Int. J. Production Economics ∎ (∎∎∎∎) ∎∎∎–∎∎∎

Contents lists available at ScienceDirect

Int. J. Production Economics

journal homepage: www.elsevier.com/locate/ijpe

Coordination contracts of dual-channel with cooperation advertising in closed-loop supply chains

JiaPing Xie [a], Ling Liang [b,*], LuHao Liu [a], Petros Ieromonachou [c]

[a] School of International Business Administration, Shanghai University of Finance and Economics, Shanghai, PR China
[b] Tourism and Event Management School, Shanghai University of International Business and Economics, Shanghai, PR China
[c] Faculty of Business, University of Greenwich, London SE10 9LS, UK

ARTICLE INFO

Article history:
Received 30 October 2015
Received in revised form
24 July 2016
Accepted 30 July 2016

Keywords:
Closed-loop supply chains
Contract coordination
Channel conflict
Revenue sharing
Online to offline

ABSTRACT

On the background of an online/offline dual channel, this paper studies contract coordination of centralized and decentralized dual-channel closed-loop supply chains. With the feature of recycle rate fluctuation, we develop a revenue-sharing mechanism by taking the relationship between the recycle rate and the recycle revenue sharing ratio into consideration. After comparing of centralized decision and the manufacturing led decentralized decision, the optimal online/offline price, wholesale price and advertising investment are derived. The influence of revenue sharing ratio in forward and reverse channels on the online/offline prices and wholesale prices is discussed. The numeric example is used for observing the relationship between variables, and between the optimal profit and variables through analysis of changing parameter valuations.

1. Introduction

In the era of E-commerce, many enterprises choose to develop an online channel for direct sales with the traditional retail channel being maintained to establish an online/offline dual-channel distribution system. In the dual-channel of supply chains (SCs), manufacturers not only work as the upstream suppliers, but also as the peer competitors on the same level. On one hand, manufacturers control the scale of traditional retail channels by establishing online routes to restrict the retailers' bargaining power. On the other hand, traditional retail channels continue to play an irreplaceable role: the brand effect is cultivated by providing offline service support, customer experience and product maintenance, and the customers' post-market service demands are therefore created and satisfied.

By comparing the prices and profits under three modes—online, offline and mixed channels—and discussing the effect of cost structure and elasticity of demand in pricing, Park and Keh (2003) believe that manufacturers adopting a mixed channel strategy can reduce retail price, boost demand and increase the total profit of both the manufacturer and the SC. These days, manufacturers constantly devote themselves to improving the shopping experience and aftermarket service of physical retail stores, with focusing on service competition strategy rather than price competition strategy. For the purpose of reducing the negative effects of the online channel for direct sales on the offline retail channel, some manufacturers seek cooperation relating to market service support, such as part exchange and product repair, so that retailers will be able to gain service benefits from E-channels. Dan et al. (2012) study the dual-channel of a conventional SC where retailer provides service and decides the pricing and service strategy. They conclude that retailers should increase the retail price as a result of improved service and the manufacturer's pricing strategy depends on consumer loyalty.

On the other hand, an enterprise's environmental responsibility has become an inescapable practical problem. Remanufacturing saves costs and the recycling of used products contributes to increased profits, so manufacturing enterprises tend to recycle used products in a more active way and implement closed-loop supply chains (CLSC). Savaskan et al. (2004) discuss three different recycling scenarios where manufacturers, retailers and third parties playing a leading role respectively. By comparing the impact of wholesale price, retail price and recycle rate on the total profit of CLSC under these three scenarios, the study shows that manufactures' profit is maximized when recycling led by the retailer. Jing and Bell (2012) discuss whether the recycling channel and recycling price would affect retailers' pricing and order decisions, with return rate, return cost and consumers' return preferences as parameters in the study. They conclude that the recycling mechanism could improve profits for retailers.

For advertising investment decisions, Yue et al. (2006) and Xie

* Corresponding author at: Tourism and Event Management School, Shanghai University of International Business and Economics, Shanghai, PR China.
E-mail addresses: jiaping@mail.shufe.edu.cn (J. Xie), liang-ling@foxmail.com (L. Liang), IP07@gre.ac.uk (P. Ieromonachou).

http://dx.doi.org/10.1016/j.ijpe.2016.07.026
0925-5273/

Nomenclature

Q	Total market demand when the dual-channel product price and advertising investment levels are zero
A	Recycling channel input
c	Unit manufacturing cost
s	Unit cost saving by remanufacturing
β	Intrinsic price elastic coefficient
δ	Cross-price elastic coefficient, $0<\delta<\beta$
k	Advertising effect, the influence factor of advertising investment on total market demand, $k>0$
i	Recycle rate for used products
ρ	Consumers' preference for the offline channel, $0 \le \rho \le 1$
$1-\rho$	Consumers' preference for the online channel
α	The advertising expense proportion assumed by the manufacturer, $0 \le \alpha \le 1$
$1-\alpha$	The advertising expense proportion assumed by the retailer

