5

The Cowles Commission at the University of Chicago, 1939–1955

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1 The Cowles Commission Comes to Chicago

From 1939 to 1955, the Cowles Commission for Research in Economics, a research organisation affiliated with the Econometric Society and devoted 'to advance the scientific study and development…of economic theory in its relation to mathematics and statistics', was affiliated with and located in the University of Chicago's Department of Economics (see Christ 1952, 1994; Hildreth 1986). During that period, Cowles Commission researchers made pathbreaking contributions in mathematical economics and econometrics (not then securely part of the mainstream as taught in leading graduate programmes in economics),[1] many were later recognised with the Royal Bank of Sweden Prize in Economic Science in Memory of Alfred Nobel (the "Nobel prize" in economics, established in 1969), that included advances in simultaneous equations econometrics and maximum likelihood (Haavelmo 1944; Koopmans 1950; Hood and Koopmans 1953), nationwide macroeconomic modelling (Klein 1950), linear programming and activity analysis (Koopmans 1951), social choice (Arrow 1951), general equilibrium analysis (Arrow and

[1] Lucas (2016: 11) reports that in 1946, when Milton Friedman and Tjalling Koopmans became Associate Professors, 'Chicago PhD students still had to petition to substitute a calculus course for one of the two foreign language requirements' and refers to 'what we then called "mathematical economics" and now call simply "economic theory"'.

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Debreu 1954; McKenzie 1954; Debreu 1959), portfolio diversification (Markowitz 1952, 1959) and behavioural economics (Katona 1945 and the articles reprinted as Simon 1957). Of the eight Cowles monographs published in the 1950s (all representing work undertaken before the move from Chicago), only one was not written, edited or coedited by a future Nobel laureate.[2] Nonetheless, the Commission came into increasing conflict over economic methodology with the emerging "Chicago school" of economics and especially with Milton Friedman, who wrote to Arthur Burns in October 1954 that he was 'glad to report that the rumors are entirely true' that the Cowles Commission would be moving from Chicago to Yale University: 'Poor Yale' (item 18 of the online appendix to Mitch 2016; see also Patinkin 1981, Reder 1982, Dimand and Rivot 2021).[3]

The Cowles Commission was founded in Colorado Springs in 1932 by Alfred (Bob) Cowles 3rd, an investment counsellor whose grandfather and namesake had been the founding treasurer of the *Chicago Tribune*. The 1929 stock market crash disillusioned Cowles about forecasting services, both the ones to which he subscribed and that provided by his own Cowles and Company. In "Can Stock Market Forecasters Forecast?" (Cowles 1933), Cowles showed that the predictions of 16 weekly forecasting services were no better than 16 random series of weekly stock recommendations (see also Cowles 1944). While working on that paper, Cowles consulted Harold T. Davis, an Indiana University mathematics professor who summered in Colorado Springs, and learned from Davis about the recently founded Econometric Society. The Society was then a small group, which had assets of just $21 when Cowles became its Treasurer in April 1932. It was transformed by Cowles's guarantee of at least $12,000 a year for a journal (*Econometrica*) and a research laboratory, the Cowles Commission, once the Society's founding president, Irving Fisher, managed to reassure the Society's Council that Cowles's offer was not just a crank letter (fortunately Fisher

[2] In addition to Arrow, Debreu, Haavelmo, Klein, Koopmans, Markowitz and Simon, Leonid Hurwicz and Franco Modigliani were among the nine future Nobel laureates listed among 26 current Cowles research associates or research consultants (not counting two "computation leaders" and an administrator) in Cowles Commission for Research in Economics (1952) (but, in the case of Modigliani and partially in that of Hurwicz, their Nobel recognition was not primarily for work done at the Commission). Marschak was president-elect of the American Economic Association (AEA) when he died in 1977. However, Boumans (2016: 602) believes that 'the history of the Cowles period at Chicago was almost forgotten'.

[3] In his memoirs, Friedman suggested that 'the reason we failed [to dissuade the Cowles Commission from leaving] was a combination of Cowles's ties to Yale, of which he was a graduate, and financial incentives offered by Yale that Chicago was not able to match. Whatever the reason, the move was a significant loss to Chicago' (M. Friedman in Friedman and Friedman 1998: 198). Rather than offering financial incentives, Yale required that Cowles provide an endowment for the new Cowles Foundation in place of his annual gifts to the Cowles Commission.

had known Cowles's father and uncle as Yale undergraduates in the 1880s). The Commission's main activities in the 1930s, beyond financial and administrative support of *Econometrica* and the Econometric Society, were month-long summer research conferences in Colorado Springs on mathematical economics and econometrics from 1936 to 1940 and the compilation of a database on US common stock prices and returns (see Cowles and Associates 1938).

