CHAPTER 1

Press Release—The Royal Swedish Academy of Sciences

11 October 1994

The Royal Swedish Academy of Sciences has decided to award the Bank of Sweden Prize in Economic Sciences in Memory of Alfred Nobel, 1994, jointly to

Professor **John C. Harsanyi,** University of California, Berkeley, CA, USA,
Dr. **John F. Nash,** Princeton University, Princeton, NJ, USA,
Professor Dr. **Reinhard Selten,** Rheinische Friedrich-Willhelms-Universität, Bonn, Germany,

for their pioneering analysis of equilibria in the theory of non-cooperative games.

Games as the Foundation for Understanding Complex Economic Issues

Game theory emanates from studies of games such as chess or poker. Everyone knows that in these games, players have to think ahead—devise a strategy based on expected countermoves from the other player(s). Such strategic interaction also characterizes many economic situations,

and game theory has therefore proved to be very useful in economic analysis.

The foundations for using game theory in economics were introduced in a monumental study by John von Neumann and Oskar Morgenstern entitled *Theory of Games and Economic Behavior* (1944). Today, 50 years later, game theory has become a dominant tool for analyzing economic issues. In particular, non-cooperative game theory (i.e., the branch of game theory that excludes binding agreements) has had great impact on economic research. The principal aspect of this theory is the concept of equilibrium, which is used to make predictions about the outcome of strategic interaction. John F. Nash, Reinhard Selten, and John C. Harsanyi are three researchers who have made eminent contributions to this type of equilibrium analysis.

John F. Nash introduced the distinction between cooperative games, in which binding agreements can be made, and non-cooperative games, where binding agreements are not feasible. Nash developed an equilibrium concept for non-cooperative games that later came to be called Nash equilibrium.

Reinhard Selten was the first to refine the Nash equilibrium concept for analyzing dynamic strategic interaction. He has also applied these refined concepts to analyses of competition with only a few sellers.

John C. Harsanyi showed how games of incomplete information can be analyzed, thereby providing a theoretical foundation for a lively field of research—the economics of information—which focuses on strategic situations where different agents do not know each other's objectives.

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John Nash arrived at Princeton University in 1948 as a young doctoral student in mathematics. The results of his studies are reported in his doctoral dissertation entitled *Non-Cooperative Games* (1950). The thesis gave rise to "Equilibrium Points in *n*-Person Games" (*Proceedings of the National Academy of Sciences*, USA, 1950), and to an article entitled "Non-Cooperative Games" (*Annals of Mathematics*, 1951).

In his dissertation, Nash introduced the distinction between cooperative and non-cooperative games. His most important contribution to the theory of non-cooperative games was to formulate a universal solution concept with an arbitrary number of players and arbitrary preferences (i.e., not solely for two-person zero-sum games). This solution concept later came to be called Nash equilibrium. In a Nash equilibrium, all of the players' expectations are fulfilled and their chosen strategies are optimal. Nash proposed two interpretations of the equilibrium concept: one based on rationality and the other on statistical populations. According to the rationalistic interpretation, the players are perceived as rational and they have complete information about the structure of the game, including all of the players' preferences regarding possible outcomes, where this information is common knowledge. Since all players have complete information about each other's strategic alternatives and preferences, they can also compute each other's optimal choice of strategy for each set of expectations. If all of the players expect the same Nash equilibrium, then there are no incentives for anyone to change his strategy. Nash's second interpretation—in terms of statistical populations—is useful in so-called evolutionary games. This type of game has also been developed in biology in order to understand how the principles of natural selection operate in strategic interaction within and among species. Moreover, Nash showed that for every game with a finite number of players, there exists an equilibrium in mixed strategies.

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Through their contributions to equilibrium analysis in non-cooperative game theory, the three laureates constitute a natural combination: **Nash** provided the foundations for the analysis, while **Selten** developed it with respect to dynamics, and **Harsanyi** with respect to incomplete information.