

The Application of Basic Game Theory in Financial Decision-Making

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Abstract. This paper examines the application of basic game theory in financial decision-making, with a focus on strategic interaction, information asymmetry, and equilibrium outcomes in financial markets. Traditional financial decision-making models often assume that market participants act independently and have access to similar information. However, in reality, investors, firms, and financial institutions frequently make decisions by predicting the behaviour of others. Based on the theoretical foundations of von Neumann and Morgenstern's game theory and Nash's equilibrium concept, this paper reviews how game-theoretic models can explain important financial phenomena. It mainly discusses three areas: investment decisions, market information efficiency, and IPO pricing. Grossman and Stiglitz's model shows that perfectly informationally efficient markets are impossible when information acquisition is costly, while Rock's IPO underpricing model explains how asymmetric information between informed and uninformed investors leads to discounted offer prices. The paper concludes that game theory provides a useful framework for understanding financial decision-making, but its application is limited by assumptions of rationality, the complexity of markets, and the difficulty of measuring information asymmetry.

Keywords: game theory, Nash equilibrium, financial decision-making, information asymmetry, IPO pricing

1. Introduction

Financial decision-making is not only a process of calculating risk and return, but also one of strategic interaction among different market participants. In real financial markets, investors, firms, underwriters, and financial institutions often make decisions while considering how others may respond. For example, investors may change their portfolio choices according to market expectations, while firms may adjust financing or pricing decisions based on the possible reactions of investors. However, traditional financial models sometimes rely on simplified assumptions, such as perfect rationality, symmetric information, and independent decision-making. These assumptions make it difficult to fully explain many real financial phenomena, especially when information asymmetry and conflicts of interest exist.

Game theory provides a useful framework for analysing these problems because it focuses on how rational participants choose strategies in situations where their outcomes depend on the actions

of others. This paper reviews the application of basic game theory in financial decision-making. First, it introduces the basic concepts and development of game theory, including von Neumann and Morgenstern's contribution and Nash equilibrium. Second, it discusses how game theory can be applied to financial decisions, especially investment decisions, market information efficiency, and IPO pricing. Finally, it analyses the limitations of game-theoretic models in finance and discusses their future development. By reviewing classical literature, this paper aims to show that game theory can help explain strategic behaviour in financial markets and can provide a more realistic perspective for understanding financial decision-making.

2. Theoretical foundations of game theory

Game theory provides an important theoretical framework for analysing decision-making situations in which the outcome of one participant depends not only on his or her own choice, but also on the choices made by others. In financial markets, investors, firms, underwriters and other market participants do not make decisions in isolation. Their decisions are usually affected by expectations about the behaviour of other participants. Therefore, game theory is especially useful for studying financial decision-making under conditions of uncertainty, information asymmetry, and strategic interaction.

The modern formalization of game theory can be traced back to the seminal work *Theory of Games and Economic Behavior* by von Neumann and Morgenstern. Their work attempted to provide a mathematical treatment of economic behaviour and argued that many economic problems could be analysed through the theory of games of strategy [1]. In their view, economic problems such as exchange, monopoly and competition involve interactions among different decision-makers, and these interactions require analytical tools different from traditional economic methods. The book therefore established an important foundation for applying mathematical models to economic and financial behaviour. As von Neumann and Morgenstern suggested, the theory of strategic games is closely related to economic theory and can offer a new approach to unresolved economic questions.

Nash's contribution further expanded the application of game theory. In his paper *Equilibrium Points in N-Person Games*, Nash formalized the definition of an n-person game: every player possesses a finite set of pure strategies, and each player's final payoff is determined by the full strategy profile selected by all participants [2]. He also introduced the concept of an equilibrium point. A strategy combination is an equilibrium when each player's strategy is the best response to the strategies chosen by the others. This concept is highly relevant to financial decision-making because market participants often choose strategies by considering the possible reactions of other participants. For example, investors adjust their portfolios according to expectations about other investors' behaviour, while firms consider market reactions when making financing or pricing decisions.

