



Used intimate apparel collection programs: A game-theoretic analytical study[☆]



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ABSTRACT

This paper explores the used intimate apparel collection (UIAC) programs in a supply chain system. Our game-theoretic analysis reveals that the collector type and the level of retail competition affect the UIAC program significantly. In particular, we show that the benefit-cost ratio of the collector's investment plays a decisive role in determining whether an increased level of competition will improve the UIAC program's levels of social, environmental, and economic sustainability. We further find that an increased level of competition will lead to a higher consumer surplus if the respective consumer goodwill of donation is sufficiently small.

1. Introduction

With the increasing awareness and concern on socially responsible operations and environmental sustainability issue, there are many discussions on the proper treatment of “end-of-life”, “obsolete”, and used items (Shi et al., 2016). In the electronics industry, under the extended producer responsibility (EPR) rule, manufacturers are responsible for the collection and further processing (such as recovery and disposal) of many end-of-life electronics products (Atasu and Subramanian, 2012). In the automobile industry, BMW, Renault, and Fiat establish a joint venture on the recovery and processing of the used cars under their brands (Savaskan and Van Wassenhove, 2006). In the copier and printer industry, many companies such as Canon and Xerox have collection and recovery programs for their own used machines and cartridges. In fact, the detailed mechanism and operations behind the used product collection programs vary a lot in different industries. For instance, companies such as Canon and Xerox directly collect their used products (such as cartridges) from consumers using postal mailboxes; Kodak collects the used “one-time-use cameras” via the retailers and each retailer is reimbursed under the collection program (Savaskan and Van Wassenhove, 2006).

Product return and recycling (PRR) is also popular in the intimate apparel industry. In fact, intimate apparel is a special category in the fashion apparel industry (Hart and Dewsnap, 2001). In addition to environmental sustainability, PRR in intimate apparel helps enhance female consumer's body and health as the over-used and aged bras may cause tension in shoulders and neck, lead to headaches, and even some more terrifying breast diseases.¹ In order to maintain body health, in intimate apparel, every woman user is advised to continuously renew her bras and dispose the old ones. In the fashion industry, intimate apparel retailers have been well-

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¹ Against breast cancer website: <http://www.againstbreastcancer.org.uk/> (accessed Feb 9, 2017).

aware of the importance of socially and environmentally responsible operations in their business and have widely implemented the UIAC programs to provide cash incentives and encourage consumers to return old bras and buy new ones. For example, Bonluxe, a famous luxury brand of intimate apparel in Hong Kong, is currently granting a HK\$800 (about US\$100) cash voucher as an incentive to consumers for returning every piece of old bra. The collected bras will be recycled. In particular, the buckles, wires and other metallic components will be treated separately.² In the mass market, the intimate apparel brand Wacoal allows consumers in Hong Kong to return the old bras of any brand, and consumers can redeem HK\$50 (about US\$ 6) cash coupon for new purchase (see Appendix A.4 for photos of the cash coupons offered by Bonluxe and Wacoal). Similar UIAC programs are also widely adopted in Japan where both Wacoal, and Triumph have launched them, under which consumers can receive cash coupons upon returning the used bras. Observe that both Triumph and Wacoal collect old bras and recycle them into refuse paper and plastic fuel (RPF). Triumph has helped produce about 14 tons of RPF from recycling bras from 2009 to 2014³ and Wacoal has collected more than 563,000 bras and helped produce 56.3 tons of RPF from 2008 to 2014.⁴ Thus, the UIAC programs are non-trivial operations with a substantial scale.

As a remark, in terms of the unique features of UIAC programs (compared to other used product collection programs), first, the used intimate apparel products such as bras have the unique modules like the metallic wires, soft materials, etc. which facilitate the recycling and reuse processes. In fact, in Wacoal stores in Hong Kong, we even find that the sales people would help decompose some collected bras in the store by taking out the “modules” and put them in the respective boxes for re-collection. Second, the metallic wire has a very high value and can be reused after simple treatments. Third, for the other materials (such as fabrics and plastics), for hygiene issues, they are not re-manufactured to produce bras again. Fourth, unlike the electronic wastes in which there are government rules on “extended producer responsibility”, currently there is no such a rule in intimate apparel. Thus, the brands launching the UIAC program are not under the pressure of the government. Thus, it is totally a self-initiated socially responsible and commercial program. These are some critical features that differentiate the UIAC program from other used product programs such as electronics.

