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ESCAPING THE EQUILIBRIUM: STRATEGIC INNOVATION AS A DELIBERATE DISEQUILIBRIUM MECHANISM IN OLIGOPOLISTIC COMPETITION

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Abstract

This study aims to analyze the application of game theory in understanding strategic behavior among firms in an oligopolistic market. Using a qualitative approach with a literature review method, this research examines the concepts of Nash equilibrium, dominant strategy, and price discrimination as foundations for determining optimal strategies among market players. The findings show that game theory, particularly the Cournot, Bertrand, and Stackelberg models, effectively explains competitive interactions in markets with limited participants. Moreover, regulations such as Law No. 5 of 1999 play an important role in maintaining fair competition. Game theory proves to be an effective analytical tool for formulating corporate strategies and economic policies in oligopolistic markets.

Keywords: *Game Theory Oligopoly Market; Nash Equilibrium; Dominant Strategy; Price Discrimination*

INTRODUCTION

An oligopoly market is a unique and dominant market form in many global and national industrial sectors, including in Indonesia. This market is characterized by a small number of dominant firms controlling a large market share, making strategic interactions between market players crucial and determining the outcome of competition. In an oligopoly market, every strategic move taken by one firm directly influences the decisions and behavior of other firms. This creates a complex state of strategic interdependence, where firms cannot act independently without considering the potential reactions of their competitors. Therefore, a thorough understanding of the dynamics and strategies implemented in an oligopoly market is crucial (Jean Tirole, 1988).

Game theory is a branch of mathematics and economics that focuses on analyzing situations where the decisions of actors depend on the decisions of other actors. Game theory provides formal models and analytical strategies used to determine optimal strategies in strategic interactions. Because oligopolistic markets rely heavily on these strategic interactions, game theory is an important tool for understanding and designing strategic economic behavior in the context of oligopolistic competition (Von Neumann & Morgenstern, 1944).

The history of game theory dates back to the 18th century with early ideas by James Waldegrave in two-player games. A major revolution occurred in the 20th century with seminal publications by von Neumann and Morgenstern, who combined mathematics with

economics to formally define strategic interactions. The concept of Nash equilibrium, proposed by John Nash in 1950, introduced the equilibrium point where each player chooses its best strategy considering the strategies of the other players, providing a crucial guide to understanding stable and rational market outcomes (Nash, 1950).

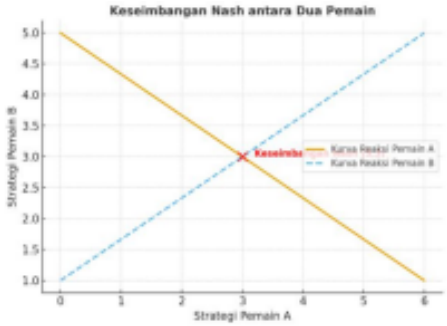

Figure 1. Nash Equilibrium Graph between Two Players

The Nash Equilibrium graph between Two Players illustrates the strategic interaction between two economic actors (player A and player B) who influence each other in decision-making. Each player has a set of strategies from which to maximize their profits. However, the payoffs of each player are determined not only by their own strategies but also by the strategies chosen by the other player. In the graph, there are two main curves: player A's reaction curve and player B's reaction curve. Player A's reaction curve shows how the optimal strategy chosen by player A depends on the strategy chosen by player B. It shows all combinations of strategies in which player A achieves the best payoff, assuming player B's strategy remains constant. Player B's reaction curve shows the same thing from player B's perspective—namely, player B's optimal strategy for each possible strategy chosen by player A.

In the graph, this point is marked with coordinates (3,3). This point represents a situation where both players have chosen their own optimal strategy, taking into account the opponent's strategy. At this point, neither player can increase their advantage by unilaterally changing their strategy, as any change in strategy would actually decrease their payoff.

A Nash equilibrium is a strategically stable condition because neither party has an incentive to deviate. This means that player A's strategy is optimal if player B's strategy remains unchanged, and vice versa. In an oligopoly market, this point represents the price and output position at which each firm has adjusted to its competitors' policies. If one firm attempts to unilaterally raise or lower its price, it will lose profits because competitors' reactions will rebalance the market.

Visually, the slope and direction of the reaction curve reflect the interdependence between two market participants. If one player changes its strategy (e.g., lowering price or increasing output), the other player will respond by adjusting its strategy to maintain equilibrium profits. Intersecting reaction curves at a certain point indicates that both participants ultimately arrive at the most rational joint decision and adjust to each other.

