

# Kenneth J. Arrow

## (1921–2017)

One of the most influential thinkers in economic theory.

**K**enneth Arrow was the doyen of economic theory during the second half of the twentieth century. His fundamental and diverse contributions — to fields including welfare economics, which aims to evaluate social welfare on the basis of individual choices or preferences — were founded on abstract reasoning and remarkably few elementary mathematical concepts.

The tools and concepts he introduced helped to shape important aspects of US President Barack Obama's Affordable Care Act. They are also staples of research and teaching in economics at both undergraduate and graduate levels.

Arrow was born to Romanian Jewish immigrants on 23 August 1921 in New York City — on the same day as another Nobel prizewinner, the US economist Robert Solow. (Both men served as members of the staff of President John F. Kennedy's Council of Economic Advisors in the early 1960s.) Arrow stayed in New York for his education. After attending Townsend Harris High School, he pursued a bachelor's degree at the City College of New York, and a master's and PhD (1951) at Columbia University in New York City. Between 1942 and 1946, he worked as a weather officer in the US Army. His first publication, a 1943 paper entitled 'On the optimal use of winds for flight planning', indicated a preoccupation with optimality — the *sine qua non* for his subsequent intellectual vision.

Mathematical economics involves the use of mathematical principles and methods to create theories and analyse problems in economics. Mathematical politics is the use of mathematics to try to understand how governance affects society. Arrow was crucial to the most significant achievements of both these subjects in the latter half of the twentieth century.

He was responsible for the modern mathematical version of the two fundamental theorems of welfare economics. With French-born US economist and mathematician Gerard Debreu, he also provided a mathematical proof of the existence of a general economic equilibrium in a private ownership economy: he identified that there are certain scenarios (even under conditions of uncertainty) in which supply and demand will be at equilibrium.

The crown jewel of mathematical politics



is Arrow's impossibility theorem — the demonstration that collective decision-making based on the choices of individuals cannot produce results that reflect the preferences of society as a whole. This is akin to Heisenberg's uncertainty principle in quantum mechanics, which states that there is a limit to the precision with which certain pairs of physical properties of a particle (position and momentum) can be known.

In 1972, at the age of 51, Arrow was awarded (jointly with John Hicks) the Nobel prize in economics for his contributions to general economic equilibrium theory and welfare theory. He was the youngest economist ever to receive the prize.

Arrow spent the bulk of his career at Stanford University in California, but briefly worked at the Cowles Foundation for Research in Economics (then in Chicago, Illinois) and the University of Chicago, and taught and did research at various distinguished universities overseas. He also helped shape the research pursued at the Santa Fe Institute in New Mexico, where he helped to organize a 1987 meeting between physical scientists and economists entitled 'The economy as an evolving, complex system'.

Arrow remained professionally active for almost 75 years. Indeed, the final book about his work on the ethics of mathematical politics — *On Ethics and Economics: Conversations with Kenneth J. Arrow* (Routledge, 2016) — was published only last year. His most fertile period seems to have been the years between his first work on the impossibility theorem in the early 1950s and his pioneering contribution, in 1962, to what

became endogenous growth theory. (He demonstrated that factors inside a system, such as workers learning how to use machinery better, as well as exogenous factors, such as the provision of more machines, could affect the system's performance.)

Ken was a cultured genius of enviable modesty. In his reminiscences, he described his indebtedness to statistician and theorist Harold Hotelling, who had introduced him to economics and the economist's way of thinking during his years at Columbia University. He similarly acknowledged the role of mathematician and mathematical philosopher Alfred Tarski in teaching him the fundamentals of set theory, a branch of mathematics

that deals with the properties of collections of objects and provides the foundations of standard mathematics.

Although Arrow remained a theorist of depth and purity, he was well aware of the limits of theory and observed in an interview in 1995 that "one thing I learned from meteorology is that being an actual science was no guarantee of exactness" and that "economic theory, being abstract, cannot of course state that government expenditures should be 31.732% of gross national product". This healthy attitude to theory was reinforced by his extensive knowledge of the history of economic theory — particularly the works of the Scottish founding father of economics, Adam Smith, and his followers.

While giving a talk at a conference at the University of California, Irvine, in 2001, I quoted the last sentence from his 1986 paper 'Rationality of self and others'. Ken, seated in the front row, was not aware that he had penned the lines. The problem, however, was not with his memory. He recognized, immediately, that Thomasina's thoughts on bluebells and mathematical equations, which I also cited, came from Tom Stoppard's *Arcadia*. ■

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