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Research on Independent Knowledge Transaction Within Enterprise

LIU Zhongcheng[a],*; LI Hongyu[a]

[a] Finance & Economics Department, Shandong University of Science & Technology, Jinan, Shandong Province, China
* Corresponding author.

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Abstract
Knowledge innovation depends on knowledge sharing. It is possible to exchange knowledge products between suppliers and demanders in knowledge market within enterprise. After the analysis of how to price knowledge product, the bargain mechanism is researched respectively under complete information and incomplete information. Furthermore, with the analysis of defects of independent transaction, the effective method for knowledge transferring and sharing within enterprise is put forward.

Key words: Enterprise; Knowledge product; Knowledge sharing; Independent transaction

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INTRODUCTION
During recent years, there is an ongoing hot topic in academic and business circles that is how to conduct knowledge management effectively. Many large enterprises do not hesitate to pay large sum of money for the practice of knowledge management to improve their innovative abilities and accelerate the market reactive speed through the formation of knowledge sharing mechanism. The premise of knowledge sharing is that the knowledge owners contribute their knowledge to others. On one hand, knowledge owners could gain interests or advantages, so they do not want to contribute their knowledge easily; on the other hand, in the daily work and research activities, the complexity of information and limitation of personal knowledge restrict the personal processing power, so people can not master all knowledge they need, and this leads to the demand to obtain other's knowledge, which forms the basis of knowledge market within enterprise.

Knowledge market transaction within enterprise is that demanders of knowledge master what they want through the deal with knowledge suppliers. Knowledge transaction is the foundation of knowledge sharing, and through the transaction, knowledge products can be transferred from suppliers to demanders. Knowledge products are divided into two types: explicit knowledge and implicit knowledge. However, the two kinds of knowledge transaction are different from each other during the actual transaction process. Usually, explicit knowledge can be transferred though only one deal, but the trade of implicit knowledge, from the discovery of knowledge to reach a deal and be transferred in the end, often needs several continuous processes.

According to the enterprise whether interpose the transaction of internal knowledge market, the means of knowledge exchange can be divided into two types: independent transaction and management participatory transaction(Ying & Qian, 2010). Independent transaction means the trade of knowledge products is conducted among individuals independently, and enterprise's managers are not involved in. Management participatory transaction means the enterprise provides convenient conditions for knowledge transaction and favorable incentive to propel knowledge transfer among individuals, or between individuals and the enterprise, so as to realize the process of knowledge transaction.

1. BARGAINING ANALYSIS OF INDEPENDENT TRANSACTION UNDER COMPLETE INFORMATION

First of all, according to the characters of knowledge product, we discuss a simple case. Assume that, for a certain knowledge product to trade, supply and demand market takes on bilateral monopoly characteristics. It means there is only one buyer and one seller in the market, so the competition relationship between the demander and supplier will no longer be considered. It is supposed that the supply cost of knowledge product is c, and utility of knowledge product is v. When $c \geq v$, it means knowledge product does not have exchange value; when$c < v$, it is considered that the transaction price $p \in [c, v]$ is pareto optimality from the point of view of society, so the profits of buyer and seller are v-p and p-c, and the total trade surplus is v-c. The game process of pricing knowledge product is actually a carving up process for the sales income v-c of knowledge product for the buyer and seller. Following Rubinstein's modeling method (Song, 2005), we will analyze the bargaining process and the transaction price which is decided by sub-game refined equilibrium. Above all, we have to make sure that bargaining rules are as follows: the seller bids firstly, and then the buyer decides to refuse or accept the price, if the buyer accepts the price, the bargaining process will be over; if rejects, then goes into the next round, where the buyer offer a price, and the seller decides whether or not to accept it, if rejected, then goes into the next round again, such a cycle over and over again. Each bid to give a price x, and it means the share that the seller gains from sales benefits, so (1-x) represents buyer's share in the total surplus. Suppose that parameter δ is the discount rate, when $0 < \delta < 1$, discount rates of the buyer and the seller are δ_b and δ_s, when the game ends in the t-th period, the present value that the seller shares the surplus is $y_s=\delta_s^{t-1}x_t$, and the present value which the buyer shares the surplus is $y_b=\delta_b^{t-1}(1-x_t)$, so the bigger is t, and the smaller is the discount profits. According to the research of Rubbinstein (Rubinstein, 1982), taking turns to offer in a game indefinitely, the only sub-game refined Nash equilibrium result is provided directly as follows:

$$x^* = \frac{1-\delta_b}{1-\delta_s\delta_b} \tag{1}$$

Thereby, it could get the balance of the transaction price:

$$p^* = c + \frac{1-\delta_b}{1-\delta_s\delta_b}(v-c) \tag{2}$$

Now discuss the economic meaning of above model based on equation (1). The greater the parameter δ is, the more patient the participants have; conversely, the smaller the parameter δ is, the little patience the participants have, which means the participants urgently look forward to an early end to the bargaining process.

