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Principal-agent Relationship and Agency Problem

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Abstract: Progressively stricter requirements of labor division have led to the blossom of the principal-agent model, where differences in objective functions between the principal and the agent, as well as information asymmetry, often hinder the principal from maximizing their utility and can result in potential harm to both parties and social welfare. This paper aims to analyze the endogenous causes and issues resulting from the principal-agent model and proposes solutions. Additionally, the shareholder-CEO relationship in finance is applied as a specific case of the principal-agent model for further analysis. Through the construct of a simple model and a signaling mechanism pondering more realistic elements, the negative effect of information asymmetry can be weakened. Lastly, based on the findings of this paper and existing empirical research, the article proposes specific schemes for the above-mentioned mechanism and discusses their implementation and implications. The investigation of principal-agent issues and the proposal of appropriate countermeasures are of great significance and are always frontier concerns for both academia and society.

Keywords: principal-agent model, information asymmetry, agency problem

1. Introduction

The evolution of the social division of labor has led to increasing demand for specialized professionals to act as agents, resulting in the development of the principal-agent model. This model has found widespread application across various fields, including economics, political science, sociology, and management, but has been a long-standing issue due to unique challenges, which have been the focus of extensive scientific inquiry.

The principal-agent model is a theoretical construct utilized to explicate the difficulties inherent in delegating decision-making authority from a principal to an agent. The principal refers to an individual or organization that hires an agent to perform a task. However, agents may not always act in the best interests of the principal due to asymmetric information, moral hazard, and other factors. The principal-agent model can be traced back to the work of Nobel laureate economist Kenneth Arrow, whose seminal 1963 paper focused on the challenges associated with decision-making in organizations [1]. Arrow's work emphasized the critical role of incentives in ensuring that the agent acts in the principal's best interests. He argued that healthcare markets are characterized by significant uncertainty, externalities, and information asymmetry, giving rise to adverse selection, moral hazard, and principal-agent problems. Arrow's contribution marked the first time that the concepts of principal-agent and information asymmetry were formally introduced in economics. As the healthcare market is an imperfectly competitive market, market failure occurs due to the non-marketability of

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risk-taking and the inability to grasp market information. Based on the first and second best principles of welfare economics, Arrow analyzed that healthcare market failure is mainly due to these factors, leading to the deviation of the healthcare market from a perfectly competitive state. Arrow's work highlights the significance of addressing or mitigating the challenges posed by the principal-agent model and information asymmetry to prevent market failure and promote efficient resource allocation.

In the 1970s, Michael Jensen and William Meckling developed the first formal principal-agent model in their paper, highlighting agency problems arising from the separation of ownership and control from corporations [2]. This model defined the principal-agent relationship as a contract, with one party providing the service and the other offering the pay accordingly. The authors proposed a framework for analyzing the costs of the delegation, including monitoring and bonding costs, and laid an emphasis on aligning the interests of managers and shareholders through incentives and contracts. Since then, the principal-agent model has been expanded and refined, with researchers introducing new concepts and factors that can affect the behavior of principals and agents. For instance, Holmstrom and Milgrom constructed a model that can explain why providing constant salaries even in situations when good, objective production indicators are available and when agents are intensively sensitive to incentive pay and can account for why employment is preferable to independent contracting in specific circumstances [3]. In addition, researchers have examined the effects of social norms and reputation on the contractual outcome and have developed models to address issues such as moral hazard and adverse selection [4-6].

The principal-agent model is widely used as a theoretical framework to analyze issues related to decision-making in the principal-agent model, emphasizing effective incentives, supervision, and communication to ensure that the agent acts in the best interest of the principal. However, many industries and fields still face problems such as information asymmetry, which compromises the interests of a particular party. This paper will examine the causes, traits, and issues with the principal-agent model, structure a model based on the traditional principal-agent issue between shareholders and CEOs, and discuss the problems with the principal-agent model of shareholders and CEOs, along with empirical studies and their solutions.

