Research on Purchasing Intention of Remanufactured Products: the Effect of Consumer Perception and Environmental Consciousness

Yuanfang Shi[1], Tingting Tang[2] and Xiaomin Zhao[3*]

2422769157@qq.com[1], tingtingtang9507@163.com[2] and zhaoxiaomin@shu.edu.cn[3*]

School of Management, Shanghai University, Shanghai, 200444, China

Abstract. Remanufacturing is vital for circular economy, but low consumer recognition and misconceptions hinder its growth. This study examines the impact of product knowledge, consumer perception, and environmental consciousness on Chinese consumers' intention to purchase remanufactured products. With 540 valid questionnaires, findings reveal: product knowledge positively influences purchase intention; consumer perception mediates this relationship, where perceived value increases intention; consumer consciousness moderates the relationship between perceived risk and intention negatively. Thus, improving product knowledge, perception, and consciousness can foster consumer acceptance of remanufactured products.

Keywords: Remanufacturing; Product knowledge; Consumer perception; Environmental consciousness; Purchase intention

1 Introduction

Compared with traditional manufacturing, remanufacturing operations are a set of industrial procedures used to return used goods to their original, functional (or "like new") state, remanufactured products are provided with an identical warranty to that of new products [1], highlighting the clear ecological advantages of the remanufacturing process. For example, the remanufacturing of a diesel engine offered CO reductions of 22.83%, the SO_2 emissions were reduced by 70.80%[2]. When compared to the production of a new cylinder block, the remanufactured cylinder block reduces the potential for global warming by 90%[3].As for economic benefits, according to certain studies, the cost of remanufacturing products is usually around 45% -65% of new products, and the price is usually within the range of 60% -70% of the new products [4], thus affecting the manufacturer's production decision[5].

Considering the social, environmental, and economic advantages of remanufacturing products, government decision-makers, industry practitioners, and scholars have shown great interest in it. However, the market recognition of Chinese consumers is very low, which hinders the sustainable development of remanufactured products[6].In order to explore which factors can motivate consumers to buy remanufactured products, some scholars have studied consumer behavior from different perspectives. Japanese consumers know little about remanufactured products, believing they offer fewer benefits and more risks, especially in terms of quality[7]. Brand equity is an important factor affecting remanufacturing sales. However, according to

MSIEID 2023, December 08-10, Guangzhou, People's Republic of China

DOI 10.4108/eai.8-12-2023.2344812

Abbey et al.[8], the impact of brand equity manipulation on consumer was found to be less significant compared to their perception of the quality specific remanufactured products.

Overall, the conclusions about consumers on remanufactured products are inconsistent. The types of remanufactured products, the industry characteristics, the consumers perception in different countries, may lead to different research findings. This article examines the influence of product knowledge, consumer perception, and consumer environmental consciousness on remanufactured product purchase intention among Chinese consumers.

2 Literature review and hypotheses

2.1 Product knowledge

Product knowledge refers to the consumer's understanding of specific product information. Wang Yacan et al. studied consumers' purchase intention for remanufactured products, they discovered that product knowledge was significantly negatively correlated with consumers' purchase intention[9].Y. Qu et al. took product knowledge as a moderating factor and found that and conducted a study to examine its relationship with consumers' purchase intention[10]. Product knowledge can actively enhance consumer' purchase intention, and it can be measured in various dimensions [11].Product knowledge is considered one of the top two factors that influence consumers' purchasing behavior, it will help ease consumer concerns[12].

The following presumptions are put forth in light of this:

H1: Product knowledge has a positive effect on the purchase intention of remanufactured products.

2.2 Perceived value

Consumers' overall opinion of a product or service's usefulness is known as perceived value.Consumers choose the option with the greatest perceived value[13].Michaud and Daniel found that the perceived value of a remanufactured camera was much lower than the actual value of a remanufactured camera[14].Perceived value can be divided into social perceived value and individual perceived value[11].Purchasing remanufactured products can not only bring significant social benefits, but also bring direct economic benefits to individuals. However, most Chinese consumers lack understanding of remanufactured products, resulting in their weak perception of the value of remanufactured products.

Based on this, this paper proposes the following assumptions:

H2: Perceived value plays a mediating role between product knowledge and purchase intention.

2.3 Perceived risk

One of the elements influencing consumers' purchasing decisions is perceived risk, it is the uncertainty existing in the process of purchasing goods[15].Due to information asymmetry and the abundance of phony and subpar products, consumers may associate the purchase of recycled products with higher perceived risks[9].Consumers know more about remanufactured products, are more assured of their functions and quality, and the lower the perceived risk. Product knowledge can lower uncertainty and risk[1]. Chinese consumers have an inaccurate perception

of remanufactured products and hold the belief that there are potential risks associated with purchasing such items, resulting in low purchase intention[16].

