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Review Article

The strategic role of Game Theory in financial markets

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Abstract

This study examines the strategic role of game theory in financial markets through a literature-based analysis. Game theory, as a powerful tool that enables the mathematical analysis of rational decision-makers' strategic interactions, provides significant contributions to understanding key processes such as competition, cooperation, arbitrage, pricing, speculation, and manipulation in financial markets. The study first explains the fundamental concepts of game theory (players, strategies, payoffs, and equilibrium points) and emphasizes the critical importance of the Nash equilibrium and its extensions in market analyses. Within the context of financial markets, different types of markets—such as money markets, capital markets, organized and over-the-counter markets—are examined, and the integration of game theory into strategic decision-making processes is discussed. The literature reveals that game theory has broad applications in areas such as portfolio optimization, risk management, market equilibrium analysis, oligopoly models, and the investigation of speculative bubbles in cryptocurrency markets. In conclusion, game theory emerges not only as a theoretical analytical tool but also as a practical method for understanding the dynamics of financial markets, supporting strategic decision-making processes, and strengthening market stability. In this regard, the study contributes to the theoretical literature while also offering insights for strategic decision-makers in financial markets.

1. Introduction

Game theory, as a mathematical and analytical discipline that examines the strategic interactions of rational decision-makers (players), has acquired a significant position across many fields of the social sciences. Its fundamental assumption is that players do not merely attempt to maximize their own payoffs, but must also take into account the strategies and behaviors of other actors [39, 65]. In this respect, game theory provides a framework for modeling strategic relationships among individuals, firms, and institutions, and offers a theoretical basis for analyzing different competitive environments. Particularly in the fields of economics and finance, game theory has found wide application, providing a rational and systematic approach to decision-making processes and contributing to a better understanding of market mechanisms [32, 79]

The increasing adoption of game theory in the economics literature from past to present clearly demonstrates its strength in analyzing decision-making processes within dynamic market structures and competitive settings. Core concepts such as Nash Equilibrium reveal how stable outcomes can emerge from strategic interactions among players, making them frequently used analytical tools in financial markets [59, 60]. Game theory, by considering elements such as information sharing, competition, cooperation, and uncertainty in

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decision-making processes, stands out as a mathematical model that enables the identification of the most appropriate strategic equilibrium [2, 14, 75].

The aim of this study is to explore the role of game theory in strategic decision-making and market equilibria within financial markets. In this context, the research first focuses on game theory-based studies specifically addressing financial markets in both national and international literature, evaluating these studies comparatively in terms of their objectives, methods, and results. Subsequently, the study discusses in detail how game theory has been applied in financial markets, and which models and approaches have been used for analysis. In doing so, it seeks to provide a framework that enhances the understanding of the analytical contributions of game theory for both researchers and market participants.

Finally, the conclusion presents a general assessment of the role of game theory in financial markets, summarizing the findings with respect to strategic decision-making processes and market equilibria. In this regard, the study not only contributes to the theoretical literature but also offers insights for practitioners in developing policies and strategies.

2. Literature Review

A review of the literature on the applications of game theory in financial markets reveals that studies have concentrated on a wide variety of areas. Huang [39] examined the strategic effects of game theory on financial decision-making by combining qualitative and quantitative datasets, emphasizing its risk-reducing role particularly in mergers, acquisitions, and portfolio management. The role of game theory in energy markets is also noteworthy; Janan et al. [42] and Jiang et al. [43] focused on evolutionary games, Stackelberg models, and pricing strategies in blockchain-based energy trading. Vidler and Walsh [95] identified liquidity games in the bond market, while Song and Wu [87] discussed the effectiveness of Bayesian games in post-forecast decision-making processes.

In the field of portfolio optimization, Acar and Ünal [2] demonstrated, using BIST data, that game theory enhances Sharpe ratios; meanwhile, Simonion [85] applied the Shapley value in portfolio diversification. Similarly, Ibrahim et al. [40] and Pekkaya & Gümüş [71] analyzed the effects of political changes on portfolio selection and trends in the literature. In this context, cooperative models (e.g., Shapley value, coalition games) provide diversification benefits by distributing portfolio risk based on marginal contribution across assets, whereas non-cooperative models (e.g., minimax, robust games) generate conservative allocations under uncertainty, thereby reducing model risk. However, the outcomes of these two approaches sometimes diverge: cooperative models enhance diversification, while non-cooperative models yield more cautious but higher opportunity-cost strategies.

Regarding the relationship between financial regulation and innovation, An et al. [100] employed an evolutionary game theory model to reveal the mutual interdependence between regulatory policies and financial innovation, thereby providing an analytical framework for balancing regulation and innovation. In the context of financial risk management, Moosakhaani et al. [57] used Nash equilibrium in flood risk modeling, while Liu et al. [52] examined the role of game theory in blockchain security and mining economics. More recently, Wang [108] employed evolutionary game theory to study Chinese household financial investment behavior, and Langenohl [105] demonstrated how social coordination in decentralized finance (DeFi) projects can be achieved through game theory. These studies highlight the potential of game theory in blockchain-based financial applications, while also bringing to light significant challenges such as regulatory uncertainty, scalability, and security.

