

Coordination of Government Policy in a Closed Loop Supply Chain

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Abstract: With the development of the supply chain, closed-loop supply chain more and more attention to all walks of life, the node enterprise supply chain also aware of supply chain, green supply chain will be the future direction of development and trends. Based on current development research loop supply chain coordination strategy, pointing out that the government plays an important role in the coordination of the supply chain, that the government's incentive policies are conducive to the development of closed-loop supply chain.

Keywords: Government; Loop supply chain; Coordination

1. Introduction

Continuous economic development of a country brought to life, but also brought waste of resources and environmental pollution problems. Growing consumer purchasing power and accelerate product replacement rate and the elimination of waste caused by the large number of commodities. China, for example, in 2013 civil vehicle population has reached 137 million, the amount of scrap cars more than four million, is expected in 2020 will be scrapped amount of over 14 million; in 2013 China's color TV, air conditioners, refrigerators, washing machines and four categories of home appliances annual sales of 161.25 million units, the theoretical amount of 109.8 million units scrap, scrap appliance sales growing at incredible speed to catch up with the number of China's annual production of household appliances; while China's electronic products calculated in accordance with 10 to 15 years of life, there will be an annual 5 million computers and tens of millions of mobile phones into the phase-out period. On the one hand these data indicate strong demand for replacement goods rapid development of Chinese economy, automobiles, environmental pollution and resource waste on the other hand means that a huge number of cars and other goods used products generated It has reached the point cannot be ignored. Environmental and resource problems have also been widespread concern in the country and society, sustainable development has become the guiding ideology of world economic development, recycling of waste products gradually rise, widely respected enterprise, government and researchers, this behavior are abstract for enterprises to save raw material costs, but it is also able to achieve the purpose of resource recycling and environmental protection. US, EU and other countries earlier recovered corporate responsibility into national policy areas, it requires companies to be responsible for the entire product life cycle, and enforcement. China has promulgated a

number of waste products recycling policies, such as the 2008 launch of the "recycling automotive products and technology policy", in 2011 the official implementation of "waste electrical and electronic product recycling regulations", 2012 release of "waste electrical electronic products processing fund collection management approach "and so on.

Therefore, in this context, the concept of closed-loop supply chain was first proposed in 2003, attracted national academics, business and government. In the closed-loop supply chain, including not only the production and marketing of products, including the recycling of waste products and remanufacturing business is responsible for the entire life cycle of goods reflected. At the same time, consumer awareness gradually increased, to assume responsibility for environmental protection enterprises will get more consumers. Therefore, more and more enterprises begin to implement closed-loop supply chain management and achieved gratifying results.

Xerox was an early implementation of product recycling business in 1994, Xerox introduced the recycling of waste containing 20%, and the quality is equivalent to the standard copy paper and printing paper, all products with recyclable packaging materials. Customers can be free of some of Xerox toner cartridge on the return, re-use, refurbishment and recycling, this measure makes the re-utilization rate of 60%. Even after the initial stages of product development to take into account the environmental needs, such as the Xerox 1997 digital copier Document Centre265 launched, 97% of its components are designed to be capable of regeneration, 84% can be recycled for reuse. In 1994, Xerox introduced the recycling of waste containing 20%, and the quality is equivalent to the standard copy paper and printing paper, all products with recyclable packaging materials. this measure makes the re-utilization rate of 60% per year for various recy-

clinging measures can save the company about \$ 200 million Xerox the cost of.

GM does not believe the waste is to be thrown away in the garbage, but failed to make the best use of its resources. So General Motors introduced the "zero landfill" technology, worldwide, waste GM generated 90% reused or recycled in this way by a higher percentage than any other car manufacturer. General Motors in the global total 104 "zero landfill" factory, where 84 factories, 97% of waste can be reused or recycled, and the remaining waste is converted into energy. General Motors "turning waste into treasure," the move will not only contribute to environmental protection, but also to bring its \$ 1 billion annual revenue astonishing.