After the death of Cowles's father in January 1939, Alfred Cowles moved to Chicago to look after his family's business affairs.[4] The death of Chicago's sole econometrician Henry Schultz in an automobile accident a few months after speaking at the 1938 Cowles summer conference, together with the enthusiasm for mathematical economics and general equilibrium of Oskar Lange at the Chicago, contributed to the University's Economics Department being receptive to providing a new home for the Cowles Commission, which was rechartered as a not-for-profit corporation in Illinois in September 1939. The Research Directorship of the Commission, vacant since 1937, was taken by Theodore Yntema, author of a Chicago dissertation (supervised by Jacob Viner) and book *A Mathematical Reformulation of the General Theory of International Trade* (Yntema 1932) and Professor of Statistics in Chicago's Business School, who had previously declined to move to Colorado to direct the Commission. The University of Chicago provided four rooms rent-free, gave some university privileges to Cowles staff, and named Jacob Viner to represent it on the Commission's Advisory Council (see Christ 1952). The Council, named by the Econometric Society, was later replaced by an Advisory Committee named by the University of Chicago. Alfred Cowles 3rd remained actively engaged, far beyond writing an annual check, as President of the Commission, Secretary and Treasurer of the Econometric Society, and business manager of *Econometrica*.

The most notable achievement of the Yntema years was Jacob Mosak's Cowles monograph *General Equilibrium in International Trade* (Mosak 1944), originally a 1941 Chicago PhD dissertation supervised by Viner, Lange and Yntema. But Yntema's interests shifted away from mathematical economics and statistics, first to public policy as he left the Cowles Commission and his Chair in statistics in 1942 to direct research at the Committee for Economic Development and be a Professor of Public Policy in the Business School, and then outside academia as he joined the Ford Motor Company as vice-president for finance, rising to chair the Finance Committee (in effect, Chief Financial Officer), while Mosak pursued a distinguished non-academic career at the

[4] Düppe and Weintraub (2014a: 75) attribute the move instead to avoidance of state taxes in Colorado.

United Nations. Mosak had been unmistakably one of the top two Chicago economics undergraduates of his year but the other was Paul Samuelson, and Mosak did not try to compete with him as an economic theorist.

2 Jacob Marschak Transforms the Cowles Commission

The Cowles Commission was transformed and invigorated at the beginning of 1943 by the arrival as Research Director of the Commission and as Professor of Economics in the University of Chicago of Jacob Marschak. An undergraduate student of the statistician and mathematical economist Evgeny Slutsky in Ukraine, briefly a political prisoner as a student and then a teenaged Minister of Labour in a Menshevik regional government in the Northern Caucasus during the Russian Revolution, Marschak emigrated from Bolshevik Russia to Germany, where he did his doctorate at Heidelberg and taught there until he emigrated from Nazi Germany, becoming the founding Director of Oxford University's Institute of Statistics before coming to the United States on a Rockefeller Foundation Fellowship in 1939, joining the University in Exile at New York's New School for Social Research the following year (see Cherrier 2010; Dimand and Hagemann 2020). Marschak, who spoke at the 1937 and 1939 Cowles summer conferences in Colorado, would have become Research Director of the Commission in 1938 had an application by Cowles for Rockefeller funding succeeded. While at the New School, Marschak and Lange (visiting at Columbia University) conducted a National Bureau of Economic Research (NBER) econometrics seminar at weekends, with participation from Trygve Haavelmo (a speaker at the 1939 and 1940 Cowles summer conferences), Tjalling Koopmans, the Columbia mathematical statistician Abraham Wald (previously a Cowles research fellow in Colorado), and Franco Modigliani, whose New School dissertation was supervised by Marschak.

This seminar initiated the research programme in econometrics that Marschak brought to Cowles and provided the link between the revived Commission and the pre-Second World War European advances in mathematical economics and econometrics in the persons of Slutsky's student Marschak, Ragnar Frisch's student Haavelmo from Norway, Jan Tinbergen's student Koopmans from the Netherlands, and Wald from Karl Menger's Vienna mathematical colloquium. Marschak recruited Haavelmo as a Cowles Research Associate in July 1943, Koopmans (funded by a Rockefeller grant) and Lawrence Klein (Paul Samuelson's first PhD student at MIT) in 1944,

