application of game theory

in accounting

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aBSTRACT

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*Game Theory has been widely used in many studies that analyzed human behavior. But in the field of accounting, in particular the use of Game Theory in Indonesia has not been fully applied to develop the building accounting knowledge and also the theory of accounting to be used as the basis of fundamental research. This is certainly unfortunate, given the potential of game theory for its application in accounting. The objective of this article is to explore the feasibility to adopted game theory for its application in accounting and also analyze the utility of game theory methodology in accounting.*

*Game Theory models the interaction between two or more players and predict the outcome of a conflict between rational individuals characterized by uncertainty and information asymmetric. Hold the assumption that players are rational and expected utility maximizing, game theory analyzes decision-making and strategy of each player performed in a conflict. The similar situation often occured in accounting seeting and make game theory suitable to adopted in accounting field.*

*The potential use and application of Game Theory in the field of accounting is potential to develop in accounting. These areas are: Relations Agency, Sector Auditing, Earnings Management, Contract Work and compensation manager. While the interaction between players that can be observed and studied using game theory can include settings that often occur in the science of accounting, for example: Investors vs. Manager, Principal versus Agent, Manager vs. Creditors, Manager vs. regulators, and also Agent vs auditors.*

*KEYWORDS:*

*Game Theory, Principal-Agent Problems, Asymetric Information*

**ABSTRAK**

*Game Theory* telah secara luas digunakan dalam penelitian yang menganalisis perilaku manusia. Namun dalam bidang akuntansi terutama penggunaan *Game Theory* di Indonesia belum secara penuh dikembangkan dalam membangun pengetahuan dan teori akuntansi untuk digunakan sebagai dasar dari riset fundamental. Tujuan artikel ini adalah untuk mengeksplor kelayakan adopsi *Game Theory* untuk diterapkan di bidang akuntansi dan juga menganalisis penggunaan metodologi *Game Theory* dalam akuntansi.

*Game Theory* memodelkan interaksi antara dua atau lebih pemain dan memprediksi hasil konflik antara ketidakpastian individual yang rational dengan informasi yang tidak simerik. Berdasarkan asumsi para pemain adalah orang yang rational dan mengharapkan maksimisasi utilitas, *Game Theory* menganalisis pengambilan keputusan dan strategi masing-masing pemain yang menghasilkan konflik. Situasi yang sama sering terjadi di dalam *setting* akuntansi dan membuat *Game Theory* sesuai untuk diadopsi dalam bidang akuntansi.

Penggunaan dan aplikasi *Game Theory*  dalam bidang akuntansi berpotensi untuk mengembangkan akuntansi. Area yang dapat dikembangkan adalah: hubungan agnesi, sector audit, pengelolaan laba, kontrak kerja, dan kompensasi manajer. Sedangkan untuk interaksi di antara para pemain yang dapat dikaji dan diteliti dengan menggunakan *Game Theory* meliputi semua *setting* yang sering terjadi dalam ilmu akuntansi, misalnya, investor vs manajer, *principal vs* agen, manajer vs kreditor, manajer vs regulator, dan agen vs auditor.

*Kata kunci:*

*Game Theory, Principal, setting* akuntansi

INTRODUCTION

The company is an organization consisting of many parties. These parties are organized to collaborate all the available resources according to its mission and vission. Achievement of this goal is crucial for the company because of the achievement must be done effectively and efficiently. The company's strategy to achieve its goal to be precise, since involving many parties accomplishments within the organization. The process of achieving this goal should be able to be communicated to the parties which have an interest with the company. The financial report plays its role as tool to communicate financial information to external parties outside the company.

The financial statements are expected to provide information to investors and creditors in decision making process related to economic decisions. The stakeholders often used company’s profit to measure corporate performance. If in a condition where the management did not successfully achieve the specified profit target, then the management will take advantage of the flexibility allowed by the accounting standards in preparing financial statements to modify the financial statements. Management is motivated to show good performance in generating value or the maximum profit so that management tends to select and apply accounting method that can provide a better information.