According to $\frac{\partial x^*}{\partial \delta_s} = \frac{(1-\delta_b)\delta_b}{(1-\delta_s\delta_b)^2} > 0, \frac{\partial x^*}{\partial \delta_b} = \frac{(\delta_s-1)}{(1-\delta_s\delta_b)^2} < 0$

It is clear that the share of seller is in proportion to his patience, and it is in inverse proportion to the buyer's patience. When the buyer has no patience, the seller gets the entire surplus; however, when the seller has no patience, the buyer gets share surplus. When $\delta_s=\delta_b$, which means both sides have the same patience, the seller's share is simplified to $x^*=1/(1+\delta)$; if both sides have complete patience at present, that is $x^*=1/2$, which means both sides share the surplus equally. So the share allocation of knowledge product transaction is based on the patience of the buyer and seller, and the urgency of the buyer and seller affects the efficiency of knowledge product transaction. More urgent the buyer is, more surplus the seller could gain, meanwhile, it could improve the trading efficiency. Likewise, the reverse is also true for the seller.

2. BARGAINING ANALYSIS OF INDEPENDENT TRANSACTION UNDER INCOMPLETE INFORMATION

Under complete information situation, the buyer and seller bargain for the distribution of sales revenue, which is decided by discount factors of both sides. However, in practice, the buyer does not understand the cost that the seller paid for during the process of creating the knowledge product; at the same time, the seller also does not familiar with the purpose and utility that the buyer buy the knowledge product. Especially, if a long-term business relationship can not be set up between the buyer and the seller, the assumption that cost and utility are considered as public knowledge can not be established. The pricing model under incomplete information we are going to talk about is to turn knowledge cost and utility into private information, which is mainly based on the both-offer model of Chatterjee and Samuelson (Rubinstein, 1982; Chatterjee & Samuelson (1983), and the both-offer auction model of Zhang Weiying (Zhang, 2007).

Assuming that supply cost c of knowledge product is private information of the supplier, and c~U[0,a] is public information; knowledge utility v is private information of the demander, and v~U[0,b] is public information. Bids of the seller and the buyer are p_s, p_b, and then both sides make sure a sharing ratio k of p_b-p_s through infinite times bargaining, here k has the same meaning with x^* in equation(1). According to equation (2):

$$p = p_s + (p_b - p_s)k = kp_b + (1-k)p_s$$

In this Bayesian game, the seller's asking price p_s is the function of c, and the buyer's asking price p_b is the function of v, so there is a Bayesian equilibrium, namely

strategic combination ($p_s^*(c)$,$p_b^*(v)$). This game has many Bayesian equilibriums, in order to limit the number of Bayesian equilibriums we assume that both the buyer and the seller are to take linear bidding strategies, so it is given that:

$p_s(c)=\alpha_s+\beta_s c, c\sim U[0,a]$

$p_b(v)=\alpha_b+\beta_b v, v\sim U[0,b]$

The optimal solution of the buyer is the solution of buyer's objective function:

$$\max_{p_b}\left\{v-\left[kp_b+(1-k)E(p_{s(c)}\left|p_{s(c)}\le p_b\right.)\right]\right\}\Pr ob\left\{p_b\ge p_{s(c)}\right\}$$

Here, $E(p_{b(v)}\left|p_s\le p_{b(v)}\right.)$ is the seller's asking price expected by the buyer, which is under the condition that the given seller's asking price is lower than the buyer's offer.

The optimal solution of the seller is the solution of seller's objective function:

$$\max_{p_s}\left\{\left[(1-k)p_s+kE(p_{b(v)}\left|p_{b(v)}\ge p_s\right.)-c\right]\right\}\Pr ob\left\{p_{b(v)}\ge p_s\right\}$$

Here, $E(p_{b(v)}\left|p_s\le p_{b(v)}\right.)$ is the buyer's asking price expected by the seller, which is under the condition that the given seller's asking price is lower than the buyer's offer.

