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A Game Model for the Pricing of the Government's Subsidy in the Green Supply Chain for Home Appliances Industry in China

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Abstract: Today green supply chain management (GSCM) has received increasing emphasis, as a kind of modern management mode which takes environmental impact and resource efficiency into a comprehensive consideration within the entire supply chain. In this paper, the government's subsidy in the green supply chain for home appliances industry is studied by constructing a three-player game model among governments, home appliances enterprises and consumers. Through studying the relationships and game status and analyzing the equilibrium of the game model, the paper points out the necessity of creating a government's subsidy, and proposes the principles of the subsidy as well as provides a numerical example. The research results indicate that the governments can improve the enthusiasm and likelihood of enterprises and consumers to participate in this model of green supply chain management by creating appropriate subsidy to the enterprises, to the consumers and by imposing penalties to those enterprises that do not participate in the green supply chain management. This will promote the implementation of the green supply chain management for the home appliance industry effectively.

Keywords: green supply chain, government's subsidy, home appliance industry, three-player game model, static games of complete information, Nash equilibrium

1. INTRODUCTION

Since the beginning of the 21st century, the topic of protecting ecological environment and realizing sustainable development has achieved increased concerns. Many governments in the world have paid great attention to environmental issues that stand in the way of their further economic and social development in terms of the sustainable development. The green supply chain management emerged under these circumstances, which emphasizes on strengthening the environmental factors in the supply chain.

As a result, the urgency and importance of integrating the home appliances industry with the green supply chain has gained more attention all over the world, due to the fact that discarded used or recycled home appliances become hazardous substances and are harmful to the environment if disposing them by traditional means. In recent years, many countries in the world formulate more strict environmental protection laws and regulations to strengthen the environmental protection and management, e.g., WEEE directive 2002/96/EC (Waste Electrical and Electronic Equipment, as amended by 2003/108/EC) and RoHS directive 2002/95/EC (Restriction of Hazardous Substances). The objective of the WEEE directive is to improve the level of environmental protection within the European Union through the reduction of waste from household electrical and electronic equipments. Equipment producers are responsible for the management of takeback and disposal of waste starting from August 13, 2005. The RoHS directive aims at harmonization of the legislation in the EU Member States on the restriction of the use of hazardous substances in household electrical and electronic equipment. The general rule is that equipment containing a certain level of lead, mercury, cadmium, hexavalent chromium, PBB's and PBDE's may not be placed onto the market after July 1 2006. On August 15, 2012, EU

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started to implement a series of new directives that contain more restrict requirements for recycling used home appliances. As the main country of manufacturing and exporting home appliances, China will be seriously affected by these regulations. Furthermore, it has already reached a peak of recycling used home appliances in China since 2003 and the increment speed of electrical trash is triple the household refuse. How to take back used home appliances and improve the consumption of the green home appliances could be with great significance for the development of the home appliances industry of China.

Comparing with the traditional one, the pricing issues of the green supply chain for home appliances industry is more complicated due to its operational objectives and in consideration of its economic efficiency, social and environmental impact as well as its unique characteristics. Meanwhile, there are many difficulties about how to make pricing decisions in the home appliances industry when considering the influences of the effective recycle behavior of the used home appliances to the whole supply chain and the specific characteristics concerned with coordination. Since a unified effect of economic, environmental and social can not be obtained through independent decisions by enterprises, it is necessary to let governments come into play. Therefore, this paper will study the government's subsidy in the green supply chain for home appliances industry.

2. LITERATURE REVIEW

In 1996, the National Scientific Funds (NSF) in USA provided $400,000 financial aid to the Manufacture Research Consortium (MRC) in Michigan State University to conduct a research project named "Environmental Responsible Manufacture" and then the definition of Green Supply Chain was proposed firstly [1]. From then on, more and more scholars began to research the green supply chain from many different perspectives. Although no agreed-on definition of green supply chain exists, there are some common characteristics among the concepts and connotations proposed by scholars at home and abroad, which focus on the integration of management strategy, environmental consciousness and supply chain management, i.e. emphasize the environmental attributes of supply chain and decrease the consumption of energy and resources. Green supply chain also combines the multi-dimensional operating objectives and the environmental management to the entire lifecycle of the product [2]. Hence so-called green supply chain is a kind of modern management mode which takes the environmental impact and resource efficiency into a comprehensive consideration within the entire supply chain. Taking green manufacturing theory and supply chain management technology as the foundation, it involves suppliers, manufacturers, distributors and users, with the purpose to make the environmental impact (negative effect) minimum and resource efficiency maximum during the whole process from material acquisition, processing, packaging, storage, transportation, usage to scrapping [3]. The basic objective of green supply chain management is to protect environment and make use of resources effectively.

