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Study on Behavior Incentive Mechanism of Energy Conservation and Emission Reduction for China Freshwater Live Fish Supply Chain

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Abstract:

Purpose: The purpose of this paper investigates the subject behavior of Energy conservation and emission reduction (ECER) based on structured classification of the organization types of FLF supply chain, and explores reasonable behavior incentive mechanism for ECER of FLF supply chain in China.

Design/methodology/approach: This paper classifies the organization subjects of FLF supply chain, and different characteristics of organization subjects are compared in detail. ECER behavior incentive mechanism modeling of FLF supply chain is explored by taking advantage of principal-agent model in view of asymmetry information. Incentives issue of different operating subjects is discussed as enlightenment of the model.

Findings: Three types of the organization subjects of FLF supply chain in China have been identified as: loose organization, semi-compact organization and compact organization. Subjects of different types have different abilities to conduct ECER work. Government needs to propose differentiation polices of incentive compensation for different operating subjects, widen the gap of differentiated subsidies/rewards for different investment levels on ECER conducted by different operating subjects of FLF supply chain.

Research limitations/implications: It will take long-term unremitting efforts to achieve the target of ECER work for FLF supply chain in China, the dynamic issues and simulation modeling on behavior incentive mechanism of ECER should be developed in future research.

Practical implications: Clear understanding of structured classification of the organization subject types of FLF supply chain and the behavior incentive mechanism for ECER, will help government to improve the ECER work in an efficient and effective way.

Originality/value: Research to behavior incentive mechanism of ECER has important theoretical value and practical significance. This paper contributes to distinguish three types of operating subjects of FLF supply chain in China, put forward the behavior incentive mechanism of ECER to support the government to improve the ECER work scientifically.

Keywords: behavioral incentive, energy conservation, emission reduction, freshwater live fish, supply chain organization

1. Introduction

Modern supply chain of freshwater live fish (FLF) refers to link the various functional links of FLF from production areas to consumption areas into an organic whole which includes production, fishing, commercialization, transport, handling, culturing, distribution, transaction and settlement, quality information and so on, carry out effective coordination and control for the physical flow, organizational flow, information flow and value flow, promote the realization of preservation and appreciation for the whole industry chain, meet the demand of production and consumption of FLF (Lu, Wu, Li & Chen, 2014). The framework model of modern supply chain of FLF is shown in Figure 1.

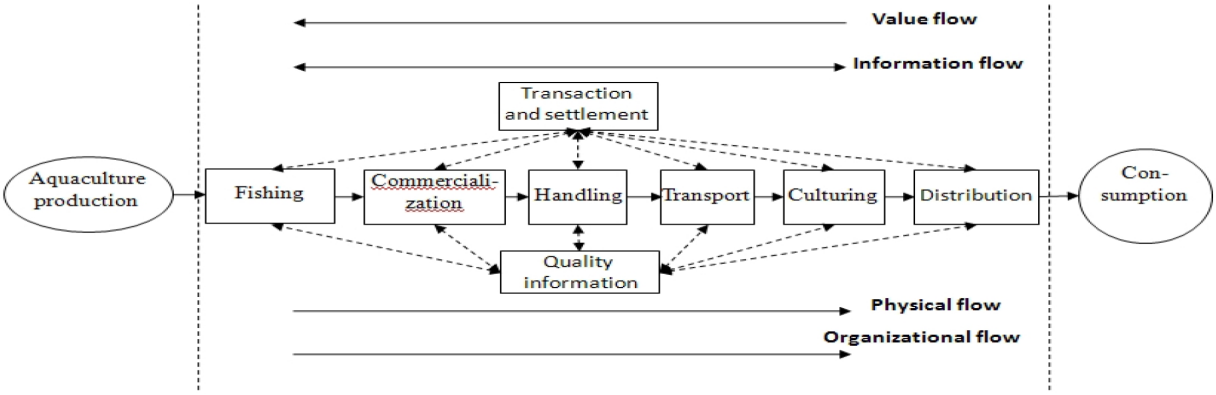

Figure 1. Modern supply chain of freshwater live fish (FLF)

Compared with the traditional FLF supply chain, the modern supply chain of FLF should have modern features in the management philosophy, management style, organizational

mechanism, technology, equipment and facilities etc., and this is the indispensable theme for supply and distribution modernization of FLF to achieve ecological environment by using the modern technology of energy conservation and emission reduction (ECER). ECER goal is to save energy consumption and reduce environmental hazards (including gas, waste water and noise etc.) emissions, and make use of resources in environmentally friendly way to organically combine economic development and environmental protection (Wang, 2012).

