

Game Theory Analysis of Corporate Donations in the Context of Emergencies

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Abstract:

In the context of emergencies, there is a significant divergence between consumers and companies regarding donation behavior, which can be viewed as a game. This paper applies game theory methods to analyze the game of corporate donation behavior in emergencies based on the characteristics of different types of companies. The analysis aims to maximize the self-interest of companies and identify the refined Nash equilibrium strategies for donation behavior under complete information game conditions.

Keywords:

Emergencies, Corporate Donations, Game

1. Introduction

Corporate donations contribute to promoting social welfare and economic development, facilitating the redistribution of resources and achieving common prosperity. During emergencies, corporate donations play an important role in alleviating public crises. However, there are controversies among consumers and companies regarding the motivations behind donation behavior, and significant differences exist in opinions about such behavior. Scholars hold two mainstream viewpoints: the first emphasizes that corporate donations are acts of voluntary social responsibility and have altruistic and public interest characteristics; the second views corporate donations as profit-driven business activities serving both financial and social purposes. Corporate donations during emergencies have short-term effects, including enhancing reputation and obtaining economic benefits through advertising efficacy. They are also positively correlated with stock returns. However, their long-term impact on company performance is limited [1].

Given that the level and capacity of corporate donations are influenced by multiple factors, such as economic and ethical considerations, different stakeholders inevitably engage in a game during this process. Therefore, this paper uses game theory methods to divide companies into different types based on factors like brand reputation and product functionality. The analysis explores corporate donation behavior in the context of emergencies, aiming to understand the significance and purpose of such

behavior and provide recommendations to governments for formulating scientific donation strategies after emergencies occur.

2. Basic Assumptions

In this paper, corporate donations refer to the provision of goods and cash by companies for emergency situations, including disaster relief, education, culture, art, and healthcare. Corporate donation behavior is influenced by various stakeholders, including relevant companies, consumers, and the government [2]. The participants in the game consist of two companies. Based on complete information game assumptions, where all players are aware of the economic benefits associated with strategy combinations, this paper discusses the donation behavior strategies of companies within the game. In the game, companies are rational, aiming to maximize their expected utility, while consumers act rationally and socially. The demand for products remains constant, but consumer preferences may change based on corporate donation behavior.

After an emergency occurs, companies can choose between donating or not donating. Companies can be categorized into well-known companies and small and medium-sized enterprises based on brand reputation. They can also be classified as unrelated companies, substitute product companies, and complementary product companies based on the relevance of their product functionalities. For simplicity, this paper only examines the donation behavior game between two companies (A and B) with equal donation amounts. This analysis can be extended to multiple companies. The following basic assumptions are made:

- a: Company A donates, resulting in a decrease in profit.
- b: Well-known company B does not donate, but faces pressure from the public, resulting in a decrease in profit.
- c: Company A's image improves due to donations, leading to an increase in product sales and profit increment c.
- c: Due to increased sales of substitute products from company B, company A experiences a decrease in product sales and a reduction in profit.
- d: Due to increased sales of complementary products from company B, company A experiences increased product sales and an increment in profit.
- M: In addition to increased product sales, companies receive additional income resulting from donations.

Based on the given scenario, where $a, b, c,$ and $d > 0$, and the increase in product sales resulting from corporate donation behavior yields profits smaller than the donation amount, with $a > c$.

3. Game Analysis

3.1. Well-known Companies

Well-known companies refer to those that enjoy high recognition domestically, have a significant market share, and possess strong brand power. After a sudden event occurs, the donation behavior of well-known companies becomes not only a game between companies but also a game between the expectation gap of corporate donations. The expectation gap can be divided into historical expectation gap and

social expectation gap. The historical expectation gap represents the extent to which the actual donation amount falls below the historical expectation level, while the social expectation gap represents the extent to which the actual donation amount falls below the social expectation level. The expectation gap of corporate donations can lower the legitimacy of companies, leading to questioning and lack of support from stakeholders [3]. The larger the expectation gap, the more companies need to increase their social responsibility activities to mitigate the negative impact, such as increasing donations [4].

After a sudden event occurs, due to the strong cultural standards and social expectations associated with “virtue” in society, well-known companies face a strategic choice regarding donation behavior. Assuming they choose not to donate, the overall profit pattern would result in greater profit loss ($b > a$), meaning $-a > -b$. Furthermore, when companies donate and their image improves, resulting in an increase in product sales, the increment in profit is smaller than the donation amount, $0 > -a+c > -b$. Therefore, under the scrutiny of public opinion, both well-known companies A and B would choose a Nash equilibrium strategy that maximizes their own interests, represented by $S_0 = (-a+c, -a+c)$. Consequently, the game of donation behavior for well-known companies does not require categorization based on the functionality of products provided. Even if there are no other additional income sources ($M_0=0$), they will still choose to donate and engage in a game with consumers and their past donation levels. Combining the assumptions and analysis above, we can establish the payoff matrix for the game as shown in Table 1.