In terms of pricing and liquidity in financial markets, Evangelista et al. [103] modeled price formation processes using multi-player and mean-field game approaches; Pagliarani et al. [107] analyzed the strategic impact of renewable energy producers on market prices within the framework of Nash equilibrium. Lavigne and Tankov [106] examined the decarbonization of financial markets using a mean-field game approach, modeling how investors' strategies are shaped by carbon footprint considerations and contributing to the literature on sustainable finance. Bao [102] integrated game theory into option pricing through a binomial tree model, proposing a novel pricing method, while Azarberahman & Mohammadnejadi Modi [101] developed a fuzzy logic–based game-theoretic approach to financial market competition using a Kalman–Jacobi hybrid model.

Historically, Yıldırım [97] developed strategic investment models for ISE sectors, while Deng et al. [23] and Farias et al. [29] employed minimax models in portfolio selection. Thakor [90] on the other hand, provided a theoretical perspective on the potential applications of game theory in finance.

Overall, this literature demonstrates that game theory has a broad and growing influence on portfolio management, market equilibria, risk management, pricing strategies, and emerging technological platforms (e.g., blockchain and DeFi) in financial markets. However, common limitations in the literature include the predominance of theoretical models, the lack of empirical validations, and the uncertainty of regulatory frameworks, particularly in blockchain-based markets. A summary of the literature review is presented in Table 1.

Table 1. Literature review

Author(s)	Topic / Purpose	Method / Model	Findings	Contribution	Sources
Huang (2025)	Strategic effects on financial decision-making	Qualitative and quantitative datasets; Nash equilibrium, cooperative/non-cooperative games, evolutionary games	Game theory is critical in determining strategic actions; reduces risks in mergers and acquisitions	Enhances portfolio management, contributes to market stability	[39]
Janan et al. (2025)	Pricing and financing in blockchain-based energy markets	Evolutionary games, Stackelberg model	Optimization of energy sales prices; efficiency in financing processes	Proposal of a sustainable financing model in blockchain-based energy	[42]
Azarberahman & Mohammadnejadi Modi (2025)	Financial competition	Kalman–Jacobi hybrid model + fuzzy logic	Developed a hybrid equilibrium model in market competition	Proposed a hybrid game-theoretic model	[101]
Vidler & Walsh (2024)	Liquidity games in bond markets	Non-cooperative game; 'liquidity game' model	Strategic decisions determine market liquidity	New model proposal for market design and regulation	[95]
Bao (2024)	Option pricing	Binomial model + game theory	Developed an alternative approach to option pricing	Innovation in pricing literature	[102]
Pagliarani et al. (2024)	Renewable energy market	Nash equilibrium, stochastic game	Modeled price effects among renewable producers	Strategic game application at the energy-finance intersection	[107]

Author(s)	Topic / Purpose	Method / Model	Findings	Contribution	Sources
Song & Wu (2023)	Post-forecast game theory and decision-making	Bayesian games	Early action proves beneficial; forecasts influence investor behavior	Theoretical framework explaining forecasting behavior	[87]
Wang (2023)	Household investment behavior	Evolutionary game theory	Revealed strategic interactions of Chinese investors	Explains investment behavior at the micro level	[108]
Koliechkina & Vuzii (2023)	Automated stock trading systems	Analysis of game theory methods	Showed impact of strategic behavior on trading algorithms	Game-theoretic approach to algorithmic trading	[104]
Lavigne & Tankov (2023)	Decarbonization of financial markets	Mean-field game approach	Modeled interaction of investors considering carbon footprint in financial decisions	Opens new perspective on sustainable finance using game theory	[106]
Acar & Ünal (2022)	Portfolio optimization in BIST 100	Minimax + simplex algorithm	Portfolios calculated with game theory achieve higher Sharpe ratios	Application of game theory in portfolio management in Turkey	[2]
Moosakhaani et al. (2022)	Financial model for flood risk management	Nash equilibrium	Optimal equilibrium when insurance and state support are combined	Model for risk sharing and distribution of financial responsibilities	[57]
Evangelista et al. (2022)	Price formation	Mean-field games	Modeled price dynamics in multi-player interactions	New perspective on market microstructure	[103]
Langenohl (2022)	Social coordination in DeFi	Game theory + sociological analysis	Examined mechanisms of coping with uncertainty in DeFi projects	Demonstrated the social role of game theory in DeFi	[105]
An et al. (2021)	Inter-relationships between financial regulation and innovation	Evolutionary game theory model	Showed how regulatory policies and financial innovation influence each other dynamically	Provides analytical framework for balancing regulation and innovation	[100]
Pekkaya & Gümüş (2021)	Literature review on portfolio optimization	Review of 300 studies	Limited use of game theory in portfolio studies	Identification of a gap in the literature	[71]
Ibrahim et al. (2020)	Portfolio selection during Malaysian elections	Cooperative game; Shapley value	Changes observed in portfolio selection before and after elections	Explains political impacts on financial markets through game theory	[40]
Jiang et al. (2020)	Electricity trading in blockchain-based energy markets	Stackelberg game + algorithms	Win–win outcomes in buyer–seller interactions	Proposal of a blockchain-based pricing model	[43]
Liu et al. (2019)	Applications of game theory in blockchain	Selfish mining, majority attack, DoS models	Solutions proposed for security and economic challenges	Systematic framework for blockchain security using game theory	[52]
Simonion (2019)	Portfolio selection using Shapley value	Shapley value-based model	Facilitated portfolio diversification	Cooperative solution approach in portfolio selection	[85]
Yıldırım (2006)	Game theory in ISE sector analysis	Mathematical modeling	Sector-based monthly investment recommendations developed	One of the early applications in the Turkish stock market	[97]