In agency theory, agency relationship arises when one or more persons (the principal) hire another person (the agent) to provide a service and then delegate decision-making authority to the agent (Jensen and Meckling, 1976). Agency relationship is a contractual relationship where the managers who run the company's operations have information advantages compared to principal. Therefore manager more aware of internal and prospect information in the future than the owners (shareholders). In these conditions the manager should provide a signal about the state of the company to the owner. However, the information is not always provided with the actual conditions of the company. This condition is known as asymmetric information (Harris, 2004).

Jensen and Meckling (1976) stated that the conflict of interest in the agency relationship between the owner and the agent happen because of the possibility of agents do not always act in accordance with the interests of the principal, thus triggering the agency cost. As agents, managers responsible to optimize the benefits of the owner (principal) and in return will receive compensation in accordance with the contract. Thus there are two different interests in the company in which each party seeks to achieve or maintain a desired level of wealth (Ali, 2002)

Eisenhardt (1989) states that the agency theory using three assumptions of human nature, ie (1) self-interest, (2) bounded rationality and (3) risk averse. Based on the assumption of human nature that the agent will act opportunistically, with emphasis on personal interests (Harris, 2004). The existence of information imbalance will lead to the emergence of a condition known as information asymmetry.

Conflicts among parties as constituents in the agent-principal relationship can be modeled as a game, because the decisions required by the different constituents may not be similar. Investors will want financial statement information relevant and reliable in assessing the expected value and the risks their investment. Manager are not always willing to reveal all the information needed by investors. Manager also prefer to not reveal all of the accounting policies used to manage reported earnings by changing accounting policies when necessary. A conflict between management and principals, with different interests and attempt to maximize expected utiliy between the parties will lead to asymmetry of information. The interaction between two parties to maximizing their expected utility can be modelled as a game according to game theory.

Game theory to analyze decision-making and strategy of each player performed in a conflict. Models in Game Theory is the interaction of two or more players. These interactions occur in the presence of uncertainty and information asymmetry. This makes Game Theory is felt suitable for the underlying conflict between the agent-principal are often caused by the emergence of information asymmetry where the conditions often occur in the setting of accounting phenomena.

This study aims to explore the application of game theory in accounting field and adaptation of game theory metodology. The areas which have the potential application of game theory are: agency relationship, auditing, earnings management, contractual work and compensation. While the interaction between players that can be observed and studied using game theory for example: Investors vs. Manager, Principal versus Agent, Manager vs. Creditors, Manager vs. regulators, and also Agent vs auditors.

Expected findings of this research is the establishment the use of Game Theory in Accounting. Game Theory can be used in setting the decision-making process of the interaction of the economic purposes of accounting phenomena and also the potential application of Game Theory in research design and methodology.

THEORITICAL REVIEW

Game Theory attempts to explore the behavior of human decision-making. We can reference the Game Theory to underlie a variety of issues in financial accounting theory. This theory analyzes the decision-making process when there is more than one decision maker when the outcome of each agent depends on the actions performed by other agents. Because the agents preferences of actions depend on the actions taken by the other party, then the action will depend on the beliefs he held about what action will be done by other parties. In this way, the act of a player depend on the actions available to each agent, each agent preferences on outcome, each player available beliefs about the actions and how each players rank on the results.

The implications of this suboptimal decision process is phenomenal. On the one hand, this is a very basic question that a person's ability to make the best decisions, both for themselves, for others or even society. Nash was moved from this then prove that in an 'n​​' people in a non-cooperative game, a lot of Nash equilibrium point that can arise. The impact of this equilibrium very useful in economic studies.

According to Curiel (1997) there are two main conditions for Game Theory: (1) There are two or more entities . (2) Each entity received compensation that is dependent on the decisions made by the entity and another entity which there is interdependence between compensation)

Rasmusen argue that the information is incomplete in the game of moral hazard. In this situation hidden information and action will lead to the existence of the inverse-choice game, signaling and screening. Participants who are not careful with the quality of information likely to reject high quality information, leading to market failure. This is often reflected in studies that use principal-agent models to describe the effect created by asymmetric information. Principals may represent shareholders, corporate bonds, bank loans. While the agent represents the corporate management of multiple identification regardless, because the manager of the company may have a number of shares.

