controller, admin & personnel manager
Agrochem PLC	151	B407.75M	0.146	Agrochemical Industry	Accounting manager
Exporter Co. Ltd.	24	B130.115M	0.132	Sugar Exporter	Chief of accounting and finance division

* The exchange rate was Thai Baht 30 for C$1.

Anonymity: T. Man Pharma Partnership Ltd. and Thaipharmed 1942 Co. Ltd. allow revelation of their identity in academic publications. Narai Hotel allows the revelation of their identity in the thesis but **not** in any other publication. The rest of the sample do **not** allow the revelation of their identities anywhere. Therefore, a fictitious name identifying its main operations is used for each business.

Appendix 2: Case Studies on the Use of Non-monetary Compensation

2.1 Descriptive Overview

2.1.1 Cash Compensation

Before presenting the use of non-cash compensation in the businesses studied, I show below the use of cash compensation for comparison.

	T. Man	Thai Phar med	Auto Parts	Narai Hotel	Audi -tor	Frei-ghter	Agro chem	Ex-por -ter
Cash Compensation								
Monthly Salary	√	√	√	√	√	√	√	√
Cash bonus for tenure	√	√	√			√	√	√
Cash bonus for performance	√		√	√	√	√	√	
Other								
Assurance Money	√							
Over-time		√			√			
Commission							√	
Subsidy for New Year party		√						
Gas expense reimbursement			√			√		
Mobile phone expense reimbursement						√		
Gift for a new-born child, a funeral, etc.			√	√				
Provident (Retirement) funds				√		√	√	
Additional for executive								
Extra bonus			√					
Higher company contribution to Provident fund						√		

Explanation of a Special Term

Assurance Money (paid at T. Man Pharma): For certain jobs (e.g. medicine coating), accurate monitoring is not possible. There is naturally an idle time during the production process (waiting for a certain task to be done by the machine). Also, there are random factors other than carelessness and unskillfulness that lead to defective outcomes. Mistakes are also costly. In addition to salary, these employees are paid an additional bonus called “assurance money” for satisfactory production outcomes finished in time. (The money assures satisfactory outcome from production.)

2.1.2 Types of Non-cash Compensation Used

The types of non-cash compensation used in each company for most employees are summarized below.

	T. Man	Thai Phar med	Auto Parts	Narai Hotel	Audi -tor	Frei- ghter	Agro chem	Ex- por -ter
Non-cash Compensation								
Health Insurance	√	√	√			√	√	√
Medical Check-ups or in-house medical services	√	√	√	√		√	√	√
Paid leaves	√	√	√	√	√	√	√	
Group annual trip	√		√			√	√	√
Training programs	√	√	√	√	√	√	√	
Food	√		√	√				
Lodging	√	√						
Others								
Uniforms		√	√	√				
Laundry of staff uniforms				√				
Coffee break /Coffee room/ Free coffee or other drink		√			√	√		
Monthly group birthday party	√			√				
Religious activities	√							
Annual staff party	√			√				√
Transportation				√				
Sport facilities/activities				√				
Funeral flower for death of staff's close relative				√				
Accident insurance					√			
Goods sold at discount prices		√						
Life insurance								√

The types of non-cash compensation used for executives in each company are summarized below.

	T. Man	Thai Phar med	Auto Parts	Narai Hotel	Audi -tor	Frei- ghter	Agro chem	Ex- por -ter
Additional for executive								
A better office	√			√		√		
A company car			√	√	√	√	√	√
A driver	√	√	√	√ [26]				
A secretary				√				
Better meals				√				
Better paid vacation					√		√	
Hospital medical expenses				√				
Official Check				√				
Lodging				√				
Gym facilities				√				
Entertainment			√					√
In-house entertainment bills				√				
Cars sold at discount prices			√					
Privilege (no need to punch time card)	√							
Better health and accident insurance policy						√		
Additional for foreign executive								
Lodging			√					

<u>Explanation of Special Terms</u>

Official Check (used at Narai Hotel): "Official checks" are commonly used in the hotel industry as a quality control measure. A high-level employee can dine at any of the hotel's own restaurants, and sign the official checks. He can order anything at any prices, except alcoholic drinks. There are no limits on the amount a staff can sign the checks. If the employee brings guests, they will be billed separately. The portion consumed by the guests is classified as an "in-house entertainment bill," rather than official check.

In-house entertainment bills (used at Narai Hotel): The respondent gave the following explanation for this item.

> When sales executives or high level staff bring guests – suppliers, advisors, tour operators, commercial account secretaries, police officers, government agency people, etc… , they sign entertainment bills. …. The entertainment bills are

[26] For the managing director only.

subjected to a yearly entertainment budget. We do not allow outside entertainment. There is a [separate] budget for outside dining – the observation budget. This budget is tightly controlled by ... Research and Development unit under [the supervision of the] Resident Manager (GM's deputy). Staff from various departments, such as Food and Beverage, Cooks, Quality Control, Marketing, and Internal Audit, are normally invited to join the observation missions. Only the MD [Managing Director] and GM [General Manager] can sign the outside entertainment bills, according to their budgets.