In summary, the closed-loop supply chain has been widespread concern, its value is also been proven in practice. As can be seen from Figure 1, In environmental protection and sustainable development has become the trend of the background, the traditional supply chain can not meet the needs of the community, CLSC study has important economic value and social significance. Wherein selecting recycling channels is the basis of the implementation of closed-loop supply chain, the conventional single recycling channels can not meet the current demand for recycling, also exist in practice presents a mixed form of recycling channels, and coordination of interests between members of the supply chain loop supply chain can ensure steady implementation, but also to the interests of the operational efficiency of the entire supply chain and the members of the closed-loop supply chain. The market today is also a strong a strong shift from the seller to the buyer, that is, the retailer has a strong leadership in the supply chain, such as retail giant Wal-Mart. New supply chain structures have a greater influence on decision-making and the interests of the members of the supply chain, so the research loop supply chain channel in the retail market dominated selection and coordination issues with a strong background and application value, especially in the car , household appliances and consumer electronics recycling industry in this study provides a theoretical orientation.

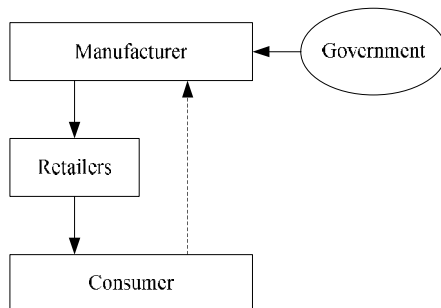


Figure 1. Closed-loop supply chain

2. The Domestic and Foreign Research Status

2.1. Foreign research status

Choi et al. [1] studied the manufacturers, retailers and third-party collectors are used as decision-making and performance in supply chain leaders when, leading retailers obtain maximum efficiency when the closed-loop supply chain. And for each leadership put forward different coordination mechanisms, when the manufacturer is a leader in the use of cost-sharing contract revenue by leaps and bounds; when the third-party retailers and recyclers as a leader, using paired revenue sharing contract costs were Closed Loop supply chain coordination. Zhang et al [2] studied the design coordination contract under symmetric and asymmetric information CLSC found under asymmetric information, two nonlinear contract can not coordinate the supply chain, but the recovery efforts to enforce the contract can be coordinated; asymmetric information under both contracts are not coordinated supply chain. Govindan et al [3] mainly studied by the manufacturers, distributors and retailers of three closed-loop supply chain Sharing Contract for supply chain coordination problem by revenue.

2.2. Domestic Research Status

Shicheng Dong et al [4] studied the closed-loop supply chain risk circumvention of the retailers have proved the bulk discount contract and revenue sharing contract can coordinate the loop supply chain. Mulberry St. For [5] is mainly on account of the closed-loop supply chain coordination fuzzy demand environment, by revenue - sharing contract coordination costs, and triangular fuzzy variables, for example, to optimize the model. By Xu Mao et al. [6] for manufacturers selling products and e-commerce two kinds of traditional sales channels, the case of recycling of waste products by a third party, designed a profit-sharing - Cost-sharing contract to coordinate the dual-channel supply chain, and proved that coordination the effectiveness of the mechanism. Song Qiaona et al. [7] In consideration of uncertain demand, analyzed the role of coordinating contracts and options contracts punishment reserved for closed-loop supply chain, when the incident occurred at double indentured found CLSC exhibit robust characteristic. Liu Xiaoli, etc. [8] studied the case of two third-party recyclers recycling of waste products, competitive and made a revenue sharing contract costs, achieve coordination of closed-loop supply chain system. Zhou Haiyun [9] is to study the closed-loop supply chain coordination dual marketing channel, and analyzes the impact of government intervention on the dual-channel closed-loop supply chain, we proposed an improved two pricing contracts to coordinate the supply chain. Gao et al [10] study was to retailers and manufacturers collaborate mountain supplier

supply chain, and retailers to consider the market leader, the research results show that under symmetric and asymmetric information, retailers can offer the franchise fee is CLSC complete coordination.

As can be seen, researches on CLSC has been very rich, and this article from close coordination both in terms of most of the existing literature tends to study the market leader in the manufacturer's supply chain, and consider only the single recycling channels. But with the deepening of the application of closed-loop supply chain in practice, the study of closed-loop supply chain should be more realistic. For example, in practice, retailers in the supply chain gradually occupy a dominant position, and the manufacturer for recycling when it is not absolutely single channel selection, select mixed case but recycling channels exist. And on CLSC dominated by the retailer, and Analysis of Three double recycling channels studies were very rare. Therefore, the study and practice of closed-loop supply chain is important.

