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What Does Theory of Moves Enable that Classical Game Theory Could Not? A Study on Methodological Tools of Theory of Moves

Hareketler Teorisi Klasik Oyun Teorisinin Sağlayamadığı Neyi Sağlıyor? Hareketler Teorisinin Metodolojik Araçları Üzerine Bir Çalışma

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ÖZ

Oyun Teorisi ve oyun teorisi modelleri uzun yıllardır bilhassa uluslararası siyaseti ve rasyonel aktörlerin stratejik etkileşimlerini irdelemek, genel olarak sosyal dünyanın dinamiklerini incelemek için kullanılmaktadır. Oyun Teorisi'nin açıklayıcı kapasitesini geliştirmek için çeşitli modeller ve yaklaşımlar geliştirilmektedir. Bu bağlamda Hareketler Teorisi stratejik etkileşimleri daha gerçekçi bir şekilde inceleyip açıklayabilmek için Stephen Brams tarafından geliştirilmiştir. Bu makalenin amacı, Hareketler Teorisi'nin temel varsayımları, kuralları ve kavramlarını, Klasik Oyun Teorisi'nin yapısı ve kısıtlarıyla bir arada inceleyerek Hareketler Teorisi'nin sağladığı metodolojik araçları değerlendirmektir. Hareketler Teorisinin Oyun Teorisi'ne yaptığı dikkate değer katkılar olduğu savunulurken, Hareketler Teorisi'nin kendi metodolojik kısıtlarına da dikkat çekilmiştir.

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ABSTRACT

Game Theory (GT) and game-theoretic models have been used for many years to examine particularly international politics and strategic interactions between rational actors, in general, the dynamics of the social world. Different models and approaches have been developed to enhance the explanatory capacities of GT. In this regard, Theory of Moves (TOM) was developed by Stephen Brams in order to analyze and explain strategic interaction more realistically. The purpose of this article is to examine the main assumptions, rules and concepts of TOM with the structure and drawbacks of Classical GT to evaluate methodological tools of TOM. The purpose of this article is to examine two game-theoretic models, Classical GT and TOM, and to scrutinize what sorts of methodological utilities could be achieved by them. Thus it is aimed to illustrate methodological constraints and drawbacks of Classical GT and how the rules and features of TOM intend to overcome these issues. In the study, although it is claimed that TOM made remarkable contribution to GT, the methodological constraints of TOM are pointed out.

1. Introduction

Game Theory (GT) can be defined as the study of mathematical models of conflict, cooperation between intelligent, rational decision-makers (Myerson, 2013: 1). The first important text in GT was the Theory of Games and Economic Behavior by John von Neumann and Oskar Morgenstern, published in 1944 and aimed to explain cooperative strategic interaction between rational actors. Since then, GT has been contributed by several scholars. In the 1950s, John Nash introduced the most crucial concept for non-cooperative games, Nash Equilibrium, and made a breakthrough for the explanation of the games of conflict of interest. In 1960, Nobelist Thomas Schelling's book, *The Strategy of Conflict*, is considered the first significant work from a social science perspective. In the 1970s, in accordance with Nash's contribution to non-cooperative games and the dominance of the positivist paradigm in the social sciences, GT was used frequently by the scholars of International Relations and Political Science. Besides, by the

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time of progress, it is used in various disciplines from economics and business to biology and even in biblical studies.

GT might be considered as a technique to conduct the scientific inquiry in different disciplines. In this sense, it has particular answers to the question regarding epistemological and ontological assumptions such as; what might be considered as a scientific object, what is the limit for our scientific investigation, what sorts of causalities might occur between scientific objects, etc. First, an individual who intends to use GT would assume methodological individualism, meaning, presume the actions of human beings and their organizations (different actors might be added to the assumption) cause to reproduce or transform the society in which they exist (Wendt, 1987: 337). Second, the individual would assume that the actors make their actions in accordance with their purposes in different scales. Here, it is essential to note that purposefulness does not necessarily mean that actors have an exact list of their goals or calculate all the possible actions and outcomes (Ordeshook, 1986: 2).