Characteristics of an oligopoly market include a limited number of firms, high barriers to entry, interdependence among players, and products that can be either homogeneous or differentiated. High barriers to entry can include high investment costs,

exclusive distribution access, and the power of established brands. Strategic interdependence requires companies to conduct risk analysis of potential competitor reactions when making decisions about pricing, production, R&D investment, and marketing strategy (Joe S. Bain, 1956).

In game theory, there are several key models used to predict and analyze behavior in oligopoly markets. The Cournot model, for example, describes quantity competition in which each firm chooses its optimal production quantity based on the assumption that competitors' output remains constant. Equilibrium is achieved when no firm wants to change its production quantity because it has maximized its profits given competitors' output (Augustin Cournot, 1838).

Unlike Cournot, the Bertrand model focuses on price competition. In this model, firms set prices strategically to gain market share, often setting competitive prices close to marginal cost. The Bertrand model is more appropriate for homogeneous products and markets with a high level of information (Joseph Bertrand, 1883).

Furthermore, the Stackelberg model introduced the concept of market leadership, where the leader firm chooses its strategy first, and the follower firms respond optimally. This model depicts the hierarchy of strategies in a realistic oligopoly, showing the advantages of the firm holding the leading position in setting output or prices (Bertrand, 1838).

Firms' strategic behavior in oligopoly markets encompasses not only price and quantity competition but also a variety of more complex non-price strategies. These strategies include predatory pricing, price discrimination, product development, aggressive advertising, and capacity expansion. Predatory pricing involves temporarily pricing a product below production costs with the aim of eliminating competitors from the market and gaining market dominance, followed by extreme price increases after competitors are eliminated (Salmah, 2022).

Price discrimination is the practice of setting different prices for different consumers based on their price sensitivity or market segment attributes. This discrimination is classified into three levels: first-degree discrimination (perfect pricing based on individual consumer willingness to pay), second-degree discrimination (based on quantity or product characteristics), and third-degree discrimination (based on market segment or demographics). This strategy allows firms to maximize revenue by optimally capturing consumer surplus (Alamanda et al., 2024). The concept of Nash equilibrium is crucial for predicting the behavior of oligopolistic markets in the context of strategic competition. This equilibrium shows the strategy chosen by each player when each takes into account the reactions of rivals, ensuring that no player gains an advantage by unilaterally changing strategy. However, in practice, oligopolistic markets can exhibit various equilibria or even instability, which adds to the challenges in designing and predicting strategies (Mubarok, 2015).

Various empirical studies in Indonesia and internationally support the application of game theory in analyzing oligopoly markets. Studies in the Indonesian cement sector reveal the use of the Cournot and Stackelberg models in regulating production and pricing strategies. Research in telecommunications also shows intensive adaptation of pricing strategies and service development in response to competitors' moves. This research also

indicates the existence of covert collusion practices that are difficult to detect, so government oversight is essential to maintain healthy competition (Riyandani, 2013; Marina, 2008). From a policy perspective, Law Number 5 of 1999 concerning the Prohibition of Monopolistic Practices and Unfair Competition serves as the legal umbrella for regulating oligopoly markets in Indonesia. This regulation plays a significant role in limiting collusion and monopolies that can harm consumers and other business actors. The Business Competition Supervisory Commission (KPPU) uses a game theory approach to detect anti-competitive practices and develop effective enforcement strategies (KPPU, 2010).

Oligopoly Market

An oligopoly market is one of the most common market structures found in modern economic systems. This structure is unique because only a few large companies control the majority of the market share in an industry. For example, in Indonesia, the telecommunications sector is dominated by several large operators such as Telkomsel, Indosat, and XL Axiata, which together control almost the entire market share of cellular services. A similar phenomenon is also seen in the cement and automotive sectors. The main characteristic of an oligopoly market is strategic interdependence, where every decision made by one player directly impacts the decisions of other players. Therefore, each company in an oligopoly must carefully calculate potential competitor reactions before making important decisions such as determining selling prices, production volumes, or new marketing strategies. Furthermore, oligopoly markets are characterized by high barriers to entry, including the need for large investments, limited access to raw materials, and limited market share. Advanced technology, established brands, and strong distribution relationships. These barriers maintain the dominance of large companies and prevent new players from entering the market. Products circulating in oligopoly markets are typically homogeneous, such as cement and steel, although in some industries, these products are differentiated, such as motor vehicles and telecommunications services, adding to the complexity of competition. From a consumer perspective, oligopoly markets sometimes present few real choices due to the dominance of a handful of large companies. This implies market power that can influence the price and quality of products and services. Therefore, regulatory and supervisory aspects are crucial to ensure healthy and fair market competition for consumers. (Tirole, 1988; Naeruz et al., 2015; Nikensari, 2018)

