Proceedings of the 5th International Conference on Business and Policy Studies
DOI: 10.54254/2754-1169/2026.31825

A Trade-in Closed-Loop Supply Chain Considering Carbon Cap-and-Trade Policy

Yichen Zhang

School of Management, Huazhong University of Science and Technology, Wuhan, China
zhang_yc2001@163.com

Abstract. Many companies today are seeking to implement closed-loop supply chains and remanufacturing activities to save costs and protect the environment. At the same time, China is actively promoting trade-in polices and optimizing carbon emission reduction policies, aiming at green economy development. This paper considers a closed-loop supply chain with trade-in service and remanufacturing considering carbon cap-and-trade policy. The analysis offers models for comparing regimes with or without a government trade-in subsidy. This paper examines how various parameters, including customer profiles, product residual value, reuse profit, environmental benefit, carbon price, and government subsidy, influence the optimal strategy and profits of the close-loop supply chain. Results show that the positive impact of product resale value and reuse profit on trade-in rebate. These findings indicate, although the benefits of a lower remanufacturing cost and reduced emissions increase the price at which they are offered for sale, this leads to reduced purchases by original purchasers, and greater demand for replacements. Higher carbon price has the potential to the price schedule consists of wholesale price, retail price, and trade-in rebate, it discourages new consumer sales and has mixed influences on replacement consumer sales, possibly increasing or decreasing these transactions. Government subsidy reduces first-time purchases, yet increase the trade-in purchases. As the subsidy decreases, profit of the manufacture increases and that of the retailer declines. On the other hand, increased subsidy results in lower manufacture profits and higher retailer profits.

Keywords: Closed-loop supply chain, remanufacturing, trade-in, cap-and-trade, government subsidy

1. Introduction

In recent years, closed-loop supply chains have attracted more and more attention. Products produced by companies are used by consumers and returned for remanufacturing. The regeneration of the products is completed at low cost, thereby attracting consumers' desire to purchase. Chinese government attaches great importance to sustainable development and actively promotes the development of circular economy. In 2021, the national carbon emissions trading market was officially opened, and carbon emission policies have been continuously improved since then. Under the total carbon emissions control and trading system, companies will be guided to use more low-carbon and cleaner remanufacturing technologies, and China continues to introduce and improve trade-in subsidy measures to use replacement to increase consumers' willingness to purchase.

The existing works in the area of closed-loop supply chains mainly focuses on recycling channel selection [1-3], trade-old-for-new programs [4-6], trade-old-for-remanufactured programs [7-9], government subsidies [7,8], and carbon policies [3,7,8]. However, there is a lack of studies that investigate the joint effect of both product remanufacturing and carbon emission cap-and-trade in closed-loop supply chains.

This paper considers the case of a closed-loop supply chain which is led by one manufacturer and investigates the following research problems: Firstly, it studies the optimal behaviors of supply chain members in a product remanufacturing system under carbon emission cap-and-trade policy. Secondly, it investigates the effect of product remanufacturing on price and profit under a recycling market. Thirdly, the paper investigates how carbon trading regulations influence decisions making and economic performances in trade-in closed-loop supply chain. Finally, the paper analyses how government trade-in subsidies on consumers affect prices and profits in the closed-loop supply chain.

2. Models

2.1. Model description

This paper constructs the closed loop supply chain problem with one manufacturer and one retailer facing the cap-and-trade policy, denoted by Model N. In the forward channel, the manufacturer is involved with both the new product manufacturing and the remanufacturing processes, wholesales these items to the retailer. The retailer sells the products to customers at retail price. The government sets a bound on the emission of the manufacturer's manufacturing process. If the manufacturer emits less than this bound, then it could sell its excess allowance on a carbon market and earn proceeds for doing so. If the covered entity emits more than its allocated amount, then that the manufacturer must buy another allowance in the market. In reverse channel, the manufacturer provides a trade-in service where it collects returned products from the consumers and reuses them, meanwhile it offers a subsidy price of new ones to consumers. The closed-loop supply chain under government support, denoted by model G, means that government gives some subsidies for consumers participating in the remanufacturing activities. The structures of the closed-loop supply chain are shown in Figure. 1.

