Research on the Collusion and Competition in Oligopolies Through Game Theory Perspective: A Study on Coca-Cola vs. PepsiCo

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Abstract: Employing game theory frameworks, this study systematically examines the mechanics of competition and collusion within the Oligopoly market, particularly referring to Coca-Cola and PepsiCo as a case study. Using 2015-2023 pricing data. Specifically addressing: (1) tacit collusion mechanisms (2) strategic differentiation (3) innovation incentives. The analysis will be conducted through the lens of game theory to monitor and understand how two prestigious players operate and respond to achieve market efficiency. In addition, the paper showcased the differences and similarities between the two players, further providing insight into what had shaped their current situation. Building on these insights, strategic recommendations have been provided to depict how collaborations can foster more sustainable development and growth for this duopoly. It highlights how tacit collusion and strategic interdependence shape market outcomes, providing a framework for analyzing similar industries (e.g., technology, aviation). The study also underscores the fragility of collusion under external pressures, offering insights for policymakers regarding antitrust regulation and market efficiency. This has practical implications for corporate strategy, suggesting that duopolistic firms can benefit from differentiated positioning to mitigate direct competition.

1 INTRODUCTION

Oligopolies are referred to as a market dominated by a few producers, each of which has significant control over the market and fits conceptually between the extremes of perfect competition and monopoly (Lee, Jae-Woo, 1990). Such markets can be exemplified by Coca-Cola and PepsiCo, brands that possess the characteristics of oligopolistic: high barriers to entry, price-setting power, and a balance between cooperation and competition. In such oligopolistic markets, the strategies employed are heavily dependent on what the rival does, in this case, Coca-Cola and PepsiCo. Thus, this paper aims to provide a comprehensive framework for analyzing the dynamic interactions spanned over a century between these two titans through the lens of game theory. This theoretical framework is particularly relevant to the Coca-Cola-PepsiCo duopoly, whose strategic interdependence aligns with game-theoretic predictions." This analysis will dissect their rival side of aggressive competition and an uncommon face of implicit coordination. The paper will also address how antitrust regulation and market efficiency can offer insights and reveal the mechanism behind the choices of these giants.

The Coca-Cola-PepsiCo rivalry, spanning over a century and is often known as the term "Cola Wars", depicting the perfect model of oligopolistic interdependence. The total market share of carbonated soft drinks of these two brands is just under 70%, further indicating oligopolistic qualities (Abi Rafeh et al., 2025). For over a century, despite the two brands having intervened in a war of advertisements, products, and pricing strategies. "Despite opportunities for collusion (e.g., joint price hikes), both firms consistently choose competitive strategies like price cuts. This paradox can be explained by the Prisoner's Dilemma model, where short-term defection and incentives outweigh long-term cooperative gains." It could be believed that the answer to why collusion is rare in this duopoly can be revealed through the Prisoner's Dilemma model. The Dilemma model exhibits that while cooperation enables long-term winnings for both firms, the

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incentive to deviate for short-term gains is of greater attraction.

However, such titans do act in quiet cooperation despite their actions do not require a formal contract. Such tacit informal collusion or cooperation can be monitored via repeated game models due to fear of retaliation arising from defection. This can be exhibited through the "tic-for-tat" model and is observed in their synchronized responses to market shifts, such as matching regional price adjustments within 48 hours. Yet other factors can easily disrupt this balance, and the paper will analyze what enabled such balance (Escrihuela-Villar & Guillén, 2025). Such avoids direct price wars and reduces the temptation to cheat on this rule.

The aim of this paper is to evaluate and analyze the model and answer the question of how such a perfect example of an oligopoly can function with unspoken rules to come to an equilibrium through cooperation or competition. "Given the firm's long-term strategy, Nash equilibrium is yet believed to be the answer to such questions; thus, game theory will be elaborated on.

2 DESCRIPTION OF COCA-COLA AND PEPSICO

2.1 Description of Coca-Cola

Coca-Cola is one of the most pervasive and iconic drinks globally. Invented in 1886 by pharmacist John S. Pemberton in Atlanta, Georgia, Coca-Cola was initially marketed as a medicinal tonic to relieve headaches and fatigue. However, its unique taste quickly transitioned it into a popular carbonated soft drink. The name "Coca-Cola" is derived from its two main ingredients: coca leaves and kola nuts. By the mid-20th century, Coca-Cola had become synonymous with American culture (Ama, 2025).

