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Coordinating a socially responsible closed-loop supply chain with product recycling

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ABSTRACT

This paper analyzes the effects of corporate social responsibility (CSR) and explores channel coordination in a socially responsible manufacturer-retailer closed-loop supply chain (CLSC) by considering two areas – profit maximization and social responsibility through product recycling. The manufacturer is socially responsible and exhibits it by recycling of used product that it collects through the retailer using the reverse channel. It is found that the channel's non-profit maximizing motive through CSR practice generates higher profit margin than the profit maximizing objective and revenue sharing contract resolves channel conflict. Recycling is a key factor for the wholesale price and hence pure profit of the manufacturer because variation of it may lead to decrement or increment even negative wholesale price. Thus, there must be a limit of recycling for optimal benefit. For best channel performance the manufacturer provides the retailer all revenues that it generates through recycling in the form of reward. Thus, CSR is purely a costly endeavor to the manufacturer. Moreover, unlike the pure profit maximizing supply chain CSR has the ability to vary surplus profit share.

1. Introduction

With increasing trend of globalization and competitive business environment companies are interested in improving economic and environmental performances for long term sustainability. As a consequence of environment friendly activity and resource minimization (fresh raw materials) for economic viability, a large number of companies are using reverse supply chain, besides the forward, to collect used products and recycle these to new. This is known as closed-loop supply chain (CLSC), where the manufacturer not only sells the products to the customers through its forward channel but also collects the used products through the reverse channel and recycles them. Recycling is a process to convert waste materials into new products. It helps to reduce the consumption of fresh raw materials, energy usage, air pollution, water pollution, etc. Recyclable materials are, for example, some kinds of metal, plastic, glass, textiles, paper, electronics, among others (http://en.wikipedia.org/wiki/Recycling). Hagerty and Glader (2011) mentioned that about $ 100 billion of recycled/remanufactured items are vended each year in U.S. and it is also of large volumes in other countries. So, design of a proper reverse channel is essential for improving environmental and financial benefits.

Corporate social responsibility (CSR) is a form of a corporate self-regulation which at this time does not have a sole definition. Broadly speaking, the CSR is regularly defined as a strategy which encourages social activities management in organizations. CSR proposes that firms hold responsibilities toward a broader group of stakeholders such as customers, employees, etc., jointly with their traditional financial responsibilities to stockholders (The regional economist, 2009). In the global business environment, CSR is a key factor in consumer and client decisions that organizations cannot disregard. Organizations who fail to maximize the adoption of a CSR strategy could be left behind. According to the results of a global survey in 2002 by Ernst and Young (2002), 94% of organizations trust that the implementation of a CSR strategy can produce real business benefits. Recent empirical evidence demonstrates that customers are willing to pay a higher price for goods with CSR attributes and CSR programs influence 70% of all consumer purchasing decisions (Cotte and Trudel, 2009; Auger et al., 2003). Modern theoretical and empirical analysis suggests that firms can strategically involve in socially responsible activities to increase private profits. Thus, alongside business goals companies are under pressure to look after social and environmental issues although only 11% have made significant progress in setting up the CSR strategy in their organization (Kitzmueller and Shimshack, 2012). On social issue, largest apparel retailer GAP admits to have substandard working

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conditions in 3000 factories worldwide (Merrick, 2004). Also, Nike is frequently blamed for inhuman labour and business practices in several Asian manufacturing factories (Amaeshi et al., 2008). For environmental issues, in 2009 a group of 186 investment institutions with assets valuated in 13 trillion US dollars signed a statement. This statement proposes some directions to do in order to reduce the global warming and greenhouse gases (Economist, 2009). In this direction, some organizations such as GAP, Adidas, WalMart, Nike, among others had been impelled to include CSR in their supply chains (Amaeshi et al., 2008). As a result a large number of principle organizations in different supply chain networks perform CSR through a code of conduct and use CSR as a tool for profit enhancement while how the profit of the channel is affected by the CSR is still unexplored.

Channel coordination is imperative for improving channel wide performance because it has the potentiality to generate profit benefit. Channel coordination using contract mechanism is the design of contract between the channel members that effectively neutralizes the difference between the centralized solution predicted by a single decision maker and decentralized solutions made jointly by the channel members. Variety of contracts are used to cut out double marginalization in traditional profit maximizing supply chain but are rarely applied in a socially responsible supply chain.

