

## Research on Pricing Negotiation of New Product Processing Outsourcing of High-Tech Enterprises

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### Abstract

**More and more enterprises choose to outsource production with the continuous development of economic globalization and the intensification of market competition, so how to set the outsourcing price of product production is particularly important. Based on the bargaining chains theory, this paper analyzes the structure of the target company and its supply chain to formulates an acceptable outsourcing production price range for new products. At the same time, a numerical case study and a simulation analysis are carried out on the two-stage supply chain negotiation model to obtain the influence of product quality and suppliers' bargaining power on the outsourcing price of products. Finally, suggestions on price negotiation are put forward for the managers.**

### Keywords

**Bargaining chains; pricing negotiations; decision support; supply chain coordination.**

### 1. Introduction

With the continuous development of economic globalization and the aggravation of market competition, the "horizontal integration" of supply chain is deepening, and the renewal of products is also accelerating. More and more manufacturers choose to hand over the production and even research and development of molecular system in the middle of products to other enterprises because of various reasons. This phenomenon is common in many industries, such as electronic equipment manufacturing, automobile manufacturing, software development and so on. The main reasons why enterprises choose the mode of production outsourcing are as follows: rapid response to the market, cost saving and capital pressure relief, focusing on core competence. However, in recent years, product quality problems have been reported frequently. There are many of the world's world-class enterprises. The quality problem is inevitable in large enterprises, which not only affects the normal production and sales of the enterprise, but also has an inestimable impact on the enterprise image. If we investigate the reasons behind the quality problem, we can find that this is not only caused by the mistakes of the leading enterprises, but also the failure of the enterprises at all levels in the supply chain may lead to the final product quality is not up to standard. It is found that the reason why the product quality is not less than 20% is the raw materials, the outsourced parts are not up to standard, and the mechanical and electrical products provided reach 40%. It can be seen that the quality of the supplier's products has an important influence on the quality of the final product. Therefore, when the manufacturer and enterprise outsource the product production, it is necessary to use the appropriate quality control means to monitor the supplier and reduce the failure cost, so that the profit can be guaranteed. Certificate.

To sum up, in today's era, the global market competition is increasingly fierce, outsourcing mode makes enterprises ushered in a rare opportunity, but also facing severe challenges. We find that the competition between enterprises has already changed greatly, and the competition

between enterprises has become the trend of the times. The mutual competition among enterprises has evolved into the competition between supply chains, and the enterprises have become the core strategy of market competition by cooperating with strategic partners to perfect their own supply chain system and pursue the maximization of the overall benefits. An enterprise wants to compete in the market. To achieve outstanding results in the competition, we must manage our own supply chain.

## 2. Literature References

In this paper, based on the theory of the negotiation chain established in the paper, Lovejoy [1], the pricing negotiation mechanism of the two parties is put forward in consideration of the influence of the product quality and the bargaining power. A supply chain structure with multi-tier multi-enterprise is set up. In this supply chain, an enterprise designs a new product, it is expected to push it to the market, but the enterprise cannot control and ownership of the resources that make up the product. You must obtain the required resources by selecting a supplier enterprise upstream, and so on. Make a reasonable price by selecting the appropriate supplier. If the product components are obtained, the product can be combined and produced successfully to the market. In such a market, the author divides the transaction process of the supply chain enterprise of the network structure into two parts: Vertical transactions (the supply chain has multiple layers and each layer has only one enterprise to form the chain supply chain) and horizontal competition (the one-to-one selection between the upstream and downstream of any adjacent upstream and downstream of the supply chain). Lovejoy analyzes the structure of a complete network supply chain as above, and makes a reasonable transaction price inquiry through the cost difference between the enterprises, and the cost difference reflects the competitiveness of the enterprises and decides the intersection between them. Easy and cooperative.