Because c is uniform distribution on $[0,a]$, so p_s is uniform distribution on $[\alpha_s,\alpha_s+\beta_s a]$. Therefore, we get the following equation:

$$Prob\left\{p_b\ge p_s(c)\right\}=\Pr ob\left\{p_b\ge\alpha_s+\beta_s c\right\}=\Pr ob\left\{c\le\frac{p_b-\alpha_s}{\beta_s}\right\}=\frac{p_b-\alpha_s}{a\beta_b}$$

$$E\left[p_s(c)\left|p_b\ge p_s(c)\right.\right]=\frac{\frac{1}{\alpha\beta_s}\int_{\alpha_s}^{p_b}xdx}{Prob\left\{p_b\ge p_s(c)\right\}}=\frac{1}{2}(\alpha_s+p_b)$$

Substituted into the buyer's objective function:

$$\max_{p_b}\left\{v-kp_b-\frac{1}{2}(1-k)(\alpha_s+p_b)\right\}\frac{p_b-\alpha_s}{a\beta_s}$$

The optimal first-order condition means:

$$p_b=\frac{1}{k+1}(v+k\alpha_s)\qquad(3)$$

Similarly, v is uniform distribution on $[0,b]$, so p_b is uniform distribution on $[\alpha_b,\alpha_b+\beta_b b]$, so:

$$Prob\left\{p_b(v)\ge p_s\right\}=\Pr ob\left\{\alpha_b+\beta_b v\ge p_s\right\}=\Pr ob\left\{v\ge\frac{p_s-\alpha_b}{\beta_b}\right\}=1+\frac{\alpha_b-p_s}{b\beta_b}$$

$$E\left[p_b(v)\left|p_b(v)\ge p_s\right.\right]=\frac{\frac{1}{b\beta_b}\int_{p_s}^{\alpha_b+\beta_b}xdx}{Prob\left\{p_b(v)\ge p_s\right\}}=\frac{1}{2}(\alpha_b+b\beta_b+p_s)$$

Substituted into the seller's objective function:

$$\max_{p_s}\left\{\frac{1}{2}k(\alpha_b+b\beta_b+p_s)+(1-k)p_s-c\right\}\frac{\alpha_b+b\beta_b-p_s}{b\beta_b}$$

The optimal first-order condition means:

$$p_s=\frac{1}{2-k}\left[(1-k)(\alpha_b+b\beta_b)+c\right]\qquad(4)$$

Based on $p_s(c)=\alpha_s+\beta_s c, p_b(v)=\alpha_b+\beta_b v$, solve the two first-order equations (3) and (4), and the Bayesian equilibrium is given as follows:

$$p_b=\frac{k(1-k)}{2(k+1)}b+\frac{1}{k+1}v;\ p_s=\frac{1}{2}b(1-k)+\frac{c}{2-k}$$

Based on the discussion and analysis for the above models, it is clear that:

The sales revenue distribution of the buyer and the seller is decided by discount factors of both sides. When discount factors of the buyer and the seller are δ_b and δ_s, then $k=\frac{1-\delta_b}{1-\delta_s\delta_b}$.

When the buyer has no patience at all, namely $\delta_b=0$, $k=1$, and the Bayesian equilibrium is $p_s=c$, $p_b=v/2$. When $p_b>p_s$, the transaction price is $p=p_b=v/2$.

When the buyer has complete patience ($\delta_b=1$), and the seller's patience is relatively not enough ($\delta_s<1$), and then $k=0$. At this time, the Bayesian equilibrium is $p_s=(b+c)/2$,$p_b=v$, and then the transaction price is $p=p_s=(b+c)/2$.

