



Working together
www.rcis.ro

Revista de Cercetare si Interventie Sociala

ISSN: 1583-3410 (print), ISSN: 1584-5397 (electronic)

THE IMPACTS AND DECISION OF COMMUNITY-FRIENDLY CORPORATE SOCIAL RESPONSIBILITY BASED ON THE DUOPOLY MODEL

Junlong CHEN, Bo XU, Yayun XIAO, Chaoqun SUN

Revista de cercetare și intervenție socială, 2021, vol. 73, pp. 215-237

<https://doi.org/10.33788/rcis.73.13>

Published by:
Expert Projects Publishing House



On behalf of:
„Alexandru Ioan Cuza” University,
Department of Sociology and Social Work
and
HoltIS Association

REVISTA DE CERCETARE SI INTERVENTIE SOCIALA
is indexed by Clarivate Analytics (Social Sciences Citation Index),
SCOPUS and CROSSREF

The Impacts and Decision of Community-friendly Corporate Social Responsibility Based on the Duopoly Model

Junlong CHEN¹, Bo XU², Yayun XIAO³, Chaoqun SUN⁴

Abstract

There are multiple relationships between enterprises and communities, and the community-friendly corporate social responsibility (CSR) is unique. This paper constructs a duopoly model composed of two enterprises and a community, examines the impacts of community-friendly CSR on stakeholders, and analyzes the CSR decision. The results show that the level of community-friendly CSR, negative externalities, tax rate, and consumer sensitivity have multiple effects on profits, consumers, and social welfare, and the impacts of each factor are affected by the other factors; whether the competitors implement CSR affect the CSR decision of the other one; under certain circumstances, the implementation of CSR is conducive to achieving a win-win situation for the enterprises and the community.

Keywords: corporate social responsibility, community-friendly, duopoly, consumer sensitivity, social economy, social welfare.

Introduction

After nearly a hundred years of in-depth theoretical exploration and practice, Corporate Social Responsibility (CSR) has formed a very mature ideological and theoretical system, which profoundly affects the choice of enterprise behavior and sustainable development. In the modern market economy, CSR has become

¹ School of Humanities and Law, Northeastern University, Shenyang, CHINA; School of Economics, Northeastern University at Qinhuangdao, Qinhuangdao, CHINA. E-mail: shikuangzhiwang@126.com

² Northeast Asian Research Center of Jilin University, Jilin University, Changchun, CHINA. E-mail: xubo2015@jlu.edu.cn (*Corresponding author*)

³ School of Economics, Northeastern University at Qinhuangdao, Qinhuangdao, CHINA. E-mail: 2175511473@qq.com

⁴ School of Economics, Northeastern University at Qinhuangdao, Qinhuangdao, CHINA. E-mail: suncq0505@163.com

a universally recognized corporate code of conduct (McWilliams *et al.*, 2006; Sun, 2021), and an important criterion for judging an enterprise's sustainable development capability and social contribution. At present, CSR has become an important guarantee for enterprises to achieve sustainable operation and sustainable development of the social economy.

CSR involves many stakeholders, and stakeholders have become an important perspective of CSR research. For example, Carroll (1979) believes that there is a natural fit between the concept of CSR and organizational stakeholders. Russo & Perrini (2010) believe that the CSR of large enterprises should be studied from the perspective of stakeholders. With the evolution of the times, the community as a stakeholder is increasingly valued by enterprises and has become an important dimension for measuring CSR. The important reason that enterprises actively perform CSR in the community is that the performance of CSR can improve corporate reputation and expand corporate influence, which is an important means to achieve the goal of maximizing profits. At the same time, CSR can also have an important impact on the development of the community, and both enterprises and the community can achieve a win-win situation. What impacts does CSR have on community and enterprises? Whether the enterprises implement CSR? These problems are to be solved in this paper.

Compared with existing research, the main contributions of this article are as follows. First, the existing research on CSR is more consumer-friendly. Tax and production externalities are not incorporated into consumer utility in most of the literature. Thus, they cannot effectively reflect the multiple connections between enterprises and the community. Based on this context, this article constructs a community-friendly CSR analysis framework and considers consumer surplus, tax rate, production externalities as well as consumer sensitivity. Accordingly, the multiple influences of CSR on stakeholders are examined and CSR decisions are determined in our paper. This contribution expands the utility function of CSR and enriches the suggestions dealing with the relationship between the enterprises and the community. Second, most researchers seldom consider the consumer's response to CSR, which is an important decision-making factor, to explore the optimal CSR level of the enterprises. In addition, the optimal level of CSR maximizing social welfare is also analyzed. These also have certain significant contributions to make CSR decision-making and formulate government regulation.

The rest of this article is organized as follows. Section 2 is the literature review. In section 3, a duopoly model is constructed including two companies and a community, and relevant assumptions are given. In section 3, we investigate the equilibrium results under the three situations and the influence of CSR level, tax rate, negative externalities, and consumer sensitivity on the equilibrium results. Then, we also compare equilibrium profits under the three situations and explore enterprises' CSR decisions. The last part is the conclusion.

Literature Review

It is generally believed that CSR helps to reduce costs and risks, increase corporate profits, extend the loyalty of consumers and shareholders, and promote social relationships. It can also improve corporate organizational culture, recruit and retain excellent employees, create competitive advantages, improve corporate image and protect the ecological environment, and so on (Chen *et al.*, 2017; Hull & Rothenberg, 2008; Xu *et al.*, 2020). However, many scholars argue that CSR might not always have a positive effect on corporate performance (Hong & Kacperczyk, 2009; Hirigoyen & Poulain-Rehm, 2014; Renneboog *et al.*, 2008; Wang *et al.*, 2018). Therefore, it is crucial to estimate the role of CSR comprehensively.

There are many related studies on relationships between CSR and community, which provide useful enlightenment for this article. On the one hand, CSR plays a positive role in community governance, which is manifested in various aspects such as economic development, social harmony, and ecological balance (Appiah, 2019; Luning, 2012; Uduji & Okolo-Obasi, 2018; Uduji *et al.*, 2019; Rowe *et al.*, 2018; Rela *et al.*, 2020a). Kapelus (2002) believes that CSR can effectively promote the development of local communities. Moreover, when companies formulate CSR strategies, they take the relationship between the company and the local society as an important consideration. Sun *et al.* (2019) study the implementation of CSR and the impact of CSR on local communities. They find that CSR has greatly improved community education, health care, environment, and employment, providing new perspectives for the sustainable framework establishment for CSR and the development mechanism of community. Rela *et al.* (2020b) adopt Partial Least Squares-Structural Equation Modeling (PLS-SEM) to study the effect of CSR on the resilience of the community. The results show that CSR has an important positive impact on the resilience of the community, which is mainly reflected in the community's collective effectiveness, mobility, and adaptability. Rahmawati *et al.* (2019) focus on the influence of CSR on the ability of communities to adapt to climate change. The impact of CSR on it is also positive, affected by the government and stakeholders. On the other hand, the community also has an impact on CSR, which is reflected in the formulation, implementation, and planning of CSR strategies (Imbun, 2007; Hatipoglu *et al.*, 2019; Kim *et al.*, 2013; McLennan & Banks, 2018; Pasaribu *et al.*, 2020). Hoi *et al.* (2016) analyze 3688 companies from 1997 to 2009 and find that community capital can promote positive CSR activities and curb negative CSR activities. Besides, non-shareholder stakeholders may obtain spillover effects. Wu *et al.* (2016) explore the impacts of local stakeholders on CSR by a 20-year sample. The results imply that religious beliefs play an important role in promoting CSR, enriching the stakeholder theory. From various perspectives, Gursoy *et al.* (2019) examine the impact of destination CSR on community emotions (social satisfaction and community commitment) and suggest enterprises' strategic CSR plans should be developed according to community dynamics and stakeholders' expectations.