This paper proposes the following assumptions, based on the information provided.

H3: Perceived risk plays a mediating role between product knowledge and purchase intention.

2.4 Environmental consciousness

Environmentally conscious consumers tend to buy environmentally sustainable products. Since the emergence of remanufacturing, scholars have explored Chinese consumers' cognition of remanufacturing industry and products. Remanufactured products will be viewed more favorably by environmentally conscientious consumers, thus affecting perceived value [17]. It's possible that most consumers like products that are green, eco-friendly, or made of recyclable materials.[18].However, some environmentally conscious consumers may not be fully aware of the potential environmental or green characteristics of remanufactured products. Compared with consumers' environmental awareness, economic factors have a greater impact on consumers' purchase intention[19].

In light of this, the following presumptions are put forth in this paper:

H4a: Environmental consciousness can moderate the relationship between consumers' perceived value and purchase intention.

H4b: Environmental consciousness can moderate the relationship between consumers' perceived risk and purchase intention.

The figure presented in **Fig. 1** illustrates the conceptual model utilized in our study.

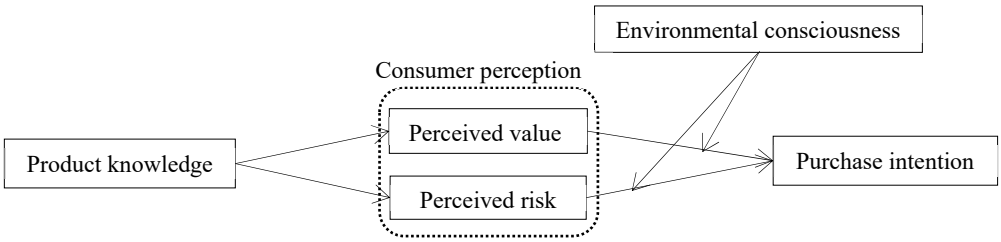

Fig. 1 Theoretical framework

3 Methods

3.1 Sample and data collection

Our study takes remanufactured electronic products as an example to investigate the mechanism of consumer purchase intention through questionnaire survey. Data were gathered from Chinese consumers. A total of 595 participants were recruited through online platform (One of the leading professional survey platforms in China), and 540 surveys were completed and deemed usable, resulting in an effective rate of 91%.

3.2 Measures

This paper designed a 5-point Likert scale with 16 items. The 5 scale goes from "1 = strongly disagree" to "5 = strongly agree." Questionnaire consists of product knowledge; Perceived value; Perceived risk; Environmental awareness; Purchase intention; The study selected education level, occupation, etc. as control variables.

4 Data analysis

4.1 Reliability and validity analysis

Table 1 demonstrates that all variables' composite reliability (CR) and Cronbach's α are more than 0.7, demonstrating strong internal consistency and reliability for the scale utilized in this investigation. The mean variance extraction (AVE) and combination reliability (CR) for every variable were computed in order to confirm the sample's convergent validity. According to **Table 1**, every variable's AVE is higher than 0.5 (only AVE of the environmental awareness scale is less than 0.5, but 0.46 is very close to 0.5, which can be approximated as 0.5), and the CR is greater than 0.7, indicating that the model has good convergence effectiveness.

Table 1. Analysis of validity and reliability

Variables	Item	Cronbach's α	CR	AVE	Variables	Item	Cronbach's α	CR	AVE
PK	PK1	0.78	0.78	0.55	EC	EC1	0.72	0.72	0.46
	PK2					EC3			
	PK3					EC4			
PV	PV1	0.74	0.75	0.50	PI	PI1	0.85	0.85	0.59
	PV2					PI2			
	PV3					PI3			
PS	PS1	0.85	0.85	0.66		PI4			
	PS2								
	PS3								

Note: PK=Product knowledge; PV=Perceived value; PR=Perceived risk; EC=Environmental Consciousness; PI=Purchase intention.

4.2 Analysis of correlations

As shown in **Table 2**, purchase intention and product knowledge ($r=0.543$, $p<0.01$), perceived value ($r=0.503$, $p<0.01$), environmental consciousness ($r=0.278$, $p<0.01$) significant positive correlation; Purchase intention is significantly negatively correlated with perceived risk ($r=-0.343$, $p<0.01$). These findings serve as a foundation for additional proof of the hypothesis.