The purpose of this paper is to address the above mentioned issues by merging three research streams: CSR, recycling and channel coordination. Although several models were developed in these disciplines, none explored the effect of CSR through recycling on the channel coordinated decisions. This paper considers a manufacturer-retailer supply chain, where besides pure profit the manufacturer considers stakeholders welfare through CSR. In addition to producing new products, the manufacturer collects the used product through the reverse channel, recycles them to new products and sales the products through the forward channel. The manufacturer exhibits CSR activity through product recycling. Thus, the manufacturer's higher degree of social responsibility is reflected to the stakeholders and shareholders through higher environmental friendly activity by product recycling. As such, the profit function of the socially responsible manufacturer consists of pure profit that it earns by selling newly manufactured products, effects of CSR through consumer surplus that it earns from the stakeholders and profit due to recycling of used products. Apart from using revenue sharing mechanism and Nash bargaining product to resolve channel conflict and to divide surplus profit, this paper explores the effects of CSR and hence recycling on channel optimal decisions. In particular, this paper is designed to address the following five queries. Firstly, how the CSR and product recycling are related? Secondly, is it possible for the manufacturer to be the perfect welfare maximizer through the environment friendly recycling? Thirdly, can a socially responsible manufacturer encourage a retailer to exert full effort on used product collection for recycling, i.e., is it possible for a CSR manufacturer to provide utmost effort on recycling through the retailer? Fourthly, how to coordinate such a supply chain using any coordination contract? Fifthly, what is the effect of CSR and hence recycling on the wholesale price and profit of the manufacturer?

2. Literature review

Supply chains have conventionally been conceptualized as flowing products from manufacturers to end customers. A closed-loop supply chain recovers post consumer used materials so that these may be used as new after recycling by the same channel. The benefit of performing recycling processes is the possibility to create a new business. For example, the electronics giant Panasonic setup recycling system through which it recycles its own products and provides recycling services to its competitors, which is proved to be a profitable business for Panasonic. A large body of literature on supply chain formulated closed-loop supply chain (CLSC) models to address this issue. For example, Savaskan et al. (2004) considered a CLSC with product collection and recycling. They showed that the reverse channel with retailer's collection is optimal. In the same line, Choi et al. (2013) developed a manufacturer-collector-retailer CLSC and depicted that retailer-led channel is most effective. Later, Xu and Liu (2014) formulated a CLSC with manufacturer managed, retailer managed and third party managed reverse channels and analyzed the reference price effects on these channels. They concluded that higher reference price coefficient results in higher third party profit but lower profits for other two cases. At the same year, Jena and Sarmah (2014) considered a CLSC with two competitive manufacturers and a common retailer, who collects the used products and analyzed the non-cooperative and cooperative scenarios. On the other hand, Chuang et al. (2014) developed a CLSC in the line of Savaskan et al. (2004) for short life-cycle product with volatile demand and investigated the impact of collection cost structure and implementation of product take-back law on the manufacturer's choice of reverse channel structures. Hsueh (2011) investigated inventory control policies in a manufacturing/remanufacturing system during the product life cycle, which consists of four phases: introduction, growth, maturity, and decline. In this direction interested readers may consult (Atasu et al., 2008) for complete review.

Although there is a rich content on individual firms CSR consideration in a supply chain, application of CSR has emerged in the last two decades. Murphy and Poist (2002) considered a socially responsible supply chain and have proposed a total responsibility approach by including social issues to classical economy. Savaskan et al. (2004) focused on identifying a socially responsible CLSC that involved in product manufacturing and remanufacturing. Taking into account a socially responsible supply chain network, Hsueh and Chang (2008) demonstrated that the social responsibility sharing through monetary transfer leads to channel optimization. Afterwards, Ni et al. (2010) developed a two-level CSR supply chain by considering that the dominant upstream channel member's CSR cost is shared by the downstream channel member through wholesale price contract. After, Ni and Kevin (2012) developed a two-echelon supply chain by taking into account that each channel member has individual CSR cost. Specifically, they examined the effects of strategic interactions among the channel members under game theoretical setting. Hsueh (2014) proposed a new revenue sharing contract for coordinating a two-tier socially responsible supply chain. Panda (2014) considered a CSR supply chain and used revenue sharing contract to resolve channel conflict. Recently, Wang et al. (2015) examined the relationships among CSR, brand equity, and firm performance in Taiwanese high-tech companies over the period 2010–2013 using quantile regression and structural equation modeling. Considering a three-echelon supply chain with socially responsible manufacturer, Panda et al. (2015) proposed a contract-bargaining process to resolve channel conflict and to distribute surplus profit among the channel members. Modak et al. (2014) examined the effect of the manufacturer's CSR on product compatibility and discusses feasibility of the successful operation of a dual-channel supply chain.

In a seminal work Vickers (1985) first demonstrated that a firms non-profit maximizing objective may earn higher profit margin than would the profit maximizing objective. In a duopoly framework he assumed that one firm instructs its agents to maximize profits instead gives incentive for sales. The rival firm only prescribes its agents to maximize profits. He showed that the firm with incentive for agents earns higher profit than the rival firm. However, instead of considering duopoly framework this paper considers a manufacturer-retailer supply chain, where the retailer collects used products from the customers and supplies to the manufacturer for recycling. The manufacturer is socially responsible and exhibits it through product recycling. Unlike the natural intension of maximizing the channel members' profits, this paper uses the concept of Vickers (1985)'s principle. This principle indicates that non-profit maximizing firm may earn higher profits than profit-maximizers. Here, the main objectives of the manufacturer is to collect used products as much as possible through