and, on a recommendation from Harold Hotelling, Hotelling's Columbia University student Kenneth Arrow in 1947. Leonid Hurwicz had already been hired in January 1942 as an assistant to Lange. Koopmans also became an Associate Professor of economics at Chicago in 1946 and Arrow an Assistant Professor in 1948, joining Marschak on the payroll of the University rather than the Commission. Herbert Simon, a Chicago PhD in political science teaching at the Illinois Institute of Technology,[5] was named a Research Consultant in 1947, rather than hired as a Research Associate. In addition to these future Nobel laureates in economics, the mathematical statisticians Herman Rubin and Theodore Anderson, the co-inventors of limited information maximum likelihood (LIML), joined in 1944 and 1945, respectively (see Cowles Commission for Research in Economics 1952). Koopmans succeeded Marschak as Research Director in July 1948.

3 The Cowles Commission Approach to Simultaneous Equations Macroeconometric Modelling

From 27 January to 1 February 1945, the Cowles Commission held what Edmond Malinvaud termed 'the most influential conference on statistical inference in economics ever held' (Malinvaud in Arrow et al. 1991: 57), which led to the publication of Koopmans (1950). Building on Hurwicz (1944) and especially on Haavelmo (1944), Koopmans, Marschak, Anderson, Jean Bronfenbrenner, Haavelmo, Hurwicz, Rubin, Simon, Wald and other contributors to Koopmans (1950) and Hood and Koopmans (1953) analysed the identification and full- and LIML estimation of simultaneous equations dynamic economic models. Tinbergen's multi-equation model of fluctuations in the inter-war US economy (Tinbergen 1939) had been estimated one equation at a time using ordinary least squares, causing simultaneity bias avoided by the Cowles Commission approach.[6] Klein's Cowles monograph, published in 1950 but largely completed by 1947 (see Klein 1991), provided an

[5] Although Simon's doctorate and his Illinois Tech appointment were in political science and his later academic positions were in computer science, psychology and industrial administration, he published on identification conditions for simultaneous equations models in Cowles monographs and on behavioural models of choice in the Cowles Commission Papers reprint series. He denied being a polymath, insisting that he wrote on only one subject, decision-making, and was not responsible for disciplinary boundaries drawn by others.

[6] Tinbergen, commenting on Klein (1950) in NBER (1951), remained unpersuaded, continuing to uphold single-equation OLS because system-wide estimation methods such as maximum likelihood could spread incorrect specification of one equation to the whole system of estimated coefficients.

empirical implementation of such a simultaneous equations model of macroeconomic fluctuations for the United States. Klein's models followed the interpretation of Keynes's *General Theory* (Keynes 1936 [1973]) as a small equilibrium system of simultaneous equations, the subject of Klein's MIT dissertation on *The Keynesian Revolution* (Klein 1947a), an approach expounded in Marschak's lectures on *Income, Employment and the Price Level* (Marschak 1951), the first graduate-level textbook of Keynesian macroeconomics.

Marschak's doctoral student Don Patinkin (1948, 1949) developed a theory of Keynesian unemployment equilibrium whilst at the Commission, shifting to a disequilibrium interpretation of Keynesian macroeconomics (see Patinkin 1956; Boianovsky 2002; Rubin 2002). Keynes himself had been critical of Tinbergen's method, largely on grounds of fundamental uncertainty and structural breaks[7] (see Hendry and Morgan 1995 for the Keynes-Tinbergen exchange and for a 1940 defence of Tinbergen by Marschak and Lange that Keynes declined to publish in the *Economic Journal*). The Commission's approach to macroeconomic modelling, while drawing inspiration from Keynes (1936 [1973]) and Tinbergen (1939), nonetheless diverged from these two approaches. Klein (1947b) and Marschak's "Economic Measurements for Policy and Prediction" (the opening chapter of Hood and Koopmans 1953) stressed the role of such models in guiding interventionist Keynesian macroeconomic policy, stabilising the economy by managing aggregate demand, and in evaluating the macroeconomic consequences of policy changes.[8]

Milton Friedman, attending Cowles seminars, later recalled, 'I developed a reputation as something of a hair shirt since I was, and still am, a persistent critic of the approach to the analysis of economic data that became known as the Cowles approach' (M. Friedman in Friedman and Friedman 1998: 197). Arthur Burns, who had taught Friedman statistics at Rutgers and Columbia,

[7] However, Keynes's later view of Tinbergen, in a 23 July 1945 letter to Alfred Cowles, was that 'I very much hope that Tinbergen can be elected Vice-President [of the Econometric Society, of which Keynes was then President and Cowles Secretary-Treasurer] … I had the pleasure two days ago to give a luncheon party at Cambridge in honour of Tinbergen and three other Dutch economist-statisticians … I felt once again, as I had felt before, that there is no-one more gifted or delightful or for whose work one could be more anxious to give every possible scope and opportunity' (Keynes in Patinkin 1982: 228). In contrast, Mirowski (2012: 139) takes the curious position that the Cowles Commission was 'an anti-Keynesian stronghold' because it was 'a nest of Tinbergers [sic]' and 'at least in the 1940s, Keynes's *bête noire* was Tinbergen'.

