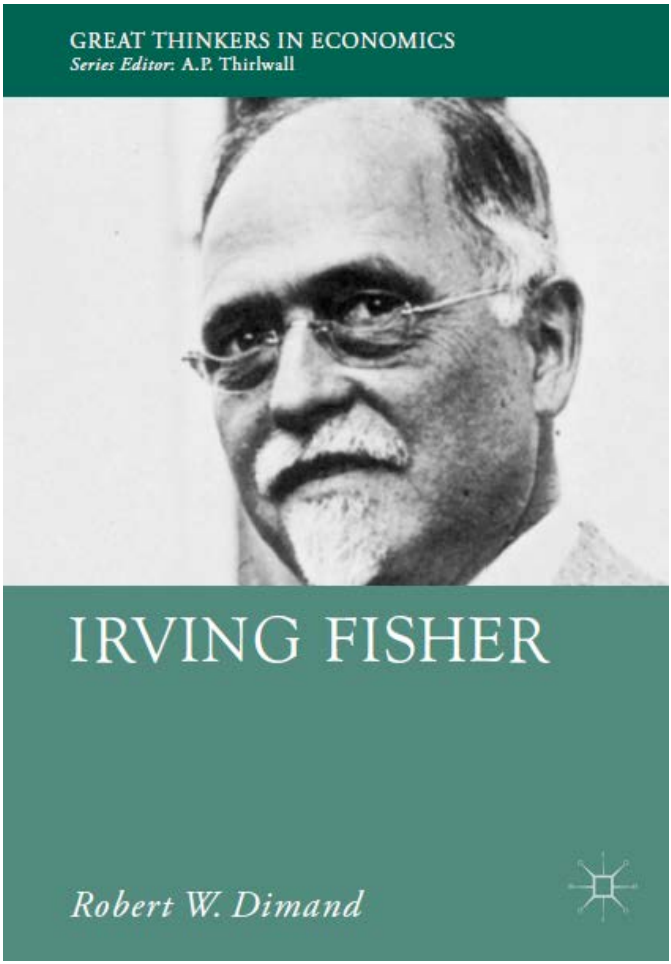
Robert W. Dimand

Irving Fisher



2019

palgrave
macmillan

Contents

Acknowledgements

In my research on Irving Fisher, I have benefitted greatly from discussions with and encouragement from the late William J. Barber and the late James Tobin, and especially from the opportunity to be an assistant editor for Bill's edition of *The Works of Irving Fisher* (14 volumes, London: Pickering & Chatto, 1997), for which Jim was consulting editor and Kevin Foster was the other assistant editor. I also gratefully acknowledge helpful comments on papers and draft chapters from participants in annual meetings of the Canadian Economics Association, Eastern Economic Association, European Society for the History of Economic Thought and the History of Economics Society and from the editor of this series, Anthony P. Thirlwall.

I am grateful for financial support from Brock University's Committee for Research in the Social Sciences, from the Brock University Advancement Fund and from the Cowles Foundation for Research in Economics at Yale University.

I thank my coauthor Hichem Ben-El-Mechaiekh, editor Charles Renfro and IOS Press for permission to use material from "General equilibrium reaches North America: The hydraulic simulation model

in Irving Fisher's *Mathematical Investigation in the Theory of Value and Prices* (1891)," *Journal of Economic and Social Measurement* 37 (2012), 97–118, in Chapter 2. I thank my coauthor Rebeca Gomez Betancourt for permission to use material from "Retrospectives: Irving Fisher's *Appreciation and Interest* (1896) and the Fisher Relation," *Journal of Economic Perspectives* 26:4 (Fall 2012), 185–196, in Chapter 3 and I thank the American Economic Association for publishing the *Journal of Economic Perspectives* as an open-access journal. I am grateful to the editor and publishers of *History of Economic Ideas* for permission to use material from "100% Money: Irving Fisher and Monetary Reform in the 1930s," *History of Economic Ideas* 1:2 (1993), 59–76, in Chapter 5, and to Taylor & Francis for permission to use material from "The quest for an ideal index: Irving Fisher and *The Making of Index Numbers*," from Malcolm Rutherford, ed., *The Economic Mind in America* (Routledge, 1998), in Chapter 6, and from "Irving Fisher's Debt-Deflation Theory of Great Depressions," *Review of Social Economy* 52:1 (Spring 1994), 92–107, in Chapter 8.

1

Economic Scientist, Economic and Social Reformer

Introduction

Irving Fisher was justly acclaimed as "the greatest of America's scientific economists" by Joseph Schumpeter (1954, p. 872). His outstanding scientific contributions ranged from the Fisher relation between interest rates in any two standards (e.g. real and nominal, gold and silver, two different currencies); to the Fisher diagram for intertemporal allocation; to the Fisher ideal index number. His reputation within the discipline of economics has recovered from association with his varied efforts at economic and social reform, some prescient and others not, and from being spectacularly wrong about the stock market in October 1929.

Irving Fisher was born in Saugerties-on-Hudson, in the Catskills of New York, on February 27, 1867, the son of George Whitefield Fisher, a Congregational minister who had graduated from Yale College and Yale Divinity School and edited the *Yale Literary Magazine*. Fisher grew up in Peace Dale, Rhode Island, where Whitefield Fisher became minister in 1868 as the choice of Rowland Hazard, the local woolen mill-owner and Allied Chemical cofounder whose daughter Margaret married Irving Fisher in 1892. Fisher's background in the provincial

R. W. Dimand, *Irving Fisher*, Great Thinkers in Economics,
https://doi.org/10.1007/978-3-030-05177-8_1

intellectual isolation of a seaside Rhode Island mill-town has been contrasted with the cosmopolitan environment of his European contemporaries (e.g. by Robert Dorfman 1995) but Rowland Hazard was a friend of John Stuart Mill, whom he visited in Avignon and with whom he corresponded about American monetary history. When Whitefield Fisher was Congregational minister in Cameron, Missouri, Irving graduated from the Smith Academy in St. Louis, better known as the school where T. S. Eliot (nephew of Irving Fisher's lifelong best friend Will Eliot and grandson of the academy's founder) was a classmate of Groucho Marx. Irving Fisher entered Yale College in September 1884, just two months after his father died from tuberculosis, and combined study with mathematics tutoring to help support his mother and younger brother. He was chosen for Skull and Bones and elected to Phi Beta Kappa, won a race rowing a single scull, won mathematics prizes (including one with funding for graduate study), and was class valedictorian, graduating with the highest honors of his year. However, his classmate, lifelong friend and rival Henry Stimson became chairman of the Phi Beta Kappa chapter and defeated Fisher in the pre-graduation oratorical contest (and went on to achieve more worldly success, as William Howard Taft's Secretary of War, Herbert Hoover's Secretary of State and Franklin Roosevelt's wartime Secretary of War[1]). Fisher graduated with a BA in 1888 and with a PhD in mathematics and political economy in 1891, Yale's first doctorate in political economy or economics, with a path-breaking thesis *Mathematical Investigations in the Theory of Value and Prices*, supervised jointly by mathematical physicist Josiah William Gibbs and political economist William Graham Sumner. He spent his entire career at Yale, as a limited-term instructor