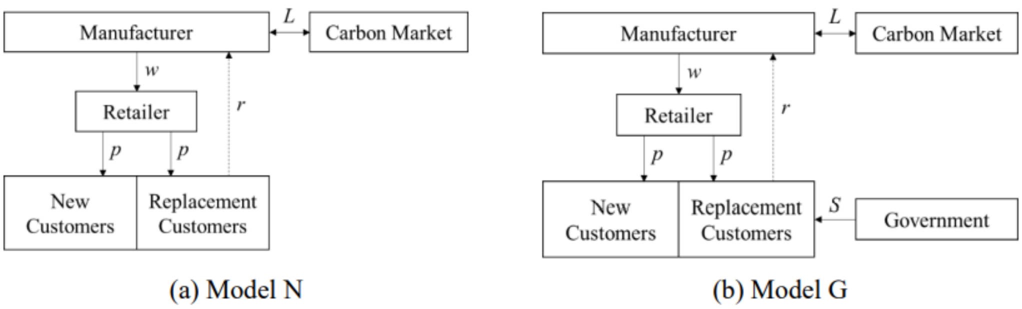

Figure 1. Supply chain structures

The key decisions variables and parameters of the models are given in Table 1. In the following, the profit of player i in model j is defined as Π_i^j, where $i = M, R$, represents for manufacturer or retailer respectively, $j = N, G$, represents for model N and model G respectively.

DOI: 10.54254/2754-1169/2026.31825

Table 1. Decision variables and parameters

Variable	Definition
w	wholesale price
p	retail price
r	rebate for a replacement consumer
c	cost of a new product
d	reduced cost of a remanufactured product
e	carbon emission of a new product
λ	reduced carbon coefficient emission of a remanufactured product
θ	consumer's pay willingness
β	residual value coefficient of old products
α	proportion of new consumers
S	government subsidy for a replacement consumer
E	carbon emission quota
L	carbon price

This paper considers an environment where there is only one product class and at any given time every consumer may have access to either the current generation or the old generation of that product, but not at the same time. All the previous old models are supposed to be equal in everything. This paper defines 1 as a measure of all consumers in the whole market and α represents proportion of new customers that do not own previous generation, and the rest of $1-\alpha$ are users that are able to replace their old ones with newer ones. New buyers can purchase the products either by paying full price while upgraders can benefit from exchanges programs. This research uses θ as a measure of how much customers value new products and assume that it is distributed in range $U(0,1)$. The value of used products for replacement consumers is reduced to $\beta\theta$, where $0<\beta<1$.

DOI: 10.54254/2754-1169/2026.31825

In the marketplace there are new products made of new material as well as used products which may be recycled or reused, either directly or through a trade-in program, consumers send back the product to be collected by the manufacturer so that it may be processed again into another new product. Remanufacturing technology is now sufficiently advanced so as to produce products that have the same appearance and performance as newly manufactured ones. Therefore, it is assumed that in this paper the remanufactured units and new products are completely substitutable. They have the same wholesale price and retail price, and that buyers value them equally.

The manufacturer produces goods from used parts with the help of recovery, component substitution, and modularity. The latter approach demands less material inputs and fewer manufacturing processes, thus creating much less costs of operation than the traditional way of manufacturing using new products. Therefore, this paper assumes that $d > 0$ and $d < c$. The reduction rate in environment is significant as carbon emission for each remanufactured product reduces to $(1-\lambda)e$, where $0 < \lambda < 1$ .To enhance the model's validity and solubility, this paper assumes that $S < p - r$, $E > 0$, and $L > 0$.