2. Principal-Agent Model

There exist two fundamental rationales that underlie the problems in the principal-agent model. Above all, the utility and objective functions of the principal and the agent differ, resulting in potential conflicts of interest between the two parties. This leads the agent to prioritize safeguarding their interest over that of the principal, causing a loss for the principal if their interests clash. In addition, the existence of information asymmetry between the principal and the agent, arising from the division of labor, exacerbates the problem.

Due to the above-mentioned reasons, the principal-agent model exhibits several key characteristics. Firstly, the behavior of the agent is partially unknown to the principal, as they cannot fully supervise the agent's work. Secondly, the agent's behavior tends to be deceptive, a feature generated based on the previous statement, as the principal can only judge the effort level by the outcome. Due to the inconsistency of the objective functions, the agent is highly possible to exaggerate the unfavorable factors and his working difficulty before the outcome occurs so that the agent may successfully raise the principal's estimation of the effort level while lowering the principal's expectations of the outcome. Thirdly, the agent can selectively hide information from the principal due to information asymmetry and differences in utility functions. Lastly, the efforts of the agent can be dualistic, as the agent is capable of making both positive and negative efforts, depending on how his objective function aligns with that of the principal.

Since the utility and objective functions are influenced by individuals' personalities, identities, and situations, the differences between the principal and the agent's objective functions can be narrowed

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by adjusting the agent's situation to incentivize him to change his position. As for the information asymmetry between principal and agent, whether it can be ameliorated or even ultimately eliminated is worth in-depth mulling. The root of information asymmetry is the "information paradox". For the principal, on the one hand, sound choices and decisions require sufficient information and knowledge, and on the other hand, the resources and time required to gain adequate information and deliberate analyses are nonnegligible costs, consequently implying that the collection of information is barely possible to go on indefinitely to reach a balance of the information equilibrium. To what extent the amount of information to be collected is a tough nut to crack. In addition, the value of information production is unpredictable since it is arduous to know in advance the costs and benefits of a certain type of information gathering. Specifically, we are not aware that what information is to be obtained, how much time it is to be spent, whether this piece of information will eventually be found out, whether it has the expected value, and exactly how much benefit it will generate during the information search process. Therefore, the only way to dig deeper into the estimation of the agent's ability is to practically commission them to do the job. Moreover, even after commissioning, the principal may not be able to accurately determine the type of agent due to limited information. In the above situation where the cost of the information search is high and the result is uncertain, people can only rationally choose to obtain a specific part of information rather than the complete information. However, because of this, information asymmetry cannot be eliminated, and people can only weaken the harm brought by information asymmetry to the principal through institutional design.

2.1. Information Asymmetry

To design targeted mechanisms for the problems caused by information asymmetry, it is necessary to first understand what exactly these problems are. According to the formation period, the problems arising from information asymmetry can be divided into two categories, one is before signing the contract, where asymmetric information can cause adverse selection problems, and the other is after signing the contract, where asymmetric information can cause moral hazard problems.

Adverse selection arises as the principal cannot predict the type of agent (e.g., whether the agent is at a high or low level, whether the agent has professional ethics) before signing the contract. Markets with very high requirements and barriers for agents are excluded here. In this type of market, it is more likely that the principal himself has the power to acquire relatively true information about the agent prior to the engagement. At the same time, these markets generally carry a narrower range in their target audience, as well as with fewer but specialized agents, so that scores of information about the agents may already be known within the industry. In this case, the cost of information research is partly reduced. This section of the article temporarily excludes such markets as described above and examines only the case where the principal is unable to identify the type of agent. When the principal is unsure about the type of agent, he generally sets the remuneration corresponding to the average level of agents in the market in order not to damage his interests, and then the high-level agent cannot be guaranteed to receive a reward commensurate with his ability. As a result, such high-level agents can only choose to either withdraw from the market or lower the quality of their services to reduce their costs. In consequence, it may well be that the agent chosen is a 'defective product' as the market is possibly glutted with low-quality agents, with the truly high-quality agents gradually being outbid and driven out of the market.

