Relation of Game Theory to Economic History and Marginalism

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Abstract

The Article presents a brief survey of economic history, by emphasizing the earlier history of neo-classical economic theory and the economic theory of marginal utility. The Articles does so, by exploring the relation of game theory or the strategic game to developments in the field or science of economics, especially developments in economic thought occurring during the earlier marginal revolution or the economic history of marginalism. By doing so, the Article intends to show, though most attribute the new science of modern game theory to the field of mathematics, that the influence of corresponding or correlating developments in the field, science or discipline of economics was equally influential in the birth of game theory or the strategic game.

1. Introduction

The roots or lying at the core of what now generally hails as the discipline or science of game theory or the strategic game, though some theorists, scholars, and practitioners might disagree when applying the tools of game theory to economic problems (Ghoniem and Reda, 2008), are earlier important developments in both classical economics and neo-classical economic theory. Notwithstanding a correlating history of mathematics, from the Egyptian or Babylonian mathematics (i.e., the Talmud results) (Aumann, 1985), to Greek or Hellenistic mathematics, and then to modern mathematics (Sir Heath, 1963), it is a history of economic theory that also associates or correlates with the economic history of marginalism or the economic theory of marginal utility.

In the context of (both earlier forms or origins and modern) game theory, the earlier developments in economic theory are better understood in the context of a before and after period that associate with the earlier 1944 advancements made by the Austrian economist Oskar Morgenstern and the mathematician John von Neumann (Morgenstern

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and Neumann, 1944). In 1944, Morgenstern, working with von Neumann, establishes the mathematical field of what hails as modern game theory (Morgenstern and Neumann, 1944). The classical work of Morgenstern and Neumann, in their *Theory of Games and Economics Behavior*, still serves as the foundation of modern game theory, which is the expected utility hypothesis or the Neumann-Morgenstern utility.

Notwithstanding expounding a two-person zero sum theory and expanding game theory in their notion of a cooperative game (i.e., with transferable utility), such as the coalitional form and its Neumann-Morgenstern stable sets, what distinguishes the work of Morgenstern and Neumann (1944) is their account of axiomatic utility theory, which subsequently experiences wide acceptance in the field of economics. More importantly, in the field of economics, they proved that any normal preference relation over a finite set of states is reducible to an expected utility. Morgenstern and Neumann (1944), when explicating their classic theory of games, eventually presented what may theorists, scholars, and economists hail as the first axiomatization of the expected utility model that receives widespread attention, which mostly, though not universally, postulates to be bounded functions of wealth. Both Karl Menger (1934) and his *The Role of Uncertainty in Economics* (*Das Unsicherheitsmoment in der Wertlehre, and Frank Ramsey*, 1931) and his work *Truth and probability*, also, though only partially, predate the treatment of utility by Morgenstern and Neumann (1944).

Before 1944, or before the announcement of the expected-utility hypothesis or the Neumann-Morgenstern utility, there are the early eighteenth century theories of Daniel Bernoulli (1954) and Nicolas Bernoulli (1982). There is the theory of Daniel Bernoulli (1954: 22-36), whom, in 1738, made an earlier statement of the same or similar

hypothesis as a means of resolving what is referred as the St. Petersburg paradox, which is an economics—paradox in probability theory and decision theory. Many theorists, scholars, and economists consider the St. Petersburg paradox as arguably predating the Neumann-Morgenstern utility.

The St. Petersburg paradox, which results from an irrational application of probability mathematics, generally involves a bet with an exponentially increasing payoff. As for the namesake of St. Petersburg paradox, the name or phrasing comes from Daniel Bernoulli's (1982) earlier statement of the problem or paradox in his *Commentaries of the Imperial Academy of Science of Saint Petersburg* (*Specimen theoriae novae de mensura sortis, Commentarii Academiae Scientiarum Imperialis Petropolitanae*, 1738).