Author(s)	Topic / Purpose	Method / Model	Findings	Contribution	Sources
Deng et al. (2005)	Portfolio selection with equilibrium prices	Minimax + linear programming	Developed a non-negative equilibrium price system	Analytical contribution to portfolio selection under uncertainty	[23]
Farias et al. (2004)	Portfolio optimization in the Brazilian stock market	MV, Minimax, Weighted Minimax models	Minimax model yielded higher returns	Comparison of different game-theoretic models	[29]
Thakor (1991)	Potential of game theory in finance	Theoretical analysis	Predicted growing importance of cooperative and evolutionary games	Pioneering contribution to finance	[90]

3. Game Theory

Game theory is a mathematical approach that enables the systematic analysis of decisions made by individuals under different conditions and the impact of these decisions on other actors. Rooted in human behavior, this discipline is not limited to a single field of study but has gained prominence for its applicability across economics, social sciences, biology, engineering, computer science, and even philosophy [24]. The central premise of game theory is that individuals' decisions directly influence the decisions and outcomes of others in society, and this interdependence requires an examination of how rational behavior is shaped in such contexts. For this reason, game theory is often described as the study of "cooperation or competition within mutual interaction."

For a game to emerge, there must first be players—decision-makers—who make choices under specific strategic conditions. The structure of a game is defined by the information available to players, their strategy sets, and the payoffs resulting from these strategies. Games are mathematical models that capture players' strategies for each possible situation, the potential outcomes of these strategies, and the resulting gains or losses. In this way, game theory provides a formal framework for analyzing how actors with different modes of reasoning make moves against each other [14].

One of the most important contributions of game theory is its ability to explain strategic decision-making in competitive environments. When considering the counter-moves of rival players, the key question becomes: "How should a player develop the most appropriate strategy while maximizing their own payoff in response to the rival's actions?" Accordingly, game theory contributes to the identification of optimal strategic decisions in any sector where competition exists [67]. Each player must therefore account not only for their own interests but also for their rivals' potential strategies. Since every strategy determines the player's payoff or loss, the mathematical analysis of these outcomes enables more rational decision-making [54].

The historical development of game theory dates back to the 17th century. The foundations were laid by Émile Borel's work in 1921, followed by John von Neumann's 1928 research on strategic games, which gave the discipline a mathematical character. In 1944, John von Neumann and Oskar Morgenstern published The Theory of Games and Economic Behavior, which systematized game theory and introduced it into modern economics [31]. From the 1960s onwards, the theory attracted not only mathematicians but also economists, rapidly advancing due to its robust theoretical foundations and practical success. After the 1980s, the development of more advanced models for addressing complex economic and social problems turned game theory into a vital analytical tool [61].

Over time, game theory has found applications not only in economics and finance but also in disciplines such as biology, genetics, engineering, industry, social sciences, sports sciences, and computer science. Particularly in economics and finance, game theory has guided both theoretical and applied research on market functioning, competitive strategies, auctions, portfolio management, and market equilibria. Concepts such as the Nash equilibrium have become indispensable analytical tools, showing how equilibrium states arise in strategic interactions [6, 27]. In this sense, game theory continues to provide a multidimensional perspective in strategic decision-making and market analysis, contributing significantly to interdisciplinary research.

3.1 Game Theory Terminology

Game theory is grounded in conceptual foundations that enable the systematic analysis of strategic interactions. These foundations are generally defined as players, strategies, payoffs, and equilibrium points [8, 32, 37, 59, 65].

3.1.1 Games and Players

One of the most fundamental concepts in game theory is the notion of players. Players are defined as actors who make decisions within strategic interactions; these actors may be individuals, firms, institutions, or even states. Each player seeks to maximize their own interests while simultaneously being influenced by the strategies of others. Therefore, game theory examines not only individual decisions but also the processes of mutual interaction [27, 65, 76, 89].