Two key assumptions are highly interrelated, and they also give us a clue about another important concept; rationality, its meaning, and its function to shape the social world. Rationality might be simply defined on the basis of two simple ideas;

i)Confronted with any two options, denoted x and y, a person can determine whether s/he does not prefer option x to option y, does not prefer y to x, or does not prefer either.

ii)Confronted with three options x, y, and z, if a person does not prefer y to x and does not prefer z to y, then she must not prefer z to x (McCarty and Meirowitz, 2007: 6).

Adopting the principle of rationality as it has mentioned above enables to make analyses on the behaviors of the actors while determining the best possible outcome for them. Furthermore, for expanding the analyses in a way to include the interactions of two or more actors, it is crucial to mention another crucial concept. GT is a technique used to analyze the situations where the actions of two or more actors affect not only the one that takes action but also the other(s). Therefore, in these situations, actions that are taken by the actors and the outcomes of these actions bond the actors in a way that the actors must consider the other actors' possible actions while taking their own actions. This is called strategic interdependence - such situations are also called games of strategy- and GT provides the tools to examine these kinds of relations between the actors or the players as it is in the GT terminology (Carmichael, 2005: 5).

Throughout the years, different models of GT has been developed to enhance its utility. In this paper, I focus on two models of GT, namely, Classical Game Theory (CGT) and Theory of Moves (TOM). While CGT has been used for analyzing international politics and the strategic actors of political actors several times, TOM is a comparatively new approach, and its application has been relatively less widespread than CGT. The main purpose of this study is to illustrate what has been the main problems of using CGT in social sciences, specifically in international relations, and in comparison with CGT, what sort of tools and features which TOM provides to explain the complexity of the social world. For this purpose, the paper is designed to have three main parts. In the second part, the main assumptions of CGT will be mentioned. Afterward, the drawbacks of CGT will be ascertained in order to conduct a comparative investigation of the methodological tools of CGT and TOM later. Following two parts will be provided to concretize the methodological possibilities that comes with the features of TOM. In the third part, the fundamental principles and rules of TOM will be explained. This will be succeeded by criticisms raised towards TOM. In the fourth part, to show the differences between CGT and TOM in practice, both models will be applied to the Prisoner's Dilemma game. In conclusion, the issue of how the features, principles and rules of TOM developed to overcome the drawbacks of CGT will be analyzed.

2. Classical Game Theory: A Method of Simplicity

Under the title of GT, there are plenty of different models that are based on the fundamental assumptions and concepts that have mentioned above. Among many different models, Classical Game Theory (CGT) might be considered as the most refined-one in terms of its basic assumptions. CGT has been the reference point for the development of other models.

2.1. The Fundamental Assumptions of CGT

As a model, CGT requires some basic assumptions to function correctly. In addition to strategic interdependence and rationality – to be more concrete, instrumental rationality- in most cases, it is simply assumed that all the players are quite aware of their actions and the outcomes of other players' actions. Even though the players do not really know the other players' choices, since they know that other players will pursue the best outcome for themselves, players might suppose others' choices and act accordingly. Under these three conditions, it is presumed that the players make their strategy independently and simultaneously, meaning and when one of the players makes its choice, the others' strategy could not be affected by the decided strategy. Therefore, an exact simultaneousness of actions is not required. Here, the critical point is that even though the players made their choices at different times, the latter choice of one player should not be influenced by the other player's previous choice.