The overall characteristics of China's FLF supply chain are high energy consumption (Wang & Wang, 2008; Zhu, Peng & Wang, 2010), low efficiency (Zhu & Chen, 2006) and weak statistical basis (Jing & Wang, 2009), which is still in the extensive development. Liu (2012) finds that the organization subjects of FLF supply chain have weak consciousness of ECER and are unwilling to adopt new technology of ECER in China. Since the cause-and-effect relationship of the investment cost and gains for ECER is undetermined, enterprises with low ability would be lack of motivation to conduct ECER work. Facing the risk of increased cost when involved in ECER and meanwhile declining proficiency of skilled workers, rational choice of general enterprises is the negative response to cope with ECER work (Liu, 2012). Lu et al. (2014) points out that the basic and applied research of ECER technology in China is not enough, and core technology on ECER is underdeveloped. The research and development of product and process technology for ECER is lag behind, and the R&D and promotion service systems of ECER is not perfect (Lu et al., 2014). There is lack of effective means for Chinese government to promote ECER and policy support is insufficient. China has not set up special organizations responsible for advancing the ECER work in this domain, let alone to do a good job in logistics statistical work of ECER. The implementation of ECER policy mainly relies on command - control administrative means (Qu, Shi & Hua, 2012). ECER has characteristics of externalities and public welfare, which easily leads to relevant subjects' lack of implementation motivation (Zhao, 2011). Qu et al. (2012) and Huang (2014) suggest the government should encourage enterprises to actively participate in, and resolve the inherent externalities, internalize the externalities through effective measures; internalize the social benefits formed from ECER into the main economic benefits for operating subjects (Yang, Wang & Pan, 2014).

It is no doubt that the behavior incentive policy is important to carry out ECER work for FLF supply chain. The innovation of the research in this paper is to investigate the subject behavior of ECER based on structured classification of the organization subject types of FLF supply chain in China. The contribution to theoretical research is to distinguish three types of operating subjects and organizations of FLF supply chain, and show that the ability and motivation of operating subjects to participate in ECER work and their effects are significantly different for different types. Then this research put forward the behavior incentive mechanism of ECER to support the government to improve the ECER work scientifically, which makes contribution to the practice community.

The remainder of this paper is organized as follows. Section 2 puts forward organizational behavior analysis on ECER, and classifies the organization subject types of China FLF supply chain, characteristics of different supply chain organizations are compared in this section. Section 3 explores ECER behavior incentive mechanism modeling by taking advantage of principal-agent model in view of asymmetry information, incentives issue of different subjects of FLF supply chain organization is discussed as enlightenment of the model in this section. The last section is conclusions.

2. Organizational Behavior Analysis on ECER of FLF Supply Chain

The competition or cooperation game between the government and main body of FLF supply chain is focus of decision analysis of supply chain organization behavior on ECER. According to the fluid quality, FLF is generally divided into three categories: rare fish, homely fish and mid-range fish. There are significantly different organization forms for the supply chain of different FLF, and it results in different behaviors on ECER.

The subject types of FLF supply chain include government management services subject and investment operating subject. The logistics industrial chain of FLF has the collection of investment operations subject affiliated with all upstream and downstream, which constitutes the supply chain organization of FLF, and it can be roughly divided into three types: loose, semi-compact and compact organizations.

