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To collaborate or not to collaborate: Prompting upstream eco-efficient innovation in a supply chain



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ABSTRACT

Large retailers are a source of great stress for suppliers in supply chains: they want better environmental performance and ever-lower prices without sacrificing product quality. Retailers' initiatives pressure suppliers to invest substantially upfront to reduce packaging and energy use. The potential savings in packaging materials, production and shipping costs that could offset suppliers' upfront investments, however, are not going mainly toward suppliers' bottom lines, since the retailers appear to share only the savings but not the upfront investment. Thus, retailers' heralded sustainability initiatives are weighed down by the substantial costs to be borne by suppliers alone, and retailers' efforts to improve the environmental performance of their supply chains do not materialize as predicted. In this paper, we consider a two-echelon supply chain where an upstream supplier sells through a downstream retailer. The supplier is accountable to invest effort in an eco-efficient innovation, which decreases her unit production cost while improving the per-unit environmental performance of her product and increases the value of the product to consumers (so enhancing market demand), and the retailer who embodies the channel power sets the product price and sells to consumers. First, we delve into the non-collaborative case where the retailer imposes a minimum requirement on the level of eco-efficient innovation effort to be invested by supplier. Second, we study the profit/cost implications of collaboration between two parties for upstream eco-efficient innovation by scrutinizing two types of contracts: a cost-sharing agreement wherein the retailer shares a fraction of the supplier's upfront cost of investment in innovation; and a revenue-sharing agreement under which the retailer shares a fraction of his revenues generated by the supplier's eco-efficient innovation effort. For each contract, we also contemplate the possibility of negotiation between the retailer and supplier which forms the basis of division of costs and revenues under a cost- and revenue-sharing contract, respectively.

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1. Introduction

The mounting pressures from various stakeholders – customers, governments, NGOs and environmental groups – to conduct business in a sustainable fashion has pushed big-box retailers to step into the “green” scene. Shareholder resolutions, for example, pushed companies as diverse as Wal-Mart, Avon, Safeway, Dow and Whole Foods to act on environmental and health issues tied to certain chemicals and toxics (Esty & Winston, 2006). NGOs pressured such consumer-facing brands as Victoria's Secret and McDonald's to change their environmental practices.¹ Most have responded to those pressures in conformity with the way their sup-

pliers extend services. In addition to tweaking their own operations and dabbling with a number of green store concepts to reduce their own operational footprint (e.g., the lighting system of Wal-Mart built around energy-efficient lights, and the company's use of chlorofluorocarbon-free cooling, and shopping cart corrals, bumper blocks and signs composed of recycled plastics), they have unilaterally re-structured their relationships with their suppliers. They put increasing pressures on their suppliers, impugning them to lower the energy use of their products, eliminate hazardous materials, use more organic or bio-based ingredients, reduce packaging and lessen negative environmental impact of their production processes – while at the same time wanting ever-lower prices without loss of product quality.

Big retailers have rapidly inserted themselves into the sustainability equation and become a source of great stress for suppliers. Today, suppliers have no choice but to heed mandates and satisfy environmental standards set by retailers for their products/processes to keep getting major contracts from those big

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¹ See http://www.alternet.org/story/35244/victoria's_dirty_little_secret (accessed date October 22, 2016), and Vidal, J. (1996) *McLibel: Burger Culture on Trial*, Basingstoke: Macmillan.

buyers.² In October 2008, Leo Scott, then the CEO of Wal-Mart, handed over a directive to 1000 suppliers in China, stating that they had to reduce waste and emissions, decrease packaging costs by 5 percent by 2013, and improve the energy efficiency of products supplied to Wal-Mart stores by 25 percent in three years' time. More notably, Scott issued a stern warning: "Go green the Wal-Mart way or Wal-Mart will take its business elsewhere."³ In September 2007, the company announced that it would stock only compacted versions of detergents in all of its U.S. and Canadian stores – no more big bottles.⁴ It is more than Wal-Mart, of course. In 2007, Target announced they would systematically eliminate polyvinyl chloride (PVC) from a range of products sold at Target stores (e.g., shower curtains, tableware, infant products).⁵ Sears Holdings, parent of Kmart and Sears & Roebuck, followed suit by phasing out PVC. Staples, the office supply company, set goals for paper-based products to come from sustainable forests by 2010, and declared that they would work only with suppliers using pulping and paper-making technologies that minimize the raw material utilization and release of hazardous emissions.⁶ Those big-box retailers have started to look upstream for solutions and set aggressive standards on suppliers, because (1) their green store concepts were tinkering around the margins relative to the environmental impacts of the products they sell, and (2) as public-facing companies in their supply chains, they have increasingly been held accountable by stakeholders for negative environmental impacts caused by their upstream suppliers.