After a principal-agent contract is signed, the principal's real interest is placed in the hands of the agent. On account of information asymmetry, the principal is not aware of whether the agent is doing his job with due diligence. When a conflict of interest occurs between the two parties, the agent is then capable of maximizing his utility without being penalized by the environment, regardless of whether such behavior is detrimental to the principal. The above possible actions done by the agent are known as moral hazards. Moral hazard can be reflected in specific events such as (1) reducing the

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effort level, or sometimes even giving up fighting for the interest of the principal to lower the agent's costs. (2) using the position to extract more pay than is merited by the agent's qualifications. (3) choosing the option that maximizes the agent's interests while foregoing the "best decision" that maximizes the principal's interests.

2.2. Countermeasures

There are two main ideas on how to alleviate the problem of principal loss wrought by information asymmetry. One is to directly control the agent, i.e., to restrict the agent's behavior by direct regulation, but this will bring constraint costs, specifically including (1) information costs. In order to effectively bind the agent's behavior through a contract, the content of the contract must be considered as elaborately as possible. Thus it is particularly important for the principal to have adequate information to formulate the contract. However, as mentioned above, the acquisition of sufficient information requires significant costs. (2) the cost of investigating and monitoring the agent. (3) the loss of final output owing to the agent's restricted behavior. From the above description of the constraint cost, it can be roughly seen that the loss suffered by the principal and the constraint cost is negatively correlated to a large extent (the output loss due to the agent's restricted behavior is probably not heavier than the cost of the first two in the unconstrained case), i.e., the principle suffers a smaller loss the more complete the constraint rule is. However, in practice, when directly controlling the agent, it is difficult for the principal to anticipate the extent to which the constraint cost will increase, so it is vexing to decide the specific amount of input of the constraint cost. Hence, the practicality of direct control is not very strong.

Another idea is indirect control, which can be imperceptibly implemented by market competition and incentives so that the agent can maximize the principal's interests out of maximizing his interests, actively weakening the impact of information asymmetry. There are several practical execution plans as follows. (1) Compensation incentives. The separation of control rights and residual claimants is one of the main reasons why agents lack the passion for maximizing the benefits for the principal, while how to motivate the agent's initiative in terms of compensation angle is the problem to be solved by the compensation incentive system. The specific design of the compensation incentive system needs to be analyzed in detail and targeted according to different industries. (2) Market competition. The natural competition in the market is to apply the screw to agents. If the agent causes heavy losses to the principal due to mistakes or his low level, his human capital tends to be devalued in this market. The agent is then apt to treasure the reputation of the professional accomplishments in the past and thus exert more effort in the future as a result of his long-term value evaluated in the competitive market. Furthermore, in an impartial market, the agent cost to the principal is relatively low, even if the effect of direct compensation incentives on the agent is not considered. (3) Establish a risk-absorbing deposit system. To demonstrate to the principal that there is no risk of adverse selection in choosing a certain agent, the agent may opt to offer a performance bond to the principal upon contract signing. The performance bond, held in an escrow account, can only be withdrawn upon fulfillment of the contract terms. In addition, the agent may choose to disclose certain aspects of his professional information within the industry (e.g., by establishing a database) to enhance his reputation and credibility among potential principals.

3. Agency Problem

As enterprise structures become increasingly complex and labor is further specialized, contemporary enterprises frequently elect to separate ownership and operation. The separation entails shareholders entrusting operational duties to the CEO while retaining ownership of the enterprise. Typically, the objective functions of CEOs and shareholders exhibit misalignment, and there is inherent information

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asymmetry between the two parties. Shareholders yearn for the firm to appreciate because they have the right to demand and control the final residual profit from the enterprise, while the CEO seeks the satisfaction of utility in the CEO market, such as high income, comfortable working environment, fame, and status enhancement. As the CEO is more aware of the business operations, whereas the shareholders cannot accurately estimate and entirely monitor the CEO's professional level and effort level, the CEO might potentially benefit personally at the expense of the shareholders.