Table 2. Correlation analysis（N=540）

Variables	PK	PV	PR	EC	PI
PK	1				
PV	.785**	1			
PR	-.231**	-.094*	1		
EC	.294**	.376**	.012	1	
PI	.543**	.503**	-.343**	.278**	1

4.3 Direct effect

This study uses SPSS25.0 software to carry out hierarchical regression. **Table 3** demonstrates that purchasing intention is significantly positively impacted by product knowledge (Model 2, β=0.511, P<0.001), thus H1 is verified, it demonstrates that consumers are more inclined to purchase remanufactured products the more information they possess.

Table 3. Regression Analysis of Direct Effect

Variables	PI	
	Model 1	Model 2
Gender	-.073	-.068
Age	-.044	-.037
Education	.200**	.088*
Income	.091*	.045
PK		.511**
R-squared	.070	.313
F	10.131**	48.646**

4.4 Mediating effect of perceived value and perceived risk

Product knowledge significantly improves perceived value (Model 3, β=0.762, p<0.01), as **Table 4** illustrates. Purchase intention is significantly positively impacted by product knowledge (Model 5, β=0.511, p<0.01). Model 7 shows that product knowledge (β=0.381, p<0.01) and perceived value (β=0.170, p<0.01) have a significant positive impact on perceived value after the mediation variable was added, indicating that perceived value acted as a partial mediating factor between product knowledge and purchase intention, H2 was confirmed.

Similarly, we discovered a negative relationship between perceived risk and product knowledge (Model 4, β=-0.249, p<0.01). Furthermore, our analysis revealed a significant positive effect of product knowledge on purchase intention (Model 5, β=0.511, p<0.01). After the mediating variable perceived risk is introduced, Model 8 demonstrates that product knowledge (β=0.452, p<0.01) is still considerably favorably connected with purchase intention, whereas perceived risk (β=-0.239, p<0.01) is significantly negatively correlated with purchase intention, indicating that perceived risk may act as a partial intermediary factor between product knowledge and purchase intention, H3 was verified.

Table 4. The mediating effect of perceived value and perceived risk

Variables	PV	PR		PI		
	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Gender	-.078	.134	-.146	-.136	-.123	-.104
Age	-.056*	-.072	-.042	-.035	-.026	-.053
Education	.068*	.074	.189**	.083*	.071	.101
Income	.020	.002	.081	.040	.037	.041
PK	.762**	-.249**		.511**	.381**	.452**
PV					.170**	
PR						-.239**
R-squared	.627	.068	.070	.313	.356	.366
F-value	179.790**	7.818**	10.131**	48.646**	42.523**	51.327**

4.5 The moderating impact of environmental consciousness

Table 5. The moderating effect of environmental consciousness

Variables	PI						
	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14	Model 15
Gender	-.146	-.103	-.111	-.112	-.099	-.113	-.122
Age	-.042	-.011	-.069	-.016	-.066	-.071	-.056
Education	.189**	.084*	.181*	.088*	.196**	.172**	.169**
Income	.081*	.043	.078	.048	.075*	.080*	.073*
PV		.466**	.420**	.420**			
PR					-.345**	-.347**	-.333**
EC			.116*	.118**		.273**	.237**
PV*EC				.004			
PR*EC							-.141**
R-squared	.070	.268	.280	.280	.188	.262	.284
F-value	10.131**	39.197**	34.519**	29.537**	24.703**	31.519**	30.211**

As shown in **Table 5**, when the perceived value, environmental consciousness and interaction terms were introduced into the regression equation, the interaction terms were not significant (Model 12, β=0.004, P>0.05), demonstrating that the relationship between perceived value and purchase intention was unaffected by environmental consciousness, H4a was not valid. When perceived risk, environmental awareness, and interaction terms enter the regression equation, the interaction terms are significant (Model 15, β=-0.141, P<0.01), suggesting that the relationship between perceived risk and purchasing intention is moderated by environmental consciousness, H4b was verified.

Fig. 2 illustrates the interaction effects of varying environmental consciousness levels on perceived risk and purchasing intention. Both the high and low environmental awareness groups have negative slopes, however the high environmental awareness groups have larger slopes than the low ones. The results show that environmental awareness can enhance the negative effect between perceived risk and purchase intention.