In International Relations discipline there have been several attempts to explain international politics via GT, particularly CGT. As Robert Jervis claims, GT and realism are generally compatible; they are structural, strategic and rational. In accordance with GT's epistemological and ontological premises, as it is expected, these sorts of analyses are made by rationalist scholars, thus not only neorealists but also neoliberals (Baldwin, 1993; Keohane, 1998). Several scholars who made their analyses at structural level used the so-called *Prisoner's Dilemma* and *Chicken* games to scrutinize the possibilities of international cooperation, collective security and international system (Snyder, 1971; Poundstone, 1993; Van Evera, 1985). Furthermore, many others used CGT to illuminate the strategic dynamics between two rational actors, and ignored the causalities that are generated by structure of international politics (Schelling, 1966; Snyder and Diesing., 1977; Zagare, 2014; Zagare, 1973; Sexton ve Dennis, 1985). In these studies, mostly states were considered as rational actor and included in the analyses. However, there are also some studies which

acknowledged other political entities than states like social movements and armed organizations as rational and gave places in the analyses.

Despite all the advantageous tools of CGT to explain strategic relations among actors, there are also some drawbacks regarding CGT which might lead the practitioners to neglect some important aspects or relations concerning their objects of study, or basically, it does not supply any technique to define some certain relations among the objects (Sandler, 2003).

2.2. The Drawbacks of CGT

In this section, I intend to summarize the drawbacks of CGT under five points. Some of these drawbacks of CGT are directly related to the very nature of GT (i.e., its ontological and epistemological premises), while others are linked to the simplistic characteristic of CGT. First, as it has mentioned before, one of the assumptions that CGT requires is that the players make their choices independently and simultaneously. However, most of the time, in international politics, or more generally in the social world, the players build their strategy after considering other players' moves or even make their choices as a direct response to the others. Thus, the conditions that is assumed while applying CGT are not realistic and would mislead the practitioners, especially in such cases that has to be analyzed in detail.

Second, after the game is set, the players will choose one of the strategies according to their interests, and then the game will immediately end after the choices are determined. However, the states -or in general, the players-, do not immediately reach the result assumed by CGT. In fact, during a strategic game, the states even follow the strategies that might lead to a disaster – meaning, the worst possible payoff for both players- to reach their ultimate interest. Therefore, during a strategic game, players make plenty of moves, and not all of them are consistent with CGT calculations to get through the best possible payoff. CGT is unable to show these kinds of strategic changes.

Third, while using CGT, the practitioners presume that the players are highly aware of the payoffs and the structure of the game they are settled, which is formed. The players are considered like they are in a sort of state of omniscience concerning the possible outcome of all the strategies. Nevertheless, as rationalist scholars admit, the actors are easily misperceived about social reality. Therefore whether practitioners should use additional tools to demonstrate the situations that the actors misperceive the conditions and outcomes while using CGT, or they should consider simply these implications of the CGT model.

Fourth, in some cases, a particular political event is analyzed with a different game structure; in this regard, the application of Cuban Missile Crisis (1962) is a typical example. In 1966, Schelling applied so called *Brinkmanship Game* to explain the resolution of the crisis; on the other hand, same event is analyzed by Snyder and Diesing via so called *Called Bluff Game* (Schelling, 1966: Chapter 3; Snyder and Diesing, 1977). In other words, different phenomena might be considered by different scholars as the keystone to understanding a particular political event. Thus, using CGT may one follow different conclusions than others who used CGT. In this way, CGT provides a variety of distinct interpretations over a specific event. On the other hand, the occurrence of several different analyses that do not have and theoretical flaws brings the question mind: Is it possible to draw any conclusion by using CGT? Hence, the plurality of the analyses might be considered something that undermines the claims of CG and positivists concerning objectivity.

Last but not least, CGT is criticized for its demand for excessive information for functioning properly. Here there are two problems; CGT often seems to require more information than can feasibly be obtained, and as an ironic fact, it cannot always adequately incorporate relevant historical details about the context of interaction (Snidal, 1985: 26). Thus, CGT can only be applied in a limited amount of cases in which the vagueness in the content is highly eliminated. In the next part, it will be explained how some of these drawbacks are planned to be overcome by the rules of Theory of Moves.

