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Jacob Marschak and the Cowles Approaches to the Theory of Money and Assets

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Abstract: Jacob Marschak shaped the emergence of monetary theory and portfolio choice at the Cowles Commission (which he directed from 1943 to 1948, but with which he was involved already from 1937) at the University of Chicago, where he was the doctoral teacher of Leonid Hurwicz, Harry Markowitz and Don Patinkin, and then from 1955 at the Cowles Foundation at Yale University, where he was a senior colleague of James Tobin until moving to UCLA in 1960. Marschak's later attempts to clarify the concept of liquidity and to emphasize the role of new information for economic behavior date back as far as to his early experiences with hyperinflationary processes in the Northern Caucasus during the Russian Revolution. Marschak came to monetary theory with his 1922 Heidelberg doctoral dissertation on the quantity theory equation of exchange (published in 1924 as "Die Verkehrsgleichung"), and embedded monetary theory in a wider theory of asset market equilibrium in studies of "Money and the Theory of Assets" (1938), "Assets, Prices, and Monetary Theory" (with Helen Makower, 1938), "Role of Liquidity under Complete and Incomplete Information" (1949), "The Rationale of the Demand for Money and of 'Money Illusion'" (1950), and "Monnaie et liquidité dans les modèles macroéconomiques et microéconomiques" (1955), as well as in *Income, Employment and the Price Level* (lectures Marschak gave at Chicago, edited by Fand and Markowitz, 1951). We examine Marschak's analysis of money within a broader theory of asset market equilibrium and explore the relation of his work to the monetary and portfolio theories of his doctoral students Markowitz and Patinkin and his colleague Tobin and to the revival of the quantity theory of money by Milton Friedman, a University of Chicago colleague unsympathetic to the methodology of the Cowles Commission.

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Introduction

Jacob (Jascha) Marschak shaped the development of monetary theory and portfolio choice at the Cowles Commission for Research in Economics (which he directed at the University of Chicago from 1943 to 1948), both through his own writings and as supervisor of the doctoral dissertations of Harry Markowitz and Don Patinkin at the University of Chicago and, just before Marschak joined Cowles, of Franco Modigliani at the New School for Social Research. The distinctive Cowles embedding of the theory of money in a theory of asset markets and of choice under risk built on earlier work by Marschak (1938) and Makower and Marschak (1938) when he was still director of the Institute of Statistics at the University of Oxford but already involved with the Cowles Commission through its month-long summer conferences in Colorado Springs where he presented that research program (Marschak 1937a, 1937b, 1939a, 1939b). Marschak (1951), in a series of twenty lectures given in 1948 and 1949, gave the definitive exposition of the Cowles Commission version of Keynesian macroeconomics and monetary economics as it was at the time when Markowitz, Patinkin and Leonid Hurwicz were Marschak's doctoral students, students on whom Marschak made a deep and lasting impression[1]. That approach to macroeconomics and monetary economics contrasted sharply with the revival of the quantity theory of money by Milton Friedman and his doctoral students elsewhere in the University of Chicago's Department of Economics (Friedman, ed., 1956). As relations between the two camps worsened, Marschak moved with the Cowles Commission (including future Nobel laureates Debreu, Koopmans and Markowitz) to form the Cowles Foundation at Yale in 1955. Remaining at Yale until he joined UCLA in 1960, Marschak was a senior colleague of James Tobin when Tobin (1958) was developing the "Yale School" approach to money in a

[1] Franco Modigliani, Marschak's doctoral student at the New School, recalled in his autobiography that "Marschak was at once a great economist, a supreme teacher, and an exceptionally humane person … a connoisseur of economic theory with a certain bent for mathematical economics and statistics" (Modigliani 2001, p. 19).

theory of asset markets (Tobin with Golub 1998 was largely drafted between 1958 and Tobin's 1961 appointment to President Kennedy's Council of Economic Advisers).

Such a long and productive academic career devoted to the Cowles Commission's goal of "advancement of economic theory in relation to mathematics and statistics" might seem a surprising fate for a Menshevik revolutionary who had been a political prisoner and then a teenaged cabinet minister in the short-lived Terek Republic during the Russian Revolution (Marschak 1971), but it followed naturally from Marschak's pre-Revolution training in Kiev (now Kyiv) as an undergraduate student of Eugen (or Evgenii) Slutsky, who had just published Slutsky (1915) on income and substitution effects in the theory of consumer choice, before Marschak emigrated the first time and became Emil Lederer's doctoral student in Heidelberg.