Adida and DeMiguel (2011) [1] studied a competitive supply chain system. In the model, they allowed both parties to conduct non-exclusive transactions and set the manufacturer as the leader of Stackberg's game. Feng and Lu (2012) [3] established a two-tier supply chain system model, which includes two competing manufacturers and two competing retailers. They added wholesale price contracts and two-part fee contracts to the system and compared bilateral bargaining with the Stackberg game. Through research and analysis, they proved that under certain scenarios, Stackberg's game could be equivalent to the marginal case of bargaining game, but in reality, it could not predict the performance of contract like bargaining game. Zhang(2012)[6] et al. established a game model based on real-time quality control and analyzed the formulation of quality control strategies in the process of product batch ordering in a two-stage supply chain. Paksoy(2012)[8] analyzed how to design quality strategy among supply chain enterprises. Nair, Narasimhan, and Bendoly (2011)[16] show that the relative bargaining power in the supplier-buyer relationship can be adjusted by the relative endowment of key resources. Therefore, a behavioral experiment can be designed to test the dynamic evolution of bargaining power. Gurnani and Shi(2006) use the Nash bargaining model to solve the incentive compatibility problem in a single supply chain, in which both buyers and sellers have a single metric information about supply delivery. Feng and Lu (2013) [17] studied the low-cost outsourcing behavior of competitive manufacturers under the framework of multi-unit bilateral negotiation. They found that manufacturers with low bargaining power were more likely to suffer from outsourcing (even if they were positioned as low-cost suppliers). Baron (2016) [18] wants to investigate the influence of bargaining power in an industrial chain, and points out that in mature industries, the main determinant of equilibrium is to make a good response to the behavior of competitive chain rather than directly maximize the profit of each chain. In other words, equilibrium may not maximize profits for the whole industry.

### 3. Problem Description and Symbolic Description

This paper assumes that a new high-tech company produces a new product, but decides to outsource the manufacturing production to a special outcontractor. At first there was only one high-tech  $M1$  enterprise in the monopoly market and an outsourcing company  $O1$ . However, with the gradual breakthrough of technology, the product has entered new manufacturing  $M2$  enterprises in the market and the new outsourcing company  $O2$ .

The symbols used in the model are described as follows:

- $c_1$  : The original outsourced  $M1$  in the market the unit cost of producing the product;
- $c_2$  : Foreign contractors  $M2$  who participate in the market after taking part in the market. Unit cost of production;
- $D$  : Quantity of market demand for new products;
- $P$  : Unit retail price of the product;
- $w_i$  : High-tech  $Mi$  enterprise Intermediate wholesale prices traded with production contractors, and  $i = 1, 2$ ;

### 4. Modeling and Analysis.

#### 4.1. Case 1:One Manufacturer and One Outsourcer

In the initial cooperative market, only the manufacturer  $M1$  and the outsourcer  $O1$  have a one-to-one two-tier supply chain cooperative relationship. The manufacturer shall turn all products to the subcontractor for production, and the subcontractor shall be responsible for purchasing necessary raw materials and shall be obliged to report to the manufacturer. The manufacturer and the outsourcer are equal partners. The two companies share the product profits and share the total profits equally.

Describe the amount of market demand, where  $A$  and  $B$  represent market constants:

$$D(q) = A - Bp$$

Then the profits of the manufacturer and the outsourcer are:

$$\pi_{M1}^1 = 0.5 * (p - c_1)(A - Bp)$$

$$\pi_{O1}^1 = 0.5 * (p - c_1)(A - Bp)$$

Thus, it can be concluded that the wholesale price of products of manufacturers and retailers is:

$$w_1^1 = 0.5 * (p + c_1)$$

#### 4.2. Case 2:One Manufacturer and Two Outsourcers

With the development of market demand, other external products  $O2$  gradually enter the market and produce the same products  $O1$ . The original supply chain has an effect, and the original one-to-one supply chain structure becomes the two-to-one structure. We assume that the post-entry enterprise resource is weak, so  $c_1 < c_2$ .

Suppose the outsourced contractor  $O2$  is irrational, then  $O1$  want to get cooperation with  $M1$ , it must be quoted:

$$w_1^2 = C_2$$

Then the outsourced contractor  $O1$ 's profits are as follows:

$$\pi_{O1}^2 = (c_2 - c_1)(A - Bp)$$

It can be seen that, at this time, the profit of the external enterprise  $O1$  is actually determined by the cost difference of itself and the competitor, and the profit of the unit product is the difference of the cost of the two competitors.

The remaining profits in the market of Manufacturer  $M1$  are obtained:

$$\pi_{M1}^2 = (p - c_2)(A - Bp)$$

If the outsourced contractor  $O2$  is rational, according to the negotiation chain theory, outsourcing  $O1$ 's Profit:

$$\pi_{O1}^2 = 0.5 * (c_2 - c_1)(A - Bp)$$

Manufacturer  $M1$ 's Profit:

$$\pi_{M1}^2 = [p - 0.5 * (c_1 + c_2)]Q$$

From this, we get the wholesale price of the product manufacturer  $M1$  and outsourcing  $O1$ .

