

# Theoretical Analysis on the Pricing and Advertising Coordination of Multi Retailer Supply Chain from the Perspectives of Common Interest Maximization

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## Abstract

*With the arrival of global economic integration, the enterprise gradually realized the joint and downstream enterprises form a complementary advantage on its importance to enhance the overall competitiveness of the supply chain. To deal with the corresponding challenges, in this paper, we conduct research on pricing and the advertising coordination of multi retailer supply chain from the general perspectives of common interest maximization. For the two stage supply chain consisting of a single manufacturer and single retailer as the background, study retailers to establish online channel and manufacturers to establish the online channel and applicable condition, the difference between two kinds of the channel model and double channel of supply chain coordination mechanism. The core idea of supply chain management is focus on supply chain node enterprise specializing in their core business, and outsources non-core business to other enterprises, so as to achieve supply chain of all enterprises focus on their good at business. Our research optimizes the traditional game theory framework to achieve the better model for the issues. The experimental analysis verifies the feasibility and the effectiveness of our approach compared with the others.*

**Keywords:** *Multi Retailer; Interest Maximization; Pricing and Advertising; Game Theory; General Coordination; Mathematical Modelling; Optimization*

## 1. Introduction

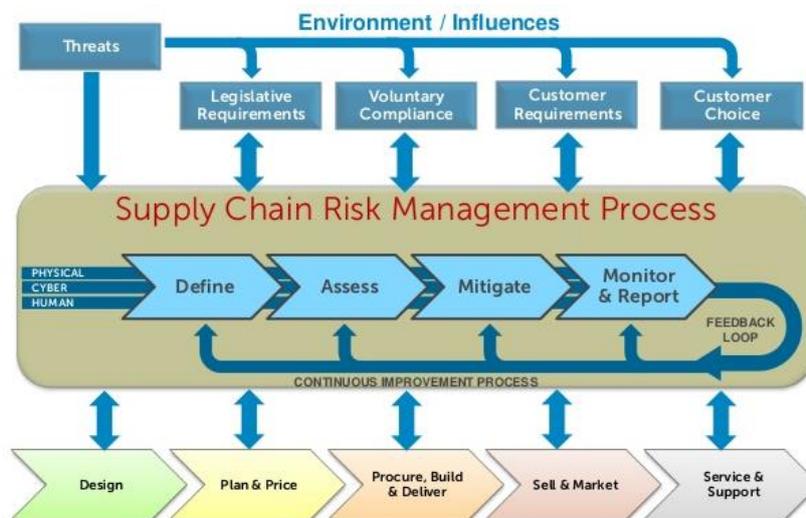
With the arrival of global economic integration, the enterprise gradually realized the joint, the downstream enterprises form a complementary advantages on its importance to enhance the overall competitiveness of the supply chain, so different degree, and different levels of the supply chain arises at the historic moment, which makes the operation coordination and the cooperation between supply chain members problem has attracted widespread attention. If is the integration of the supply chain, namely the members belong to the same economies, so at this time all the interests of the members of the target is consistent, easy to realize the supply chain coordination. However, most of supply chain of real integration, that is, the members of the supply chain is belong to different companies, so each member after is the maximization of self-interest, and its goal is often conflict, this makes the operation strategy of coordination between each member becomes quite difficult, how to design suitable incentive mechanism to induce better coordinate supply chain become one of hot issues of supply chain management theory research. Referring to the literature review, the general reform of modern supply chain can be categorized as the listed aspects. (1) Under the environment of supply chain mode of the

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production in the collaborative production. To accomplish collaborative production and supply of this objective, it is bound to achieve organizational management structure of the flat and the network management of the whole. (2) Multi-agent organization model is established. Production operation plan decision model of supply chain is distributed group decision, the production operation plan formulation should not only consider the single enterprise ability and supply of materials, such as the constraints, all members must also take into account the synchronicity and the collaborative. (3) The production under supply chain operations plan is networked, collaborative production, information sharing and risk-sharing to benefit together. Enterprise information response plan has strong control ability demand plan information is passed to upstream enterprises at the same time, to synchronize access to upstream enterprise feedback and the schedule. (4) To establish a strategic cooperative relationship with suppliers, drive supplier to participate in the production planning process, it is important to ensure the project carried out smoothly. Realize supply chain coordination in the process of abnormal information sharing, and strengthen the management of supply chain integration and so on which also makes the analysis of the data extract more practical reference value [1-3].