Many theorists, scholars, and economists also consider Daniel Bernoulli's (1954) statement of the problem as, actually, being earlier predated by a statement of the same problem by Daniel Bernoulli's cousin, who was Nicolas Bernoulli (1999). This statement is attributable to an earlier letter that Nicolas Bernoulli's (1999) sent to Pierre Raymond de Montmort. It is in the September 9, 1713 correspondence of Nicola Bernoulli that Nicola Bernoulli is said to have set forth an earlier form of the classical St. Petersburg paradox. The September 9, 1713 of Nicola Bernoulli (1999), in important part, reads as follows.

> Fourth Problem. A promises to give a coin to B, if with an ordinary die he achieves 6 points on the first throw, two coins if he achieves 6 on the second throw, 3 coins if he achieves this point on the third throw, 4 coins if he achieves it on the fourth and thus it follows; one asks what is the expectation of B?
>
> Fifth Problem. One asks the same thing if A promises to B to give him some coins in this progression 1, 2, 4, 8, 16 etc. or 1, 3, 9, 27 etc. or 1, 4, 9, 16, 25 etc. or 1, 8, 27, 64 in stead of 1, 2, 3, 4, 5 etc. as beforehand.

> Although for the most part these problems are not difficult, you will find however something most curious.

There is also the November 13, 1713 letter of James Waldegrave that was sent to Pierre-Remond de Montmort, who, in turn, wrote a letter to Nicolas Bernoulli (Kuhn, 1968). In his November 13, 1713 letter to Montmort, Waldegrave described a two-person version of the card game known as *le Her*. This is the same game that Arthur T. Benjamin and A.J. Goldman (2002) later employed when presenting their complete solution to *le Her*, by an analysis exploiting "convexity properties in the payoff matrix," thereby "allowing this discrete to be resolved by continuous methods."

According to Benjamin and Goldman (2002), they analyzed a modern variant of *le Her*, which is a card-game enjoying a long history in mathematical literature. In terms of the mathematical history of the game, although they acknowledged that the authentic two-player 52-card-game of *le Her* is reportedly solved by Dresher (1951), though with an earlier anticipation of a solution by R. A. Fisher (1934). Todhunder (1949), as explained by Benjamin and Goldman (2002), described the efforts of Nicolas Bernoulli when attempting a solution, and the efforts of Montmort, though both of their efforts suffered from the critical lack of a mixed strategy concept.

Nonetheless, in his November 13, 1713-letter to Nicola Bernoulli, Montmort described Waldegrave's solution, which is an earlier form of what is known as the minimax mixed strategy equilibrium (Kuhn, 1968). However, Montmont failed to mention to Nicola Bernoulli that he had not made an extension of his results to other games, while also expression his concern that a mixed strategy "does not seem to be in the usual play" of games of chance (Kuhn, 1968). Moreover, some theorists, scholars, historians, and economists even go as far as to attribute the principle of marginal utility to

Gabriel Cramer (1738) and his earlier attempt to solve the classical St. Petersburg paradox in a 1738 letter to Nicolas Bernoulli.

In modern parlance, the concept of a mixed strategy equilibrium associates with a mixed strategy, which refers to a probability distribution that one uses to randomly choose among available actions for avoiding being predictable; whereas, the mixed strategy equilibrium specifically refers to what each player in a game uses, or colloquially speaking, the strategy that is best for him/her against strategies of other players. As such, in various interactions, situations or experiences, a player's success is contingent on his/her actions remaining unpredictable (i.e., competitive sports; games of chance). For this reason, in terms of the history of the strategic game, many associate John von Neumann's (1928) earlier (i.e., before 1944) theoretization, in his *Zur Theorie der Gesellschaftsspiele* (*On the Theory of Parlor Games*), of the strategic game or situations, actually, with the birth of game theory. This is because many associate von Neumann with the explication of the concept of the mixed strategy (i.e., random acts occurring in some binominal process).

In other words, in all zero sum two-person games, when each player's set of available strategies is finite there must be a value (i.e., security level) for each player, while each player must also have at least one minimax strategy, which is a strategy that assures the player that no matter how his opponent plays, he/she will achieve at least his/her security level for the particular game, in expected value terms. A problematic is that in many games, admittedly, the minimax strategies are often pure strategies, thus, some games require no mixing strategies, while other games do.

