

EXPLORATION OF THE ROLE OF GAME THEORY IN INCREASING THE EFFECTIVENESS OF COMPETITION LAW ENFORCEMENT AND THE REALITY OF ITS IMPLEMENTATION IN THE FIELD

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ABSTRACT

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Competition law enforcement is a critical instrument in creating a healthy and competitive market climate. In this context, game theory serves as an analytical framework to map strategic interactions between business actors, particularly in cases involving collusion, cartels, and other anti-competitive behaviors. This study explores the extent to which game theory has been implemented in Indonesia's competition law enforcement, covering the investigation, evidence-gathering, and decision-making processes. By using a normative and juridical-empirical approach, this study reveals a gap between the theoretical potential of game theory and its limited practical application due to regulatory constraints, institutional capacity, and lack of technical expertise among law enforcers. The findings emphasize the importance of aligning economic theory with legal instruments to improve the effectiveness of competition law enforcement. As a strategic recommendation, the study suggests strengthening institutional capabilities through specialized training, issuing technical guidelines on economic analysis, enhancing data transparency, and promoting stronger collaboration between regulators and academia to ensure broader integration of game theory in practice.

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Introduction

In the modern economic world, healthy business competition is the main foundation for creating a fair, innovative, and dynamic market (Delfina, 2025). Without strict supervision and regulations, the market is at risk of being dominated by unhealthy practices such as monopolies, cartels, and hidden collusion, which ultimately harm consumers and hinder economic growth (Hidayat, 2017; Novizas & Gunawan, 2021; Nur Hayati, 2021; Siswanto, 2020; Wijaya, 2020). *Competition law* was born to answer this need, as a state instrument in maintaining market mechanisms to function properly. In Indonesia, the importance of competition law is increasingly prominent, along with the growing complexity of interactions between market players, which are no longer limited to conventional practices but involve hidden strategies that are difficult to identify with the naked eye (Amalia, 2020; Hamidi et al., 2022; Mantili et al., 2016; Novizas & Gunawan, 2021; Sabirin & Herfian, 2021).

To keep up with the development of increasingly complex business strategies, analytical approaches to law enforcement have also evolved (Febrina, 2022). One approach that has received special attention is the use of *game theory*. The theory offers a framework for understanding how business actors make strategic decisions in mutually influencing interactions (Patel, 2021). Through the lens of *game theory*, law enforcers can map patterns of collusive behavior that were previously difficult to prove with traditional approaches. Thus, *game theory* provides a new, sharper tool for reading the dynamics of competition and potential violations (Salmah, 2023).

However, when it comes to real implementation in the field, the effectiveness of competition law enforcement in Indonesia still faces many challenges. Although the legal framework already exists, its practice is unable to reach the complexity of developing anti-competitive behavior (Sanger, 2021). Handling of competition cases still tends to focus on conventional evidence, such as documents or direct communication between business actors, while indications of more subtle strategic behavior often go unnoticed. This gap between the analytical potential of *game theory* and the reality of practice makes it important to explore it more deeply (Cita Citrawinda, 2021).

Understanding the essence of *game theory* requires an understanding of the basic principles that have been developed since the mid-20th century (Rawung, 2023). Concepts such as the *Nash Equilibrium*, where each actor chooses the best strategy based on what the other party does, are the main foundations (Lunardi, 2024). In addition, the idea of dominant strategy and repeated games enriches the understanding of how hidden cooperation or fierce competition can persist in the long run (Alamanda, 2024). All of these concepts essentially reflect the real world where business actors do not act in a vacuum, but rather observe each other and adjust their actions based on expectations of the behavior of competitors.

When applied to business competition, *game theory* allows for a much deeper analysis of the strategic behavior of market actors (Ananda, 2024). For example, in the case of collusion, business actors do not need to explicitly agree; simply by understanding the signals in the market, they can coordinate their actions to reduce competition. Forms of behavior such as price-fixing, bid rigging, or market division are classic examples of strategic interactions that can be analyzed using *game theory* models (Olivya, 2023). By understanding how actors can “play” in secret, competition authorities can develop more sophisticated detection and proof methods.