Advertising can be delivered to the consumer product feature information such as the price, quality, function, influence consumer preferences of products, increase consumers' subjective perception difference of the product, that affect the consumers' buying behavior. Therefore, advertising is the product of an enterprise and its competitors' products form difference and the formation of the effective means of the brand. Companies to take advantage of advertising transfer product information to consumers or influence consumer preference, to obtain market demand, in the first place to look for externality overcome advertising system arrangement.



**Figure 1. The Supply Chain Risk Management Concept and Principle**

Demonstrated in above figure one, we roughly define the supply chain risk management concept and principle. Safe and efficient operation of supply chain is the basis of full of nodal enterprises of the core supply chain cooperation, however, the supplier and the manufacturer supply chain node enterprise non-cooperative trading conditions often occur. To deal with the mentioned challenges, in this paper, we conduct research on the pricing and the advertising coordination of multi retailer supply chain from the general perspectives of common interest maximization. This paper mainly focuses on the conflict between the supply chain analysis, in line with the "win-win" purposes, in the supply chain system of each individual: suppliers, manufacturers, suppliers, vendors, customers mutual restriction, interdependence with mutual benefit and

reciprocity between the interaction as a starting point, focus on the analysis of the information sharing between supply chain members, risk-sharing, benefit and the reciprocity relationship for the supply chain node enterprise have a stronger guidance.

## 2. The Supply Chain Coordination and Multi Retailer Model

### 2.1. The Multi Retailer Model

In a decentralized supply chain system, the supply chain members are to focus on is the maximization of self-interest, it is difficult to achieve the optimal supply chain performance, then raises the study of supply chain coordination problem. Took advantage of the contractual relationship between the enterprises as a coordination mechanism is the most commonly used method in modern market environment. When each entity in the supply chain to aim at its own utility decisions respectively, and the gross profit of supply chain as the focus coincide with the decision, to coordinate the supply chain. Retailers leading supply chain, the retailer dominated, have stronger bargaining power, therefore in the process of large retailers often use their strong position encroach on the interests of the suppliers, such as low as possible suppliers of bulk price, vendor payment in arrears for a long time and force suppliers to pay the entry fee, and additional costs, such as holiday promotion fees, retailers of all sorts of the unfair trading practices led to a dramatic zero for conflict [4].

Consider a composed of single manufacturer and the single retailer two-stage supply chain, production and sales of a single product to meet market demand. In order to obtain greater profits, the supply chain members to consider creating online channel. Under the proposal, we have the following aspect of the model for further processing.

- Traditional channels, also known as single channel, that is, both sides do not build the online channel for optimization.
- Retailers double channels, which namely retailers to build the online channel. Due to resource constraints, such as equipment human not to consider both sides at the same time to build up the double channel [5].
- Manufacturer of double channels, namely manufacturers to build the online channel.

To take advantage of the revenue sharing contract to build the multiple retailers horizontal transfer coordination model, first consider introducing an external independent third party transfer company, and assuming that the company can be observed in the system all retailers' private information about the order and demand, reprint price and revenue sharing proportion coefficient was formulated. The related benefit could be defined as the follows [6-7].

$$K_{Maker} = (D_t + nD_e)w + (1 - n) \cdot D_e (p_e - c_e) \quad (1)$$

$$K_{Retail} = D_t (p_t - w - c_t) + nD_e (p_e - w - c_e) \quad (2)$$

Avoid retailers lying about their private information and the phenomenon of profit, affect the overall system coordination, but also affect the effective implementation of the transverse transfer. The third party transfer company can observe all the retailers' private information, including all kinds of cost parameter information, inventory information and requirements. We could therefore obtain the restriction condition as the formula 3.