As to game theory, it is a very useful tool to study the relationships among the participating subjects in the green supply chain and model pricing decisions. However, so far only a few researchers have conducted some study on the relationships by using game theory. Pantumsinchai [4] pointed out that government's support increased enterprise's economic and environmental performance, and then the enterprise further integrated and make the whole supply chain "green". In order to investigate the game between governments and core-enterprises in green supply chains, Zhu and Dou [5] analyzed their respective costs and benefits, and studied the game status by evolutionary game theory. Li and Liu et al [6], from the government supervision's angle, built up dynamic game models of reverse logistics by using the game theory. Xu and Zheng [7] studied the relationship between governments and corporations in green supply chain under the condition of impeaching. Cao and Wen [8] also set up a game model between governments and enterprises in green supply chain and analyzed their behavior and equilibrium strategies. There are also a few scholars having tried to conduct preliminary analysis of the multilateral game relationship between governments, enterprises and consumers in

the green supply chain, e.g., Wang [9], Yu and Liu [10], Xu et al [11-12].

Some researchers analyzed the relationship between the enterprises within green supply chain, e.g., Wang and Yan [13] analyzed the respective costs and benefits of suppliers and core-enterprise in green supply chain, and established an evolutionary game model between governments and enterprises based on evolutionary game theory. Hou and Wang [14] studied the relationship between enterprises of green supply chain and those of traditional one.

Some other researchers have made some analysis of the game relationship in the green supply chain in specific industries, e.g., Zhou and Zhang [15] analyzed the relationship between government in coal and electricity, Feng and Wang [16] analyzed the different intention and game action between client and general contactor in the progress of constructing green supply chain in construction industry. Xu et al analyzed the relationship between enterprises and consumers in green supply chain of home appliances industry [11-12].

The studies about the government's subsidy in the green supply chain are few and far between. Zhu and Dou established a three-stage game model by considering products' green degree and government subsidies. The first stage is that the government determines the subsidies coefficient; the second stage is that manufacturers with various green strategies in supply chains determine their own products' green degree; the third stage is that manufacturers in supply chains determine their own products' prices [17].

Therefore, it is essential to study the game relationship among the main stakeholders in the green supply chain for home appliances industry and make equilibrium analysis to argue for the necessity and principles for governments to set the subside price. Through the intervention of governments, let the pricing decisions guide enterprises to act in an ethically and socially responsible manner to the environment in the green supply chain for home appliances industry, thus maximizing the profits and effectiveness of the supply chain as a whole.

3. MODEL ASSUMPTIONS AND NOTATION

The construction of the green supply chain in the home appliances industry requires involvement of governments, enterprises, consumers and other relevant society members. In order to facilitate the analysis, here we assume that there are only three stakeholders, i.e. governments, home appliance enterprises (simply as "enterprises") and consumers. In other words, the game is a three-player game. Governments refer to local governments and also include some relevant organizations or committees who focus on the environment protection and are entitled to issue some environmental regulations or rules. Enterprises refer to those who are engaged in home appliances manufacturing or sales and consumers get home appliances from enterprises. Meanwhile, we assume that governments, enterprises and consumers are all rational economic men, who take the benefit maximization as their goal. All players of the game know the strategies and payoffs of others. In short-term equilibrium, the game problem can be regarded as a kind of static games of complete information and to seek Nash equilibrium.

In the current market conditions with green home appliances and traditional home appliances coexist, the enterprises have two strategies: one is to offer green home appliances, e.g., home appliance manufacturers actively develop ecological design and introduce some available technologies to manufacture green home appliances, or retailers actively promote and sell the green home appliances; the other one is to offer traditional home appliances by using traditional methods to design, manufacture and sell home appliances, and in this circumstance enterprises will be punished by governments and pay for penalty due to not meeting the requirements of environmental protection. Consumers also have two strategies to adopt: i.e., acceptance or rejection. Here we assume that consumers should return the waste home appliances when they decide to accept green home appliances, and they can get an amount of compensation from governments correspondingly, which just reflects the current policy of "trading in old appliances for a new one" in China. As for governments, they

can adopt the strategy of supervision, which means they will supervise whether the enterprises has deployed green supply chain management. If they find the enterprises are offering green home appliances, they give them a sum of money as subsidy. Conversely they will punish the enterprises. Governments can choose the strategy of unsupervision too, which means they will do nothing, so there is no subsidy and no penalty in this case.