Game Theory and Strategic Behavior

Game theory, as introduced by Von Neumann and Morgenstern (1944) and further developed by Nash (1950), is the primary analytical framework for studying the strategic behavior of oligopolistic market participants. It provides a mathematical approach for understanding decisions made based on the interactions between interdependent players. The Nash equilibrium, the point at which no one gains by deviating from their chosen strategy, serves as a crucial foundation for analyzing oligopolistic markets, where the strategies of individual firms influence each other. In the context of oligopolistic markets, game theory helps explain complex patterns of competitive behavior, including how firms make decisions about pricing, output, investment, innovation, and marketing strategies, taking into account potential competitor reactions. Common game theory models include the Cournot model, which focuses on production quantity, the Bertrand model, which

focuses on price, and the Stackelberg model, which introduces the leader-follower concept into market competition. These three models provide powerful insights into the dynamics of oligopolistic markets and help predict competitive outcomes under various market conditions. Game theory also distinguishes between cooperative and non-cooperative behavior. In a non-cooperative oligopoly, firms must act independently without formal agreements, but still take into account competitors' responses. In cooperative oligopoly, there is overt or covert collusion. The use of game theory allows for quantitative and qualitative predictions of various forms of interaction. (Von Neumann & Morgenstern, 1944; Nash, 1950; Riyandani, 2013)

Dominant Strategy

A dominant strategy is the best strategy a firm can adopt regardless of its competitors' strategies. In oligopolistic markets, a dominant strategy is sometimes difficult to find due to the complex interdependencies between players. However, when a dominant strategy exists, it often has a significant impact on shaping equilibrium outcomes and pricing or output decisions. For example, in the technology industry, a firm may have a dominant innovation strategy that other players must follow to survive. Oligopolistic firms also often adopt reactive strategies, adapting their strategies based on the latest moves of competitors. These tactics demonstrate that while finding a dominant strategy is challenging, adaptation and strategic adjustment mechanisms are central to business survival in a limited and competitive market. (Mubarok, 2015)

Nash Equilibrium

The Nash equilibrium offers a framework for understanding interactions in markets with many players where each player's payoff cannot be improved independently without the reaction of other players. Oligopoly firms, using this model, ensure that their strategies are optimal in conjunction with those of their competitors, minimizing the risk of failure. In reality, oligopoly markets can have multiple competing Nash equilibria, demonstrating the complexity of the strategies firms must develop. These conditions can lead to uncertainty and instability in the decisional business environment, necessitating expertise in risk management strategies and long-term planning. (Alamanda et al., 2024; Nash, 1950)

Price Discrimination

Price discrimination is the practice of companies selling the same product at different prices to different customer groups. It is a key strategy in oligopolies to increase revenue and optimize market share. This discrimination is divided into three levels: first-, second-, and third-level, each adjusting price levels according to willingness to pay, purchase volume, or geographic and demographic market segmentation. Price discrimination is particularly feasible in oligopolies with differentiated products and is an important tool for maximizing profits without triggering a damaging price reaction. (Salmah, 2022)

RESEARCH METHOD

Types of research

This research uses a qualitative approach with a literature review method. Qualitative research was chosen because it focuses on understanding the strategic behavior of companies

in oligopoly markets through in-depth game theory analysis without primary data collection. The data used are secondary data drawn from various sources such as textbooks, scientific journals, research articles, and documents related to game theory and oligopoly market behavior.

Population and Sample

The population of this study is all literature discussing game theory and strategic behavior in oligopoly markets. This population encompasses various sources, such as textbooks, scientific journal articles, research reports, conference proceedings, and economic and competition policy documents published both nationally and internationally. In other words, all references related to the application of game theory in oligopoly market analysis are included in this study's population.

This research sample was drawn from a portion of the population deemed most relevant to the research objectives and focus, namely game theory analysis in oligopoly markets. The sampling technique used was purposive or criterion sampling, which involves deliberately selecting sources based on specific criteria.