2.1. Loose Organization

Loose organization refers to the organization connecting the upstream and downstream subjects of industrial chain and associated supporting subjects only with pure relationship of market supply and demand of FLF, which generally consists of ordinary farmers, information brokers, distribution merchants, market dealers, market distributors and retailers and so on. The relationship between various types of subjects in such supply chain is mainly the contractual relationship, and once the transaction is completed, the contract between two parties will be automatically removed. Such supply chain organization is open, but the behaviors between subjects have poor binding and high transaction risks. Relationship structure of operating subjects of loose organization is shown in Figure 2.

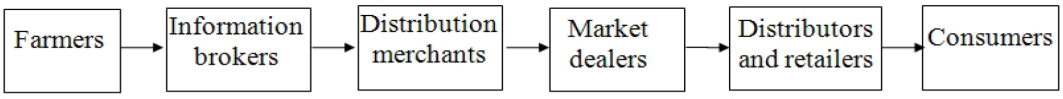

Figure 2. Subjects relationship of Loose Organization

2.2. Compact Organization

Compact organization refers to the organization connecting the upstream and downstream subjects of industrial chain and associated supporting subjects by taking full advantage of investment partnership for FLF supply and distribution, which generally controls all functions of the industrial chain with only one dominant subject, and the dominant subject may be fisheries operations / scale farms, or logistics operations / companies, or large market distributor / marketing enterprises and so on. Various subjects in compact organization have unified and explicit organizational goals, and have established longer-term and fixed subject relationships. The explicit cooperation agreement negotiated and signed between the subjects has specified the responsibilities and tasks assumed and rights and gains shared by related subjects in advance, and this agreement has legal force. Relationship structure of operating subjects of compact organization is shown in Figure 3.

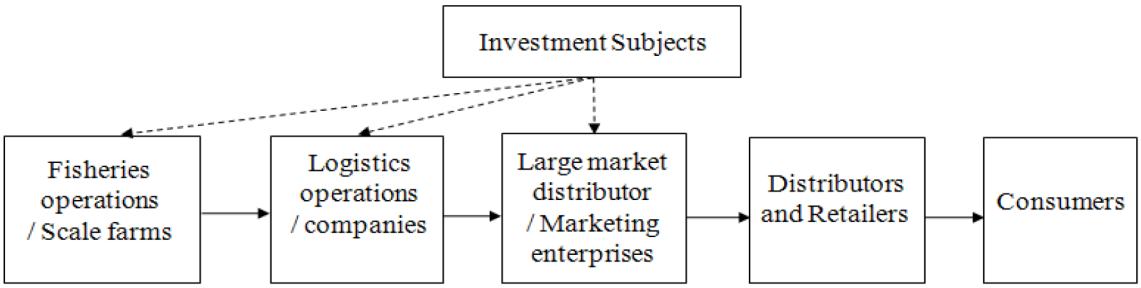

Figure 3. Subjects relationship of Compact Organization

2.3. Semi-compact Organization

Semi-compact organization refers to the organization connecting the upstream and downstream subjects of industrial chain and associated supporting subjects with explicit or implicit contractual relationships for FLF supply and distribution, which generally consists of large breeders / fishery cooperatives / scale farms, logistics cooperatives / companies, large market distributors / marketing companies, terminal retail companies and so on. Various subjects in semi-compact organization often do not sign an essential cooperation agreement, but depends on credit accumulation and relationship integration in many years, namely psychological contract, forming a tacit, long-term and stable cooperative relations with each other; new opportunities and profits gained during the transaction will be shared, and the additional costs and loss of risk arisen will also be jointly born. Such supply chain organization not only has emotional trust and commitment, but also has exchange of interests and credit between subjects, which takes into account the advantages of loose and compact organizations. Relationship structure of operating subjects of semi-compact organization is shown in Figure 4.

