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Research on the Impact of Carbon Credit Policy on Household Electronic Waste Recycling Behavior

Yingli Dong, Xiaolin Zhu

School of Business Administration, University of Science and Technology Liaoning, Anshan 114051, China

Abstract

With the promotion of the "dual carbon" goal, the Carbon Credit Policy has been gradually implemented, and the pilot program has been carried out relying on the platform of carbon credits policy. At present, there are problems of resource waste and environmental pollution in the treatment and recycling of household electronic waste. Based on this background, this paper explores the impact of carbon credits policy on household electronic waste. Typical application cases include Alipay Ant Forest, Chengdu Carbon Huitianfu and Haier Zhijia APP, etc. This study builds theoretical models based on the technology acceptance model and the theory of planned behavior, and tests the hypotheses through empirical analysis. The conclusion is that the perceived ease of use and perceived usefulness of carbon credit policy have a positive impact on environmental protection attitude, environmental protection attitude will positively affect the recycling intention of household e-waste and positively promote recycling behavior, and carbon credit policy will positively affect consumers' subjective norms and positively promote recycling intention and behavior. Based on the empirical conclusions, this paper puts forward practical suggestions to promote the recycling of household electronic products and enhance consumers' enthusiasm for carbon reduction.

Keywords

Carbon Credit Policy; Household Electronic Waste; Behavior of Recycling.

1. Introduction

Under the "dual carbon" target, resource recycling is an important part of reducing carbon emissions. In 2024, the state will write "Carbon universal benefits" into the central document for the first time. Carbon universal benefits quantifies, records and verifies green and low-carbon behaviors, generates individual carbon emission reduction and converts it into carbon credits, and encourages consumers' environmental protection behaviors through the form of carbon credits exchange. In the outline of the 15th Five-Year Plan, it is mentioned that we should give priority to saving, strengthen policy incentives, guide the participation of the whole society, accelerate the green and low-carbon transformation of development mode, and form a new way of green production and a new style of life [1]. In response to the policy call, some platforms have launched carbon credit platforms for e-waste recycling behavior, thus influencing the recycling of household e-waste and promoting a circular economy.

2. Research Model and Hypothesis

Based on the technology acceptance model and the theory of planned behavior, this paper constructs a theoretical model of the impact of carbon credit policy on household electronic waste recycling behavior, as shown in Figure 1.

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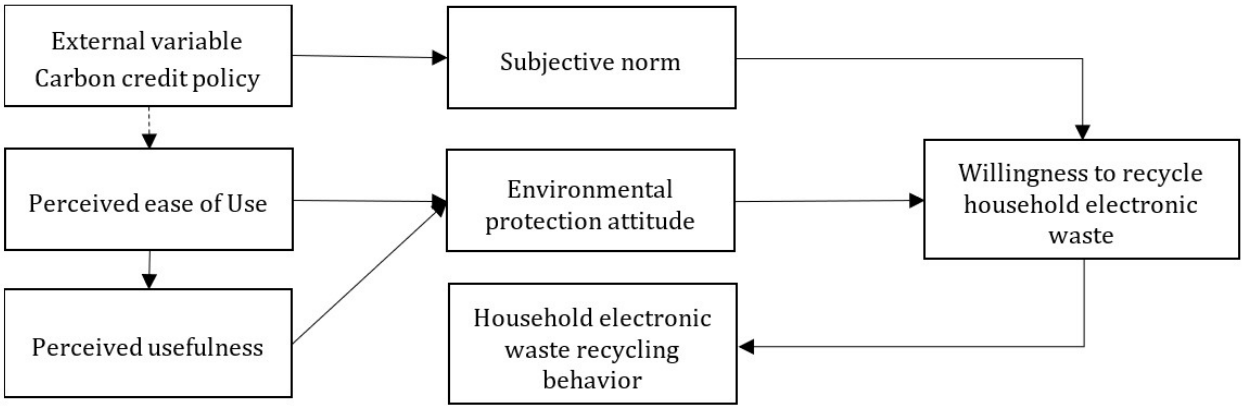


Figure 1. Theoretical model of the impact of carbon credit policy on household e-waste recycling behavior

2.1. Influence Path based on the Technology Acceptance Model

The implementation of carbon credit policies mostly relies on online platforms such as apps or mini programs, and online platforms calculate, accumulate and exchange points. The impact of carbon credit policies on household electronic waste recycling behavior is based on the realization of online platform functions, so technical factors should be taken into account. At the same time, the influence of technology acceptance on consumers' environmental protection attitude is considered, which is combined with the theory of planned behavior. In previous studies, the technology acceptance model was applied to low-carbon behavior, specifically including low-carbon travel [2], low-carbon tourism [3], low-carbon shopping [4], etc.