As Secretary of Labor in the regional government in the Northern Caucasus 1917/18 Marschak had already made his experience with inflationary processes due to the creation of "white money"[2]. He started his academic career with a PhD thesis on *Die Verkehrsgleichung* (The equation of exchange) for which he was awarded a doctorate from the University of Heidelberg in the middle of the German hyperinflation in 1922 (Marschak 1924). Marschak retained his strong interest in monetary macroeconomics during his professional career which extended across 58 years and three countries with very different environments: Weimar Germany (1919-33), the United Kingdom (1933-38) and the United States (1939-77).

In his thesis Marschak abstained from using the term 'quantity theory' and instead preferred the term 'equation of exchange'. Inspired by Fisher's *Purchasing Power of Money* (Fisher 1911) and Schumpeter's long essay on "Money and the social product" (Schumpeter 1917-18) Marschak analyses the conditions for the equation of exchange to transcend a mere tautology into a causal relationship between the quantity of money and the price level. Naturally,

[2] See Marschak (1971, pp. 48-9)

he focuses attention on possible changes in the velocity of money V and the value of trade Q. Since neither V nor Q can be assumed to be constant over time, the equation of exchange should provide information on the direction and the degree of variability in the other factors. Marschak elaborates the 'concept of relative elasticity' among the variables in the equation of exchange.[3] The proportionality between the quantity of money and the price level then could claim empirical validity, as well as a theoretical interpretation of a causal relationship, only if a relatively high elasticity in the price level exists in relation to variations in the velocity of money and the volume of trade. In a regime of free competition, the price level is the most elastic variable adapting to the other variables. Only in this sense one can give a causal interpretation to the equation of exchange (quantity of money only as cause, price level only as effect).[4]

Marschak kept his interest in this subject during the Weimar years as is best indicated by his essay on "National Wealth and the Demand for Cash" (Marschak 1932)[5], which got inspiration from the new works of Marius Holtrop, Friedrich Hayek and particularly John Maynard Keynes. It directly affected his activities as the excellent teacher Marschak always was. Thus, in his autobiographical reflections Richard A. Musgrave (1997, p. 64) recalls: "Serious study of economics began with my transfer to Heidelberg in the Fall of 1931. Marschak, then a young *Privatdozent*, offered a seminar on Keynes' *Treatise* [*on Money*] and on integrating fiscal flows into the national income accounts." In a letter to Wesley C. Mitchell of 19 April 1933, Joseph Schumpeter declared Marschak "probably the most gifted scientific economist of the exact quantitative type now in Germany" (Schumpeter 2000, p. 247).

[3] Whereas Marschak (1941c) later wrote an article on 'Wicksell's two interest rates', surprisingly, Wicksell's analysis in *Interest and Prices* (1898) was largely neglected in Marschak's thesis.
[4] See Marschak (1924, p. 356).
[5] Interestingly, this was the first publication listed in the official information leaflet of the American Economic Association when Marschak was candidate for office as President-Elect in 1977.

Monetary Theory within a Theory of Asset Prices and Quantities

Marschak was dismissed as a *Privatdozent* at the University of Heidelberg on grounds of "non-Aryan descent" on April 20, 1933, and, after short stays in Austria, Spain and the Netherlands, became Chichele Lecturer in economics at All Souls, Oxford, that autumn. In 1935 he was promoted to Reader in Statistics and became the founding director of the Oxford Institute of Statistics (Hagemann 2006, 2007). While at Oxford, Marschak collaborated on "Assets, Prices and Monetary Theory" (1938) with Helen Makower of the London School of Economics, as a joint product with a single-authored article "Money and the Theory of Assets" (1938) addressed to a more mathematical audience. Makower, whose major work, *Activity Analysis and the Theory of Economic Equilibrium* (1957), was closely related to another, later Cowles Commission theme, also worked with Marschak on labor mobility in Britain, finding intercity differences in unemployment rates a key determinant of mobility (Marschak, Makower and Robinson 1938, 1939-40). Makower and Marschak (1938, p. 283 n1) "reconsiders certain ideas which were treated by one of the present authors in a memorandum on Investment circulated privately in 1935 and in a paper read at the 1935 Meeting of the Econometric Society. A mathematical version of the article is to appear shortly in *Econometrica* [Marschak 1938]; see also the Report of the Colorado Springs Conference for Research in Economics, 1937 [Marschak 1937a, 1937b]." While those references were to work signed by Marschak alone, the footnote added that "The subject was also treated by the authors in an unpublished thesis called *The Theory of Value in the Capital Market*," although the published articles avoided the words value and capital, instead referring to prices and assets, measurable quantities. Makower and Marschak (1938) and Marschak (1938) built upon, but advanced beyond, Marschak's earlier work: as expressed by Perry Mehrling (2010, p. 208), "Whereas previously [Marschak 1934a and the summary in