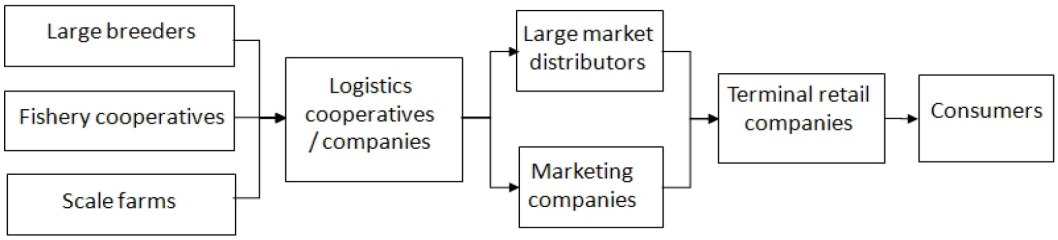

Figure 4. Subjects relationship of Semi-compact Organization

2.4. Characteristics Comparison to FLF Supply Chain Organizations

Different types of FLF supply chain organizations have significant characteristics difference in subjects relationships, market positioning, distribution technology, distribution distance, investment operations, behavioral constraints and ability of subjects, etc., which are shown in Table 1.

Factors	Loose Organization	Semi-compact Organization	Compact Organization
Subjects Relationship	• approximate a perfectly competitive market • a large number of subjects involved • loose relationship between subjects • without stable contractual relationship • low entry- exit barriers	• approximate a monopolistic competitive market • fewer subjects involved • close relationship between subjects • a strong psychological contractual relationship • relatively high entry- exit barriers	• approximate an oligopolistic market • usually only one subject involved • close relationship between subjects • with strict contractual relationship • high entry- exit barriers
Market Positioning	Mainly for average income groups, operating low-end FLF	Mainly for middle-income groups, operating high-end FLF	Mainly for high income groups, operating high-end FLF
Distribution Technology	Fluid technology grade and technical grade of equipment and facilities are low.	Fluid technology grade and technical grade of equipment and facilities are relatively high.	Fluid technology grade and technical grade of equipment and facilities are high.
Distribution Distance	Mainly in small radius and short distance.	Mainly in large radius and medium or long distance.	Flexibility in distribution radius and transport distance.
Investment Operation	Fixed investments, fixed costs and management costs needed to be borne are very low, but the transaction costs and information asymmetries risk needed to be borne are high.	Fixed investments, fixed costs and management costs needed to be borne are relatively high, but the transaction costs and information asymmetries risk needed to be borne are relatively low.	Fixed investments, fixed costs and management costs needed to be borne are high, but the transaction costs and information asymmetries risk needed to be borne are low.
Behavioral Constraint	• mainly subject to supervision of government and market • the abilities of risk control, quality assurance and credit support are relatively low.	• subject to supervision of government and market and also has strong industry self-discipline • the abilities of risk control, quality assurance and credit support are relatively high.	• subject to supervision of government and market and also has strong self-discipline • the abilities of risk control, quality assurance and credit support are high.
Ability of Subjects	Low level in ability and will for ECER.	Moderate level in ability and will for ECER.	High level in ability and will for ECER.

Table 1. Characteristics of three types of FLF supply chain organizations

ECER behavior choice of operating subjects of FLF supply chain can be roughly classified into three categories: advanced ECER technology and equipment innovation, intermediate ECER technology and equipment adoption, and primary ECER technology and equipment application. Different types of operating subjects can be distinguished by striking difference of their behavior choices on ECER.

Premise for operating subjects of FLF supply chain organization to implement ECER strategy is that its benefits is greater than the relevant costs, whose behavioral motivations include: respond to the situation of rising energy prices and reduce the operating costs of enterprise production, reduce the tax credits related to the environment protection paid to the government, while increasing economic improvement, enhance the good social image in the public, etc.

Operating subjects of compact organization are relatively consistent with their targets while they conduct the ECER work, which can be more consciously to practice the ECER, and can coordinate the government to establish a win-win symbiotic mechanism on ECER.

Operating subjects of loose organization are lack of enthusiasm for the initiative to adopt technologies of ECER, which generally only passively accepts the minimum standards of ECER, and the primary issue they face is ability-building.

Operating subjects of semi-compact organization have two possible behavioral choices: either strive to adopt technologies of ECER and follow the high standards to obtain higher income; or do not work hard to carry out ECER, and then their behavior is similar to that of operating subjects of loose organization.