For this reason, John Nash's (1950a; 1950b) later theoretizations are distinguishable. This is because Nash (1950a; 1950b) developed the concept of equilibrium in games, including his famous non-zero-sum games and games with arbitrary numbers of players. His equilibrium represents a combination of strategies, with a singular strategy for a singular players, thereby manifesting the concept that each player's strategy is the best strategy for his/her against the strategies of the other players; thereby, ultimately, presenting the concept of a sustainable combination of strategies, or simply, an equilibrium manifesting that a player is without incentive to change his/her strategy. As for the mixed strategy equilibrium in this context, as each player employs a mixed strategy, this game with only an equilibria that is mixed represents a mixed strategy equilibrium game. This is because in the two-person zero-sum game, there exists an equivalence between the minimax and equilibrium. This is due to being equilibrium for each player to employ a minimax strategy, while equilibrium is only capable of comprising minimax strategies (Nash, 1950a; 1950b; 1953). There are also the modern translations or interpretations of mixed strategy play and the minimax hypothesis (Shachat, 2002; Crawford, 1990; Harsanyi, 1973).

Then there are the subsequent developments, though predating the Neumann-Morgenstern utility, during the Hicks-Allen "ordinal revolution" of the 1930's, which are developments in the science of economics owing to the works of Sir John Richard Hicks and Sir Roy George Douglas Allen (Samuelson, 1974: 1255-1289). As observed by the Austrian economist Ludwig von Mises, in his classical treatise on economics in *Human Action: A Treatise on Economics* (*Nationalökonomie: Theorie Des Handelns und Wirthschaftens*, 1940; English version, 1949), "Action sorts and grades; originally it

knows only ordinal numbers, not cardinal numbers. But the external world to which acting man must adjust his conduct is a world of quantitative determinateness" (Mises, 1940: 119-127). Significance attaches to the ordinal revolution because it revives the idea of cardinal utility in economic theory, in particular, in choice theory.

The expected value of the game, or Bernoulli's expected utility hypothesis, generally is the sum of the expected payoffs of all the consequences ensuing from the game. What is important is the historical progression from Bernoulli's expected utility hypothesis, to the Hick-Allen ordinal revolution, to the Neumann-Morgenstern utility. The influence of neoclassicism is obvious, as these and other earlier developments in the fields of economics and mathematics, ultimately influence the development of modern game theory. As Seen (2000: 271-292) observed and demonstrates in his study entitled "Mathematics and the social sciences at the time of the modern beginnings of the social sciences" (2000), many of the earlier developers of the new science of society did employ mathematics in earlier social thought, from the earliest use of the term le science sociale (the social sciences); during the 1700s, to the era of modern social sciences, including the discipline or science of modern game theory.

2. The Marginalist Revolution

The approach of the earlier economists, such as Carl Menger, to marginal utility, actually, though not so obvious to many, comprises a not so well known psychological approach, or the approach of the Psychological School. The approach of the Psychological School refers to these earlier proponents by what John Hobson earlier coins as marginalism and marginalists, which are only new nomenclatures serving as alternative means of describing neoclassical economic theory. There are also the second-generation

marginalists that would later crystallize both marginalism and neoclassical economic theory. The second-generation marginalists comprise economists such as Philip Henry Wicksteed, William Smart, Alfred Marshall, Eugen Ritter von Böhm-Bawerk, Friedrich von Wieser, Vilfredo Pareto, Herbert Joseph Davenport, Frank A. Fetter, and many others that would join the second phase of the marginal revolution. This school of thought characterizes empirical analysis or empiricism and its scientific method (Howey, 1973: 15-36).