$$w_1^2 = 0.5 * (c_1 + c_2)$$

### 4.3. Case 3: Two Manufacturers and Two Outsourcers

The technology is gradually updated, and other high-tech  $M2$  enterprises enter the market and form two-to-two supply chain levels in the market. At this time, it is no longer a monopoly position, and the price of its external package needs to take into account the influence of the bargaining power  $\lambda_1$ . The use of profit as the maximum objective is not reasonable, and the utility  $U$  can be used to describe:

$$U = \pi_{M1}^\lambda * \pi_O^{1-\lambda}$$

There is a unique market optimal price for manufacturer  $M1$ :

$$P = \frac{A + Bw}{2B}$$

There is an equilibrium solution in Nash game:

$$w = \frac{A + Bc_1 - \lambda_1(A - Bc_1)}{2B}$$

In the equilibrium solution of wholesale contract under Nash game, the optimal profit ratio between manufacturer and outcontractor increases with the enhancement of retailers' bargaining power, and the ratio increases  $Y > 0.5$ . That is, manufacturers have inherent advantages.

## 5. Summary

The price negotiation between two adjacent layers of the supply chain is analyzed, and the two-layer bargaining module is connected into a supply chain of arbitrary length to give the pricing method. Analyze the structure of the target company and its supply chain, and determine the acceptable outsourcing price range for new products. In the case of uncertain market demand, considering the impact of new product quality and suppliers' bargaining power on the outsourcing price of production, this paper solved the market equilibrium outsourcing price of new product production based on Nash bargaining game with maximum social benefit as the objective function. In the two-stage supply chain formed by manufacturers and outsources, four different supply chain structures are analyzed and the equilibrium price under each structure is given to provide decision support for manufacturers' negotiation.

## References

- [1] Lovejoy W S. Bargaining Chains [J]. *Management Science*, 2010, 56(12): 2282-2301.
- [2] Adida E, Demiguel V. Supply Chain Competition with Multiple Manufacturers and Retailers [M]. 2011.
- [3] Feng Q, Lu L X. Supply Chain Contracting Under Competition: Bilateral Bargaining vs. Stackelberg [J]. *Production & Operations Management*, 2013, 22(3): 661-675.
- [4] Cui H, Tony, Raju, et al. Fairness and channel coordination [M]. 2007.
- [5] Qi F, Lai G, Lu L X. Dynamic Bargaining in a Supply Chain with Asymmetric Demand Information [J]. *Management Science*, 2014, 61(2): 301-315.
- [6] Zhang S, Wang F, Dakuo H E, et al. Real-time product quality control for batch processes based on stacked least-squares support vector regression models[J]. *Computers & Chemical Engineering*, 2012, 36(1): 217-226.
- [7] Bernstein F, Federgruen A. Decentralized Supply Chains with Competing Retailers Under Demand Uncertainty [J]. *Management Science*, 2005, 51(1): 18-29.
- [8] Paksoy T, Pehlivan N Y, Kahraman C. Organizational strategy development in distribution channel management using fuzzy AHP and hierarchical fuzzy TOPSIS [J]. *Expert Systems with Applications*, 2012, 39(3): 2822-2841.
- [9] Baiman S, Fischer P E, Rajan M V. Information, Contracting, and Quality Costs [M]. 2000.
- [10] Lim W S. A lemons market? An incentive scheme to induce truth-telling in third party logistics providers [J]. *European Journal of Operational Research*, 2000, 125(3): 519-525.
- [11] Balachandran K R, Radhakrishnan S. Quality Implications of Warranties in a Supply Chain [J]. *Management Science*, 2005, 51(8): 1266-1277.
- [12] Tapiero C S, Kogan K. Risk and quality control in a supply chain: competitive and collaborative approaches [J]. *Journal of the Operational Research Society*, 2007, 58(11): 1440-1448.
- [13] Iyer G, Villasboas J M. A Bargaining Theory of Distribution Channels [J]. *Journal of Marketing Research*, 2003, 40(1): págs. 80-100.
- [14] Ertek G, Griffin P M. Supplier- and buyer-driven channels in a two-stage supply chain [J]. *Iie Transactions*, 2002, 34(8): 691-700.
- [15] Dukes A J, Gal-Or E, Srinivasan K. Channel Bargaining with Retailer Asymmetry [J]. *Journal of Marketing Research*, 2006, 43(1): 84-97.
- [16] Nair A, Narasimhan R, Bendoly E. Coopetitive Buyer-Supplier Relationship: An Investigation of Bargaining Power, Relational Context, and Investment Strategies [J]. *Decision Sciences*, 2011, 42 (1): 93-127.
- [17] Feng Q, Lu L X. The Strategic Perils of Low Cost Outsourcing [J]. *Management Science*, 2013, 58 (6): 1196-1210.
- [18] Baron O, Berman O, Wu D. Bargaining within the Supply Chain and Its Implications in an Industry [J]. *Decision Sciences*, 2016, 47(2): 193-218.