Table 1. Game income matrix of well-known enterprises.

		Enterprise B	
		Donate	Not Donate
Enterprise A	Donate	$(-a+c, -a+c)$	$(-a+c, -b)$
	Not Donate	$(-b, -a+c)$	$(-b, -b)$

3.2. Small and Medium-sized Enterprises (SMEs)

SMEs account for over 90% of the total number of enterprises in China. They are an important microeconomic foundation for the development of our economy and play a significant role in improving people’s livelihoods. However, due to their relatively small business scale and shorter establishment period, SMEs have lower donation expectations and less social supervision after a sudden event occurs. Therefore, in this paper, we categorize SMEs into three subcategories: unrelated enterprises, substitute product enterprises, and complementary product enterprises, based on the relevance of the products they provide, for the analysis of donation behavior games.

3.2.1. Unrelated Enterprises

Unrelated enterprises refer to two companies whose products have no functional relationship, and the companies are not influenced by factors such as policies, social status, organizational nature, new media, and region. After a sudden event occurs, if one company donates while the other does not, the donating company’s image will improve, resulting in increased product sales. However, the increment in profit is smaller than the donation amount ($a > c$), $0 > -a+c$. On the other hand, the non-donating company is not affected because its products are unrelated. If both companies choose to donate, their profits will increase to a balanced state $(-a+c, -a+c)$.

Based on the assumptions made and the analysis conducted, assuming there are no other additional income sources, the overall profit pattern remains unchanged. In this scenario, both companies would choose the strategy that maximizes their expected payoff, represented by $S_1 = (0, 0)$, and neither of them would donate. Combining the assumptions and analysis above, we can establish the adjusted payoff matrix for the game as shown in Table 2.

At this stage, in order for unrelated companies A and B to both choose the strategy space {donate, donate} after a sudden event occurs, there needs to be additional income other than the increase in product sales. Therefore, we introduce the additional income that companies receive from donations as M_1 . By reverse induction, we can determine the Nash equilibrium strategy where both companies choose to donate as $(-a+c+M_1, -a+c+M_1)$, which requires $-a+c+M_1 > 0$, $M_1 > a-c$. Thus, to obtain donation behavior from unrelated companies, besides the product profits generated from increased sales due to donations, there needs to be other additional income, and $M_1 > a-c$. Combining the assumptions and analysis above, we can establish the adjusted payoff matrix for the game as shown in Table 3.

Table 2. Returns matrix of irrelevant enterprise game.

		Enterprise B	
		Donate	Not Donate
Enterprise A	Donate	$(-a+c, -a+c)$	$(-a+c, 0)$
	Not Donate	$(0, -a+c)$	$(0, 0)$

Table 3. Adjusted - irrelevant enterprise game return matrix.

		Enterprise B	
		Donate	Not Donate
Enterprise A	Donate	$(-a+c+M_1, -a+c+M_1)$	$(-a+c+M_1, 0)$
	Not Donate	$(0, -a+c+M_1)$	$(0, 0)$

3.2.2. Substitute Product

Enterprises Substitute product enterprises refer to two companies that provide products with the same or similar functionality, which can be used interchangeably to satisfy consumers' desires. These companies compete with each other as substitutes, such as Company A and Company B both selling milk tea. As rational individuals, consumers in the market maintain a constant demand for the product but may change their preferences for the company supplying the desired product based on their donation behavior. After a sudden event occurs, if one company donates while the other does not, the donating company's image improves, resulting in increased product sales and higher profits. Conversely, the substitute company experiences a decrease in product sales and lower profits. Based on the social reality, the increment in profit is smaller than the donation amount, $0 > -c > -a+c$. If both companies choose to donate, the impact of substitute product enterprises cancels each other out, and the profits remain unchanged, reaching a balanced state $(-a, -a)$. In this scenario, assuming there are no other additional income sources, the overall profit pattern remains unchanged. Both companies would choose the Nash equilibrium strategy combination, represented by $S_2 = (0, 0)$, and neither of them would donate. Combining the assumptions and analysis above, we can establish the adjusted payoff matrix for the game as shown in Table 4.