Before 1879, the theory of marginal utility has two schools of thought. First, there is value-use theory. Second, there is the theory of objective value, such as the British classicists and their "labor value." The history of the theory of marginal utility from Aristotle (384–322 BC) to the Prussian economist Hermann Heinrich Gossen (Kauder, 1953; Weinberger, Ohlin, 1926; Bernoulli, 1896) demonstrates that theorists of the objective value had earlier discovered the theory of marginal utility.

During the seventeenth and eighteenth centuries, it was obvious to Italian and French economists that the interplay between utility and scarcity explains the value of consumer goods, money, and wages. While Robert Jacques Turgot (Baron de l'Aulne) theorizes a price theory, though at a later date, which is similar to that of Johan Gustaf Knut Wicksell, it is Daniel Bernoulli, in his *Versuch einer neuen Theorie der Wertbestimmung von Glucksfallen* (published 1896), whom presented a mathematical analysis of marginal utility.

What is interesting in terms of understanding the principle of marginal utility, economic theory, neoclassicism, including Austrian economics such as that of Carl Menger, is a hidden psychological approach that lies beneath its veil. For instance, there

is Hermann Heinrich Gossen (1967) and his classical statement of the general theory of marginal utility. Gossen employed an abstract and psychological concept of utility (i.e., "want-satisfaction"), which is measurable and comparable across individuals (Howey, 1973). In comparison, Austrian economics, which associates with the approaches of Menger, is generally perceived as pursuing deductive, a priori reasoning rather than empirical analysis or empiricism; whereas, neoclassical economics is generally associated with empiricism and its scientific method.

Jörg Guido Hülsmann (2007), an economist of the Austrian school, explains that Carl Menger (2007) and his empiricism emphasized a search for means to explain why actual pricing processes in the liberal market defies economic theory. Menger (2007) undertook the task of showing that the properties and laws of economic phenomena result from empirically discoverable "elements of the human economy." These elements comprise an individual's human needs, knowledge, ownership, and further, quantities of goods, time, and individual error. Menger did identify these elements for analysis, while also undertaking to explain how these elements cause market phenomena such as prices. This was Menger's empiricism, which he emphasized as having been the same method (i.e., empirical method) employed so well in the natural sciences.

The distinction between economics, more particularly Austrian economics, and the natural sciences is important. This is because empiricism supposedly does not involve abstract postulates in forming hypotheses, which is a common practice when studying natural phenomena. The empiricist approach of the social sciences generally employs the systematic construct of a causal theory, which is a grounding of theory on observations of empirical phenomena, such as human needs, wants, knowledge, etc.

However, Menger, and his psychological approach, uses the concept of "value" as being the relative importance for an individual of the marginal unit of a good, such as "good X". Relativity lies in an individual comparing "good X" to others, such as "good Y", "good Z", and on and on. The result is a market price reflecting an interaction between buyers and sellers. While Menger was justifying prices as being the result of comparing "good X" to other goods, conversely, there are other economists such as Gossen, William Stanley Jevons (1871) and his marginal utility theory of value, and Léon Walras (1874) offering different interpretations.

When undertaking to understand the marginalist revolution, the viewpoints of Jevons, Walras, and Menger are important. This is because many consider them the founding fathers of the marginalist revolution and the neoclassical approach. As a courtesy of Antoine Augustin Cournot and his earlier functional relationships (i.e., demand function, partial equilibrium model, or Cournot competition) between quantities, and prices and costs, Walras (1838), had come under the influence of French rationalism and the new knowledge or tool of mathematics in economics, as he later became one of the leaders of the marginalist revolution (Theocharis, 1990; Morrison, 1998). Cournot (1838) as concerns issue of the competition of producers, actually, also provided an earlier variety of what later hails as the Nash equilibrium (Nash, 1950a: 48-49; Nash, 1950b: 155-162; Nash, 1953: 128-140) when addressing the case of a duopoly and employing a solution concept.