Variables

P_t	1 Offline price
P_e	Online price, $P_t > P_e$
w	Wholesale price
b	Total advertising investment of the dual-channel SC
Φ_1	Revenue sharing ratio in forward channel—RSR-FC, the ratio of manufacturer shares sales revenue from an offline channel of the retailer, $0 \le \Phi_1 \le 1$
Φ_2	Revenue sharing ratio in reverse channel—RSR-RC, the ratio of retailer shares remanufacturing cost savings from recycling, $0 \le \Phi_2 \le 1$

and Wei (2009) analyze the optimal price and advertising decisions in a conventional forward SC of the offline channel when market demand is affected by price and advertising investment; while Szmerekovsky and Zhang (2009) look for the optimal decision when both the manufacturer and retailer invested in advertising. Pietro (2014) claims green advertising investment helps establish commercial goodwill for both manufacturer and retailer. So it can stimulate investment for green advertising if reverse revenue sharing contract is adopted in reverse supply-chain of closed-loop supply chain. Yi and Xiao (2012) construct a CLSC game theory model of certain demands under the influence of advertising, and discuss optimal pricing, advertising investment and recycle rate decisions as well as the coordination method. However, most scholars discuss the optimal pricing decision and cooperation advertising strategies in a dual-channel forward SC based on the assumption that demand is only affected by advertising; the influence of the competitive channel price on the channel price itself is not covered in the demand function. In fact, advertising investment will not increase product demand, but change the distribution of product demand in different channels.

"Double marginalization" decided by channel members exist in dual-channel closed-loop networks. After comparison and analysis of revenue-sharing contracts, buyback contracts and wholesale price contracts, Cachon and Lariviere (2005) conclude that revenue-sharing contracts can coordinate the SC channel and determine the retail price and the retailers' pricing, which is better than the coordination of buyback and discount contracts in a single case; besides, in revenue-sharing contracts, SC profits can be divided arbitrarily instead of depending on the retailers' order quantity and price option. Yan and Pei (2011) show that although retailers and manufacturers could share the information about consumer demand, only manufacturers could benefit from the information sharing, while the retailer unaffected. Altug (2016) discusses the impaction of revenue sharing contract in contract design from the perspective of cost. He regards cost as added value for contractor. Different types of revenue sharing brings different cost in the process of executing contract. Xu et al. (2014) establish a dual-channel supply chain coordinating contract, which consists of a two-way revenue sharing contract. Manufacturer gets a fraction of the revenue generated by retailer's channel in the traditional revenue sharing contract, while retailer gets a fraction of the revenue generated by manufacturer's direct channel in the reverse revenue sharing contract. However they do not consider recycling and remanufacturing, as well as sharing for remanufacturing cost savings. Yi and Yuan (2012) research on the influence of channel conflict on CLSC coordination in mixed sales channels. Therefore, for node enterprises in dual-channel closed-loop distribution networks, eliminating channel conflict and double marginalization has been a new eminent task.

Some manufacturers have already adopted a differential price strategy and service strategy in order to relieve the competition conflict between manufacturers and retailers. The mode has relieved channel conflict to a certain degree, but will it resolve dual marginalization altogether? How much do centralized versus decentralized decisions differentiate? And how are the profits of all members of the SC reallocated and reach a better recycle rate by determining a reasonable revenue sharing ratio in the CLSC? These are the questions studied and answered in this paper.

The remainder of this paper is organized as follows. Section 2 introduces the problem description and model. In Section 3, channel conflict coordination model of cooperative advertising in centralized CLSC is discussed, followed by the numerical analysis. Section 4 presents discussion of channel conflict coordination model of cooperation advertising in decentralized CLSC, as well as comparing with the performance in centralized CLSC. Section 5 summarizes the findings.

2. Problem description and model

2.1. Problem description

Fig. 1 shows a dual-channel CLSC consisting of single manufacturer/single retailer. The sales channel of this kind is about the simultaneous online and offline sales of certain products produced by the manufacturer at unit cost c. The manufacturer wholesales the product to the retailer in the wholesale price w through the offline channel, the retailer sells the product to consumers at the offline price P_t and the manufacturer sells the product to consumers at the direct sale price P_e through the online channel. Total

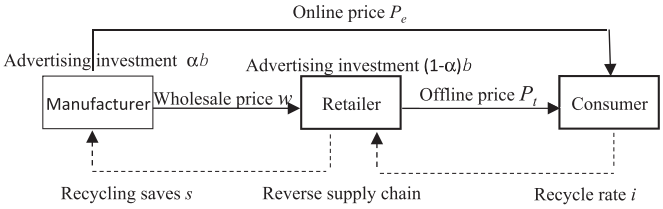

Fig. 1. Revenue-sharing decision model of cooperation advertising in a dual-channel CLSC.

Please cite this article as: Xie, J., et al., Coordination contracts of dual-channel with cooperation advertising in closed-loop supply chains. International Journal of Production Economics (2016), http://dx.doi.org/10.1016/j.ijpe.2016.07.026