Analysis Based on Principle-Agent Model: the Application of Motivation Theories in Labor Safety Regulation

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Abstract

Labor safety regulation is the major content in social regulation and it main concerns laborer's life, health and sustainability. The central government cooperates with local government and other relative monitoring organization by the way of improving labor safety standard in all walks of life, however, the frequency of production accident exposed the underlying problems during producing, that is: it appears weaken regulation vigor, put enterprise without satisfying safety standard under local government's protection even occurred collusion while implementing the thorough safety regulation & supervising issued by central government. This article will analyze from the point of Principle-Agent.

Keywords: Principle-Agent model, Motivation theory, Game theory, Safety regulation

1. Forward

Labor safety regulation is the statute made by government and a institutional arrangement conducted, monitored & managed to operation business and labor as like through assigning facility, for the sake of ensure life, healthy and safe. Labor safety regulation is an important content of sociality regulation with its specific, because it comes down to life and health of human and would bring about irreversible loss once an accident arises. Its definite content indicated as later.

The link chain is composed by 4 nodes of central government, local government; line operation business and labor which is also form two main parts of regulator and being regulated. The government as regulator follows the basic principle of "national-supervising, local-monitoring and enterprise in charge" all the time, central government cooperates with local government at all levels and other relative monitoring organization, which improved the labor safety level all kinds of industries of greatly, but according to the data from National Statistical Division, it occurred 30 serious accidents with 392 death; 2 special serious accidents with 108 death, 2 coal mine accidents among them with 108 death, 1 accident and 73 death increased over the same period of the previous year, arising 100% and 208.6% separately. The problem within deep level during producing has been exposed while frequent accidents: why accidents arising constantly though there is thorough laws and regulations and labor safety supervising content? It can be found the reason through analyzing the combination of inspecting result and labor safety regulation: the situation of imperfect regulation dimension appears during executing, even the enterprise without up to the safety standard been protected or "collusion" case exists; operation business do not comply with the labor safety regulation, several of them try to cut down the necessary input and maintains by rash advance or the way of "rent-seeking" from regulator; some businesses are short of labor training and protection, conceal accident or desert afterwards so as to reducing cost. The government plays a very important role no matter wherever the link is within this regulation. As regulator, the government has its division: the central government establishes the rules and regulations, local government undertake & carry out it definitely. This article makes analysis from the former two links of regulation and looks out the inconsistency between central and local, find the cause for it behind through entrust-acting model so come up with resolve strategy.

2. Analytical Framework of Principle-Agent Model in Labor Safety Regulation

The entrust side indicate central government and the agent side indicate local government herewith, that is: during the implementation process of this regulation, central and local clear and definite the aim of it and what measures should be taken, as it were symmetrical when "signing a contract"; local government does regulating work, central government acquire the executing status by the way of knowing accident rate, applying work injury insurance funds and daily inspection like that; but the central government cannot on top of status for regulation being carried out definitely and as agent side, the local government might acting in favor of itself in some cases. This agency relations is a moral hazard model hiding acting, is a kind of specific game, it causes the result of regulation is not completely independent of

initiative of central government, but been affected by the attempt of local government. The following analysis by applying entrust-acting model covers three main parts:

2.1 Production Technology

The production technology here is referring to regulated effect by local government to enterprise safety status, not a production functions within general economical area. It has three variables in the process of safety regulating:

(1) The action taken by local government during regulating marked as *a*: it is reflected in inspecting on labor safety, and finds the existing hidden trouble or punish unlawful act etc.

(2) The effect (output) of local government regulating marked as *r*: it is reflected in improving labor safety level and decreasing accident rate etc.

(3) The uncontrollable fortuitous event marked as θ: It means natural disaster in sudden with not controlled by client and agent, often cause personnel injury and property damage after occurred accident.

These three variables play a part in labor safety regulation model on following sequence:

First, central and local government define the specific content of regulation jointly, disclosure what responsibilities and power the local government has as agent, with rewards and punishment rule by the way of law, legislation and regulations etc; next, local government choose what action they would take as *a*, but as client, central government cannot observe or cannot observe completely what local government choose to act; third, the event θ with out of controlled by local appeared; fourth, action *a* and event θ determine regulation effect *r* together; Fifth, central government conduct rewards or punishment through effect *r* can be observed and what did in first step, or adjust regulation made their self.