[8] William Hood, a University of Toronto Economics Professor who was a Postdoctoral Fellow at Cowles when he coedited *Studies in Econometric Method* with Koopmans (and co-authored with Koopmans a 78-page chapter on "The Estimation of Simultaneous Linear Economic Relationships"), became a more direct participant in policy making as Advisor to the Bank of Canada, then successively Assistant Deputy, Associate Deputy and Deputy Minister of Finance of Canada, and then Economic Counsellor and Director of Research at the International Monetary Fund.

had criticised Keynesian macroeconomic modelling in the 1946 Annual Report of the NBER. In turn, Koopmans (1947) had attacked the NBER approach of Burns and Mitchell (1946) as "Measurement Without Theory" because the Bureau's investigation of leads and lags in economic time series did not make use of exclusionary restrictions drawn from explicit economic theory to identify the structural equations of a formal model (see the exchange between Koopmans and Rutledge Vining reprinted in Hendry and Morgan 1995). Friedman (1950) argued that Wesley Mitchell was as much an economic theorist as the Cowles mathematical economists but doing a style of theory different from Walrasian general equilibrium, and also offered a formalisation of the equations implicit in Mitchell's work in an appendix. In light of later New Classical criticisms of Keynesian macroeconomics for not being explicitly grounded in microeconomic optimisation, it is ironic that Friedman was criticising the Keynesian modellers at Cowles for trying to do exactly that, to present Keynesian macroeconomics as a dynamic general equilibrium model built on optimising consumption and investment decisions. When Friedman (1953) stressed that models should be judged by their predictive power rather than their assumptions, the implication was against accepting macroeconomic models for their consistent microeconomic foundations (their assumptions). Another irony is that the atheoretical, purely statistical Burns-Mitchell approach to analysing economic time series derided by Koopmans reappeared as the influential vector autoregression (VAR) approach to analysing macroeconomic time series without too much a priori economic theory that won Christopher Sims a Nobel Prize, in part for work that Sims did while a member of the Cowles Foundation.

Cowles researcher Carl Christ, in a Commission discussion paper published in the proceedings of a 1949 NBER conference on business cycles (NBER 1951), showed that Klein's Models I through III of the US economy (Klein 1950) did poorly at out-of-sample prediction, no better than some naïve models. Friedman, as one of Christ's discussants (in NBER 1951), gleefully acclaimed Christ's results as proof of the failure of such economy-wide modelling based on presumptuous attempts to specify the equations of general equilibrium, rather than as showing that the first generation of any type of model will have considerable room for improvement, and urged the abandonment of such modelling. As Christ thanked Friedman for suggesting two particular naïve models to use as benchmarks, Boumans (2016) has acclaimed Friedman as the pioneer of using comparison with naïve models to evaluate predictive performance. But the Cowles Commission only existed because Alfred Cowles (1933, 1944) was interested in using naïve models to evaluate predictive success, and Cowles researchers such as Klein (1946) and Markowitz

("The Accuracy of Naïve Models" 1949) continued to evaluate the performance of economic forecasting. Christ did indeed let Friedman, as a critic of the Cowles approach, suggest two examples of naïve models to use. However, Friedman did not invent the concept of using naïve models as a benchmark. Rather, the significance of Friedman's discussion of Christ is that Friedman wrote his famous article "The Methodology of Positive Economics" (Friedman 1953), claiming predictive success as the criterion for accepting or rejecting models, at a time when he believed that Christ had shown that criterion would reject Keynesian macroeconomic modelling. David Hendry and Neil Ericsson (e.g. with Hood 2016) point out that later, when Friedman and Schwartz (1982) did poorly at out-of-sample prediction at a time of instability of the money demand functions in the United States and the United Kingdom, Friedman was content to discard prediction as a criterion and to test assumptions instead.