In the research on CSR, the duopoly model has been widely adopted and has been proven to be an effective tool for analyzing the role and decision-making of CSR. Bian *et al.* (2020) study the internal CSR compliance strategies of enterprises under monopoly and competitive situations. When exposure risks are high and cost premiums are low, enterprises are more likely to adopt compliance strategies. Chen *et al.* (2019) establish a capacity decision-making model to reveal the impact of different competition models on overcapacity, which provides support for the enterprises' capacity selection. Chen *et al.* (2021a) incorporate consumer sensitivity into corporate social responsibility decision-making and explore the best level of corporate social responsibility. Besides, under certain conditions, CSR may harm social welfare. Galbreth & Ghosh (2013) use a horizontal competition model that considers the awareness of sustainable development to propose a sustainable enterprise development strategy and management strategy. Kim *et al.* (2019) analyze the privatization policy of a company through a hybrid oligopoly model. The results demonstrate that CSR activities have an important impact on the degree of privatization of a company. Liu *et al.* (2015) explore the incentive effect of competition structure on enterprises to undertake environmental CSR, showing that the incentive effect is greater in Cournot competition. Planer-Friedrich & Sahm (2019) explore the strategy of CSR in an incomplete market and suggest CSR may increase market concentration, and enterprises may do not undertake CSR in Bertrand competition. This paper continues to use the duopoly method to investigate the research issues.

Methodology

To accomplish the research goals, the duopoly model and the sequential game are employed to explore the impacts and decisions of community-friendly CSR. We construct a duopoly model composed of enterprises and a community and put forward the following assumptions.

Assumption 1. Assume two enterprises (Enterprise 1 and Enterprise 2) and a community are engaged. Enterprises compete in Cournot competition and products are homogeneous. There are multiple connections between enterprises and the community. First, the community is the consumer market for enterprises. Second, enterprises provide taxation for the community where consumers live. Third, the production activities of enterprises produce negative externalities. Therefore, the impacts of CSR on the community are reflected in three aspects: consumer surplus, taxation, and negative externalities.

Assumption 2. According to the existing CSR utility function (Chen *et al.*, 2021b), and incorporate the community-based corporate social responsibility. Suppose utility functions are $U_i = (1 - \beta)\pi_i + a[CS + \beta\pi_i - \lambda(q_1 + q_2)]$,

$i = 1 \text{ or } 2$ π_i is profit, $CS = \frac{(q_1 + q_2)^2}{2}$ (Chen *et al.*, 2020), and

$SW = \pi_1 + \pi_2 + CS - \lambda(q_1 + q_2)$. The market function for implementing CSR is $p_i = b + ae - q_1 - q_2$, and the market function for not implementing CSR is $p_i = b - q_1 - q_2$. Among them, β is the tax rate levied by the government where the community is located ($0 < \beta < 1$), a is the level of CSR ($0 \leq a \leq 1$), λ is the negative externality caused by enterprise production to the community ($0 < \lambda < \frac{b-c}{2}$), and e is the consumer sensitivity to CSR ($e > 0$). The greater e , the higher price. c is the marginal cost of the firm, which is a constant that is greater than 0.

Assumption 3. Assume there are three situations: neither enterprises implement CSR and pursue the maximization of $(1 - \beta)\pi_i$; Enterprise 1 implements CSR and pursues the maximization of U_1 ; Enterprise 2 does not implement CSR and pursues the maximization of $(1 - \beta)\pi_2$; both enterprises implement CSR and pursue maximization of U_i . We define these situations as Model NN, Model CN, and Model CC respectively. By comparing the three situations, we determine the enterprises' CSR decision-making.

Under the above assumptions, two enterprises compete for production in Cournot Competition. The paper solves the optimal outputs q_i^* in the three cases, explore the impacts of a , β , λ , e on the equilibrium results and compare equilibrium profits of these cases and analyze CSR decisions, then propose corresponding policy implications.

Results and Discussion

Model NN

In this case, neither enterprises implement CSR and pursue the maximization of $(1-\beta)\pi_i$. According to the principle of profit maximization, the output

decision of Enterprise 1 satisfies $\frac{\partial(1-\beta)\pi_1}{\partial q_1} = 0$, and the output of Enterprise

2 is determined by $\frac{\partial(1-\beta)\pi_2}{\partial q_2} = 0$, outputs are obtained as

$$q_1 = \frac{b-c-q_2}{2} \quad (1)$$

$$q_2 = \frac{b-c-q_1}{2} \quad (2)$$

Combining (1) and (2), equilibrium outputs are derived as

$$q_1^{NN} = q_2^{NN} = \frac{b-c}{3} \quad (3)$$

To ensure $q_i^{NN} > 0$, $b-c > 0$ should be satisfied.

Lemma 1. The equilibrium results when neither enterprise implement CSR are:

$$\pi_i^{NN} = \frac{(b-c)^2}{9}, \quad CS^{NN} = \frac{2(b-c)^2}{9}, \quad SW^{NN} = \frac{(4b-4c-6\lambda)(b-c)}{9}.$$

Analyze the impacts of a , β , λ , e , we can obtain Proposition 1.

Proposition 1. The effects of community-friendly CSR on stakeholders in Model NN are:

(i) the effects of a :

$$\frac{\partial CS^{NN}}{\partial a} = 0, \quad \frac{\partial \pi_i^{NN}}{\partial a} = 0, \quad \frac{\partial SW^{NN}}{\partial a} = 0.$$

(ii) the effects of β :

$$\frac{\partial CS^{NN}}{\partial \beta} = 0, \quad \frac{\partial \pi_i^{NN}}{\partial \beta} = 0, \quad \frac{\partial SW^{NN}}{\partial \beta} = 0.$$

(iii) the effects of λ :

$$\frac{\partial CS^{NN}}{\partial \lambda} = 0, \quad \frac{\partial \pi_i^{NN}}{\partial \lambda} = 0, \quad \frac{\partial SW^{NN}}{\partial \lambda} = -\frac{2(b-c)}{3} < 0.$$

(iv) the effect of e :

$$\frac{\partial CS^{NN}}{\partial e} = 0, \quad \frac{\partial \pi_i^{NN}}{\partial e} = 0, \quad \frac{\partial SW^{NN}}{\partial e} = 0.$$

Proposition 1 implies that among the influences of a , β , λ , e the equilibrium results, only production externalities have a negative influence on social welfare, and the other variables have no influences on the equilibrium results. The reason is that when the two enterprises do not implement CSR, that is, two enterprises consider little the interests of the community, then CSR (including concerning consumers, paying taxes, and reducing negative externalities) is not reflected, so the level of CSR and its sensitivity, tax rate, and negative externalities have no effects on consumer surplus and profits. As for social welfare, it is the sum of enterprises' profits and consumer surplus minus the negative externality of production. Thus, negative externalities decline social welfare. In other words, the greater the negative externality, the greater the harm to society. Therefore, the government should strictly control the negative externalities brought about by the production of enterprises and urge enterprises to reduce the generation of negative externalities.