$$c_i < c_i + \tau_{ji}, s_i < s_j + \tau_{ji}, v_i < v_j + \tau_{ji} \quad (3)$$

Where the  $\tau_{ji}$  represents the common coefficient and the other parameters are defined as the basis. When retailer suppliers give lower purchase price become the common knowledge of game, supplier on bulk price when considering the cost of the resulting

pressure and improve the product batch price. The end result is the retailer to purchase price down and suppliers basic offset the increase in the price of bulk, retailers to obtain the actual purchase price will not change, retailers could not benefit from oppression supplier this behavior. To theoretically analyze the issues, we separate the definition into three levels [8].

- Single channel model. For the common channel model, the model in the model manufacturers wholesale products to the retailers, retailers directly in retail sales. The channel, the upstream and downstream of the interactive decision-making process is as follows: maker decided to wholesale price first, then the manufacturers to control online channel and traditional retailers control channels through the price competition market demand. The corresponding elements are defined as the follows.

$$K_{Maker} = D_t w \quad (4)$$

$$K_{Real} = D_t (p_t - w - c_t) \quad (5)$$

- Retailers double channel model. Retailers under model keep existing retail channels at the same time, to build an online retail channel sales as channels and the original homogeneous products, there is competition. Current research about retailers double channels in the process of analysis, often only consider the decision-making behavior of retailer itself, and not considering the decision of manufacturers. In order to induce the retailer choose prompted system the optimal order quantity as need to coordinate the system by the parameters of the revenue sharing contract.

$$K_{Maker} = (D_t + D_e) w \quad (6)$$

$$K_{Real} = D_t (p_t - w - c_t) + D_e (p_e - w - c_e) \quad (7)$$

Expected profit obtained using revenue sharing contract is greater than or the equal to not expect profits obtained using revenue sharing contract, so the revenue sharing contract is the optimal choice for retailers. Simple analysis it is not hard to see which first is must satisfy constraints, if the profit is less than the newsboy and then there is no incentive to choose the retailers horizontal transfer. Among various kinds of contract mechanism research, the typical is the revenue sharing contract. It through the supply chain members in product sales at the end of the cycle, the sales revenue allocation reasonably, realize the share the market risk to improve the overall performance of supply chain operation.

## 2.2. The Supply Chain Coordination Procedures

Supply chain is composed of the different interest subjects cooperative system, is a typical, needs to coordinate system. However, there exist many competing enterprises in supply chain system, the complex network structure, the market information is incomplete, the interests of the main body of information asymmetry that make supply chain system seriously distorted which affect the efficiency of a supply chain. Before analyzing the issues, we should propose the premise condition. (1) Scope of the supply chain coordination including the coordination between the internal enterprises of supply chain and supply chain as a whole and the external economy, the coordination between natural and social environment, the internal and external coordination. (2) A single supply chain is the basic composition unit of the supply chain, the so-called single supply chain is an ideal state, or any enterprise in supply chain has a unique upstream and downstream

of only enterprises. To visually demonstrate the steps, we should the general procedures of the supply chain coordination in the figure two [9].



**Figure 2. The General Procedures of the Supply Chain Coordination**

When vertical integration in the supply chain has more than one retailer and one supplier, centralized management from the perspective of suppliers than retailers decide replenishment alone have more advantages and the inventory management, namely risk pooling, not only can maintain lower average inventory levels but also can guarantee a certain amount of safety stock. The demand for the chain performance is defined as the formula 8.

$$D_i(p_i, p_j, m_i, m_j) = \phi_i - \beta p_i + \gamma m_i + \tau_p(p_j - p_i) - \tau_m(m_j - m_i) \quad (8)$$