A game is defined within the framework of players' strategy sets, the payoffs or losses that result from these strategies, and the rules governing this process. In competitive environments, players do not merely pursue their own benefits; they also attempt to constrain or redirect the moves of their rivals. Thus, a game represents a decision-making environment where two or more actors engage in strategic interaction. Information asymmetry, uncertainty, and risk are significant elements in this decision-making environment [32, 59].

Games are generally divided into three categories: cooperative, non-cooperative, and mixed-motive games. In cooperative games, players form coalitions to maximize their common interests, and the resulting outcomes reflect both individual and collective benefits. In non-cooperative games, each player acts independently, with conflicts of interest becoming more pronounced as players conceal their strategies to gain advantage. Mixed-motive games, on the other hand, combine elements of both cooperation and competition, reflecting situations where players' interests partially converge and partially conflict [4, 50, 86].

In particular, zero-sum games represent situations in which one player's gain is exactly equal to the other player's loss. Conversely, in non-zero-sum games, all players may win or lose simultaneously. Hence, non-zero-sum games are of critical importance for understanding cooperation, bargaining, and negotiation processes [65, 86, 89].

In conclusion, the concepts of games and players form the foundation of the theoretical framework of game theory. The level of players' access to information, the range of available strategies, and the quality of their choices play a decisive role in shaping outcomes and equilibrium conditions within the game [4, 27, 32, 59, 76].

3.1.2 Strategies

One of the most fundamental elements of game theory is the concept of strategy. A strategy is defined as a comprehensive plan of action that specifies what moves a player will make under all possible circumstances. In other words, a strategy is not merely a momentary choice but a systematic decision rule that applies throughout the course of the game. Since players' efforts to maximize their own interests must take into account the potential moves of their opponents, strategy lies at the very core of both individual rationality and mutual interdependence [89, 99].

The concept of strategy was first introduced by John von Neumann as part of the mathematical foundation of game theory and has since been extensively developed in both theoretical and applied contexts. The decisions that players make against one another are shaped by the rules of the game, and each strategy reflects an attempt to anticipate the possible moves of rivals. Consequently, strategies constitute the basis for key solution concepts in game theory, such as the Nash equilibrium [32, 59].

In the game theory literature, strategies are generally divided into two main categories: pure strategies and mixed strategies. A pure strategy involves a player choosing a single specific action in every situation, while a mixed strategy refers to selecting among possible actions with certain probabilities. Under conditions of uncertainty, mixed strategies allow players to behave more flexibly and unpredictably. In recent years, the application of mixed strategies has expanded in fields such as artificial intelligence, algorithmic games, and market design, making them an indispensable component of modern equilibrium analysis [41, 50].

Strategies also differ depending on whether the game is static or dynamic. In static games, players make their decisions simultaneously, whereas in dynamic games, decisions are made sequentially, and past moves influence future strategies. In this context, "repeated games" and "reputation models" highlight the long-term dimensions of strategies [53].

In conclusion, strategy is not merely an abstract notion within game theory but a central concept with broad applications, ranging from economic models to political decision-making, from international negotiations to artificial intelligence algorithms. Strategies not only safeguard players' interests but also shape cooperation or competition, the resulting equilibrium conditions, and the overall functioning of the system [25].

3.1.3 Payoffs

One of the fundamental components of game theory is the concept of payoffs. In a game, players may face three basic outcomes: winning, losing, or withdrawing from the game. These outcomes are expressed as positive, zero, or negative values. In this way, the benefits players gain or the losses they incur can be represented in measurable numerical or proportional terms. An important point here is that the units of measurement must remain consistent under all conditions, ensuring that the payoffs and losses of different players can be compared reliably [88].

The results obtained by players, depending on their strategies, are systematically represented in a table known as the payoff matrix. The payoff matrix is one of the most important tools of the mathematical structure of game theory, as it demonstrates the gains or losses associated with every combination of strategies. The values in the matrix can take three forms: positive (benefit), negative (loss), or zero (neutral outcome). If the value is positive, the column player transfers or generates that amount of benefit for the row player. If it is negative, the row player pays the column player the absolute value of that number. If the value is zero, no transfer occurs [64, 68].

In a zero-sum game, where one player has n strategies and the other has m strategies, the payoff matrix is of size $m \times n$. Each entry in the matrix, such as a_{11}, a_{12}, ..., a_{mn}, represents the payoff resulting from the chosen strategy pair, thus capturing the fundamental competitive logic of the game.

$$\begin{bmatrix} a_{11} & a_{12} & a_{13} & \cdots & a_{1n} \\ a_{21} & a_{22} & a_{23} & \cdots & a_{2n} \\ a_{31} & a_{32} & a_{33} & \cdots & a_{3n} \\ \cdots & \cdots & \cdots & \cdots & \cdots \\ a_{m1} & a_{m2} & a_{m3} & \cdots & a_{mn} \end{bmatrix} \quad (1)$$

In any payoff matrix, player A is placed in the rows, while player B is represented in the columns. If player A has m strategies and player B has n strategies, the payoff matrix becomes an m × n matrix. The entries of the matrix (a_{11}, a_{12}, ..., a_{mn}) indicate the payoffs corresponding to each pair of strategies chosen by the players [48, 84].