[1]During World War II, Colonel Stimson politely rejected Fisher's suggestion to create alcohol-free zones around military bases. See Robbins (2002, 182–186) on Stimson and Skull and Bones. The Skull and Bones connection was relevant for Fisher's access to William Howard Taft (tapped for Bones ten years before Fisher and Stimson), who supported Fisher's 1912 proposal for an international conference on the rising cost of living, and, in 1931, for Fisher's reassurance to skeptical Econometric Society members of the seriousness of a proposal to fund a journal and research commission in econometrics made by Alfred Cowles, 3rd (a 1913 Yale graduate and Skull and Bones member whose father, Alfred Cowles, 2nd, had been tapped for Skull and Bones two years before Fisher).

of mathematics, then (after a year travelling in Europe and meeting such leading economic theorists as Francis Ysidro Edgeworth, Vilfredo Pareto and Matteo Pantaleoni) with a permanent appointment as assistant professor of political and social science from 1895 until he was promoted to full professor of political economy in 1898 (skipping the rank of associate professor), retiring in 1935.

Fisher's mathematical training, commitment to neoclassical economics, and interest in formal theory and quantitative methods made him an anomaly among Yale economists of his time (see Barber 1988). William Graham Sumner, the Professor of Political and Social Science, who had written on the history of American currency and the history of banking, was a celebrity who had outraged Yale's president, a Congregational minister, by assigning readings from Herbert Spencer; outraged the captains of industry who sent their sons to Yale by denouncing tariff protection, and opposed American expansionism in the Spanish-American War, becoming a vice-president of the Anti-Imperialist League. A social scientist who was the second president of the American Sociological Society (soon changed to Association), Sumner was not a technical economist, had never studied or taught political economy before leaving the Episcopal ministry to take his chair, and in 1891 withdrew from teaching political economy to focus on sociology and anthropology. Two Yale economics teachers, Arthur Twining Hadley and Henry W. Farnam, rose to the presidency of the American Economic Association before Fisher did, but, unlike Fisher, were more prominent in university administration than in research. Farnam, president of the American Economic Association in 1911, second president of the American Association for Labor Legislation and for many years secretary of Yale University, took his doctorate at the University of Strasbourg in 1878 (when Strasbourg was German and when Gustav Schmoller taught there) with a dissertation on the doctrines of Colbert and Turgot, and was strongly influenced by the German historical school. He appears in the AEA *Index of Economic Journals* only for his AEA presidential address, but he published in the *Yale Review* until 1911. Arthur Twining Hadley, AEA president in 1898, dean of the Yale graduate school from 1892 to 1895 and president of Yale from 1899 to 1922 (the first Yale president who was not

a Congregational minister and the last to lack any degree beyond the BA), wrote a notable book on the economics of railroads in 1886 (see Cross and Ekelund 1980) and an introductory textbook, but he withdrew from research while presiding over the university. Farnam, the son of a railroad entrepreneur, was a generous and influential donor: he paid for the construction of Fisher's hydraulic model of general equilibrium, donated his professorial stipend to create a position for Hadley, financed (and with the other Yale economists, editing from its foundation in 1892 until 1911) the *Yale Review*, funded the establishment of the *American Economic Review* during his year as AEA president (at which time the *Yale Review* became a literary journal, so as not to compete), and gave the university both Farnam Gardens and the mansion that is now the official residence of the university's president (Barber 1988). Because of their role as university administrators, Hadley and Farnam were far more prominent in the Yale community than Fisher, but they were not engaged in publishing economic research in the way that Fisher was.

Closest to Fisher were two Yale assistant professors who had taken Yale BAs and PhDs, John Pease Norton, author of a thesis on *Statistical Studies of the New York Money Market* (Norton 1902), and Harry Gunnison Brown, who assisted Fisher with *The Purchasing Power of Money*, but neither remained long on Yale's faculty and Brown became a Henry Georgist single-taxer. James Harvey Rogers, a 1916 Yale Ph.D. (and a student of Pareto in Lausanne, as well as of Fisher), returned in 1930 as the first Sterling Professor of Economics and was sympathetic to Fisher's work and to his leadership of the Econometric Society, publishing an article on fractional-reserve banking in the inaugural volume of *Econometrica*. Rogers became a special advisor to the Roosevelt Administration (apart from Fisher and Rogers, the other Yale economists bitterly opposed the New Deal) but died in an airplane crash in 1939. Economics at Yale would have been transformed if Fisher had succeeded in enticing Wesley Mitchell from Columbia to a Yale professorship in 1913, or Ragnar Frisch to stay permanently after his visiting position in 1930–1931, or Joseph Schumpeter to join Yale instead of Harvard when he left Bonn for North America in 1932, but the only consequence of these efforts by Fisher was that the University of Oslo

had to create a personal chair to keep Frisch from leaving. Schumpeter organized a celebration of Fisher's 75th birthday at Harvard in 1942 because it was evident that Yale would do nothing (see Fellner et al. 1967 for how the attitude of Yale's Economics Department to Fisher changed dramatically over the quarter century from 1942).