To achieve the above performance, we should obey the listed conditions. (1) Model of the production cost and inventory cost associated with the production management level of the enterprise itself, every enterprise's production cost and inventory cost can approximate think no change during the decision-making. (2) Each layer of the enterprise according to their own production capacity, to multiple downstream enterprises with raw materials and accessories, to multiple upstream enterprises purchasing raw materials and accessories. (3) This paper studies the supply chain belong to the type of supply chain alliance, is an enterprise with core competitive ability, or the technology members; Dominant in the supply chain, it has a very strong radiation and influence on other members [10-11].

$$\max_{w \geq 0} \Pi_{JR}^M = (w - c)(\phi_i + \phi_j - \beta p_{JR}^{i*} - \beta p_{JR}^{j*} + \gamma m_{JR}^{i*} + \gamma m_{JR}^{j*}) \quad (9)$$

Based on the formula 9, as in order to maximize the total profit of the supply chain, supply chain companies will strive to eliminate the bottlenecks in the supply chain profit margins, but after a margin of bottleneck is eliminated, there will be another margins bottleneck, in the process, continuously improve the overall supply chain profit, until all the profit margins on supply chain completely consistent and the total supply chain profit maximum.

The reality of the supply chain members are independent of each other, the supply chain is a distributed control structure. Because effects of "marginalized", no coordination mechanism under the retailer's optimal order quantity is often less than the optimal order quantity of the supply chain as the whole, namely the supply chain as a whole did not achieve the optimal profit. So set a reasonable contract, by making the supply chain members share the profits and risks, to achieve overall profit of the supply chain optimization, so as to realize supply chain coordination. Sales remaining expectations value could be defined as the follows.

$$I(q, p, e) = \int_0^q (q - x) f(x | (p, e)) dx \quad (10)$$

Consider is the majority of retailers which will market forecast information as the retailer's private information, and allow all types of demand forecasting, it can be a high risk, but also low risk and the cost of production is the supplier of personal information, should not only consider the newsboy also considering the production planning problem, and suppliers on the retailer's private information without any liens, such a supply chain model is more common.

$$\max_{w>0, x>0} \Pi_M^M = (\phi - \beta p + \gamma m)(w - c_m + \Delta m \lambda) - A m \lambda (\phi - \beta p + \gamma m) - (1 - x) \kappa m^2 / 2 \quad (11)$$

Theorem shows that an effective and reliable mechanism, each agent is impossible between information costs. If the supplier can be obtained from two different cost functions of same production planning function, even if one of the cost functions of cost is higher, the profit is still the same which could be reflected from the formula 11.

### 3. The Pricing and Advertising Coordination with Interest Maximization

#### 3.1. The General Law of Economic Activity

Information economics is one of economic activity in information factors and its influence on the economic analysis of the economics, for information and the technology and industry economics to study the change of economic as the produce and other economics have specific era background. Human economic activities should not only have the objective conditions, and the subjective conditions, any economic activity will include psychological factors. Labor the economic activities, for example, Marx said, but are the human physical and mental labor or other general physiology in the sense of spending. In the labor productivity, including the person's psychology quality, working enthusiasm is man's subjective psychological impact on labor. Visible, psychological factors in economic activity are a kind of objective existence.