As described in the principal-agent model in the Section 2, the two main problems arising from information asymmetry between CEOs and shareholders are also "adverse selection" and "moral hazard". In the CEO market, the ability of CEOs is also uneven. When making decisions, shareholders may consider the market value attributed to CEOs based on their past performance. However, this market value information can be uncertain and require unknown costs, as mentioned previously. If a shareholder lacks an accurate picture of a CEO's true capability, he may inadvertently select a CEO with a subpar professional and ethical level. A CEO who is 'low-level' may overstate his competence in a competitive market and present evidence to persuade shareholders to select him. To address such situations, targeted solutions are required.

3.1. Model Construction

This section will begin by framing the principal-agent relationship between shareholders and CEOs using a simplified model, followed by incorporating specific considerations to formulate a new model that alleviates the negative consequences of information asymmetry.

3.1.1 A Simple Model (Sign the Contract or Not).

In this part, a simple model is to be constructed with a composite indicator called "CEO's level", which encompasses the CEO's level of effort, dedication, and inherent ability demonstrated during a given delegation, to simulate the principal-agent relationship between the shareholder and the CEO. The CEO's level is classified into two types: high-level and low-level, as shown in Table 1. If the shareholder subjectively believes that the CEO is high-level, he will be willing to sign a contract with the CEO, and vice versa.

Table 1: Shareholder vs. CEO (high and low levels).

CEO/Shareholder	Sign the contract	No contract
High-Level		
Sign the contract	k, k	0, -t
No contract	0, 0	0, 0
Low-Level		
Sign the contract	k, -k	0, -t
No contract	0, 0	0, 0

Assume that regardless of the CEO's level, the CEO receives k units of expected utility whenever the shareholder chooses to sign a contract, while the shareholder's utility is related to the shareholder's perception of the CEO (the CEO's level). If the shareholder chooses to sign a contract with a high-level CEO, the shareholder will also receive k units of utility. If he contracts with a low-level CEO, he will lose t units of utility. Supposing that the probability that the CEO is deemed high-level by the shareholder is p, then if the two parties sign a contract, the shareholder's utility is as follows.

$$U = kp + (-k) * (1 - p) \quad (1)$$

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If the two parties sign a contract. If they do not sign a contract, the shareholder's utility is as follows.

$$V = -t \tag{2}$$

It is explicit that the probability that the shareholder considers the CEO to be high level is higher than $-t/2k + 1/2$ ($U > V$), when signing the contract is the option that enables the shareholder to achieve maximum utility. When (1) < (2), i.e., $p < -t/2k + 1/2$, not signing the contract is the best choice. Through an analysis of the composition of p, it can be deduced that a less restrictive condition for p as an inequality constraint for $U > V$ will increase the likelihood of a shareholder signing a contract, as indicated by the inverse relationship between t/k and $-t/2k + 1/2$. Here, t/k represents the ratio of the shareholder's potential loss from not entering into a contract with a CEO to the utility (loss) gained from signing a contract with a high (low) level CEO. Thus, the greater the shareholder's valuation of the loss from not entering into a contract and the less his valuation of the utility (loss) gained from signing a contract with a high (low) level CEO, the more likely he is to opt for a contract. This seemingly paradoxical conclusion may be interpreted by the shareholder's loss aversion towards tying a CEO with a contract and the diminishing marginal utility after employing a CEO. In practice, information asymmetry can result in shareholders lacking sufficient knowledge about the true state of affairs and the specific caliber of the CEO, making it challenging to objectively measure k and t. Consequently, the decision-making of whether to sign a contract may not allow the shareholder to optimize his utility. In the subsequent section, we develop a model to address the adverse selection issue stemming from information asymmetry and examine the actions that both the shareholder and the CEO should take before entering into a contract to mitigate the problem of information asymmetry to a significant degree.

