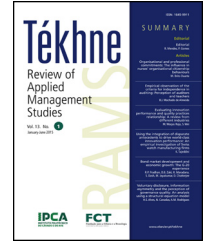




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ARTICLE

## A three-layer supply chain coordination in socially responsible distribution system

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### KEYWORDS

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suggested retail price

**Abstract** This paper deals with channel coordination in a socially responsible distribution system comprising of a manufacturer, multiple distributors and multiple retailers under each distributor. The manufacturer intends to swell stakeholder welfare by exhibiting corporate social responsibility (CSR). Demand at the retailers' end is linear function of price and is influenced by the manufacturer's suggested retail price. In manufacturer-Stackelberg game setting, a new revenue sharing (RS) contract is used to resolve channel conflict and win-win wholesale price and RS fraction ranges are identified in closed forms. It is found that the manufacturer's and the distributors' wholesale prices of the RS contract are negative when the manufacturer's CSR practice is above of some thresholds. So, the manufacturer's pure profit may be negative though the distributors' profits are positive because they receive some consumer surplus from the manufacturer.

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### 1. Introduction

Increasing trend of globalization, technological improvement and severe competition among the business entities cause enormous effect on the society as well as the

environment because companies are under pressure to accelerate their growth by the means of improved product quality and increased production rate. Consequently, the companies are forced by stakeholders and shareholders to perform socially (Dyllick & Hockerts, 2002). Consequently, corporate social responsibility (CSR) becomes an important issue to control the supply chain. In a recent survey, 74 percent of the top 100 U.S. companies, based on revenue, have published CSR reports in 2008, increment from 37 percent

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in 2005. Globally, 80 percent of the world's 250 largest companies have issued CSR reports in 2008 that highlights social and environmental issues (KPMG, 2008). On social issue, largest apparel retailer GAP admits to charge of its sub-standard working conditions in as many as 3000 factories worldwide (Merrick, 2004). Nike is often accused for inhuman labor and business practices in Asian manufacturing factories (Amaeshi, Osuji, & Nnodim, 2008). For environmental issues, in 2009, a group of 186 institutional investors having assets of 13 trillion US dollars have signed a statement. It suggests directions to deal with global warming and greenhouse gases. Recent empirical evidence shows that customers are willing to pay a higher price for products with CSR attributes (Auger, Burke, Devinney, & Louviere, 2003). As a result many leading international brands like WalMart, Nike, Adidas, GAP have been impelled to incorporate CSR in their complex supply chains by a code of conducts (Amaeshi et al., 2008).

A significant amount of research has been done in the area of supply chain coordination. Most of these have been concentrated on the direct collaboration between two individual members. The models dealt with resolving channel conflict in three-echelon supply chain are notably fewer. In practice, it is more difficult to cut out channel conflict in a three-tire supply chain by applying coordination contract than a two-tire supply chain. When the number of echelon increases, self cost minimizing/profit maximizing objectives increase. As a result, dimension of the solution space increases and the channel coordination using contract becomes more complex. The problem further intensifies if there are multiple members in some echelons. Due to multiple members, there are several system and cost parameters in each echelon and one-to-one interactions between the members of different echelons are needed as each member has its own reservation. Therefore, apart from the vertical coordination, horizontal coordination is essential for the best performance of the channel. Also, many constraints remain when it comes to carry out any coordination contract for channel members. The constraints are geographical constraints, administrative problems, performance measurement and incentives at individual forms based on local perspective, dynamically interchanging products and the like (Kanda & Deshmukh, 2008).

The purpose of the paper is to incorporate CSR in a three-level distribution channel that consists of a manufacturer, multiple distributors and multiple retailers under each distributor. Besides pure profit, the manufacturer as the leader of the channel considers stakeholders' welfare through CSR and influences the downstream channel members to behave socially. In the modeling, instead of considering the manufacturer's CSR activity, the effect of CSR in the form of consumer surplus is incorporated in its profit function. In manufacturer-Stackelberg game approach apart from discussing the effects CSR in decentralized and centralized decision making, a new revenue sharing (RS) mechanism is applied to resolve channel conflict and to find win-win profits of the channel members. In particular, the main objective of the proposed model is to explore the effects of CSR on the channel members coordinated profits. Also, how the parameters of the RS contract are affected by the CSR attribute of the channel is examine.

## 2. Literature review

Corporate social responsibility is the corporate self-regulation which currently does not has unique definition. Dyllick and Hockerts (2002) defined CSR meeting the needs of a firm's direct and indirect stakeholders (e.g. shareholders, employees, clients, pressure groups, communities, etc.), without compromising its ability to meet the needs of future stakeholders as well. Dahlsrud (2008) analyzed 37 definitions of CSR and developed five dimensions of CSR: environmental, social, economic, stakeholder, and voluntariness. Application of CSR in supply chain has emerged in the last two decades. Considering a socially responsible supply chain, Murphy and Poist (2002) suggested a total responsibility approach by adding social issues to traditional economy. Carter and Jennings (2004) explained the necessity of CSR consideration in supply chain decision making through a case study and survey research. Analyzing a French sample data set, Ageron, Gunasekaran, and Spalanzani (2012) derived several conditions for a successful sustainable supply chain management. Cruz (2008) traced equilibrium condition for an environmentally responsible supply chain network using multi-criteria decision making approach. Cruz and Wakolbinger (2008) extended the model to multi-period setting for measuring long-term effects of CSR. Considering a socially responsible supply chain network, Hsueh and Chang (2008) showed that the social responsibility sharing through monetary transfer led to channel optimization. Cruz (2009) developed a decision support system framework for modeling and analysis of a CSR supply chain network. Ni, Li, and Tang (2010) studied a two-tire CSR supply chain assuming the dominant upstream channel members CSR cost which is shared by the downstream channel member through wholesale price contract. Ni and Kevin (2012) developed a two-echelon supply chain by implementing each channel member's individual CSR cost. They examined the effects of strategic interactions among the channel members under game theoretical setting. Panda (2014) and Panda, Modak, and Pradhan (2016) considered CSR supply chains and have used different contracts to resolve channel conflict. They have used Nash bargaining product to divide surplus profit between the channel members.

Supply chain coordination is essential to improve its performance (Modak, Panda, & Sana, 2015a, 2015b, 2015c; Sarkar, 2013, 2016; Sarkar, Saren, Sinha, & Hur, 2015). Focusing on the multi-echelon supply chain, Munson and Rosenblatt (2001) developed a supplier-manufacturer-retailer supply chain. They explored coordination using quantity discounts on both ends of the supply chain to decrease costs compared to concentrating only on the lower end. Jaber, Osman, and Guiffrida (2006) extended Munson and Rosenblatt's (2001) model by assuming profit function, discount dependent demand and profit sharing. Van Der Rhee, Van Der Veen, Venugopal, and Nalla (2010) introduced a new type of revenue sharing contract mechanism for multi-echelon supply chains between the most downstream entity and all upstream entities. Saha, Panda, Modak, and Basu (2015) examined mail-in-rebate and downward direct discount coordination contracts for a three-echelon supply chain

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