Game Theory to analyze decision-making and strategy made ​​by players in a conflict. The model in game theory is the interaction process of two or more players. These interactions occur in the presence of uncertainty and information asymmetry. This makes the game theory suitable for the underlying theory, the perceived conflict between the agent-principal are often caused by asymmetry of information. Each player is assumed to maximize expected utility as do investors and managers in the agent-principal relationship.

In game theory, the uncertainty that comes from the realization of a natural condition, and also resulted from the actions of players that should be taken into account by other players. Actions taken by other players can be very difficult to predict, because the actions chosen by the players actions will depend on what players think about what other players are thinking and vice versa. Game theory will be more complex than decision theory and the theory of investment.

According to decision theory, there is one player who plays dealing with natural conditions (nature), in a game played against nature condition can be thought of as the realization of a natural condition which is better able to predict. At the other side, the market is a 'game' with a large number of players. If the market is in perfect economic, the number of players will be so great that action is taken the player can not influence what happens in the market, or in economics is referred to as price-takers, as in investment decisions.

In Game Theory, number of players, which is greater than one but small enough to analyze the actions of one player affect other players, so the conflict of the game where players perform actions of another player's actions could be taken into account. Game theory suggest that the actual number of player lies between the theory of individual decision (single decision) and the market. In game theory, there are several types of games. One of the bases that can be used to classify are cooperative and non-cooperative games. In cooperative games, parties may enter a mutually binding agreement. If the agreement is not possible, then the game is a non cooperative game.

**Agent- Principal Relationship in Game Theory Framework**

Managers have the motivation underlying the economic consequences of its agency relationship with the principal. Understanding of the interests of managers in financial reporting will provide a clear picture of why managers perform certain actions in the agency contract. The interests of the manager can be clarified with the model depicted in game theory. Game theory seeks to model and predict the out come of a conflict between two individuals assumed to be rational. The economic consequences characterized the conflicts arise in this setting. Game theory helps to understand why managers, investors and other parties involved can rationally make a deal on the economic consequences arising from the financial statements. Accounting policies have economic consequences when the contract is affected by this policy. Game Theory will help us to see why the contract is often dependent on the financial statements.

A large number of problems in a corporate environment is characterized by interaction between agent and principal in situation which is asymmetry of information occured. This is the impact arising agency problems, where the principal is not able to fully observe the efforts of agents, so that it takes as much as possible the alignment of incentives between the two parties.

. Principal- agent theory examines the relationship between agent and principal argues that under conditions of incomplete information and uncertainty. In this condition two agency problems will arise, ie: adverse selection and moral hazard. Adverse selection is a condition in which the principal can not know for sure if the agent accurately represents his ability to do a job where he gets paid for it. And moral hazard is a situation where the principal can not be sure whether the agents perform maximal effort.

Theoretical literature on the principal agent indicates that reliable financial reporting can be trusted to be use to induce maximal levels of effort by the agent. This theory assumes that principals know the function of the effort of the agent. The agent assumed to maximize her/ his expected utility. According to these points then the principal will design a construct based on this assumption. Somehow this asumption often not realistic because the level of rationalization which is not realistic to applied to agen decision making process. The empirical proving alsa difficult to do since there are not enough available datas to analize the effort function of the agent.

**Information Asymetric in Agent-Principal Relationship**

Information asymmetry model used as a generic model that explains the existence of information asymmetry. In the asymmetric information, there is one player who knows informations, while the other party does not know the information. In a principal-agent relationship, the agent is a player who knows the information relating to the condition of the company because he/she is in the company's internal parties. While the principal is a player who does not know the information.

Game theory divides games of asymmetric information in the following five categories:

1. Moral Hazard with Hidden action   
The players, the principal and the agent started with information symmetry and agreed to initiate the contract, but then the agent perform actions that can not be observed by the principal.