According to the technology acceptance model proposed by Davis in 1989, under external variables, perceived ease of use affects perceived usefulness, and the two jointly drive environmental protection attitude, which is then transformed into consumer behavior [5]. In this paper, the carbon credits policy is taken as an external variable. Perceived ease of use is the subjective view on the recycling convenience, operation convenience and platform response speed of the application platform of carbon credits policy. Perceived usefulness is the subjective judgment on the recycling value and platform value. Environmental protection attitude affects household e-waste recycling intention, and recycling intention affects recycling behavior. Therefore, the hypothesis is put forward:

H1: Perceived ease of use of carbon credits policy positively affects perceived usefulness.

H2: Perceived ease of use of carbon credits policy positively affects recycling attitudes.

H3: Perceived usefulness of carbon point platform positively affects recycling attitude.

Further, the stronger the perceived ease of use and perceived usefulness of the carbon credit policy are, the more positive the attitude of consumers towards environmental protection is, and the easier the recycling intention is to be stimulated, so it is easier to use carbon credit recycling behavior. Therefore, the hypothesis is put forward:

H4: Environmental protection attitude and household e-waste recycling intention have a chain mediating effect between perceived usefulness and household e-waste recycling behavior

H5: Perceived usefulness, environmental attitude and household e-waste recycling intention have a chain mediating effect between perceived ease of use and household e-waste recycling behavior

2.2. Page Numbers

E-waste recycling behavior is a personal behavior, which is conducive to resource recycling and environmental protection, so the formation of behavior must consider the influencing factors of consumer psychology. According to Ajzen's theory of planned behavior proposed in 1991 to

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explain consumer behavior, behavioral intention will affect individual behavior. Behavioral intention will be affected by three consumer psychological factors: attitude, subjective norm and perceived behavioral control [6]. Attitude is a consumer's psychological tendency and view of behavior, and a positive attitude is more likely to promote the behavioral intention. Therefore, the following assumptions are made:

H6: Recycling attitude positively affects the behavioral intention of e-waste recycling.

Subjective norm refers to the social pressure perceived by consumers. In this study, subjective norm refers to the social pressure felt by consumers under the influence of carbon credit policy, which specifically includes the influence of relatives, friends and others, community atmosphere and public opinion on environmental protection behavior. Carbon credit policy is closely related to individual low-carbon behavior, so the influence of carbon credit policy on subjective norm is considered. Therefore, subjective norms promote individuals to form the intention of household electronic waste recycling and make points to complete the household electronic waste recycling behavior. Combined with this paper, the following hypotheses are proposed:

H7: Carbon credit policy positively affects subjective norms.

H8: Subjective norms positively affect the behavioral intention of e-waste recycling

H9: e-waste recycling behavior intention positively affects e-waste recycling behavior

H10: Subjective norms and household e-waste recycling intention play a mediating role between carbon credit policy and household e-waste recycling behavior

To sum up, the two concepts of technology acceptance model and theory of planned behavior can be divided into two paths. One is the practical path at the level of technology acceptance, which involves consumers' attitude and affects consumers' willingness to recycle, while the other is more inclined to achieve the environmental protection behavior of recycling through the subjective norm of carbon credit policy on consumers. Through the intermediary variables, household electronic waste recycling behavior is promoted, and carbon points are accumulated to contribute to circular economy and sustainable development.

3. Empirical Analysis

3.1. Questionnaire Design and Collection

In order to ensure the reliability of the survey results, this study designed questionnaires for the variables of carbon credit policy, perceived ease of use, perceived usefulness, environmental protection attitude, subjective norms, household e-waste recycling intention and household e-waste recycling behavior. The questionnaire contains the opening greeting, relevant instructions, demographic information survey and the main part of the questionnaire. The demographic information includes five items, including gender, age, education background, occupation and monthly average disposable income. The main part of the questionnaire uses the five-point Likert scale to score, which is reasonably adapted based on the maturity scale and this study. Specifically, it includes the scales of NARTOVA-BOCHAVER S K et al. [7], RAGHOEBAR S et al. [8], Shan et al. [9], Zhang Yanmei et al. [10], Li Wenchao et al. [11], Gao et al. [12] and some self-developed scales.