3. Game theory and financial decision-making

Allen and Morris provide a useful overview of why game-theoretic models are important in finance. They explain that finance is mainly concerned with how investors' savings are allocated through financial markets and intermediaries to firms. They also divide finance into two broad areas: asset pricing, which focuses on investors' decisions, and corporate finance, which focuses on firms' decisions [3]. This classification framework facilitates a clear analysis of how game theory can be applied to diverse financial strategic decisions. In asset pricing, game theory helps explain how

investors form expectations and respond to information. In corporate finance, it helps analyse how firms, managers and investors make strategic choices under asymmetric information.

Traditional financial models often assume certainty, symmetric information or representative investors. However, Allen and Morris argue that finance developed as an independent field after uncertainty was introduced into asset pricing and after classical analysis failed to explain many aspects of corporate finance [3]. This point shows why game theory is necessary in finance. Real financial markets are uncertain and interactive. Prices, investment decisions and financing choices are affected by many participants who have different information and different objectives. As a result, financial decisions often resemble games rather than simple individual optimisation problems.

Allen and Morris also note that early game-theoretic models revolutionized finance, but that many problems remain unexplained. They suggest that richer informational models are especially relevant for the future development of finance [3]. This argument is important because it connects game theory with one of the most important features of financial markets: information asymmetry. In reality, some traders, firms or institutions may possess better information than others. Their decisions influence prices and the decisions of less-informed participants. Therefore, game theory can help explain why market outcomes may differ from the predictions of traditional efficient market models.

4. Investment decisions and market information

One major application of game theory in finance is the analysis of investment decisions under asymmetric information. Grossman and Stiglitz's paper *On the Impossibility of Informationally Efficient Markets* is a classic contribution in this area. They challenge the idea that financial markets can be perfectly informationally efficient. Their argument is that if prices fully reflected all available information, investors would have no incentive to spend resources collecting information. However, if no one collected information, prices could not fully reflect information. Therefore, perfectly informationally efficient markets are impossible when information acquisition is costly [4].

This model is closely related to game theory because it describes a strategic relationship between informed and uninformed traders. Grossman and Stiglitz explain that prices reflect the information of informed individuals only partially, allowing those who spend resources on information to receive compensation. They also argue that the number of informed traders is endogenous, meaning it depends on the incentives created within the market. In this sense, investment decision-making becomes a strategic game. Each investor weighs the expected excess returns from private information against information collection costs to decide whether to engage in costly information acquisition.

The distinction between informed and uninformed traders is particularly important. In the Grossman and Stiglitz model, informed traders observe costly information, while uninformed traders rely mainly on prices. Prices reveal some information, but they do not reveal everything because uninformed traders cannot perfectly distinguish whether price changes are caused by informed trading or by other market factors [4]. This explains why information asymmetry can persist in financial markets. It also shows that financial prices are not just passive reflections of value; they are the result of strategic interactions among traders with different information.

This literature is useful for analysing investment decisions and portfolio choices. Traditional portfolio theory focuses mainly on the trade-off between risk and return. From a game-theoretic perspective, however, each investor must additionally anticipate the information acquisition behaviours, price signal interpretation logic and portfolio rebalancing strategies of rival market

participants. When more investors become informed, the price system becomes more informative, but the relative advantage of informed traders may decline. Grossman and Stiglitz therefore show that financial markets may reach an equilibrium in which some investors choose to become informed while others remain uninformed. This equilibrium perspective helps explain why different investors adopt different investment strategies in the same market.

5. Game theory and IPO pricing

Another important application of game theory in financial decision-making is IPO pricing. Rock's paper *Why New Issues Are Underpriced* provides a classic model of IPO underpricing based on information asymmetry among investors. Rock argues that IPO underpricing depends on the existence of a group of investors who have better information than the issuing firm and other investors. If new shares are priced at their expected value, informed investors will participate heavily in good issues and avoid bad issues. As a result, uninformed investors are more likely to receive shares in bad issues and less likely to receive shares in good issues. To attract uninformed investors, firms must offer shares at a discount [5].

Rock's model can be understood as a game among issuing firms, informed investors and uninformed investors. The issuing firm chooses an offer price. Informed investors decide whether to participate based on their private information. Uninformed investors decide whether to buy shares based on their expectation of allocation and return. This setting is strategic because each participant's decision depends on the expected behaviour of the others. The firm cannot simply set the IPO price at the expected value of the shares, because doing so may discourage uninformed investors from participating.