4 Resource Allocation, General Equilibrium and Marshall Versus Walras

Supported by a research contract with the RAND Corporation on "Theory of Resource Allocation", signed in January 1949, the Cowles Commission held a conference on "Activity Analysis of Production and Allocation" from 20 to 24 June 1949 (see Düppe and Weintraub 2014a: Chapter 5, 2014b; cf. Arrow and Debreu in Arrow et al. 1991). This conference and its proceedings volume (Koopmans 1951) brought together several communities of mathematically sophisticated scholars with academic or government jobs across a number of disciplines then regarded as disparate (economics, statistics, mathematics, and the emerging operations research or management science) whose work involved linear programming: Koopmans and his Cowles colleagues such as Arrow, Hildreth, Hurwicz and Simon on the economic implications of activity analysis; George Dantzig and Marshall Wood of the Department of the Air Force (originally the sole client of RAND) on the simplex algorithm for solving programming problems; Paul Samuelson[9] (visiting RAND from MIT), Robert Dorfman from the University of California, Berkeley, the Princeton

[9] As Düppe and Weintraub (2014a: 100, fn. 2) remark, Samuelson, who in 1947 had been the inaugural winner of the AEA's John Bates Clark Medal, was the exception of the then otherwise marginal position in the US economics profession of the conference participants, many of whose names were later well known to economists (e.g. Kuhn and Tucker). Samuelson's visit at RAND in Santa Monica, California, and his participation in the Cowles conference led to his and Solow's collaboration with Dorfman on linear programming and economic analysis.

Mathematics Department game theorists David Gale, Harold Kuhn and Albert Tucker on the equivalence of strictly competitive games and linear programming problems; and Nicholas Georgescu-Roegen, associated with Wassily Leontief's Harvard Economic Research Program in input-output analysis (Leontief, although his name appeared in the titles of several chapters of the resulting monograph, was ill and did not take part in the conference or the volume). One result of the conference was that since linear programming problems and two-person zero-sum games could be written as formally equivalent, and algorithms existed for finding solutions to linear programming problems, a method was available for finding the solution of a two-person zero-sum game, not just showing that some solution must exist. Only Oskar Morgenstern from Princeton, a co-founder of game theory but a member of Princeton's Economics Department rather than a mathematician, presenting and publishing in the conference volume a short précis of his *On the Accuracy of Economic Observations* (Morgenstern 1950 [1963]), tried, without success, to chasten the enthusiasm of the mathematical economists by reminding them of the limitations of their knowledge of the underlying facts.

Düppe and Weintraub (2014a, b) found that the 1949 Cowles activity analysis conference created two preconditions for the emergence at the Commission of general equilibrium theorising (e.g. Debreu 1959), and particularly fixed-point proofs of the existence of Walrasian competitive general equilibrium (see McKenzie 1954; Arrow and Debreu 1954—Arrow and Debreu at first worked independently of each other before being brought together by Koopmans), far more abstract and more committed for formal economic theory than the discipline-bridging emphasis on optimisation and computation at the conference. One was a shared commitment to mathematical rigour in economics, in contrast to such treatises as John Hicks's *Value and Capital* (1939 [1946]) where, as in Alfred Marshall's *Principles of Economics* half a century before, mathematics was relegated to a mathematical appendix. The other was a concern with legitimacy and acceptance within mainstream economic theory, as distinct from such areas of applied mathematics as military operations research (the concern of RAND and the Office of Naval Research), but also distancing such mathematical economic theorising from the identification of Walrasian general equilibrium as a schema for socialist planning, as argued in the socialist calculation debate of the 1930s, notably by Lange (see articles reprinted in Lange and Taylor 1938).

The protagonists in developing existence proofs of general equilibrium in the early 1950s—differing among themselves in various ways (e.g. continuity of preferences or continuity of demand functions) but all proving existence of an equilibrium under conditions considerably more general than those of

John von Neumann and Wald in their papers to Menger's Vienna colloquium in the 1930s—each had Commission connections.[10] Arrow remained a Cowles research consultant long after leaving the University of Chicago for a position at Stanford in the fall of 1949 and developed his "impossibility theorem" on social choice into a Cowles monograph (Arrow 1951). Debreu, after spending some weeks at Cowles in the fall of 1949 while a Rockefeller Foundation Fellow, was a Research Associate from the fall of 1950, moving to Yale with Cowles in 1955. McKenzie, teaching at Duke, spent the 1950–1951 academic year at Cowles, writing his first paper on Frank Graham's model of world trade for Koopmans's graduate course on activity analysis, and was a research consultant and visitor at the Cowles Foundation at Yale.