What is important is that Gossen, Jevons, Walras, and other proponents of the theory of marginal utility or the marginalists, generally explain pricing as resulting from the impact of a marginal quality of a good on an individual; in others words, the psychology

of the actor (i.e., the individual, buyer or seller). These three proponents of marginalism variously describe the impact of a marginal, which is respectively by Gossen as "want-satisfaction," by Jevons as "utility," and by Walras as "satisfied needs." For example, Jevons (1862), when defining utility or the coefficient of utility, wrote, "This function of utility is peculiar to each kind of object, and more or less to each individual. Thus, the appetite for dry bread is much more rapidly satisfied than that for wine, for clothes, for handsome furniture, for works of art, or, finally, for money. And every one has his own peculiar tastes in which he is nearly insatiable."

A commonality between these economists is, actually, a resulting similar explanation of the pricing process in a liberal market. For instance, Menger's theory and his marginal value produce structurally the same role that marginal utility plays in Jevon's theory. There is also the commonality of their respective psychological approaches, as each of these theorists either explicitly or implicitly employed the human psyche as the common denominator of all economic value, thereby advancing the ability of economists to derive from the consumption of goods a mathematical function of these quantities (Hülsmann, :130-133).

3. Ludwig von Mises and Marginalism

Then there are the distinguishable observations of the Austrian economist Ludwig von Mises (1949) concerning the law of marginal utility. Herr von Mises (1949) challenged the psychological approach or the Psychological School. For von Mises, the external world of what he deems "action man" as one in which man must adjust his conduct is one of quantitative determinateness, where there exist quantitative relations between cause and effect. Otherwise, definite things could render unlimited services, which results in

things never becoming scarce, or capable of being subject to treatment as means. His hypothesized "acting man" values things as means to remove his uneasiness, which is distinguishable from the natural sciences and perception of events resulting in the satisfaction of human needs and wants.

Acting man does not discern these difference, because, as being more or less the same thing for him, "In valuing very different states of satisfaction and the means for their attainment, man arranges all things in *one* scale and sees in them only their relevance for an increase in his own satisfaction" (Mises, 1949). As such, satisfactions derived from food, work or one's job, art, etc., as concerning acting man's judgment is "a more urgent or a less urgent need; valuation and action place them in one scale of what is more intensively desired and what is less." For Mises' acting man there exists only various degrees of relevance and urgency with regard to his own well-being. The concept of utility serves as the "causal relevance for the removal of felt uneasiness," because, "Acting man believes the services a thing can render are apt to improve his own well-being, and calls this the utility of the thing concerned" (Mises, 1949).

A problem of old (classical) economics or earlier economists is that, "They observed that things whose 'utility' is greater are valued less than other things of smaller utility." Mises illustrates this point by using the example of a greater appreciation for gold than iron, which he deems incompatible with the theory of value and prices as grounded on the concepts of utility and use-value. According to Mises, "The economists believed that they had to abandon such a theory and tried to explain the phenomena of value and market exchange by other theories." Economists later discover "that the apparent paradox was the outcome of a vicious formulation of the problem involved. The valuations and

choices that result in the exchange ratios of the market do not decide between *gold* and *iron*. Acting man is not in a position in which he must choose between *all* the gold and *all* the iron" (Mises, 1949).

> There is no abstract problem of total utility or total value. There is no ratiocinative operation which could lead from the valuation of a definite quantity or number of things to the determination of the value of a greater or smaller quantity or number. There is no means of calculating the total value of a supply if only the values of its parts are known. There is no means of establishing the value of a part of a supply if only the value of the total supply is known. There are in the sphere of values and valuations no arithmetical operations; there is no such thing as a calculation of values…The concepts of total utility and total value are meaningless if not applied to a situation in which people must choose between total supplies. The question whether *gold* as such and *iron* as such is more useful and valuable is reasonable only with regard to a situation in which mankind or an isolated part of mankind must choose between *all* the gold and *all* the iron available (Mises, 1949).

For von Mises (1949), economists did not need to employ the concept of "psychology" in description of these facts, nor resort to psychological reasoning when seeking to prove these facts. By claiming that the acts of choice are not contingent on value attached to a whole class of wants, but, instead, that attached to concrete wants in question regardless of the class, we fail to add anything to our field of knowledge and "do not trace it back to some better-known or more general knowledge." This language of classes of wants only becomes intelligible after we remember the critical role-played in the history of economic thought by the alleged historical paradox of value.