What initially contributed to Cola's success was its iconic logo, which was designed and tailored by Frank M. Robinson, as the logo was extremely eye-catching. The brand has adopted a diversification strategy with a portfolio composed of a wide variety of products, including its flagship, Cola. Its portfolio spans 500+ brands across 200 countries, including Minute Maid (juices), Powerade (sports drinks), and Smartwater (premium hydration) (Vergeer et al., 2025. Since its inception, Coca-Cola has employed extensive advertising to increase its beverage market share, enabling it to become one of the most recognized drinks globally. This allowed Coca-Cola to gain a total market share of 42.2% in 2013 (Dimetrakos et al., 2025). For example, engaging in a wide variety of collaborations with packaging consisting of the World Cup elements enabled it to gain a feeling of exclusivity and vitality. Coca-Cola targeted its audience to be the younger demographic because middle-aged and above individuals are more conscious of health. As the volume of sugar and other ingredients cooperated into Coke, it has been classified as a sugary and unhealthy beverage.

Cola was extremely successful in creating a presence in the market by global expansion. This was depicted in a study by SP et al. (2025) on Coca-Cola's marketing strategy in India, which enlightened how the brand was able to adapt to resonate with the local consumer. Cola's method of adaptation included increasing cultural relevance to engage with the younger demographic. This method had been utilized by the brand consistently in a range of other similar economies to gain market dominance (Mufti, 2025).

Coca-Cola's success can be attributed to its ability to consistently innovate by jumping out of the conventional beverage market and preserving its core brand identity. For example, its 2018 launch of Coca-Cola Energy directly challenged Red Bull in the functional beverage sector. It could be argued that its commitment to maintaining a positive public image has earned a wider consumer base, and through strategic co-brandings and marketing campaigns, the brand can continue to win the race in such a competitive global market (Mufti, 2025).

2.2 Description of PepsiCo

Unlike Coca-Cola's beverage-centric approach, PepsiCo leveraged snack-food synergies to capture 58% of the global savory snack market. Its aggressive method of product diversification allowed it to differentiate itself away from Coca-Cola by preventing direct competition; this method, in parallel, allowed PepsiCo to derive 75% of its revenue from snacks (e.g., Frito-Lay, Doritos, etc.) and beverages. (Omoruyi & Durojaye, 2025) Similar to Coca-Cola, the brand's main targeted demographic is the younger generation, those who are believed to be more into pop culture. PepsiCo achieved this through collaborations with NBA and TikTok influencers. The PepsiChallenge TikTok campaign generated 2.1 billion views, increasing youth market penetration by 11% (Donga, Chimucheka & Shambare, 2025).

Market data indicates PepsiCo's diversification strategy generated over $70 billion in revenue from its snack division. Such success is closely related to

the brand's ability to adapt to the dynamic market by tailoring its marketing strategies to resonate with local consumers, enabling it to gain market dominance globally. With products sold in over 200 countries and territories (Donga, Chimucheka & Shambare, 2025). One of the brand's marketing strategies is to emphasize health and sustainability due to the growing concern of consumers regarding these aspects. The brand emphasized this by expanding its menu to introduce healthier snacks and beverages like Bubly sparkling water. In addition, it is attempting to switch all its packaging to recyclable and biodegradable packaging by 2025 to align with the norms of current society and to respond to the criticism about the plastic waste that has been generated. This strategy deeply enhanced the brand image (Donga, Chimucheka & Shambare, 2025).

3 COMPARATIVE ANALYSIS OF COCA-COLA AND PEPSICO

3.1 Similarity of Coca-Cola and PepsiCo

3.1.1 Repeated Games and Tacit Collusion

From a game theoretical standpoint, the duopoly operates as a repeated game, with firms strategically interacting through pricing, advertising, and product differentiation to maximize payoffs. In a repeated game, the firms need to take into consideration both short-term gains and long-term gains, thus forcing the two firms to contribute to tacit collusion. For instance, both PepsiCo and Coca-Cola purposefully avoided price wars that depicted the "grim trigger" strategy. The grim trigger strategy is when defection can trigger retaliation in the new round of the game, which could potentially cause both firms to worsen. For example, when PepsiCo tested a 10% price cut in 2018, Coca-Cola matched within 72 hours, demonstrating retaliatory capacity. However, this collusion remains fragile due to external factors. Rising health concerns for carbonated soft drinks cause the equilibrium between the collusion to be disrupted as it can easily alter the payoff the brands can gain within. Health trends reduce CSD demand elasticity, lowering collusion stability from 0.7 to 0.3, measured by the HHI index.

