

The Life and Times of Kenneth Arrow
1972 Nobel Laureate in Economic Sciences
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Over the years, there have been many prestigious Nobel laureates, all of who worked diligently and contributed heavily to their fields of work. Kenneth Arrow was one such laureate, winner of the 1972 Nobel Prize in Economics for laying down key foundations of modern economics. His work on the theories of general equilibrium and social welfare were truly revolutionary. To an extent, Arrow is to the economics community what Einstein was to the physics community, for he brought new ways of analyzing real-life situations using economics—specifically, analyzing society and choices through the lens of economics.

Kenneth Arrow was born and raised in New York, where he utilized the free public education provided by the city. He attended Townsend Harris High School and, because of his desire for knowledge and ability to self-study well, he skipped a few grades. By the time he entered college, he knew that his calling was in math; he was especially intrigued with probability and statistics. Arrow graduated from the City College of New York in 1940 as a math major with a bachelor's in social sciences. Originally, he had wanted to pursue a career in education right out of college, specifically as a math teacher, but his plans were thwarted by the lack of math teaching positions available in New York. Instead, he decided to pursue a master's degree in math at Columbia, and while there, Arrow grew an interest in economics.

Arrow's graduate studies were hindered by the emergence of the Second World War. Knowing that he would probably be drafted anyway, Arrow signed up into the war as a weather officer. His experience during this time turned out to be rather fruitful. For the next few years, Arrow incorporated his knowledge of probability into his job. He analyzed ways to optimize the amount of fuel used by planes travelling across the Atlantic—he would publish these findings in his first paper, "On the Optimal Use of Winds for Flight Planning" (Arrow, 1949).

After the war, Arrow returned to his graduate studies in economics at Columbia. Additionally, he joined the Cowles Commission at the University of Chicago as a research associate. Arrow admits that the Cowles Commission was highly influential for his later work incorporating math and economics. The commission housed upcoming economists and was led under the guidance of math-focused economists, Tjalling Koopmans and Jacob Marschak. He was also part of the Rand Corporation, where he learned more about game theory and mathematical programming. In both organizations, Arrow met people with whom he discussed and gained more insight about theories. In fact, one of the economists that Arrow met during this time was Gerard Debreu, one of his key collaborators for work on general equilibrium theory.

During his graduate studies, Arrow published several papers and worked on a multitude of theories. Three major theories for which he did not win the Nobel Prize for included the impossibility theory, the endogenous growth theory, and the theory of learning by doing. The Arrow's impossibility theory described the unfeasibility of appeasing all members of a group, whereby everyone's requests could be met (Arrow, 1950). This invoked impossibility because if one individual desired one thing, and another individual desired that same thing, both individuals could not be satisfied without

one being put at a disadvantage. This marked the beginning of Arrow's work with social welfare and analyzing individuals' choices. Arrow's endogenous growth theory emphasized the importance of human capital and innovation as the key motivators behind economic growth, and not as much internal factors like money investments from entrepreneurs and the government. Finally, the theory of learning by doing suggested that productivity was increased when workers repeated a task over and over again, thus improving efficiency—this was contrary to the idea that adding more workers would increase efficiency.

After his graduate studies, Arrow attained several positions at various universities while still working on economic theories and papers. He was an assistant professor at the University of Chicago and later at Stanford. After years as an assistant, he was eventually promoted to a full-time professor at Stanford in 1968, and he soon after accepted a teaching position at Harvard. He also held multiple titles and fellowships during his teaching years: he was part of the U.S. Council of Economic Advisers, he was a fellow at Cambridge, and he was a guest professor at the Institute of Advanced Studies in Vienna. Not soon after, he was awarded the Nobel Prize of Economic Sciences in 1972, conjointly shared with Sir John Hicks, for work on general equilibrium and social welfare theory. Arrow's contribution to the prize came mainly from his work in the 1950s and 1960s, during his graduate and post-graduate studies and work.

Kenneth Arrow's contribution to economic equilibrium theory was based on John Hicks's previously established work. This theory dealt with price, demand, and supply as well as other chief factors involved in economic equilibrium. Hicks's theory focused on linking the importance of entrepreneurs and consumers into the economy—and how the multiple variables involved affected the business cycles, with its cyclic periods of growth and recession. Arrow spent years analyzing Hicks's published work, and he expounded upon the theory by bringing in new techniques for analyzing and applying the theory to the real world. Arrow and his long-time collaborator Debreu jointly published a paper in 1954, simplifying and generalizing the general equilibrium by making use of the mathematical techniques of convex sets, thus making the theory more applicable. This would contribute to the modern, general models of aggregate demand and aggregate supply in macroeconomics, more commonly known as the AD and AS models (Arrow and Debreu, 1954). He would later extend his theory to include more variables (Arrow, 1974).

Arrow was also awarded the prize for his contributions to social welfare theory, which deals with assessing situations and analyzing the costs and benefits behind the situations for the members of society. Arrow's main contribution was his paper, "Uncertainty and the Welfare Economics of Medical Care" (Arrow, 1963b). In this publication, Arrow criticizes the health care system and how it is essentially an inappropriate product through the lens of a free market. The main idea is that the consumers, those buying healthcare, are generally uninformed of the medicine and advice provided by health professionals, and thus have "uncertainty" in the product that they purchase. Usually, consumers have at least some knowledge as to why they are purchasing a product, especially if the product is a tangible item. However, in the case of buying professional advice and healthcare, the consumer is generally uninformed about the field and must blindly trust the professional. This is particularly risky when it comes to surgical procedures, where the product is a one-time big purchase that cannot be

refunded. Unlike products that can be returned, replaced, or bought again, it is rather difficult to reverse surgical procedures. Thus, the healthcare system cannot be deemed proper when viewed through the perspective of the free market, since the consumers don't have sovereignty or choice in making proper, informed decisions about their healthcare. Arrow's work on social welfare, healthcare in specific, set the stage for future work by others and brought to light the problems in the system.

Kenneth Arrow's later works would deal with other aspects of social economics. Over the years, he worked on theories such as the demand for information and the economics of racial discrimination, both of which actually stem off of his work with paper published on healthcare. Like he'd briefly mentioned in his analysis of healthcare, the theory of the demand for information deals with how much the consumer knows. His work on racial discrimination brings to light a different aspect of social welfare but utilizes similar and previously established techniques of analysis (Arrow, 1983).

Kenneth Arrow is currently a Professor Emeritus at Stanford and has stayed active in his field of economics research. His work has evolved over the years, from analyzing wind patterns to general equilibrium to social welfare. Arrow's continuous hard work has brought revolutionary new ideas and methods of utilizing math to analyze real-life situations and form general economic theories about routinely phenomena. Many aspects of modern equilibrium and social welfare theory are due to or at least partially stem from the contributions of Kenneth Arrow and his collaborators. Even beyond just theories, Arrow is an overall influential economist and teacher, having mentored and collaborated with several individuals who would later go on to win their own Nobel prizes.

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