Mises (1949) observed that these earlier economists, such as Carl Menger in his *Principles of Economics* (*Grundsätze der Volkswirtschaftslehre*, 1871) and the Austrian economist Eugen Ritter von Böhm-Bawerk in his *Capital and Interest: Positive Theory of Capital* (*Kapital und Kapitalzins: Positive Theorie des Kapitales*, 1909), had to make use of the term "class of wants," though now a superfluous concept, for purpose of refuting

the objections raised by those who "considered *bread* as such more valuable than *silk* because the class want of nourishment" is more important than the "class want of luxurious clothing." Finally, the law of marginal utility and its attendant decreasing marginal value is independent of Gossen's law of the saturation of wants, which is the first law of Gossen. Therefore, when addressing issues of treating marginal utility, we deal neither with sensuous enjoyment nor with saturation and satiety. This concept of classes is not in this world, as it is our mind classifying the phenomena for purpose of organizing our knowledge (Mises, 1949; Menger, 1909).

Accordingly, von Mises perceived those mathematicians and economists who adopt Daniel Bernoulli's mode of reasoning as unable to succeed in solving the paradox of value. He writes, "The mistakes inherent in the confusion of the Weber-Fechner law of psychophysics and the subjective theory of value have already been attacked by Max Weber." In this respect, he is generally addressing the law describing the relationship between the physical magnitudes of stimuli and the intensity of the stimuli. This law, more accurately, posits, "that any change in our level of sense perception is closely and proportionally related to any change in the intensity of the stimuli that were just acting on the senses. The extent to which our eyes detect that the light in a room has gotten brighter, for instance, depends on and is proportional to the previous level of brightness"(Zafirovski, 2001). This law is attributable to the German physician Ernst Heinrich Weber, who is the founder of experimental psychology, as what is known as Weber's Law. Subsequently, this law known as Weber's Law later evolves, which is due to further elaborations of Weber's theory by the German experimental psychologist Gustav Theodor Fechner,

thereby becoming known as the Weber-Fechner Law or the fundamental law of psychophysics.

However, both Alexius Meinong, in his *About the importance of Weber's law, contributions to the psychology of comparison and measurement* (*Über die Bedeutung des Weberschen Gesetzes: Beiträge zur Psychologie des Vergleichens und Messens*, 1896) and Max Weber, in what is consider his magna opus *Economy and Society: An Outline of Interpretive Sociology* (*Wirtschaft und Gesellschaft: Grundriss der verstehenden Soziologie*, published posthumously 1922), were critical of the Weber-Fechner Law (Meinong, 1896; Weber, 1922; Weber, 1967).

This is because the limitations of the Weber-Fechner Law are that verification routinely fails for very high and low intensities of sensation; notwithstanding the actual nature of sensations that we prepare, the power of discrimination may be subject to influence of many factors; the relation between intensity of a stimulus to that of an absolute intensity of sensation may not be contingent other conditions, but rather on the mere intensity of the stimulus itself; and one could assume this law to be perfectly exact, in regards that it states that unlikeliness between sensations depend on their respective relative differences, without supporting proposition that this relative difference is determined solely by difference of external stimulation.

Moreover, Mises generally considered Max Weber as not sufficiently familiar with economics and too much under the influence of historicism to arrive at a correct insight into the fundamentals of economic thought, especially modern economic thought or neoclassical economy theory. Nonetheless, he still, though seemingly contradictory, senses in Weber an ingenious intuition that enables him to find a way toward the correct

solution. For instance, Max Weber (1922) observed that the theory of marginal utility is "not psychologically substantiated, but rather—if an epistemological term is to be applied—pragmatically, i.e., on the employment of the categories: ends and means." (Bernoulli, 1922). Consequently, for Mises (1949), "The confusion of marginal utility and the Weber-Fechner Law originated from the mistake of looking only at the means for the attainment of satisfaction and not at the satisfaction itself."