2.1.3 Proportion of Formal Cash and Non-cash Compensation for an Average Employee

	T. Man	Thai Phar med	Auto Parts	Narai Hotel	Audi -tor	Frei- ghter	Agro chem	Ex- porter
Cash Compensation								
Monthly Salary	80	89	65	90	88	85.1	67.5	76
Cash bonus for tenure	10	10	24	-	-	7.1	8.1	24
Cash bonus for performance	5	1	8	7	7	7.1	1.4	-
Other	5	-	2	3	5	0.7	23	-
Total	100	100	100	100	100	100	100	100
Non-cash Compensation								
Health Insurance and health benefits	15	20	25	5	-	30.3	16.6	100
Paid leaves	25	-	-	4	58	28	21.6	-
Training programs	20	20	25	4	38.5	3.4	6.2	-
Food	20	-	40	80	-	-	-	-
Lodging	20	20	-	-	-	-	-	-
Other	10	40	10	7	3.5	38.3	55.6	-
Total	100	100	100	100	100	100	100	100
Cash compensation	60	75	70	90	98	92.9	96	NA
Non-cash compensation	40	25	30	10	2	7.1	4	NA
Total	100	100	100	100	100	100	100	NA

From the questionnaires, I find that, if not required by law, most of the non-cash compensation used is productive. Often, the company has cost advantages in providing the goods (to be discussed below). This seems consistent with the theoretical prediction in chapter 2 that there is no benefit from paying in terms of non-productive goods if the goods are available from the market and the firm does not have a cost advantage in providing them.

Also, it seems that firms in some industries rely more heavily on non-cash compensation than firms in other industries. For example, non-cash compensation seems to constitute a significant amount of total compensation in manufacturing settings. Furthermore, in a hotel, many of the non-cash compensation components can be provided relatively easily and cheaply (because the hotel has production facilities), and many different kinds of non-cash compensation are used at all levels in an organization. This seems consistent with the theoretical prediction that the company provides a good which it can produce or acquire at a lower cost. The theory also predicts that, given that the cost advantage is sufficient large, the agent consumes more than she would have if she had to purchase the good from the market herself. Evidence from Narai hotel includes the payments in terms of uniform laundry, food, lodging, official checks, and in-house entertainment bills. If not paid in terms of goods, it is not likely that employees will pay for professional laundry every day, or purchase hotel-quality food for daily consumption. If she has to pay for it herself, it is not likely that an executive will stay in a hotel with room service, or dine in a restaurant in a hotel often. She may also take a business guest to a less costly restaurant. Note that the goods provided are the goods which the hotel can prevent their employees from selling to an external market.

One may expect a firm to pay in terms of its own products as part of compensation, especially if they are consumption goods for employees. At T. Man (and Thaipharmed), the business does not pay its employees in terms of defective or overstocked products, because in Thailand drugs are prohibited from distribution without pharmacists' approval. One exception at T. Man is the cases of employees' minor illnesses. The pharmacists at the plant can issue some medicine for immediate use. The medicine given is the flawed or excess product that cannot be sold. This appears to suggest the practice of providing a good due to cost advantages.

Further, a firm seems to attempt to research employees' preferences on the non-cash items provided. Auto Parts Co. Ltd., for example, pays in terms of lunch. The quality and quantity of food are controlled by the catering committee. The twelve committee members are chosen by the employees. At Narai Hotel, sport facilities/activities are chosen by popular votes from all staff, " … we [hotel staff] have selected badminton as one of our sport activities. The company pays for all expenses including monthly court fees, shuttlecocks, and drinking water. The players bring their own rackets. We play twice a week on a regular basis." Voting seems to be one way the firm extracts private information about the employees' preferences.

2.2 Why Pay in Terms of Non-cash Compensation?

Chapter two demonstrates that an employer will provide goods as compensation when (i) he is the only source of the goods, or (ii) he has cost advantages in providing those goods (whether the goods are productive or not). Consider a productive good which is available from an external market. The employer will also pay in terms of the good, even when he has no cost advantage, if he can prevent the employees from selling the good in the market.

One may expect cost saving to be the most important motive. This seems true only in some companies. At Thaipharmed, the respondent mentioned in the questionnaire that the company pays in terms of goods to benefit from " ... an economy of scale, and employees also can use the non-cash items like uniforms [i.e., the goods also benefit the employees, not just the firm]. In addition, the company sells tissue papers to employees at discount prices, to solve the problem of an employee stealing tissue paper from the washroom."