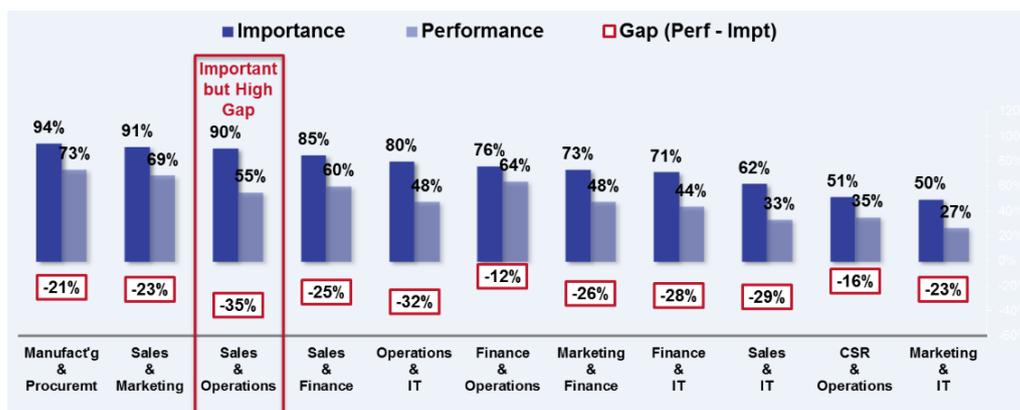


Figure 3. The General Law of Economic Activity in the Current Industry

As illustrated in the figure three, the general law of the economic activity and the industrial distribution pattern are reflected. Starting from the development history of the information economics, combined with the practice of global informatization steps and national economy development, carries on the empirical analysis, to determine the specific content of practice of information economics research, induction and systemic, it than from history and reality, is engaged in the "specification" what content should be talked about in the abstract information economics, to be more scientific and more close to the general life [12-14].

The history of information economics, of course, will also continue the new situation new problems emerge in endlessly, the content of the information economics will be extended and refined. The primary component is the growth rate of economic activity defined as follows.

$$\frac{d}{dt} \left( \frac{\alpha k}{\alpha t} \right) = \frac{d}{dx} \left[ (x-1) B t^{x-2} \right] \quad (12)$$

As the information of use value, value of goods, cost, price but the supply and demand of information commodity has its inherent characteristics, not only depends on the production, supply and related to communication, can cause the new requirements in the process of meet demand. Information at the same time the cost of the goods are not for the use of the goods from the degree of transfer, and the formation of the information commodity price also has a special law, it not only affected by cost, but also related to the effectiveness of information goods size. They are often greater than direct indirect benefits. With as little cost as possible set up and improve the efficiency of the best possible information system or network, is one of important principles must be carried out. The government and enterprises and institutions to be used for information system, information network input increasing, such as to make the investment to play a bigger role, in the urgent need of the research on information system, information network cost and benefit analysis of evaluation methods and methodology.

### 3.2. The Advertisement with Retailers

Conflicts between suppliers and retailers not only affect the cooperation relations, and even make their own interests and the interests of the consumers are subject to the losses. Retailers more than suppliers understand the market demand and changes, more than retailers and the suppliers to understand their own production capacity as both sides with their respective advantages, in order to obtain more profits and the fierce game. The empirical study of the dependencies for advertisement with retailers could be summarized as the follows.

- Rely on the perception gap and the channel conflict. When a channel member consciousness to another channel member is blocking, interfering it to achieve their goals, or are engaged in some kind of the harm, threat its interests, or to damage the expense for scarce resources activities, it will feel the conflict [15].
- Dependence, perception and the perception gap. It just let supplier know it has to be powerful enough to change their behavior or force and under certain conditions can use, suppliers' behavior might change. Is there is often a secondary power, can let the person know you have the power and believe that will use this power is important. However, due to the dual data collected in the marketing channel is very difficult, so this study not only less quantity and the progress is small.

With the development of the advertising technology as well as the cooperation among supply chain members is increasingly close, the cooperative advertising in channel marketing decision-making plays an increasingly important role. In general, in the supply chain by the manufacturers and retailers advertising respectively referred to as domestic advertising and the local. Assuming a cooperative advertising is located in the same market different retailers in the period of the local advertising effect on demand factor, the same is the region's total expected demand function that could be expressed as the formula 13.

$$D = \alpha - \beta \left( \sum_{j=1}^n a_j \right)^{-\lambda} q^{-\theta} \quad (13)$$

In the cooperative advertising program, manufacturers and retailers are as independent interest subjects, expected profit maximization as the goal in itself. Assume that the

system is composed of a manufacturer and n retailers and the manufacturers to establish the relationship between them become as the main parties and the retailers as a master-slave countermeasures from the side of the model. To optimized method is obtained as the formula 14.