Model CN

In Model CN, Enterprise 1 implements CSR and pursues the maximization of U_1 . Enterprise 2 does not implement CSR and pursues the maximization of $(1-\beta)\pi_2$. Based on the principle of maximum utility, the output decision of Enterprise 1 satisfies $\frac{\partial U_1}{\partial q_1} = 0$; based on the principle of maximum profit, the output decision of Enterprise 2 satisfies $\frac{\partial (1-\beta)\pi_2}{\partial q_2} = 0$, then outputs can be derived as

$$q_1 = \frac{(a-1)(ae+b-c-q_2)\beta + (e+q_2-\lambda)a+b-c-q_2}{(2a-2)\beta - a + 2} \quad (4)$$

$$q_2 = \frac{b-c-q_1}{2} \quad (5)$$

Combining (3) and (4), equilibrium outputs can be deduced as

$$q_1^{CN} = \frac{2a^2\beta e + [(b-c-2e)\beta + b-c+2e-2\lambda]a - (\beta-1)(b-c)}{(3\beta-1)a - 3\beta + 3} \quad (6)$$

$$q_2^{CN} = \frac{-a^2\beta e + [(b-c+e)\beta - b+c-e+\lambda]a - (\beta-1)(b-c)}{(3\beta-1)a - 3\beta+3} \quad (7)$$

Lemma 2. The equilibrium results when Enterprise 1 implements CSR and Enterprise 2 does not implement CSR are:

$$\begin{aligned} & \{e(2\beta-1)a^2 + [(b-c-2e)\beta - b+c+2e+\lambda]a - (\beta-1)(b-c)\} \\ \pi_1^{CN} &= \frac{2a^2\beta e + [(b-c-2e)\beta + b-c+2e-2\lambda]a - (\beta-1)(b-c)}{(3a\beta - a - 3\beta + 3)^2} \\ \pi_2^{CN} &= \frac{a^2\beta e + [(-b+c-e)\beta + b-c+e-\lambda]a + (\beta-1)(b-c)^2}{(3a\beta - a - 3\beta + 3)^2} \\ CS^{CN} &= \frac{[(a-1)(ae+2b-2c)\beta + (e-\lambda)a + 2b-2c]^2}{2(3a\beta - a - 3\beta + 3)^2} [\\ & \beta e^2(11\beta-4)a^4 + [(8b-8c-22e-6\lambda)\beta^2 + (2b-2c+26e-8\lambda)\beta - 2b+2c-4e+4\lambda]ea^3 \\ & + \left\{ \begin{aligned} & [11e^2 + (-16b+16c+12\lambda)e + (b-c)(8b-8c-12\lambda)]\beta^2 + \\ & [-22e^2 + (14b-14c-4\lambda)e - (4b-4c-6\lambda)(-c+\lambda+b)]\beta + 11e^2 + (2b-2c-8\lambda)e + \end{aligned} \right\} a^2 \\ & \left. \begin{aligned} & (2b-2c-3\lambda)\lambda \\ & -(\beta-1)\left\{ \begin{aligned} & [(-8b+8c+6\lambda)e + (b-c)(16b-16c-24\lambda)]\beta + \\ & (8b-8c-6\lambda)e - (4b-4c-6\lambda)(-c+\lambda+b) \end{aligned} \right\} a + (\beta-1)^2(b-c)(8b-8c-12\lambda) \end{aligned} \right\} \\ SW^{CN} &= \frac{2(3a\beta - a - 3\beta + 3)^2}{2(3a\beta - a - 3\beta + 3)^2} \end{aligned}$$

To ensure prices, outputs are positive,

$$0 < e < \frac{[(b-c)\beta - b+c+\lambda]a - (\beta-1)(b-c)}{a(a\beta - \beta + 1)} = A \text{ should be satisfied. Next,}$$

analyze the impacts of a , β , λ , e on CS^{CN} , π_i^{CN} and SW^{CN} . Proposition 1 can be obtained.

Proposition 2. The effects of community-friendly CSR on stakeholders in Model CN are:

(i) the effects of a :

$$\frac{\partial CS^{CN}}{\partial a} = \frac{[3e(a-1)^2\beta^2 + (-a^2e + 6ae - 2b + 2c - 6e + 3\lambda)\beta + 2b - 2c + 3e - 3\lambda]}{[(a-1)(ae + 2b - 2c)\beta + (e - \lambda)a + 2b - 2c]} > 0;$$

$$\frac{\partial \pi_1^{CN}}{\partial a} = \frac{e^2(3\beta - 1)\beta(8\beta - 4)a^4 + \left[\frac{12(b - c - 6e)\beta^3 + (-7b + 7c + 110e - 6\lambda)\beta^2}{+(-2b + 2c - 40e + 8\lambda)\beta + b - c + 2e - 2\lambda} \right]ea^3 - [36(b - c - 2e)\beta^2 + (-9b + 9c + 90e - 18\lambda)\beta - 9b + 9c - 18e + 18\lambda](\beta - 1)ea^2 - (\beta - 1) \left\{ \frac{-e(36b - 36c - 24e)\beta^2 + \left[\frac{-48e^2 + (38b - 38c + 12\lambda)e}{+(b - c)(2b - 2c - 3\lambda)} \right]\beta}{+24e^2 + (-2b + 2c - 12\lambda)e - (-3c - 4\lambda + 3b)(2b - 2c - 3\lambda)} \right\}a + (\beta - 1)^2(-12\beta e + 2b - 2c + 12e - 3\lambda)(b - c)}{(3a\beta - a - 3\beta + 3)^3},$$

if $e < e_1$, then the relationship between π_1^{CN} and a is inverted U, there is an optimal a^{CN} , $\frac{\partial \pi_1^{CN}}{\partial a} \Big|_{a=a^{CN}} = 0$; if $e_1 < e < A$, $\frac{\partial \pi_1^{CN}}{\partial a} > 0$.

$$\frac{\partial \pi_2^{CN}}{\partial a} = \frac{[6e(a-1)^2\beta^2 + (-2a^2e + 12ae - 4b + 4c - 12e + 6\lambda)\beta + 4b - 4c + 6e - 6\lambda]}{[(a-1)(ae - b + c)\beta + (b - c + e - \lambda)a - b + c]} < 0$$

$$\frac{\partial SW^{CN}}{\partial a} = \frac{e(a-1)^3(33ae + 12b - 12c - 9\lambda)\beta^3 - (a-1) \left[\frac{23e^2a^3 + e(b - c - 117e + 9\lambda)a^2}{-e(26b - 26c - 99e)a + (36b - 36c - 27\lambda)e} \right] \beta^2 + \left[\frac{4a^4e^2 - e(4b - 4c + 43e - 10\lambda)a^3 + e(18b - 18c + 135e - 54\lambda)a^2}{+[-99e^2 + (16b - 16c + 27\lambda)e + (2b - 2c - 3\lambda)(2b - 2c - 5\lambda)]a + (-36b + 36c + 27\lambda)e - (4b - 4c - 6\lambda)(-c - 3\lambda + b)} \right] \beta + e(b - c + 2e - 2\lambda)a^3 - 9e(b - c + 2e - 2\lambda)a^2 + [33e^2 + (10b - 10c - 27\lambda)e - (2b - 2c - 3\lambda)(b - c - 2\lambda)]a + (12b - 12c - 9\lambda)e + (2b - 2c - 3\lambda)(-c - 3\lambda + b)}{(3a\beta - a - 3\beta + 3)^3},$$

if $e < e_2$, then $\frac{\partial SW^{CN}}{\partial a} < 0$; if $e_2 \leq e < e_3$, then the relationship between SW^{CN} and a is inverted U, there is an optimal a^{CN} , $\frac{\partial SW^{CN}}{\partial a} \Big|_{a=a^{CN}} = 0$; if $e \geq e_3$ then $\frac{\partial SW^{CN}}{\partial a} > 0$.

(ii) the effects of β :

$$\frac{\partial CS^{CN}}{\partial \beta} = \frac{(ae + 2b - 2c - 3\lambda)a(1-a)\{a^2\beta e + [(2b - 2c - e)\beta + e - \lambda]a - 2(\beta - 1)(b - c)\}}{(3a\beta - a - 3\beta + 3)^3} > 0$$

$$\frac{\partial \pi_1^{CN}}{\partial \beta} = \frac{a(1-a)\{2e(\beta - 1)a^2 + [(b - c - 2e)\beta - 3b + 3c + 2e + 4\lambda]a - (\beta - 1)(b - c)\}(ea + 2b - 2c - 3\lambda)}{(3\beta a - a - 3\beta + 3)^3},$$

if $\frac{2a-1}{a-1} < \beta < 1$ and $0 < \lambda < -\frac{[(\beta - 2)a - \beta + 1](b - c)}{2a}$, then $\frac{\partial \pi_1^{CN}}{\partial \beta} < 0$;

otherwise, if $0 < e < e_4$, then $\frac{\partial \pi_1^{CN}}{\partial \beta} < 0$; if $e_4 < e < A$, then $\frac{\partial \pi_1^{CN}}{\partial \beta} > 0$, where

$$e_4 = \frac{[(-b + c)\beta + 3b - 3c - 4\lambda]a + (\beta - 1)(b - c)}{2a(\beta - 1)(a - 1)}.$$

$$\frac{\partial \pi_2^{CN}}{\partial \beta} = \frac{2(1-a)\{a^2\beta e + [(-b + c - e)\beta + b - c + e - \lambda]a + (\beta - 1)(b - c)\}a(ea + 2b - 2c - 3\lambda)}{(3a\beta - a - 3\beta + 3)^3} < 0$$

$$\frac{\partial SW^{CN}}{\partial \beta} = \frac{\left\{e(5\beta - 2)a^2 + \left[\frac{(b - c - 5e - 3\lambda)}{\beta - b + c + 5e + 2\lambda}\right]a - (\beta - 1)(b - c - 3\lambda)\right\}a(1-a)(ea + 2b - 2c - 3\lambda)}{(3a\beta - a - 3\beta + 3)^3}$$