According to existing literatures, we make some assumptions and definitions about the benefits and the costs for governments, enterprises and consumers in order to determine the payoff for each player with every possible combination of actions. When enterprises choose to offer traditional home appliances, R_B and C_B respectively represent the average revenue by unit and the average cost by unit, and F_B represents the payable penalty to governments by unit due to not meeting the requirement of implementing green supply chain. When enterprises choose to offer green appliances, R_B' and C_B' respectively represent the average revenue by unit and the average cost by unit in this case, and S_B represents the subsidy by unit that enterprises can obtain from governments. As for consumers, according to western theory of cost-benefit analysis, the benefits include indirect benefits and direct benefits. Indirect benefits can be expressed by the difference between the price consumer willing to pay psychologically and the actual one, and R_C and R_C' respectively represent the indirect benefits from traditional home appliances and green ones. Here direct benefit mainly refers to the subsidy S_C from governments if the consumers return the waste home appliances at the same time of choosing green home appliances. As for governments, except the subsidy S_B and S_C, C_E represents the unit cost of supervision and L_E shows the unit loss of the social welfare due to the environmental disruption from the traditional home appliances.

4. A THREE-PLAYER GAME MODEL AMONG GOVERNMENTS, ENTERPRISES AND CONSUMERS

4.1 Gaming payoff matrix among governments, enterprises and consumers

Based on the above assumptions and definitions, we can construct a three-player game model among governments, enterprises and consumers, which is represented by a payoff matrix shown in Table 1. Each player has two strategies, which are specified following the name of players. The payoffs are provided in the interior. The first number is the payoff received by enterprises; the second one is the payoff for the consumers; and the third one is the payoff for governments.

Table 1. Gaming payoff matrix among governments, home appliances enterprises and consumers

		Consumers Acceptance (C_1)	**Consumers** Rejection (C_2)
Governments Supervision (E_1)	**Enterprises** Offer Green Home Appliances (B_1)	$R_B'-C_B'+S_B$ $R_C'+S_C$ $-C_E-S_B-S_C$	$-C_B'+S_B$ 0 $-C_E-S_B$
	Enterprises Offer Traditional Home Appliances (B_2)	$R_B-C_B-F_B$ R_C $-C_E-L_E+F_B$	$-C_B-F_B$ 0 $-C_E-L_E+F_B$
Governments Unsupervision (E_2)	**Enterprises** Offer Green Home Appliances (B_1)	$R_B'-C_B'$ R_C' 0	$-C_B'$ 0 0
	Enterprises Offer Traditional Home Appliances (B_2)	R_B-C_B R_C $-L_E$	$-C_B$ 0 $-L_E$

4.2 Equilibrium analysis of the three-player game model

4.2.1 Pure strategy Nash equilibrium

Through a basic analysis of the above-proposed three-player game model, it could be found that six strategies

combinations will be pure strategy Nash equilibriums under particular conditions, see Table 2.

Table 2. Pure strategy Nash equilibrium of the three-player game model among governments, home appliances enterprises and consumers

Conditions	Pure strategy Nash equilibrium
$R_B'-C_B'>R_B-C_B$ $R_C'>0$	(Offer Green Home Appliances, Acceptance, Unsupervision)
$C_B'<C_B$ $R_C'<0$	(Offer Green Home Appliances, Rejection, Unsupervision)
$R_B-C_B-F_B>R_B'-C_B'+S_B$ $R_C>0$ $-C_E+F_B>0$	(Offer Traditional Home Appliances, Supervision)
$-C_B-F_B>-C_B'+S_B$ $R_C<0$ $-C_E+F_B>0$	(Offer Traditional Home Appliances, Rejection, Supervision)
$R_B-C_B>R_B'-C_B'$ $R_C>0$ $-C_E+F_B<0$	(Offer Traditional Home Appliances, Acceptance, Unsupervision)
$C_B<C_B'$ $R_C<0$ $-C_E+F_B<0$	(Offer Traditional Home Appliances, Rejection, Unsupervision)