3.1.2 Signaling Model.

For shareholders, information asymmetry can prevent them from effectively discerning between high-level and low-level CEOs. Similarly, for high-level CEOs, being precisely identified is necessary; otherwise, there is a risk of "adverse selection" where low-quality CEOs are preferred over high-quality ones. Therefore, it is critical to ensure that CEOs transmit signals that accurately reflect their true level, and that shareholders are able to receive and interpret these signals. In information economics, 'costly signaling' is one of the crucial factors that can distinguish high levels from low levels [7]. One way for a CEO to demonstrate his willingness to assume risk is by making a specific capacity commitment, such as committing to a stable index of company stock price appreciation on average per quarter over the contract period with a guaranteed minimum value. If the CEO breaks the commitment by not meeting the target, he may bear the cost of risk in terms of reputational damage, reduced confidence, and demands from shareholders for repositioning. Therefore, the CEO's endorsement of making a commitment can be interpreted as a signal of his high level of competence. Such commitment is able to effectively reduce adverse selection and align the interests of shareholders and CEOs. Subsequently, we introduce a hypothetical model for a specific analysis. For the shareholder, the higher the CEO's level is, the higher the utility obtained by the shareholder. Here are several assumptions for model building. The high-level CEOs are more capable of taking risks; the CEO's utility is positively related to his market value. If the CEO breaks his commitment, he will be penalized by the cost of risk. The CEO's probability of breaking his promise is assumed to be negatively correlated with level and positively correlated with risk. The CEOs reflect their risk-taking ability by making commitments of varying difficulty. Under these assumptions, a low-level CEO is less likely to make high-difficulty commitments to impersonate a high-level CEO. Assume that, in this model, there are two individuals (CEO, shareholder) and two periods. Let k be the CEO's level

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(assuming k is continuous) where the CEO knows the specific value of k, but the shareholder knows only the probability distribution of k as p(k). In the first period, the CEO chooses an appropriate A(k) as his risk-taking capacity based on himself and the environment, and the shareholder then determines the CEO's market value B(A) based on A. In the second period, the CEO demonstrates his ability through the achievements made in the first period.

The CEO's objective utility function is assumed to be the weighted average of B in the first period and the market value obtained after the second period of the practical operation, as follows.

$$u\,(A, B(A), k) \;=\; (1-t) \;*\; B(A) \;+\; t \;*\; (k/2 \;-\; (PA)/k) \tag{3}$$

Where k/2 is the expectation received by the CEO in the second period, P is the penalty received by the CEO for breaking the promise, t is a weighted parameter, and A/k is the probability of paying the penalty as determined by risk-taking capacity and the CEO's level. Suppose further that the market value of the CEO as determined by the shareholder from the first period's CEO's choice A is:

$$B_0(A) \;=\; (k_a(A))/2 \tag{4}$$

Derivation of the CEO's utility yields is:

$$du/dA \;=\; 1/2\,(1-t) \;*\; (dk_a(A)/dA) \;-\; (\lambda P)/k \;=\; 0 \tag{5}$$

In the case of equilibrium, ka(A) = k, where the shareholder is able to correctly identify the CEO's level. Substituting this equation into (3) and solving for it yields, which is the CEO's optimal decision.

$$A(k) \;=\; ((1-t)/(4tP)) \;*\; k^2 + C \tag{6}$$

Then substitute k into (4) to get the shareholder's optimal decision as:

$$B_0(A) \;=\; ((A-C) \;*\; (tP)/(1-t))^{1/2} \tag{7}$$

Based on Bayesian inference, there exists a positive relationship between the level of a CEO and his risk-taking capacity. In the context of information asymmetry, a CEO may withhold information from shareholders, and the greater the risk the CEO undertakes, the higher the likelihood of incurring penalties. Consequently, a CEO willing to bear such costs is transmitting a robust signal to the shareholder about his high level of capability. As a result, although the shareholder may not have direct knowledge of a CEO's level, he can indirectly assess it by observing the CEO's propensity for risk-taking. Therefore, we propose that this hypothetical model, which reflects a CEO's level, can alleviate the problem of adverse selection caused by information asymmetry.

The limitation of this model is its presumption that the two parties can establish a binding contract without renegotiation. However, if the contract is open to renegotiation, the time being after the CEO selects his course of action and before the results of his behavior are observed, the shareholder cannot persuade the CEO to 100% exert maximum effort, as the shareholder can presumably modify the terms of the contract to cushion his risk. In a situation where renegotiation is allowed, a revised optimal contract is formulated, wherein the shareholder may offer the CEO an optional compensation plan, consisting of a fixed income and other benefits, based on the CEO's declared level of ability. This optimal contract may provide the CEO with positive utility as compared to the absence of renegotiation.