Throughout his career (except from 1898 to 1904, as he recovered from tuberculosis), Fisher was a prolific author, pouring forth books and articles scholarly, semi-scholarly and popular. His son's *Bibliography of the Writings of Irving Fisher* (Fisher 1961) is, at six hundred pages, more than twice the length of his biography *My Father Irving Fisher* (I. N. Fisher). His books, including three opposing the repeal of Prohibition (largely on the grounds that workers were more productive when sober), two urging the United States to join the League of Nations (a League which be believed with some justification to have been his idea), and one on a new world map projection to eliminate the Mercator projection's exaggeration of the area of countries far from the Equator, in addition to his economic books, were accompanied by journal articles, newspaper pieces, interviews, speeches, and Congressional testimony. The present book is about Irving Fisher the economist, but he was also determined to improve the world, whether the world wanted to be improved or not: "Perhaps I'm a Don Quixote but I'm trying to be a Paul Revere" (see Dimand 2013). He induced the Yale football team to adopt a low-protein diet and wrote up the results in the *Yale Medical Journal*, and he was happy to answer journalists who wished to know whether "Yes, we have no bananas" was grammatical (according to Fisher, that depended on the question to which the phrase was a response). His greatest best-seller, reaching its twenty-first edition in 1946, was not an economics book but a guide on *How to Live*. Although Fisher was eager to humbly acknowledge himself a follower of illustrious predecessors in economics (Léon Walras and Francis Ysidro Edgeworth for general equilibrium, Simon Newcomb for the equation of exchange and for the compensated dollar, Edgeworth and Correa Moylan Walsh on index numbers, John Rae and Eugen von Böhm-Bawerk on capital theory, Thomas Joplin on 100% reserve requirements), his humility did not extend to recognizing limits on the range of subjects where he had authority to pronounce expert judgment or to

admitting that someone could honestly and reasonably continue to disagree after Fisher had carefully explained why he was right.

Fisher remained active after his debacle in the stock market crash, nurturing the Econometric Society and Cowles Commission, offering his debt-deflation theory of depressions (Fisher 1997, Vol. 10), advocating 100% reserve requirements to separate risky financial intermediation from the medium of exchange (Fisher 1997, Vol. 11), and giving advice to policy-makers, whether solicited or not (Fisher 1997, Vol. 14). The Roosevelt Administration raised the price of gold to allow for raising the price level, as Fisher wished, but his direct influence on that policy was very limited (although he had some indirect influence through James Harvey Rogers and George Warren). Fisher called for a consumption tax to replace the income tax, because savings were used to purchase assets and the market value of those assets was simply the present value of their expected taxable earnings so counting saving as income would be double taxation and would introduce a bias toward consumption and against saving and investment (Fisher 1997, Vol. 12), an argument now widely accepted by economists but unintelligible to non-economists, who are much more numerous. Few listened to Fisher in the 1930s and 1940s, and very few economics articles cited him, even when he was presenting research, as on the debt-deflation process, that would attract much attention from later generations of economists. Fisher died of cancer on April 29, 1947 at the age of eighty.

A handful of leading economists continued to admire Fisher's work, notably the Nobel laureates Maurice Allais (who dedicated his *magnum opus*, *Économie et Intérêt*, to Fisher in 1947, and wrote the entry on Fisher in the *International Encyclopedia of the Social Sciences*); Milton Friedman (see Bordo and Rockoff 2013); Ragnar Frisch (whose dinner address honoring Fisher's 80th birthday appeared in *Econometrica*); Paul Samuelson (the only non-Yale contributor to Fellner et al. 1967); and James Tobin. Most of the economics profession forgot about Fisher and knew little about what he had contributed, until *Ten Economic Studies in the Tradition of Irving Fisher* (Fellner et al. 1967) marked the beginning of renewed appreciation of, and interest in, Fisher and his work.

Overview of the Book

As a Yale student, Fisher was most influenced by the mathematical physicist Josiah Willard Gibbs and by William Graham Sumner, the outspoken Social Darwinist, professor of political economy and pioneering sociologist (and co-supervisor of Thorsten Veblen's 1884 Yale Ph.D. dissertation in philosophy). Seeking to bridge the two areas in which he had taken courses, Fisher wrote his dissertation on *Mathematical Investigations in the Theory of Value and Prices* (in Fisher 1997, Vol. 1), independently inventing general equilibrium analysis and indifference curves, considering the integrability of utility functions, and constructing a hydraulic model to simulate the determination of equilibrium prices and quantities (see Chapter 2). Shortly before completing his thesis, Fisher managed to obtain copies of books by Walras and Edgeworth and discovered their prior work in general equilibrium. This was not unusual in the academic world before globalization, before airmail, let alone e-mail, and Max Planck and Albert Einstein both found that results they published in thermodynamics and statistical mechanics had already been published by Fisher's teacher J. Willard Gibbs. But the construction of a hydraulic mechanism to compute equilibrium prices and quantities was original. It was fitting that Herbert Scarf published the first account of his fixed-point algorithm for computable general equilibrium in *Ten Economic Studies in the Tradition of Irving Fisher* (Fellner et al. 1967). Fisher proceeded to use hydraulic analogies to explain the quantity theory of money and analyze how bimetallism would work (see Morgan 1997). Fisher's dissertation, and the course on "The Mathematical Theory of Prices" that he based on his thesis, were extraordinary for economics in the 1890s, closer to the economics of three quarters of a century later than to the economics of his contemporaries, some of whom (e.g. J. Lawrence Laughlin and Frank Taussig) continued into the new century to teach political economy from Mill as if Jevons had never published, let alone Marshall.

The populist crusade for bimetallism, climaxing in William Jennings Bryan's 1896 presidential campaign, led Fisher to revitalize the quantity theory of money and to extricate the quantity theory from the

embrace of the populists. Contrary to the hard-money opponents of the bimetallists, notably Laughlin and his students at the University of Chicago, Fisher offered a statistical verification of the quantity theory as the explanation of price level movements. Contrary to the populists, Fisher argued that money was neutral in the long run, although in the short run monetary shocks were the driving force behind economic fluctuations. Changes in the price level affected real variables, such as real interest, only if the changes in the purchasing power of money were unexpected. Chapter 3 examines Fisher's restatement and development of the quantity theory of money from the Fisher relation between interest rates in any two monetary standards in *Appreciation and Interest* in 1896 (in Fisher 1997, Vol. 1) through Fisher's extension of the equation of exchange to allow different velocities of circulation for currency and deposits, in the *Economic Journal* in 1897 (in Fisher 1997, Vol. 1) and at the heart of *The Purchasing Power of Money* in 1911 (Fisher 1997, Vol. 4). Fisher fully deserved to have his photograph appear with Alfred Marshall and Knut Wicksell on the cover of David Laidler's *Golden Age of the Quantity Theory* (1991), and to have his work in the 1890s recognized by J. Bradford DeLong (2000) as the starting point of twentieth century macroeconomics.

In 1898, shortly after his promotion from assistant professor to full professor, Fisher was informed that, like his father, he had tuberculosis and that he had only a few months to live. But Fisher was a fighter and he recovered fully (and then patented a tent for tuberculosis patients). Surviving that ordeal convinced Fisher that he had been spared for a purpose, that he had a mission to use his knowledge and intelligence to change the world for the better, and at no point, in any of his many efforts to reform the world, did he ever doubt that he knew exactly how the world should be changed. As he wrote to his wife in 1924, he did not wish to be remembered just as someone who had written a book on index numbers (Fisher 1956; Allen 1993).