From a further interview, I find that Thaipharmed also provides certain goods for productivity and legal reasons. They provide lodging for some employees – a driver and maintenance workers. The driver is allowed to live in a unit on site, and is expected to serve after working hours when an executive wishes to go somewhere after work. Maintenance workers are allowed to live on site just in case machines require emergency repair. Their cash salaries are not decreased because of the additional housing benefits.

Cleanliness is really important in a pharmaceutical manufacturing setting. It is legally required for consumer safety. Employees are not allowed to eat in manufacturing areas, since the residual food may attract insects and mice. Those employees who are caught will be fined. However, wrapping papers or emptied cartons of milk were always found. This is because some employees have not had breakfast before coming to work, and they get hungry. Thaipharmed solves this problem by allowing a coffee break once in the morning and again in the afternoon. Employees now can eat only at the break room. The break room is situated far from the manufacturing area. Food and drink are sold at the prices lower than the market prices. There is no cashier. Those who eat must put the money in the pay box themselves. The company announced that the coffee break will be cancelled if it loses money. Employees, who seem to want to keep the coffee break, pay honestly. Sometime they even overpay. Employees have to record their names in the guestbook before using the break room. It turns out that about 30% of the employees use the break room, and that it is the same employees frequenting the break room, mostly in the morning.

Uniforms are also given to those in production, transportation, cleaning, and lab departments. Production workers are required by law to wear uniforms for consumer safety. Employees change at work. Uniforms are in very vivid colors to prevent employees from using them at home. There are no uniforms for administrative workers.

Consider the company's practice of selling tissue paper, food and drink at low prices to its employees. The tissue paper sold is for use both at work and at home. The employees can purchase food and drink, and consume as much as they want. This is consistent with the prediction in chapter two that if the company can purchase a good at a lower price, it provides the goods both for production and personal consumption to employees. The practice of selling rather than simply giving the goods to employees seems to be the company's response to its uncertainty about agents' preferences – who wants foods and drink, the kind of food and drink the employees like, how many rolls of tissue paper the employees want, etc. The practice of allowing the employees to eat only in the break room (they cannot bring food out) seems to reflect the company's attempt to prevent the agent from selling the good to an external market. (Note that food is productive.) Also, a uniform is made in a very vivid color possibly to prevent the employees from selling it.

At Freighter Co., the respondent gave the following reasons for paying non-legally-required non-cash compensation. The first reason listed is cost saving. This is true for group health insurance (about B50,000/C$1,633.33 saving), annual group trips (about B20,000/C$633.33 saving), etc. The company also pays in terms of goods to make the compensation bundles more attractive to their employees and job applicants.

For other companies, although they admit that they benefit from cost-saving in providing a good, cost-saving does not seems to be a main motivation. The respondent at Auto Parts Co. replied that the firm pays in terms of goods "For uniformity and convenience". At T. Man, the psychological effects of non-cash compensation seems important, i.e., the business pays in terms of fringe benefits "(1) To show that the organization cares for its employees, (2) To allow employees to have social activities together, and (3) To promote sincere loyalty from the employees."

Interestingly, at Narai Hotel, it seems that the company pays in terms of goods to avoid their employees being overly cash-sensitive, which is counter-productive in the hotel industry, where good service is a key to success. Also, the use of non-cash compensation is to deal with moral hazard issues other than shirking. As the respondent put it,

> Cash is just a tool to promote an activity, event, and/or experience. If we want certain things to happen, we had better create them. Paying cash and creating experiences are two different things. And, in many cases, cash represents greed and selfishness. Good experience brings morale. We do not want to promote a cash-oriented mind among our staff. ... many compensation types fit into the cost saving scheme. [entertainment bills at the hotel's own restaurants, official checks, lodging, gym, laundry services] But they do not play an important role in our organization. There are reasons for each item provided. For example, employee's meal will prevent everyone from going out to find food, and they may not be back on time. Someone may skip lunch because she/he has no money. Laundry will make sure that staff put on clean and good-condition uniforms.

This is reinforced by the fact that Narai Hotel does not pay cash bonus for performance to employees on an organizational-wide basis. (Cash rewards are paid to only an employee selected as an employee of the month. The rewards seem to be in terms of recognition, rather than economic benefits per se.)

I did not get a very clear reply from Auditor Ltd. The respondent simply mentioned they pay in terms of non-cash "Because it benefits the company better than paying in cash." There is no reply from Freighter Co. and Exporter Co.

Agrochem PLC's respondent replied that the health-related benefit is necessary in an agrochemical setting, since those health benefits help assure and motivate employees – enhancing their morale. (Recall that this company imports, distributes, and produces pesticides.) I anticipate that health benefits may be particularly important for those working in a harmful industry, like a chemical industry, both because the employees are concerned with their health (i.e., they have great preference for health benefits), and because it helps increase productivity by keeping employees healthy.

2.3 An Economy of Scale?

I asked the respondent to specify whether the company benefits from an economy of scale from providing non-cash compensation to a large number of employees. All companies accept that they benefit from cost advantages for at least some types of non-cash compensation, e.g. group insurance and group annual trip.