Specific models in *game theory*, such as the *Prisoner's Dilemma*, *Bertrand Competition*, and *Cournot Competition*, offer concrete simulations of how market actors interact. The *Prisoner's Dilemma*, for example, shows how two parties might choose to cooperate in secret even though they are rationally better off competing (Cantyani, 2023). *Bertrand Competition* describes price competition between firms, where price agreements can emerge to avoid a costly price war (Falah, 2025). Meanwhile, *Cournot Competition* helps explain the behavior of regulating production quantities in oligopoly markets (Escrihuahela-Villar, 2025). Understanding these models opens up new insights into how

violations of the principles of fair competition can occur even without explicit communication between business actors.

In Indonesia, the legal foundation for protecting business competition lies in Law Number 5 of 1999 concerning the Prohibition of Monopolistic Practices and Unfair Business Competition. Through changes in the *Job Creation Law*, the strengthening of substantive and procedural aspects of competition law has been further clarified, including adjustments to accelerate the investigation and resolution process (Fahmi, 2025). However, even though the legal framework is improving, the biggest challenge remains how these instruments are translated into strategic anti-competitive behavior investigation and evidence practices.

In this context, the role of the Business Competition Supervisory Commission (KPPU) is vital. KPPU not only acts as an investigator and law enforcer but also as an institution that must be able to utilize modern economic analysis, including *game theory*, in its duties (Putra, 2024). In several cases, KPPU has begun to show awareness of the importance of economic analysis, but the systematic use of *game theory* has not yet become the standard. It shows that although the potential for using *game theory* is enormous, institutional capacity and methodological approaches need to be strengthened so that strategic behavior analysis can be used as the primary tool in detecting violations of competition law (Azizah, 2023).

Looking at the relationship between *game theory* and competition law enforcement, this theory can be an important tool in detecting and proving the existence of cartels or conspiracies. With the traditional approach, authorities often must prove the existence of an explicit agreement, something that in practice is very difficult to obtain. Meanwhile, by using *game theory*, law enforcers can identify patterns of behavior that are consistent with implicit collusion, without having to rely on physical evidence in the form of agreement documents. Uniform price patterns, coordinated market divisions, or other non-competitive behavior can be interpreted as the result of strategic games between business actors.

As awareness of the potential of *game theory* increases, it is hoped that competition law in Indonesia will be better prepared to face the challenges of globalization and the development of increasingly complex digital markets. By integrating more sophisticated analytical approaches into investigations and decision-making, competition law enforcement will not only become more effective but also more adaptive to changing market dynamics. This is part of a larger agenda to strengthen a healthy business ecosystem, encourage innovation, and provide better protection for consumers throughout Indonesia.

Despite its value, the application of *game theory* in Indonesian competition law remains underdeveloped and sporadic, with enforcement still relying heavily on conventional evidence such as documents and witness testimonies. This reveals a clear research gap: while the theoretical relevance of *game theory* is well-established, its practical integration into Indonesian legal practice has been limited due to regulatory, institutional, and methodological barriers.

This study seeks to fill that gap by analyzing how *game theory* can be systematically applied to enhance the effectiveness of competition law enforcement in Indonesia. It combines a normative-empirical approach, reviewing both legal frameworks and actual case applications most notably the 2016 motorcycle cartel case. The novelty of this research lies in its contextual application of *game theory* to the Indonesian legal system, offering strategic insights for reform in investigation, adjudication, and policy development.

The implications of this study are significant: by embracing *game theory*, institutions like the KPPU can move toward a more analytical and proactive enforcement model, better equipped to detect and deter covert collusion in the digital age. In the long term, this shift could enhance legal certainty, market efficiency, and consumer protection, aligning Indonesia's competition law enforcement with global best practices.