When the buyer and the seller have the same and infinite patience ($\delta_b=\delta_s=\delta=1$), $k=1/2$. Now the Bayesian equilibrium is: $p_s=\frac{1}{4}b+\frac{2}{3}c, p_b=\frac{1}{12}b+\frac{2}{3}v$

The transaction price is:

$$p=\frac{1}{2}(p_s+p_b)=\frac{1}{6}b+\frac{1}{3}(v+c)$$

3. THE DEFECTS OF INDEPENDENT TRANSACTION

Bargaining is the most direct and effective way of reaching a consensus and sharing information among the participants, and the final price of the knowledge product can be obtained from the analysis of above models. However, there are a lot of obstacles in the actual operation process of independent knowledge product transaction. In addition, the above models also have some defects in the concrete practice process, and it is mainly manifested in the following aspects:

Firstly, according to the both-offer model of Chatterjee and Samuelson, the concrete price of knowledge product can be finally determined through the bargaining mechanism, but we found the above determinate price of knowledge product only had theoretical guidance function and short of concrete value. According to the final conclusion of the models, it is clear that the final price of knowledge product depends on discount factors of the buyer and seller, and it also means patience degree, cost of knowledge product c and utility v. But in the actual operation process of knowledge product transaction, the seller usually cannot completely make sure his production cost of knowledge product. Because different sellers' personal intellectual level, the knowledge content and education experience are different, the production

costs are different for the knowledge products with the same function, which makes the supply cost of private information c difficult to be quantified. Meanwhile, the utility of the knowledge product is hard to confirm because of different purchasing purpose and use value after purchase, so v in the models is also difficult to determine. Additionally, because of the unpredictability of the buyer and seller, the discount factors of both sides are constantly changing and difficult to determine during the process of negotiation. So eventually the above models only have the theoretical guidance function, which can help people understand the bargaining strategies of both sides and know the price of knowledge product under the determinate c and v, but there is poor maneuverability in the actual operation process of knowledge product transaction.

Secondly, due to the participants's some bad attempts, it maybe provide false information in the bargaining process, or maybe doubt the other party's bargaining motive and information, and thus for speculation or fraud, which may cause the loss of potential gains from other participants, and make every participant not be willing to firstly publish the offer (Zhang, 2007). Such as the seller has a minimum sales price l_s, and the buyer has a maximum purchasing price h_b, at the beginning, if the buyer provides the purchase price $h_b > l_s$, according to the general situation, the seller will not directly accept the buyer's offer, in most cases, even if the trader has been satisfied with the bid, he usually continues to strive for a better price. So, at this time, the seller may refuse h_b, and modify his lowest sale price l_s into h_b, which would cause the loss of potential profits $h_b - l_s$. Similarly, when the seller bids firstly, the buyer may modify his private information secretly. It will cause the income loss and make the bargaining process longer, and sometimes even failure.

Thirdly, in the real bargaining process, people often mutually quote the price, and according to the first price to revise their next offer, in order to achieve that the knowledge products could trade successful eventually. But in bargaining process there are loopholes because of public bids, which would make some participants to exploit an advantage and damage the interests of rightful traders. Especially, if a participant's real purpose of trading knowledge product is not to deal with his opponent, but only wants to collect more accurate product price information through the negotiation process, so that he can be in a better position during the real negotiation process in the future. Such as the following special case, the seller *S* based on sincerity, but buyer *B* tries to get more exact information of the product price. Assume that the seller has a minimum sales price l_s=120 and the most ideal sales price h_s=200; and the buyer's highest bid price h_b=210, the most ideal purchasing price l_b=130. In the fourth stage of bargaining process, the buyer quits because the seller has no sincerity. The bargaining situation is shown in Table 1:

Table 1
Bargaining Sequence

Stage	The buyer B's offer	The seller S's offer
1	100	200
2	110	190
3	115	170
4	120	170

From Table 1 we can see that the buyer's last offer 120 is not higher than his ideal price 130 before the bargaining is over, and his biding sequence does not match his private information, but he still gains a lot from the bargaining process. Based on *S*'s last offer 170, *B* can get a very important conclusion that he mostly needs to pay 170 to buy this knowledge product. According to this information, *B* will drop his highest purchasing price h_b from 210 to 170 or even lower. Thereby, the seller will be in a disadvantage situation in the next bargaining process because of the information leakage, which would harm the seller's normal rights and interests.

CONCLUSION

Based on above analysis, it could not be analyzed whether the knowledge product is valuable, how much value it has, and how to price it simply according to the cost plus and utility of the knowledge product. Considering respective demand, credibility, knowledge distance, urgency and cognitive difference, there should be a price interval accepted by both sides instead of a single price based on the cost and utility of the knowledge product, especially within the enterprises, and both sides had better negotiate with the participation of the manager who can help make a reasonable price interval to promote the transaction, transfer and sharing of knowledge products.

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