

# The Signaling Mechanism of Fairness Concern in E-CLSC

Yanhong Qin, Chongqing University of Technology, China\*

Shaojie Wang, Chongqing University of Technology, China

Neng Gao, Chongqing University of Technology, China

Guirong Liu, Chongqing College of Mobile Communication, China

## ABSTRACT

The E-CLSC (E-closed-loop supply chain) game model dominated by manufacturer is set, and information value about asymmetry fairness concern of E-platform (E-commerce platform) is calculated for manufacturer, recycler, and E-platform. By signaling model under various signal costs, the authors study the condition for E-platform to transmit real information about fairness concern so as to reduce profit loss for all parties in E-CLSC. The authors prove that E-platform has the motivation to disguise or exaggerate fairness concerns in order to obtain more profit, and manufacturers must try to identify the E-platform's real fairness concern to avoid profit loss. Besides, only when different types of E-platforms need significantly different signaling cost, both of them would like to send real fairness-concern signal, and thus manufacturer can effectively identify E-platform's real information about fairness concern so as to improve recycling rate and optimize the whole E-CLSC operation.

## KEYWORDS

Asymmetric Information, E-CLSC, Fairness Concern, Signaling Game

## INTRODUCTION

With rapid economic growth and industrialization, the problems of resource scarcity and environmental pollution are becoming increasingly serious (Govindan et al., 2015; Aderonke et al., 2020). To solve these problems, the European Union promulgated the Industrial Emission Directive from the perspective of producer responsibility (Europe, 2010), and the United States also issued the Electronic Waste Collecting Law in terms of recycling and remanufacturing (USA, 2003). Recycling and remanufacturing play extremely important roles in resource reuse and sustainable development (Zhu et al., 2016; Zou et al., 2016; Hye et al., 2020). Recently, advanced Internet technology has promoted a circular economy and remanufacture. An increasing number of enterprises (e.g., Gome, Amazon, and Tmall) combine an e-platform with a traditional closed-loop supply chain (referred to as a CLSC) to form an E-CLSC, which can obviously improve the return rate of used products, promote comprehensive resource conservation, and improve the circular economy. In 2019, Chinese e-commerce transactions reached 34.81 trillion yuan, up 6.7 more than one year ago (Report, 2021a),

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\*Corresponding Author

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and the recycling volume of renewable resources was 354.474 million tons, up 10.2% more than one year ago (Report, 2021b). In current practice, many companies recycle used products and sell remanufactured products using the e-platform. For instance, Aihuishou cooperates with JD.com to recycle used products and then sell remanufactured products through the e-platform JD (JD, 2019; Wang et al., 2018). Some enterprises, such as IBM and Dell, have formed a department dedicated to recycling used products and selling their products on Taobao (Ma et al., 2016; Taobao, 2022). Lei Shing Hong Machinery sells Caterpillar's old equipment on its online platform (LSHM, 2022; Zheng et al., 2019).

As an important E-CLSC member, the e-platform is not only critical to the sale of new products and remanufactured products but also essential to recycling products. The e-platform may care more about the distribution fairness of profit in the supply chain, so it may even sacrifice some profit to pursue a more equitable distribution. For example, the online recycling platform Re-Life has to shut down due to unfair profit distribution (Daily, 2022). Spotify, a music service provider, has complained to the European Union about Apple's unfair charging practice because Apple charges only 30% more for service providers but does not draw service commissions for itself (James, 2019; Naresh et al., 2020). Furthermore, as an inherent psychological behavior, fairness concerns are subjective and private. Manufacturers usually do not know the real information about the e-platform's fairness concerns, which could cause wicked problems, such as an uncoordinated supply chain and a lower return rate. A recent survey indicated that if the Chinese e-platform could provide more reliable and real information, online shopping transactions would reach 5 trillion yuan in 2016 (Wang et al., 2018). The information authenticity of fairness concerns is essential to realize effective E-CLSC operation, and thus, it would be important to research the asymmetry effect of the e-platform's fairness-concern information on price and recycling decisions.

This paper provides four contributions. First, we set a three-party game model of E-CLSC by considering the e-platform's fairness-concern behavior. Second, we calculate the information value about asymmetry fairness concerns for manufacturers, e-platforms, and recyclers in the E-CLSC, which proves the significance of identifying real fairness concern information. Third, we set the signaling model under different signal costs and prove the condition when the e-platform would transmit a real fairness signal by solving the Bayesian perfect Nash equilibrium. Finally, we design a signal recognition mechanism to identify real information about the fairness concerns of the e-platform.

The rest of the paper is organized as follows. First is a literature review, followed by the model and solution by considering the asymmetric information of the fairness concern of the e-platform and calculating the information value about asymmetry fairness concerns. The following section establishes two signaling models of the same cost and different costs to analyze certain effective conditions when the e-platform transmits real fairness information. The remaining sections present an effective signal recognition mechanism to distinguish the e-platform's real fairness information, provide a numeric analysis, and present conclusions.

## **LITERATURE REVIEW**

Although E-CLSC has recently attracted considerable attention, existing research has focused on traditional CLSC (closed-loop supply chain). Therefore, we primarily conducted a literature review regarding three streams: recycling decisions and contract coordination in CLSC, recycling decisions and coordination under fairness concerns in CLSC, and coordination under fairness concerns in E-CLSC.

### **Recycling Decision and Contract Coordination in CLSC**

Some research has focused on optimal recycling decisions and coordination in CLSC. Savaskan et al. (2004) and Hong et al. (2015) designed a two-part tariff to optimize the recycling decision. Ma et al. (2016) proved the different impacts of various cooperation methods on recycling decisions in

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