2. Moral Hazard with Hidden Information   
The agent and the principal started with information symmetry and agreed to start a contract, but then makes actions condition that can be observed by the agent but can not be observed by the principal.   
3. Adverse Selection   
The condition starts with the selected game by agents, the payoff and strategies offered by agents, and can not be observed by the principal. Agents and principals then agreed to make a contract. Information in this condition is incomplete.   
4. Signalling and Screening   
The condition begins with the chosen game by agent (payoff and strategies undertaken by agent), and it is not known by the Principal. These types of games are selected to perform indicated the action of agents that can be observed by the principal. When agents take action before they agreed to perform the contract, then it is referred to signaling, when agents perform actions after the contract, then it is referred to screening

This game uses in the "principal-agent model" to analyze the information asymmetry. Two players involved in this game, ie the agent and the principal, which usually represent the two parties or two individuals. Principals hire the agents and agents perform tasks requiring gain information about the types of actions and strategies undertaken.   
• Principals (uninformed player) is a player who has limited information   
• Agent (the informed player) is a player that has more information than the principal.

Inspiration comes from the creation of assessment company financial policy decision quality (Altman, 1968; Kaplan & Norton, 1992). A lot of cheating going on in the company made ​​by the company's management authority. Cheating is done by an argument involving administrators companies with financial manipulation, dishonesty and ambition to advance personal interests. Further more, they provide information that is not correct financial statements with announce financial statements to deceive financial statement users such as investors, creditors and others. The consequence is that the higher the information asymmetry will be negatively correlated with the stock price. Many of the business executive who has the expertise to make the financial statements to be better than it should be and create enterprise value solely on their personal interests (Beasley, 1996; Luo, 2001).

Agent-principal relationship in this paper refers to the principal-agent model is used to describe the asymmetry of information that could affect this relationship. Principals indicate an agency relationship in general such as shareholders, bondholders, banks as lenders and others. While the agent representing the management company but by ignoring their position as a company owner. Choice of action by managers as agents will affect the selection of the accounting policies that will reflect the transparency of information, investors are trying to avoid risk would then carefully choose the target investment to maintain the best condition.

**Moral Hazard In Information Asymetric Condition**

Information is a valuable economic resource. Unlike economic goods, volume of information more difficult to define. Besides, the quality of information from each economic entity is unique, so that ordinary investors are not able to identify the characteristics of the data contained in the financial statements. Since most informastion disclosure dominated by agents, this create a condition which are (1) investors can not obtain such information (2) principals are prohibited from using certain information by the agent.

The important point is the information not only influenced by the surrounding environment, the information itself affecting other elements in the environment. The information is a public good, where investors will reduce their investment if the information is privatized. The characteristics of existing information, because of the inconsistency of the each parties interests affect of the inability of decision-making with full information. This inability of one party will cause opposite condition of the other party, since this party will use its usefulness more information.

Reluctance to provide full information by the agent in a timely manner or frequently because of the agent intention agent to have more information that is important to other related parties. This condition lead into asymetri information. The parties who have incomplete information will be placed in adverse conditions. Then the reaction to benefit themselves is referred to moral hazard. We can define moral hazard as the effect that the agent uses the economic entity to perform actions that could increase the likelihood of loss of principal (Rasmusen, 2001). In this incomplete information condition, decision-makers should try to get as much information as possible to reduce the negative effect of these uncertainties.

The public information announced on the market through the company's financial statements, forecasting financial statements, and other operating information help investors evaluate their investment strategies. If the investor uses the information contained manipulation by the agent as the provider of this information, investors could adopt the wrong strategy based on existing information. Compared with external investors, management companies always have excess information. Conversely, investors who make investment decisions solely on the disclosure of information from the management company. For these reasons, the competent authority of the capital market requires insight on the phenomenon of asymetric information and take an action to revise law and relevant regulations to protect minor investors.

The Application of Game Theory in Accounting

Game theory predict the outcome of the interaction between the parties, where one party actions taken directly affects the payoff obtained by other parties that participate in an interaction. interaction between related parties is certainly done in the decision-making process involving these parties. this decision-making process can be a fairly complicated thing, given the results of the interaction in this process would affect the results in the form of economic benefits. this interaction is a form of strategic actions to be taken by each party with a vested interest respectively.

