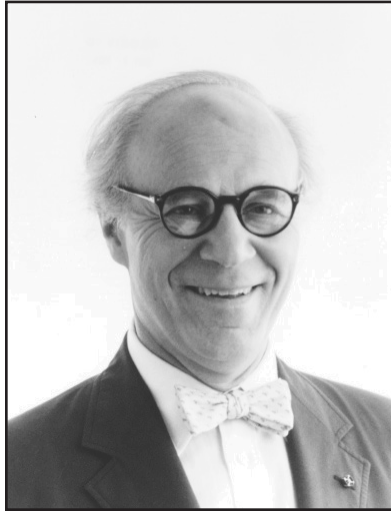# LAWRENCE R. KLEIN

14 SEPTEMBER 1920 · 20 OCTOBER 2013

Lawrence Robert Klein, Nobel Laureate in Economic Sciences (1980), was one of the leading figures in macroeconometric modeling. Klein was certainly the real expert on nowcasting and real-time forecasting, as is evidenced by his contributions in modeling, nowcasting, forecasting, machine learning, and his guiding principles on modeling (for details and additional references, see Klein 1992; Klein and Mariano 1987; Mariano 2008; Mariano and Ozmucur 2020). Klein's principles and contributions are more relevant now than ever.

Klein was born on September 14, 1920 in Omaha, Nebraska as the second child of Leo Byron Klein and Blanche (Monheit) Klein. His public school education prepared him well in the basic subjects of mathematics, English, foreign languages, and history. He studied at Los Angeles City College and completed his undergraduate training at the University of California, Berkeley. He then went on to be the first person to get a Ph.D. at M.I.T. in economics. According to Klein, his time as a Ph.D. candidate studying under the supervision of Paul A. Samuelson and his time with the econometrics team at the Cowles Commission of the University of Chicago were fundamental in his training and professional development (Klein 1992). After four years at the University of Michigan and four years at the University of Oxford, Klein joined the faculty of the University of Pennsylvania in 1958, where he spent the rest of his professional life.

Klein's guiding philosophy was to look at a problem as a system, then, use all available information to analyze the problem and solve it. This philosophy could be observed in his research and his daily life. He incorporated input/output and flow-of-funds into the standard Keynesian-type macro models that he pioneered (Klein with Welfe 1983).

Klein was one of the first economists to see the importance of global linkages. He was also one of the first to note that economic models are to explain systematic relationships, and that these relationships are best known by local economists and econometricians. This philosophy led to a global model called Project LINK, a large cooperative, non-governmental research consortium that integrated independently developed national econometric models into a world econometric model. Project LINK started in 1968 with a few countries and, after 50 years, has grown to include more than 100 countries.[1] Klein believed that if it was possible to bring prominent researchers from different countries together, it could be possible to learn more about those countries and solve problems associated with them. The

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1 https://www.rotman.utoronto.ca/FacultyAndResearch/ResearchCentres/Project-LINK; https://www.un.org/development/desa/dpad/project-link.html.

new coronavirus- or modeling-related developments are another reminder that the world needs Klein's visionary approach now, more than ever.

One of the last LINK meetings that Klein attended took place in October 2008, in the midst of what was, at the time, the worst financial crisis of the post–World War II era. All of the speakers who preceded Klein's speech started their talks with almost the same sentence: "We have not seen anything as bad as this crisis." When it was his turn, Klein started with a different sentence: "I have seen worse," a remark that was met with supportive laughter from the audience. He then compared an economy in a "great depression" with one in a "great recession," adding that the experience of growing up during the Great Depression had a profound impact on his intellectual and professional career (Klein 1992). With that background, he helped put everything in perspective.

Klein's Current Quarter Model (CQM) estimates gross domestic product (GDP) and its components using expenditure, income, and production methods (Klein and Sojo 1989; Klein and Park 1993, 1995; Klein and Ozmucur 2008). It should be noted that what he called a "current quarter forecast" is called a "nowcast" these days. This model tries to mimic the Bureau of Economic Analysis' (BEA) national income and product accounts (NIPA). This was the pioneering work using bridge equations, linking series at different frequencies and principal components. If a daily, weekly, or monthly series related to a component of quarterly GDP (that is used in the calculation of it) is available, it may be used immediately. Klein provided weekly forecasts from the early 1980s to his last day in 2013. His bridge equations led to more flexible mixed-data sampling (MIDAS) equations. Klein's CQM results were released weekly, but the model was estimated as frequently as new data became available or needed. Klein managed to show that it is possible to provide real-time forecasts at any given time (Klein and Ozmucur 2006, 2009).

The concept of a "replicable model" is becoming very important as we see academic journals provide data and computer programs (or code) used in a paper. Klein did not just preach this but practiced it by providing data and methods in all of his research. Klein Model I, which was published by Klein in 1950, is used as a practice model in many econometrics and statistical software textbooks. A FORTRAN program for matrix operations (Klein 1974, 296) and step-by-step calculations for several methods are also provided (281–320), which may seem trivial today but not so at the time.

Different from many leading econometricians, Klein was also a great economist. His book, *An Introduction to Econometrics*, includes chapters on both microeconomics and macroeconomics (Klein 1962; see also Klein and Rubin 1947), and his Ph.D. thesis at M.I.T was entitled "The Keynesian Revolution" (Klein 1944). He was not just interested in very short-term forecasts, but also medium-term in his macroeconometric models, as well as the very long-term (Klein and Kosobud 1961).

The Nobel Committee summarized Klein's impact by noting that "few, if any, research workers in the empirical field of economic science, have had so many successors and such a large impact as Lawrence Klein."

Klein lived by example. His life taught everyone around him that it is possible to be both a great scientist and a humble human being who treats everyone equally and with dignity. We had not only the pleasure of knowing a decent man with unmatched qualities, but also the honor of working with a great econometrician and an economist. Indeed, Lawrence R. Klein was not just an academic giant who pioneered economic model-building and developed a worldwide industry in econometric forecasting and policy analysis. He also was a caring colleague who generously attracted scholars from all over the world to his circle of researchers through his academic excellence and his concern and respect for the diverse personalities of every individual with whom he interacted (see Pauly 2018).

Professor Klein died in Gladwyne, a suburb of Philadelphia, on October 20, 2013, just a day before the 2013 Project LINK meetings were set to begin at the United Nations in New York. He was survived by his wife, the late Sonia Adelson Klein, four children, and grandchildren. We consider ourselves very fortunate and honored to have known him and to have had the opportunity to work with him for many years. Like many of his students and colleagues, our professional careers and personal lives would not have turned out as they did without Lawrence Klein. It is really very hard for us to find words to express our genuine emotions and true level of gratitude. Knowing that he had a wonderful wife and family, an outstanding career with incomparable accomplishments, and many friends, colleagues, and students all over the world who will continue his legacy eases our pain.

Elected 1970

ROBERTO S. MARIANO[2]
Professor Emeritus of Economics
University of Pennsylvania

SULEYMAN OZMUCUR[3]
Visiting Scholar, Department of Economics
University of Pennsylvania

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2   Roberto S. Mariano has taught at the University of Pennsylvania since 1971, when Lawrence Klein invited him to join the Department of Economics faculty, initially as a visiting lecturer in economics and research associate at Klein's Wharton Econometric Forecasting Associates.

3   Suleyman Ozmucur joined the Department of Economics at the University of Pennsylvania in 1997, when Lawrence Klein invited him to teach in the department and work on Klein's LINK and Current Quarter Model Projects.

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