3. Theory of Moves: An Attempt to Analyze Social World More Realistically

Theory of Moves (TOM) is a model based on GT, makes significant changes in CGT. It is developed by Steven Brams, and explained in detail in his famous book Theory of Moves. To elaborate what it is meant by stating TOM is a model based on GT, it might help remember the key assumptions and concepts of GT. Claiming that TOM is based on GT means that these key assumptions and concepts (i.e., methodological individualism, purposefulness, instrumental rationality, and strategic interdependence) are crucial in terms of understanding the structure of the model and how it works. In this sense, it is possible to claim that Brams agrees with the ontological and epistemological premises of GT perspective. Nevertheless, for him, CGT has specific problems regarding illuminating social reality. Unlike CGT implies, according to Brams, Players do not usually choose strategies simultaneously or independently of each other and do not adhere to a specified sequence of choices as it is presumed and represented by a game tree (Brams, 2000: 222). With his words, "*Although, these models* [arcane game-theoretic models] *sometimes offer important insights into strategic interaction, their canvass is narrow. Worse, many are hopelessly far removed from ever being applicable to real-life situations, for either explanatory, predictive or prescriptive purposes*" (Brams, 1994: 5). Due to these reasons, he aimed to develop a dynamic model that could explain sequential interactions and how misinformation misperception, or deception may affect the players since these are the things that genuinely play significant roles in real life. In short, TOM tries to analyze the social phenomena in a more realistic way while examining the sequential choices players make and putting a considerable effort into how exactly the players aware of the reality.

TOM has been used by several scholars to make analyses in international politics (Brams, 2000; Brams, 1993; Brams and Hessel, 1984; Brams and Togman, 1996; Zeagar and Bascom, 1996; Mor, 1995; Simon, 1995; Kiryluk-Dryjska, 2016). In these analyses, in accordance with the theoretical presumptions of GT, the strategic interactions among states, social movements, regional actors, and terrorist organizations are investigated. Unlike CGT, TOM offers tools that enable practitioners to scrutinize the cases in which

i) some sort of misperceptions influence the strategic interaction ii) players clearly take actions while considering the actions of other player(s) in chronological order, and iii) some political development that their influences to the game cannot be simply demonstrated in the game matrices. It is possible to find examples for all these three categories from Brams' analyses. Brams' analysis of the Iran Hostage Crisis is an example of how misperception might change the strategic conditions drastically. Moreover, Brams & Togman's analysis of the conflict between several actors in Northern Ireland and the British Government demonstrates TOM as a model is a fruitful tool to scrutinize the strategic moves throughout the years (Brams and Togman, 1996). Last but not least, Brams & Hessel's analysis on the conflict between Solidarity and Polish Communist Party in 1980-81 shows the influence of capability of one player to threaten the other might be settled in a game matrix (Brams and Hessel, 1984). In the next section, to elaborate on the new features of the model, the rules of TOM will be explained, and how the rules are developed to resolve the issues concerning the drawbacks of CGT.

3.1. The Rules of TOM

Creating a game-theoretic model to analyze the strategic interactions more realistically was the main purpose of Brams to develop TOM. In accordance with this purpose, he envisaged some rules and coined some concepts to improve TOM's explanatory tools.

The first four rules of TOM are designed as follows (Brams,1994; chapter 1: Brams, 1993: 10-25):

•Rule 1: Play starts at an initial state, means that the players are already situated in one of the four possible intersections of the matrix. There are two ways to establish the initial state: the state might be chosen by considering the real social situation, or it is assumed that the players choose their strategy independently and simultaneously.

•Rule 2: Either of the players can unilaterally switch its strategy (i.e. make a move), thereby changing the initial state into a new state. The new state will be in the same row or column (it depends on which player makes the move)

•Rule 3: If we consider the player which made the first move as Player 1 and the other as Player 2, Player 2 can respond by switching its strategy, therefore, moving the game to a new state.

•Rule 4: The alternating responses continue until one of the players whose turn it is to move next chooses not to switch its strategy. The preference of not switching the strategy terminates the game and establishes the final state. Only at this point, the payoffs are paid, thus, the players can benefit from them.