Marschak 1934b of Marschak's 1933 Econometric Society paper "Theoretical Problems Suggested by Roosevelt's Policy"[6]] he had a quantity equation framework with a Walrasian system *appended*, from 1938 on he would have a Walrasian system with a money demand equation *incorporated*."

In Marschak (1934a, 1934b), he used a system of equations that first equated the supply function (σ) to the demand function (δ) for each commodity and then added the quantity-theory equation of exchange, with demand depending on all prices and on nominal income (wage rate w times real earnings e) and supply of each good depending on that good's price deflated by the wage rate (1934b, p.196):

$$q_i = \sigma_i(p_i/w) = \delta_i(p_1, p_2, \ldots p_n, we)$$

$$\Sigma p_i q_i = we = MV$$

$$P = \lambda(p_1, p_2, \ldots p_n, q_1, q_2 \ldots q_n)$$

The 1934 system of equations embodied what would later be considered the invalid classical dichotomy (Samuelson 1968), with the supply and demand functions of the first line determining relative prices before the quantity-theory equation of exchange was brought in to determine the absolute price level. In contrast, from 1938 onwards Marschak included the "yields"[7] from money and other assets in the utility function and derived first-order conditions, treating markets for money and other assets symmetrically to how markets for all other goods were modelled: "We do not want the Velocity of Circulation to save the situation like a *deus ex*

[6] Franklin Roosevelt's New Deal mixed policies such as the National Industrial Recovery Act and Agricultural Adjustment Administration, targeting individual prices, wages and quantities, with policies such as raising the dollar price of gold, aimed at purchasing power and the price level. Marschak's paper stressed that these variables were not independent of each other.

[7] "For each of the *r* individuals in the market there are two sets of unknowns: (1) his best accessible balance sheet, or best accessible collection of *m* present *assets a*, *b*, …; and (2) his best accessible consumption plan, or best combination of *n* future consumption items *x*, *y*, … which we shall call for brevity 'yields,' because unfortunately 'consumptions' would be ungrammatical. A further set of unknowns are (3) the *m* market *prices* of assets: *p* (of *a*), *q* (of *b*), etc." (Marschak 1938, p. 313).

machina" (1938, p. 311). Instead of a separate equation of exchange, Marschak (1938, p. 315) derived a full set of simultaneous equations determining the equilibrium quantity and yield of all assets (although, p. 312n4, he indicated that he would try as much as possible to avoid the term "equilibrium" lest it be taken to imply constancy over time). Far more than Marschak (1934a, 1934b), Marschak (1938) calls to mind the subsequent Cowles approach to asset market equilibrium culminating in Tobin with Golub (1998).

Central for Marschak is the "marginal productivity theorem"

$$\frac{p}{q} = \frac{U_x\frac{dx}{da}+U_y\frac{dy}{da}+\cdots}{U_x\frac{dx}{db}+U_y\frac{dy}{db}+\cdots}$$, (marginal productivity equations).

> "The numerator in the right-hand part of the last equation may be called for brevity the "marginal productivity" of the asset a; although a more precise name would be "the utility of the best accessible combination of marginal yields of the asset a"; or "the asset´s largest possible contribution to the total utility of the consumption plan".[8]

From the marginal productivity theorem follows that the price ratio p/q is equal to the time-preference rate U_x/U_y. However, as Marschak emphasizes, beyond the special case of two periods, "[i]n general there is no simple relationship between the market price of assets and the preference rates between yields. …There is, therefore, strictly, no single 'market rate of interest'." (ibid).