After returning to teaching and research, and in addition to campaigning for a national Department of Health, health insurance and dietary reform, Fisher reformulated the neoclassical theory of interest and capital in two books, *The Nature of Capital and Income* in 1906 (Fisher 1997, Vol. 2) and *The Rate of Interest* in 1907 (Fisher 1997, Vol. 3),

later combined and revised in *The Theory of Interest* in 1930 (Fisher 1997, Vol. 9), drawing on the foundational work of John Rae in 1834 and of Eugen von Böhm-Bawerk in the 1880s. Fisher emphasized the time pattern of expected income, the concept of the net present discounted value of the stream of expected future payments and receipts, and the role of the interest rate in equilibrating saving and investment. Chapter 4 explores Fisher's crucial role in neoclassical capital theory, focusing on the Fisher diagram, his 1907 depiction of the terms of trade between consumption in two periods. The Fisher diagram inspired fundamental diagrams in risk analysis (terms of trade between consumption in two states of the world) and in international trade theory.

Chapter 5 examines Fisher's view, from Chapter IV of *Purchasing Power of Money* onwards, that the "so-called business cycle" was really a "dance of the dollar" (phrases from the titles of 1923 and 1925 articles reprinted in Fisher 1997, Vol. 8), driven by monetary shocks and slow adjustment of expectations of inflation, and his plans for how to tame those fluctuations. These plans ranged from Fisher's "compensated dollar" proposal from 1911 onwards to stabilize the price index by varying the dollar price of gold (Fisher 1997, Vols. 4 and 6) through his *100% Money* (1935, in Fisher 1997, Vol. 11) proposal to insulate the medium of exchange from risky financial intermediation. Despite the efforts of Fisher and Senator Robert L. Owen, the Federal Reserve Act provided for a fixed dollar price of gold, not a rule for price level stabilization, yet a century later the gold standard was no more, and monetary policy rules dominated thinking about central banking (notably inflation targeting, one derivative up from Fisher's price level rule). Financial innovation has moved the economy toward the zero-reserve, pure-credit economy envisioned by Knut Wicksell (1898) (with the interest rate rather than the quantity of money as a policy instrument) and away from the 100% reserve requirements proposed by Fisher and by the Chicago plan of banking reform, yet the problem of insulating the medium of exchange from financial volatility has attracted renewed concern in the aftermath of the 2008 Global Financial Crisis.

Fisher held that *The Money Illusion* (the title of his 1928 book, in Fisher 1997, Vol. 8), the failure to fully perceive or expect changes in the value of money, was the root cause of economic instability. He

strove to combat money illusion by educating the public, by indexation, and by urging governments to stabilize the price level. Each of these remedies required knowing what the price level was, so Fisher (1997, Vols. 4 and 7) examined hundreds of possible index number formulas to find his ideal index number, the geometric mean of the Paasche and Laspeyres indexes, which Fisher believed was the ideal index for any purpose because it came closest to satisfying a set of statistical tests that he put forward (see Boumans 2001; Diewert 2013). Chapter 6 "Fighting Money Illusion: The Fisher Ideal Index Number" examines this quest, which involved not only choosing the ideal index number but also, for thirteen years, producing a weekly number from an Index Number Institute in the basement of Fisher's home, with a weekly syndicated newspaper article discussing how prices had changed that week.

Chapter 7 "Hubris, Nemesis, and Analysis" investigates Fisher's noteworthy contributions to the understanding of financial markets, both directly and through encouragement of the work of students such as John Pease Norton. The chapter shows how those contributions combined with Fisher's habitual overconfidence to bring him to disaster and disgrace. In the bull market of the 1920s, Fisher, by then teaching only one semester a year to allow more time for business and for promoting reforms, made a fortune of ten million dollars, in part from his "Index Visible" invention (ancestor of the Rolodex) which he sold for stock in Rand Kardex (later Remington Rand, then Sperry Rand). Speculating on margin, Fisher lost more than everything he had in the crash, owing more than a million dollars to his sister-in-law, who forgave the debt in her will in 1945. He sold his house to Yale University, paying the rent with promissory notes that the university eventually wrote off. Fisher's statement in October 1929 that "Stock prices appeared to have reached a permanently high plateau" just as they were about to drop by 85% over three years was by far the most memorable thing that he, or perhaps any economist, ever said. In contrast, Roger Babson acquired renown for predicting a stock crash in 1929, as he had in each year since 1926, and despite his prediction of a stock boom in 1931 (see Friedman 2014). The disaster wrecked both Fisher's reputation and his finances, yet it stemmed from recognizing what is now called the equity premium puzzle: over the long run, the real return on common stocks

in the United States has been too high to explain by differences in risk. Unfortunately, Fisher learned that one must survive the short run to reap that long-run return.

The Great Depression took from Fisher his audience and fortune, and made him a figure of ridicule, but it also stimulated his scientific creativity, as he struggled to understand what had happened. Chapter 8 looks at Fisher's debt-deflation of Great Depressions, published in 1932 and 1933 (Fisher 1997, Vol. 10), which was little noticed at the time but, along with Chapter 19 of Keynes (1936), was rediscovered by Hyman Minsky and James Tobin in the 1970s, influenced Ben Bernanke and Mervyn King in their responses as central bankers during the Global Financial Crisis of 2008, and has attracted renewed interest in the wake of that crisis (see Minsky 1975; Tobin 1980; Bernanke 2000; Shiller 2013).

Chapter 9 "Changing Economics" shows Fisher the institution-builder taking leading roles in creating the Econometric Society (he was the founding president, serving for five years) and the Cowles Commission for Research in Economics, institutions that proved effective in promoting the formal theorizing, use of mathematical techniques and econometrics that were characteristic of Fisher's approach to economics but that set him apart from most of the economists of his generation. The Econometric Society and the summer research conferences of the Cowles Commission also provided Fisher with a sympathetic and knowledgeable audience in the 1930s, which he did not then have in his university or in the wider economics profession, let alone among the public. Chapter 10 "Fisher's Legacy in Economics" concludes the book by presenting the strikingly atypical trajectory of his reputations among economists: honored and widely cited before 1929, then for decades ridiculed by the public and largely ignored within the profession (except for a handful of eminent theorists, most notably Maurice Allais, Milton Friedman, Ragnar Frisch, Paul Samuelson and James Tobin), then returning to the profession's attention (see Loef and Monissen 1999; Dimand and Geanakoplos 2005; Shiller 2013).