The Cowles general equilibrium theorists differed in various ways—for example, Debreu's interests lay more in pure mathematics—and there were contested issues of priority, with McKenzie publishing his proof in the issue of *Econometrica* preceding the Arrow-Debreu proof yet being the only one of the three not to become a Nobel laureate. But what they had in common was that they were doing work that was repugnant and not recognisable as serious economics to Friedman and the other intellectual descendants of Frank Knight's Chicago economics. Friedman identified himself as a Marshallian opposed to Walrasian general equilibrium analysis and sceptical of mathematical economics, doubting that enough was known about the structure of the economy to write out a general equilibrium model, although Robert Lucas remarks that Friedman's lectures on price theory stressed 'what he [Friedman] dislike[d] about Walras more than anything he ha[d] learn[t] from Marshall' (Lucas 2016: 11):

> I believe that mathematicians, whether pure mathematicians or economists or statisticians, tend to be favorable to central planning … First, suggested solutions to mathematical problems are either clearly right or clearly wrong and "first-rate" mathematicians will agree which it is. Second, mathematical ability is frequently recognized at an early age. As a result, individuals who have exceptional mathematical ability get early deference, and develop great confidence in their ability to solve problems. When they enter a field like economics they carry over the belief that all problems have clear-cut solutions and that they are competent to find them (M. Friedman in Friedman and Friedman 1998: 262).

[10] As had Wald, a Cowles Research Associate in Colorado in 1938 before Hotelling brought him to Columbia University (where Wald taught statistics while Arrow was a student there) and thereafter a Research Consultant at Cowles, contributing in econometrics to Koopmans (1950), but he did not return to general equilibrium theory after emigrating in 1938, and he died in 1950, just as Arrow, Debreu and McKenzie were taking an interest in existence proofs.

Friedman was by no means devoid of confidence in his own ability to discern the correct solution to problems of economic policy, but these solutions tended to have the government leave things alone rather than engage in planning. He stressed that,

> I taught economic theory as, in Alfred Marshall's words, an "engine for the discovery of concrete truth," not as a branch of mathematics. This was, and I believe remains, the distinctive feature of "Chicago economics," in sharp contrast to economic theory as taught at some other leading centers of graduate economics (ibid.: 204).

Debreu's *Theory of Value* (1959) exemplified the style of economic theory rejected by Friedman. Writing in 1948 to Joseph Willets of the Rockefeller Foundation about a grant application from the Cowles Commission, Friedman urged that the mathematical economists at the Commission be required to explain their methodology in a way accessible to nonmathematical economists (see Dimand and Rivot 2021). However, Friedman showed little interest in or appreciation for Koopmans' attempt to do just this in *Three Essays on the State of Economic Science* (Koopmans 1957).

'Looking back', observed Lucas (2016: 11), 'I think that Friedman (in common with many socialists at that time) viewed mathematical models as a tool for central planners. Now, of course, some view mathematical models as tools of the right, of "market fundamentalists"'. Lange, who played a key role in bringing the Cowles Commission to the University of Chicago and wrote both a Cowles monograph (Lange 1944) and the first article reprinted as a Cowles Commission Paper, was the clearest example of such a socialist. Lange's "market socialist" contributions to the "socialist calculation" debate of the 1930s (reprinted in Lange and Taylor 1938) saw Walrasian general equilibrium as applicable to socialist planning rather than to understanding capitalism. Lange caused an uproar[11] when, severing his ties with the wartime Polish government-in-exile in London, he first took leave and then left Chicago to represent the Soviet-backed Polish government in Lublin as ambassador to the United States, later returning to Poland to chair a committee of economists advising the Planning Commission (with Michał Kalecki as vice-chair). Friedman wrote a highly critical review article (reprinted in Friedman 1953: 277–300) deploring Lange's 1944 Cowles monograph as lacking empirical content and as 'verbal mathematics', not mentioning the mathematical

[11] In the papers of the offices of the University of Chicago's President and Chancellor there is more material on the Lange affair than on the University's relationship with the Cowles Commission.

appendix that Lange, following the examples of Marshall and Hicks, included. As seen above, Friedman was no better pleased when Klein (1950) provided an empirical implementation of the Cowles Commission version of Keynesian macroeconomic modelling.