Time and Location of Research

This research was conducted from September to October 2025. During this timeframe, the researcher conducted all stages of the research, including library collection, literature review, analysis of relevant theories, and the preparation of research findings. The research process began with the identification of primary literature discussing game theory and its application to oligopoly markets, followed by an in-depth analysis of concepts, models, and previous research findings that support the study's objectives.

Because this research is a library study, the research activities were not conducted in the field, but rather in locations that provide relevant scientific reference sources. Data collection was conducted in university libraries, digital libraries, and online scientific journal databases such as Google Scholar, Scopus, and ResearchGate. Furthermore, the researcher utilized various printed and electronic library sources accessible through the official websites of educational institutions and agencies related to economics and business competition.

Research Instruments

The literature identification sheet used in this study is a recording format designed to capture bibliographic data for each source. This sheet includes the author's name, year of publication, title, publication type, publisher or journal, and brief notes on the source's main topic and relevance to the research focus. This instrument allows researchers to systematically organize each source and ensure that all references used are accurate.
are truly relevant and meet established scientific criteria. Furthermore, this study utilizes a source quality evaluation sheet to assess the credibility and reliability of each library material. Assessments are based on criteria such as the reputation of the publisher or journal, clarity of research methodology, consistency of argumentation, and the level of recency of the information presented. Sources deemed to possess high academic value will be used as the primary source of analysis, while sources that do not meet quality standards will be

eliminated. This process ensures that the analyzed data is valid and scientifically accountable.

Another important instrument is the data extraction sheet, a recording format used to copy important information from each source that has passed the evaluation stage. Through this sheet, researchers record important things such as the research objectives in the source, the theory or model used (e.g., the Cournot, Bertrand, Stackelberg, or Nash Equilibrium models), the methodological approach, the main results, and the conclusions or contributions of the research to the field of game theory. These extraction results are then used as a basis for analysis and comparisons across the literature.

Data collection technique

Data collection for this study was secondary through a literature review, in line with the chosen qualitative approach. Because this research was not conducted in the field, the data collection process was systematic and focused on scientific reference sources.

The data collection process began with the identification and literature search of a population of library materials discussing game theory and strategic behavior in oligopoly markets. This secondary data was drawn from various sources such as textbooks, scientific journals, research articles, and economic policy documents. The search was conducted in places that provide relevant scientific reference sources, such as university libraries, digital libraries, and online scientific journal databases (Google Scholar, Scopus, and ResearchGate).

Data Analysis Techniques

The data analysis technique used in this study, which adopts a qualitative approach with a literature review method, focuses on an in-depth analysis of the contents of the literature to synthesize a comprehensive understanding of game theory and strategic behavior in oligopoly markets.

- **Content Analysis (Content Analysis):** Content analysis is the primary technique applied to systematically and in-depth review the content of all literature from which data has been extracted. The goal is to identify, classify, and synthesize key concepts, models, and empirical findings related to game theory and strategic behavior in oligopoly markets. The process involves critical reading of relevant texts from books, journals, and other documents. The researcher will focus on analyzing key theoretical concepts, including the definition and mechanisms of Nash Equilibrium, Dominant Strategy, and Price Discrimination. Furthermore, content analysis also includes a comparative analysis of the applications and assumptions of oligopoly models such as Cournot (quantity competition), Bertrand (price competition), and Stackelberg (market leadership). Furthermore, this technique is used to identify various non-price behaviors and strategies, as well as analyze the role of regulations, such as Law Number 5 of 1999, in limiting anti-competitive behavior.
- **Literature Synthesis:** Literature synthesis is conducted after data has been extracted, classified, and analyzed, involving the integration of findings from various sources into a coherent argument. The purpose of this synthesis is to build a comprehensive conceptual framework and address the research objective, which is to analyze the application of game theory in understanding the strategic behavior of firms in

oligopolistic markets. The process involves comparing findings from different studies to find patterns, similarities, or contradictions. Researchers integrate different concepts, for example, how Nash Equilibrium is achieved through the Cournot or Bertrand models, to demonstrate the interconnectedness of the theories. Literature synthesis will result in an integrated compilation of findings to conclude the effective role of game theory as an analytical tool for formulating corporate strategies and economic policies in oligopolistic markets.

- **Interpretation and Conclusion:**The final stage involves interpreting the synthesized findings and drawing conclusions relevant to the research questions to provide a deep and conclusive understanding. The process begins with the analysis and interpretation of theoretical illustrations, such as the Nash Equilibrium Graph between Two Players, to visually illustrate key concepts and their implications for strategic interdependence.