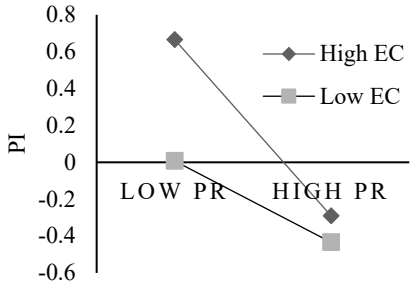

Fig. 2 Moderating effects of environmental consciousness

5 Conclusion and discussions

According to our findings, purchase intention and product knowledge are significantly positively correlated. The enterprises that produce remanufactured products and the relevant departments of the state should strengthen the publicity, so that consumers gradually eliminate the prejudice against remanufactured products. Secondly, perceived risk has a negative impact on consumers' purchase intention, improving consumers' awareness of remanufactured products, improving the quality of remanufactured products, reducing perceived risk, improving perceived value, and making consumers more willing to buy remanufactured products. Finally, the relationship between perceived risk and purchasing intention is moderated by environmental knowledge, and the moderating modes of high and low environmental awareness are the same. In short, from the perspective of the state and enterprises, we should strengthen the publicity of remanufactured products, in order to lower customers' perceived risks and help them understand the information about remanufactured items available through a variety of channels.

References

[1] van Loon, P., D. Diener, and S. Harris, *Circular products and business models and environmental impact reductions: Current knowledge and knowledge gaps.* Journal of Cleaner Production, 2021. **288**.

[2] Gonzalez-Garcia, S., A.C. Dias, and L. Arroja, *Life-cycle assessment of typical Portuguese cork oak woodlands.* Science of the Total Environment, 2013. **452**: p. 355-364.

[3] Afrinaldi, F., et al. *The advantages of remanufacturing from the perspective of eco-efficiency analysis: A case study*. in *24th CIRP Conference on Life Cycle Engineering (CIRP LCE)*. 2017. Kamakura, JAPAN.

[4] Zlamparet, G.I., et al., *Remanufacturing strategies: A solution for WEEE problem.* Journal of Cleaner Production, 2017. **149**: p. 126-136.

[5] Qin, L., et al., *Cooperation or competition? The remanufacturing strategy with quality uncertainty in construction machinery industry.* Computers & Industrial Engineering, 2023. **178**.

[6] Cao, J., et al., *Overview of remanufacturing industry in China: Government policies, enterprise, and public awareness.* Journal of Cleaner Production, 2020. **242**.

[7] Matsumoto, M., K. Chinen, and H. Endo, *Comparison of US and Japanese Consumers'*

Perceptions of Remanufactured Auto Parts. Journal of Industrial Ecology, 2017. **21**(4): p. 966-979.
[8] Abbey, J.D., et al., *Remanufactured Products in Closed-Loop Supply Chains for Consumer Goods.* Production and Operations Management, 2015. **24**(3): p. X-X.
[9] Wang, Y., et al., *Understanding the purchase intention towards remanufactured product in closed-loop supply chains An empirical study in China.* International Journal of Physical Distribution & Logistics Management, 2013. **43**(10): p. 866-888.
[10] Qu, Y., et al., *Promoting remanufactured heavy-truck engine purchase in China: Influencing factors and their effects.* Journal of Cleaner Production, 2018. **185**: p. 86-96.
[11] Wang, Y., et al., *Green information, green certification and consumer perceptions of remanufctured automobile parts.* Resources Conservation and Recycling, 2018. **128**: p. 187-196.
[12] Wang, Y., et al., *How product and process knowledge enable consumer switching to remanufactured laptop computers in circular economy.* Technological Forecasting and Social Change, 2020. **161**.
[13] Souza, J.d.L., et al., *Effect of perceived value, risk, attitude and environmental consciousness on the purchase intention.* International Journal of Business Environment, 2020. **11**(1): p. 11-31.
[14] Michaud, C. and D. Llerena, *Green Consumer Behaviour: an Experimental Analysis of Willingness to Pay for Remanufactured Products.* Business Strategy and the Environment, 2011. **20**(6): p. 408-420.
[15] Wang, S., *The influence of consumer information interaction experience on purchasing decision evaluation from the perspective of retail industry.*Consumer Market, 2023(13): p. 43-46.
[16] Xu, B., *Development status and prospect of green remanufacturing engineering.* Strategic Study of CAE, 2011. **13**(01): p. 4-10.
[17] Yu, M., C. Wang, and X. Gao, *The formation Mechanism of Comsumer Purchase Intention for Remanufactured Products:Grounded Theory Research Based on Remanufactured Cell-phones.* Journal of Management Case Studies, 2016. **9**(04): p. 368-382.
[18] Magnier, L., R. Mugge, and J. Schoormans, *Turning ocean garbage into products - Consumers' evaluations of products made of recycled ocean plastic.* Journal of Cleaner Production, 2019. **215**: p. 84-98.
[19] Bittar, A.d.V., *Selling remanufactured products: Does consumer environmental consciousness matter?* Journal of Cleaner Production, 2018. **181**: p. 527-536.