3. ECER Behavior Incentive Mechanism Modeling of FLF Supply Chain

The main game factors for theme scene of ECER on the FLF supply chain are: the upgrading of equipment and facilities (including upgrading of distribution vehicles, etc.), the degree of organization and specialization of operating subjects and so on. The game analysis to theme scene of ECER on FLF supply chain is to analyze the possible conflicts of subjects' interest and policies or solutions based on the above-mentioned variable factors.

3.1. Model Hypothesis and Variable Settings

Denote δ is the marginal cost to implement ECER technologies, also it can be set to characterize the type of operating subjects, and it is the function of organizational degree: α.

Assume the operating subject of compact organization has high ability to conduct ECER work, its organizational degree is denoted as α_H, and δ_H is the marginal cost to conduct ECER work which denote $\delta_H \equiv \delta(\alpha_H)$, where $\frac{\partial \delta_H}{\partial \alpha_H} < 0$.

Assume the operating subject of semi-compact organization has intermediate ability to conduct ECER work, its organizational degree is denoted as α_M, and δ_M is the marginal cost which denote $\delta_M \equiv \delta(\alpha_M)$, where $\frac{\partial \delta_M}{\partial \alpha_M} < 0$.

Assume the operating subject of loose organization has primary ability to conduct elementary work on ECER, its organizational degree is denoted as α_L, and δ_L is the marginal cost which denote $\delta_L \equiv \delta(\alpha_L)$, where $\frac{\partial \delta_L}{\partial \alpha_L} < 0$.

Assume the following relationships are satisfied:

$$\alpha_H > \alpha_M > \alpha_L, \delta_H < \delta_M < \delta_L.$$

Assume that the government is in the monopoly position at the ECER market, and act as principal; operating subjects of FLF supply chain organization who act as agent is the essential factor for ECER production, their reserved utility is zero.

Set q denotes the investment level of operating subjects on ECER work, and $R(q)$ indicates the benefit function of operating subjects on ECER work, taking into account the economic benefit, social benefit and environmental benefit, where satisfy:

$$R'(\cdot) > 0, R''(\cdot) < 0, R(0) = 0.$$

The difference of three types of operating subjects of FLF supply chain organization is reflected by the investment cost (private information) which characterizes the operating subject types on ECER work.

Set C_H denotes the production cost of operating subject of compact organization with high ability, where $C_H = \delta_H \times q$.

Set C_M denotes the production cost of operating subject of semi-compact organization with intermediate ability, where $C_M = \delta_M \times q$.

Set C_L denotes the production cost of operating subject of loose organization only with primary ability, where $C_L = \delta_L \times q$.

The government principal could not make a distinction for the organization type of operating subject due to the private information, but the distribution of ability structure of operating subjects is common knowledge. Set p_H denotes the proportion of operating subjects with high ability on ECER work, p_M denotes the proportion of operating subjects with intermediate ability on ECER work, and p_L denotes the proportion of operating subjects only with primary ability on ECER work, where satisfy $p_L + p_M + p_H = 1$.

Assume that the investment level of operating subject of compact organization with advanced ECER technology is q_H, and receives the subsidy, b_H, from government. The investment level of operating subject of semi-compact organization with intermediate ECER technology is q_M, and receives the subsidy, b_M, from government. The investment level of operating subject of loose organization only with primary ECER technology is q_L, and receives the subsidy, b_L, from government.

Utility functions of operating subjects of FLF supply chain are shown in Equations (1-3):

$$U_H = b_H - \delta_H \times q, \tag{1}$$

$$U_M = b_M - \delta_M \times q, \tag{2}$$

$$U_L = b_L - \delta_L \times q. \tag{3}$$

For the government principal, the question is how to make an incentive mechanism to drive those operating subjects of FLF supply chain to be actively involved in the ECER. More specifically, the question is how to set standard for the investment level of operating subjects of FLF supply chain on ECER, and the corresponding subsidy or reward.