Conclusion: A Great Economist

Irving Fisher extended the quantity theory of money to allow different velocities of circulation for currency and deposits, using the theory to explain price movements and the long-run neutrality of money, and he stressed expected inflation as the difference between the real and nominal interest rates. He modeled the formation of inflation expectations and saw lags in the adjustment of such expectations as the basis of a monetary theory of short-run fluctuations, and then in his debt-deflation theory of depressions analyzed how the adjustment mechanism could break down. "Moreover," observed James Tobin in his *New Palgrave* entry on Fisher (reprinted in Dimand and Geanakoplos 2005, 39), "in his neoclassical writings on capital and interest Fisher had laid the basis for the investment and saving equations central to modern macroeconomic models. Had Fisher pulled these strands together into a coherent theory, he could have been an American Keynes. Indeed the 'neoclassical synthesis' would not have had to wait until after World War II. Fisher would have done it all himself" (see also DeLong 2000). Although Fisher's varied contributions to monetary economics shared as motivation a concern with the effects of imperfectly anticipated changes in the purchasing power of money, he did not pull the strands of his work together into a single coherent theory: his monetary economics was not set in the general equilibrium framework of his dissertation and there was an unresolved, and perhaps unresolvable, tension between the equilibrating role of financial markets in Fisher's neoclassical writings on capital and interest and the destabilizing role of incomplete interest rate adjustment in the "dance of the dollar" and of financial structure in the debt-deflation theory of depressions.[2] Once overshadowed by the Keynesian revolution (despite Keynes's 1937 acknowledgement of Fisher as his intellectual "great-grandparent,"

[2]There was a comparable tension between the equilibrating role of asset markets and the potential instability of a monetary economy in Tobin's work, see Dimand (2014).

Keynes 1971–1989, Vol. XIV, p. 203n) and known to the public only for being so wrong about the stock market, Irving Fisher is now recognized as indeed a "Great Thinker in Economics," a vitally important contributor to the development of monetary economics, macroeconomics, capital theory, index number theory, general equilibrium analysis, and econometrics in the forty-five years preceding Keynes's *General Theory*.

References

Allais, Maurice. 1947. *Économie et Intérêt*. Paris: Imprimerie Nationale et Librairie des Publications Officieles; 2nd ed., Paris: Éditions Clement Juglar, 1998.

Allen, Robert Loring. 1993. *Irving Fisher: A Biography*. Boston and Oxford: Blackwell.

Barber, William J. 1988. The Fortunes of Political Economy in an Environment of Academic Conservatism: Yale University. In *Breaking the Academic Mould: Economists and American Higher Learning in the Nineteenth Century*, ed. William J. Barber, 132–168, 400–405. Middleton, CT: Wesleyan University Press.

Bernanke, Ben S. 2000. *Essays on the Great Depression*. Princeton, NJ: Princeton University Press.

Bordo, M.D., and Rockoff, H. 2013. The Influence of Irving Fisher on Milton Friedman's Monetary Economics. *Journal of the History of Economic Thought* 35: 153–172.

Boumans, Marcel. 2001. Fisher's Instrumental Approach to Index Numbers. In *The Age of Economic Measurement*, ed. Judy L. Klein and Mary S. Morgan. Annual Supplement to *History of Political Economy* 33: 313–344.

Cross, Melvin L., and Robert B. Ekelund Jr. 1980. A. T. Hadley on Monopoly Theory and Railway Regulation: An American Contribution to Economic Analysis and Policy. *History of Political Economy* 12: 214–233.

DeLong, J. Bradford. 2000. The Triumph of Monetarism? *Journal of Economic Perspectives* 14: 83–94.

Diewert, W. Erwin. 2013. Irving Fisher and Index Number Theory. *Journal of the History of Economic Thought* 35: 199–232.

Dimand, Robert W. 2013. 'Perhaps I'm a Don Quixote But I'm Trying to Be a Paul Revere': Irving Fisher as a Public Intellectual. In *The Economist as Public Intellectual*, ed. Tiago Mata and Steven G. Medema. Annual Supplement to *History of Political Economy* 45: 20–37.

Dimand, Robert W. 2014. *James Tobin*. Basingstoke and New York: Palgrave Macmillan, Great Thinkers in Economics.

Dimand, Robert W., and John Geanakoplos (eds.). 2005. *Celebrating Irving Fisher*. Malden, MA: Blackwell (also as supplement to *American Journal of Economics and Sociology* 64: 1).

Dorfman, Robert. 1995. Austrian and American Capital Theories: A Contrast of Cultures. *Journal of the History of Economic Thought* 17 (1): 21–34.

Fellner, William, et al. 1967. *Ten Economic Studies in the Tradition of Irving Fisher*. New York: Wiley.

Fisher, Irving. 1997. *The Works of Irving Fisher*, 14 vols., ed. William J. Barber assisted by Robert W. Dimand and Kevin Foster, consulting editor James Tobin. London: Pickering & Chatto.

Fisher, Irving Norton. 1956. *My Father Irving Fisher*. New York: Comet Press.

Fisher, Irving Norton. 1961. *A Bibliography of the Writings of Irving Fisher*. New Haven, CT: Yale University Library, with supplement 1961.

Friedman, Walter A. 2014. *Fortune Tellers: The Story of America's First Economic Forecasters*. Princeton, NJ: Princeton University Press.

Keynes, John Maynard. 1936. *The General Theory of Employment, Interest and Money*. London: Macmillan.

Keynes, John Maynard. 1971–1989. *The Collected Writings of John Maynard Keynes*, 30 vols., General eds. D.E. Moggridge and E.A.G. Robinson, Volume eds. E.S. Johnson and D.E. Moggridge. London: Macmillan and New York: Cambridge University Press, for the Royal Economic Society.

Laidler, David. 1991. *The Golden Age of the Quantity Theory*. London: Phillip Allan and Princeton, NJ: Princeton University Press.

Loef, Hans-E., and Hans G. Monissen (eds.). 1999. *The Economics of Irving Fisher*. Cheltenham and Northampton, MA: Edward Elgar.

Minsky, Hyman P. 1975. *John Maynard Keynes*. New York: Columbia University Press.

Morgan, Mary S. 1997. The Technology of Analogical Models: Irving Fisher's Monetary Worlds. *Philosophy of Science* 64: S304–314.

Norton, John Pease. 1902. *Statistical Studies in the New York Money Market*. New York: Macmillan.

