On the design of organization and collusion in the hierarchy

Sui Jigang  Li Jian  Cui Zheng
School of Management and Economics,
Beijing Institute of Technology, P.R.China, 100081

Abstract: The performance of an organization is affected by its structure. There are many branches in a firm, and how they can move in order is the task of the design of an organization. Firm as a multicontract organization should be designed as a hierarchy. But in the multi-layer organization, asymmetric information causes a new agency problem-- collusion.

Keywords: organization design; hierarchy; collusion

1 Introduction

There is a widespread belief that the performance of an economic system or organization is influenced by its internal structure. One important feature of a firm is the limited capabilities of individuals to gather, absorb, and process information within a limited amount of time. This is why organizations may be able to do more than any single individual.

The design of the organization can possibly be used to increase the transaction costs of side contracting, to improve both individual and group incentives and by the same token to increase the firm's profit.

The fact that complexity of the decisions needs to coordinate the activities of large firm calls for some specialization and a division of labor between management, supervision and production. The design of these supervisory structures is thus a crucial ingredient to achieve a better coordination of the firm's activities and to enhance the individual and collective incentives of the different members of the organization. So the collusion-proof is important to design an organization. But the research in this area has by and large ignored the possibility of collusion.

In this paper, we will illustrate how to organize a firm to enhance the executing efficiency, how collusion does harm to a firm, and how collusion can be constrained by creating an alternative source of information.

We present a three-layer hierarchy with three players: a principal, an auditor, and a manager. The principal owns the firm, the manager runs it with private information about its efficiency, and the auditors collect information for the principal. We assume that the principal lacks the time or knowledge required to supervise the manager, that the manager lacks the resources to buy the firm, and that the auditors lack the resources required to acquire or run the vertical structure.

2 The efficiency of an organization
Contract theory is helpful to illustrate how the organizational form affects a firm’s efficiency. Contract theory has made rapid progress in the past 30 years. There are several famous economists in this field, such as Tirole, Laffont, Grossman and Hart. Their theory can be gathered up as follows: (1) a firm is an organization made of incomplete contracts; (2) the reason of incomplete contracts is the asymmetric information among the partners and the exogenous uncertainty; (3) there exists incentive incompatibility between the principal and the agent. The owner will bear valuable agency cost (including the agent’s moral hazard and opportunism), so he should design a reasonable mechanism by which the agent works hard and maximizes the principal’s profit.

In recent years, agency theory has begun to study the design of multi-person organization. Principal-agent theory has paid considerable attention to the incentive problems which arise in two-layer (principal-agent) hierarchies.

Transaction cost theory is the branch of new institution economics, which has widely spread since 1970s. The theory views transaction as basic analysis unit, instead of the customer and the manufacturer. The theory has four basic assumptions: (1) human has limited sense; (2) there exists opportunism; (3) future is uncertain; (4) incomplete competition. Because the market is more complex, highly costs(searching, negotiating, and monitoring) need to be paid for a transaction. To save these transaction costs, the firm takes the place of the market.

Williamson (1985) argues that vertical integration improves communication channels but that it is also associated with lower powered incentives than those implemented between units owned separately. He also claimed that the internal organization of an enterprise is a hierarchy, which can reduce the opportunism action and dissension. Because the internal auditor and the higher-up in hierarchy can use their authority to lessen the asymmetric information and issue. A firm can be viewed as a contract of saving transaction cost.

When a firm expands its scale of production or integrates forwards or backwards, the informational gaps between the firm's owners and decision makers engaged in the day-to-day control of those activities are significantly enlarged.

Stiglitz (1986) divided the economic organization into two forms: polyarchy and hierarchy. A polyarchy is a system in which there are several decision makers who can undertake projects independently of one another. In contrast, decision-making authority is more concentrated in a hierarchy in the sense that only a few individuals can undertake projects while others provide support in decision making.