The models consider only one stage of Stackelberg game. In both two models, the manufacturer is the leader first determining the wholesale price schedule along with the trade-in bonus level. Then, the retailer sets the consumer's final selling price. In the last step consumers decide to buy or not according to the selling price compared with its own reservation value; it can be a consumer who is going to purchase for the first time or just wants an upgrade in its consumption of this good. Consumers are perfectly informed and fully rational, both the manufacturer and the retailer pursue the highest profits of their own. There are no stock limitations and shortage of supply in these models.

2.2. Model N: without government subsidy

Considering the existing selling price p given by the retailer, the utility of new customers purchasing this innovative product is $U_n^N = \theta - p$. When $U_n^N > 0$, that is, $\theta > p$, the new consumers will choose to purchase new products. Therefore, the total demand of new consumers is:

$$q_n^N = \alpha \int_p^1 d\theta = \alpha(1-p) \tag{1}$$

Due to the trade-in, any replacement consumer wanting a new product will not pay the market price. The utility of replacement consumers from purchasing a new product under such a policy is: $U_r^N = \theta - p + r$. The utility of retaining the used product is $\beta\theta$, so when $U_r^N > \beta\theta$, that is, when $\theta > (p-r)/(1-\beta)$, replacement consumers will choose to participant in the trade-in program for new products. The total demand of replacement consumers who take advantage of the trade-in program will be:

$$q_r^N = (1-\alpha) \int_{\frac{p-r}{1-\beta}}^1 d\theta = (1-\alpha)(1 - \tfrac{p-r}{1-\beta}) \tag{2}$$

In model N, the profit functions of the manufacturer and the retailer are:

$$\Pi_M^N = (w-c)q_n^N + (w-r-c+d)q_r^N - ((q_n^N + q_r^N)e - E)L + \lambda e q_r^N L \tag{3}$$

$$\Pi_R^N = (p-w)(q_n^N + q_r^N) \tag{4}$$

Put formula (1) and formula (2) into formula (3):

$$\begin{gathered}\Pi_M^N = \alpha(w-c)(1-p) + (1-\alpha)(w-r-c+d)(1-\tfrac{p-r}{1-\beta}) \\ -((\alpha(1-p)+(1-\alpha)(1-\tfrac{p-r}{1-\beta}))e-E)L \\ +(1-\alpha)(1-\tfrac{p-r}{1-\beta})\lambda eL\end{gathered} \tag{5}$$

Put formula (1) and formula (2) into formula (4):

$$\Pi_R^N = (p-w)(\alpha(1-p)+(1-\alpha)(1-\tfrac{p-r}{1-\beta})) \tag{6}$$

The equilibrium for model N is obtained by applying backward induction as shown in Table 2.

Table 2. Equilibriums of model N and model G

Optimal Solution	Model N	Model G
w	$\frac{1}{2}(1+c+eL)$	$\frac{1}{2}(1+c+eL)$
p	$\frac{\begin{gathered}(1-\alpha\beta)c+(1-\alpha)d \\ +((1-\alpha\beta)+(1-\alpha)\lambda)eL \\ +3-\beta-2\alpha\beta\end{gathered}}{4(1-\alpha\beta)}$	$\frac{\begin{gathered}(1-\alpha\beta)c+(1-\alpha)d \\ +((1-\alpha\beta)+(1-\alpha)\lambda)eL \\ +3-\beta-2\alpha\beta+(1-\alpha)S\end{gathered}}{4(1-\alpha\beta)}$
r	$\frac{1}{2}(\beta+d+eL\lambda)$	$\frac{1}{2}(\beta+d+eL\lambda-S)$
q_n	$\frac{\alpha\begin{pmatrix}-(1-\alpha\beta)c-(1-\alpha)d \\ -((1-\alpha\beta)+(1-\alpha)\lambda)eL \\ +1+\beta-2\alpha\beta\end{pmatrix}}{4(1-\alpha\beta)}$	$\frac{\alpha\begin{pmatrix}-(1-\alpha\beta)c-(1-\alpha)d \\ -((1-\alpha\beta)+(1-\alpha)\lambda)eL \\ +1+\beta-2\alpha\beta-(1-\alpha)S\end{pmatrix}}{4(1-\alpha\beta)}$
q_r	$\frac{(1-\alpha)\begin{pmatrix}-(1-\alpha\beta)c \\ +(1+\alpha-2\alpha\beta)d \\ -(1-\alpha\beta)eL \\ +(1+\alpha-2\alpha\beta)\lambda eL \\ +(1-\beta)(1-2\alpha\beta)\end{pmatrix}}{4(1-\beta)(1-\alpha\beta)}$	$\frac{(1-\alpha)\begin{pmatrix}-(1-\alpha\beta)c \\ +(1+\alpha-2\alpha\beta)d \\ -(1-\alpha\beta)eL \\ +(1+\alpha-2\alpha\beta)\lambda eL \\ +(1-\beta)(1-2\alpha\beta) \\ +(1+\alpha-2\alpha\beta)S\end{pmatrix}}{4(1-\beta)(1-\alpha\beta)}$

