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The Relation between Game Theory and Mergers and Acquisitions

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ABSTRACT

This paper analyses how game theory can be used to understand mergers and acquisitions (M&A). It focuses on how the strategic interactions between companies influence the outcomes of these deals. Game theory, which studies rational decision-making and strategic behaviour, provides a useful tool for analysing the complex negotiations and competition involved in M&A. This paper explores key concepts like Nash equilibrium and cooperative and non-cooperative games and how they apply to M&A. It uses case studies, such as the Kraft-Heinz merger, to show how game theory can predict negotiation outcomes, improve bidding strategies, and make M&A processes more efficient. The paper also discusses recent developments in algorithmic game theory and how they can be used for automated decision-making in corporate finance. By combining theory and practice, this research highlights the importance of game theory in understanding and improving the strategic manoeuvres involved in M&A.

Keywords: *Mergers and acquisitions, game theory, prospect theory, Nash equilibrium*

I. INTRODUCTION

Game theory extends beyond a mere mathematical model, finding applications in numerous real-world scenarios. While the prisoner's dilemma is the most well-known example, it offers a simplified perspective on how individual actions impact collective outcomes. A pertinent application of game theory is in the valuation of companies during mergers and acquisitions (M&A). Various methods, such as discounting cash flows, using comparable company analysis, and options valuation, yield different results for the same company. Game theory helps the involved parties the acquirer and the target company devise optimal negotiation strategies to achieve the best price, factoring in human behaviour and actions.

This paper will utilize the practical example of the 2015 merger between Kraft and Heinz to illustrate the application of game theory in the decision-making process to reach a final resolution. The primary objective of mergers and acquisitions (M&A) is for both companies to achieve the best possible outcome, enhancing their positions compared to when they were competitors.

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Game theory has become increasingly relevant to mergers and acquisitions. M&A transactions are complex negotiations where companies try to get the best possible deal. Game theory can help us understand these interactions and predict how companies will behave. It provides a framework for analysing the strategic interplay between acquiring and target firms, offering insights into the underlying dynamics that drive M&A outcomes.

By studying concepts like Nash equilibrium, signaling, and the prisoner's dilemma, we can analyse how companies strategize during M&A negotiations. Nash equilibrium, a fundamental concept in game theory, predicts the likely outcomes of negotiations based on the strategic interactions between players. Signaling refers to the action's firms take to convey information about their intentions or capabilities, which can influence the bargaining power of both parties. The prisoner's dilemma illustrates the tension between cooperation and competition, often relevant in M&A when firms must decide whether to engage in hostile takeovers or negotiate collaboratively.

II. GAME THEORY

Game theory is a branch of mathematics that analyzes strategic decision making in situations where individuals or organizations must consider the actions of others. It provides a powerful framework for understanding the complex interplay between strategies and outcomes in a wide range of contexts, from economics and politics to biology and computer science. Game theory is the formal study of conflict and cooperation among various agents known as players, such as individuals, animals, computers, groups, and businesses.[2] Essentially, game theory offers valuable mathematical models and tools for understanding potential strategies that agents might use when competing or collaborating in games. It provides a mathematical framework for the formulation, structuring, analysis, and understanding of these scenarios. Game theory is applicable to a wide range of games from recreational to political, business, and even international disputes. Currently, this branch of applied mathematics is employed across diverse fields including political science, international relations, economics, social sciences, biology, computer science, and philosophy. Game theory is primarily divided into non-cooperative and cooperative games. Noncooperative games assume that each participant acts independently without collaboration, choosing strategies to maximize personal benefits. In contrast, cooperative game theory examines strategies when players collaborate, including coalition games in which players unite to enhance their collective performance in a competitive environment, achieving goals otherwise unattainable alone. Game theory can both

[2] Hayes, A. (no date) *Game theory: A comprehensive guide*, *Investopedia*. Available at: https://www.investopedia.com/terms/g/gametheory.asp

predict actual behavior and provide advice on optimal behavior, with its applications in AI and computer science proving its usefulness.[3]

III. Elements of the game

There are a series of essential requirements for the game to exist. Conflict is the basis of any game, and a series of rules on how to act accordingly must also be known to those who are playing. The main goal of playing is winning - or obtaining the maximum reward or the lowest loss - maximizing their utility. Overall, players must take decisions (strategies) that best suits them to win, having to follow certain guidelines, and having other players that will affect their return outcome. Game theory rigorously analyses these situations, their possible outcomes and the strategies taken by the players.