[8] Marschak (1938, p. 316, equation 4.4'). See note 7 for the notation.

Publication of Makower and Marschak (1938) (and of Boulding 1944) in *Economica* continued a conversation started there by John Hicks in his "Suggestion for Simplifying the Theory of Money*"* (Hicks 1935), which Makower and Marschak (1938, p. 294 n13) cited together with a talk by Hicks on "The Application of Mathematical Methods to the Theory of Risk" at the 1933 Econometric Society meeting in Leyden (abstracted in *Econometrica*, see Marschak 1934b) and an earlier Hicks article in *Economica* (Hicks 1931). Citing Hicks (1935), Marschak (1938, p. 311) reported that "a few economists only, of whom Dr. Hicks is the most outstanding" had treated "cash holdings on the same lines on which holdings of any other Stocks are treated in the General Theory of Prices." Hicks (*Value and Capital*, 1939) did not follow Makower and Marschak (1938) in eschewing the terms value and capital.

Makower and Marschak (1938, pp. 283-84) began by stressing that demand for cash balances could only be understood as part of the theory of prices and quantities of assets, which "necessitates the application of Equilibrium Theory generalized to take account of time, imperfect competition and uncertainty ... Even the marginal productivity theory of prices of factors of production is a special case, because it assumes only one yield jointly produced by many factors." Since the quantities of assets are endogenous, the required theory was not only a theory of asset prices but one which encompassed decisions to divide income between saving and consumption (Marschak 1937b, 1939a). Only after they had sketched the theory of asset prices and quantities in a riskless economy did they extend the theory to a hazardous world in sections 8 to 10 (see also Marschak 1937a), order assets by safety and saleability (liquidity) in sections 11 to 14, and finally apply the theory to decisions to hold cash balances in sections 15 to 18.

Marschak (1938, p. 312) called for "an extension of the concept of human *tastes*: by taking into account not only men's aversion for waiting but also their desire for safety, and other traits of behavior not present in a world of perfect certainty as postulated in the classical static economics." Makower and Marschak (1938, p. 293 n12, italics in original) "interpret[ed] Professor Knight's 'risk' as the dispersion of the frequency distribution of alternative future events, and his 'uncertainty' as the degree of ignorance about this frequency distribution … as to the second, we find it more convenient to call it *degree of ignorance*" (see Knight 1921). They noted that "there are rates of preference between the mean and dispersion of yield: we may call these rates *safety preferences*" (p. 295, italics in original), what would later be known as risk aversion. "'Audacious' people have a low safety preference. They would give up a lot of safety in exchange for a small increase in mean or lucrativity. Using the individual's safety preference rates, we can express any expected bundle of yields in terms of a standard unit of yield, namely present lucrativity of a given quality. We can … call this process … discounting for risk" (1938, p. 295), using a single parameter for risk-adjusted expected return where the mean-variance analysis of Markowitz (1952, 1959) and Tobin (1958) would use two parameters. Marschak (1938) and Makower and Marschak went beyond the first two moments of the distribution: "people are not indifferent about the asymmetry of the probability distribution: of two equally lucrative and equally safe properties, the one offering a small chance of a very large gain is often preferred" as with football pools (Makower and Marschak 1938, p. 295 n16). They formalized liquidity, the ability to sell an asset without depressing its price, as "saleability … the reciprocal of the difference between an asset's actual present price and the price which it would have at present if the market in which it may be sold in the future were perfect" (Makower and Marschak 1938, p. 302).