,if $0 < \lambda < \frac{(b - c)(\beta - 1)(a - 1)}{(3a - 3)\beta - 2a + 3}$, then $\frac{\partial SW^{CN}}{\partial \beta} > 0$; when

$\frac{(b - c)(\beta - 1)(a - 1)}{(3a - 3)\beta - 2a + 3} < \lambda < \frac{1}{2}(b - c)$, if $0 < e < e_5$, then $\frac{\partial SW^{CN}}{\partial \beta} < 0$; if

$e_5 < e < A$, then $\frac{\partial SW^{CN}}{\partial \beta} > 0$, where

$$e_5 = \frac{[(-b + c + 3\lambda)\beta + b - c - 2\lambda]a + (\beta - 1)(b - c - 3\lambda)}{a(5a\beta - 2a - 5\beta + 5)}.$$

(iii) the effects of λ :

$$\frac{\partial CS^{CN}}{\partial \lambda} = \frac{[(1 - a)(ae + 2b - 2c)\beta - (e - \lambda)a - 2b + 2c]a}{(3a\beta - a - 3\beta + 3)^2} < 0;$$

$$\frac{\partial \pi_1^{CN}}{\partial \lambda} = \frac{\left\{ 2e(1-\beta)a^2 + [-(b-c-2e)\beta + 3b-3c-2e-4\lambda]a - (1-\beta)(b-c) \right\} a}{(3a\beta - a - 3\beta + 3)^2}$$

, when $\frac{2a-1}{a-1} < \beta < 1$, if $-\frac{[(\beta-2)a-\beta+1](b-c)}{2a} < \lambda < \frac{b-c}{2}$ and

$e_6 < e < B$, then $\frac{\partial \pi_1^{CN}}{\partial \lambda} < 0$; otherwise, $\frac{\partial \pi_1^{CN}}{\partial \lambda} > 0$; when $0 < \beta < \frac{2a-1}{a-1}$, if

$0 < e < e_6$, then $\frac{\partial \pi_1^{CN}}{\partial \lambda} > 0$; if $e_6 < e < A$, then $\frac{\partial \pi_1^{CN}}{\partial \lambda} < 0$, where

$$e_6 = \frac{[-(b+c)\beta + 3b-3c-4\lambda]a + (\beta-1)(b-c)}{2a(\beta-1)(a-1)}.$$

$$\frac{\partial \pi_2^{CN}}{\partial \lambda} = -\frac{2a\left\{ a^2\beta e + [(-b+c-e)\beta + b-c+e-\lambda]a + (\beta-1)(b-c) \right\}}{(3a\beta - a - 3\beta + 3)^2} > 0$$

$$\frac{\partial SW^{CN}}{\partial \lambda} = \frac{(-3\beta^2e-4\beta e+2e)a^3 + [(-6b+6c+6e)\beta^2 + (b-c-2e+6\lambda)\beta + b-c-4e-3\lambda]a^2 + [(12b-12c-3e)\beta - b+c+3e-6\lambda](\beta-1)a - 6(\beta-1)^2(b-c)}{(3a\beta - a - 3\beta + 3)^2} < 0$$

(iv) the effects of e :

$$\frac{\partial CS^{CN}}{\partial e} = \frac{[(a-1)(ae+2b-2c)\beta + (e-\lambda)a + 2b-2c][(a-1)a\beta + a]}{(3a\beta - a - 3\beta + 3)^2} > 0$$

$$\frac{\partial \pi_1^{CN}}{\partial e} = \frac{a\left\{ e\beta(8\beta-4)a^3 + [(4b-4c-16e)\beta^2 + (-b+c+20e-2\lambda)\beta - b+c-4e+2\lambda]a^2 - [8(b-c-e)\beta - b+c+8e-2\lambda](\beta-1)a + 4(\beta-1)^2(b-c) \right\}}{(3a\beta - a - 3\beta + 3)^2} > 0$$

$$\frac{\partial \pi_2^{CN}}{\partial e} = \frac{2\left\{ a^2\beta e + [(-b+c-e)\beta + b-c+e-\lambda]a + (\beta-1)(b-c) \right\} a(a\beta - \beta + 1)}{(3a\beta - a - 3\beta + 3)^2} < 0$$

$$\frac{\partial SW^{CN}}{\partial e} = \frac{a\left\{ e\beta(11\beta-4)a^3 + [(4b-4c-22e-3\lambda)\beta^2 + (b-c+26e-4\lambda)\beta - b+c-4e+2\lambda]a^2 - (\beta-1)[(8b-8c-11e-6\lambda)\beta + b-c+11e-4\lambda]a + (\beta-1)^2(4b-4c-3\lambda) \right\}}{(3a\beta - a - 3\beta + 3)^2} > 0.$$

From Proposition 2, we have the following discussions.

First, the CSR level has impacts on stakeholders. CSR level is positively correlated with consumer surplus. The reason is that increasing the CSR level is conducive to increasing the total outputs. This result shows that actively encouraging enterprises to adopt CSR is beneficial to protect consumer rights. Enterprise 1 implements CSR which may not be able to increase profit, which depends on consumer sensitivity. If the consumer sensitivity is lower than a certain level, it is optimal to implement appropriate CSR. For Enterprise 2, the implementation of CSR by Enterprise 1 will lead to a decline in profit. The reason is that with the increase of CSR level, the price and output of Enterprise 2 decrease, which leads to the decrease in profit. There are not line relationships between social welfare and CSR level. Non-implementation of CSR, implementation of moderate CSR, and implementation of full CSR may achieve maximum social welfare. This also relies on consumer sensitivity, which means that the pursuit of CSR may not necessarily increase social welfare.

Second, the tax rate influences stakeholders. An increase in the tax rate is conducive to increasing the total market outputs and consumer surplus, which is beneficial to consumers. The impact of the tax rate on the profit of Enterprise 1 depends on the consumer sensitivity and the degree of negative externalities of the product. Increasing the tax rate helps increase the output of Enterprise 1, and can increase profit when the market is more sensitive. Therefore, a higher tax rate may not harm the enterprise. For Enterprise 2, as the tax rate rises, the output decreases, and because the total output increases, the price decreases, and then the profit also decreases. For social welfare, when the negative externalities of the product are higher than a certain level and the consumer sensitivity is lower than a certain level, the increase in tax rate increases will reduce social welfare, otherwise, it will increase social welfare. This shows that the design of the tax rate is very important, and various market factors need to be considered comprehensively.

Third, negative externalities affect stakeholders. The more negative externalities, the lower total outputs, which in turn will reduce consumer surplus. However, if the impact of negative externalities on consumers is comprehensively considered, negative externalities may be beneficial to consumers as a whole. For Enterprise 1, negative externalities' impact on profit depends on the tax rate, consumer sensitivity, and the level of negative externalities. It may be positively correlated or negatively correlated, which indicates that the impact of negative externalities on Enterprise 1 is complex. For Enterprise 2, an increase in negative externalities will reduce the total market output, which in turn will increase prices, thus gaining higher profit. This shows that negative externalities are not necessarily a bad thing for enterprises, and it also reflects the problem of market failure. For society, an increase in negative externalities will inevitably harm social welfare.