Robbins, Alexandra. 2002. *Secrets of the Tomb: Skull and Bones, the Ivy League, and the Hidden Paths of Power*. Boston: Little, Brown.

Schumpeter, Joseph A. 1954. *History of Economic Analysis*. New York: Oxford University Press.

Shiller, Robert J. 2013. Irving Fisher, Debt Deflation and Crises. *Journal of the History of Economic Thought* 35: 179–183.

Tobin, James. 1980. *Asset Accumulation and Economic Activity*. Oxford: Blackwell and Chicago: University of Chicago Press.

Wicksell, Knut. 1898. *Interest and Prices*, trans. R.F. Kahn with Introduction by Bertil Ohlin. London: Macmillan, 1936.

2

Indifference Curves and a Hydraulic Model of General Equilibrium

Introduction: Fisher's General Equilibrium

In his 1891 Yale doctoral dissertation in mathematics and political economy (published as Fisher 1892), Irving Fisher reinvented general equilibrium analysis for himself before he discovered (and fully acknowledged) the writings of Léon Walras (1874–1877) and Francis Ysidro Edgeworth (1881). Fisher (1892) went beyond Walras and Edgeworth to rely on preferences represented by indifference curves, denying that the theory of value needed to rest on a foundation of cardinally measurable utility: only the ratios of marginal utilities matter for the logic of choice, not the utilities themselves. In an era predating electronic computers, Fisher not only imagined, but built, a hydraulic mechanism to simulate the determination of equilibrium prices and quantities (see Brainard and Scarf 2005). Ragnar Frisch (1947) felt that "It will be hard to find any single work that has been more influential than Fisher's dissertation." Joseph Schumpeter and the eighteen other senior members of Harvard's Economics Department, writing to President Seymour of Yale upon learning of Fisher's death, stated that Fisher's *Mathematical Investigations in the Theory of Value and Price*

R. W. Dimand, *Irving Fisher*, Great Thinkers in Economics,
https://doi.org/10.1007/978-3-030-05177-8_2

"must, in fact, be recognized as among the best works of its time in any country" (Allen 1993, p. 296). Paul Samuelson (1967) modestly acclaimed Fisher's dissertation (Fisher 1892) as the greatest doctoral dissertation in economics.[1] George Stigler (1971, p. xiii), introducing a reprint of Frank Knight's dissertation, declared that Knight and Fisher had written the only two pre-World War I dissertations "which are still a part of the living literature of general economic theory."

And yet Norbert Schulz (1999, p. 304) is justified in stating that "consulting any current textbook—post-1950—on general equilibrium would not reveal Irving Fisher even as a contributor, let alone an important one" (See also Schwalbe 1999). Joseph Schumpeter (1948) remarked, "I am sure that Ragnar Frisch surprised his audience when, at the American Statistical Association's testimonial dinner to Irving Fisher, he described the *Mathematical Investigations* as a work of 'monumental importance'." In contrast to the praise of Fisher's dissertation by Frisch, Schumpeter, and Samuelson, Robert Dorfman (1995, p. 23n) mused that "If Fisher's examiners had been better versed in European economic literature than they were, a promising career might have been blighted at its inception."

Although such luminaries as Edgeworth, Pareto, Frisch, Schumpeter, and Samuelson recognized Fisher's *Mathematical Investigations* as a work of analytical power and originality, no mere rediscovery of Walras and Edgeworth, Fisher (1892) failed to spark a flourishing of general equilibrium analysis in North America, and his pioneering course on "The Mathematical Theory of Prices" in Yale's Mathematics Department in the 1890s attracted few students. Even Fisher's own later major works in the theory of capital and interest (e.g. Fisher 1907) and monetary

[1]Nonetheless, although Samuelson (1966), collecting all his scientific papers preceding his contributions to that 1967 volume in the tradition of Fisher, had twenty-two passing mentions of Fisher on the measurability of utility and in lists of quantity theorists, early mathematical economists, and economists who recognized that expected inflation affects the nominal interest rate, the only substantive reference to Fisher's dissertation was in 1950 when Samuelson credited Fisher (1892) with introducing economists to the problem of integrability of utility functions in "perhaps the best of all doctoral dissertations in economics" (Samuelson 1966, Vol. 1, p. 75). Samuelson ([1947] 1983, pp. 95, 139n) referred to Fisher's discussion of integrability without saying where Fisher had discussed it. The only work by Fisher cited in Samuelson's *Foundations* was his 1927 essay on the possibility of measuring marginal utility (Fisher 1927; Samuelson [1947] 1983, pp. 173n, 174n, 228n).

economics (e.g. Fisher with Brown 1911) were not set in an explicit general equilibrium framework, and his one, isolated return to utility theory (Fisher 1927) was, of all things, an attempt at statistical measurement of utility. The post-1950 development of general equilibrium theory stemming from the work of Kenneth Arrow and Gerard Debreu at the Cowles Commission (an institution founded under Fisher's aegis) ignored Fisher until Herbert Scarf (1967) invoked Fisher as a precursor when proposing an algorithm for computing Walrasian general equilibrium. Fisher had drawn on the vector analysis and multiple algebra of his teacher, the mathematical physicist Josiah Willard Gibbs (see Gibbs 1909, 1961, Vol. 2), while Debreu started from the later and very different mathematical approach of the Bourbaki group, an approach that emphasized pure mathematics in contrast to the applied mathematics of Gibbs and his students (see Weintraub and Mirowski 1994; Mashaal 2006).

The example of his teacher and mentor Gibbs presumably explains why Fisher published his dissertation in the *Transactions of the Connecticut Academy of Arts and Sciences* (as well as with the New York branch of Macmillan). Bill Bryson (2003, pp. 116–117) reports that "In 1891 [Max Planck] produced his results and learned to his dismay that the important work on entropy *had* in fact been done already, in this instance by a retiring scholar at Yale University named J. Willard Gibbs." Gibbs's *On the Equilibrium of Heterogenous Substances* "has been called 'the *Principia* of thermodynamics,' but for reasons that defy speculation Gibbs chose to publish these landmark observations [as a series of articles from 1875 to 1878] in the *Transactions of the Connecticut Academy of Arts and Sciences*, a journal that managed to be obscure even in Connecticut, which is why Planck did not hear of him until too late … From 1902 to 1904 [Albert Einstein] produced a series of papers on statistical mechanics only to discover that the quietly productive J. Willard Gibbs in Connecticut had done the work as well, in his *Elementary Principles of Statistical Mechanics* of 1901" (Bryson 2003, p. 121). This not only indicates that Fisher's teacher Gibbs was a formidable mathematical physicist, who set Fisher the example by publishing in the *Transactions of the Connecticut Academy*, but illustrates that Fisher's reinvention of general equilibrium before reading Walras

and Edgeworth was part of a pattern of unnecessary originality resulting from sluggish scientific communication across the Atlantic, and that Gibbs and his students did not always lag behind their European counterparts.