DOI: 10.54254/2754-1169/2026.31825

2.3. Model G: with government subsidy

In model G, the government gives financial subsidies to consumers that take part in the trade-in program. New consumers do not gain government subsidies. Therefore, the demand of new consumers for new products is the same as model N, which is:

$$q_n^G = \alpha \int_p^1 d\theta = \alpha(1-p) \tag{7}$$

Due to the trade-in rebates and government subsidies, replacement consumers will not purchase new products at the original price. The utility that consumers obtain from trading in is: $U_r^G = \theta - p + r + S$. The utility of retaining used products is $\beta\theta$. Therefore, when and $U_r^G > \beta\theta$, that is, when $\theta > (p-r-S)/(1-\beta)$, consumers choose to trade old products for new products. Therefore, the total demand of replacement consumers taking advantage of the trade-in program will be:

$$q_r^G = (1-\alpha)\int_{\frac{p-r-S}{1-\beta}}^1 d\theta = (1-\alpha)(1-\tfrac{p-r-S}{1-\beta}) \tag{8}$$

In model G, the profit functions of the manufacturer and the retailer are:

$$\Pi_M^G = (w-c)q_n^G + (w-r-c+d)q_r^G - ((q_n^G+q_r^G)e-E)L + \lambda e q_r^G L \tag{9}$$

$$\Pi_R^G = (p-w)(q_n^G+q_r^G) \tag{10}$$

Put formula (7) and formula (8) into formula (9):

$$\begin{aligned}\Pi_M^N = \alpha(w-c)(1-p) + (1-\alpha)(w-r-c+d)(1-\tfrac{p-r-S}{1-\beta}) \\ -((\alpha(1-p)+(1-\alpha)(1-\tfrac{p-r-S}{1-\beta}))e-E)L \\ +(1-\alpha)(1-\tfrac{p-r-S}{1-\beta})\lambda e L\end{aligned} \tag{11}$$

Put formula (7) and formula (8) into formula (10):

$$\Pi_R^G = (p-w)(\alpha(1-p)+(1-\alpha)(1-\tfrac{p-r-S}{1-\beta})) \tag{12}$$

The equilibrium for model G is obtained by applying backward induction as shown in Table 2.

3. Results analysis

3.1. Parameters analysis

This part discusses the impact of several variables on the optimal decisions of the closed-loop supply chains based on customer characteristics, remanufacturing practices, cap-and-trade regulation, and government subsidy.

Theorem 1.