IV. Mergers and acquisitions

Corporate growth, whether by increasing size or diversifying, or for other purposes, is facilitated by M & A (mergers and acquisitions) which clearly remains one of the most significant strategies used by the companies. They include different financial arrangements, such as consolidation, merger, acquisition, tender offer and management buyout, in which companies or assets are integrated. The M&A process has the power to revolutionise industries, alter the competitive terrain and create enormous wealth for the shareholders. Nevertheless, it comes with some high risks and high challenges. Successful mergers and acquisitions can transform a company, but misguided acquisitions can waste billions of shareholders' money.[4]

A. Mergers vs. Acquisitions

Although both of the words are used together merger and acquisition are two completely different processes and have their own differentiating uses:

1. Mergers

A merger occurs when two or more companies agree to equally merge their businesses and form a new company. This is mostly a consensus where both parties see the benefit in sharing their assets, business plans, and operational frameworks. The emergence of mergers is prompted by the urge of realising synergies; although in this instance no economic values are created mostly when two companies decide to decrease costs without enhancing their market

[3] Wooldridge, M., 2012. Does Game Theory Work. *IEEE Intelligent Systems*, 27, pp. 76-80. https://doi.org/10.1109/MIS.2012.108.

[4] Edmans, A., £10m, G., & 20m, W., 2019. Mergers and acquisitions. *European Competition*. https://doi.org/10.4324/9781003022039-5.

presence or new technologies. Mergers can be of various forms like:

Horizontal Mergers: Such mergers occur within a certain industry division, that is between rival companies, and they are likely to increase the market concentration or eliminate competition.

Vertical Mergers: These are between firms operating at successive stages of the same industry, like a manufacturer merging with a supplier.

Conglomerate Mergers: These involve companies in unrelated businesses and are often pursued for diversification or risk management.

2. Acquisitions

An acquisition is described as a situation where a company buys another. The acquired company as the one being acquired, in many cases ceases to exist as an independent entity. The buying firm typically inherits the purchased firm and its assets, its activities and in many cases, its image. It is worth mentioning that, an acquisition can either be friendly, whereby the target company wishes to be purchased or hostile, where the target company is opposed to the acquisition. Acquisitions can be classified into:

Asset Acquisitions: Also known as asset purchases, occurs where a company purchases distinct assets of another's company.

Share Acquisitions: Which involves the purchase of the target company's stock in order to take control over it.

B. Motivations for M&A

Mergers and acquisitions are high risk business activities with between 50-80% of them being financially unsuccessful in the long term [5]

Still there are many various reasons companies resort to merging or acquiring other companies.

Growth: Mergers and acquisitions are mostly used to achieve expansion in many cases. Rather than having to list a company's advancement within many operations or even the use of other company's resources in the natural growth of new markets, with an acquisition or a merger comes a wealth in terms of market space and the client base.

Synergies: Synergies are generally regarded as one of the primary reasons for undertaking

[5] Cartwright, S., & Cooper, C., 1990. The Impact of Mergers and Acquisitions on People at Work: Existing Research and Issues. *British Journal of Management*, 1, pp. 65-76. https://doi.org/10.1111/J.1467-8551.1990.TB00163.X.

M&A activities. Operational synergies can be referred to as when two firms combine or merge and reduce cost while achieving their business operation. Also known as financial synergies, this is when the merged companies cut down their capital borrowing costs. Revenue enhancement, where the merger knows no bounds and expands the markets: the company can upsell to existing customers, or be liked by customers without cross selling access.