Writing the Dissertation

As a Yale undergraduate and graduate student, Fisher not only studied mathematics and physics with J. Willard Gibbs, but also took courses in political economy taught by a Yale celebrity, William Graham Sumner, the outspoken sociologist, free trader, anti-imperialist, and Social Darwinist. Sumner, together with Yale president Rev. Noah Porter, co-supervised Thorstein Veblen's doctoral dissertation, completed seven years before Fisher's dissertation was completed under the joint supervision of Gibbs and Sumner (see Dimand 1998). Fisher took courses from Gibbs on the mathematical theory of electricity, thermodynamics, and multiple algebra and vector analysis, and from Sumner on advanced political economy, finance, and politics in the history of the United States, sociology, and the logic and method of the social sciences (Allen 1993, pp. 36–38). Fisher studied corporations, railroads, and the history of political economy with Arthur Twining Hadley (president of the American Economic Association 1898–1999 and president of Yale 1899–1921) and principles of public finance and history of labor organizations with Henry Farnam (president of the American Economic Association 1911 and for decades secretary of Yale University). During a postdoctoral year in Europe in 1893–1894, Fisher attended lecture courses on number theory by Ferdinand Georg Frobenius and on physics by Hermann von Helmholtz, both in Berlin, and on probability by Henri Poincaré in Paris, but by then his dissertation was completed and published. When the time came to choose a dissertation topic, Fisher consulted Sumner on how to combine his two interests. Sumner told Fisher that, although he had not read anything about mathematical economics, he had heard of a new book on the subject by Rudolf Auspitz and Richard Lieben (1889), two Austrian businessmen (see Hutchison 1953, pp. 188–191, on Auspitz and Lieben).

In his preface, Fisher (1892, p. 4) stated that the equations for general economic equilibrium in Part I, Chapter IV, "were found by me two years, when I had read no mathematical economist except Jevons.[2] … These equations are essentially those of Walras in his *Éléments d'économie politique pure*. The only fundamental differences are that I use marginal utility throughout and treat it as a function of the quantities of commodity, whereas Professor Walras makes the quantity of each commodity a function of the prices. That similar results should be obtained independently and by separate paths is certainly an argument to be weighed by those skeptical of the mathematical method. … Three days after Part II was finished I received and saw for the first time Prof. Edgeworth's *Mathematical Psychics*. I was much interested to find a resemblance between his surface on page 21 and the total utility surfaces described by me." Hence the suggestion by Robert Dorfman (1995) that if Fisher's examiners had known the existing literature of the subject more thoroughly, they might have rejected Fisher's thesis. Fisher reacted promptly and properly to his belated discovery of Walras (1874–1877) and Edgeworth (1881). Walras's "Geometrical Theory of the Determination of Prices" was translated under Fisher's supervision (presumably by his brother-in-law Nathaniel Bacon, who translated Cournot under Fisher's supervision five years later) and published in the *Annals of the American Academy of Political and Social Science* in June 1892, while Parts II and III were still forthcoming in French, and Walras was elected an honorary foreign member of the American Economic Association in 1892. As Appendix IV of *Mathematical Investigations*, Fisher (1892, pp. 120–124) included a comprehensive "Bibliography of Mathematico-Economic Writings," extending the earlier bibliography begun by William Stanley Jevons in the 1879s edition of his *Theory of Political Economy* and continued in the posthumous third edition in 1888 by his widow, Harriet A. Jevons. Appendix III (pp. 106–119) considered "The Utility and History of Mathematical

[2]Hutchison (1953, pp. 271–273) is generally excellent on Fisher (1892), but errs in including Walras in the statement, "Fisher started with the works of Jevons and Walras, and more especially to his purpose with that of Auspitz and Lieben" (1953, p. 271).

Method in Economics" with ample quotation from the literature that Fisher should have read before writing his dissertation instead of discovering it afterwards. By the end of his postdoctoral year in Europe in 1893–1894, he had also met almost all the leading European economists outside Scandinavia, having visited Edgeworth in Oxford, Marshall in Cambridge, Walras and Pareto in Lausanne, Barone in Florence, Pantaleoni in Rome, and Menger, Böhm-Bawerk, Wieser, and Lieben in Vienna (Allen 1993).[3]

According to Robert Loring Allen (1993, pp. 76–77), in 1888 (the year he graduated from Yale College and began graduate study), Fisher had written a review (never published) of Jevons's *Theory of Political Economy*—so, when he came to write a dissertation in mathematical economics, he might reasonably have been expected to take note of Jevons's "bibliography of mathematico-economic writings," which cited Walras and Edgeworth, whether or not Sumner or Gibbs knew their work. Fisher's unpublished review of Jevons (in Box 32, File 467, of the Fisher Papers, Yale Manuscripts, and Archives), if indeed written in 1888, is inconsistent with Fisher's recollection (Allen 1993, p. 53; Fisher 1997, Vol. 1, p. 4) that in the spring of 1890, when Sumner suggested mathematical economics as a dissertation topic, Fisher replied, "I have never heard of such a subject," and Sumner then referred him to Jevons (1871) and to Auspitz and Lieben (1889). Presumably the date 1888 on Fisher's unpublished review refers only to the date of the edition he was reading, not (as Allen thought) to when he wrote the review, and there was a lag between seeing the titles of Walras (1874–1877) and Edgeworth (1881) listed by Harriet Jevons and actually obtaining copies of the books. Since Fisher wrote his dissertation in a remarkably short time, those books may well have arrived in New Haven after Fisher had reinvented the relevant wheels.

After spending the summer of 1890 working his way through Auspitz and Lieben (1889) in the original German while tutoring the sons of

[3]After hearing a few economics lectures in Berlin, Fisher chose not to pay further attention to the German historical school, attending the lectures of Frobenius and Helmholtz instead. He appears not to have met Auspitz or Launhardt (Fisher [1892] made several references to Launhardt 1885, but Launhardt taught in Hanover, somewhat off the beaten track for a grand tour of Europe).

railway magnate J. J. Hill in Minnesota, Fisher began writing his dissertation in September 1890, and successfully defended it in April 1891. Jevons (1871) had advocated the use of differential calculus in economics, treating marginal utility (which he termed final degree of utility) as the first derivative of a person's utility function with respect to the quantity of a commodity consumed, but (in contrast to Walras) Jevons did not consider the problem of simultaneous determination of prices and quantities in a system of interrelated markets. Jevons taught both logic and political economy in Manchester and London, and in 1870 he published a paper "On the Mechanical Performance of Logical Inference" (reprinted in Jevons 1890, 137–172), but no hint of that appeared in his *Theory of Political Economy* or other economic writings.