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3.2. Discussion on Empirical Research

In the process of constructing our model, our primary focus was devising solutions to address the challenges posed by adverse selection, whereas in this section, we will shift our focus toward tackling the problems caused by moral hazard. Internal within a corporation, shareholders need to implement some control mechanisms to align the goals of contracted CEOs with those of the shareholders to the greatest extent. The following two aspects can be taken into account when setting up the mechanisms.

The first aspect that shareholders can consider when implementing control mechanisms is to tie the CEO's compensation to the outcomes of his actions, thereby incentivizing the CEO to work harder. To implement this mechanism effectively, it is significant to comprehensively delineate the behavioral outcomes that are linked to CEO's compensation. Rather than simply linking compensation to corporate revenue, it is more appropriate to choose indicators that are closely related to the CEO's behavior. Direct linkage to corporate revenue can potentially lead to short-term beneficial and long-term damaging behaviors, which can be detrimental to the long-term development of the company. Moreover, corporate revenue is not solely determined by the CEO's ability. In practice, many companies utilize equity incentives as a means of compensation for their CEOs. The role of equity incentives has also been studied and written about by empirical scholars. For instance, Sun Yiwen verified in a study using Chinese A-share data that equity incentives are effective in enhancing corporate performance, with equity concentration mediating the effect of equity incentives on corporate performance [8]. Zhang concluded that, based on empirical research on equity incentives in small and medium-sized enterprises in the capital market, equity incentives have a positive effect on the share price of companies in the capital market [9]. Additionally, Liu and Liu confirmed that equity incentives increase the value of diversified companies by influencing the efficiency of the internal capital market of such companies through a dual principal-agent model [10].

Nevertheless, it is worth noting that in practice, some companies have been phasing out equity incentive policies. However, this does not necessarily imply that there are flaws in the underlying mechanism design. While the discontinuation of equity incentives may be attributed to factors such as excessive costs or the inability to achieve performance targets, it may also be due to external factors, such as the recent COVID-19 pandemic and changes in education policies, as stated by Wu et al. [11]. Moreover, in the case of Wu's study, the company adjusted its incentive design, introduced high-quality talent under good governance, stabilized the team, and achieved outstanding performance in innovative output and social responsibility [11]. As a result, the company was able to increase shareholders' wealth even if the equity incentive plan was terminated.

Secondly, it may be worthwhile to increase CEO monitoring, as incentives alone may not be sufficient to ensure diligent effort from the CEO. However, since monitoring incurs costs, shareholders must weigh the costs and benefits of monitoring to determine an optimal level that maximizes overall benefits. Given the complex interplay between adverse selection and moral hazard, it is essential to adopt a multifaceted approach that accounts for these two problems to effectively cushion potential risks. The development and implementation of such strategies are supposed to involve rigorous testing and refinement through an iterative process to ensure their practical applicability and effectiveness.

4. Conclusion

In conclusion, the principal-agent model is a crucial framework for understanding the relationships and problems between principals and agents, particularly in the context of corporate governance. This paper has discussed the causes of the principal-agent model, the challenges that arise, and potential solutions to address them. Specifically, the paper has focused on the information asymmetry between shareholders and CEOs, which leads to adverse selection and moral hazard problems. Through the

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establishment of an ideal model and theoretical analysis, this paper has highlighted the importance of aligning incentives and monitoring mechanisms to ensure that agents act in the best interests of principals. Furthermore, the empirical study presented in this paper provides evidence of the effectiveness of the principal-agent model in practice.

However, it is important to note that the principal-agent model is not without its limitations and drawbacks. In particular, the model assumes rational behavior and complete information, which may not always hold in real-world situations. Therefore, ongoing research and refinement of the principal-agent model are needed to improve its applicability and effectiveness. Overall, the principal-agent model remains a vital tool for understanding and managing the relationships between principals and agents, particularly in the context of corporate governance. Through continued research and refinement, this model has the potential to contribute to improved decision-making and performance in organizations.

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