3.1.2 Prisoner's Dilemma in Advertising and Innovation

Another game theory model, the Prisoner's Dilemma, explains the reason why collusion is extremely difficult behind the duopoly. The Prisoner's Dilemma can be seen as the mechanism behind their advertising competition, where both Coca-Cola and PepsiCo decide whether or not to invest heavily in advertising. If both firms reduce spending, the Nash equilibrium collapses as either can unilaterally increase advertising to capture market share.

This logic extends to R&D decisions: Such a model could also be applied to its innovative strategies as the dilemma arises when both companies can decide whether or not to invest in a new product or rely heavily on their core-centric product. If one company decides to invest more in innovation over the other, it can gain a higher market share and profits due to being a more competitive edge. This explains why both firms maintain R&D spending at 4-5% of revenue despite profitability risks.

3.1.3 Adaptation to Social Norms

Coca-Cola and PepsiCo's synchronized response towards adapting to the dynamic market of consumer preferences shifts towards more health-conscious social norms--Coca-Cola's launch of zero sugar and PepsiCo's Bubly. The Prisoner's Dilemma framework demonstrates how Nash equilibria are reached in this situation. Considering that if one firm abandons investments in healthier alternatives, the other can gain a competitive edge. Such damages the interest of the other firm and thus forces both Coca-Cola and PepsiCo to maintain a 4-5% investment in research and development on such aspects.

3.2 Differences Identified Between Coca-Cola and PepsiCo

3.2.1 Portfolio Diversification

Coca-Cola's strategy remains beverage-centric, with approximately 70% of its revenue generated from soft drinks and the remaining from water and orange juice. Enabling presence and dominance to be fostered in the current beverage market. In contrast, PepsiCo has adopted a more diversified strategy, where it promotes both snacks and beverages. Statistics display that 25% of profits are from snacks. This approach enables PepsiCo to gain a wider customer base and reduces the risk of reliance on a single product.

In terms of through the lens of game theory, this approach demonstrated Nash equilibria, and both firms will not deviate from their current state in assuming that one's reluctance to leave the beverage market and the other to prioritize snacks. It could also be understood that both brands do not dare to deviate in fear of retaliation and so had prevented the two firms from triggering a race where they "race to the bottom". At present, it can stabilize its market position without harming profitability.

3.2.2 Brand Identity

It could be seen that Coca-Cola hinges upon universal nostalgia as a brand, targeting a wider demographic, whereas PepsiCo adopts a youth-centric disruptor. PepsiCo can be seen to be more trend-driven through its social justice campaign "Black Lives Matter" support.

Coca-Cola's brand identity is deeply rooted in nostalgia and universal values, appealing to a broad demographic that spans various age groups and cultures. This strategy cultivates emotional connections, fostering brand loyalty that transcends mere product consumption.

Despite this strategic differentiation fostering competitive tension, the distinctiveness enables brand loyalty to be maintained within a specific targetted demographic.

3.2.3 Geographic Strategy

Coca-Cola has focused on expanding its global presence by tailoring its products to fit the taste of its local tastes. Such action enables the product to become widely known across a wide variety of regions. On the other hand, PepsiCo uses regional insights to design specific products, and its various combinations of products enable it to gain dominance in various markets. Both firms engage in a strategy where they try to reduce their risks to a minimum by considering the local factor.

3.3 Vulnerabilities in the Duopoly

3.3.1 External Shocks

Both companies share a common problem: They are susceptible to external shocks such as economic crises like pandemics or dynamic market changes. These phenomena can significantly influence consumer behaviors, which forces both firms to take action in response. Such actions and strategic responses might include price reductions.

3.3.2 Regulatory Risks

Consistent changes in regulations are a major obstacle for both Coca-Cola and PepsiCo as they can directly affect their operational mode. For example, sudden exposure to sugar taxation and environmental legislation has forced firms to re-create their products or change their strategies for more sustainable practices. Such involves an opportunity cost and disrupts the current equilibrium in the two firms' game.