There are two important assumptions:

(1) The effect from local labor safety regulation, also called output function *a*, is a one-dimensional strive variable, it can be formed as:

$$r = a + \theta$$

(2) Mean value of θ is zero, variance is a positive distribution random of σ^2, represent uncertainty factors. The strive level of local determines the mean value of regulation effect, but without effect on variance:

$$E(\theta) = 0 \quad V(\theta) = \sigma^2$$

Exogenesis variable θ been implemented when local government choose action *a*, *a* and θ come into being a result *r* (a, θ) observable, in which, the direct ownership of income belongs to client-central government, the expenses spent by local while regulation marked as $c(a)$.

2.2 Contract/ Agreement

Local government at all levels work out executing scheme of regulation based on the labor safety objective of central and combine the features of local business, pass on to central. With the year of access, central conducts rewards and punishment on the basis of actual regulating result to local. Since local is in charge of the labor safety work and with all-important meaning for priming of economy and harmonious social development, no matter how the final affect it is, central would afford encourage or reward properly, just with variable range of intensity, positive or negative, and marked as *g* with fixed value here, being unrelated with regulating effect. β Refers to intensity coefficient, and is related with labor regulating effect *r*, when *r* increase one unit, the reward of local would increase β units. Assume the risk between client and agent is indifferent; the reward of local is the linear function for labor safety regulation effect. Reward marked as $w(r)$, then:

$$w(r) = g + \beta \times r$$

2.3 Earnings/profit

Assume the earnings for central to regulating is $\pi(a, \theta)$, π is strict ascending function of *a*, given θ, the more serious supervised by local, the more clearer the effect is, but the marginal benefit of regulating is diminishing. π is strict increasing function of θ.

$$\pi = r - w(r)$$

Assume the Von Neumann and Morgenstern expecting utility function for both central and local are $v(r - w(r))$ and $u(w(r)) - c(a)$ separately, in which $v' > 0, v'' < 0; u' > 0, u'' < 0; c' > 0, c'' > 0$. It's been assumed that client is risk neutrality, and then $E(v(r)) = v(E(r))$. It can be known as pre above (1), $E(r) = E(a + \theta) = a$

The exceptive effect of central as client is equal to exceptive income:

$$E(r - w(r)) = E(r - g - \beta \times r) = -g + E((1 - \beta) \times r) = -g + (1 - \beta)E(r)$$
$$= -g + (1 - \beta) \times a$$

The actual income of local as agent is:

$$w(r) - c(a) = g + \beta \times (a + \theta) - c(a)$$

Assume that agent is risk neutrality, and then exceptive income is:

$$E(w(r) - c(a)) = E(w(r)) - c(a)$$

$c(a)$ Does not take any expected value, because the local government as agent can fix on strives cost, the more serious of monitoring, and the higher of cost. While $w(r)$ lies on r, and r lies on uncertainty variable θ, so only take exceptive value of $w(r)$, then:

$$E(w(r) - c(a)) = g + \beta \times E(r) - c(a) = g + \beta \times a - c(a)$$

3. The Optimal Action Analysis of Local Government in Principle-Agent Relation

By setting entrust-acting model for central and local, the optimal action of local can be obtained as:

$$\max_a [E(w(r) - c(a))] = \max_a [E(g + \beta \times (a + \theta) - c(a))]$$

The necessary factor for optimal action value *an* existed can be got by means of optimization first order term:

$$c'\left(a^*(\beta)\right) = \beta$$

The optimal action value taken by local within entrust-acting relations is: the marginal cost of labor safety regulation equals to marginal income β. In the meanwhile, β is also a motivation coefficient, when β is increasing, the greater exceptive value $E(w)$ is; in return stronger encourage action a can be on local government. The action taken by local government during the regulating process has strong relationship with motivation coefficient, stronger motivation, more force on regulation, and more better effect ideally reached. The inconsistent objective between local and central can be found intuitively on the issue of labor safety regulation via entrust-acting model and its relative academic content, because utility functions of local and central are different. Since local government has the impulse for achieving self-interest, that leads to weaken force of regulating by central.