The mechanism of rationing is central to Rock's argument. In a firm commitment offering, the firm and its investment bank agree on a price and quantity before the offering. In cases of oversubscription, the underwriter rations shares; in cases of undersubscription, some shares go unsold. Importantly, the presence of informed trading is not fully observed until after the offering date [5]. This creates uncertainty for uninformed investors. When good issues are oversubscribed, informed investors crowd into the offering and uninformed investors may receive only a small allocation. When bad issues are offered, informed investors withdraw and uninformed investors may receive more shares. Therefore, uninformed investors face a winner's curse.

Rock shows that underpricing is a natural result of asymmetric information and rationing. If uninformed investors expect to receive fewer good issues and more bad issues, they will lower their valuation of IPO shares and may refuse to participate unless the offer price is discounted. This model explains why IPO underpricing can be a rational equilibrium outcome rather than a pricing mistake. It also shows how game theory can explain real financial phenomena that are difficult to understand through traditional valuation models alone.

6. Limitations and future development

Although game theory provides powerful tools for analysing financial decision-making, the literature also shows several limitations. First, many game-theoretic models depend on strong assumptions about rationality. In reality, investors may be influenced by emotions, overconfidence, herd behaviour and other behavioural biases. Second, information asymmetry is difficult to measure precisely. Models such as those of Grossman and Stiglitz and of Rock clearly show the importance of information, but real markets contain many types of information, and the quality of that information varies across investors and institutions.

Third, financial markets are dynamic and complex. A simple static model may not fully capture continuous changes in prices, expectations and market conditions. Allen and Morris point out that game-theoretic methods continue to develop and that richer informational models are especially important for finance [3]. This suggests that future research should combine game theory with behavioural finance, big data and artificial intelligence to better explain real-world financial decisions. Future models may also need to consider higher-order beliefs, meaning not only what investors know, but also what they believe others know and how others will react.

Taken together, the reviewed body of literature demonstrates that game theory has evolved into an indispensable analytical paradigm for decoding diverse financial strategic interactions. Von Neumann and Morgenstern established the mathematical foundation of strategic interaction, while Nash provided the equilibrium concept that allows strategic decisions to be analysed systematically. Grossman and Stiglitz applied this logic to investment decisions and market information, showing that perfect informational efficiency is impossible when information is costly. Rock extended the logic of information asymmetry to IPO pricing and explained why underpricing can emerge as an equilibrium outcome. Together, these studies show that financial decisions are not only technical calculations of value, risk and return, but also strategic interactions among participants with different information, incentives and expectations.

7. Conclusion

In conclusion, this paper has reviewed the application of basic game theory in financial decision-making. The reviewed literature verifies that financial decisions are not isolated individual behaviours, but are profoundly shaped by strategic interdependence among heterogeneous market participants. The works of von Neumann and Morgenstern and Nash provide the theoretical foundation for understanding how rational participants choose strategies and how equilibrium outcomes are formed. Based on these foundations, game theory can be applied to explain important financial issues such as investment decisions, market information efficiency, and IPO pricing.

This literature review confirms that information asymmetry serves as the core driving factor for the applicability of game theory in financial research. Grossman and Stiglitz show that perfectly informationally efficient markets are impossible when information is costly, because informed investors must receive some compensation for collecting information. Rock's IPO underpricing model further shows how asymmetric information between informed and uninformed investors can lead to discounted offer prices. These studies demonstrate that many financial phenomena cannot be fully explained by traditional models that assume perfect information and independent decision-making.

However, the application of game theory in finance also has limitations. Many models rely on assumptions such as rational behaviour, simplified market structures, and clearly defined information. In practical financial scenarios, however, investors are susceptible to subjective emotional biases, herd mentality and pervasive information incompleteness. Therefore, future research should combine game theory with behavioural finance, big data analysis, and artificial intelligence to improve its explanatory and predictive power. Overall, game theory provides a valuable framework for understanding financial decision-making and offers a more realistic perspective on the strategic behaviour of investors, firms, and financial institutions.

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