The survey will be carried out from April to May 2026 and mainly distributed through the cloud of the Questionnaire Star platform. Questionnaires from different regions and populations on network platforms with heavy traffic (including wechat, Douyin, Xiaohongbook and Weibo, etc.) will be collected to ensure the differentiation and coverage of the questionnaire. The purpose, research method and questionnaire content of this study were explained before the questionnaire was distributed.

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3.2. Reliability and Validity Test

The results of the reliability and validity test are shown in Table 1.Reliability is used to measure the internal consistency of the scale, and the closer the Cronbach Alpha coefficient is to 1, the better the internal consistency of the items is [13]. The general standard is that the Alpha coefficient is greater than 0.7, indicating that the reliability of the scale is acceptable. Alpha coefficients of each variable in this study are 0.835 for carbon credit policy, 0.869 for perceived ease of use, 0.921 for perceived usefulness, 0.951 for attitude, 0.943 for subjective norm, 0.789 for willingness to recycle household electronic waste, and 0.828 for behavior to recycle household electronic waste. The overall Alpha coefficient of all variables reaches 0.937. The Alpha values of all variables are higher than the critical standard of 0.7, indicating that the measurement items corresponding to each latent variable in this study have good internal consistency, the reliability of the questionnaire is up to the standard, and the measurement results are stable and reliable.

Validity analysis refers to the analysis of the accuracy of the measurement index achieved by the scale [14]. The KMO value interval is 0-1; in general, a KMO value greater than 0.7 and a p-value less than the significance level are considered suitable for factor analysis. The KMO value of each variable is between 0.785-0.919, and the overall KMO of all variables is 0.930, which is higher than the evaluation standard of 0.7. Bartlett test results show that the significance p values of all variables are less than 0.001, and there is a significant correlation between variables.

Table 1. Reliability and validity test

Variable	Mumber of terms	Cronbach's alpha	KMO	Bartlett's test of sphericity
Carbon credit policy	4	0.835	0.857	4200.381 (p=0.000)
Perceived ease of Use	5	0.869	0.870	1078.133 (p<0.001)
Perceived usefulness	4	0.921	0.855	1386.285 (p<0.001)
Environmental protection attitude	5	0.951	0.919	2321.962 (p=0.000)
Subjective norm	5	0.943	0.910	2203.396(p=0.000)
Willingness to recycle household electronic waste	4	0.789	0.785	520.193 (p<0.001)
Household electronic waste recycling behavior	4	0.828	0.811	666.278 (p<0.001)
All the variables	31	0.937	0.930	9950.204(p=0.000)

Based on the results of reliability and validity, the reliability and validity of the scale used in this study meet the basic requirements of empirical research, the items are set reasonably, and the sample data are of good quality, so the subsequent structural equation model and path hypothesis testing analysis can be continued.

3.3. Analysis of Fitting Degree

In this study, AMOS26 software is used to complete the calculation of structural equation model. The ideal standard of CMIN/df is less than 3, and the calculation result of this study is 2.816, which meets the evaluation requirements; RMSEA is the root mean square error of

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approximation, and if the index is lower than 0.08, the model fitting effect is acceptable. AGFI greater than 0.8 is standard, and the result of this study is 0.870; The qualification threshold of IFI, TLI and CFI is 0.9, and the corresponding values in this study are 0.921, 0.913 and 0.920, respectively.

Table 2. Goodness of fit test

Indicators	Standard of reference	Measured results	Evaluation of fitness
CMIN/df	<3	2.816	Conform
RMSEA	<0.08	0.062	Conform
AGFI	>0.8	0.870	Conform
IFI	>0.9	0.921	Conform
TLI	>0.9	0.913	Conform
CFI	>0.9	0.920	Conform

All the fit indicators meet the measurement standards, indicating that the theoretical model and sample data have a good matching degree, which can further carry out the path hypothesis test.

3.4. Path Analysis

Path analysis is used to test the hypothesized causal relationship between variables. Estimate stands for standardized path coefficient, reflecting the degree of influence between variables, C.R. Is the critical ratio, and the p-value judges the significance of the path, representing $p < 0.001$.