In the context of zero-sum games, the payoff matrix plays an even more critical role. In such games, the gain of one player is exactly equal to the loss of the other; therefore, the sum of all values in the payoff matrix is zero. This structure represents the mathematical embodiment of a perfectly competitive game. For example, if player A has m strategies and player B has n strategies, the resulting payoff matrix of size m × n specifies, through its entries, the exact gain or loss each player experiences under every strategic combination [48, 50].

Recent studies show that the payoff matrix is not only a theoretical tool but also a critical analytical method in applied economics, market design, international negotiations, and algorithmic game theory. Particularly in artificial intelligence systems and multi-agent digital platforms, payoff matrices are widely used to optimize different strategies and to model system behaviors [62, 80].

In conclusion, payoff matrices do not only display the individual gains and losses of the players but also provide a framework to understand the equilibrium structure and strategic dynamics of a game. For this reason, payoff matrices have become indispensable tools in modern game theory, both in classical economic analysis and in today's complex, data-driven decision-making processes.

3.1.4 The Outcome of the Game or the Equilibrium Point

One of the most critical concepts in game theory is the equilibrium point reached as a result of players' strategic interactions. Under the assumption that competing players proceed with unbiased strategies, the final outcome of the game is defined as the game's result or equilibrium point. The most well-known form of this concept is the Nash Equilibrium, developed by John Nash [60, 65].

Nash equilibrium refers to a situation in which no player can improve their payoff by unilaterally changing their strategy, given that the strategies of all other players remain fixed. In other words, no individual player has an incentive to deviate, since such deviation would not yield a better outcome. As such, Nash equilibrium embodies the principle of "mutual rationality" and remains one of the foundational concepts for analyzing games [32, 86].

The notion of equilibrium plays a vital role not only in theoretical discussions but also in practical applications. In financial markets, for instance, equilibrium concepts are employed to explain price formation, auction design, competitive behaviors in oligopolistic markets, and strategic decision-making in international relations [59, 89]. Moreover, extended forms of Nash equilibrium—such as subgame perfect equilibrium, Bayesian equilibrium, and the evolutionarily stable strategy—are widely applied today, especially in addressing games that involve uncertainty and asymmetric information [34, 53].

Recent studies demonstrate that Nash equilibrium has also found applications in artificial intelligence, machine learning, and algorithmic game theory. In particular, in multi-agent systems, Nash equilibrium serves as a basis for the coordination and cooperation of autonomous agents [50, 62]. More recently, AI-supported equilibrium analyses have been developed to predict player behavior in complex digital platforms [18, 80]. Additionally, research in behavioral economics has revealed discrepancies between Nash equilibrium predictions and actual human decision-making, enriching classical equilibrium theory with experimental and psychological insights [15, 20].

In conclusion, the outcome of the game or the equilibrium point lies at the core of game theory from both theoretical and practical perspectives. Nash equilibrium and its extensions not only reflect the maximization of individual payoffs but also represent the rational balance of strategic interdependence among players.

4. Financial Markets

Economic units initially use their own internal resources to meet their funding needs. When the savings of an individual or institution can be allocated to investment, this condition is defined in the literature as having “financial capacity.” However, when internal resources are insufficient, investors must turn to other economic institutions to meet their financing requirements. At this point, investors direct their demands to companies or institutions with surplus funds and satisfy their needs through financial markets [97].

There are three primary economic units within economic activity: households, firms, and the government. These units may experience imbalances in their income–expenditure levels over time. In some periods, income exceeds expenditure, while in others, expenditures surpass income. Thus, economic units must either invest their savings or access financing sources to balance income and expenditure [45]. Units with a savings surplus make their funds available in exchange for a return, whereas those with a savings deficit seek to utilize these resources.

The fundamental rationale for the existence of financial markets lies in the inability of individual or institutional actors to balance savings and investment independently. Consequently, the mechanisms that bring together suppliers and demanders of funds constitute financial markets. In a country, the institutions that facilitate resource flows between fund suppliers and demanders, the securities that make these transactions possible, and the legal–administrative framework that regulates these interactions collectively form the structure of financial markets [13, 16].

Today, financial markets extend beyond traditional debt instruments and securities, having become increasingly complex due to technological advances and globalization. FinTech applications, crypto-assets, digital payment systems, and green bonds are now integral components of modern financial markets. Within this context, financial markets play a critical role in supporting economic growth, ensuring efficient capital allocation, and distributing risk [7, 49].

Financial markets are indispensable both at the micro and macro levels for ensuring economic stability, regulating the flow of funds, and enabling the efficient allocation of resources. Therefore, the institutions, instruments, and regulations within financial systems must be continuously updated in light of contemporary developments. Figure 1 presents the components of financial systems [13].