Among the pure strategy Nash equilibrium listed in the above table, the strategies combination (Offer Green Home Appliances, Rejection, Unsupervision) is obviously an unreasonable state, which will occurs when $C_B'<C_B$ and $R_C'<0$. In this circumstance, the cost of green home appliances is lower than the traditional one; however consumers reject to accept the green home appliances. There must be some problem of the pricing for the green home appliances. If changing the pricing policy, the equilibrium state will move to the ideal one. As for the strategies combination (Offer Green Home Appliances, Acceptance, Unsupervision), it is an ideal equilibrium, which could exists when $R_B'-C_B'>R_B-C_B$ and $R_C'>0$. This indicates that the enterprises' payoff of offering green appliances surpasses the amount of offering traditional appliances, therefore, enterprises will be certainly choose to offer green home appliances. At the same time, the consumers' benefit of accepting green home appliances is more than the one when they choose traditional appliances. Hence governments do not need to supervise. In the long term, this will be the result we should see. Because when the green supply chain management is deployed widely, green manufacturing technology become mature, used home appliances are to be recycled properly and resources are utilized more effectively, the payoff of offering green appliances surpasses the amount of offering traditional appliances. But it should be noted that one condition $R_B'-C_B'>R_B-C_B$ is hard to be achieved in the initial stage of the construction of the green supply chain, because normally the costs increase will be more than revenue increase in the green supply chain in this period. Meanwhile, it could be found that the governments will choose to unsupervise from the perspective of economic benefit when enterprises choose to offer green home appliances. Thus the strategies combinations (Offer Green Home Appliances, Acceptance, Supervision) and (Offer Green Home Appliances, Rejection, Supervision) won't be pure Nash equilibrium.

4.2.2 Mixed strategy equilibrium

When no pure-strategy Nash equilibrium exist, there will be mixed strategies equilibrium, where a pure strategy is chosen at random, subject to some fixed probability, and the green supply chain will come true too. Here we assign enterprises the probability p_1 of playing B_1 (Offer Green Home Appliances) and $(1-p_1)$ of playing B_2 (Offer Traditional Home Appliances), assign consumers the probability p_2 of playing C_1 (Acceptance) and $(1-p_2)$ of playing C_2 (Rejection), and assign governments the probability p_3 of playing E_1 (Supervision) and $(1-p_3)$ of playing E_2 (Unsupervision), where $0\leq p_1\leq 1$, $0\leq p_2\leq 1$ and $0\leq p_3\leq 1$, then the expected revenue of different strategies for governments, enterprises and consumers can be determined by the following equations.

$$E_{E_1}(p_1,p_2)=p_1[p_2(-C_E-S_B-S_C)+(1-p_2)(-C_E-S_B)]+(1-p_1)[p_2(-C_E-L_E+F_B)+(1-p_2)(-C_E-L_E+F_B)]=-p_1p_2S_C+p_1(-S_B-F_B+L_E)+(-C_E+F_B-L_E) \quad (1)$$

$$E_{E_2}(p_1,p_2)=p_1[0p_2+0(1-p_2)]+(1-p_1)[p_2(-L_E)+(1-p_2)(-L_E)]=(1-p_1)(-L_E) \quad (2)$$

$$E_{B_1}(p_2,p_3)=p_3[p_2(R_B^{'}-C_B^{'}+S_B)+(1-p_2)(-C_B^{'}+S_B)]+(1-p_3)[p_2(R_B^{'}-C_B^{'})+(1-p_2)(-C_B^{'})]=p_3S_B+p_2R_B^{'}-C_B^{'} \quad (3)$$

$$E_{B_2}(p_2,p_3)=p_3[p_2(R_B-C_B-F_B)+(1-p_2)(-C_B-F_B)]+(1-p_3)[p_2(R_B-C_B)+(1-p_2)(-C_B)]=p_2R_B-p_3F_B-C_B \quad (4)$$

$$E_{C_1}(p_1,p_3)=p_3[p_1(R_C^{'}+S_C)+(1-p_1)R_C]+(1-p_3)[p_1R_C^{'}+(1-p_1)R_C]=p_1p_3S_C+p_1R_C^{'}+(1-p_1)R_C \quad (5)$$

$$E_{C_2}(p_1,p_3)=0 \quad (6)$$

For governments, enterprises or consumers, when the expected revenue of their two strategies is equal, the game will reach to an equilibrium state and then we can determine the probability p_1, p_2, and p_3 correspondingly.

$$MakeE_{E_1}=E_{E_2},\qquad then\qquad p_1=\frac{F_B-C_E}{S_B+F_B+p_2S_c} \quad (7)$$

$$MakeE_{B_1}=E_{B_2},\qquad then\qquad p_2=\frac{p_3(S_B+F_B)+(C_B-C_B^{'})}{R_B-R_B^{'}} \quad (8)$$

$$MakeE_{C_1}=E_{C_2},\qquad then\qquad p_3=\frac{p_1(R_C-R_C^{'})-R_C}{p_1S_C} \quad (9)$$

It should be taken into consideration that governments should play a leading role in the construction of the green supply chain in the home appliances industry. Therefore, they should not make decisions only from the view of economic benefit and need to adopt some policies to motivate enterprises and consumers to participate the green supply chain, although these policies could add costs to them. Here we focus on the analysis of the factors influencing the probability p_1 and p_2.