As Perry Mehrling (2002, p. 182 n12) observed, "There is a straight line from Marschak's 1938 'Money and the Theory of Assets' [and Makower and Marschak 1938] to his 1949 'Role of Liquidity under Complete and Incomplete Information' and 1950 'The Rationale of the Demand for Money and of "Money Illusion"'. Important works that follow Marschak's preferred line include Harry Markowitz's 'Portfolio Selection' (1952) and James Tobin's 'Liquidity Preference as Behavior Toward Risk' (1958)." Mehrling (2010, p. 203) argued that Marschak (1938) "set the agenda … for the monetary Walrasian project" of Modigliani (1944), Patinkin (1956) and Tobin (1958), while Mehrling (2014, p. 179) reiterates his "insistence on tracing the roots of the approach to the early work of Jacob Marschak (1934[b], 1938) as well as John R. Hicks's more familiar 'Suggestion for Simplifying the Theory of Money' (1935)" (see also Marschak 1934a, Makower and Marschak 1938). The two 1938 articles and the related 1937 and 1939 Cowles conference papers, which drew inspiration from Hicks (1935)[9], led directly to Marschak's later writings on money in a theory of asset market equilibrium (Marschak 1948a, b, c, 1949a, b, 1950a, b, 1951b, 1955b), a line of research taken up by Marschak's doctoral student Harry Markowitz (1952 a, b, 1959) and then, beginning when Marschak and Markowitz were Tobin's colleagues in the Cowles Foundation at Yale, by James Tobin (1958, Tobin with Golub 1998).

Five years before Marschak became research director of the Cowles Commission, Alfred Cowles 3rd was sufficiently impressed by Marschak's papers at the 1937 Cowles summer conference (Marschak 1937a, 1937b) to try to recruit Marschak to direct the Cowles Commission. On April 20, 1938 (Marschak Papers, UCLA), Cowles wrote to Marschak that "On

[9] Ivo Maes (1991) draws attention to Chambers (1934) as a striking contribution to portfolio theory parallel to and contemporary with Hicks (1935), but Marschak, Makower, Markowitz and Tobin do not appear to have noticed Chambers's article. In addition to Hicks (1935), Makower and Marschak (1938) cited a 1931 *Economica* article and 1933 Econometric Society paper (abstracted in *Econometrica* in 1934) by Hicks, preceding Chambers (1934).

my return yesterday to Colorado Springs I found your letter of April 3 and at once sent a night cable in reply as follows: 'Our failure to secure Rockefeller grant makes it impossible at present to offer salary mentioned in your letter of April third, letter follows.'" Cowles was "working on a plan to secure a permanent endowment for our organization and, if this is successful, I shall be better able to provide an ample research director's salary with guarantees for the future." But in the meantime, given "the unfavorable business developments of recent months in the United States," Cowles had "made up my mind to get along for the present with a research director at a substantially lower salary than the one mentioned." He added that he was "very sorry to hear that recent developments in Austria [the *Anschluss* with Germany the previous month] have affected your family adversely and hope that you will be able to work out a satisfactory solution of these difficulties. The Cowles Commission has recently awarded a research fellowship to Dr. A. Wald of Vienna and has received requests for assistance in connection with several other Viennese scholars who are in difficulties." Although Cowles's first attempt to recruit Marschak as research director failed, the two remained in contact, with Marschak speaking at the 1939 Cowles summer conference (Marschak 1939a, 1939b).

Marschak at the New School

Marschak embarked for the United States in December 1938 with a one-year fellowship from the Rockefeller Foundation. He stayed in the US after the outbreak of WWII and became an American citizen in 1945. In September 1939, he was appointed Professor of Economics at the New School for Social Research in New York where his former mentor Emil Lederer had become the founding Dean of the University in Exile in 1933. Marschak succeeded Gerhard Colm, whom he knew well from his time at the Kiel Institute for the World Economy 1928-30,

who had moved to the Roosevelt administration. After Marschak's move to the Cowles Commission in Chicago in January 1943 Marschak was replaced at the New School by Abba Lerner who had begun his work on functional finance (Lerner 1943).

While at the New School Marschak published in *Social Research* on topics related to Keynesian macroeconomics: the effect of lack of confidence (animal spirits) on investment decisions (1941a), the role for government in macroeconomic stabilization (1941b), and, linking Keynesian macroeconomics to earlier Swedish monetary economics, Knut Wicksell's natural and market rates of interest (1941c). During this period Marschak continued with two other lines of research, both more closely related to monetary theory and macroeconomics than might appear at first. He kept on studying demand analysis and especially estimation of demand elasticities (the subject of his 1931 *habilitation* thesis in Heidelberg), but his papers on combining national income data and family budget studies in demand analysis (Marschak 1939b, 1939d) were accompanied by an article on using family budget data to estimate the Kahn-Keynes spending multiplier (Marschak 1939c) and followed by an article on money illusion in demand analysis (Marschak 1943). He also persevered with work on simultaneous-equations macroeconomic models: Marschak and Andrews (1944), although published after his 1943 move to the Cowles Commission (and circulated as the Cowles Commission Paper immediately following Hurwicz 1944 and Haavelmo 1941) reported research conducted while Marschak was at the New School and followed from such earlier writings as Marschak (1934a).