The first four rules are clearly designed to give a non-static and interactive nature to TOM. In this way, TOM rejects the principle of simultaneousness and independence regarding the actions of players. However, neither of these four rules provide any information about the essential aspect of the game. What induces a game to end? Rule 4 answers this question roughly, the game ends when one of the players decides to stop moving. However, the real question is what makes a player not switch the strategy?

•Rule 5 (Rational Termination Rule): A player will not move from an initial state if this move (a) leads to a less prefered final state (i.e., outcome); or (b) returns play to the initial state (i.e., makes the initial state the outcome).

Rule 5 is strongly connected to instrumental rationalism assumption. With this rule, it is assumed that at one point the game will end. However, as Brams scrutinized in his book elaborately, cyclic games (i.e., the games that does not end) exists and undermines the applicability of TOM. For dealing with this problem, Brams simply adds another rule;

•Rule 5': If at any state in the move-countermove process a player whose turn it is to move next receives his or her best payoff (i.e., 4 among 1,2,3 and 4), that player will not move from this state. Rule 5' might be considered as an alternative rule, to the cases that rule 5 could not explain.

Finally a rule is needed to ensure that both players calculate before leaving the initial state.

•Rule 6 (Two-sidedness rule): Each player takes into account the consequences of the other player's rational choices, as well as his or her own, in deciding whether or not to move from the initial state or any subsequent state. If it is rational for one player to move and the other player not to move from the initial state, then the player who moves takes precedence, meaning his or her move overrides the player who stays, so the outcome will be induced by the player who moves.

For the players, it is important to know when to make the first move or to stop moving because, after all, moves are made, the players might suffer by transaction cost, meaning the assumed cost that is paid by the players to move. In addition, in some cases, the players might move to a Pareto inferior (it basically means an outcome that is less beneficiary than the other) square, aiming to force the other player to move a new square that provides higher payoffs to both players or just the one who moved to Pareto inferior square. Thus, the method, which is called backward induction, is needed to interpret the game accurately.

Backward induction is simply a reasoning process in which players, working backwards from the last possible move in a game, anticipate each other's rational choices (Brams, 1994: 27) . In a game, if we consider all the squares as a possible initial state for both players, at maximum eight outcome states could be anticipated. Here there are three concepts that Brams mentioned. These are blockage, stoppage and survivor. Blockage shows the situation that the player does not move to a new state since it is not rational. Survivor is the payoff selected at each state as the result of backward induction. when backward induction is applied to the game, after illustrating the blockages, the blockages are going to divide the scheme to different parts. For all the divided parts, there will be a survivor state. Finally, stoppage occurs when blockage halts play for the first time from some initial state. It appears when the initial state is Pareto superior (simply, Pareto superior and Pareto inferior are antonyms) to the next state, therefore it is not rational to move; or moving from the initial state will cause cycling.

3.2. Criticism towards TOM

As this paper suggests, the features of TOM provided plenty of tools for the practitioners of GT to analyze the strategic

interactions more realistically than CGT. Despite all the benefits provided by TOM to explain social phenomena successfully, like every other scientific approach, TOM is criticized by scholars from different principles such as; economics, political science, philosophy, psychology, mathematics, etc. (Brams, 1994: 146). Criticisms might be considered under two categories. First, some scholars have been agreed on the main structure and features of TOM however, rejected one particular part of the model and/or suggested a new mechanism or feature. For instance, Edwin Woerdman claimed that Brams' interpretation on Prisoner's Dilemma is flawed. He claimed that cooperation is only possible if the initial state is (3,3) (Woerdman, 2000). Abraham Kandel and Yan-Qing Zhang (1998) attempted to develop Theory of Fuzzy Moves, an approach that combines TOM and fuzzy logic. Stephen J. Wilson (1998) proposed several changes on rules and suggested some revision on the rules (Ericson and Zeager, 2006).