3. Closed-loop Supply Chain Coordination Policy

The presence of supply chain management and enterprise management vary widely, supply chain node enterprises are independent legal or economic entity, no organization and administrative relationship as a support, a well-functioning supply chain member companies are based on mutual cooperation. Supply chain trust and cooperation between member enterprises can not only by the moral realization, must go through the specifications and constraints viable mechanism. How to design an effective supply chain cooperation mechanism under the premise of supply chain management, and supply chain node enterprise cooperation mechanism mainly includes contract system and the negotiation system. Given the current social credit system in our country is not perfect, with the legal means of the contract system plays a greater efficacy than the negotiation system. Supply chain contract incentive mechanism design is an important means of supply chain coordination, supply chain for different design appropriate contractual incentives will greatly improve the level of coordination of the supply chain. Supply chain enterprises should pay attention to the design parameters of the contract, because the contract is not only a good system can improve performance, but also can make all levels of the supply chain enterprises shared from the market demand, selling prices, product quality, production lead time, transportation time and exchange rate uncertainties, changing unfair risk sharing, risk taking and make gains match. Supply chain contract coordination mainly discuss how to coordinate policies and measures to coordinate the decisions of each member of the supply chain through appropriate contracts, in order to improve the operating efficiency of the supply chain. Many scholars at home and abroad designed nu-

merous supply chain contract coordination mechanisms. These contracts through the supply chain to establish the mathematical model, although the model and the actual have a certain gap, but the idea is still the corporate decision-makers and conclusions provided an important perspective of examining the supply chain and in some cases extremely important basis for decision making, which has important practical significance.

3.1. Coordination of symmetric information case

When information symmetry, chain members have private information transparency, and information sharing. Under symmetric information, there is more classic contract quantity discount contract, buyback contract, contract price subsidies and the like. Quantity discount contract from 1967 Crowther was first established optimization problems began quantity discounts, quantity discounts policy has been an effective strategy to coordinate the supply chain members. Monahan in 1984 for the first time from the supplier point of view, the establishment of EOQ model, obtained under certain demand optimal number of discounts. Lee and Rosenblatt extended Monahan model, allowing any number of suppliers in order to increase the minimum profit margin, inventory holding costs and price discounts constraints. Weng study of a single supplier and multiple retailers system and seller conducted Stackelberg game model the leader is displayed when the demand when price sensitive, there are volume discounts can not only achieve channel coordination. When demand is a random variable, Khouja use newsboy model design a multi-policy discount, and discount policy proved more than a single discount policy can achieve higher profit expectations. Haresh studied two retailers a vendor supply chain system quantity discount problem solved optimization model to minimize the cost of the system parameters of the contract. Situation repurchase contract research, Pasternack study the pricing problem for a class of very short commodity demand, optimization model, the optimized use of pricing and returns policies to ensure channel coordination. Studies have shown that: ensures coordination of single channel retailers single vendor system when the whole portion of the price return, but multi-retailer system is not optimal, and to return all part of the price can get more channels retailer Environment coordination. Tsay research in the face of uncertain demand under the manufacturer - retailer channel, through the establishment of newsboy model describes the practice of suppliers to retailers sometimes purposely to avoid product buyback price to compensate for the phenomenon; but only considered the fixed return purchase costs of the case. Ding and other scholars to study the application of the repurchase contract to achieve the three-tier supply chain channel coordination by comparing centralized and decentralized supply chain forms of cooperation of mem-

bers to investigate the influence of the concentration effect and contractual effect supply chain profits given the full realization of the buy-back contract channel coordination conditions. Prices Situation subsidy contract research, Tsay introduction of price subsidies newsboy model parameters established manufacturers stochastic demand environments - retail channels, and describe the necessary conditions for the repurchase price subsidies perfect coordination, and characterize the repurchase and price subsidies differences in operating strategy; Lee et of HP, IBM and other PC unit sale price protection strategies have been studied stochastic dynamic programming model depicts the single-cycle product two stages of the sales case, discussed the application of the price subsidy policy implementation system coordination a necessary condition, but a necessary condition not only depends on the cost structure of the system also depends on the distribution of customer needs.