Since suppliers find it difficult to escape from this growing downstream pressures to reduce environmental impacts, this trend has presented a new set of challenges. Suppliers, in general, are convinced that the more sustainable their products/processes become, the more their effort would erode their competitiveness. The underlying reason is that substantial costs are incurred for investments in environmental innovation, and it is the suppliers who pay dearly to improve the environmental performance of their products/processes. For example, when P&G created "2X" versions of their products (packaging the same number of loads into a half-sized bottle) in order to meet the standards set by Wal-Mart for liquid laundry detergents, the substantial development costs for the reformulated and repackaged products – to the tune of \$200 million – was borne by P&G alone, while most of the benefits accrued to Wal-Mart (Makower, 2009). Besides, even though environmental investment in products/processes enable retailers to generate additional revenues from better products, suppliers' wholesale prices do not rise enough to compensate for and/or their savings in production costs (e.g., savings in packaging costs) do not offset their upfront investment. Apparel retailers, for example, had made it amply clear to their suppliers that they would not be paying premium prices for clothes made with organic cotton.⁷ Being concerned that those "requests" would increase their costs without necessarily improving their revenues from downstream retail-

ers, and perceiving the benefits of environmental innovation as going mainly to retailers' bottom lines, many small/midsize suppliers resist retailers' efforts to get them to adopt sustainable production methods. However, given that those retailers do have a tremendous power advantage over them, suppliers seem to have little choice but to comply by retailers' standards and accept the uneven returns from environmental innovation – or lose their big-box buyers.

It is apparent that retailers' stepped-up enforcement on their upstream suppliers' investments in environmental innovation has been undermining their efforts to boost sustainability of their supply chains. Uneven returns from suppliers' environmental innovation and substantial upfront investment costs borne by suppliers alone under enforcement hamper all those sustainability efforts, and this in turn leads to supply chains that are not, well, sustainable. Then, rather than imposing strict requirements on their suppliers, how could retailers navigate such trade-offs/conflicts in their supply chains and incentivize their suppliers to invest more effort in environmental innovation, all the while protecting their profit margins? What would be the financial and environmental implications if large retailers could change their relationships with suppliers to be more like partnerships, offering them incentives to cut their investment costs and increase the benefits of becoming environmentally-conscious? In this context, the purpose of this paper is to conceptualize and formulate a two-echelon supply chain with an upstream supplier who is supposed to invest in environmental innovation and a downstream retailer who embodies channel power and sells to consumers, and examine the impact of collaboration between these two parties on the level of supplier's investment in environmental innovation and firm-level profits. In regard to collaboration, stemming from the aforesaid challenges facing suppliers, we place emphasis on two distinct contract scenarios: a *cost-sharing* agreement wherein the retailer shares a fraction of the supplier's upfront cost of investment in environmental innovation; and a *revenue-sharing* agreement under which the retailer shares a fraction of his revenues generated by environmental innovation with the supplier. For each contract, we also consider the possibility of negotiation between the retailer and supplier which forms the basis of division of costs and revenues under a cost- and revenue-sharing contract, respectively.

In particular, we attempt to address the following questions: (1) How do a retailer and a supplier perform under a non-collaborative case where the supplier must fully comply by a minimum standard determined by the retailer? How do structural parameters of the model affect those two firms' individual performance and the overall channel performance? (2) What is the impact of collaboration between the retailer and supplier on the level of supplier's environmental innovation effort, market price of the product and firm-level profits? (3) Which contract form is the most effective in motivating the upstream supplier to invest in environmental innovation, and which contract form helps maximize the retailer's profits? (4) What are the impacts of cost-decreasing and demand-enhancing effectiveness of environmental innovation on key decision variables, contract terms and firm-level profits? (5) Can collaboration through cost- or revenue-sharing contracts achieve the win-win-win situation for the retailer and supplier who earn more and the environment which gains from lower environmental impact of the supplier's product/production process. In our attempt to answer these questions, we develop a retailer-supplier decision-making model and intend to help retailers manage the trade-offs between environmental and financial performance of their supply chains.

The rest of the paper proceeds as follows. Section 2 provides a review of the related literature. In Section 3, we detail our modeling assumptions. In Section 4, we initially analyze the non-collaborative case where the retailer sets a minimum requirement

² The reader is referred to (Dauvergne & Lister, 2013) for an in-detail discussion over the growth of big-box retailers within supply chains with a focus on the governance power and limits of eco-business, eco-business tools for supply-chain control and big retailers' governing authority.

³ <http://www.greenbiz.com/news/2008/10/22/wal-mart-ramps-standards-suppliers-china-around-globe> (accessed date October 15, 2015).

⁴ http://corporate.walmart.com/_news_/news-archive/2008/05/29/wal-mart-completes-goal-to-sell-only-concentrated-liquid-laundry-detergent (accessed date October 16, 2015).

⁵ <http://www.environmentalleader.com/2007/11/08/target-to-reduce-pvc-use> (accessed date October 16, 2015).

⁶ http://www.staples.com/sbd/cre/marketing/staples_soul/documents/staples-sustainable-paper-procurement-policy-1.pdf (accessed date October 15, 2015).

⁷ <https://hbr.org/2010/10/dont-tweak-your-supply-chain-rethink-it-end-to-end> (accessed date October 15, 2015).

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