Second, according to some other scholars, TOM has very significant errors and flaws within its structure. In this category, Randall Stone's criticism and Brams' reply is an outstanding debate. In his review, Stone's criticism might be considered under two main points. Stone claims that Brams' two general claims are mistaken. These are; i) TOM generates new insight about the familiar 2x2 games commonly used in international relations; ii) TOM captures the nuances of strategic interaction that GT misses because GT treats the extensive form—who gets to move when—as exogenously determined, whereas TOM makes it endogenous (Stone, 2001).

First, Stone underscores the fact that the classical games of GT were analyzed by the Sequential Model that introduces the contingent strategies to any chosen strategy. Therefore, TOM analyses of the sequential situation is not something uniquely provided by TOM. According to TOM, the structure of the games is mainly formed by the initial state and the order of moves. Therefore, TOM could not provide any concrete solution to any games since the structure of the games might change totally with a slight change in one of these components. In the light of these, according to Stone, TOM modeling totally different situations than GT views, instead of generating new insight to GT. TOM makes so many changes to CGT. After all these changes, is it still related to Game Theory? This might bring minds Thesus' paradox, after replacing all the components of the total, is it still the same thing? Obviously, Brams did not change all the components of GT with their equivalents. Then, how many changes to GT would generate a different theory? Brams claims that he has not abandoned the framework of GT, but, TOM is his attempt to make major changes in its focus (Brams, 1994: 15).

Stone's second argument is against the method of TOM. He implies that, TOM arbitrarily pick the initial state and the order of the moves. Therefore, TOM is such an approach that might be used to reach any outcome on the game matrix. Brams strongly denies this argument; "*There is nothing arbitrary about this starting point, as Stone claims; it needs to be selected carefully, with sensitivity to issues of time, place, and the circumstances of the players, to model accurately the strategic situation at hand*." (Brams, 2001: 247) Certainly, TOM is not a model or theorem that is above criticism. However, the critics should be aware of that, TOM is by no means the be-all and end-all of applied game-theoretic modelling (Brams, 2001: 249).

Despite all the criticisms that mentioned above, I believe TOM has serious potential to overcome the drawbacks of CGT that I have ascertained in the first part. In the next part, I will attempt to demonstrate the difference between two models and test if the drawbacks are truly overcome by TOM.

4. The Comparison of TOM and CGT from the Perspective of Prisoner's Dilemma

To compare two game models, CGT and TOM will be applied to Prisoner's Dilemma. In Figure 1, CGT is applied to Prisoner's Dilemma and in Figure 2 TOM is applied to the same game.

Figure 1. Prisoner's Dilemma (CGT)

		Column	
		R	C
	R	(3,3)	(1,4)
Row			
	C	(4,1)	<u>(2,2)</u>

Figure 2 Prisoner's Dilemma (TOM)

		Column	
		R	C
	R	(3,3)*	(1,4)
Row		[3,3]	[2,2]
	C	(4,1)	(2,2)*
		[2,2]	[2,2]

Key:

(x,y)= (payoff to R, and payoff to C).

[x,y]= [pay of to R and payoff to C according to backwards induction].

4= best, 3= next best, 2=next worst, 1= worst.

Nash Equilibrium is underscored.

* = Non-myopic equilibria

To illustrate the different outcomes that is calculated by different models, backward induction will be applied to initial state (3,3);

Figure 3. Backwards Induction for Row, Initial State (3,3)

	R		C		R		C		
R starts:	(3,3)	→|	(4,1)	→	(2,2)	→|	(1,4)	→|	(3,3)
Survivor:	(3,3)		(2,2)		(2,2)		(4,1)		

Figure 4. Backwards Induction for Column, Initial State (3,3)

	C		R		C		R		
C starts:	(3,3)	→|	(1,4)	→	(2,2)	→|	(4,1)	→|	(3,3)
Survivor:	(3,3)		(2,2)		(2,2)		(4,1)		

Key:

→: Moves from one state to other

→|: Stoppage

According to CGT, in the conditions of the Prisoner's Dilemma, the Nash Equilibrium (i.e., the inevitable outcome) would be (2,2). On the other hand, according to TOM, in the case of Prisoner's Dilemma, there are two possible outcomes – (2,2) and (3,3) - in other words, two non-myopic equilibria (NMEs). NMEs might be understood as the equivalent of Nash Equilibrium in TOM. They are the consequences of both players' rational calculations of where, from each of the initial states, the move counter-moves process will end (Brams, 1994: 33). They could be easily detected via the application of backward induction for each possible initial state for both players. According to TOM, if the initial state is (3,3), the players will not attempt to take any action to risk their position. By involving a dynamic structure and considering the conditions before the game settled, TOM enables the practitioners to conduct deeper analyses. In this example, it enables a different possibility for the game, other than CGT envisages.

5. Conclusion

For many decades, GT has been used to explain the complexity of the social world via considerably simple game matrices. Throughout the years, different models and approaches have been developed to enhance its explanatory capacities. One of these models, CGT, has been used various times by scholars of international relations discipline in order to answer fundamental questions concerning international politics. By the time, the occurrence of new models brought questions to mind regarding the effectivity and preciseness of CGT. In this sense, with its claims, new rules, and interpretations of classical games like Prisoner's Dilemma, TOM might be considered as a challenger to CGT.

Main purpose of this study was to illustrate what has been the main issues of using CGT in social sciences, specifically in international relations, and in comparison with CGT, what sort of tools and features which TOM provides to explain the complexity of the social world. For this purpose, after providing general information about GT and CGT, I underlined five possible drawbacks of CGT. These were; i) its assumption of independent and simultaneous action is not realistic; ii) it lacks a vision on reciprocal moves; iii) it lacks proper tools to illustrate misperception in strategic interactions; iv) it enables to reach so many different conclusions on a specific historical event; v) it needs so much information to be practiced, and it cannot incorporate all relevant details of a historical event. In the fourth part, I intended to scrutinize how the rules and concepts of TOM are developed to resolve the problems concerning CGT. In this sense, the rules of TOM (specifically the first four rules) provide necessary theoretical tools to overcome the first and the second drawbacks of CGT. Moreover, backward induction demonstrates all the possible rational preferences for the player. In this way, by using backwards induction and forming different forms of game (such as; the real game and misperceived game), it is possible and practical to analyze the cases that misperceptions blurred players' decision making. (Brams, 2000: 227) Considering the fourth drawback of CGT, TOM does not exceptionally provide any tool to resolve this issue. As it has mentioned before, there are some different opinions on some rules of the model. These differences cause different interpretations of certain games. Furthermore, as Stone argues, selecting the initial state differently might change all the analysis. In this case, one can claim that the practitioners select initial states arbitrarily; thus, any conclusion might generate, and plenty of different analyses might occur. Lastly, like CGT, for applying TOM into cases, the practitioners need plenty of details to make an accurate analysis. However, it might be claimed that, in comparison with CGT, TOM enables to include many historical details into analyses such as actions and counter-actions, misperceptions, and strategic moves that seem to lead to Pareto-inferior outcomes; however in a more extended scale turn to Pareto-superior outcomes.

In the fourth part, I examined Prisoner's Dilemma from both CGT and TOM perspectives in order to demonstrate how CGT and TOM might imply different outcomes for one particular strategic interaction. Unlike CGT perspective on Prisoner's Dilemma which claims no possibility for reaching (3,3) outcome, for the initial state (3,3) TOM envisages the possibility of cooperation between the players. By applying two models in same scenario, I attempted to show that the drawbacks that I claimed TOM overcomes i.e., the first, second and third drawbacks. While the application CGT and TOM in Prisoner's Dilemma might be an accurate example for proving my claim regarding first and second drawback, without providing any historical content, it does not say anything about the third drawback.

TOM also has some methodological drawbacks like any other valid scientific approach. Nevertheless, as I claimed in this paper, it provides a rich set of methodological tools to analyze social world more realistically. Therefore, while being aware of its theoretical constraints, as a game-theoretic model, TOM might be used to analyze strategic interactions between rational actors in a considerably realistic way.

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