- $\frac{\partial w^N}{\partial \alpha} = \frac{\partial w^G}{\partial \alpha} = 0$, $\frac{\partial r^N}{\partial \alpha} = \frac{\partial r^G}{\partial \alpha} = 0$, $\frac{\partial w^N}{\partial \beta} = \frac{\partial w^G}{\partial \beta} = 0$, $\frac{\partial r^N}{\partial \beta} = \frac{\partial r^G}{\partial \beta} > 0$;
- If $\beta < d + eL\lambda$, then $\frac{\partial p^N}{\partial \alpha} < 0$; If $\beta \geq d + eL\lambda$, then $\frac{\partial p^N}{\partial \alpha} \geq 0$;

DOI: 10.54254/2754-1169/2026.31825

- If $\beta < d + eL\lambda + S$, then $\frac{\partial p^G}{\partial \alpha} < 0$; If $\beta \geq d + eL\lambda + S$, then $\frac{\partial p^G}{\partial \alpha} \geq 0$;
- If $\alpha < \frac{1}{d+eL\lambda}$, then $\frac{\partial p^N}{\partial \beta} = \frac{\partial q_n^N}{\partial \beta} < 0$; If $\alpha \geq \frac{1}{d+eL\lambda}$, then $\frac{\partial p^N}{\partial \beta} = \frac{\partial q_n^N}{\partial \beta} \geq 0$;
- If $\alpha < \frac{1}{d+eL\lambda+S}$, then $\frac{\partial p^G}{\partial \beta} = \frac{\partial q_n^G}{\partial \beta} < 0$; If $\alpha \geq \frac{1}{d+eL\lambda+S}$, then $\frac{\partial p^G}{\partial \beta} = \frac{\partial q_n^G}{\partial \beta} \geq 0$.

Theorem 1 explores how the proportion of customers and the depreciation rate influence the equilibrium results for the entire supply chain, respectively. We can draw different conclusions from the analysis about the forward chain and reverse supply chain.

In terms of the forward supply chain elements, both the proportion of new consumers and the residual rate have no impact on the wholesale price. The proportion of new consumers and the residual value of old products together have a complex impact on retail prices and demand of new consumers.

Regarding reverse logistic activities, it can be found that trade-in rebates do not depend on the proportion of customers. However, it is influenced by the residual value of used products. Higher residual value associates with higher trade-in rebates for consumers.

Theorem 2.

- $\frac{\partial w^N}{\partial d} = \frac{\partial w^G}{\partial d} = 0$, $\frac{\partial r^N}{\partial d} = \frac{\partial r^G}{\partial d} > 0$, $\frac{\partial w^N}{\partial \lambda} = \frac{\partial w^G}{\partial \lambda} = 0$, $\frac{\partial r^N}{\partial \lambda} = \frac{\partial r^G}{\partial \lambda} = 0$;
- $\frac{\partial p^N}{\partial d} = \frac{\partial p^G}{\partial d} > 0$, $\frac{\partial p^N}{\partial \lambda} = \frac{\partial p^G}{\partial \lambda} > 0$;
- $\frac{\partial q_n^N}{\partial d} = \frac{\partial q_n^G}{\partial d} < 0$, $\frac{\partial q_r^N}{\partial d} = \frac{\partial q_r^G}{\partial d} > 0$, $\frac{\partial q_n^N}{\partial \lambda} = \frac{\partial q_n^G}{\partial \lambda} < 0$, $\frac{\partial q_r^N}{\partial \lambda} = \frac{\partial q_r^G}{\partial \lambda} > 0$.

Theorem 2 shows that in the forward supply chain, the saving on manufacturing costs and lower carbon footprint via remanufacturing does not impact the wholesale price. These factors increase retail prices and cause lower purchases by first time purchasers and higher demands by replacement purchasers.

In terms of the reverse channel activities, there is no relationship between carbon reduction and trade-in bonus, whereas the lower the costs are, the higher is the value of the rebate offered by the consumer in exchange for a used vehicle. That is, as the reduction in production costs increases, so does the trade-in price demanded by the buyer.

Theorem 3.