4. Strategy Study

The Nobel Prize winner Morris think that many special issues faced to China needs to be resolved by means of special analysis. Encouragement issue is a core problem is faced with all economies; it seems that the encouragement issue is the one being solved by economic reformation in China. The inconsistency of objectives of regulating is due to the existence of "encourages vacancy" through the analysis on entrust-acting model, to depress the benefit inconsistency and the agency cost creative by information asymmetry, it needs to create encouraging reward model based on agent's achievement, motivate agent working hard by means of sharing risk and inspiring.

(1) Set up specific objective for labor safety regulation, refining monitoring work. Divide work target to operational staff and draw up ration indicator. Ration does not mean how many businesses got out of line or how much penalty it is, but rather refining working content. Therefore, central government should definite what duties and obligations local government have, local government at all levels should record labor safety status of all businesses under administration and do task decomposition; for branch in charge, require each of them confirm the number of business inspected annually, reach appointed standard for reforming hidden trouble, increase the frequency of inspect for hazardous industry, set the rule of accident and the amount of penalty clearly. Refining indicator is the only way to reach regulating target, improve the efficiency of regulation through the way of quantification.

(2) Complete incentive system, enhance individual motive power. From uniform motivation scheme by central to adjust flexible by local according to practical situation, refining assess award indicator and clear cut award level & standard, emerge a kind of "dominant incentive mechanism". In addition, look out the relationship between award and individual expected value. Generally, when there is no obvious differ between award and individual expected value, income is the direct way to regulated staff, it should not ignore the motivation on material matter while spirit incentive been conducted on monitoring staff. With the rapid expansion in economy, it exist a variety change among all orders of society, the status of lower income level on monitoring staff not only affect their enthusiasm but also provide the opportunities of "rent-seeking "and "rent-demand" . For example, the higher accident rate in coal mine industry has a significance bearing on power-for-money deal with bureaucrat. So it is necessary to raise income level for monitoring staff and strengthen benefit incentive. Certainly, fat salary does not necessarily lead to efficient, material matter incentive can not achieve favorable alone, must keep within bounds at the same time. At present, "central accumulation

fund" in Singapore and "retire security deposit" in Hong Kong are the rather successful method, that ism accumulate "reserve fund" on the basis of variable detain of different duties, years of experience and salary level, once they violate the law and discipline, not only "reserve fund" been subtracted but also lose the right for drawing retire security deposit. This "reserve fund system" can be used for reference in our country so make the incentive and restrict to monitoring staff more effective.

(3) Expend the scale of incentive; give full play to the initiative to all monitoring staff. The assess mechanism is used for civil servant now, but with the limitation of awarded staff and the majority been promoted as their conducting regulation well, so lesser the incentive to staff on average, and that most of works on basic level is done by general staff. Therefore, it should strive to fair on drawing up incentive policy, extend awarding level and scale into the majority and balance what they put into given what they gains to improve regulating effect.

(4) Depress the hierarchy agency relation by authorization of incentive. There is multiple agency relation between central and local government at all levels, what is more, local government face jointly agency relation for multi-client. The more of client, the stronger substitution of strive cost to different agent duties at all level local government, the function of dominant incentive is getting little at public sector. Local government takes charge for economic development, social stability, safety production etc, and take in inspect by central even more, more basic level with more supervising. Under the impeccable incentive system, central government can work out and authorize to local based on relative laws and regulations, stimulate subordinate to bear the responsibilities for certain industry and deal with promptly by applying strategy in practice. Certainly, authorization in not equal delegation, the aim is lessening intervene and reducing the status of lower efficiency due to multi-level agency relation.

To this end, set up incentive system both in external and interior; the external incentive system is mainly used for prevent agent deviating client's goal due to benefit prime mover, while the interior incentive system arisen when sense of honor, a sense of responsibility and sense of era mission appears. The formation of interior incentive system has an important meaning on solving the problem in which local and central behavior differs, but the setting up is not the work of a single day, it needs to form with in usualness, durability instruction, training and good social atmosphere together.

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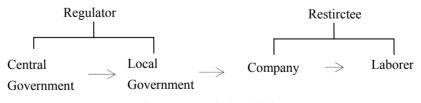
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Figure 1. Regulation Chain