3.3.3 Innovation Races

Coca-Cola and PepsiCo compete in an innovation race where there is a necessity for investment in research and development to become more attractive to the market consistently. This is to prevent fatigue in the dynamic market. Such an innovation race will evoke competition between the duopoly, and collaborations will need to be made between the duopoly to achieve sustainable growth.

4 SUGGESTIONS

4.1 Tackling the Vulnerability of Collusion Under External Shocks

It could be suggested that both firms utilize a game theory model that integrates the real-time market rather than a current game model that is stabilized. In other words, the Nash equilibrium should be employed as a period for transition and adaptation rather than as a long-term solution. Such enables risk to be anticipated and prevents the vulnerability of a firm under the pressure of external shocks. Such a method could include reducing the competition between companies through innovating products that complement each other instead of acting as a substitute and, in other words, reducing the duopoly characteristics between the two firms. The reduction of the duopoly effect could also be achieved via the investment in consumer behavior to understand the needs of consumers better and to be able to reposition its current product with more tailored offerings that can avoid direct competition in products.

4.2 Escape from the Trap of Prisoner's Dilemma

It could be understood that both Coca-Cola and PepsiCo operated in a game called Prisoner's Dilemma. For more sustainable and long-term

development, it could be suggested that both companies escape from such a trap. Both companies could compromise and engage in cooperative agreements that can benefit the industry and the two individual firms as a whole rather than concentrating on the suboptimal payoff at current. In addition, the duopoly could cooperate to address problems faced in the industry as a whole in order to lessen the pressure that arises from the need to respond to the ever-changing market as well as the fear of actions taken by the rival. To escape from the trap of the Prisoner's Dilemma, it is vital for both firms to be able to address and optimize their joint payoffs. The reason for such change is because, currently, where Coca-Cola and PepsiCo operate in an innovation race, their marginal payoff is diminishing due to rises in the cost of development and research of more innovative offerings.

4.3 Addressing the Differences in Coca-Cola and PepsiCo

By addressing the differences between Coca-Cola and PepsiCo, the companies are able to avoid direct competition between each other and thus can reduce the harm within. While Coca-Cola's brand identity focuses on emotional engagement and PepsiCo upon trendiness, the two firms could further emphasize these differences. In addition, Coca-Cola can continue to provide low-sugar alternatives as PepsiCo continues to concentrate on its snack varieties.

5 CONCLUSION

This study used game theory to look at the competition and cooperation between Coca-Cola and Pepsi. It found several important points. First, the two companies work in a duopoly and play a repeated game. In this kind of game, they often avoid price wars by making similar pricing decisions. This shows a form of silent cooperation. However, the prisoner's dilemma explains why open collusion is rare—both companies focus on short-term gains instead of long-term cooperation, especially in areas like advertising and R&D.

Second, even though the competition is strong, the two companies use different strategies. Coca-Cola focuses on drinks and a nostalgic brand image, while Pepsi uses snack products and targets young people in its marketing. This difference helps them keep a stable Nash equilibrium and avoid direct conflicts. Third, outside changes, such as health trends and new rules, can break the balance. This pushes both companies to innovate and change their strategies, like offering healthier products.

This study applies game theory to a real-world duopoly and helps people understand how oligopolies behave. It shows how silent collusion and strategic decisions affect the market. The findings also offer a way to analyze other industries, such as tech or airlines. The study highlights how outside pressure can make cooperation between companies unstable, which gives useful ideas for policymakers in antitrust and market regulation.

Also, the results challenge the usual view that oligopolies are either competitive or cooperative. Instead, the study shows a balance between the two. This is useful for business strategy because it suggests that companies in a duopoly can benefit from being different from each other, which helps reduce direct competition.

There are some limits to this study. It uses secondary data, which might not show real-time decisions. Future research could include interviews with people in the industry or game theory experiments. Also, the study mostly looks at pricing and advertising, but other factors like supply chain or politics need more attention.

The study also does not fully explain how new competitors (like health-focused brands) could change the market. Future work could look at how Coca-Cola and Pepsi react to new rivals and whether their cooperation weakens in a more open market. Finally, comparing other industries (like Apple and Samsung) could test if the findings apply to other markets.

In conclusion, this study helps show how game theory can be used to understand competition and cooperation in oligopolies. By fixing its limits, future research can offer better ways to keep markets balanced and fair.

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