Stiglitz compared the merits of polyarchies with that of hierarchies and claimed that advocates of polyarchies point out that a good project has many opportunities of being accepted in their system, whereas critics contend that polyarchies fail to provide adequate checks against incompetent decision-making.

There are many branches and departments in a firm, they can be separated according to different functions and be connected by communication instruments. It’s necessary for a firm to be organized as a hierarchy to manage mass economic action. Hierarchy can correspond the internal management
mechanism, and needs less cost than that of the market. Any organization of the firm is equivalent to a centralized organization with a very simple hierarchical structure in which all the information flows up directly to a mediator in the form of reports and down to the managers and workers as instructions and contingent plans.

The purpose of this paper is to illustrate hierarchies based on the allocation of authority. We take the view that a firm’s owners have ultimate authority over a firm’s decisions, but that they have limited time or capability to exercise this authority. So the owners must delegate some authority to subordinates. However, these subordinates also have limited time or capability to exercise authority and so further delegation must occur to other subordinates. Thus we view a firm as a chain of command over decisions, namely a hierarchical organization.

Hart (1999) argued the optimal chain of command given that different agents have different tasks; in particular, some agents are engaged in coordination and others in specialization.

In our view, an owner has formal authority in the Aghion-Tirole sense, while a subordinate has real authority if his boss cannot exercise authority but he can.

The way a hierarchy works is as follows: if the first person in the hierarchy has an idea, he implements it; if he does not have an idea, control passes to his subordinate, who implements his idea if he has one; if the subordinate does not have an idea, the subordinate’s subordinate has a chance to implement his idea, and so on.

The benefit of putting someone high up in a hierarchy is that if the person has a good idea, he is likely to be able to implement it. The cost is that the person may block others from implementing better ideas.

Hart assumed that the organizational form—characterized by a chain of command over each asset and an assignment of tasks to each individual—is chosen ex ante to maximize expected total surplus. The coordinators should be senior to small thinkers or specialists.

Hart and Moore (1999) showed that the optimal hierarchy is a pyramid, in the sense that each individual has at most one boss. If the gains from coordination are large enough, it is optimal for the organization to be centralized.

Hierarchy is a system of ranking or bureaucracy in which the internal transaction can be finished through administration orders. It is an efficient organizational form. The simple application of the revelation principle tells us that centralization always at least weakly dominates decentralization in the absence of any side contracting and any limit on communication.

Laffont and Martimort (1997a) proved that in the absence of communication constraints, centralization still strictly dominates decentralization. The reason is that the principal is then unrestricted in the set of mechanisms he offers. In particular, he can offer sufficiently complex mechanisms that destroy any possible stakes of collusion.

3 Collusion in hierarchy
In this paper, collusion refers to the agents who contract with the principal to achieve sub-contract among them in private, which offends the principal’s will, instead of the monopoly firms’ colluding with each other to gain more profit. The purpose of collusion is to improve colluders’ utility at the cost of the principal’s benefit.

3.1 The supervisor’s role in collusion

If the principal has perfect information, he will know whether the manager works hard. If the manager finishes the task, the principal will pay him wage; if he doesn’t finish his task, then the principal will reduce his wage. The wage is exactly equal to or higher than the income which the manager can earn in the market if he doesn’t accept the contract. Because the wage is not less than the income in the market, the manager will accept the contract. So the principal can control the manager if the information is perfect. In other words, if there exists perfect information, the hierarchical organization is efficient.

The fact that information often is asymmetric requires the use of a monitoring device or a supervisor. Because the supervisor “live in the firm” and is a specialist in auditing, he possess high quality information. He provides principal with valuable information concerning not only the financial status of the firm, but also other aspects outside the accounting area.

Both the principal and the manager face the problem of how to stimulate the supervisor. Incentive is to design a mechanism by which the supervisor’s outcome of self-interest behavior is just the principal’s objective. If the objectives of the supervisor and the principal differ, the principal will have to motivate the self-interested supervisor to act on his behalf.