Following the rise of marginalism and its marginal analysis, economics secured the means to explain the mechanisms guiding human behavior. The idea being that once we come to understand how values evolve into market prices that guide the market behavior of individuals, then we able to also understand how property is formed, thereby, as Walras explained, how humankind ultimately "determines and carries out the appropriation" (Sima, 2004). Carl Menger, as uniquely both an economist and jurist, played a key role in the rise of marginalism or the then new science of marginalist economics. Menger (1967) described the relationship between economics and the law as follows.

> Thus human economy and property have a joint economic origin since both have, as the ultimate reason for their existence, the fact that goods exist whose available quantities are smaller than the requirements of men. Property, therefore, like human economy, is not an arbitrary invention but rather the only practically possible solution of the problem that is, in the nature of things, imposed upon us by the disparity between requirements for, and available quantities of, all economic goods.

Because of such statements, and his training in both the science of law and science of economics, most recognize Menger as an earlier leader in both the marginalist revolution or the new science of marginal economics, and the new science of law. Following his earlier influence is the establishment of Menger's new Austrian school and its general

theory of human action, which is a praxeology that experiences further development, though later, by Ludwig von Mises.

A key to the understanding the significance of both this new school of economics—Austrian school and this new science of economics—marginalist economics, or simply, the Mengerian-Misesian tradition, is ultimately a sufficiently wide girth in analysis that allows the science of economics to include "the analyses of legal processes as an integral part of its study" (Sima, 2004). Although for years, the Mengerian-Misesian tradition hails as the mainstream approach in economics, during the Second World War, its influence wanes when the science of economics shifts to a more technical analysis, which was mostly due to the Austrian school being too social science oriented, rather than more narrow and technical economics oriented. However, during the post-Second World War period, this "formalized, propertyless economics" became increasingly irrelevant to the real world (Sima, 2004).

An important shift in the focus of economic analysis subsequently occurs with the new economics schools, such as Chicago Law and Economics, New Institutional Economics, and Public Choice Theory, commencing to integrate, though contra post-World War Two conventional praxeology, social dimensions into the science of economics, or simply, the new schools regenerated the link between law and economics. This is the relationship between law (i.e., property) and economics earlier envisaged by Carl Menger. There is also Ludwig von Mises, in his *Liberalism* (1927), who gives definitional meaning to law by explaining why a property based social system is "the only workable system of human cooperation in a society based on the division of labor."

There is also the viewpoint of the earlier German Historical School of economics (*Die Historische Schule der Nationalökonomie*) and its German historicism. One source described German historicism as "unabashedly inductive in its approach." This is because many deem German historicism as reducing all economic generalizations, or perhaps more accurately, the reduction of abstractions to relative judgments. A direct consequence of the latter is German historicism then advancing an argument that each economic problem must be undertaken "*de novo*" (Latin: *Anew*; A second time; afresh). By doing so, the German Historical School of economics effectually stood in contravention of the idea of an expert in the field, though employing an array of economic tools such as the principles of deduction, being unable to address problems in economics as a singular authority.

In the history of economic thought, the earlier German Historical School of economics, though by the 1880s following a *Methodenstreit* (German: literally, "strife over methods") that eventually resulted in an acceptance of neoclassical theory and marginal analysis, earlier rejects both classical economic theory and the then new intellectual fashion of marginal analysis. The rejection of these two schools of economic thought was due to their viewpoint that the approaches of both the classicists and marginalists "abstracted timeless economics laws from specific historical settings and from the social and political context of economic activity" (Ringer, 1979; Ringer, 1969). The progressing economic history from the classicists, to neoclassicists, and especially the German "Historical School of economics" and its German historicism, serves as a reminder of the progression from Newtonian methods, to then later Enlightenment economics. (Bernsterin, 2004).