At this stage, in order for substitute product companies A and B to both choose the strategy space {donate, donate}, companies must receive additional income from their

donation behavior, denoted as M_2 . By reverse induction, we can determine the Nash equilibrium strategy where both companies choose to donate as $(-a+M_2, -a+M_2)$, which requires $-a+M_2 > -c$ and $-a+c+M_2 > 0$, $M_2 > a-c$. Thus, to obtain donation behavior from substitute product companies, there needs to be additional income, $M_2 > a-c$. We can establish the adjusted payoff matrix for the game as shown in Table 5 based on the assumptions and analysis above.

Table 4. Game return matrix of substitute firms.

		Enterprise B	
		Donate	Not Donate
Enterprise A	Donate	$(-a, -a)$	$(-a+c, -c)$
	Not Donate	$(-c, -a+c)$	$(0, 0)$

Table 5 Adjusted - substitute matrix game earnings.

		Enterprise B	
		Donate	Not Donate
Enterprise A	Donate	$(-a+M_2, -a+M_2)$	$(-a+c+M_2, -c)$
	Not Donate	$(-c, -a+c+M_2)$	$(0, 0)$

3.2.3. Complementary Product

Enterprises Complementary product enterprises refer to two companies that provide products that complement each other, where the consumption of one product must be paired with the consumption of the other, creating a certain consumer interdependence. For example, Company A sells mobile phones and Company B sells phone cases. An increase in the sales of one product will drive up the sales of the other.

After a sudden event occurs, if one company donates while the other does not, the donating company experiences an increase in product sales due to the donation, and the non-donating complementary product company still sees an increase in product sales and profits. Thus, we have $d > 0 > -a+c$. If both companies choose to donate, not only will their profits increase due to improved company image, but they will also benefit from the impact of complementary products, resulting in further profit increases. This eventually leads to a balanced state $(-a+c+d, -a+c+d)$. Assuming there are no other additional income sources, after considering the game, the choice of donation behavior will not change, and the Nash equilibrium strategy that maximizes their interests is $(0, 0)$. Combining the assumptions and analysis above, we can establish the adjusted payoff matrix for the game as shown in Table 6.

Table 6. Game return matrix of complementary products firms.

		Enterprise B	
		Donate	Not Donate
Enterprise A	Donate	$(-a+c+d, -a+c+d)$	$(-a+c, d)$
	Not Donate	$(d, -a+c)$	$(0, 0)$

At this stage, in order for complementary product companies A and B to both choose the donation behavior as the Nash equilibrium strategy, they need to obtain profits from donations along with the increase in product sales profits from complementary products and additional income that exceeds the donation amount. We require $-a+c+d+M_3 > d > 0$. Therefore, to encourage donation behavior from complementary product enterprises, besides the product sales profits generated from donations, additional income $M_3 > a-d-c$ is needed. We can establish the adjusted payoff matrix for the game as shown in Table 7 based on the assumptions and analysis above.

Table 7. Adjusted - complements matrix game earnings.

		Enterprise B	
		Donate	Not Donate
Enterprise A	Donate	$(-a+c+d+M_3, -a+c+d+M_3)$	$(-a+c+M_3, d)$
	Not Donate	$(d, -a+c+M_3)$	$(0, 0)$

4. Conclusions

This study on game theory finds that after a sudden event, well-known companies, due to public opinion pressure and fear of reputational damage or punishment, would still engage in donation behavior to maximize their own interests, even if there is no additional income from the donation. The donation amount also needs to be considered. For small and medium-sized enterprises (SMEs), after a sudden event, their expectation for company donations is relatively low. After game analysis in the previous sections, the probability of adopting a donation strategy is low, and additional income needs to be introduced. When the other additional income, M_1 , exceeds $a-c$, irrelevant companies would engage in donation behavior after game analysis. When M_2 exceeds $a-c$, substitute companies would consider donation. And when M_3 exceeds $a-d-c$, complementary product companies would choose donation behavior after game analysis.

To sum up, after a sudden event, although well-known companies have a higher motivation for fulfilling social responsibilities, the government should still optimize tax policies to provide tax incentives and reduce donation costs for companies. Praising well-known companies for their donation behavior, releasing lists of corporate donations, or conducting news promotions can set a good social example for SMEs and stimulate donation behavior through the same-group effect or herd effect, thus fostering a positive corporate atmosphere in society. As SMEs do not face the same public pressure for donation, it is worth further considering how to cultivate their sense of social responsibility. Given their relatively weak capabilities, apart from creating a united social atmosphere, SMEs can also be encouraged to participate in donation actions through policies such as bidding and loans, promoting community charity involvement by businesses, increasing the probability of corporate donations, and achieving sustainable development.

Conflicts of Interest

The author declares that there is no conflict of interest regarding the publication of this article.

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