Fourth, the impacts of consumer sensitivity on stakeholders are as follows. The increase in consumer sensitivity makes consumers willing to pay higher prices, thus

total market outputs increase, which in turn is conducive to improving consumer surplus. For Enterprise 1, the higher the consumer sensitivity and the higher the market price of its products, the higher the profit. For Enterprise 2, the higher the consumer sensitivity, the greater the total market output, the lower the price, the greater the market disadvantage that Enterprise 1 may have, and the lower its profit. As far as society is concerned, increasing consumer sensitivity will encourage enterprises to implement CSR. At the same time, the price rises to a certain extent. Although it is not good for Enterprise 2, it is beneficial to social welfare.

Model CC

In Model CC, both enterprises implement CSR, they maximize U_i . That is, their output decisions satisfy $\frac{\partial U_i}{\partial q_i} = 0$, outputs can be obtained as

$$q_1 = \frac{(a-1)(ae+b-c-q_2)\beta + (e+q_2-\lambda)a+b-c-q_2}{(2a-2)\beta - a + 2} \quad (8)$$

$$q_2 = \frac{(a-1)(ae+b-c-q_1)\beta + (e+q_1-\lambda)a+b-c-q_1}{(2a-2)\beta - a + 2} \quad (9)$$

Then equilibrium outputs can be deduced as

$$q_1^{CC} = q_2^{CC} = \frac{(a-1)(ae+b-c)\beta + (e-\lambda)a+b-c}{(3a-3)\beta - 2a + 3} \quad (10)$$

Lemma 3. The equilibrium results when both enterprises implement CSR are:

$$\begin{aligned} \pi_1^{CC} &= \pi_2^{CC} = \frac{\{a^2\beta e + [(b-c-e)\beta + e - \lambda]a - (\beta-1)(b-c)\}}{(3a\beta - 2a - 3\beta + 3)^2} \\ CS^{CC} &= \frac{2[(a-1)(ae+b-c)\beta + (e-\lambda)a+b-c]^2}{(3a\beta - 2a - 3\beta + 3)^2} \\ SW^{CC} &= \frac{2(2ae+2b-2c-3\lambda)(a-1)(\beta-1)\{a^2\beta e + [(b-c-e)\beta + e - \lambda]a - (\beta-1)(b-c)\}}{(3a\beta - 2a - 3\beta + 3)^2} \end{aligned}$$

To ensure $q_i > 0$ and $p_i > 0$,

$(\beta - 2)a^2e + ((b + 2c - e)\beta + e - 2b + 2\lambda)a - (\beta - 1)(b + 2c) > 0$ can be

obtained, where $e > \frac{(1-a)(b-c)\beta - \lambda a + b - c}{a((a-1)\beta + 1)} = B$.

Proposition 2. The effects of community-friendly CSR on stakeholders in Model CC are:

(i) the effects of a :

$$\frac{\partial CS^{CC}}{\partial a} = \frac{4[(a-1)(ae+b-c)\beta + (e-\lambda)a + b - c]}{(3a\beta - 2a - 3\beta + 3)^3} > 0$$

$$\frac{\partial \pi_i^{CC}}{\partial a} = \frac{6e(a-1)^3(ae+b-c)\beta^3 - (a-1)\left[2(19b-19c-9e-3\lambda)ea - (2b-2c-18e-3\lambda)(b-c)\right]\beta^2 + \left\{8a^4e^2 + (8b-8c-38e+4\lambda)ea^3 - (36b-36c-54e+9\lambda)ea^2 + [-18e^2 + (58b-58c-12\lambda)e + (-c-4\lambda+b)(-2c-3\lambda+2b)]a + (b-c)(4b-4c-18e-6\lambda)\right\}\beta + 4e(e-\lambda)a^3 - 18e(e-\lambda)a^2 + \left[-2(-c-2\lambda+b)(-2c-3\lambda+2b)\right]a - (2b-2c-6e-3\lambda)(b-c)}{(3a\beta - 2a - 3\beta + 3)^3},$$

,when $\beta \leq \beta_1$, if $0 < e \leq e_7$, then $\frac{\partial \pi_i^{CC}}{\partial a} < 0$; if $e > e_7$, then the optimal

CSR level a^{CC} exists, which can maximize profit; if $\beta > \beta_1$, then $\frac{\partial \pi_i^{CC}}{\partial a} < 0$.

$$\frac{\partial SW^{CC}}{\partial a} = \frac{\left\{6e(a-1)^3(4ae+4b-4c-3\lambda)\beta^2 - \left[16a^3e^2 + e(16b-16c-60e)a^2 - (56b-56c-48e-18\lambda)ea\right] + (48b-48c-36\lambda)e + (-c-3\lambda+b)(-4c-6\lambda+4b)\right\}(a-1)\beta - 8e(e-\lambda)a^3 + 36e(e-\lambda)a^2 + [-24e^2 + (32b-32c)e + (-8c-12\lambda+8b)(-c-2\lambda+b)]a + (-24b+24c+18\lambda)e - (-c-3\lambda+b)(-4c-6\lambda+4b)}{(3a\beta - 2a - 3\beta + 3)^3}(\beta - 1)$$

,if $0 < e \leq e_8$, then $\frac{\partial SW^{CC}}{\partial a} < 0$; if $e > e_8$, then the optimal CSR level a^{CC}

exists, which can maximize social welfare.

(ii) the effects of β :

$$\frac{\partial CS^{CC}}{\partial \beta} = \frac{(1-a)\{a^2\beta e + [(b-c-e)\beta + e - \lambda]a - (\beta - 1)(b-c)\}a(8ae + 8b - 8c - 12\lambda)}{(3\beta a - 2a - 3\beta + 3)^3} > 0$$

$$\frac{\partial \pi_i^{CC}}{\partial \beta} = \frac{(2ae + 2b - 2c - 3\lambda) \{e(\beta + 2)a^2 + [(b - c - e)\beta + 2b - 2c + e - 4\lambda]a - (\beta - 1)(b - c)\} (a - 1)a}{(3a\beta - 2a - 3\beta + 3)^3} < 0$$

$$\frac{\partial SW^{CC}}{\partial \beta} = \frac{(4ae + 4b - 4c - 6\lambda)(1 - a)a \left\{ e(\beta - 2)a^2 + \left[\frac{(b - c - e - 3\lambda)\beta}{-2b + 2c + e + 4\lambda} \right] a - (\beta - 1)(b - c - 3\lambda) \right\}}{(3\beta a - 2a - 3\beta + 3)^3} > 0$$

(iii) the effects of λ :

$$\frac{\partial CS^{CC}}{\partial \lambda} = - \frac{4[(a - 1)(ae + b - c)\beta + (e - \lambda)a + b - c]a}{[(3a - 3)\beta - 2a + 3]^2} < 0;$$

$$\frac{\partial \pi_i^{CC}}{\partial \lambda} = \frac{\{e(\beta + 2)a^2 + [(b - c - e)\beta + 2b - 2c + e - 4\lambda]a - (\beta - 1)(b - c)\}a}{(3a\beta - 2a - 3\beta + 3)^2},$$

$$\text{if } 0 < \lambda < \frac{(2\beta + 1)(ae + b - c)}{4}, \text{ then } \frac{\partial \pi_i^{CC}}{\partial \lambda} < 0;$$

$$\text{if } \frac{(2\beta + 1)(ae + b - c)}{4} < \lambda < \frac{b - c}{2}, \text{ then } \frac{\partial \pi_i^{CC}}{\partial \lambda} > 0,$$

$$\frac{\partial SW^{CC}}{\partial \lambda} = \frac{\{e(6\beta + 4)a^2 + [6(b - c - e)\beta + 4b - 4c + 6e - 12\lambda]a - 6(\beta - 1)(b - c)\}(\beta - 1)(1 - a)}{(3a\beta - 2a - 3\beta + 3)^2} < 0.$$

(iv) the effects of e :

$$\frac{\partial CS^{CC}}{\partial e} = \frac{4[(a - 1)(ae + b - c)\beta + (e - \lambda)a + b - c][(a - 1)a\beta + a]}{(3a\beta - a - 3\beta + 3)^2} > 0;$$

$$\frac{\partial \pi_i^{CC}}{\partial e} = \frac{a \left\{ 2e\beta(\beta - 2)a^3 + [2(b - c - 2e)\beta^2 + (\lambda - 4b + 4c + 8e)\beta - 4e + 2\lambda]a^2 \right.}{(3\beta a - 2a - 3\beta + 3)^2} > 0 ;$$

$$\frac{\partial SW^{CC}}{\partial e} = \frac{(\beta - 1)(a - 1)a[(8ae + 8b - 8c - 6\lambda)(a - 1)\beta + (8e - 4\lambda)a + 8b - 8c - 6\lambda]}{(3a\beta - 2a - 3\beta + 3)^2} > 0.$$

According to Proposition 3, this paper discusses as follows.