Game Theory ideal in situations where strategic competitive or individual behavior can be modeled in many areas, decisions and conditions. In particular, a strategic game that can be played for a variety of modeling various processes of interaction, a variety of payoffs and potential strategies that could be done. The aim of this game is: 1 gives a series of recommendations to guide strategic decision results in an optimal action. 2 Analyze how a series of strategic steps can predict the outcome of optimal decision-making. The different types of games can be used depends on the strategic situation, number of players and the amount of information available and the time constraints. The characteristics of game theory fits in accounting field and has the potential to be applied in various areas of accounting.

Analysis of the conflict in relation to the financial accounting using Economic models Game theory and its branches, the Agency Theory. Agency theory is a kind of Cooperative Game Theory modeling maanger contract between the owner and the business entity. Agency theory in this case, there is the implication that the net income plays a role in motivating and supervising the performance of managers. Non-cooperative models may provide ideas in the conflict of interests between different groups on users of accounting information.

The Agency theory often used as theoretical framework in accounting. As an cooperative game in game theory theory, the use of agency theory is not necessarily appropriate for every context of interaction in accounting. To accomodate phonemena in accounting game theory can be consider to adopt in accounting as an underlying theory. The description explain why game theory is approriate to adopt in accounting field.

According to the characteristics of game theory which is rooted in math disipline and how game theoy adopted in another major outside math, here are several factor should be consider when game theory have to adopted in accounting:

* + - 1. Avoiding mathematical notation while maintaining the fundamental aspects of Game Theory
      2. Focus on games that have available from previous work in game theory and choose one of them which is fit for the observed phenomenon.
      3. Required knowledge in the field of behavioral accounting and decision-making processes related to accounting information, rather than accounting as a process of construction of financial statements.
      4. Game theory can be applied in wide area of accounting, where there is interaction as the decision making process.
      5. Game theory very potential to adopt in accounting field as an alternative research metodology.
      6. Applied game theoy can be enhancing the development of body of knowledge of accounting.
      7. Understanding in math is a necessary in using game theory. The mastery of mathematical notation will enhance the understanding the use of game theory in accounting.
      8. The accounting phenomenon modeled from real through simplification process via assumptions.
      9. The explanatory and predictive power of game theory can be identified.
      10. Outcome of the game or payoffs for each party could be identified
      11. Underlying the process of modeling in economics
      12. Used as a tool to understand the principles of economics, both at the level of macro-economic and economic mirko.
      13. Game Theory is generally accepted as a standard tool in microeconomics, so accounting can be accommodated the use of Game Theory in scientific development.
      14. Game theory is an effective tool to teach accounting to students who study business and finance.
      15. Can be used as a tool to explore accounting for students through an interdisciplinary approach.
      16. Game theories have a very fundamental concept that enables to be adapted in accounting to implement on strategic decision-making process.
      17. Application of Game Theory requires understanding in accounting and also requires students to think critically about the assumptions used in the economic model and the effect the assumptions used in the modeling. Game Theory will encourage students to think critically about this.

Adaptation of Game Theory in Accounting is possible by taking into account the following aspects:

1. Restricting the use of mathematical notation which are difficult to understand for people without mathematical background
2. Game theory can be applied in accounting using applied math rather than theoritical math. The simplification of using theoretical math in accounting make the adaptation of game theori easier to understand.
3. Application of game theory in accounting can be using the extensive form or matrix rather than complex mathematical notation
4. Adopting game theory in accounting can be done by selecting phenomenon which is specific enough to be modeled in a common setting.
5. Using relevant assumptions to contrained the application of game theory, thus reducing the complexity.
6. Since game theory analyze the interaction process, it requires understanding in domain of accounting behavioral thus develop this part.
7. Provide a wider portion of interest in accounting, spesifically on strategic decision making process and not limited to the construction process of the financial statements.