- $\frac{\partial w^N}{\partial L} = \frac{\partial w^G}{\partial L} > 0$, $\frac{\partial r^N}{\partial L} = \frac{\partial r^G}{\partial L} > 0$, $\frac{\partial p^N}{\partial L} = \frac{\partial p^G}{\partial L} > 0$, $\frac{\partial q_n^N}{\partial L} = \frac{\partial q_n^G}{\partial L} < 0$;
- If $\lambda < \frac{1-\alpha\beta}{1+\alpha-2\alpha\beta}$, then $\frac{\partial q_r^N}{\partial L} = \frac{\partial q_r^G}{\partial L} < 0$; If $\lambda \geq \frac{1-\alpha\beta}{1+\alpha-2\alpha\beta}$, then $\frac{\partial q_r^N}{\partial L} = \frac{\partial q_r^G}{\partial L} \geq 0$.

Theorem 3 indicates that the carbon price has positive impacts for both the forward and reverse chains. Higher carbon price leads to higher wholesale price, higher retail price, and higher trade-in rebates. This pricing rule discourages new entry. If abatement costs are high, higher carbon prices increase the demand of replacement customers. In contrast, if there is little in the way of emission reductions, then higher carbon prices also lower replacement customer demand.

Theorem 4.

- $\frac{\partial w^G}{\partial S} = 0$, $\frac{\partial r^G}{\partial S} < 0$, $\frac{\partial p^G}{\partial S} > 0$, $\frac{\partial q_n^G}{\partial S} < 0$, $\frac{\partial q_r^G}{\partial S} > 0$.

Theorem 4 shows the government's financial subsidy improves trade-in programs. The financial subsidy plays a role similar to that of the trade-in incentive, thus reducing the recyclers costs to the manufacturer; and reduces sales to new customers but induces trade-ins.

DOI: 10.54254/2754-1169/2026.31825

3.2. Models comparison

To further analyze the influence of the government's trade-in subsidy, this section compares the profits of manufacturers and retailers in Model N with those in Model G.

Theorem 5.

• If $S < \frac{2(((1-\alpha\beta)-(1+\alpha-2\alpha\beta)\lambda)eL+(1-\alpha\beta)c-(1-\beta)(1-2\alpha\beta))}{1+\alpha-2\alpha\beta} - 2d$, then $\Pi_M^G > \Pi_M^N$;

• If $S \geq \frac{2(((1-\alpha\beta)-(1+\alpha-2\alpha\beta)\lambda)eL+(1-\alpha\beta)c-(1-\beta)(1-2\alpha\beta))}{1+\alpha-2\alpha\beta} - 2d$, then $\Pi_M^G \leq \Pi_M^N$;

• If $S < \frac{2(((1-\alpha\beta)-(1-a)\lambda)eL+(1-\alpha\beta)c-(1-\beta))}{1-a} - 2d$, then $\Pi_R^G < \Pi_R^N$;

• If $S \geq \frac{2(((1-\alpha\beta)-(1-a)\lambda)eL+(1-\alpha\beta)c-(1-\beta))}{1-a} - 2d$, then $\Pi_R^G \geq \Pi_R^N$.

Theorem 5 shows that the government subsidy policy has a differential impact on the profit of each member in the supply chain. When the subsidy is low, the manufacturer's profit rises and the retailer's profit declines. When the subsidy increases further to a certain extent, this relationship is reversed, the manufacturer's profits declines, and the retailer's profits rises.

4. Conclusions and further research

This paper analyzes the decision-making of a centralized reverse supply chain subject to carbon cap-and-trade regulation. By comparing the decisions in the case that the government offers incentive or not on the remanufacturing program, the study indicates several influencing factors on supply chain strategy such as customer's purchasing behavior, remanufacturing, trading systems, and government subsidy.

On consumer-side variables: The coupling of new consumer penetration rate and residual value leads to complex interactions in price response and demands. Higher residual value leads to higher trade-in rebates, suggesting that the producer needs to provide greater incentive in recycling durable goods.