First, the impacts of CSR level on stakeholders are discussed. Similar to the Model CN, increasing the level of CSR is conducive to increasing consumer surplus, because both enterprises can increase outputs due to the implementation of CSR. For Enterprise 1 and 2, the impact of CSR level on profits is uncertain, which is different from Model CN. Non-implementation of CSR or implementation of moderate CSR can maximize profits. Therefore, if enterprises want to implement CSR aimed at maximizing profits, they need to consider tax rate, consumer sensitivity, and negative externalities. For society, the impact of increased CSR level on social welfare depends on consumer sensitivity. Not implementing CSR or implementing appropriate CSR is conducive to maximizing social welfare. This conclusion is different from Model CN.

Second, the tax rate influences stakeholders. Increasing the tax rate is in favor of increasing the outputs of the two enterprises and then the consumer surplus. This conclusion is the same as Model CN, but the difference is that the outputs of the two enterprises in Model CC increase due to the increase in the CSR level. For both enterprises, increasing the tax rate will reduce profits. The reason is that both enterprises have implemented CSR, and there will be no unique competitive advantages brought about by the implementation of CSR. This is different from the conclusion of Model CN. As far as society is concerned, increasing the tax rate is conducive to increasing social welfare, because the increase in consumer surplus is greater than the decrease in the profits of the two enterprises, so a higher tax rate should be engaged in this case.

Third, negative externalities influence stakeholders. The increase of negative externalities will reduce the output of enterprises, thereby reducing consumer surplus, which is consistent with the conclusion of Model CN. The reason is that enterprises will consider the impact of negative externalities when implementing CSR. The higher the negative externalities, the lower the enterprises' outputs. For the two enterprises, the impacts of negative externalities on profits depend upon the level of negative externalities. When the level of negative externalities is low, an increase in negative externalities will reduce profits. If the negative externalities are higher than a certain level, the case is opposite, which is different from Model CN. For society, as in Model CN, an increase in negative externalities hurts social welfare.

Fourth, consumer sensitivity affects stakeholders. Increased consumer sensitivity help increase the outputs of the two enterprises, consumer surplus, price, which leads to higher profits and social welfare. Compared with Model CN, the impacts of consumer sensitivity on the two enterprises are different because only one enterprise implements CSR in Model CN.

CSR Decision Analysis

To determine whether an enterprise implements CSR, we compare the profits of the above models.

The decision of Enterprise 2 when Enterprise 1 implements CSR.

When Enterprise 1 implements CSR, if Enterprise 2 implements, its profit is $\pi_2^{CC} = \frac{\{a^2\beta e + [(b-c-e)\beta + e - \lambda]a - (\beta-1)(b-c)\}\{e(\beta-2)a^2 + [(b-c-e)\beta - 2b + 2c + e + 2\lambda]a - (\beta-1)(b-c)\}}{(3a\beta - 2a - 3\beta + 3)^2}$; if

Enterprise 2 does not implement, its profit is $\pi_2^{CN} = \frac{a^2\beta e + [(-b+c-e)\beta + b-c+e-\lambda]a + (\beta-1)(b-c)^2}{(3a\beta - a - 3\beta + 3)^2}$, Then the CSR

decision of Enterprise 2 depends on the sign of $\pi_2^{CC} - \pi_2^{CN}$. Let $f(e) = \pi_2^{CC} - \pi_2^{CN}$ and set $C = b - c$, we can get:

$$\Delta = \frac{a^2\{[16c^2\beta^4 - 24(2C-\lambda)C\beta^3 + (-28C\lambda + 36C^2 + 9\lambda^2)\beta^2 + (8C\lambda - 8C^2 - 6\lambda^2)\beta + \lambda^2]a^4 - [64C^2\beta^3 - (144C - 72\lambda)C\beta^2 + (72C^2 - 56C\lambda + 18\lambda^2)\beta - 8C^2 + 8C\lambda - 6\lambda^2](\beta-1)a^3 + (\beta-1)^2[96C^2\beta^2 - (144C - 72\lambda)C\beta + 36C^2 - 28C\lambda + 9\lambda^2]a^2 - (64C\beta - 48C + 24\lambda)(\beta-1)^3Ca + C^2(\beta-1)^4\}}{(3a\beta - a - 3\beta + 3)^2(3a\beta - 2a - 3\beta + 3)^2}$$

Corollary 1 can be obtained.

Corollary 1. If $0 < a \leq \frac{\beta-1}{\beta-2}$, then $\Delta > 0$, that is, $\pi_2^{CC} < \pi_2^{CN}$; when

$\frac{\beta-1}{\beta-2} < a < 1$, if $0 < \lambda \leq \lambda_1$, $\Delta \leq 0$, that is, $\pi_2^{CC} < \pi_2^{CN}$; if $\lambda_1 < \lambda < \frac{C}{2}$, then

$\Delta > 0$, that is, $\pi_2^{CC} > \pi_2^{CN}$, where

$$\lambda_1 = \frac{\left[-12(a-1)^2\beta^2 + 4(2a^2 - 8a + 6)\beta + \sqrt{[192(a-1)^2\beta^2 + (-144a^2 + 528a - 384)\beta + 2a - 3]}\left[(a-1)\beta - \frac{a}{2} + 1\right]C\right]}{(3a\beta - a - 3\beta + 3)^2 a}$$

It can be seen from Corollary 1 that when the CSR level is lower ($0 < a \leq \frac{\beta-1}{\beta-2}$

), the profit of Enterprise 2 when it implements CSR is lower than that of non-implementing CSR, therefore, Enterprise 2 will choose not to implement CSR.

When the CSR level is large ($\frac{\beta-1}{\beta-2} < a < 1$) and the negative externalities are

small, not implementing CSR is still the best choice for Enterprise 2. Only when CSR and negative externalities are both large, the profit of Enterprise 2 implementing CSR is higher than that not implementing CSR, then implementing CSR is the best choice for Enterprise 2. It can be seen that when certain conditions can be met, the implementation of CSR is the best choice, but if not, Enterprise 2 should not implement CSR, and this condition is closely related to the tax rate and negative externalities. In the case of large negative externalities, the improvement of the CSR level of Enterprise 1 can promote the implementation of CSR of Enterprise 2, but if the negative externality is small, even if Enterprise 1 implements a high level of CSR, it cannot promote Enterprise 2 to implement CSR. Therefore, if a competitor has implemented CSR, the enterprise needs to make a reasonable decision based on the tax rate and negative externalities, and cannot blindly follow it.

The decision of Enterprise 2 when Enterprise 1 does not implement CSR

When Enterprise 1 does not implement CSR, if Enterprise 2 implements, its profit is

$$\pi_2^{NC} = \frac{\{e(2\beta-1)a^2 + [(b-c-2e)\beta - b + c + 2e + \lambda]a - (\beta-1)(b-c)\} \{2a^2\beta e + [(b-c-2e)\beta + b - c + 2e - 2\lambda]a - (\beta-1)(b-c)\}}{(3a\beta - a - 3\beta + 3)^2}, \text{ if}$$

Enterprise 2 does not implement, its profit is $\pi_2^{NN} = \frac{(b-c)^2}{9}$.