The supervisor potentially improves information collection within the firm, but also creates incentives for collusive behavior with agents to share some private information. The grand contract cannot prevent those members of the organization from colluding through some implicit side contracts to promote their own collective objective instead of that of the firm. Consequently, side contracting imposes some costs on the efficiency of the organization and therefore affects the firm’s profits.

If this supervisor is benevolent, he reports freely to the principal any information that is beneficial to the manager, i.e., that gives him some informational rent. If he is not benevolent, then there is scope for collusion between him and the manager. They can manipulate numbers, conceal evidence on the profitability of some investment, or engage in a mutually beneficial exchange of favors that results in the supervisor appropriating a fraction of the manager’s rent.

The possibility of collusion imposes an additional cost on the use of the supervisor, but, under certain parameter configurations, the principal prefers to bear it.

The principal is the residual claimant of the vertical structure. He designs the contract and offers it to the manager and the supervisor: first, a formal grand contract linking together the principal, the supervisor and the manager; second, an informal collusive side-contract linking only the latter two partners.

Because of the separation between ownership and supervision, the supervisor gets some information
on the agent's productivity which can be used to improve the latter's incentives. However, through a collusive side-agreement, this information can also be concealed by the supervisor to favor the agent against the principal. When collusion occurs, the principal must design a collusion-proof grand contract which induces truthful revelation of the supervisory information. So the asymmetric information is one reason for collusion to arise. The supervisor and the manager can collude and forge evidence in order to manipulate the information of the principal.

Members of the organization are endowed with private information and have objectives that are different from those of the organization as a whole. The goal of the designer of the organization is then to set up a game to be played by the members of the firm in a way which makes them act according to their information in the best interest of the firm.

3.2 Literature review

An important weakness of the collusion literature is that frictions in side contracting are exogenous. This shortcut of the exact modeling of the constraints affecting the efficiency of a side-contract is nevertheless enough to make significant progresses towards a better understanding of the optimal organizational responses to the threat of collusion. However, this shortcut cannot capture the relationship between the external environment where the firm evolves and the transaction costs of side contracting.

Tirole(1986) studied the efficiency losses that can result from collusion with side-payments in a principal-supervisor-agent hierarchy. He identified that an organization can be viewed as a cross network of principal-agent. There are series of contracts instead of one. When one employee has the authority to evaluate others’ performance and supervise others, he will bring the possibility of collusion.

Kofman and Lawarree (1993) introduced other ways to analyze collusion. They claimed that even if there is external auditor, collusion still arises in hierarchical agency.

Tirole(1986) claimed that the supervisor's degree of risk aversion affects the agency cost of collusion. In a multi-agent context, designing the organization to increase the transaction costs of side contracting should be viewed as a complementary tool to a set of individual incentives.

Laffont and Martimort studied collusion more comprehensively and particularly. In their literatures, they analyzed the condition and the transaction cost of collusion, and summed up the process of collusion as follows:

1. The principal offers a grand-contract to both the supervisor and the agent.
2. The supervisor and the agent both accept or refuse simultaneously this grand-contract at the ex ante stage, i.e., being still uninformed on the agent's type and the supervisor's signal. If any of them refuses, the game ends.
3. The agent learns his productivity parameter $\theta$ and the supervisor's signal $\sigma$. The supervisor learns only $\sigma$.
4. When $\sigma$ realizes, the supervisor makes a take-it-or-leave-it offer of a collusive side contract to the agent. If the latter refuses, the grand-contract is played non-cooperatively. If he accepts, the colluding partners commit to a joint manipulation of their reports to the principal and exchange a bribe.
(5) Reports are made, production takes place and transfers within the grand-contract and within the side-contract, realize.