The respondent at T. Man replied, "Yes, but not much. The non-cash compensation which involves cost-saving includes a yearly trip for all organizational members." Thaipharmed's respondent gave a similar answer, "Yes. For example, the company purchases big lots of tissue paper and sells them to the employees at a discounted price. The company benefits a little, but the employees benefit more."

Auto Parts Co.'s respondent mentioned, "No, except for the group insurance (Health insurance)." Respondent at Auditor Ltd. replied similarly, "Yes, i.e. for group accident insurance." At Freighter Co., the company saves costs from providing health insurance and annual group trips. Agrochem PLC's respondent answered that they save costs from health and life insurance and annual medical check-ups.

At Narai Hotel, although they do save costs from many types of compensation, cost saving is not their main reason as described above.

2.4 Employee's Satisfaction

Except Thaipharmed and Auto Parts Co., the firms studied never experience their employees asking them to reduce non-cash compensation, and then to increase cash compensation accordingly. Today, Thaipharmed pays a subsidy for a New Year's party, rather than arranging the party for their employees, as they did in the past. This is to accommodate their employees' request. At Auto Parts Co., employees requested the firm pay cash rather than coupons for lunch. The company accommodates the change on the condition that employees eat only at the cafeteria.

It appears that the companies generally know their employees' preferences with respect to the goods they provide (or have a way to extract the information). Also, when designing the compensation bundle, they take into consideration their employees' preferences.

2.5 Effects of Non-cash Compensation on Organizational Performance

When asked whether the company thinks that the use of non-cash compensation helps improve the firm's performance, T. Man, Thaipharmed, and Narai Hotel gave positive replies. The respondent from Narai Hotel emphasized the importance of non-cash compensation, "Non-cash compensation contributes to better organizational performance because it delivers necessities required for daily living and work activities. It also saves cost and time for everyone." Notice that much of the non-cash compensation provided in these three companies are productive goods. This appears consistent with the theory.

Compared with simply paying cash and having the agent buy the goods herself, the provision of the productive goods (while preventing employees from selling them) should lead to a higher productive outcome.

The respondent at Freighter Co. replied that the use of non-cash does not affect the firm's performance. Note that Freighter Co. earlier mentioned that they provide non-cash compensation, which is not required by law, to benefit from cost advantages, and to attract and retain employees, not because it is productive.

The respondent from Exporter Co. did not give a clear reply. The other two companies, Auditor Ltd. and Agrochem PLC, gave no reply.

Appendix 3: Case Studies on the Use of Informal Compensation

3.1 The Nature of Informal Compensation Used

The respondents are asked to report the use of informal compensation, if any, in their organizations. The respondents from Auditor Ltd. and Freighter Co. Ltd. did not reply to the questions related to informal compensation in the questionnaire. It seems that informal compensation is used more extensively in manufacturing industries.

At **T Man Pharma**, the production manager reported that he informally pays cash to important employees (e.g. the department head or some other significant employee) in various departments, and to employees in the mixing department. The cash paid comes from the founder-owner. It is included in the production manager's (the respondent's) monthly salary. The production manager then distributes this informal cash compensation himself monthly.

The production manager initiated this pay originally to solve the turnover problem in the mixing department. (Today, the majority of employees who receive the informal pay are in the mixing department.) The mixing job is extremely tiring (but this fact is not necessarily known to others). Absenteeism was high, because the workers needed to rest. The turnover rate was also high because of the hard work. This had been very problematic in the past. The production manager solved the problem by paying cash informally to compensate the workers for their hard labor. This system works well; absenteeism and turnover have decreased.

The informal cash compensation is now paid not only to the mixing workers, but also to the heads and key employees in various departments. For low-level employees (assistants to department heads) in the mixing department, punching department, coating department, and glazing department, the average amount of cash per employee is B200 per month. (An average salary per employee is B6,000 per month.) For middle-level employees (department heads), the average amount of cash per employee is B500 per month. (An average salary per employee of B8,500 per month.) The pay, as mentioned in the questionnaire, is to reward the employees' ability to perform the job satisfactorily, to supervise, to solve work-related problems, and to make useful suggestions.

This cash rewards are given after 5-7 years of working. Employees must perform well, report what is going on in the workplace to the production manager, and train any newly hired employee who is still not efficient at his work and is still not loyal to the business. The amount of cash is sometimes adjusted to catch up with inflation. In terms of tax effects to the employer, the pay is added to the production manager's salary, and thus is tax-deductible for the business. The production manager, who is the cash distributor, is taxed for this additional "salary". The employees who receive the pay informally are not taxed. However, for each payee, the amount of informal pay is not large so that there is no real tax benefit to them.