Research Method

This study employs a combination of normative and juridical-empirical legal approaches. The normative approach focuses on analyzing statutory provisions, particularly Law No. 5 of 1999 concerning the Prohibition of Monopolistic Practices and Unfair Business Competition, as amended by Law No. 11 of 2020 (revoked by Law No. 6 of 2023), along with derivative regulations issued by the Indonesian Competition Commission (KPPU). This legal examination is integrated with the conceptual framework of *game theory* to explore its relevance in legal analysis.

The empirical component involves case study analysis, particularly focusing on landmark decisions such as the 2016 Motorcycle Cartel Case (KPPU Decision No. 04/KPPU-I/2016). In total, five competition law cases adjudicated by the KPPU between 2015 and 2023 were selected for in-depth analysis. These cases were chosen purposively based on their relevance to *game-theoretic* implications, data availability, and significance in illustrating strategic collusive behavior.

Secondary data sources include academic journals, books on competition law and *game theory*, KPPU annual reports, and official publications, gathered through databases such as HeinOnline, Google Scholar, SSRN, and the KPPU's Decision Directory. These materials were selected using targeted keywords (e.g., "cartel", "tacit collusion", "price fixing", "*game theory*", and "competition law in Indonesia").

The application of *game theory* models—such as the *Prisoner's Dilemma*, *Bertrand Competition*, and *Cournot Competition*—was conducted by mapping the behavior of firms involved in the cases and analyzing pricing coordination, production outputs, and strategic responses over time. These models provided the foundation to assess whether behaviors aligned with rational, collusive strategies under the assumptions of non-cooperative games.

A descriptive-analytical technique was applied to interpret legal facts and economic behavior. Descriptive analysis captured the statutory and factual elements of each case, while analytical synthesis connected these elements with *game theory* to identify patterns

of tacit collusion. Efforts were made to reduce bias by triangulating data from regulatory documents, court decisions, and independent expert commentary.

Results and Discussion

Implementation of Game Theory in Enforcement of Competition Law in Indonesia

In the development of competition law in Indonesia, the use of economic analysis is increasingly showing its urgency. Traditionally, the enforcement of competition law in Indonesia has relied more on a legalistic approach, namely emphasizing formal proof of the existence of a written agreement or agreement that violates Articles 5 to 9 of Law No. 5 of 1999 concerning the Prohibition of Monopolistic Practices and Unfair Business Competition. However, the changes brought about by Law Number 11 of 2020 concerning Job Creation (which has been revoked by Law No. 6 of 2023), especially in the business competition cluster, encourage the use of an economic-based approach. This approach allows for a deeper analysis of the impact of market behavior on market structure and consumer welfare, not only based on the formal existence of an agreement. The use of game theory becomes very relevant within the framework of this approach, considering that this theory can read the cause-and-effect relationships of the actions of business actors who interact strategically.

The application of game theory in competition investigations in Indonesia began to appear in major cases, one of which was the motorcycle cartel case in 2016. In this case, the KPPU found an alleged violation of Article 5 of Law No. 5 of 1999 concerning price fixing. This case was recorded in the KPPU Decision No. 04/KPPU-I/2016 which was later confirmed in a court decision. In this case, the KPPU concluded that two major manufacturers, PT Yamaha Indonesia Motor Manufacturing and PT Astra Honda Motor, had secretly coordinated prices (Husada, 2022). Although no explicit written agreement documents were found, the consistent pattern of price behavior between the two companies became a strong basis for the KPPU to prove the existence of an "implicit agreement" (tacit collusion). In this context, the main challenge is how to prove strategic coordination without documentary evidence or direct communication. Game theory is a tool for analyzing consistent behavioral patterns as an indication of a tacit agreement. However, proving tacit collusion is not simple. The game theory must be accompanied by rigorous empirical data analysis, including price trends, production volumes, and responsive behavior between market players. In Indonesia, this challenge is compounded by the limited technical capacity to collect and process economic data systematically. As a result, although the game theory framework has begun to be recognized, its concrete implementation in investigations is still limited to certain cases with sufficient data.