Table 3. Path relationship of structural equation model

Path			Estimate	S.E.	C.R.	P
Perceived ease of Use	→	Perceived usefulness	0.625	0.062	11.769	***
Perceived ease of Use	→	Environmental protection attitude	0.196	0.079	3.013	0.003
Perceived usefulness	→	Environmental protection attitude	0.214	0.066	3.384	***
Environmental protection attitude	→	Willingness to recycle household electronic waste	0.438	0.043	7.390	***
Carbon credit policy	→	Subjective norm	0.847	0.211	8.654	***
Subjective norm	→	Willingness to recycle household electronic waste	0.197	0.042	3.518	***
Willingness to recycle household electronic waste	→	Household electronic waste recycling behavior	0.645	0.072	9.735	***

The results show that perceived ease of use positively affects perceived usefulness with a path coefficient of 0.625. Perceived ease of use and perceived usefulness have a significantly positive impact on environmental protection attitude, and the path coefficients are 0.196 and 0.214 respectively, both reaching significant levels, so H1, H2 and H3 are established. The path coefficient of carbon credit policy on subjective norms is 0.847, and the environmental protection attitude and subjective norms have a significantly positive effect on the household electronic waste recycling intention, with the path coefficients of 0.438 and 0.197 respectively. The recycling intention has a significantly positive impact on the recycling behavior, and the path coefficient is 0.645, all reaching the significant level,hypotheses H6, H7, H8, and H9 hold. Carbon credit policy promotes recycling willingness through technology acceptance path and subjective norm path respectively, and finally promotes recycling behavior.

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3.5. Mediating Effect Test

In this study, the Bootstrap method is used to conduct the mediating effect test, and the sampling is repeated 5000 times.

The total effect coefficient of the first path is 0.526. The direct effect is 0.302, the indirect effect is 0.224, the confidence interval of the indirect effect is [0.175, 0.278] respectively, and the interval does not contain 0, which proves that the chain mediating effect of environmental protection attitude and recycling intention is significant in this path. The total effect coefficient of the second path is 0.526, the direct effect is 0.324, the indirect effect is 0.202, and the confidence interval of the indirect effect is [0.134, 0.267], which does not include 0. The total effect coefficient of the third path is 0.485, in which the direct effect is 0.284, the indirect effect is 0.200, and the confidence interval of the indirect effect is [0.152, 0.251], without 0. It shows that subjective norms and recycling intention play a chain mediating role between carbon credit policy and recycling behavior, and Hypothesis H4, H5, H10 is supported by data.

Table 4. Path of mediating effect

Path of mediating effect	Path of mediating Effect		LLCI	ULCI	Effect of mediation
Perceived ease of Use→Environmental protection attitude→Willingness to recycle household electronic waste→Household electronic waste recycling behavior	Total effect	0.526	0.443	0.608	Support
	Direct effect	0.302	0.221	0.381	
	Indirect effect	0.224	0.175	0.278	
Perceived ease of Use→Perceived usefulness→Environmental protection attitude→Willingness to recycle household electronic waste→Household electronic waste recycling behavior	Total effect	0.526	0.444	0.608	Support
	Direct effect	0.324	0.235	0.415	
	Indirect effect	0.202	0.134	0.267	
Carbon credit policy→Subjective norm→Willingness to recycle household electronic waste→Household electronic waste recycling behavior	Total effect	0.485	0.403	0.566	Support
	Direct effect	0.284	0.200	0.369	
	Indirect effect	0.200	0.152	0.251	

In general, all the multi-chain mediating effects have been verified. Carbon credit policy can not only pass through the social norm path of subjective norms, but also through the instrumental perception path composed of perceived ease of use and perceived usefulness, through the transmission of attitude and willingness, and finally affect the household e-waste recycling behavior, which further explains the internal transmission mechanism among variables.

4. Research Conclusion

This study takes household electronic waste recycling as the research object, integrates technology acceptance model and theory of planned behavior, takes carbon credit policy as external variable, constructs chain mediation model, uses AMOS to construct structural equation model and Bootstrap mediating effect test based on valid questionnaire data. By exploring the action path of carbon credit policy on consumers' e-waste recycling behavior, the following conclusions are drawn.

First, the carbon credit policy can significantly positively affect subjective norms. The publicity, promotion and implementation of carbon credit policy will create a social atmosphere that encourages e-waste recycling, strengthen the behavioral expectations of society and surrounding groups perceived by consumers, and form a subjective norm driving force.

Second, the perceived ease of use in the carbon credit recycling mode can significantly and positively improve the perceived usefulness. When consumers believe that the operation

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process of carbon credit recycling is simple and the participation cost is low, they will further recognize the actual benefits and environmental value of carbon credit recycling mode. At the same time, perceived ease of use and perceived usefulness can significantly positively shape consumers' attitudes toward environmental protection.

Thirdly, environmental attitudes and subjective norms significantly positively affect the intention to recycle household e-waste. The subjective norm represents the behavioral expectation brought by the external society, and the environmental protection attitude is the individual's internal value judgment. The recycling intention further has a significantly positive effect on the actual recycling behavior, and the willingness is an important psychological basis for driving individuals to carry out recycling actions.