In terms of remanufactured products, because a lower-cost item is produced and less environmental harm occurs due to its manufacture, prices for such items tend to be higher than those of new goods. As a consequence, sales by initial purchasers are reduced but replacement market demands increase. Because it costs less to produce a remanufactured product, there can be greater discounts offered on trade-ins, promoting the more extensive recovery of used products to facilitate their economical reuse and recycling.

Under cap-and-trade regulation, the higher price of carbon will translate into higher wholesale price, higher retail price and higher trade-in rebate. New customer acquisitions would be harmed by this trend. The amount of replacement demand is related to the level of emissions reductions, greater emissions reductions are associated with greater replacement demand as the price rises, while small decreases are associated with the reverse relationship. Therefore, it is important for policy makers to take the ability of firms to remanufacture products into account when designing emissions prices.

For the government subsidy, it is found that it reduces initial purchases and increases trade-ins. Lower subsidy ratios lead to higher manufacturers' profits and lower retailers' profits, and the manufacturers' profits fall while the retailers' profits rise when the subsidy is increased. Therefore, the government needs to be careful with its subsidy level depending on the context so as not to upset the balance of power between manufacturers and retailers.

This research can provide guidance to the price setting of a closed-loop supply chain with carbon trading and trade-in subsidies from governments. In future research, the author will continue this work with more collection models, such as retail collection model, third-party collection model, and

DOI: 10.54254/2754-1169/2026.31825

mixed stream collection methods. The future study will also consider more flexible carbon policy instruments and financial incentives.

References

[1] Zhaowei, M., Ke, F., Zhiqiang, X., & Yu, W. (2017). Models for closed-loop supply chain with trade-ins. Omega, 66, 308-326. https: //doi.org/10.1016/j.omega.2015.11.001.

[2] Chia-Hung, C., Charles, X. W., & Yabing, Z. (2014). Closed-loop supply chain models for a high-tech product under alternative reverse channel and collection cost structures. International Journal of Production Economics, 156 , 108-123. https: //doi.org/10.1016/j.ijpe.2014.05.008.

[3] Lei, Y., Yijuan, H., & Lijuan, H. (2020). Collecting mode selection in a remanufacturing supply chain under cap-and-trade regulation. European Journal of Operational Research, 287 (2), 480-496. https: //doi.org/10.1016/j.ejor.2020.04.006.

[4] Yongbo, X., Liming, W., & Jian, C. (2020). Dynamic pricing in a trade-in program with replacement and new customers. Naval Research Logistics (NRL), 67 (5), 334-352. https: //doi.org/10.1002/nav.21911.

[5] Cao, K., Su, Y., Han, G., & Choi, T. (2022). Is it wise to offer rebates for unused extended warranties under trade-in programs in supply chains?. Transportation Research Part E, 167. https: //doi.org/10.1016/J.TRE.2022.102915.

[6] Jingchen, L., Xin, Z., & Lihua, C. (2018). Optimal pricing strategy under trade-in program in the presence of strategic consumers. Omega, 84, 1-17. https: //doi.org/10.1016/j.omega.2018.03.005.

[7] Xiaohua, H., Qianxia, Y., Jennifer, S., & Xujin, P. (2017). Optimal strategies for trade-old-for-remanufactured programs: Receptivity, durability, and subsidy. International Journal of Production Economics, 193, 602-616. https: //doi.org/10.1016/j.ijpe.2017.07.025.

[8] Tong, S., Chunfen, H., Shou, C., Shouyang, W., & Kin, K. (2018). Trade-old-for-remanufactured closed-loop supply chains with carbon tax and government subsidies. Sustainability, 10 (11), 3935-3935. https: //doi.org/10.3390/su10113935.

[9] Alegoz, M., Kaya, O., & Bayindir, Z. P. (2021). A comparison of pure manufacturing and hybrid manufacturing-remanufacturing systems under carbon tax policy. European Journal of Operational Research, 294 (1), 161-173. https: //doi.org/10.1016/J.EJOR.2021.01.018.