The production manager chooses not to ask the department heads or supervisors to distribute the money. He distributes the cash himself, for fear of embezzlement, and because he wants to maintain power over those key employees. The informal pay makes the payees more cooperative and more responsive to his orders, especially those orders related to the job beyond their job descriptions, or the job for which a formal order is not issued yet. Furthermore, he chooses to pay informally because this method is more flexible. Flexibility seems to be an important motive. In fact, the business even changes the employee evaluation and compensation practices yearly to prevent the employees from resisting the changes by arguing that the current practices are the organizational norm or tradition, as discussed below.

In this setting, the informal compensation is not designed to deter undesirable actions like employee litigation, or strikes. The production manager pays informally to obtain power over the key employees so that they will obey his orders, and report to him the "news" in the factory. However, the informal pay seems to have a side effect of deterring undesirable actions like strikes as well. Because they are reported to the manager immediately, issues can be resolved early. Also, it is difficult to initiate strikes without cooperation from the key employees, who really run the operation, and who cannot be replaced easily. With this informal pay, the key employees who receive the informal pay seem to be on the manager's side rather than on the workers' side. The informal compensation is legal, and the amount is not very large – this may imply that the workers in this factory do not have much bargaining power. (Note that the factory is not large, there is no labour union, and it is rare in Thailand that employers and employees go to court to settle labour disputes.) Also, the production manager can easily control the payee, and the amount and frequency of the pay, because he distributes this informal compensation himself. The founder-owner can perfectly control the total amount of pay, since the cash payment is recorded properly each month (as the production manager's salary) by the firm's accountant. Additionally, if not paid, the key employees can complain to the founder-owner. This prevents the production manager from keeping the cash for himself. It seems that there is no loss from unwanted thefts in this setting.

In addition to the informal cash payments, an in-person interview reveals that a New Year's party and gifts are another form of informal compensation. During the New Year Festival, gifts are given to outstanding employees. But the management does not announce truthfully that the gifts are given because of performance. They instead claim that a gift is given because a certain employee has been with the business for a long time, and has a good attendance record. (It is usually the same employees who receive the gifts each year.) This is to avoid labour conflict, since all employees think that their performance is good, and they also deserve the gifts. Attendance rates and tenure are objective.

An executive is rewarded in terms of bonus and a salary raise rather than with a New Year's gift. (An executive's bonus is based on performance rather than attendance. A low-level employee's bonus is based more on attendance rate. For the both T Man Pharma and Thaipharmed, attendance rate is important. It is very desirable to minimize absenteeism to avoid disruption in production, as explained below.)

Consider another pharmaceutical manufacturer. In the questionnaire, **Thaipharmed** mentioned they do not use any informal compensation other than cash bonus. Although cash bonuses are formal in many organizations, cash bonuses are informal in this factory. The company's charters or the employment contracts do not indicate the company's obligation to pay bonuses. The company does not pay bonuses in bad years in which the company earns no or little profit, or the years in which the economic condition is not good.

An annual cash bonus is paid to an employee whose performance and attendance rate are good. Since absenteeism disrupts the workflow, it is really important to encourage employees to minimize their leaves or lateness. The company does not have extra labor to cover those who come in late, or those who take a leave. If someone is absent, another employee must work harder to cover for her. Lateness is problematic, since the production manager does not know whether that employee will be absent for the whole day or not, and hence whether it is necessary to find someone from another department to replace her.

If employees are not late for work, do not take a leave, and do not call in sick all year, they receive a full bonus of 15% of a monthly salary. (An average monthly salary is B9,000.) If an employee is absent more often than the limit, the bonus is reduced. Those who take a leave right before, or right after the Chinese New Year or Thai New Year (to create a longer vacation), will be penalized by having their bonus decreased by 20% instantly.

Furthermore, an additional bonus equal to a month's salary will be given, if performance is good. (But if the attendance rate is not adequate, they will not receive a full one-month bonus.) Nonetheless, the company mostly uses salary raises to compensate employees for better performance. Bonuses are mostly used to minimize absenteeism.

Another form of informal compensation is discretionary financial assistance, e.g. employee loans and scholarships for child education. Discretionary scholarships for child's education may be granted case by case to employees who have been with the company for a long time, and also have performed well. The free scholarship is usually given to "good," old employees, whose child's area of study is "good," e.g. pharmacy. (Note that "good" is subjective, and hence it allows the employer freedom whether to give a free scholarship or not.) A scholarship includes both tuition and living expenses. For an average employee or an average area of study, the company gives a loan, rather than a scholarship.

In addition, for a "good" employee who has been with the company for a long time, the company may grant an interest-free loan for home improvement, etc. Employees then pay back the principal by installments. The amount to be deducted from salary each month must not be too high so that it affects the employees adversely.

Employees who need help can contact the personnel manager, who knows more about the employees' situation and performance. If the personnel manager thinks that it is appropriate to help, she requests a loan or a scholarship from executives. The maximum amount of financial assistance is approximately B50,000.

