The Application of Reputation Model in the E-literature Procurement of Library

Xin ZHANG
Library of Jimei University, Xiamen, Fujian, China

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Abstract. In the process of e-literature procurement, there is asymmetric information between the library and the e-literature provider. This paper establishes a two-stage reputation model and analyzes the process of repeated games of the designated procurement of E-literature. We find that, although the behavior of the e-literature providers is difficult to be observed, and their efforts level will be lower than the level in the scenario of full information. With the consideration of future earnings, the effort level of the e-literature provider is strictly positive before the last period. Therefore, signing a long-term contract with the e-literature provider is beneficial to the library.

Introduction

With the development of information technology, the number of E-literatures has increased quickly, but their quality is uneven. Only the E-literatures with high quality can be accepted by readers, and will have higher utilization rate. But in the practical work of reader service in the library, there are some facts that the utilization rate of E-literatures purchased with a huge sum of money is still not high. These facts are resulted from asymmetric information between libraries and E-literatures providers. Such as, before signing the contracts of purchasing E-literatures, libraries don’t know about the providing ability, the quality of provided literatures and after-sales service of E-literatures providers. While the E-literatures don’t know about the libraries’ evaluation standard, desiring service level, purchase budget and so on. After signing the contracts, owing to asymmetric information, there are some risk issues, such as, providing period of E-literatures, whether the providers keep their promises, whether the E-literatures can be renewed timely. Therefore, as a principal, it is very significant for the library to adopt a proper incentive mechanism, so that the providers can serve readers in an even better fashion. Whenever incentive mechanism is referred to, people often think that the principal can provide economic benefit, that is, visible reward, to stimulate the agent to provide better service. While the reputation effects are often forgot. On account of this, the incentive role of reputation effect to E-literature providers is worth to research. This paper will use two-stage principal-agent theory to analyze the reputation model which will provide implicit incentive for E-literatures providers. Finally, this paper will also put forth some policy suggestions.

Creating and Analyzing a Reputation Model

Introduction of Reputation Model

Fama (1980) \(^{[1]}\) is the earliest economist who research the reputation model. He thinks that, in a competitive manager market, the market value of a manager is decided by his past performance. In the long run, a manager must take full responsibility for his behaviors. Even though there is not visible incentive contract, a manager also needs to work positively. Because it will improve his reputation in the manager market, consequently his future income may rise. If libraries only sign an once a time contract with E-literature providers, that is, once a time simple game, and libraries can observe the providers’ behavior and use it as evidence to reward or punish the providers. Then the visible incentive contract can be implemented and stimulate the E-literature providers to choose the most advantageous action on the readers. In practice, it is difficult to know the providers’ behavior and the
level of effort. So the long run principal-agent relationship has great advantage. In practice, Sentinel procurement is often adopted in purchasing E-journals and E-books. The contract with fixed annual fee is signed. Libraries pay it in the end or the beginning of a year. The current payment is correlated with the service quality of prior period, that is, libraries will decide the current fee according to the service quality of last period provided by E-literature providers. So, in the form of sentinel procurement, we can treat the relationship of a library and an E-literature provider as a principal-agent relationship of a multiphase repeating game. According to the game theory, if an E-literature provider only pay attention to his short-term profit and don’t care about his reputation, he may maximize his reputation mechanism of E-literature providers can be built up, the inconsistency between E-literature providers’ profit function and libraries’ benefit function can be worked out \(^2\).

**Assumptions of the Reputation Model**

**Assumption 1.** The game between a library and an E-literature provider only have two periods, \(t=1,2\). In every period, the value created by the provider for the library (This value can be described as the visited volume of E-literature by readers) is \(^1\).

\[
\pi_t = \alpha_t + \theta + \mu_t, \quad t=1,2.
\]

(1)

where, \(\pi_t\) is the value created by the provider for the library, \(\alpha_t\) is the effort level of the E-literature provider, \(\theta\) is the operation capacity of the E-literature provider (it is independent of time), \(\mu_t\) is an exogenous random variable (it represents the uncertainty of literature policy, readers’ preference and the change of published literature number). We also assume that, \(\alpha_t\) is the private information of the E-literature provider, and \(\theta\) is common information. \(\theta\) and \(\mu_t\) are subject to independent normal distribution, their means all are 0, \(E\theta = E\mu_t = 0\); their variance are respectively \(\sigma_\theta^2\) and \(\sigma_\mu_t^2\). Furthermore, assume the random variables \(\mu_t\) and \(\mu_t\) are independent with each other, that is, \(\text{cov}(\mu_t, \mu_t) = 0\).

