

ROBERT M. SOLOW LAUDATIO

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It is a great honor to introduce Robert Merton Solow, who will receive today a Doctor Honoris Causa degree from Pompeu Fabra University. Among economists, Robert Solow needs no introduction. He is among a handful of great minds that laid the foundations of the field of macroeconomics for the 20th century and beyond. His influence on today's practice of macroeconomics is evident everywhere. Robert Solow has earned numerous prizes and awards, including the Nobel Prize in Economics in 1987.

Robert Solow was born in Brooklyn, New York on August 23, 1924. He was the eldest of three children. After going through New York's public school system, the young Solow won a scholarship to Harvard College and moved there in 1940. His interests led him to study Sociology, Anthropology and Economics. In a short autobiography written for the Nobel Prize website, he says: "Like many other children of the Depression, I was curious about what makes society tick."

In 1942, Robert Solow interrupted his studies to join the Army. He served in North Africa and Italy as a spotter in small planes for artillery

guidance. After marrying Barbara (Bobbie) Lewis, he returned to Harvard in 1945 to complete his undergraduate degree and obtain his PhD. There he found Wassily Leontief who taught him, in Robert Solow's own words, "the spirit as well as the substance of modern economic theory". During his time at Harvard, Solow also became interested in Statistics and Probability, which led him to spend the 1949-1950 academic year at Columbia University.

Robert Solow joined MIT in 1950 and, except for the short period 1960-1961 when he served on President John F. Kennedy's Council of Economic Advisors, he remained at MIT for the rest of his academic career. At MIT, he was given the office next to Paul Samuelson and, using Solow's own words again, "thus began now almost 40 years of almost daily conversations about economics, politics, our children, cabbages and kings". During those 40 years, Robert Solow trained an unparalleled number of leading economists, including various Nobel Prize winners like himself —and his advisor Leontief. He also gained the respect and admiration of colleagues and students alike. In fact, I was present at his retirement party in the spring of 1995. At that time, I had already accepted a job as an Assistant Professor at MIT but had not formally joined the faculty yet. The chairman of the department, Paul Joskow, invited me to attend the party saying that I should not miss the event. He was right. I have seldom seen such an outburst of love, appreciation and respect for a colleague and former teacher.

It was at MIT, of course, that Robert Solow wrote most of his pathbreaking papers. Let me just mention a few of them:

1) In his 1960 paper "Analytical Aspects of Anti-Inflation Policy" (with Paul Samuelson), Robert Solow introduced the Phillips curve to American academics and provided theoretical underpinnings for it. This curve relates the rate of inflation and unemployment. The vigorous theoretical debate that followed this paper, plus the spectacular empirical failure of the Phillips curve in the 1970s played a central role in the development of macroeconomics during the last quarter of the 20th century.

2) In his 1961 paper "Capital Labor Substitution and Economic Efficiency" (with Kenneth Arrow, Hollis Chenery and Bagicha Minhas), Robert Solow invented the Constant Elasticity of Substitution, or CES, production function. This function is a simple, very tractable way of summarizing production relations. It is so technically convenient that it has become a standard piece in basically all macroeconomic models.

3) In his 1980 paper “Wage Bargaining and Employment” (with Ian McDonald), Robert Solow provided a simple and powerful framework to analyze the effects of collective bargaining in labor market outcomes. This framework, sometimes labeled the “insider-outsider” theory of the labor market, was used to explain the large increase in European unemployment after the oil shocks of the 1970s. Even today, when the role of unions has substantially declined, collective bargaining remains pervasive and the issues raised by this paper remain very relevant.

I could go on and give more examples of Robert Solow’s key contributions on fiscal policy, urban economics, the theory of natural resource extraction and many other fields. But this would just move me away from where I want to go. And this is, of course, to two truly extraordinary papers that laid the foundations for the theory of economic growth as we understand it now. His 1956 paper “A Contribution to the Theory of Economic Growth” provided a theoretical model to study the long-run impact of savings, population growth and technological progress. His 1957 paper “Technical Change and the Aggregate Production Function” provided an empirical methodology to disentangle the contributions to the economic growth of factor accumulation and technological progress. Let me review both of these papers next.

Economic growth has been a central feature of modern capitalist economies since the Industrial Revolution, and a basic question in economics is to identify its sources. In his 1956 paper Robert Solow argued that, under a set of reasonably realistic and standard assumptions, *only* technological progress could be the source of long-run growth in capitalist economies. This was certainly contrary to the then popular belief that raising savings would lead to higher long-run growth in per capita incomes. To prove this simple claim, Robert Solow wrote one of the most beautiful models in the history of economics. Nowadays, everybody knows it simply as the “Solow” model.

So why is it that long run growth is determined only by technological progress? The answer, of course, is that technological progress is required to fight the law of diminishing returns. To see this, simply assume that there is no technological progress and consider the effects of an increase in the savings rate. That is, an increase in the share of output that society sets aside for the future. The additional savings raise the capital stock and therefore per capita income. This is, of course, a first round of economic growth. This leads to additional savings and a further increase in the capital stock and income. This is a second round of economic growth. But this second round of economic growth is smaller than the first round, since each additional piece of capital has less labor to

work with and this reduces its productivity. This observation, which follows from the law of diminishing returns, implies that further rounds of economic growth will be smaller and smaller. Eventually the effects of the initial increase in savings peter out and economic growth vanishes. If we want to have sustained economic growth, we need increases in productivity that counteract the law of diminishing returns. That is, we need technological progress.

Once technological progress took center stage in the theory, the fundamental question became how to measure it. Before Robert Solow's 1957 paper, this seemed an unsurmountable task. There are, of course, important economic quantities that are easily measured in practice such as inflation or unemployment. Measuring inflation only requires taking notes of prices and computing their rate of growth. Measuring unemployment only requires counting the number of people that want to work at the current wage rate but cannot find a job. Let me be clear. Measuring inflation and unemployment is not free of problems, but these can be sorted out and we can confidently construct pretty good empirical counterparts to our theoretical concepts. The same cannot be said however with respect of technological progress. How can we measure this abstract theoretical concept?

In his 1957 paper, Robert Solow answered this question by providing a simple empirical methodology to measure productivity growth, the empirical counterpart to the concept of technological progress stressed in his 1956 paper. In a nutshell, this methodology consists of chopping off from the rate of growth of per capita income, the part that is attributed to factor accumulation. The rest, which is known as the "Solow" residual, constitutes an estimate of the economywide productivity growth. Today, this methodology is widely used by academics and policymakers alike. In fact, any time you hear in the press that productivity growth has been increasing or decreasing, you will immediately know that somebody somewhere has been calculating Solow residuals.

It is almost impossible to overstate the impact of the Solow model and the Solow residual on the development of macroeconomics. In his 1956 and 1957 papers, Robert Solow laid out a rich and fruitful research program for the study of economic growth that has been vigorously pursued by various generations of macroeconomists. This research program has already produced many important results and it promises many more in the future. This research program is still very much alive today, and I would like to ask all of you to dedicate a warm applause to the man that started it all.