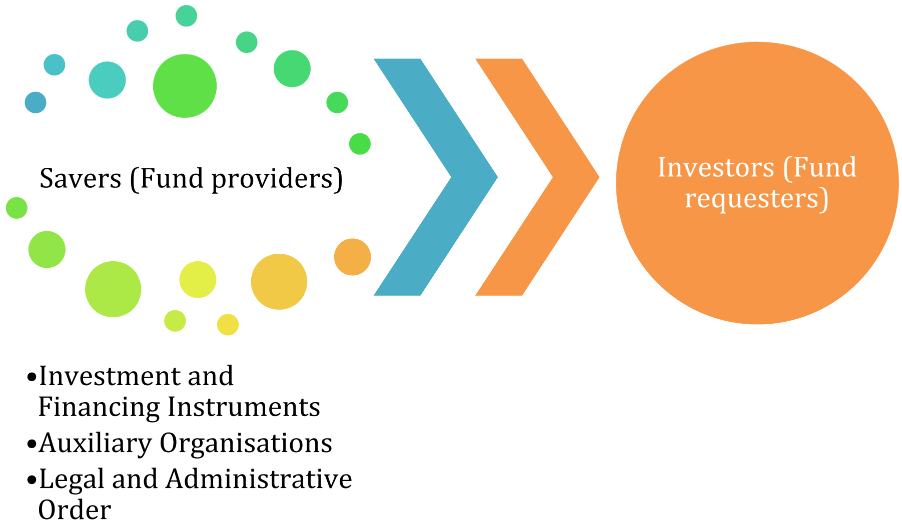

Figure 1. Components of the Financial System [13]

4.1 Types of Financial Markets

Financial markets can be classified from different perspectives based on their structure and functions. One of the most common classifications is made according to the maturity of funds being lent. In this context, markets are generally examined under two main groups: money markets and capital markets [56, 96].

4.1.1 Markets According to the Maturity of Funds Lent

Money Markets: Money markets are markets where financial instruments with maturities typically of one year or less are traded. In these markets, the supply and demand for funds are met through short-term instruments. Therefore, the risk of default is relatively low, while liquidity is high. These features make money markets critical for the short-term fund management of the economic system [13, 72, 96]

The main instruments used in money markets include checks, promissory notes, bills of exchange, commercial papers, certificates of deposit, repurchase agreements (repos), and treasury bills. Since these instruments are short-term, price fluctuations are limited while liquidity remains high. Especially during periods of high interest rates, investors tend to prefer short-term instruments, which increases the importance of money markets [28, 96].

Capital Markets: Capital markets are markets where the supply and demand for funds with maturities longer than one year meet. Because the maturity is longer, interest rates and risk factors are relatively higher. There is a continuous flow of funds between money markets and capital markets, and the two operate in a complementary manner [7, 45, 49].

Capital markets are further divided into primary and secondary markets:

•Primary Markets: These are markets where financial instruments (such as stocks, bonds, and promissory notes) that have never been traded before are issued and enter circulation for the first time. Thus, they serve as a direct source of capital for institutions demanding funds.

•Secondary Markets: These are markets where previously issued securities are traded among investors. Secondary markets not only provide liquidity for investors but also contribute to the pricing of financial assets and the improvement of market efficiency [5, 45, 56]

4.1.2 Markets by Transactions

Financial markets can also be classified according to the nature of the transactions carried out, and are divided into organized (regulated) markets and over-the-counter (OTC) markets [45, 56]

Organized Markets: Organized markets are those in which transactions take place within centralized exchanges under a set of well-defined rules. Their key characteristics include:

- The presence of a physical location or, in modern settings, advanced electronic trading platforms,
- Transactions conducted under strict supervision and regulatory oversight,
- Standardized rules and procedures governing transactions.

Financial instruments traded in organized markets typically operate under transparent pricing mechanisms and are subject to strong investor protection regulations. Examples include the Tokyo Stock Exchange, the New York Stock Exchange (NYSE), and Borsa Istanbul [45, 81].

Over-the-Counter (OTC) Markets: In contrast, OTC markets are decentralized markets where transactions are executed outside centralized exchanges, without a physical trading floor. Trades are often carried out via telecommunications networks, telephones, computer systems, or electronic platforms. The main feature of OTC markets is that oversight and regulation are either limited or more flexible. This provides participants with greater freedom of negotiation and the possibility of designing customized contracts. Examples include the London OTC market and the global foreign exchange (Forex) markets [5, 46, 96].

In recent years, the scale of OTC markets has expanded significantly, especially with the growth of derivative instruments, foreign exchange trading, and cryptocurrency markets. This development has raised critical questions about transparency, regulation, and systemic risk management in global financial systems [7, 9].

5. The Role of Game Theory in Financial Markets and Strategic Decision-Making

5.1 The Role of Game Theory in Financial Markets

In financial markets, game theory is used to model dynamic processes such as competition and cooperation, arbitrage and pricing strategies, and speculation and manipulation. The analysis of strategic interactions is critically important for understanding market mechanisms and enhancing rational decision-making processes [65, 91].