3.2. Ideal Situation of Complete Information

When government principal be fully aware of the investment cost type of all operating subjects of FLF supply chain, as a rational principal in the monopoly position, she/he would pay the subsidy/reward as low as possible, thus the operating subject only gains the reserved utility (zero utility), holds:

$$b_H = \delta_H \times q_H,\ b_M = \delta_M \times q_M,\ b_L = \delta_L \times q_L.$$

Set π_H denotes the net utility government received from operating subjects of compact organization with advanced ECER technology, π_M denotes the net utility government received from operating subjects of semi-compact organization with intermediate ECER technology, and set π_L denotes the net utility government received from operating subjects of loose organization only with primary ECER technology. They are expressed as the following Equations (4-6):

$$\pi_H = R(q_H) - \delta_H \times q_H, \tag{4}$$

$$\pi_M = R(q_M) - \delta_M \times q_M, \tag{5}$$

$$\pi_L = R(q_L) - \delta_L \times q_L. \tag{6}$$

The first-order conditions of utility profit maximization are shown as Equations (7-9):

$$R'(q_H^*) = \delta_H, \tag{7}$$

$$R'(q_M^*) - \delta_M, \tag{8}$$

$$R'(q_L^*) - \delta_L. \tag{9}$$

q_H^*, q_M^*, and q_L^* are uniquely identified by Equations (7-9). For the operating subject of compact organization with advanced ECER technology, the investment level on ECER which required by government is q_H^*, and receives the subsidy/reward, $\delta_H \times q_H^*$; For the operating subject of semi-compact organization with intermediate ECER technology, the investment level on ECER which required by government is q_M^*, and receives the subsidy/reward, $\delta_M \times q_M^*$; For the operating subject of loose organization only with primary ECER technology, the investment level on ECER which required by government is q_L^*, and receives the subsidy/reward, $\delta_L \times q_L^*$.

Due to $R''(\cdot) < 0$, and $0 < \delta_H < \delta_M < \delta_L$, it has $q_H^* > q_M^* > q_L^*$. From Equations (7-9), it gets $b_H^* > b_M^* > b_L^*$, where $b_H^* = \delta_H \times q_H^*$, $b_M^* = \delta_M \times q_M^*$, $b_L^* = \delta_L \times q_L^*$. It shows that operating subjects with higher ability will be required to invest more on ECER, and accordingly get more return for their endeavor. It reveals the thought that 'Able men are always busy'.

3.3. Optimal Contract Under Asymmetric Information

In order to improve the effect and efficiency of ECER policy implementation, it is necessary and appropriate to distinguish operating subject types of FLF supply chain. Under the situation of asymmetric information, government cannot distinguish operating subject types, or the cost of classification is so high that it is unpractical or not executable in fact. What the government could do is to formulate different subsidy/reward policy for different investment level of operating subjects on ECER work, and let operating subjects choose the investment level independently according to their ability. The key is to design a reasonable policy mechanism.

Set the requirement of the subsidy/reward policy contract is: If the investment level of operating subject is more than the value of q_H, then the subsidy/reward is b_H; otherwise if the investment level of operating subject is more than the value of q_M, then the subsidy/reward is

b_M; otherwise if the investment level of operating subject is more than the value of q_L, then the subsidy/reward is b_L.

The incentive compatible constraints of operating subject of FLF supply chain are shown in Equations (10-12):

$$b_H - \delta_H \times q_H \geq b_M - \delta_H \times q_M, \tag{10}$$

$$b_M - \delta_M \times q_M \geq b_L - \delta_M \times q_L, \tag{11}$$

$$b_L - \delta_L \times q_L \geq b_M - \delta_L \times q_M. \tag{12}$$

And the participation constraints of operating subject of FLF supply chain are shown in Equations (13-15):

$$b_H - \delta_H \times q_H \geq 0, \tag{13}$$

$$b_M - \delta_M \times q_M \geq 0, \tag{14}$$

$$b_L - \delta_L \times q_L \geq 0. \tag{15}$$

According to the hypothesis of this model, generally it has $q_H \geq q_M \geq q_L \geq 0$. Without loss of generality, here we only consider the situation of separating equilibrium that $q_H > q_M > q_L > 0$.

A reasonable and optimized policy is to stimulate operating subjects of FLF supply chain exactly, and meanwhile the standard of subsidy/reward is set as low as possible. Thus, at least one of inequality Equation (10) and Equation (13) is tight (be equality); one of inequality Equation (11) and Equation (14) is tight; one of inequality Equation (12) and Equation (15) is tight.