**Assumption 2.** The E-literature provider is risk neutral. His discount rate is 1. Then his utility function is \(^1\).

\[
U=\omega_1 - c(\alpha_1) + \omega_2 - c(\alpha_2)
\]

(2)

where, \(\omega_t\) is the earnings of the E-literature provider in period \(t\). \(c(\alpha_t)\) is his cost of effort (that is the negative utility of working). \(c(\alpha_t)\) has the following nature: \(c'(\alpha_t) > 0\) and \(c''(\alpha_t) > 0\), that is, the cost of effort increases the increasing of effort level. And it is obvious that \(c'(0) = 0, c(0) = 0\).

**Assumption 3.** The E-literature market is fully competitive. The library has the capacity of rational expectation. The relationship between the library and the E-literature provider can only maintain two periods. The period \(t=2\) is the final period. In this period, the provider need not care about his reputation. So, in period \(t=2\), the optimal effort level of the provider \(\alpha_2 = 0\). On the other hand, the earnings of the provider in period 2 depend on the library’s expectation about the operation capacity of the provider \(\theta\). Moreover, the effort level of the provider, \(\alpha_1\), will influence this expectation via \(\pi_1\) (the value produced by the provider in period 1). So, in period 1, the effort level of the provider is greater than 0, that is, \(\alpha_1 > 0\).

**The Analysis of the Reputation Model**

With the above assumption, the actual return of the E-literature provider is equal to the expectation income, that is:

\[
\omega_t = E(\pi_t) = E(\alpha_t) = \overline{\alpha_t}
\]

(3)
\[ \omega_2 = E(\pi_2 | \tau_1) \]  

where, \( \overline{\alpha}_1 \) is the library’s expectation about the effort level of the provider in period 1. \( E(\pi_2 | \tau_1) \) is the library’s expectation about the value produced by the provider for readers in period 2, given that the actual value produced by the provider in the period 1 (this value can be described as the visited volume of E-literature by readers). Owing to \( E(\alpha_1 | \tau_1) = E(\mu_1 | \tau_1) = 0 \), So,

\[ E(\pi_2 | \tau_1) = E(\alpha_1 | \tau_1) + E(\theta | \pi_1) + E(\mu_1 | \tau_1) = E(\theta | \tau_1) \]  

From assumption 3, it can be that \( \overline{\alpha}_1 \) is the actual effort level of the provider when the E-literature market is in equilibrium. However, when the library observes that the value produced by the provider is \( \pi_1 \), the library will know that \( \theta + \mu_1 = \pi_1 - \overline{\alpha}_1 \), but can’t distinguish \( \theta \) and \( \mu_1 \). Namely, the library don’t know whether \( \pi_1 \) comes from the operation capacity of the provider or the uncertain facts \( \mu_1 \) besides the effort level of the provider. So, the library have to infer the operation capacity of the provider \( \theta \) from \( \pi_1 \). Let,

\[ \tau = \frac{\var(\theta)}{\var(\theta) + \var(\mu_1)} = \frac{\sigma^2_\theta}{\sigma^2_\theta + \sigma^2_\mu} \]  

\( \tau \) is the ratio between the variance of \( \theta \) and the variance of \( \pi_1 \). The greater \( \sigma^2_\theta \) is, the greater \( \tau \) is. According to the formula of rational expectation and assumption 1, \( E\theta = 0 \). There is:

\[ E(\theta | \pi_1) = (1 - \tau)E(\theta) + \tau(\pi_1 - \overline{\alpha}_1) = \tau(\pi_1 - \overline{\alpha}_1) \]  