Corollary2. In the case that $0 < a < \frac{3}{5}$: if $\beta \leq \frac{5a-3}{3a-1}$, then $\pi_2^{NC} > \pi_2^{NN}$;

when $\frac{5a-3}{3a-1} < \beta < 1$ and $0 < \lambda < -\frac{C(3a\beta - 5a - 3\beta + 3)}{6a}$, if $0 < e \leq e_9$,

$\pi_2^{NC} \leq \pi_2^{NN}$; if $e_9 < e < A$, then $\pi_2^{NC} > \pi_2^{NN}$; if $\frac{5a-3}{3a-1} < \beta < 1$ and

$-\frac{C(3a\beta - 5a - 3\beta + 3)}{6a} < \lambda < \frac{C}{2}$, then $\pi_2^{NC} > \pi_2^{NN}$.

In the case $\frac{3}{5} \leq a < 1$: when $0 < \lambda < -\frac{C(3a\beta - 5a - 3\beta + 3)}{6a}$, if $0 < e \leq e_9$, then $\pi_2^{NC} \leq \pi_2^{NN}$; if $e_9 < e < A$, $\pi_2^{NC} > \pi_2^{NN}$; if

$$\begin{aligned}
 & -\frac{C(3a\beta - 5a - 3\beta + 3)}{6a} < \lambda < \frac{C}{2}, \text{ then } \pi_2^{NC} > \pi_2^{NN}, \text{ where} \\
 & -12(a-1)^2 C\beta^2 + 3[(C+2\lambda)a - 8C](a-1)\beta + (3C-6\lambda)a^2 + (3C+6\lambda)a + \\
 & \sqrt{\frac{[(144C^2\beta^2 - 72C^2\beta + 81(C-2\lambda)^2)a^2 - 2(\beta-1)(144\beta-36)C^2a + 144(\beta-1)^2C^2]\left[\left(\beta-\frac{1}{3}\right)a - \beta + 1\right]^2 - 12C}{12a(a\beta - \beta + 1)(2a\beta - a - 2\beta + 2)}}.
 \end{aligned}$$

Corollary 2 implies that the CSR decision of Enterprise 2 when Enterprise 1 does not implement CSR depends on the CSR level, tax rate, and negative externalities. When the CSR level is lower than a certain level ($0 < a < \frac{3}{5}$), if the tax rate is higher than a certain level, the negative externalities are lower than a certain level and the consumer sensitivity is lower than a certain level, the enterprise should not implement CSR, otherwise, it should. When the CSR level is higher than a certain level ($\frac{3}{5} \leq a \leq 1$), if the negative externalities are lower than a certain level and the consumer sensitivity is lower than a certain level, the enterprise should not implement CSR, otherwise it should. It can be seen that a lower level of negative externalities and higher consumer sensitivity are conducive to the implementation of CSR by enterprises, and the tax rate also has a direct impact on corporate CSR decision-making. Under certain circumstances, a lower tax rate is conducive to the implementation of CSR by enterprises, but this impact is affected by CSR level, negative externalities, and consumer sensitivity.

Conclusion

This paper constructs an analysis framework for functions and decision-making of community-friendly CSR. By incorporating consumer surplus, tax rate, negative externalities of production, and consumer sensitivity into corporate social responsibility, the study examines community-friendly CSR has multiple impacts on stakeholders, and further determines CSR decisions, and draws the following conclusions.

First, whether a competitor implements CSR, CSR level, negative externalities, tax rate, and consumer sensitivity have multiple effects on profits, consumers, and social welfare, and they are all affected by other factors. For example, in Model CN and Model CC, the impacts of CSR level on profits are affected by consumer sensitivity, and under the corresponding consumer sensitivity range, there is a CSR

level that maximizes profit. In Model CN, the relationship between tax rate and social welfare is not unique but positively correlated in Model CC. The impacts of negative externalities on profits differ depending on whether competitors implement CSR. Increased consumer sensitivity helps increase consumer surplus and social welfare. Therefore, the decision of CSR level should consider multiple factors such as competitors, consumer sensitivity, tax rate, negative externalities, etc., to select the optimal level of CSR. The government should not only guide enterprises to adopt their social responsibilities from many aspects, but also formulate reasonable and scientific tax rate based on the magnitude of negative externalities, and tackle the problem of negative externalities.

Second, the implementation of CSR by enterprises can achieve a win-win situation for stakeholders. Whether in Model CN or Model CC, the improvement of CSR will undoubtedly increase consumer welfare. And for enterprises that implement CSR, there is a CSR level that maximizes profits within the corresponding consumer sensitivity range. The impact of CSR level on social welfare is similar. Under a certain consumer sensitivity, there is a CSR level that maximizes social welfare. Therefore, under certain circumstances, the implementation of CSR by an enterprise can achieve a win-win situation for the enterprises and the community. Therefore, enterprises should strengthen cooperation with the government and community, rationally regulate corporate social responsibility behavior, alleviate information asymmetry between all parties, and explore a win-win path.

Third, increasing consumer sensitivity is conducive to increasing consumer surplus and profits of the enterprise implementing CSR and social welfare. Both Model CN and Model CC can draw this conclusion. Therefore, consumers should be guided to establish and strengthen the awareness of CSR, and improve consumers' awareness of CSR. First of all, enterprises should pay attention to publicizing CSR behaviors, actively disclose social responsibility information, and establish diversified information disclosure channels, to deepen consumers' understanding and attention to CSR and enhance consumers' recognition and preference for CSR. Second, the government should give more publicity and guidance to CSR behaviors, and reward enterprises that perform well in CSR, to improve consumers' awareness of CSR. Finally, the media should also actively publicize and report on CSR behaviors to enhance consumer perception.

Fourth, whether an enterprise implements CSR not only depends on whether its competitors adopt CSR, but also affected by multiple factors such as the level of CSR, tax rate, negative externalities, and consumer sensitivity. Therefore, when deciding whether to implement CSR, enterprises must fully consider factors such as the level of corporate social responsibility, tax rate, and consumer sensitivity to obtain maximum benefits. A lower level of negative externalities and higher consumer sensitivity can promote enterprises to implement CSR.

Acknowledgments

The work was supported by the National Social Science Fund in the Later Stage of China (Grant number: 20FJYB066).

References

- Appiah, J.K. (2019). Community-based corporate social responsibility activities and employee job satisfaction in the U.S. hotel industry: An explanatory study. *Journal of Hospitality and Tourism Management*, 38, 140-148. DOI: 10.1016/j.jhtm.2019.01.002.
- Bian, J., Liao, Y., Wang, Y., Tao, F. (2020). Analysis of Firm CSR Strategies. *European Journal of Operational Research*, 290(3), 914-926. DOI: 10.1016/j.ejor.2020.03.046.
- Carroll A.B. (1979). A three-dimensional conceptual model of corporate performance business and society review. *Academy of Management Review*, 4(4),497-505. DOI: 10.5465/amr.1979.4498296.
- Chen, J., Liu, J., & Qin, J. (2019). Corporate social responsibility and capacity selection. *Transformations in Business & Economics*, 18(3C), 530-545.
- Chen, J., Sun, C., Liu, J., & Huo, Y. (2021a): The optimal level of corporate social responsibility based on the duopoly model. *Managerial and Decision Economics*, 42(1), 177-184. DOI: 10.1002/mde.3222.
- Chen, J., Wang, X., & Liu, J.(2021b). Corporate social responsibility and capacity sharing in a duopoly model. *Applied Economics Letters*, 28(6): 512-517. DOI: 10.1080/13504851.2020.1761531.
- Chen, J., Wang, X., & Chu, Z. (2020). Capacity sharing, product differentiation and welfare. *Economic Research-Ekonomska Istrazivanja*, 33(1), 107-123. DOI: 110.1080/1331677X.2019.1710234.
- Chen, Y., Nie, P.Y. & Yang, Y. (2017). Effects of corporate social responsibility on food safety. *Agricultural Economics*, 63, 539–547. DOI: 10.17221/177/2016-AGRICECON.
- Galbreth, M., & Ghosh, B. (2013). Competition and sustainability: The impact of consumer awareness. *Decision Sciences*, 44(1), 127–159. DOI: 10.1111/j.1540-5915.2012.00395.x.
- Gursoy, D., Boğan, E., Dedeoğlu, B.B., & Çalışkan, C. (2019). Residents' perceptions of hotels' corporate social responsibility initiatives and its impact on residents' sentiments to community and support for additional tourism development. *Journal of Hospitality and Tourism Management*, 39, 117-128. DOI: 10.1016/j.jhtm.2019.03.005.
- Hatipoglu, B., Ertuna, B., & Salman, D. (2019). Corporate social responsibility in tourism as a tool for sustainable development. *International Journal of Contemporary Hospitality Management*, 31(6), 2358-2375. DOI: 10.1108/IJCHM-05-2018-0448.
- Hirigoyen, G. & Poulain-Rehm, T. (2014). Relationships between corporate social responsibility and financial performance: What is the causality? *Journal of Business & Management*, 4(1), 18-43. DOI: 10.2139/ssrn.2531631.
- Hoi, C.K., Wu, Q., & Zhang, H. (2016). Community social capital and corporate social responsibility. *Journal of Business Ethics*, 152(3), 647-665. DOI: 10.1007/s10551-016-3335-z.