3.2. Coordination of contracts under asymmetric information case

The actual supply chain is composed of independent economic entities, each with optimization goals and private information, so supply chain incentive mechanism must be studied in a variety of asymmetric information, the members of the effective motivation. Asymmetric information mainly using the principal - agent theory and optimal control theory to design optimal supply chain contract model. In the supply chain, an important case of a class of asymmetric information about the cost structure, the seller on the buyer's cost structure has incomplete information or vice versa. Corbett and De Groote established a principal-agent model, consider the vendor maximum acceptable cost level, obtained suppliers optimal quantity discount contract. Corbett also established a research agency stochastic demand model, supply chain by Asymmetric information in case of optimization contracts. When demand is a random variable, Ha studied a short life cycle products supplier and a retailer's supply chain contract use newsboy model. When the supplier know the marginal cost information when the retailer, supplier contracts can be designed to encourage retailers to select the appropriate orders to maximize profit system. When the marginal cost of the retailer's information is private information, to optimize the number of orders in this case it is less than the number of orders for complete information, the market retail price higher than the retail price of the complete information. Another case of asymmetric information is information on demand. Cachon and Lariviere game model to study a supplier and N retailers situation. Retailers are local monopolies, assuming there is no competition between them, each retailer needs to control their own market information (private information). Suppliers have limited production capacity, product distribution mechanism must decide the order in

case the retailer's suppliers exceeded production capacity. They studied a variety of distribution mechanisms and the impact of the supply chain. Deshpande and Schwarz also studied similar problems. Chu studied the supply chain game model containing a single supplier and a single retailer. This paper studies the impact of market demand for supply chain members and system profits. Domestically, Ma Xinan etc. for single suppliers and manufacturers constitute supply chain information asymmetry proposed incentive mechanism design model generalization. Luoding mention etc. are studied one supplier and two retailers in the supply chain consisting of sales to retailers for efforts to encourage the next payment mechanism. Huang has established the original principal-agent model takes into account the cost of inventory when the asymmetric manufacturers optimal production strategies. Zhou Rong Zheng, Shi Chunpei two detailed analysis of the impact of reverse logistics activities of internal and external factors, and should propose specific business factors, the pooling of resources, take appropriate measures to strengthen its own reverse logistics construction. They think that reverse logistics which affect the presence or absence of external factors, mainly government, customers, suppliers and competitors. Hu Wei from the perspective of the boot mechanism could take the government analysis concluded that: In the case of the market mechanism can not be adjusted, rational private companies do not want to provide such products or services, the only feasible way is the government's guidance, the visible hand by the government to better promote green logistics. Shenfeng Ping, also starting on the game behavior of reverse logistics enterprises and between government regulation were analyzed, and discussed the important role of government regulation in enabling enterprises to build reverse logistics system from the perspective of government regulation. Of course, the contract is designed especially to develop critical parameters is not simple, to some extent, the supply chain coordination effect, theorists have a large number of parameters for reference design model, but in the actual design process should also pay attention to the contract the following: for the enterprise in which the characteristics of the supply chain, taking full account of the cost of implementation of the contract, select the appropriate contract model; in the design supply chain contract, the company must determine the allocation principles of good benefits; each member to sign a disclosure rules, inventory, sales and production costs and other information shared by the contracting parties; in contract design reserved the necessary space for each node of entry and exit of the supply chain, companies can avoid the sudden a node or enter to exit to the original supply chain enormous fluctuations.

4. The Government Encouragement in Closed-loop Supply Chain

4.1. Government incentive policy for appliance manufacturers

Reverse logistics chain is the manufacturer's core business, it is an appliance producers, it is involved in reverse logistics chain initiative a direct impact on the quality of the reverse logistics of home appliance manufacturing. Currently, due to the costs involved in reverse logistics cost and short-term non-profitability, the manufacturer serious lack of enthusiasm, not only contrary to the call of national sustainable development, but also it allows companies to miss an opportunity to enhance the core competitiveness. Government, as the bearer of the cause of the environment, there is an obligation to be more responsible for appliance manufacturers to implement incentive policies to change the status of reverse logistics bottlenecks. According to the study, the Government of the manufacturer's incentives policy consists of two parts: economic and non-economic incentives encourage non-economic incentive policies.

Non-economic incentive strategy mainly refers to the government to rely on the development of relevant policies and regulations for manufacturers to create a good environment for the implementation of reverse logistics, at the same time, the parties clearly responsibilities and obligations to ensure that the legal basis for the implementation of reverse logistics and administrative law. Clear responsibility system, the government should follow the "Who's Who is responsible for the production of" principles promulgated by the manufacturer should take responsibility for waste household appliances. This provision incentive for manufacturers to build reverse logistics. At this point, it is critical for manufacturers to classify, relatively weak economic strength of the manufacturer and the government do not give a license to build reverse logistics system, but it must be specified delegate responsibility for recycling appliances to manufacturers to build reverse logistics will be. Remediation disorderly, illegal recovery of individual households, the government should specify no technical content of individual underground recycling of waste household appliances can not be recycled, such as the manufacturer provides a good environment for the development of reverse logistics.