From Equation (11) and Equation (15), as $\delta_M < \delta_L$, yields

$b_M - \delta_M \times q_M \geq b_L - \delta_M \times q_L > b_L - \delta_L \times q_L \geq 0$.

From the above equation and Equation (10), as $\delta_H < \delta_M$, yields

$$b_H - \delta_H \times q_H \geq b_M - \delta_H \times q_M > b_M - \delta_M \times q_M > 0.$$

It shows that Equation (13) and Equation (14) are not tight, so Equation (10) and Equation (11) can be separately expressed as Equation (16) and Equation (17):

$$b_H - \delta_H \times q_H = b_M - \delta_H \times q_M, \tag{16}$$

$$b_M - \delta_M \times q_M \geq b_L - \delta_M \times q_L. \tag{17}$$

At this time, the incentive compatible constraints for operating subjects of semi-compact and compact organization are working, i.e. the policy of government should encourage operating subjects of semi-compact and compact organization always to tell the truth (Telling lies means the situation that the operating subject with high ability pretends to be the subject with low ability).

When Equation (17) holds, as $\delta_M < \delta_L$, it shows that Equation (12) is not tight, thus Equation (15) must be equality Equation (18):

$$b_L - \delta_L \times q_L = 0. \tag{18}$$

Denote $\Delta_{HM} \equiv \delta_M - \delta_H > 0$, $\Delta_{ML} \equiv \delta_L - \delta_M > 0$, refer to Equation (16-18), yields:

$$b_L = \delta_L \times q_L, \tag{19}$$

$$b_M = \delta_M \times q_M + \Delta_{ML} \times q_L, \tag{20}$$

$$b_H = \delta_H \times q_H + \Delta_{HM} \times q_M + \Delta_{ML} \times q_L. \tag{21}$$

The utility function of government to promote ECER can be expressed as follows:

$$\begin{aligned} \pi(q_H, q_M, q_L) = p_L[R(q_L) - \delta_L \times q_L] + p_M[R(q_M) - (\delta_M \times q_M + \Delta_{ML} \times q_L)] \\ + p_H[R(q_H) - (\delta_H \times q_H + \Delta_{HM} \times q_M + \Delta_{ML} \times q_L)]. \end{aligned} \tag{22}$$

The first-order conditions of utility profit maximization are shown as Equations (23-25):

$$R'(q_H^{\#}) = \delta_H, \tag{23}$$

$$R'(q_M^{\#}) - \delta_M + \frac{p_H}{p_M} \times \Delta_{HM}, \tag{24}$$

$$R'(q_L^{\#}) - \delta_L + \frac{1 - p_L}{p_L} \times \Delta_{ML}. \tag{25}$$

Where $q_H^{\#}$, $q_M^{\#}$, $q_L^{\#}$ are solutions satisfying the above Equations (23-25).

From Equations (7-9) and Equations (23-25), it gets

$$R'(q_H^{\#}) = R'(q_H^{*}),\ R'(q_M^{\#}) > R'(q_M^{*}),\ R'(q_L^{\#}) > R'(q_L^{*});$$

Thus it has:

$$q_H^{\#} = q_H^{*},\ q_M^{\#} < q_M^{*},\ q_L^{\#} < q_L^{*}.$$

Compared with complete information situation, the required investment level on ECER for operating subjects of compact organization with advanced ECER technology under the situation of asymmetric information remain unchanged ($q_H^{\#} = q_H^{*}$). However, the required investment

levels on ECER for operating subjects of semi-compact organization and loose organization under the situation of asymmetric information are reduced, less than their Pareto optimal levels (q_M^* and q_L^*).

In the ideal situation of complete information, subsidies/rewards that operating subjects of FLF supply chain received from government satisfy $b_H^* > b_M^* > b_L^*$. Under the situation of asymmetric information, the reasonable and optimized subsidies/rewards that government pays to operating subjects are shown as follows:

$$b_H^\# = \delta_H \times q_H^\# + \Delta_{HM} \times q_M^\# + \Delta_{ML} \times q_L^\#,$$
$$b_M^\# = \delta_M \times q_M^\# + \Delta_{ML} \times q_L^\#,$$
$$b_L^\# = \delta_L \times q_L^\#;$$

Satisfy $b_H^\# > b_M^\# > b_L^\#$, $b_H^\# > b_H^*$, $b_L^\# < b_L^*$.