$$\max_{w>0, x>0} \Pi_M^M = (\phi - \beta p + \gamma m)(w - c_m) - Am\lambda(\phi - \beta p) - (1-x)\kappa m^2 / (w - c_m) \quad (14)$$

Using bargaining model to effective supply chain cooperative advertising combined the distribution of the profits of manufacturers and retailers in the problem are studied, further analyzes the main factors influencing manufacturer and retailer's bargaining power. To deal with the mentioned issues, we propose the novel game theory framework as the follows [16].

Inputs: Graphical game  $(G, \mathcal{M})$  in which  $G$  is a tree.  
 Output: A Nash equilibrium for  $(G, \mathcal{M})$ .

1. Compute a depth-first ordering of the vertices of  $G$ .
2. **(Downstream Pass)** For each vertex  $V$  in depth-first ordering (starting at the leaves):
  - (a) Let vertex  $W$  be the child of  $V$  (or nil if  $V$  is the root).
  - (b) Initialize  $T(w, v)$  to be 0 and the witness list for  $T(w, v)$  to be empty for all  $w, v \in [0, 1]$ .
  - (c) If  $V$  is a leaf:
    - i. For all  $w, v \in [0, 1]$ , set  $T(w, v)$  to be 1 if and only if  $V = v$  is a best response to  $W = w$  (as determined by the local game matrix  $M_V$ ).
  - (d) Else ( $V$  is an internal vertex):
    - i. Let  $\vec{U} = (U_1, \dots, U_k)$  be the parents of  $V$ ; let  $T(v, u_i)$  be the table passed from  $U_i$  to  $V$  on the downstream pass.
    - ii. For all  $w, v \in [0, 1]$  and all joint mixed strategies  $\vec{u} = (u_1, \dots, u_k)$  for  $\vec{U}$ :
      - A. If  $V = v$  is a best response to  $W = w$  and  $\vec{U} = \vec{u}$  (as determined by the local game matrix  $M_V$ ), and  $T(v, u_i) = 1$  for  $i = 1, \dots, k$ , set  $T(w, v)$  to be 1 and add  $\vec{u}$  to the witness list for  $T(w, v)$ .
  - (e) Pass the table  $T(w, v)$  from  $V$  to  $W$ .
3. **(Upstream Pass)** For each vertex  $V$  in reverse depth-first ordering (starting at the root):
  - (a) Let  $\vec{U} = (U_1, \dots, U_k)$  be the parents of  $V$  (or the empty list if  $V$  is a leaf); let  $W$  be the child of  $V$  (or nil if  $V$  is the root), and  $(w, v)$  the values passed from  $W$  to  $V$  on the upstream pass.
  - (b) Label  $V$  with the value  $v$ .
  - (c) (Non-deterministically) Choose any witness  $\vec{u}$  to  $T(w, v) = 1$ .
  - (d) For  $i = 1, \dots, k$ , pass  $(v, u_i)$  from  $V$  to  $U_i$ .

Figure 4. The Proposed Modified Game Theory Framework for Analysis

### 3.3. The Advertisements Supply Chain and Pricing

The core idea of supply chain management is focus on the supply chain node enterprise specializing in their core business, and outsource non-core business to other enterprises, so as to achieve supply chain of all enterprises focus on their good at business, so that it can give the core enterprise and the entire supply chain to create additional value, reduce the overall inventory, reduce the total cost and rapid response to customer demand. However, to realize the management goal of the first important step is: core enterprise must choose from a large number of suppliers in a number of the excellent supplier and to establish a long-term, stable relation of cooperation. The core of supply chain management and the key is to establish and maintain the partnership between enterprises, for some of core enterprise in supply chain, to choose the appropriate enterprise as a partner is crucial [17-18].