- Hong, H. & Kacperczyk, M. (2009). The price of sin: The effects of social norms on markets. *Journal of Financial Economics*, 93(1), 15-36. DOI: 10.1016/j.jfineco.2008.09.001.
- Hull, C.E., & Rothenberg, S. (2008). Firm performance: the interactions of corporate social performance with innovation and industry differentiation. *Strategic Management Journal*, 29(7), 781-789. DOI: 10.1002/smj.675.
- Imbun, B.Y. (2007). Cannot manage without the 'Significant Other': Mining, corporate social responsibility and local communities in Papua New Guinea. *Journal of Business Ethics*, 73(2), 177-192. DOI: 10.1108/10.1007/s10551-006-9189-z.
- Kapelus, P. (2002). Mining, Corporate social responsibility and the "Community": The case of Rio Tinto, Richards Bay Minerals and the Mbonambi. *Journal of Business Ethics*, 39(3), 275-296. DOI: 10.1108/10.1023/a:1016570929359.
- Kim, Y.J., Njite, D., & Hancer, M. (2013). Anticipated emotion in consumers' intentions to select eco-friendly restaurants: Augmenting the theory of planned behavior. *International Journal of Hospitality Management*, 34, 255-262. DOI: 10.1108/10.1016/j.ijhm.2013.04.004.
- Kim, S., Lee, S., & Matsumura, T. (2019). Corporate social responsibility and privatization policy in a mixed oligopoly. *Journal of Economics*, 128 (1), 67-89. DOI:10.1007/s00712-018-00651-7.
- Liu, C., Wang, L., & Lee, S. (2015). Strategic environmental corporate social responsibility in a differentiated duopoly market. *Economics Letters*, 129, 108-111. DOI: 10.1108/10.1016/j.econlet.2015.02.027.
- Luning, S. (2012). Corporate Social Responsibility (CSR) for exploration: Consultants, companies and communities in processes of engagements. *Resources Policy*, 37(2), 205-211. DOI: 10.1016/j.resourpol.2011.02.004.
- McLennan, S., & Banks, G. (2018). Reversing the lens: Why corporate social responsibility is not community development. *Corporate Social Responsibility and Environmental Management*, 26(1), 117-126. DOI: 10.1002/csr.1664.
- McWilliams, A., Siegel, D.S., & Wright P. M. (2006). Corporate social responsibility: Strategic implications. *Journal of management studies*, 43(1), 1-18. DOI: 10.1111/j.1467-6486.2006.00580.x.
- Planer-Friedrich, L., & Sahm, M. (2019). Strategic corporate social responsibility, imperfect competition, and market concentration. *Journal of Economics*, 129(1), 79-101. DOI: 10.1108/10.1007/s00712-019-00663-x.
- Pasaribu, S.I., Vanclay, F., & Zhao, Y.J. (2020). Challenges to implementing socially-sustainable community development in oil palm and forestry operations in Indonesia. *Land*, 9(3), 1-19, DOI: 10.3390/land9030061.
- Rahmawati, P. I., Jiang, M., & DeLacy, T. (2019). Framework for stakeholder collaboration in harnessing corporate social responsibility implementation in tourist destination to build community adaptive capacity to climate change. *Corporate Social Responsibility and Environmental Management*, 26(6), 1261-1271. DOI: 10.1002/csr.1745.
- Rela, I.Z., Awang, A., Ramli, Z., Sum, S.M., & Meisanti, M. (2020a). Effects of environmental corporate social responsibility on environmental well-being perception and the mediation role of community resilience perception and the mediation role of community resilience. *Corporate Social Responsibility and Environmental Management*, 27(5), 2176-2187. DOI: 10.1002/csr.1956.

- Rela, Z.I., Awang, A., Ramli, Z., Taufik, Y., Sum, S.M., & Muhammad, M. (2020b). Effect of corporate social responsibility on community resilience: Empirical evidence in the Nickel mining industry in Southeast Sulawesi, Indonesia. *Sustainability*, 12(4), 1395. DOI: 10.3390/su12041395.
- Renneboog, L., Horst, J.T. & Zhang, C. (2008). The price of ethics and stakeholder governance: The performance of socially responsible mutual funds. *Journal of Corporate Finance*, 14(3), 302-322. DOI: 10.1016/j.jcorpfin.2008.03.009.
- Rowe, K., Karg, A., & Sherry, E. (2018). Community-oriented practice: Examining corporate social responsibility and development activities in professional sport. *Sport Management Review*, 22(3), 363-378. DOI: 10.1016/j.smr.2018.05.001.
- Russo A., & Perrini F. (2010). Investigating stakeholder theory and social capital: CSR in large firms and SMEs. *Journal of Business ethics*, 91(2), 207-221. DOI: 10.1007/s10551-009-0079-z.
- Sun, C. (2020). The research and evaluation of customer relationship management and social responsibility on competitive advantage. *Revista De Cercetare Si Interventie Sociala*, 69: 131-142. DOI: 10.33788/rcis.69.8.
- Sun, Z., Jai, K., & Zhao, L. (2019). Corporate social responsibility and sustainability of local community: A case study of the transnational project in China-Pakistan economic corridor. *Sustainability*, 11(22), 6456, DOI: 10.3390/su11226456
- Uduji, J.I., & Okolo-Obasi, E.N. (2018). Does corporate social responsibility (CSR) impact on development of women in small-scale fisheries of sub-Saharan Africa? Evidence from coastal communities of Niger Delta in Nigeria. *Marine Policy*, 118, 103323. DOI: 10.1016/j.marpol.2018.10.036.
- Uduji, J.I., Okolo-Obasi, E.N., & Asongu, S.A. (2019). Multinational oil companies in Nigeria and corporate social responsibility in the HIV/AIDS response in host communities. *Local Environment*, 24(5), 393-416. DOI: 10.1080/13549839.2019.1585770.
- Wang, C., Nie, P.Y., & Meng, Y. (2018). Duopoly competition with corporate social responsibility. *Australian Economic Papers*, 57(3), 327-345. DOI: 10.1111/1467-8454.12119.
- Wu, D.J., Lin, C., & Liu, S. (2016). Does community environment matter to corporate social responsibility? *Finance Research Letters*, 18, 127-135. DOI: 10.1016/j.frl.2016.04.010.
- Xu, Y., Chen, H., & Zhai, T. (2020). Research on the impact of agricultural enterprise's social responsibility on enterprise's continuous innovation. *Revista De Cercetare Si Interventie Sociala*, 71, 403-419. DOI: 10.33788/rcis.71.24.