The company also gives gifts to employees. During the New Year season, the company receives many gifts from its traders. Some of these gifts will be given to key employees who work closely with an executive, have been with the company for a long time, and perform well. However, employees cannot expect these gifts every year.

At Thaipharmed, informal compensation seems to be used because it is a flexible way to reward an employee. The company seems to prefer the full discretion of informal pay, rather than making things formal. The items chosen as informal pay can be easily controlled.

To compare the two drug manufacturers, both businesses experienced difficulties in their mixing departments. T Man Pharma invented an informal pay system to effectively solve this problem, and also subsequently implemented it widely in the factory. The problem remains unsolved at Thaipharmed.[27] I anticipate that the unconventional use of informal compensation depends greatly on organizational culture and leadership style. Both are Chinese family businesses. At Thaipharmed, the ownership family is more conservative. The operation is controlled by the second generation. At T Man Pharma, the most powerful figure is the founder partner, who is still very active as a consultant to the business. According to the respondent, the founder partner is a very capable, resourceful, and creative person. This is evidenced by the fact that he knows very well the Chinese ancient art of face reading and astrology, and he uses these arts in hiring and business decisions. (According to the respondent, his reading is accurate many times.) The day-to-day operation is controlled by his wife and his older brother (i.e., the first generation.) Possibly, a more daring, open atmosphere or leadership style encourages more unconventional use of informal compensation.

Now, consider an auto parts manufacturer. At **Auto Parts Co. Ltd**., the informal compensation paid includes an entertainment allowance for a Japanese executive, an executive's right to purchase a used car at a discounted price, and gifts for employees.

Concerning entertainment allowances, Japanese executives (department heads) are entitled to an allowance of about B30,000 per month. (The average salary per employee is B180,000.) This allowance is "a policy dictated by the parent company." The pay must be approved by the managing director. A Japanese executive must show receipts for reimbursement. The pay is informal in the sense that the reimbursement regulations for executives are more flexible than those for operational employees.

Department managers have a right to purchase a used company car. The amount of discount is about B150,000 per car (an average salary per employee is B 35,000 – 80,000). The purpose of this special pay is to boost employees' morale. This is done once a year, 2-3 cars each year. The company uses a lottery to determine a buyer. Those who have already purchased a car cannot buy another in the next ten years, or until all the remaining managers have a chance to purchase one.

---

[27] This is not to imply that Thaipharmed is less capable in problem-solving. In fact, the company uses conventional means creatively to solve the problem, rather than inventing an unconventional solution. For example, both businesses experienced a problem of employees eating on manufacturing sites as mentioned above. While the problem remains unsolved at TMan Pharma, Thaipharmed solves the problem by using a conventional coffee room.

In addition, gifts are given to employees on different occasions, e.g. a cash subsidy for a parent's or a child's funeral, or a gift for a new born child. An average amount of pay is B2,000. (An average salary per employee is B10,000 – 50,000.) The payee must show evidence, and her supervisor must also confirm that an event actually occurred. The personnel manager then checks and approves the pay.

Further, the firm gives awards, plaques, or cash rewards to employees or units which can attain specified goals. The cash reward is to be paid for a celebration party for the unit. The rewards are paid informally because "it is easier to change, and because it helps motivate employees for a certain task." The company tries not to use this informal compensation too often. They use it only at critical times and when they want to create great motivation and morale. (They are afraid that frequent use will make an employee feel indifferent to it so that the rewards can no longer motivate effort.)

The company does not seem to have difficulties controlling the items chosen as informal pay. The pay seems to be aimed toward morale enhancement, which seems consistent with Japanese culture where a workplace is not just a workplace (as exhibited by a life-long employment policy).

At **Agrochem PLC**, the respondent reports the use of informal compensation in terms of reimbursement for gas, etc., for middle-level employees. A vice-manager of the factory can request about B 2,500 - 3,000 per month. (An average salary per employee is B 30,000 – 40,000.) A cashier is also entitled to B2,000 - 2,500 per month (The average monthly salary is B30,000 – 35,000.) The cash is paid to enhance morale and work efficiency.

At **Narai Hotel**, the respondent mentioned the hotel does not use any informal compensation in the questionnaire. From further enquiry, informal compensation in terms of gifts is paid. As the respondent puts it, "We give gifts to employees at the annual staff party only. We collect gifts from suppliers and high-level staff, and buy some more. Almost all employees receive gifts. The lucky draw will decide who gets what. The values of the gifts range from B30 to B10,000."

Interestingly, we seem to have an example of the firm which does not seriously enforce its control, in order to allow informal compensation here, as the respondent explained below.

> New Year's gifts [from suppliers] are prohibited by the managing director. Many gifts slip through because we do not seriously enforce the policy, and rejection of such a gift is difficult – it could be impolite and ruin the relationships. Small

gifts, like calendars and organizers, are common. Small gifts can help promote good will and build relationships. The question is how much is small. And this can develop into the bad habit of expecting to receive gifts from suppliers.