Fourthly, the chain mediating effect is established. Carbon credit policy can play a role through the social norm chain mediation path of "carbon credit policy → subjective norm → recycling intention → recycling behavior". At the same time, there is a tool perception transmission path, namely, "perceived ease of use → environmental protection attitude → recycling intention → recycling behavior" and "perceived ease of use → perceived usefulness → environmental protection attitude → recycling intention → recycling behavior." This shows that the carbon credit policy does not directly change individual behavior, but needs to go through the chain transmission of social norms, cognitive perception, environmental protection attitude and recycling willingness before it can be finally transformed into consumers' actual recycling behavior.

5. Countermeasures and Suggestions

Based on the above research conclusions, countermeasures and suggestions are put forward from three levels: policy authorities, carbon credits recycling platform and social publicity and guidance, so as to fully release the incentive effect of carbon credits policy and promote the development of China's household electronic waste recycling system.

Optimize the incentive rules of carbon credits, give consideration to the incentive intensity and the practicality of exchange, and strengthen the perceived usefulness of consumers. At present, some carbon point recovery projects have practical problems such as high threshold of point acquisition, low point value, few convertible goods and harsh exchange conditions, which weaken the incentive effect of policies. Policy makers should improve the residential carbon credit accounting standards, establish a reasonable and transparent credit conversion mechanism for different household electronic waste such as mobile phones and small household appliances, so that consumers can directly see the corresponding credit benefits of recycling. Recycling platforms should expand points exchange scenarios. In addition to environmental protection goods, they should connect with popular exchange categories such as life consumption coupons, phone charges deduction and consumer rights and interests of commercial supermarkets, reduce the threshold of points exchange, effectively let consumers feel the actual benefits brought by carbon points recycling, strengthen perceived usefulness, and give play to the traction role of material incentives.

Improve the supporting recycling service network, lower the participation threshold, and improve consumers' perceived ease of use. Perceived ease of use is the starting point of the entire TAM path, and the tedious recycling process will directly offset the effect brought by the incentive of points. On the one hand, the platform should continue to simplify the operation process of online mini programs, simplify the operation steps of booking, filling in and valuation, and optimize the interface for middle-aged and elderly groups. On the other hand, it is necessary to improve the offline recycling network, expand the layout of community recycling points, promote door-to-door recycling services, and shorten the distance cost and time cost of consumers' e-waste delivery. For large waste household appliances, we will improve door-to-

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door disassembly, assembly and handling supporting services to solve the practical difficulties of ordinary families in dealing with waste electronic products. Only when it is convenient for consumers to participate can the incentive effect of carbon credit policy be implemented.

Give full play to the social guidance function of carbon credit policy, strengthen subjective norms, and create a social atmosphere of universal recycling. Carbon credit policy is not only a market-oriented incentive tool, but also undertakes the function of social environmental protection education. The competent departments and recycling platforms should change the communication ideas that only focus on publicizing points and benefits, and give consideration to the guidance of social norms. With the help of community announcements, short video platforms and offline public welfare activities, the knowledge related to e-waste environmental pollution and resource recycling was popularized, and the actual cases of ordinary residents participating in carbon point recycling were publicized to show the current situation of public participation. Let consumers perceive that e-waste recycling is a behavior widely advocated by society and widely participated by groups around them, strengthen the driving role of subjective norms, and promote individuals to participate in recycling with the help of social public opinion.

Open the back-end disposal process to make up the weak link of trust and narrow the gap between willingness and behavior. This study found that there is a practical barrier between recycling intention and actual recycling behavior, and consumers are generally worried about whether the e-waste handed in through the mini program will flow to informal dismantling workshops, resulting in secondary pollution. The platform shall disclose the whole chain information of transportation, dismantling and resource disposal after recycling, publicize the qualification of cooperative dismantling enterprises to the public, provide users with channels for inquiring about recycling and disposal results, and dispel consumers' concerns about non-standard back-end disposal. By improving the level of channel trust, consumers who are willing to recycle can dare to truly carry out recycling actions, which opens up the last link of the transformation from willingness to behavior.

Differentiated group guidance will be carried out to achieve precise implementation of policy effects. Consumers with different ages and educational backgrounds have different acceptance of carbon credit policies. For young groups, relying on online platforms, focus on points rights and interests, convenient recycling service publicity; For middle-aged and elderly groups, we will rely on offline community publicity to explain carbon points rules, set up community service points to assist in completing recycling appointments, reduce participation barriers brought by digital tools, and improve policy coverage.

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