From the above discussion, there is no doubt that the UIAC program is widely implemented in the real world and is now an emerging business practice in the intimate apparel industry. For intimate apparel companies, the UIAC program is a corporate socially responsible (CSR) practice which enhances socially and environmentally sustainability⁵ as well as company image. To be specific, in terms of environmental sustainability, the collected used intimate apparel reduces landfill and enhances the probable reusability of components. For social sustainability, consumers in the market enjoy a consumer surplus from participating in the UIAC program. The UIAC program hence carries values which benefit the participating firms, organizations, consumers and the environment (Drake and Spinler, 2013). Motivated by the UIAC industrial practices in the intimate apparel industry, this paper conducts a game-theoretic analysis on the value of incentivized consumer return in CSR program. We consider a supply chain model with two intimate apparel retailers and a single collector. To be specific, based on the observations from the current industrial UIAC practices and the extant literature, we consider the case where the collector is a profit making commercial company which possesses the value maximization (VM) objective. In addition, also following the industrial practice and as a comparison, we consider another scenario in which the collector possesses the quantity maximization (QM) objective, which correspondingly represents the case in which the collector is a non-profit making ‘charity’ organization.⁶ Moreover, in the supply chain, we consider the important decisions such as the collection investment exerted by the collector for the UIAC program, and the amount of voucher rebates granted by the retailers to the consumers for attracting used bra returns. Obviously, these decisions will interact with one another and affect the end consumer market demand. Furthermore, we also examine the impacts brought by the retail-level competition on the equilibrium decisions of the collector and the retailers as well as the effectiveness of the whole UIAC program. The specific research questions that we aim to explore are listed as follows:

Comparing between the charity collector and the commercial collector: (a) Which one of them would exert a greater collection investment in the UIAC program? (b) Would the intimate apparel retailers offer a different voucher rebate value when working with different type of collector?

In terms of social welfare: (a) Will the charity collector always attain the highest possible level of social sustainability in its operations? (b) When will the social welfare created by the charity collector be lower than the commercial collector?

What are the impacts brought by retail competition on the UIAC program? What are the corresponding mediating factors?

These research questions are important because addressing them would (i) let us know about how different forms of the collectors affect the performance of the UIAC program as well as the voucher rebate scheme; (ii) reveal whether some counterintuitive insights such as the social welfare created by the charity collector will be lower than the commercial collector (and if yes, when); (iii) highlight the importance of retail competition on the UIAC program and uncover the key mediating factors. In operations management, these research questions and their answers would be taken as significance as they help to improve our knowledge regarding the widely observed UIAC program and also contribute to the respective literature.

² Bonluxe official website. <http://www.bonluxe.hk/> (accessed, 12 March 2015).

³ Tokyo Times. <http://www.tokyotimes.com/japanese-recycle-used-bras-into-industrial-fuel/> (2012).

⁴ Wacoal Bra Recycle. <http://wacoal.mbe.hk/brarecycle/> (accessed, 12 March 2015).

⁵ For example, in terms of environmental sustainability, the production of a t-shirt consumes between 10,000 and 30,000 liters of water and emits 3.6 kg CO₂. With an up-cycling production process, a t-shirt can be produced by consuming and emitting only 5–10% of water and CO₂, respectively (I:CO website).

⁶ According to our industrial observation and discussion with managers in the intimate apparel industry, the collector is mostly the third party who is profit-oriented and specialized in recycling. The presence of the collector is necessary because recycling and converting bras into RPF are complex and challenging for an apparel company. Further notice that some intimate apparel companies do work with charity collectors in some of their “promotional” campaigns. It is why we consider both the profit making and non-profit making collectors in this paper.

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