5 A Tentative Start in Behavioural Economics

During its Chicago years, the Cowles Commission was the scene of some of the first contributions to behavioural economics and bounded rationality by George Katona (1944, 1945) and Herbert Simon (1952, 1955, 1957), an approach in sharp contrast to the "Chicago School" focus on rational choice and "tight prior equilibrium" (see Reder 1982).[12] Like Marschak, Katona emigrated twice, leaving Hungary during the Communist Revolution in 1919 to go to Germany (where he took a doctorate in experimental psychology at the University of Göttingen) and leaving Germany for the United States in 1933 after the Nazi confiscation of Gustav Stolper's weekly *The German Economist*, of which Katona was an Assistant Editor. In the early 1940s, after the Second World War had begun but before the entry of the United States, Katona taught a course on the psychology of the war economy at the New School for Social Research (where Marschak was also then teaching), leading to his book *War Without Inflation* (Katona 1942), which argued 'that patriotism and cooperation would make price control, rationing, and high rates of taxation so effective that we might fight, for the first time in world history, a great war without inflation' (as summarised by Katona 1972: 13). Katona (ibid.: 13–14) recalled that Marschak became Research Director of the Cowles Commission 'and inherited a project started by Theodore Yntema on business reactions to price control. I was appointed Director of this project and organized sample surveys among businessmen', producing a Cowles monograph on *Price Control and Business* (Katona 1945). Katona sent a copy of a paper about the methods used in that monograph to a survey expert he had not previously met, Rensis Likert, head of the Division of Program Surveys at the US Department of Agriculture. A few weeks later, Likert phoned Katona to hire

[12] Richard Thaler (2015), Professor of Behavioural Sciences and Economics at the University of Chicago Booth School of Business and now a Nobel laureate, cited Simon (1957), but not Katona, as a forerunner without mentioning the Cowles Commission or that there had been any behavioural economics at Chicago before a 1985 conference at the Business School (see Hogarth and Reder 1987). Simon (1991) cited Katona's earlier work in gestalt psychology but not his writings on psychological and behavioural economics.

him away from Cowles to direct (with Eleanor Maccoby) a National Survey of Liquid Assets (from 1947 the Survey of Consumer Finances), funded by the Federal Reserve Board because of concern about inflation if consumers tried to use their wartime savings in War Bonds and other liquid assets to buy goods once hostilities were over (see Katona 1972: 14; Likert 1972: 4–5).[13] Katona, Likert and the other senior staff of the Division of Program Surveys left to establish the Survey Research Center at the University of Michigan in July 1946,[14] making the University of Michigan the leader in psychological and behavioural economics in that era (see Katona 1951).

If a Federal Reserve-funded national survey had not tempted Katona away just as Simon was starting to attend the weekly Cowles Commission seminars near the end of the war (see Simon 1991: 101), the Commission might well have taken that leading role in early behavioural economics. Although, in the words of Simon (ibid.: 105) describing a long conversation near the end of Marschak's life, Marschak 'never lost his belief that the limits of rationality must find their place in a broader frame of optimization…he expressed no impatience at my intransigence [about bounded rationality] and listened thoughtfully to my argument. Debate with him was always like that: thoughtful, neither wavering nor stubborn, considerate'.[15] Simon remained a Cowles research consultant after he moved from Illinois Tech to Carnegie Tech (later Carnegie-Mellon) and his "Behavioral Model of Rational Choice" (Simon 1955) was the last Cowles Commission Paper before Cowles left Chicago to become the Cowles Foundation at Yale.

[13] The recollections of Katona (1972) and Likert (1972) about how Marschak brought Katona to the Cowles Commission and how Likert's offer tempted Katona away contradict the assertion by Mirowski (2012: 163, fn. 32) that 'Marschak summarily terminated Katona as part of his new clean sweep of the Cowles stables'.

[14] Lawrence Klein, whose three-year contract at Cowles expired in 1947, spent a year with Ragnar Frisch in Oslo and then joined the University of Michigan and its Survey Research Center.

[15] Further development of behavioural economics at the Cowles Commission by Katona and Simon would have been acceptable to Marschak (although it was not his own approach), although it would have been yet another source of friction between the Commission and Friedman. Marschak, as president-elect of the AEA, chose Simon to deliver the 1977 Ely Lecture but died before the AEA conference. 'Someone (perhaps with imagination and a sense of humor) decided that Milton Friedman should replace him [as Chair of the Ely Lecture session]. My lecture, "Rationality as Process and as Product of Thought"…was not at all to Milton's liking. During the discussion following the talk, unable to maintain a chairman's neutrality, he engaged in debate with me. But, still mindful of his duties to the speaker, he was not his usual freewheeling self, and I distinctly had the better of the exchange—something that would have been problematic if Milton, famous for his debating skills, had not had one arm tied behind his back' (Simon 1991: 322).