**Advantages and Limitations of Application of Game Theory in Accounting:**

**Advantages**

1. The right interaction seting should be considered in accounting domain.
2. Enhance to build a theoretical foundation that is in line with the real situation and avoid misconceptions
3. Game theory can be used to explain the observed phenomena and the interaction of decision-making processes in accounting.
4. Game theory also can be adopted into research methodology in accounting to contributes the development of science
5. Game Theory helps us to know how to understand a situation of conflict and improve the quality of the result in the decision making process.
6. Accounting is an applied social science involving human interaction, this condition fit approached by game theory.
7. Game theory rooted in math which need decessary adaptation to a more universal language rather than mathematical notation according to the scientific of accounting
8. Identify the stakeholders involved in the process of interaction and interaction phenomena requires thorough observation and observation.
9. In the process of adaptation of game theory required modeling process
10. Provide added value to the contribution the application of the theory to be alternative solutions that address the real problem, because the theory is built on the conditions and phenomena that occur in a particular social setting. Game theory can be used to build theoretical framework from real phenomenon.

**Limitations**

1. Players who interact not have all the information needed by Game Theory. Most of them do not know all the strategies available and also do not know all the strategies available to a player rivals.
2. Players have to deal with high uncertainty, which have to restrict themselves to the known game results.
3. Techniques for the completion of a strategic game involving mixed payoff where the matrix is large enough, it becomes very complicated.
4. In non zero sum game the mathematical answer is not always possible. For example, the decline in commodity prices may be increasing overall demand. It is also not necessarily that the unit needs to be shifted from one player to another player.
5. In cooperative game players could not entirely follow the rules of the game.
6. The assumption that players have knowledge about their payoff and the payoff that the other party is not practical in the real world.
7. Techniques to finish the game involves a combined strategy, especially in very large payoff matrix would be very complicated.
8. Not all problems can be analyzed with the help of interaction in game theory.

Research on the basis of Game Theory in Accounting can be done by:

1. Research using secondary data   
2. Descriptive Research  
3. Analytical research, theorytical using mathematical notation   
4 Research using analytical modeling   
5. applied research using modeling   
6 experiments research  
7 class-action research

Game Theory Applications in accounting research can be done in three main areas:

1. Game Theory can be applied to the analysis of information disclosure requirements where the information could affect the collective bargaining power. Pope & Peel (1981) and Frantz & Walker (1997) provides a description of the slow lorises useful in limiting the application of game theory to model the equilibrium is possible when this is voluntary disclosure. The main limitation associated with the effect multi period, sequential disclosure and reputational effects. The constraints can be applied also accounting research using Game Theory base.
2. Research by adopting Game Theory can also be used to analyze the interaction between the client and the auditor (Hansen & Watts, 1997) which involves the formation of a hypothesis test that the selection between standard and game theory. Although it is assumed all the interaction is of a standard or strategic, they believe that these two types of phenomena appear. Scott (1997) provide a critique of these applications with a focus on two main issues, the first is the econometric problems associated with the use of availabe data to test two existing models. Both earnings management roles in financial reporting.
3. Another possible research area of Game Theory is an analysis of the regulatory accounting. Amershi, Demski and Wolfson (1982) provides an analysis of the regulatory accounting teortikal and development of the strategic model of standards-making process by the standard setters.

CONCLUSION

Game theory methodology need to be considered in the strategy development process. First, game theory assumes that players act rationally and based their own interest, which not always fit with real condition. Second, game theory assumes players act strategically response and consider other players in their actions. However, experience also shows that not all players will be thinking in the context of the strategy. Game theory will be very effective when managers understand the positive and negative payoffs for their actions. But in reality, most players do not have much knowledge about this.

Game theory when applied correctly, can reduce the risk for actions taken in the decision-making process. By using Game Theory it is hoped will produce a valuable discourse, improve alignment between strategic decisions and maximize utility. Thus it would be able to clarify thinking in every decision-making process interaction.

Game Theory is a technique that can be used to analyze strategic problems in a variety of different environments. Application of Game Theory can be done in the field of accounting. This article seeks to explore the use of Game Theory adaptation in the field of Accounting. The use of mathematical language as used in Game Theory often cause obstruction to the use of this science in the field of accounting. Despite this obstacle game theory can be considered to be applied in accounting to enchace the building block in this dicipline.

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