5.1.1 Traditional / Competition and Cooperation

In traditional competitive models, long-term information sharing is highly limited. The most important criterion in supplier selection is the price of the product to be purchased. Parties prefer to act independently while minimizing communication; information transfer is restricted to the features of the demanded products [63, 82].

Conversely, the importance of cooperative relationships has grown steadily. For example, when British manufacturers began to lose their global competitive advantage, they regained it by transforming competitive supplier relationships into collaborative models [58]. In cooperative market structures, the objective is not only to reduce prices but also to increase risk-sharing, knowledge transfer, and innovation capacity [11, 73].

5.1.2 Arbitrage and Pricing Strategies

Game theory is a powerful tool for analyzing arbitrage opportunities and pricing models. Arbitrage pricing strategies explain how investors optimize the risk–return balance. Within this framework, investors account for factors such as default risk, interest rate risk, market risk, purchasing power risk, and management risk to establish a risk–return relationship [30].

In modern literature, this approach has been extended through the Arbitrage Pricing Theory (APT) and game theory-based pricing methods. It has been demonstrated that, especially in multi-period models, investors' strategic behaviors play a decisive role in price stability [30]. Furthermore, in the context of artificial intelligence and algorithmic trading, game theory-based pricing models have emerged as a current research area for understanding market microstructure [10, 26].

5.1.3 Speculation and Manipulation

Manipulation refers to the attempts of individuals or institutions to influence markets for their own benefit by spreading false or misleading information [21, 66]. Such practices often involve generating false news, spreading rumors, or artificially inflating trading volumes [98].

Speculation, on the other hand, is the risky trading activity based on expectations about future price movements. Game theory models how speculation and manipulation can distort market pricing [78]. Recent studies highlight that speculative activities have been amplified by algorithmic trading, cryptocurrency markets, and the influence of social media [12, 19, 83].

5.2 Market Equilibria and Game Theory

Game theory is applied to the analysis of different types of market equilibria, such as perfect competition, oligopoly equilibrium, and speculative bubbles and crises.

Perfect Competition Equilibrium: Markets with many buyers and sellers where prices are not influenced by individual firms. Game theory is used to explain price formation and optimal strategies in these settings [3].

Oligopoly Equilibrium: Emerges in markets dominated by a small number of players. An example is when major banks set interest rates in the banking sector. Cournot, Bertrand, and Stackelberg models are widely used in these markets [91, 93].

Speculative Bubbles and Crises: Occur when players imitate one another, causing asset prices to deviate excessively from their intrinsic values, followed by sudden collapses. Typical examples include the 2000 Dot-Com Bubble and the 2008 Global Financial Crisis [1, 33, 47, 75]. More recently, bubbles observed in cryptocurrency markets have also been analyzed within the framework of game theory [17, 19].

5.3 Strategic Decision-Making

Strategic decisions are defined as choices made in environments characterized by intense competition, constant change, high levels of uncertainty, risk, and complexity. These decisions have long-term implications and directly shape the future direction of the organization. The primary objective of strategic decisions is to secure a more advantageous position relative to competitors and to ensure sustainable competitive advantage [70, 92].

Such decisions are expected to be original, pioneering, innovative, sustainable, and effective in addressing dynamic environmental conditions and organizational needs [69]. By their nature, strategic decisions often require the integration of analytical reasoning, managerial foresight, and adaptive capabilities. The fundamental characteristics of strategic decision-making are summarized in Table 2 [69].

One of the most decisive factors in the strategic decision-making process is the nature of the environment in which the decision is made. The decision-making environment directly influences the quality of the decision, as it determines the type of information available to managers, the level of uncertainty, and the perception of risk. Within this framework, strategic decisions are addressed under different classifications. In the literature, decision types are examined under five main categories: (i) decisions based on the environment in which they are made, (ii) decisions according to the level of management, (iii) decisions according to their structure, (iv) decisions based on the degree of interconnection, and (v) decisions according to the evaluation criteria considered [35, 69].

Table 2. Fundamental Features of Strategic Decision-Making

Category	Definition	Practical Implication
Creative and Innovative	The ability to adapt to change and respond to competitive conditions	Creating new businesses in competitive settings by disrupting (transforming) existing industries
Change-Oriented	Persistently pursuing transformation and development in the face of evolving expectations, needs, products, time, space, environment, and ideas	Anticipating the future of the organization and striving to differentiate from competitors
Sustainable	Ensuring continuity in competition, growth, permanence, and eco-environmental protection	Expanding the organization’s access to resources and markets
Effective	The ability to set the right goals and achieve them, ensuring decision-makers reach accurate outcomes	Using resources at the right place and time while minimizing risks

This classification demonstrates that the strategic decision-making process cannot be reduced to a single dimension; rather, it is shaped by a combination of factors such as the level of information, risk conditions, organizational hierarchy, the structural characteristics of the decision, and the diversity of criteria. Particularly in recent years, with the growing prevalence of uncertain and risky decision-making environments, behavioral approaches [44], multi-criteria decision-making techniques [77, 94], and data-driven decision support systems [74] have become increasingly utilized.