6 The Cowles Commission Leaves the University of Chicago

Harry Markowitz's dissertation, supervised by Marschak, became the starting point for modern financial economics, applying linear programming methods that Markowitz had learned in Koopmans' activity analysis course to derive optimally diversified portfolios, trading off risk against expected return (see Markowitz 1952, 1959). Apparently unknown to Markowitz at the time, Dickson Leavens (1945), a Cowles Commission administrator and statistician who was Managing Editor of *Econometrica*, had noticed, when computing random portfolios for Alfred Cowles (1944) to compare with stock forecasting services, that more diversified portfolios tended to have lower variance of returns. Even this innocuous, pathbreaking and potentially[16] practically useful application of activity analysis, unrelated to public policy and devoted to making capitalism more efficient, caused friction with Friedman, who was a member of the Examining Committee for Markowitz's thesis defence. In Markowitz's recollection, as recounted to Peter Bernstein (1992: 60), Friedman declared, 'Harry, I don't see anything wrong with the math here, but I have a problem. This isn't a dissertation in economics, and we can't give you a PhD in economics for a dissertation that's not economics. It's not math, it's not economics, it's not even business administration'. Markowitz recalled that he 'sat grimly through the next hour and a half listening to the same complaint over and over' but after the Committee deliberated, 'Marschak appeared, looked him in the eye, and said, "Congratulations, Dr. Markowitz!"'

The conflicts within the Economics Department at Chicago over mathematics and economic theory (Walras versus Marshall), empirical methodology (Cowles versus NBER), political ideology and public policy (market socialism and Keynesian demand management versus free markets and monetarism) and especially appointments (e.g. see Mitch 2016 and its online appendix of documents) came to a head when the Cowles Commission searched for a new Research Director when Koopmans was to go on sabbatical to write what became *Three Essays on the State of Economic Science*. Arrow declined to return to Cowles from Stanford to replace Koopmans. Cowles, Marschak and Koopmans then offered the Directorship to Yale's James Tobin (then as much an econometrician as a monetary economist). 'Although the Cowles

[16] Only potentially until, with the UCLA doctoral thesis on the capital asset pricing model by William Sharpe (supervised by Markowitz even though Markowitz, then at RAND, was not on the UCLA faculty), 'the time needed to solve a 100-security example on a state-of-the-art mainframe IBM computer was reduced from 33 minutes with the full Markowitz program to 30 seconds with the simplified model' (Bernstein 1992: 83).

appointment carried with it a professorship at the University of Chicago economics department', recalled Tobin, 'when I asked the chairman [Theodore Schultz, Chair 1946–1961] if the department would have been interested in me without the Cowles connection, he said "No"' (quoted in Dimand 2014: 14). When Tobin then telephoned Koopmans declining the offer, Koopmans asked whether Yale would care to have him [Koopmans] spend his 1954–1955 sabbatical at Yale. The transformation of the Cowles Commission at Chicago into the Cowles Foundation was arranged during Koopmans' sabbatical (see ibid. and Dimand and Rivot 2021).

Koopmans and Marschak moved away from econometrics after their role in Cowles monographs edited by Koopmans (1951) and Hood and Koopmans (1953), with their most notable later research involving the Ramsay-Cass-Koopmans theory of optimal capital accumulation and Marschak's work in behavioural science and the economic theory of teams (see Cherrier 2010 and articles collected in Marschak 1974). The Cowles Commission approach to empirical macroeconomic modelling, widely influential for decades, was continued by Klein, leading up to Project LINK modelling the whole world by linking national models, although this work was based primarily at the University of Pennsylvania. The Commission's approach to macroeconomic modelling was only taken up at the Cowles Foundation decades later with the arrival of Ray Fair. Within the economics profession at large, the Cowles Commission approach eventually lost ground in the face of the Lucas critique which argued that policy regime changes would alter the structural coefficients and of the rise of VARs, although it continued to influence empirical applications.

Portfolio selection, linear and nonlinear programming, maximum likelihood estimation and identification conditions for structural models, social choice theory and the Arrow impossibility theorem, and Arrow-Debreu-McKenzie general equilibrium analysis became pervasive in economics, no longer at the margins of the discipline (or avoidable in any graduate programme) and no longer associated with a single research organisation, so that the very achievements of the Commission and Foundation eroded its distinctiveness and centrality in mathematical economics and econometrics. Not only did the Cowles Commission transform economics in general while at the University of Chicago; it even had a discernible impact on University of Chicago economics. Chicago economics, the tradition deriving from Friedman and his allies such as Schultz who helped drive the Commission away from Chicago, came to resemble Cowles in several ways, embracing mathematics, dynamic general equilibrium, microeconomic foundations, and modern portfolio theory, ideas no longer associated, even in Chicago, with socialist planning or interventionist Keynesianism.

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