The Nobel Prize in Economics 2007: Background on Contributions to the Theory of Mechanism Design by Leonid Hurwicz, Eric Maskin, and Roger Myerson.

The theories of mechanism design and implementation provide a strategic analysis of the operation of various institutions for social decision making, with applications ranging from modeling election procedures to market design and the provision of public goods. The models use game theoretic tools to try to understand how the design of an institution relates to eventual outcomes when self-interested individuals, who may have private information, interact through the given institution. For example, the type of question addressed by the theory is: ``How do the specific rules of an auction relate to outcomes in terms of which agents win objects and at what prices, as a function of their private information about the value of those objects?''

Some of the early roots of the theories of mechanism design and implementation can be traced to the Barone, Mises, von Hayek, Lange and Lerner debates over the feasibility of a centralized socialist economy. These theories also have roots in the question of how to collect decentralized information and allocate resources which motivated early Walrasian tatonnement processes, and the later Tjalling Koopmans' (1951) formalization of adjustment processes as well as Arrow-Hurwicz gradient process.

The more modern growth of these theories, both in scope and application, came from the explicit incorporation of incentive issues. Early mention of incentive issues, and what appears to be the first coining of the term ``incentive compatibility,'' are due to Hurwicz (1960). The fuller treatment of incentives then came into its own in the classic paper of Hurwicz (1972). There he carefully posed a series of questions concerning the modeling of institutions when self-interested individuals might try to manipulate prices or other economic variables to their advantage. In this work, Hurwicz began to lay the foundation for the modern theories of mechanism design and implementation.[1] This theory models institutions through explicit description of what means of communication and action are available to each agent in the society, as well as how the eventual allocations and decisions of the society depend on agents' communication and actions. The theory then makes predictions concerning outcomes using game theoretic solution concepts.

A subsequent critical step in the development of the theory was the formalization of a simple observation that is now known as the ``revelation principle.'' This principle shows how general mechanisms (models of institutions) can be collapsed into ``direct revelation principles,'' whereby agents' only form of communication or action is revelation of their private information. Bayesian versions of this principle were stated and proven by Dasgupta, Hammond and Maskin (1979) and Myerson (1979). Myerson's subsequent work demonstrated the full power of the revelation principle, showing how it

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[1] While there was also discussion of incentives in the public goods literature, e.g. Samuelson (1954 - Review of Economics and Statistics) and Clarke (1971 - Public Choice), as well as the early auctions work of Vickrey (1961 - Journal of Finance); the first general formulation of the problem stems from Hurwicz's work.

could be used to study such things as the optimal design of auctions (Myerson (1982)), the impossibility of efficient bargaining in the presence of asymmetries of information (Myerson and Satterthwaite (1983)), as well as to deduce the limits that incentive compatibility generally imposes on societal welfare (Holmstrom and Myerson (1983)).

Eric Maskin's work also followed up on other questions that were posed by Hurwicz. As with many economic systems, mechanisms may have multiple equilibria. Hurwicz (1972) posed the implementation question: ``Which desirable allocation correspondences can be decentralized in the sense that there exists some mechanism for which all equilibria coincide with the socially desired ones?'' For instance, he asked (1972, 1979) are there mechanisms through which the equilibrium interaction of self-interested (non-price-taking) agents exactly coincide with Walrasian equilibrium allocations? Maskin's (1999) paper on Nash implementation provided a very elegant and deep answer to this question, by almost completely characterizing the correspondences that could be obtained as Nash equilibrium correspondences of various mechanisms in a very wide variety of settings.[2] Maskin's work identified a very natural necessary and (in many cases) sufficient condition for implementation, that is now often referred as ``Maskin monotonicity.'' This is a very useful theorem and condition, as one can easily check that slight modifications of well-known correspondences such as the Walrasian correspondence and the Lindahl correspondence satisfy Maskin monotonicity, and are thereby (Nash) implementable.

In summary, Leonid Hurwicz, Eric Maskin, and Roger Myerson are responsible for much of the foundational development of the theories of mechanism design and implementation. These theories have proven to be instrumental in our modeling and understanding of a wide variety of economic interactions and institutions including: bargaining, market and auction design, voting rules, contracts, and the provision of public goods.

Some Key References:

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[2] Maskin's paper dates from (1977), but was not published until (1999).

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