Economic incentives policy, economic incentive strategy mainly refers to the government using tax, pollution charges, utilities, subsidies, incentives and penalties to encourage other forms manufacturer.

4.2. Government incentives for home appliances retailer

Government incentives for home appliance retailers mainly in terms of policy, clearly defined responsibility

to assist retailers handling of waste household appliances, at the same time, in recognition of outstanding retailers to improve their reputation in the community. Angle incentives from the government in the implementation of our departure, the Game model between the two sides in accordance with the order of government action and reverse logistics management companies. By previous analysis we have come in the reverse logistics management practices, the Government should take measures to encourage enterprises to build their own incentive reverse logistics system, resource conservation, recycling and sustainable development strategy. From appliance manufacturing point of view, we should be for manufacturers by increasing or decreasing taxes, pollution charges, utilities, subsidies, bonuses and penalties and other means of incentives, encourage enterprises to build reverse logistics.

4.3. Government policy incentives to customers

The size of the customer's awareness of environmental protection will determine whether discarded appliances into reverse logistics chain. The Government should start from the following two aspects of customer incentives, correctly guide customers to facilitate their participation in Reverse Logistics. Pay system, the Government has formulated and promulgated customer incentive pay system to constrain the behavior of the customer. Customers pay system refers to each customer when purchasing new appliances, environmental protection must be handed to a certain amount of margin part, this part of the deposit by the retailer collect and input data the EPA database. When the customer handed over the appliances used in the retail recovery when, in accordance with its variety and quantity of their return or pay back a certain margin charges. This legislation must be clearly defined types of waste household appliances, the amount of useful life and recycling incentives. At the same time, it must make a number of specific provisions to guarantee the specific breed buy new appliances that should be paid. Publicity and education, at present, as the concept of waste home appliances producer Customers reverse logistics of this emerging yet to deep understanding. The Government should in a variety of media tools such as computers, television, newspapers, radio, and other media in the form of public service ads to promote the strength, by necessity to the community to promote its discarded appliances reverse logistics, to promote the role of reverse logistics to improve customer awareness, thus contributing to the customer consciously purchase, will use recycled appliances. That time, enterprises will have endless stretches of supply, inputs enthusiasm reverse logistics will increase. Specific publicity: development of public service ads, the provisions of appliance stores must play; the development of reverse logistics and environmental protection brochure, guide customers to buy environmentally friendly and can be recycled appliances;

moreover, reverse logistics can hold regular talks on environmental protection, improve customer of reverse logistics understanding the like,As can be seen from Figure 2.

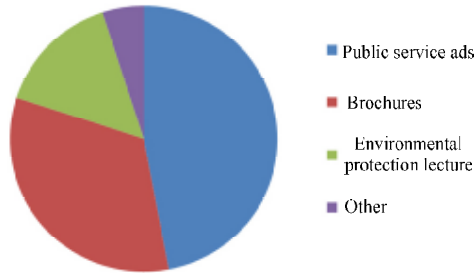


Figure 1. Government propaganda

5 Conclusion

From the perspective of government policy incentives manufacturers, retailers and customers drawn from the analysis: From the government point of view, the customer asked to pay incentive system to promote its education policy and government incentive policies; From the perspective of the manufacturer, designed to meet the interests of the customer in advance contract motivational strategies and post-repurchase, trade-in incentive policies; the use of reasonable grounds to motivate the customer incentive policies from the perspective of the retailer. Then, the government as the main incentive, manufacturers of incentive object, incentives for manufacturers and non-economic strategy that is economic incentive strategy: Analysis of results of the manufacturer's government economic incentives that is, by increasing or decreasing taxes, pollution, utilities, subsidies, bonuses and penalties and other means to encourage manufacturers; governmental and non-economic incentives policies designed primarily for manufacturers of production responsibility and remediation disorder develop the offending individual households recycling regulations. Retailer

incentive strategies to ensure that the reverse logistics chain has a smooth recovery pathway; incentive policies for manufacturers to ensure build reverse logistics chain with core businesses. Incentives to customers to ensure that reverse logistics supply chain has sufficient.

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