Therefore, distinguishing decision types in this way enables a more systematic analysis of strategic decision-making processes and provides managers with the ability to make more rational choices under varying conditions [22, 38].

5.3.1 Decisions According to the Environment in Which They Are Made

The decision-making environment is one of the most critical factors shaping the nature of the decision process. In the literature, these environments are generally classified under three categories [22, 35, 36]:

•Certain Decision-Making Environment: Situations in which decision alternatives and possible outcomes are known, and information flow is relatively complete. Rational decision-making models dominate in such contexts.

•Uncertain Decision-Making Environment: Situations characterized by a lack of information, where probabilities of outcomes are unknown. Decision-makers typically operate under bounded rationality.

•Risky Decision-Making Environment: Circumstances where alternatives and probabilities are known, but outcomes remain uncertain. Decisions are often based on measures such as expected value, variance, and standard deviation. This environment is particularly common in modern financial markets [44, 55].

5.3.2 Decisions According to the Level of Management

Decisions can also be classified according to the hierarchical level of management [35, 51]:

•Strategic Decisions: Taken by top management, these decisions are long-term, complex, and have broad organizational consequences.

•Tactical Decisions: Made by middle-level managers, these decisions serve to implement and operationalize strategic goals.

•Operational Decisions: Taken by lower-level managers, these decisions focus on routine, day-to-day operations.

5.3.3 Decisions According to Their Structure

The structural nature of decisions further determines the characteristics of the decision-making Process [35, 51]:

•Structured Decisions: Routine and repetitive, these decisions follow standardized procedures.

•Semi-Structured Decisions: Partially guided by established procedures, but requiring intuition and judgment for unresolved aspects.

•Unstructured Decisions: Novel, non-routine decisions made under conditions of high uncertainty and complexity.

5.3.4 Decisions According to the Degree of Interconnection

Decisions may also be distinguished based on their degree of interdependence [35, 51]:

•Single-Stage Decisions: Independent decisions where outcomes are determined by a single choice.

•Multi-Stage Decisions: Sequential decisions in which one decision affects subsequent ones, creating a chain of interrelated outcomes.

5.3.5 Decisions According to Evaluation Criteria

Finally, decisions may be classified based on the number of criteria considered in the evaluation process [35, 51, 77]:

•Single-Criterion Decisions: Decisions based on the optimization of a single objective or criterion.

•Multi-Criteria Decisions: Decisions involving the simultaneous optimization of multiple objectives. In contemporary practice, these decisions are increasingly supported by Multi-Criteria Decision-Making (MCDM) methods, such as the Analytic Hierarchy Process (AHP).

6. Conclusion

Game theory emerges as an indispensable tool in analyzing complex and uncertain situations encountered both in daily life and in professional contexts. The resolution of strategic interactions through mathematical models allows for a deeper understanding of the processes of competition and cooperation among individuals, firms, and institutions. In particular, the determination of strategies and the accurate analysis of the information derived from these strategies are of critical importance for rational decision-making processes in markets. The reliability and timeliness of the datasets used directly affect the accuracy of the results obtained, which clearly highlights the necessity of proper modeling.

In this study, the role of game theory in strategic decision-making and market equilibria within financial markets has been examined, with national and international literature comparatively assessed in terms of objectives, methods, and findings. The results show that game theory makes significant contributions to portfolio optimization, risk management, market liquidity, pricing strategies, and blockchain/DeFi-based systems. Cooperative models provide advantages in risk sharing and diversification, while non-cooperative models generate more conservative strategies under uncertainty. This contrast offers a strong framework for explaining the strategic behaviors of market participants.

Nevertheless, certain limitations in the literature are noteworthy. Most studies remain at a theoretical level, while empirical validations and behavioral dimensions are insufficiently addressed. Applications concerning blockchain and cryptocurrency markets are promising; however, they face critical challenges such as regulatory uncertainties, scalability issues, and data reliability. Furthermore, the integration of experimental economics and AI-supported game theory models into financial markets remains quite limited.

In terms of future research, the following concrete directions stand out:

1. Broader applications of game theory in cryptocurrency and DeFi ecosystems,
2. Integration of behavioral game theory with investor psychology in decision-making models,
3. Development of game theory–based early warning mechanisms for speculative bubbles and financial crises,
4. Integration of multi-criteria decision-making (MCDM) methods with game theory,
5. Enhancement of market forecasts through AI-supported algorithmic game theory models.

In conclusion, game theory is not merely a theoretical modeling tool in financial markets; it also stands out as a powerful analytical approach that makes strategic decision-making processes more rational, effective, and realistic. This study provides both conceptual and applied contributions to the existing literature, while also offering concrete recommendations and shedding light on new research avenues for scholars and policymakers.

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