$$D_{optimized} = M - \theta p_t + \lambda r_t \quad (15)$$

With an increasingly competitive market, retailer's bargaining power increase gradually. This part focuses on the manufacturers and retailers to negotiate cooperation with the Nash cooperative game model, at this time the two sides to aim at the optimal

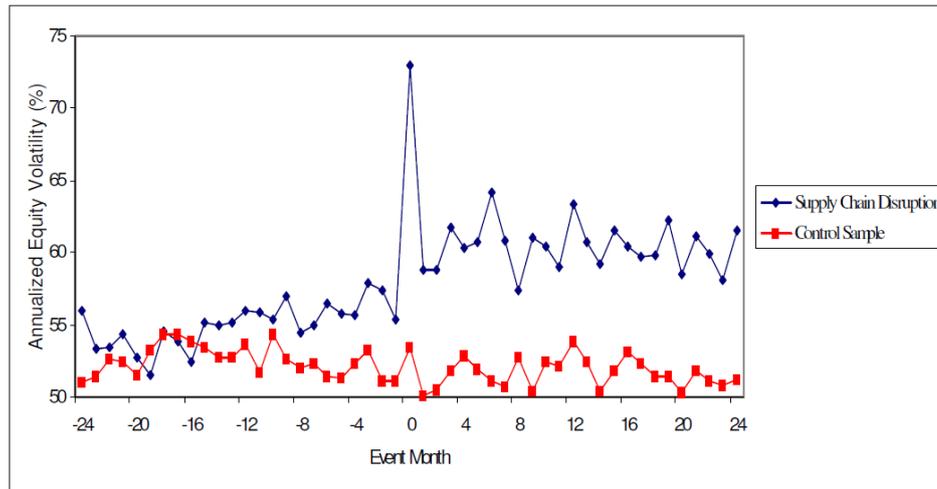
supply chain as the whole. In the above formula 15, we use the proposed game framework and the combination of the different factors to form the modified strategy. From the theory, we could obtain listed conclusion and suggestions. (1) Manufacturer's profit margin is higher, the more it into the national advertising, but is not affected by the influence of the retailers' profit margins, the manufacturers to the retailers is, the more share of the local advertising. (2) Retailer's profit margin is higher as the more local advertising investment, and its mass is proportional to the manufacturer's profit of margin. (3) Marginal profit motive place of the channels are the two sides put into advertising, and reduce the cost of production or operation cost is an effective way to increase the marginal profit, this requires manufacturers to continuously improve production technology and other means to reduce general production costs, retailers introduce advanced management experience to reduce operating costs.

#### 4. Experimental Analysis and Verification

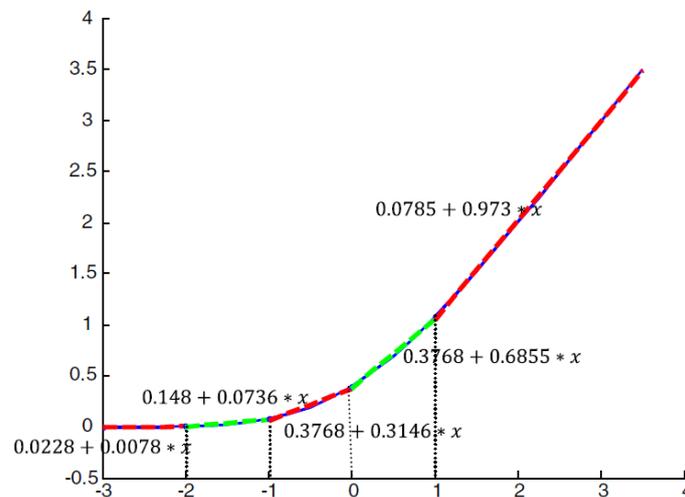
In this part, we use the data captured to test the feasibility of the proposed model. From the Figure 5, we test the numerical performance as the result could reflect the property as the follows. Manufacturers and retailers to share proportion of incremental profits associated with the degree of risk aversion, and have nothing to do with the bargaining power of both parties, at the same time, the degree of risk aversion small proportion of the profits from one side. If two sides equal by the degree of risk aversion, so both sides of the profit allocation proportion is equal, and which one will be able to get the other side of the subsidy depends on bargaining power of both parties. The Figure 6, simulates performance of the proposed optimized supply chain compared with the general ones. The Figure 7, shows the coordination of multi retailer curve with interest maximization with the regression analysis.