Laffont and Martimort (1997b) ruled out the possibility of blackmail by the supervisor. If he gets a signal favorable to the manager, he cannot threaten the manager with revealing a less favorable signal since he needs the manager’s help to falsify the evidence. They also assumed that there exists some mechanism that makes all contracts and side contracts enforceable and nonrenegotiable.

### 3.3 A simple model

The design of the multidivisional structure of the firm arises also as an optimal response to the threat of capture within large hierarchies. More generally, to see how the threat of collusion impedes incentives, we can set up a simple three-tier model of hierarchy.

Assume that the principal sets up a monitoring system or hires a supervisor who can become informed on the private information of a manager with some strictly positive probability. This private information might be for instance some knowledge on the efficiency of the production process. The supervisor then observes signals correlated with the information of the manager.

The contract must also satisfy a series of collusion-proof constraints. These constraints prevent the supervisor, when informed of the manager’s type, from concealing this evidence in exchange for the informational rent grasped in this case by the manager.

Analysis of the players’ payoff in collusion is as follows:

1. **The supervisor’s payoff.** We assume that the supervisor’s wage is $W_1$, the extra benefit he can gain is $R(\lambda)$ if he colludes with the manager, the probability of being detected is $P$, and the punishment is $F_1$. $\lambda$ represents the supervisor’s power and we suppose that the more power he has, the more extra benefit he gains ($R'(\lambda)>0$). The supervisor’s expected payoff is:

   $$(1 - P)(W_1 + R(\lambda)) - P(W_1 + F_1)$$

   The supervisor’s payoff is $W_1$ if he does not collude, so his constraint is:

   $$W_1 \geq (1 - P)(W_1 + R(\lambda)) - P(W_1 + F_1)$$

   The concise expression is:

   $$W_1 \geq \frac{1 - p}{2p} R - F_1$$

2. **The manager’s payoff.** We assume that the manager’s wage is $W_2$; he can earn $M$ if he colludes and pays the supervisor $R(\lambda)$. But we suppose the manager is risk averse, he will bribe the supervisor with the firm’s property instead of his own. We assume his probability of being detected is still $P$, the manager will be punished with $F_2$. The manager’s expected payoff is:

   $$(1 - P)(W_2 + M) - P(W_2 + F_2)$$
The manager’s wage is $W_2$ if he does not collude with the supervisor, so his constraint is:

$$W_2 \geq (1 - P)(W_2 + M) - P(W_2 + F_2)$$

The concise expression is: $W_2 \geq \frac{1 - P}{2P} M - F_2/2$

(3) **The principal’s payoff.** The fine extracted from collusion between the supervisor and the manager should be the principal’s payoff, which includes two parts: the supervisor’s $F_1$ and the manager’s $F_2$. If the principal doesn’t monitor successfully, he will lose $M$ and $R$. So his expected constraint is:

$$P(F_1 + F_2) - (1 - P)(M + R) \geq 0$$

Otherwise it is not worth monitoring.

The concise expression is: $P \geq \frac{M + R}{F_1 + F_2 + M + R} = 1 - \frac{F_1 + F_2}{F_1 + F_2 + M + R}$

Now we can see that the supervisor and the manager have similar payoff function, because they all are the principal’s agents. For the supervisor, when $P$ and $F_1$ are certain, $W_1$ is the direct ratio to $R$, which means the more power he has, more wage should be given to the supervisor. The principal also can enhance $F_1$ to decrease collusion. The same method can be adapted to the manager.

4. Conclusion

We have analyzed the organizational forms and consider that the hierarchy is more efficient in a firm. Although the multi-layer structure favors the communication in an organization, collusion arises easily. We have also analyzed the role of supervisor in a simplified hierarchy (principal-supervisor-manager) in which the supervisor and the manager can collude with each other. Because of its harm, the principal should design a defensive mechanism to prevent collusion instead of neglecting it. In fact, the principal always prevents collusion between the supervisor and the manager. Making collusion endogenous is still at the top of the research agenda in multi-agent contract theory.

Reference