(1) Influencing factors of the probability p_2

From equation (8), we can easily draw the following conclusions:

P_2 is an increasing function of S_B, F_B, C_B-C_B' and p_3.When S_B or F_B increases, enterprises would be more willing to offer green home appliances in order to obtain subsidy from the governments to compensate the costs or to avoid to be punished. As for C_B-C_B', it shows the cost difference between the strategy of offering home appliances and offering green ones. Then when C_B-C_B' increases, the cost of offering green appliances decrease more (when $C_B>C_B'$) or increase more (when $C_B<C_B'$), compared with the cost of offering traditional home appliances. Taking further considering of the governments penalty, enterprises would have more motive power to offer green home appliances. When the probability p_3 increases, i.e., governments will have more probability to adopt the strategy of supervision, enterprises will prefer to offer green home appliances. Then whenever which circumstance of the above exists, the probability of consumers to accept green home appliances may increase correspondingly along with the increase supply of green home appliances onto the market.

P_2 is a decreasing function of R_B-R_B'. Since R_B-R_B' is greater than zero, then when R_B-R_B' decreases, which means offing green home appliances would not decrease the revenue too much. Therefore, enterprises would choose to offer green appliances and the probability of consumers to accept green home appliances will increase similarity.

(2) Influencing factors of the probability p_1

Here we change equation (9) to the following form, so that we can easily find the influencing factors.

$$p_1 = \frac{1}{1 - \frac{R_C^{'} + p_3 S_C}{R_C}} \tag{10}$$

p_1 is an increasing function of R_C', S_C and p_3. More R_C' means more benefits to consumers and the probability of accepting green home appliances will be increasing. When S_C increases, consumers would be more willing to accept green home appliances because they can obtain a subsidy from governments. When the probability p_3 increases, i.e., governments will have more probability to adopt the strategy of supervision, consumers will prefer to accept green home appliances. Affected by the increasing demand of green home appliances, enterprises would be willing to offer more green home appliances to the market. Therefore, p_2 will increase.

p_1 is a decreasing function of R_C .When R_C increases, consumers will have more tendency to accept traditional home appliances and enterprises would be driven to choose offering traditional home appliances.

When governments decide to choose the strategy of supervision all the time, i.e., p_3 equals 1, equation (8) and (10) are the same as the results stated in literature [12].

4.3 Necessity and principles for government's subsidy in the three-player game

4.3.1 Necessity of the governments to supervise and set subsidy

From the analysis of pure strategy Nash equilibrium, it can be seen that the strategies combination (Offer Green Home Appliances, Acceptance, Unsupervision) is an ideal one, but the condition $R_B'-C_B'>R_B-C_B$ is hard to achieve in the initial stage of the construction of the green supply chain. Meanwhile governments will prefer to unsupervised than to supervise when enterprises choose to offer green home appliances, therefore the strategies combinations (Offer Green Home Appliances, Acceptance, Supervision) and (Offer Green Home Appliances, Rejection, Supervision) won't be pure Nash equilibrium.

From the analysis of mixed strategy equilibrium, we can draw the conclusion that the likelihood of enterprises and consumers to take part in green supply chain are directly proportional with the probability of governments' supervision. However, governments would prefer the strategy of "Unsupervision" if they are purely driven by economic benefit, which will go against the implementation of green supply chain. Since enterprises will not deploy the strategy of green supply chain actively, therefore it is necessary to encourage them to implement green supply chain management through the supervision of governments. That is to say, governments should play an active leading role in the green supply chain for home appliances industry. The game result will be influenced by the factor S_B, F_B and S_C. Appropriate penalty F_B will be helpful to motivate governments to supervise and prevent enterprises' speculative behavior to offer traditional home appliances. Meanwhile appropriate subsidy S_B will improve the initiative of enterprises to offer green home appliances. Appropriate subsidy S_C will motivate consumers to choose to accept green home appliances. All of the factors will be helpful for the construction of the green supply chain for home appliances industry.