The respondent at **Exporter Co. Ltd**. reported no use of informal compensation in the questionnaire. What comes closest to informal compensation is expense reimbursement. The kind of expenses and the amounts acceptable for reimbursement are different for employees in different levels.

3.2 Why pay informally?

I asked the respondents to give the reasons why they choose to pay informally rather than formally. There is no reply from Auditor Ltd., Freighter Co., and Exporter Co. Ltd.

The informant from **T Man Pharma** replied that

> The business does not pay informally as a main compensating way. It pays informally to promote flexibility in operation. The informal pay is used marginally. It is paid only to supervisors or other key employees. Without the informal pay, it can be difficult to ask them to so something beyond their job description, or to ask them to work on a new job for which the formal job order has not been issued yet. They may not cooperate, claiming they have to wait for the formal order. The informal pay makes them more cooperative and responsive to my request. ... The informal pay is not designed to motivate the employees to cooperate in doing anything that is already within their job descriptions. ... After the supervisor gets cash, they are responsible for monitoring and motivating the lower level employees to make sure the job is done in time. They will report any problems that occur more promptly as well.

The business does not plan to formalize the pay above, because it will lead to inflexibility. The employees are told that the informal compensation is not to be expected monthly – it is paid only at the discretion of the production manager, and it can be cancelled at any time. Note that the informal cash compensation is paid to a rather small number of employees so that it is less likely that they can join forces to resist the change in informal compensation. Therefore, it appears easier to change.

Thaipharmed reported that the company chooses to pay informally rather than formally because it is more flexible and easier to change.

At **Auto Parts Co. Ltd.**, the awards, plaques, or cash rewards for a celebration party are given informally because "it is easier to change, and because it helps motivate employees for a certain task." The company does not plan to formalize the payment since "it is not necessary".

At **Agrochem PLC**, the respondent mentioned they do not plan to formalize the informal pay. "Before paying this extra compensation to an employee, the executive considers both performance and other factors. Therefore, for convenience, paying extra compensation should be the firm's "option" [rather than commitment]; it is more suitable to pay informally."

When asked why the firm pays informally, the respondent from **Narai Hotel** replied

> ... most employees do not distinguish between formal and informal. If they receive anything regularly, those things will become "formal" to them automatically. They hardly read any rulebook unless someone points out something to them. And formal or informal does not really matter to them because management has the ability and power to change the rules. ... If we want to start something new, we want to try it first. For informal benefits, we can quit more easily if it does not work. Once again, if we do something regularly for a long time, people will think of it as formal regardless of the rules in the book. For example, we have had employee meals for over 30 years; many people think that it is required by law to provide employee meals. Only the personnel manager and few other people know that this is something extra to them. Later on we put employee meals into our employee handbook to make it official.

The reply above seems to emphasize that the distinctive feature of informal compensation may lie in the way an outsider views the pay rather than the way an insider views it. In courts, without evidence, an informal contract does not seem to exist. When it comes to illegal informal compensation, it can be simply a form of compensation for an insider, but it is fraud for an outsider. The company thus can make use of the different perspectives.

3.3 Rigidity of Formal and Informal Compensation

Researchers in organizational behavior argue that it is beneficial to pay informally because informal compensation is more flexible – easier to change (Greenberg and Scott, 1996). To explore the validity of this argument, I ask the respondents to report the procedure one needs to go through to change formal vs informal compensation. I also asked them to report employees' reaction to the changes, and to describe the latest change (if any). From their replies, it seems easier to change informal compensation, and employees do not resist the change in informal pay.

At **T. Man Pharma**, to change the formal compensation practices, one needs to propose the change to the managing partner, explaining the pros and cons of the change. It is rather difficult to change since this will directly affect the expenses.

When asked about employee resistance, the respondent replied, "The change is feasible but not very easy. To some degree, employees resist. ... the business tries to communicate in order to have the majority of employees understand the situation to prevent employees from joining forces to resist the change." The latest changes include

> (1) Change the compensation plans for the newly hired employees; (2) Employee performance evaluation is changed yearly to create a pattern of yearly changes; (3) Change a position of an employee (by arguing that the change is based on suitability and employee performance) in order to change the compensation paid to that employee; (4) The business changes the compensation structure every year. This is because the business does not want to its employees to be able to claim that the existing pay is an organizational tradition or custom.

The production manager mentioned that it is much easier to change the informal compensation plan. He needs to do nothing as long as the total amount of the pay is the same. If the production manager wants to increase the total amount, then he needs to ask for the managing partner's authorization. The production manager never reduces the amount of pay. The employees' reactions are positive since they receive more.