Franco Modigliani (2001, p. 19), Marschak's doctoral student at the New School, recalled that "Those months were decisive in my life. Marschak invited me to take part in a seminar organized in New York by Oskar Lange, the noted Polish economist at the time. As well as Lange and Marschak, the participants included leading economists like Tjalling Koopmans, who

was to win the Nobel, and the renowned statistician Abraham Wald." Wald remained at Columbia University, but Koopmans, Lange and Modigliani were active in the Cowles Commission during Marschak's directorship, so the New York seminar prefigured what Cowles would become under Marschak's leadership (see Marschak and Lange [1940] 1995, a rebuttal of Keynes's critique of Tinbergen's statistical testing of business cycle theories that Keynes rejected for publication in the *Economic Journal*). Even Joseph Schumpeter came down from Harvard to participate in the seminar of the National Bureau of Economic Research (at that time still centered in New York), "Somehow ensconced more comfortably than the rest and treating the whole matter with the benevolent condescension of a lord among well-meaning and deserving but necessarily limited peasants" (Arrow 1978: 71).

Marschak at Cowles: Marschak and Markowitz

Although Perry Mehrling (2002, p. 182 n12) rightly pointed out in an end-note that there was a "straight line" from Marschak (1938) (and from Makower and Marschak 1938) to Marschak (1949a, 1950a) that leads on to Markowitz (1952a) and Tobin (1958), the most widely-read account of the origins of the modern theory of assets and financial markets, Peter Bernstein (1992), discusses the emergence of Markowitz's portfolio theory at the Cowles Commission without suggesting that Marschak ever wrote a word about money, finance or assets, despite several mentions of Marschak. Two paragraphs by Bernstein (1992, p. 46) have regrettably become the canonical account of how Markowitz came to study portfolio choice and of Marschak's supposedly very limited role in that decision[10]:

[10] Bernstein (1992, pp. 60, 66-67, 165) also reported that Marschak took part in Markowitz's thesis defense, that Tobin's first encounter with the Cowles Commission was in 1948 as a discussant of a Marschak paper on statistics (Bernstein's only mention of Marschak writing anything), and that at the New School Marschak encouraged Modigliani's interest in quantitative methods.

"When the time came to choose a topic for his doctoral dissertation, Markowitz went to see Jacob Marschak, who had preceded Koopmans as director of the Cowles Commission. While waiting outside Marschak's office, he fell into conversation with an older man who identified himself as a stockbroker. Unaware of the ultimate consequences of his advice for the world of investing, the man suggested that Markowitz write his thesis about the stock market. When Markowitz mentioned this suggestion to Marschak, he was surprised to find that Marschak was enthusiastic about this unorthodox proposal, pointing out that Alfred Cowles himself had done major research in that area.

Marschak admitted, however, that he did not feel qualified to guide Markowitz in what was then an offbeat topic for a mathematically inclined economist. When professors have no advice of their own to give a student, they usually send the student to another professor. Marschak sent Markowitz to Marshall Ketchum, then Dean of the Graduate School of Business and co-editor of the *Journal of Finance*."

Suggesting that Markowitz also consult a finance professor (who co-edited a journal in which Markowitz might publish on the topic) did not mean that Marschak, the author of "Money and a Theory of Assets" (1938) and coauthor of "Assets, Prices and Monetary Theory" (1938), felt unqualified to guide research on asset markets, nor would the topic seem unorthodox to him (or, as he told Markowitz, to Alfred Cowles 3rd, see Cowles 1933, 1938, 1944) regardless of whether it was surprising and new to Markowitz. Marschak (1948a) pondered "Measurable Utility and the Theory of Assets" while still director of the Cowles Commission, therefore before the famous discussion about Markowitz's thesis topic and well before Markowitz (1952b) wrote about "The Utility of Wealth," which first appeared as a discussion paper in 1951 (see also Marschak 1948b, 1948c, 1949b, extensions and "Third Thoughts" about Marschak 1948a, and