In 2021, once the worst of the pandemic had passed, the M&A market climbed sharply to a staggering 65,000 deals in the world, 9% above pre-pandemic levels and a record-breaking amount (PWC, 2022). However, in 2022, after a strong first quarter, throughout the year, M&A activity decreased, leading to a 32% decline in deal value in 2022 from its record high in 2021. This could be attributed to the increase in interest rates from the US Federal Reserve Bank in June 2022 and its effects on a global scale as well economic and political uncertainty. Deals that were over $10 billion paused, and smaller deals decreased, however, although value decreased by 36%, volume only decreased by 12%.

C. Trends in mergers & acquisitions in 2024

As there are uncertainties in the nature of the market, it becomes hard to develop the worth of the company.

In Balancing these benefits of the structural models and trying to avoid the sudden sharp valuation variations, there is a likelihood that more than three earn-out decisions follow;

The seller is entitled to an additional payment of an ‘earn out’ which is tied to the business’ performance after acquisition. This is when the buyer pays the price but only a portion of it is paid at an agreed time period post-acquisition depending on certain factors that include how well the acquired the buyers agree to remit part of the total amount upon acquisition. However, some applicable goals must be achieved for these conditions to be met (Morrison Foerster, 2023). This Favors both the parties for the buyer, it minimizes the risks of overpaying. For the seller, it helps them to motivate themselves to perform well and also close the gap between the expectations they have and the amount the buyer is willing to pay for them. However as much as this is insightful, as risk is pointed out there are also concerns with this structure that may result in effects in the future if one of the target outcomes is not met.

V. GAME THEORY APPLIED TO M&A

M&A is one of the strategic options the management of a corporation can employ in order to go out and reach the strategic growth objectives of a corporation.

M&A refers to merger and acquisition, whereby constructed several theories of the game in its empirical studies for M&As, firms are the smallest unit, hence the transaction will only take place when the forecasted total figure of income outweighs the total amount that needs to be paid in terms of costs. This implies that M&A transactions advance the self-interests of the corporations and in this case by and large the market that determines the industry competition, anticipated income, future expenses, etc. The idea behind deal structures is that such M&A attempts can be viewed as noncooperative games because each player's payoff is sought to be independent of the other party's payoff and therefore each party seeks to optimize her much. [6]Nonetheless, there is usually a variation in approach towards negotiation in friendly and hostile takeovers. When it comes to friendly takeovers, there is the possibility that an acquiring agent may seek to negotiate with the target shareholders through the management team of the target company, while hostile takeovers are simply negotiations with shareholders bypassing the target company management.

The concept of a ***Nash equilibrium***, which originates from game theory, can be said to be beneficial in mergers and acquisitions (M&A) negotiations. This is the case in M&A negotiations, where each side is trying to derive the maximum value while taking into consideration the other side's possibilities. It is when such instances reach an ultimatum that neither side will opt to change its bargaining strategy so long as the other side also sticks to its unusual strategy.

There are several factors that affect the M&A bargaining including information asymmetry, bargaining power, and outside options. In some instances, information asymmetry affects the bargaining process, and it is also where one party has more information than the other. Bargaining power, which is also influenced by financial muscle, strategic importance, etc also contributes significantly to the spatial bargaining process. Outside options or the best alternatives to a negotiated agreement provide options that can impact a party when trying to negotiate.

The application of Nash equilibrium in M&A bargaining is done by identifying several Nash equilibria, exploration of the bargaining power, inquisition into the information asymmetry, and examining outside options. These are substantial characteristics of the bargaining process that are essential for the negotiators for their proactive development of optimal strategies and

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[6] González, M., Argüelles, C., Sentana, J., Madrid, L. and Junio (2023). *THE APPLICATION OF GAME THEORY IN MERGERS & ACQUISITIONS -THE KRAFT HEINZ CASE*. [online] Available at: https://repositorio.comillas.edu/xmlui/bitstream/handle/11531/69355/TFG%20-%20Gonzalez-Camino%20Arguelles%2C%20Mafalda.pdf?sequence=1&isAllowed=y [Accessed 1 Sep. 2024].

identification of the counter parties' behaviour.[7]

For instance, in a merger negotiation between Company A and Company B, the relative bargaining power of the parties, the information asymmetry between them, and their outside options can influence the final outcome. If Company A has a stronger financial position and is able to extract a significant premium from Company B, the final agreement may be closer to Company A's preferred terms. However, if Company B has a strong outside option, such as a competing bidder, it may be able to negotiate a more favourable deal.