To change the formal compensation plan at **Thaipharmed**, one needs to propose a change to the committee for approval. The committee consists of three members: the personnel manager, one member from administration, and one from finance. In practice, the changes must be approved by the committee, all executives and the personnel department. Usually, it is the personnel manager who proposes the changes. Some employees may resist the change, but usually the problem can be solved in few days by the personnel department through proper communication and explanation.

From an in-person interview, examples of the compensation granted by employees' requests are an installation of a water cooler at a particular spot in the factory, a subsidy for a New Year's party (in the past, the company arranged the party, but employees prefer to do it themselves), and a break room. (See Appendix 2 for more details.) The interviewee also mentioned the recent cancellation of the reward for tenure, "In the past, those who have been with the company for 10 or 15 years could claim a cash reward of about 8 times of their monthly salary. Recently, the law requires employers to pay for employees' social security [a compulsory social insurance scheme for employees]. Therefore, this cash reward is cancelled for newly-hired employees."

The procedure for changing informal compensation is similar to changing formal compensation. The firm has not experienced employees resisting the changes in informal compensation.

At **Auto Parts Co. Ltd.**, to change the formal compensation plan, the personnel manager need to consult the administration manager and then propose the change to the CEO (managing director). It takes in total approximately six months to complete rounds of consideration. An employee's reaction seems very important in this Japanese-Thai firm, as the respondent put it.

> More than one conference to consult and elicit opinion from employees will be arranged. If the majority of employees disagree, then there will be no change. Any changes in compensation plan will not be undertaken without approval from the majority of employees, since the company wants to avoid labor conflicts.

There has been no employees' resistance, since all the changes are to improve employees' benefits. The respondent described the latest change in 2005 to accommodate employees' requests. From the beginning of 2005, the company pays cash instead of coupons for employees to buy lunch. However, employees are required to purchase food from the canteen rather than from outside in order for the caterers in the canteen to survive.

To change informal compensation, one also needs to propose the change to the personnel committee. However, this is not difficult, since the amount of cash is small, and it is paid according to culture or tradition (i.e., gifts for special occasions). The latest change was in 2004. The reason for change was that the old amount of compensation was not suitable for the current economic conditions.

At **Narai Hotel,** to change the formal compensation plan, one needs to discuss the change with the general manager, who will then discuss the matter in a management meeting. The general manager then seeks approval from the managing director. The change is not difficult, provided all executives agree. "The personnel department will only object if the change is illegal, or has technical difficulty such as huge data collection." Employees may resist the change, which can be solved by communication. The latest change was in the beginning of 2005. The hotel cancelled its bonuses for tenure, and instead introduced a provident fund – an employee and the company pay equal contribution of 2.5% of the salary for the severance payment. This is to comply with a new regulation which requires a firm to set up a provident fund for every employee.

Since the informal pay used in Narai Hotel includes gifts, it is obviously not difficult to change.

At **Agrochem PLC**, to change formal compensation, executives need to propose the change to the board for approval, which is not difficult in practice. However, the change must not be against the law, and it must not make the employees worse off (to avoid employee resistance). Since the changes usually make employees better off, there is no resistance. The latest change was in 2004. The company decreased the workload, but increased the pay to conform to the law regulating the industry.

As to informal compensation, the change can be approved by an executive with highest authority (e.g. managing director). There is no need to obtain approval from the board. The change can be done easily and responsively to the situation. The respondent reported no changes so far.

At **Auditor Ltd.**, to change formal compensation, one needs to propose the change for approval, which is not difficult. (Note that there are only four employees in this business.) There is no employee resistance experienced. The latest change is not reported by the respondent. Auditor Ltd. does not use informal pay.

To change formal compensation at **Freighter Co. Ltd.**, one must propose the change to the parent company through the Regional Office in Singapore for approval; "It is not difficult, but it takes time. We have to compare the costs and benefits, and justify the change." Concerning employees' reaction, there has been no resistance so far since the firm never decreases the benefit. The latest change occurred in October 2003. The company started the Provident Fund Scheme, in which an employee and the firm each contribute 3% of the monthly salary. This change is to attract middle-level and high-level employees. The relatively low fringe benefits in the industry make recruitment difficult. Freighter Co. Ltd. reported no use of informal pay.

The respondent from **Exporter Co. Ltd.** did not reply to this question.

3.4 Informal Compensation and Disciplinary Action

To discipline an employee, I asked whether the company will decrease or withdraw informal compensation, before using formal disciplinary procedure or decreasing formal compensation. The respondents from T Man Pharma and Exporter Co. Ltd. replied positively. In contrast, the respondents from Thai Pharmed and Auto Parts Co. Ltd. said no. The respondent from Narai Hotel mentioned they will decrease or withdraw informal compensation before formal compensation, but will not decrease or withdraw informal compensation before taking a formal disciplinary action. The respondents from Agrochem PLC, Auditor Ltd., and Freighter Co. Ltd. did not reply to this question.