the ensuing *AER* article Marschak 1949a). Marschak's Cowles Commission Discussion Paper, "A Note on Markowitz's Theory of Investment Companies" (1951b), demonstrates his close involvement in commenting on and guiding Markowitz's dissertation research. Markowitz's first Cowles Commission Discussion Papers, on "Investment Company Behavior Equations" (No. 294) and "On the Certainty Equivalence and Risk Discount Hypothesis" (No. 295), were circulated in 1950. Particularly if one considers not only Marschak's journal articles but also his series of 1948 and 1949 Cowles Discussion Papers, the "straight line" from Marschak to Markowitz is clearly visible, quite contrary to Bernstein's famous anecdote, which was based on a conversation with Markowitz four decades later. Even the title of Markowitz's 1950 Cowles Discussion Paper (No. 295) echoed terminology coined by Marschak (1938) and Makower and Marschak (1938, p. 295), "discounting for risk."

Another Cowles Commission researcher had recently written something related to the theme of Markowitz (1952a), although Markowitz did not learn of it until considerably later. When Cowles (1944) revisited his earlier study of whether stock market forecasters did any better than chance in forecasting, he had Dickson Leavens, a statistician on the staff of the commission from 1936 to 1947, calculate the mean and variance of returns on twenty random portfolios, to compare with the returns of twenty forecasting services. Leavens (1945) noticed that returns on more diversified portfolios had lower variance and published that finding in *Trusts and Estates*, a magazine for practitioners (Bernstein 1992, p. 55, devoted one third of a sentence to Leavens). Markowitz (1952a, 1959) used activity analysis (linear programming) techniques developed by Tjalling Koopmans to minimize variance for given expected return.

Marschak at Cowles: Lectures on Income, Employment and the Price Level

Marschak (1949c, 1951a) gave series of twenty lectures on introductory econometrics and twenty on Keynesian macroeconomics in 1948, circulating both sets the following year as Cowles Commission Discussion Papers. The lectures continued in the line of Marschak's earlier work: the only citations in his lecture on the money market (1951a, p. 40) were to Marschak (1938) and Makower and Marschak (1938). The macroeconomics lectures, together with three supplementary lectures given in 1949, were edited as a book by Marschak's graduate students David Fand and Harry Markowitz (Marschak 1951a), who argued in their preface that mathematical economics, Keynesian economics and econometrics, three branches of economic sciences that had grown up in the preceding two decades, "seem to be well suited for dealing with Policy questions in the Economic Sphere" – exactly the aspect of these approaches most likely to alienate Milton Friedman, the leading figure in the emerging "Chicago school" of economics (see Reder 1982, Tavlas 1998) and a firm opponent of government intervention, who recalled that "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"[11] (Friedman and Friedman 1998, p. 197). The policy relevance was not just perceived by the editors but indicated by, for example, Marschak's reference to "the

[11] Friedman nonetheless emphasized that "Marschak was a warm, outgoing human being … a truly learned person who had wide interests and contributed to different areas of economics. He and I both taught courses in money in the department and as a result we frequently served together on departmental committees to draw up and grade the Ph.D. preliminary examination in the field of money, always amicably – though we often differed in our judgment of individuals." In contrast, Friedman considered Koopmans "rather cold and authoritarian … Unlike Marschak, he was much less cooperative in departmental matters" (Friedman and Friedman 1998, p. 198). Bernstein (1992, p. 60) recounts Markowitz's recollection of Friedman and Marschak disagreeing on whether to accept Markowitz's dissertation because Friedman felt that it was not economics. David Fand, who collaborated with Markowitz on editing Marschak's lectures, also collaborated with another graduate student to turn Friedman's lectures on price theory into a provisional textbook.

A touching portrait of Marschak is also given by Paul Samuelson (1988: 323) who characterizes Marschak "as a warm and tireless member of the working parties seeking scientific truth".

'Washington-Keynesian' model [in which] investment depends on national income" (1951a, p. 35).