VI. Challenges and Limitations of Game Theory in M&A

Game theory offers a strong framework to analyse strategic interactions in mergers and acquisitions (M&A), but it faces challenges and has limits. One big problem is the idea that people always act, which doesn't always happen in real M&A deals. Emotions limited thinking skills, or uneven information can cause people to make choices that don't fit the rational model.

When one side knows more than the other, it can restrict how well game theory works. Secret info can lead to sneaky behaviour and tricks making it hard to guess what will happen. Also many games, including those in M&A, can have several Nash equilibria, which makes it tough to predict the end result.

M&A deals are complex. They involve many stakeholders legal and regulatory issues, and cultural differences. This complexity makes it hard to apply game theory. Negotiations in these deals are dynamic. They often include multiple rounds of bargaining and counteroffers. This back-and-forth makes it tough to use static game-theoretic models.

Behavioral biases shape how people act during M&A deals, which limits how well game theory works. These biases include being too sure of yourself hating losses more than you like gains, and letting the first piece of info you hear sway you too much. Also, there's often not enough data to make game theory models work right or check if they're on target. Even with these issues, game theory helps us get M&A deals. If you know where it falls short and use it, you can learn a lot. This knowledge lets you make smarter choices in this tricky field.

Kraft – Heinz Merger

The merger between Kraft Foods and Heinz in 2015 provides a compelling example of how game theory can be applied to analyze strategic decision-making in mergers and acquisitions

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[7] *Nash Equilibrium* (no date) *Corporate Finance Institute*. Available at: https://corporatefinanceinstitute.com/resources/economics/nash-equilibrium-game-theory/ (Accessed: September 1, 2024).

(M&A). The deal, which created the largest food company in North America, was the result of a complex negotiation process influenced by various strategic factors.

Negotiation processes were affected through information asymmetries. It would be safe to assume that each company had proprietary sets of information pertaining to their business that affected the bargaining relative position.[8] For instance, distribution models would be more acceptable for Kraft while Heinz would trade more with its foreign business owners.

Bargaining power was another reason why the merger took place. Friction within the agreed merger was as a result of the relative bargaining power of Kraft and Heinz's financial status, the market share and their ability to partner with other players. A firm with better bargaining power is in a better position to dictate the terms that are agreeable to them during the table.

Outside options also played a role in the merger. Both companies probably had options to make other M&A moves or remain separate and take the business forward independently. Such outside options are likely to affect their willingness to negotiate and the bargaining range available.

The ultimate contract signed by Kraft and Heinz with respect to each other goes down on record as a Nash equilibrium strategy as neither felt the need to change either of its strategies, whatever it was, while the other strategy provided no incentive to change. Most likely, both parties engaged in some signalling: i.e., provided information concerning the intentions and the disposition of each party to the negotiations.

VII. CONCLUSION

This research paper examines the complex link between game theory and mergers and acquisitions (M&A). It provides a thorough review of how strategic decision-making frameworks have an impact on corporate consolidation activities. It looks at key game-theoretic ideas like Nash equilibrium, signalling, and the prisoner's dilemma to see how these theories can forecast and explain company behaviour during M&A talks. The study explores the competitive dynamics between firms that buy and those that sell pointing out the strategic moves used to boost value lower risks and handle uneven information. Through a mix of theoretical models and case studies, the research shows that game theory not only gives a strong set of tools to understand M&A processes but also helps to create more effective deal structures and negotiation strategies.

This study's results point out that bringing game-theory ideas into mergers and acquisitions

[8] Team, Trefis. "Analysis of the Kraft-Heinz Merger." *Forbes*, 30 Mar. 2015, www.forbes.com/sites/greatspeculations/2015/03/30/analysis-of-the-kraft-heinz-merger/.

can boost how well people make decisions, which leads to better results for everyone involved. When decision-makers grasp how buying and target companies interact, they can make smarter choices, see potential problems coming, and come up with good ways to negotiate. What's more, game theory can help spot possible traps and create plans to lower the risks that come with mergers and acquisitions.

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