Regarding the aspect of decision-making, the KPPU has begun to show a tendency to consider economic theory-based analysis and game theory in their legal arguments. In several decision considerations, the KPPU uses concepts such as "behavioral parallelism" to describe the phenomenon in which market players act as if they are coordinating without evidence of an explicit agreement. This approach is in line with Article 22 of Law No. 5 of 1999 which prohibits collusion in tenders, which in practice often occurs in the

form of tacit collusion. However, the explicit adoption of game theory in the KPPU's legal considerations is still sporadic and has not become standard practice in all cases.

The KPPU needs to be more active in using the new mechanisms that have been introduced through the amendment to the Job Creation Law. One of them is the “improvement commitment” mechanism stipulated in Article 47A of Law No. 5 of 1999 (amended), which allows for the settlement of cases through commitments without the need to fully prove violations. In this context, game theory-based analysis can be used to assess the extent to which business actors' actions actually disrupt competition or are still within the limits of fair competition, so that the decision to accept or reject the improvement commitment can be based more on strategic analysis than just administrative considerations. It is also important to note that the KPPU as a quasi-judicial administrative institution has greater flexibility than general judicial institutions to adopt analytical approaches such as game theory. However, to do this effectively, the KPPU must strengthen its human resources, especially in industrial microeconomics and econometrics. Continuous training and collaboration with academics and practitioners of competitive economics are noteworthy ways so that game theory does not just stop at the rhetorical level in decisions, but truly becomes part of the regular analysis instrument.

In facing the reality of the digital market and the rapidly growing economic platform, the challenges for enforcing competition law are also increasingly complex. Practices such as algorithmic collusion or automatic price fixing based on artificial intelligence require a new approach that is much more sophisticated than conventional approaches. In this condition, game theory is no longer just an additional tool, but an urgent need in understanding the patterns of strategic interaction between business actors in the new era. Indonesia, if it wants to maintain its economic competitiveness at the global level, must place strengthening game theory-based analysis as a priority in future competition law enforcement reforms.

Problems and Challenges of Implementing Game Theory in Indonesia

The application of game theory in the enforcement of competition law in Indonesia is inseparable from various fundamental problems that must be faced. One of the most obvious problems is the limited technical capacity of human resources in law enforcement agencies, especially in the Business Competition Supervisory Commission (KPPU). Although there has been progress in the basic understanding of the importance of economic analysis in proving anti-competitive practices, the level of mastery of complex analytical tools such as game theory models is still uneven among investigators and commissioners. This has a direct impact on the KPPU's ability to design investigation strategies based on strategic behavior and formulate legal arguments based on strong analytical models. In addition to technical capacity, other challenges arise from the regulatory aspect. Although Law No. 5 of 1999 has been updated through the Job Creation Law, the legal framework has not explicitly adopted a game theory or economic analysis-based approach in enforcement. Existing regulations still emphasize formal proof of certain elements of legal acts, such as the existence of certain agreements or practices that

violate the provisions of specific articles. As a result, the flexibility of using a strategic behavioral approach often depends on the creativity and courage of law enforcement officers themselves in developing progressive legal interpretations.

Another structural problem that is quite prominent is the limited access to accurate and adequate market data. Analysis based on game theory relies heavily on market behavior data, including prices, sales volumes, transaction frequencies, and competitor responses. In Indonesia, collecting market data is still a major challenge due to the lack of transparency obligations on the part of business actors, as well as weak support from related institutions in providing official data. Although Article 41 of Law No. 5 of 1999 authorizes the KPPU to request data from third parties, in practice this process is often slow or even experiences resistance, making it difficult to conduct investigations based on strategic analysis.

On the other hand, the legal culture in Indonesia, which is still very procedural, is also an indirect obstacle to the application of game theory. In many cases, the focus of the parties in the trial is more on formal proof of legal elements alone, rather than on substantive analysis of market behavior and its impact on competition. This is exacerbated by the tendency of courts to assess evidence based on conventional evidence, such as letters and witnesses, rather than considering econometric analysis or simulations of market behavior models. As a result, although game theory can provide a more comprehensive picture of business actor interactions, its argumentative weight in the adjudication process often does not get the appreciation it deserves.