4.3.2 Principles for government's subsidy

From the above analysis of the equilibrium, it can found that the following conditions should be tenable to make the strategies combination (Offer Green Home Appliances, Acceptance, Unsupervision) workable, if governments make decisions not only from the perspective of rational economic men.

$$R_B'-C_B'+S_B>R_B-C_B-F_B$$
$$\text{且 } R_C'+S_C>0 \tag{11}$$

If $R_B'-C_B'+S_B>R_B-C_B-F_B$, then for enterprises, this means the payoff of offering green appliances surpasses the amount of offering traditional appliances. This condition can be expressed in another way and be easy to understand, i.e., $(C_B'-C_B)-(R_B'-R_B)-S_B<F_B$, which indicates that the increased cost of offering green

appliances are compensated by the increased revenue and government subsidy and the surplus is less than the penalty F_B. Enterprises will be willing to offer green home appliances. Meanwhile another condition $R_C'+S_C>0$ indicates that the benefits to consumers including the subsidy are greater than zero; therefore consumers will be willing to accept green home appliances.

Therefore, the principles of the governments to set the subsidy price should meet the following conditions.

$$S_B+F_B>(R_B-C_B)-(R_B'-C_B')$$
$$\text{且 } R_C'+S_C>0 \quad (12)$$

It should be pointed that the home appliances mentioned in this paper are mainly refer to the home appliances closely related to the people living, such as TV, refrigerator, air conditioners and washing machines. It is very necessary to implement subsidy policy. Because the above-mentioned home appliances were bought in 90s and even 80s of last century in many families in China and need to be replaced. There are much more pressure to recycle these used home appliances in China and proper subsidy will make for leading enterprises to choose to offer green products, which will decrease the harmful influences to the environments. As for small appliances, it is obvious that the subsidy policy will be unpractical. Governments can lead the behavior of enterprises by creating appropriate penalty measures. In general, governments can affect the implementation result of the green supply chain for home appliances industry by comprehensively apply subsidy and penalty policies.

5. A NUMERICAL EXAMPLE

Here the models proposed in this paper will be analyzed by a numerical example with specific data.

Table 3. Assumption of the basic parameters

R_B	C_B	F_B	R_B'	C_B'	S_B	C_E	L_E	R_C	R_C'	S_C
2700	2400	300	3000	2800	300	100	200	100	-100	300

Through calculation and based on the conditions list in Table 3, there are no pure strategy Nash equilibrium exist in this circumstance. Governments, enterprises and consumers will choose their pure strategy at random and the green supply chain for home appliances industry will be out of effective execution.

In this case: $S_B+F_B=600>(R_B-C_B)-(R_B'-C_B')=100$ and $R_C'+S_C=200>0$

This indicates that the green supply chain for home appliances industry can be implemented when governments actively undertake the responsibility of supervision.

Meanwhile, it can be seen that enterprises will be prefer to offer green products and consumers will be willing to accept green products as long as when the conditions $S_B+F_B>100$ and $S_C>100$ satisfied. Governments can apply subsidy policy and penalty policy flexibly to improve the construction of the green supply chain for home appliances industry.

6. CONCLUSIONS

In this paper, a three-player game model among governments, enterprises and consumers is proposed, by which we can understand the game status among the main stakeholders, the possible equilibrium results, corresponding conditions and influencing factor of the probabilities for the participants to adopt different strategies under mixed strategy circumstance. Through the theoretical and numerical analysis, we can make sure the necessity and principles of the governments to deploy subsidy price policy. In the static game of complete information between governments, enterprises and consumers in the green supply chain of the home appliances industry, there probably are six pure strategy Nash equilibriums. Except the ideal strategies combination (Offer Green Home Appliances, Acceptance, Unsupervision), the others are not what we desire. Mixed strategy equilibrium also exists. From the perspective of governments, appropriate S_B, F_B and S_C will be helpful to

increase the probability of enterprises and consumers to participate the green supply chain. This indicates that governments should carry out more preferential policies to ensure consumers to gain a certain amount of subsidy S_C in order to encourage them to accept green home appliances and ensure the enterprises to gain subsidy S_B simultaneously so as to compensate their increased cost when choosing to offer green products. At the same time, the penalty F_B should be big enough so that the punishment for those enterprises choosing to offer traditional home appliances should be effective. Governments' subsidy price policies will be very helpful in the initiate stage of the construction of the green supply chain in the home appliances industry and will be contribute to the implementation of the management objectives focusing on economic efficiency, social and environmental impact simultaneously.

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