It tells that government should implement policy for differentiated subsidies / rewards, and widen the gap of differentiated subsidies / rewards for different types of operating subjects, in order to fully motivate the operating subjects of FLF supply chain under asymmetric information. For government principal, the information-rent to motivate operating subjects of compact organization with advanced ECER technology is $\Delta b_H = \Delta_{HM} \times q_M + \Delta_{ML} \times q_L$; the information-rent to motivate operating subjects of semi-compact organization with intermediate ECER technology is $\Delta b_M = \Delta_{ML} \times q_L$.

3.4. Discussions

Public welfare characteristics and externalities of ECER determine this work is policy dependent. Operating subject of semi-compact organization is generally in the statistical majority, and an important goal of the government's ECER policy should be how to motivate such operating subjects to strive to carry out ECER work, and to avoid possible problems such as adverse selection and moral hazard. Since the objective existence of asymmetry information, the defect of ECER policies from government may lead to operating subjects of semi-compact organization lack of motivation to strive to do a good job of ECER and just complete a minimum standard of ECER considering for their own economic interests. Governments need to propose differentiation polices of incentive compensation, including tax preferential policy and subsidies incentives policy, based on the classification of operating subjects of FLF supply chain.

The basic principles of government policy on ECER should, based on the sufficient subsidy incentive meeting the basic environmental constraints, compensate for market failure by rational use of subsidies, optimize the allocation of resources and promote the smooth and

effective development on ECER of FLF supply chain. Differentiated subsidies / rewards policy should be formulated for different investment level on ECER, widen the gap of differentiated subsidies / rewards for different types of operating subjects and let operating subjects choose the investment level independently according to their ability.

Since the major structure of operating subjects of FLF supply chain will evolve over time, the ECER behavior incentive policy based on the classification of operating subjects should be improved constantly with dynamic adjustment. Government's ECER work cannot accomplish in only one action, it needs to be advanced in stages, and each stage should be matched appropriate detailed rules for ECER policy in according to the current major structure of operating subjects of FLF supply chain.

4. Conclusions

ECER is a systematic project which is government-led, business-oriented and the whole society participates in, covers a wide range and is difficult. Features of ECER determine the entities-related to carry out division of labor and assume their duties. The government is in the dominant position, which should play the role of public service; the operating subject is in the subject position, which should play the dynamic role.

Operating subjects of FLF supply chain can be roughly divided into three types: loose organization, semi-compact organization and compact organization. The ability and motivation of operating subjects to participate in ECER work and their effects are significantly different for different types. Operating subjects of compact organization have the ability to carry out ECER work, and their management goal is relatively consistent with that of ECER work, thus they have power to perform government's ECER policy requirements. Operating subjects of semi-compact organization have ability to carry out ECER work, but their management goal is not relatively consistent with that of ECER work, therefore such subjects are often underpowered for ECER work and the effect of ECER is policy sensitive. Operating subjects of loose organization are lack of ability and often need to pay a considerable cost to carry out ECER work, their management goal is frequently fall in conflict with that of ECER work, therefore such subjects are serious shortage of power to carry out ECER work and the effect of ECER is difficult to guarantee.

Government should introduce some timely policy and incentives on ECER based on the classification of operating subjects of FLF supply chain, widen the gap of differentiated subsidies / rewards for different investment levels on ECER conducted by different operating subjects, and internalize the externalities through a variety of measures, such as guide, motivate and standardize the operating subjects through government subsidies incentives, tax preference and other economic incentives or regulations.

Since the major structure of operating subjects of FLF supply chain will evolve over time, and work target of ECER cannot be achieved without long-term unremitting efforts, the dynamic issues and simulation modeling on behavior incentive mechanism of ECER is worth to be explored in future research.

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