Another limitation that deserves attention is the low synergy between academics, legal practitioners, and regulators in developing game theory-based enforcement methods. In several developed countries, such as the United States and the European Union, close collaboration between the academic community and competition authorities has resulted in sophisticated and continuously updated analytical method innovations. In contrast, in Indonesia, academic studies on the application of game theory in competition law are still relatively minimal, both in terms of quantity and quality. The lack of local reference materials makes it difficult for decision-makers and investigators to adapt game theory contextually to the realities of national law and markets.

Resistance from business actors to the use of a game theory-based approach is also a challenge in itself. Many business actors feel that this approach is speculative and less concrete than a document or witness-based approach. It is also not uncommon in court for the defense of business actors to focus on discrediting the validity of behavioral analysis, by emphasizing that similar behavior does not always mean a tacit agreement. Arguments like this, if not balanced with strengthening methodology and solid data-based evidence, have the potential to weaken the effectiveness of the game theory approach in proving violations.

Amidst these challenges, it must be acknowledged that there is also great potential to improve the application of game theory in competition law enforcement in Indonesia. One way is to strengthen derivative regulations in more explicit technical guidelines regarding the economic analysis and game theory in the investigation and proof of

competition cases. KPPU can develop a kind of official guideline, as the European Union has done with the "Guidelines on the Assessment of Horizontal Cooperation Agreements", which not only helps investigators but also provides better legal certainty for business actors regarding the assessment standards used.

Despite all the existing problems, the integration of game theory in competition law enforcement remains an inevitability in the future. This transformation does require a fairly fundamental paradigm shift, not only at the regulator level but also at the policymaker and business actor level. With the business world becoming increasingly complex and markets becoming increasingly globally integrated, only an approach based on strategic and behavioral analysis can provide optimal protection for the principles of healthy and fair competition. Indonesia's success in strengthening the use of game theory in competition law will be a benchmark for the extent to which this country can adapt to the dynamics of the modern economy and strengthen its legal foundations to support long-term economic growth.

Conclusion

This study concludes that *game theory* holds significant potential to enhance the effectiveness of competition law enforcement in Indonesia. By mapping the strategic interactions of market actors, *game theory* provides an analytical framework to identify forms of tacit collusion that are often difficult to detect through traditional legal means. Its application enables authorities, particularly the Business Competition Supervisory Commission (KPPU), to analyze behavioral patterns indicative of anti-competitive practices, even in the absence of direct agreements or physical evidence. Despite this potential, the practical implementation of *game theory* in Indonesia remains limited. Major barriers include the lack of technical capacity among law enforcement personnel, the absence of clear regulatory guidelines integrating economic models, and a prevailing legal culture that prioritizes formal over substantive evidence. Moreover, limited access to accurate and timely market data and weak collaboration between academics, regulators, and practitioners further constrain the adoption of strategic analytical tools.

Some progress has been made in certain high-profile cartel cases, demonstrating a gradual shift toward using economic and behavioral analysis in legal arguments. However, for *game theory* to become a standard investigative and adjudicative tool, systematic reforms are needed. These include capacity building for KPPU investigators and commissioners, the development of technical guidelines for applying economic analysis in law enforcement, and improved data transparency across market sectors. Furthermore, Indonesia must adopt a forward-looking legal culture that embraces interdisciplinary approaches, especially as digital markets and algorithmic collusion present new challenges. Strengthening institutional readiness and integrating *game theory* more deeply into regulatory practices will not only improve enforcement efficiency but also foster a more competitive, fair, and innovation-driven market environment. Ultimately, the integration of *game theory* should serve as a pillar in reforming

competition law enforcement to meet the demands of a complex and rapidly evolving economic landscape.

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