4. The Realty of Strategic Theory

In the real reality of modern society, theorists, scholars, and practitioners, generally apply the tools of this new knowledge to real life interactions, situations or experiences, which widely range, though not an exhaustive listing, from social, economics, politics, and even international diplomacy situations. In this respect, game theory similarly, as often reflecting characteristics similar to real life interactions or situations, especially competitive or cooperative situations, is able to suggest strategies for addressing real life interactions, situations or experiences. Game theory based on the strategy of players in particular games will often involve suggestions such as predictions of how people (individual or entities), political factions, or even states will behave in given situations.

A classic example of an interaction based on real life interactions is the famous prisoner's' dilemma and its illustration of the problematic and unproductive zero-sum game or situation. The primary purpose of game theory is to consider situations or experiences where instead of agents making decisions as reactions to situations or experiences, such as exogenous prices (i.e., "dead variables"), their decisions are strategic reactions to other agents' actions (i.e., "live variables"). An agent is faced with a set of moves he can play and will form a strategy, a best response to his environment, which he will play (by). When employing game theory to these situations or experiences, strategies can be either "pure" (i.e., play a particular move) or "mixed" (i.e., random play).

The purpose, essentially, is to consider situations or experiences where agents make decisions that are strategic reactions to other agents' actions (i.e., live variables). This is instead of than making decisions as reactions to exogenous factors (i.e., dead variables).

AS a result, “An agent is faced with a set of moves he can play and will form a strategy, a best response to his environment, which he will play by. Strategies can be either “pure” (i.e., play a particular move) or “mixed” (i.e., random play).” What is referred to as the classical Nash equilibrium will be “reached when each agent’s actions begets a reaction by all the other agents which, in turn, begets the same initial action.” In other words, the best responses of all players are in accordance with each other.

As previously mentioned, the problem inherent in the zero-sum situation is extendable to many real life situations or experiences, including various fields of studies, disciplines or sciences, and a wide variety of other situations or experiences. A classic illustration of the wide birth of the applicability of game theory to situation and experiences is the post-World War II uncontrolled arms race and deterrence theory (Schelling, 1960). What occurs in the game theory of non-zero sum game, which is primarily attributable to failings that associate with non-cooperation, is generally assumed Nash equilibrium or non-cooperative equilibria. This is a theory earlier developed by the mathematician and 1994 Nobel laureate John Forbes Nash, Jr. In 1950, during a lecture at Stanford University, the mathematician Albert W. Tucker, actually, created the prisoners’ dilemma for illustrating the difficulty of analyzing particular games (Nash, 1950a: 48-49; Nash, 1950b: 155-162; Nash, 1953: 128-140; McCain, 2003).

5. Conclusion

The achievement of Neumann and Morgenstern (1944) also predates both Tucker’s model of the prisoners’ dilemma. Neumann and Morgenstern (1944), and ultimately, laid the groundwork for the introduction of an interdisciplinary research field of game theory or the strategic game. More importantly, there are the earlier works of many others,

including Neumann (1928) and his *Zur Theorie der Gesellschaftsspiele* (*On the Theory of Parlor Games*), which also predate the 1944 work of Neumann and Morgenstern. The earlier contribution of von Neumann (1928) was his thesis or proof of the minimax theorem, which states that all two-person zero-sum games with finitely pure strategies for each player is determined (i.e., with mixed strategies admitted), presents a variety of a game producing one individual-rational payoff vector. His thesis (Neumann, 1929) necessitated an involved use of both topology and functional calculus; ultimately, presenting a thesis that also introduces an extensive form of a game.

As Robert Cooter (1995) observed, when he was discussing how economic models of rational behavior have affected all fields of the social sciences, such as history, philosophy, and law, "In strategic games, each player forms his or her strategy on the assumption that other players form their strategies by anticipating what he or she will do." For game theorists, the usefulness of game theory or the strategic game is mostly attributable to the fact of its potential to generate new ideas. This is because, "having ideas is the scientist's highest accomplishment" (Lyotard, 1984: 60). Moreover, the scientific achievement of game theory or the strategic game enjoys an association with corresponding accomplishments in the earlier history and development of economic thought.

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