RESULTS AND DISCUSSION

Based on the results of the literature review, game theory has been proven to provide a deep understanding of strategic behavior between firms in oligopolistic markets. The Cournot, Bertrand, and Stackelberg models are the main approaches that explain the forms of competitive interactions among market participants with a limited number of players. In the Cournot model, firms compete to determine output quantities, assuming that competitors' output is fixed. Equilibrium is achieved when no firm can increase its profits without changing its competitors' production. This model reflects the conditions in industries such as cement or steel, where production decisions significantly determine market price levels. Meanwhile, the Bertrand model depicts intense price competition between firms, especially for homogeneous products. In this case, firms tend to lower prices close to marginal cost, resulting in very small long-term profits. Unlike both, the Stackelberg model demonstrates a leadership structure in the market, where one firm acts as the leader and others as followers. The market leader has a greater information and time advantage in determining pricing and output strategies. These three models demonstrate how market equilibrium is formed through the interaction of strategies between business actors.

The concept of Nash Equilibrium is at the heart of game theory in the context of oligopoly markets. This equilibrium represents a situation where each firm chooses its best strategy, taking into account competitors' strategies. No single player can increase its profits by unilaterally changing its strategy. Studies have shown that Nash equilibrium represents a stable market, although in reality, there can be more than one equilibrium point. For example, in the Indonesian telecommunications market, major operators such as Telkomsel, Indosat, and XL Axiata exhibit a pattern of strategic reactions that mutually adjust to data package pricing and service innovation. The achieved equilibrium is the result of strategic calculations, with each firm attempting to maintain profits without triggering a price war that is detrimental to all parties.

The study also shows that not all companies in oligopoly markets have a dominant strategy. However, in some cases, a dominant strategy emerges when one approach proves more profitable than others, regardless of competitors' actions. For example, companies with strong brand power or superior technology tend to adopt a strategy of continuous innovation as their dominant strategy. In the technology industry, companies like Apple or Samsung have the ability to influence market direction through new product innovation. However,

competitors without a dominant strategy must employ an adaptive strategy, adjusting their business actions based on the actions of other companies to remain competitive.

Price discrimination is one of the most effective forms of strategic behavior in a differentiated oligopoly market. Price discrimination allows companies to sell the same product at different prices to consumers with different characteristics and purchasing power. There are three forms of price discrimination: First-degree, setting a maximum price based on an individual consumer's willingness to pay. Second-degree, adjusting prices based on purchase volume or product features. Third-degree, setting different prices for specific market segments based on location, age, or income. This strategy helps companies maximize profits without having to lower prices across the board. For example, airlines often apply different fares for economy, business, and premium classes as a form of third-degree price discrimination.

The study also shows that the application of game theory in oligopoly markets cannot be separated from regulatory aspects. In Indonesia, Law Number 5 of 1999 plays a crucial role in maintaining fair business competition and preventing collusive practices. The Business Competition Supervisory Commission (KPPU) uses a game theory approach to analyze corporate strategic behavior and detect tacit collusion that harms consumers. Thus, the existence of regulations not only protects the market from monopolistic practices but also ensures that the Nash equilibrium remains within the limits of fair and efficient competition.

Theoretically, the results of this study reinforce the view that game theory is a powerful analytical tool for understanding strategic interactions in oligopolistic markets. The Cournot, Bertrand, and Stackelberg models are able to explain various competitive dynamics in terms of price, quantity, and market leadership. Practically, these results provide a basis for companies to formulate adaptive and rational strategies to market changes, and for governments to formulate more effective competition policies. In the long run, applying the Nash equilibrium principle can help create more efficient and equitable markets for all economic actors.

CONCLUSION

Based on the results of the literature review and analysis, this study concludes that game theory provides a strong conceptual foundation for understanding the strategic behavior of firms in oligopolistic markets. Through the application of the Cournot, Bertrand, and Stackelberg models, competitive interactions between market participants can be systematically explained, both in terms of price competition, output, and strategic leadership. The concept of Nash Equilibrium is at the heart of the analysis, describing a stable condition in which no participant can increase its profits by unilaterally changing its strategy. This equilibrium helps explain how firms adjust to each other in competition to remain efficient and avoid detrimental price wars. In addition, dominant strategies and price discrimination have proven to be effective tools.

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