The above formula indicates that, given \( \pi_1 \), the library’s expectation of \( \theta \) is the weighted average of the prior expectation of \( E\theta \) and the observed value \( (\pi_1 - \overline{\alpha}_1) \). The library will correct her judgement about the operation capacity of the provider \( (\theta) \) according to her observation. \( \tau \) indicates the information of \( \theta \) included in \( \pi_1 \). The greater \( \tau \) is, the more information \( \pi_1 \) includes. If \( \tau = 0 \), it means that there is not prior uncertainty\( (\sigma^2_\theta = 0) \), the library need not correct her judgement about the operation capacity of the provider \( \theta \). If \( \tau = 1 \), it means that, the prior uncertainty is very large\( (\sigma^2_\theta \rightarrow \infty) \), or there is not exogenous uncertainty\( (\sigma^2_\mu = 0) \). The library will correct her judgement about the operation capacity of the provider \( (\theta) \) completely according to the observation of \( \pi_1 \) (the value produced by the provider in period 1). In general, \( \tau \) is between 0 and 1.

Given \( \tau > 0 \), the equilibrium return of the E-literature provider in period 2 is \( \omega_2 = E(\theta | \pi_1) = \tau(\pi_1 - \overline{\alpha}_1) \). It means that, the greater the value produced by the provider in period 1 is, the more his return in period 2 is. Put \( \omega_1 \) and \( \omega_2 \) into the utility function of the provider Eq.2, we can get:

\[ U = \overline{\alpha}_1 - c(\alpha_i) + \tau(\alpha_i + \theta + \mu_1 - \overline{\alpha}_1) - c(\alpha_i) \]  

The first order optimal condition of the provider is:

\[ c'(\alpha_i) = \tau > 0 \Rightarrow \alpha_i > 0 \]  

The above formula indicates that, although the effort level of the provider is not large as that in the condition of symmetric information\( (c'(\alpha_i) = 1) \), considering her reputation, the effort level of the provider in period 1 is strictly greater than 0. Furthermore, the greater \( \tau \) is, the provider will pay more attention to the reputation effect, and the stronger the degree of reputation incentive is.
So, if we extend this two-stage game to N-stage game, besides the effort level of the provider in the final period is 0 (\(\alpha_N = 0\)), the effort level in all other N-1 period is greater than 0, \(\alpha_{N-1} > 0\). Furthermore, with the contract approaching to its end, the effort level of the provider with decrease with time, namely, \(\alpha_N > \alpha_2 > \cdots > \alpha_{N-1} > \alpha_1\).

**Conclusions and Suggestion**

From above analyzing of reputation model, the following enlightments can be found: the reputation mechanism has self-motivation, constraint and supervision roles on the E-literature provider. The reputation of the provider in prior period will strongly impact her utility of following periods. Once her reputation is lost, it need very high cost to rebuild it. So, it is important to use reputation mechanism in the practice of library E-literature procurement. Owing to it is still unsophisticated to wield the reputation mechanism in lots industries, the following issues should be considered:

**Information Disclosure System of E-literature Providers Should Be Established**

In every period of the contract signed with the provider, the library need to count and disclose the value produced by the provider, and disclose the information of post-sale service performance (such as, whether the provider keeps promises, and renew E-literatures timely), the period of supplying E-literature and so on, so as to encourage the provider to act in the most favourable fashion to readers. If the provider has dishonest recorders, the library should terminate the contract with her, so as to compel the provider cherish her reputation. In the meantime, the dynamic communication channel should be built, let the library and the provider keep communication for information regularly or irregularly.[5]

**Building the Reputation Evaluation System of the E-literature Provider**

After signing a contract with a provider, a library should objectively evaluate the provider in every period. Through the process of revaluating, it can stimulate the provider to work hard constantly and to enhance her own value. When the value produced by the provider becomes lower, the library would give the provider lower evaluation. The reputation of the provider would decline, and then she would face the situation of substituted by another provider. So, only when the library rewards or punishes the provider according to the accurate information of her reputation, the incentive and constraint role of the reputation mechanism would work.

**References**