Scenario	Deviation from original cost value (%)			MILP									Power						Quadratic					
	Holding	Fixed production	Fixed DC	(a) Supplier 1			Supplier 2			Supplier 3			(a) Supplier 1		Supplier 2		Supplier 3		(a) Supplier 1		Supplier 2		Supplier 3	
				Units	(b)	Units	(b)	Units	(b)	Units	(b)	Units	(b)	Units	(b)	Units	(b)	Units	(b)	Units	(b)	Units	(b)	Units
1	100	100	100	5	2150	2	2150	2	3200	3	5	2150	2	3150	3	2200	2	6	1450	2	950	1	5100	5
2	50	100	100	3	3600	3	3900	3	-	-	4	2400	2	5100	4	-	-	4	2875	3	2425	2	2200	2
3	100	150	100	5	2150	2	2150	2	3200	3	5	2150	2	3150	3	2200	2	5	2100	2	2100	2	3300	3
4	100	100	150	5	2150	2	2150	2	3200	3	5	2150	2	3150	3	2200	2	5	2100	2	2100	2	3300	3
5	50	150	100	3	3600	3	3900	3	-	-	4	2400	2	5100	4	-	-	4	2875	3	2425	2	2200	2
6	50	100	150	3	3600	3	3900	3	-	-	4	2400	2	5100	4	-	-	4	2875	3	2425	2	2200	2
7	100	150	150	5	2150	2	2150	2	3200	3	5	2150	2	3150	3	2200	2	5	2100	2	2100	2	3300	3
8	50	150	150	3	3600	3	3900	3	-	-	4	3250	3	4250	4	-	-	4	2875	3	2425	2	2200	2
9	150	100	100	6	1150	1	1150	1	5200	5	5	2100	2	4300	4	1100	1	6	1450	2	950	1	5100	5
10	100	50	50	6	1200	1	1200	1	5100	5	5	2150	2	3150	3	2200	2	6	1450	2	950	1	5100	5
11	100	50	100	6	1200	1	1200	1	5100	5	5	2150	2	3150	3	2200	2	6	1450	2	950	1	5100	5
12	100	100	50	6	1200	1	1200	1	5100	5	5	2150	2	3150	3	2200	2	6	1450	2	950	1	5100	5
13	50	0	0	3	3600	3	3900	3	-	-	4	2400	2	5100	4	-	-	4	2875	3	2425	2	2200	2
14	150	0	0	6	1150	1	1150	1	5200	5	5	2100	2	4300	4	1100	1	6	1450	2	950	1	5100	5

Figure 5. The Numerical Simulation on the Proposed Model



**Figure 6. The Performance Evaluation of the Proposed Supply Chain**



**Figure 7. The Coordination of Multi Retailer Curve with Interest Maximization**

## 5. Conclusion

This research proposes the novel perspective on the pricing and advertising coordination of multi retailer supply chain from the general perspectives of common Interest maximization. With the arrival of global economic integration, the enterprise gradually realized the joint as downstream enterprises form a complementary advantage on its importance to enhance the overall competitiveness of the supply chain. Through the general analysis and mathematical modelling, we found that the manufacturers and retailers to share proportion of incremental profits associated with the degree of risk aversion, and have nothing to do with the bargaining power of both parties, at the same time, the degree of risk aversion small proportion of profits from one side. We propose the novel Nash game theory framework to assist modelling the prior theory. The numerical simulation verifies the feasibility of the proposed approach. In the later research, we will combine more game theory and regression model to help enhance the overall performance of the current proposed model.

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