In addition to Keynes (1936) and to early expositions of Keynes written by J. R. Hicks and Alvin Hansen or edited by Seymour Harris, Marschak's suggestions for further reading (1951a, pp. 94-95) included Franco Modigliani (1944), a dissertation that Marschak had supervised at the New School (see Hagemann 2017), and two Cowles Monographs, Oscar Lange (1944) on *Price Flexibility and Employment* and Lawrence Klein (1950) on *Economic Fluctuations in the United States, 1921-1941*, plus Klein's *Keynesian Revolution* (1947), based on Klein's 1944 MIT dissertation (supervised by Paul Samuelson) but revised for publication after Klein joined the Cowles Commission in 1944 (see Klein 1991). Marschak listed George Terborgh's critique of Alvin Hansen's stagnation thesis, but the only piece of monetary or macroeconomic theory in Marschak's suggestions for further reading that would have appealed to Friedman was a 1946 *Review of Economic Statistics* symposium on fiscal and monetary policy that included the University of Chicago quantity theorist along with the Harvard Keynesian Hansen (see Tavlas 1998 on Mints as part of Chicago tradition of the quantity of theory of money leading up to Friedman, ed., 1956, and contrast Patinkin 1981). Marschak's lectures constituted the first graduate-level Keynesian textbook, and the first graduate-level macroeconomics textbook from any standpoint (as distinct from works on the theory of money that focused on the price level rather than the determination of aggregate income and employment). Friedman (1946) had criticized Lange's Cowles Monograph as "verbal mathematics,"[12] taxonomic theorizing without empirical content, but he was no better pleased

[12] Lange (1944) had a mathematical appendix on the stability of economic equilibrium, which was issued as Cowles Commission Paper No. 8, but the main text of the book did not use mathematical notation. In 1945, Lange, a socialist from Poland, left the Cowles Commission and University to Chicago to became envoy in the United States

when Klein's Cowles Monograph offered an empirical implementation of Keynesian macroeconomic modeling.

Robert Solow (in Arrow et al. 1991, p. 94) characterized Marschak's lectures as "not inspired" but, as Mauro Boianovsky (2002, pp. 233, 235, 251, 253 n.6, n.8) points out, Marschak (1951a) gave the pioneering presentation of aggregate demand and aggregate supply in price level and real income space, avoiding commodity market inconsistency common in later textbook accounts of AD-AS analysis, and of the short-side rule for the labor market. Marschak (1951a) was noteworthy for its contents, not just for being the first graduate macroeconomics textbook. As Boianovsky (2002), Mehrling (2002) and Rubin (2002) note, Marschak's lectures on AD-AS, demand constraints and the short side rule (1951a), together with his articles on money demand and money illusion (1949a, 1950a), his supervision and the seminars he organized influenced his Chicago doctoral student Don Patinkin, particularly the papers he wrote at the Cowles Commission before moving to the Hebrew University of Jerusalem in 1949 (Patinkin 1947, 1948b, 1948c, 1949a, 1949b), after abandoning an abortive thesis topic on the interwar US manufacturing sector (Patinkin 1948a). Interactions with Trygve Haavelmo and Lawrence Klein at the Cowles Commission also influenced Patinkin, as did their writings (especially Haavelmo 1950 and Klein 1947, see also Haavelmo 1941, Leeson 1998), so the environment Marschak created at Cowles was crucial for Patinkin's formation as a monetary theorist and macroeconomist, although the disequilibrium interpretation of Keynes in Patinkin (1956) was a move beyond and away from Marschak (1951a), discarding Marschak's use of the concept of money illusion.

for the new Communist government of Poland and then to return to Poland as chair of a council of economists advising the planning commission.

Conclusion

After Marschak (1955b), Marschak moved away from analyzing money in a theory of assets and from econometrics as his attention focused on a new research interest on firms as teams (organizations whose members have the same interests and beliefs but not the same information), beginning with Cowles Discussion Papers with Roy Radner (Marschak and Radner 1951, 1954) and an article in the inaugural volume of *Management Science* (Marschak 1955a) and culminating after two decades with a long-awaited Cowles Foundation Monograph on *Economic Theory of Teams* (Marschak and Radner 1972), published a dozen years after Marschak had moved from the Cowles Foundation at Yale to UCLA. Before his turn to the economic theory of teams, Marschak, through his articles on money in a theory of assets, on liquidity and on money demand and money illusion, and on simultaneous equations models, his lectures on macroeconomics and econometrics, and his doctoral supervision, shaped the Cowles approach to monetary theory and assets markets and to macroeconometric modeling, more so than is now generally remembered.

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