The Austrian sugar magnate Rudolf Auspitz and banker Richard Lieben had more to offer Fisher, although only in a partial equilibrium framework: Terence Hutchison (1953, p. 189) calls their book "certainly the fullest and more precise statement of the assumptions of price analysis and of partial equilibrium theory which had been made at the time." In an appendix, they described a three-dimensional "satisfaction surface" along which were "curves of constant satisfaction" such that "Each curve tells us by its ordinates how the expenditure or the price must change if satisfaction is to remain constant, while the quantity of the good alters" (Auspitz and Lieben 1889, p. 495, as translated by Hutchison 1953, p. 190). They did not know Edgeworth (1881), another pioneer of indifference curves. As Hutchison (1953, p. 190) notes, "Like Edgeworth their aim was in no way to dispense with or exclude the utility concept."

Indifference Curves: The Elusive Measurability of Utility

Both Edgeworth (1881) and Auspitz and Lieben (1889) had drawn curves resembling modern indifference curves before Fisher, but they drew such curves to illustrate cardinally measurable utility functions, which, although sufficient, are not at all necessary for indifference

curves: only a preference ordering is needed. The marginal rate of substitution, the rate at which a person can trade one commodity for anyone without becoming better or worse off, can be regarded as the ratio between the marginal utilities of the two goods. But the marginal rate of substitution is in principle observable from the choices that a person would make between bundles of goods, without knowing either of the marginal utilities, which, being subjective, are not observable. Edgeworth (1881, pp. 7–8) thought it both possible and necessary "to compare the happiness of one person with the happiness of another, and generally the happiness of groups of different members and different average happiness … Such comparisons can no longer be shirked if there is to be any systematic morality at all … You cannot spend sixpence utilitarianly without having considered whether your action tends to increase the comfort of a limited number, or numbers with limited comfort" (quoted by Hutchison 1953, p. 110). For the utilitarian or moral calculus, Edgeworth held, utility had to be measured in intensity as well as number and duration and aggregated into a mass of happiness.

After quoting the claim of Edgeworth (1881, p. 99) that "Just perceivable increments of pleasure are equitable," Fisher (1892, p. 5) protested that "This foisting of Psychology on Economics seems to me *in*appropriate and vicious. Others besides Prof. Edgeworth have done it. [Hermann Heinrich] Gossen and Jevons appeared to regard the 'calculus of pleasure and pain' as part of the profundity of their theory. The result has been that 'mathematics' has been blamed for 'restoring the metaphysical entities previously discarded'." Annotating his thesis in 1946 for a proposed new edition, Fisher (1997, Vol. 1, p. 173) observed that Edgeworth's praise of *Mathematical Investigations* for having deepened the foundations of economic science "was certainly magnanimous in view of what was said of him [in] the Preface to the first edition. To have my philosophy of utility accepted by Edgeworth and lead him to repudiate his own was a great satisfaction to me." Edgeworth's magnanimity in praising a work that used the word "vicious" in reference to him is clear; that he ever thought of himself as repudiating his own philosophy of utility is not.

In his preface, Fisher (1892, p. 3) noted, but excused himself from treating, the issues of discontinuity, of nonuniqueness of equilibrium, and of markets that were not competitive: "Much germane to the subject has been omitted because already elaborated by others. Cases of discontinuity belong to almost every step, to modify or extend the continuous case. But the application of this correction has been thoroughly worked out by Auspitz and Lieben. Multiple equilibrium and monopoly value are omitted for a similar reason."

Fisher (1892, pp. 88–89) pointed out that indifference relations cannot always be integrated to find utility functions. If the gradient of utility "is not distributed in the above manner integration is impossible and *there is no such quantity as total utility or gain*. Even if the integration were possible there would still be an arbitrary constant." That differential equations are integrable only under certain conditions had been known to mathematics, but the Italian engineer Giovanni Batista Antonelli (1886) and Fisher (1892) were the first to raise the issue with regard to economics. Antonelli (1886) was listed in Fisher's bibliography, following Harriet Jevons's bibliography of mathematical economics, but Fisher (1892, p. 120) stated that, "In the case of Italian and Danish writings, with which I am wholly unacquainted and in the case of a large number of others which I have not been able to see and examine, I have been guided by book notices or the wording of the title." Fisher read German and French, but not Italian. Antonelli (1886) did not appear in English until 1971.

Fisher (1892) showed that general equilibrium analysis could proceed on the basis of preference orderings and indifference curves even if no cardinal utility functions existed, because the conditions for integrability were not met. But, as Joseph Schumpeter (1948) observed, "Fisher, with unsurpassable simplicity and brilliance, supplied the theory of the measurement of this nonexistent and superfluous thing by defining its unit under the restriction that the utility of any one or at least of one commodity depends on its own quantity only and is independent of the quantities of other commodities. The defects of the method indicated may be as numerous as were the defects of Columbus' flagship if judged by comparison with a modern liner. Nevertheless, it was one of the greatest performances of nascent economics." At about the same

time, Alfred Marshall, in his *Principles of Economics* (1890), including the brief sketch of general equilibrium in Notes XX (XXI in later editions) of the Mathematical Appendix, tried to use consumer surplus as a measure of welfare by assuming a constant marginal utility of money income (see Dimand 1990; Brown and Calsmiglia 2007).

While Fisher (1927) still accepted that measurability of utility was unnecessary for positive analysis, he still sought a means of statistically measuring utility for the normative purpose of evaluating the justice of a progressive income tax, an essay that inspired his last student, the future Nobel laureate William Vickrey (1945), to investigate cardinality of utility in situations of risk (see Dimand and Koehn 2002). According to Fisher (1927, p. 180), "economists cannot afford to be too academic and shirk the great practical problems pressing upon them merely because these happen to touch on unsolved, perhaps insoluble, philosophical problems … By common sense we cut our Gordian knots … Facing our problem, then, as a practical common sense problem, rather than as an academic and philosophical one, I venture to set up as a working hypothesis, that *similar families have similar wants*, that in particular, two average American workingmen's families which are of he same size and age and sex constitution, and which have the same food budgets will also have the same want-for-one-more unit of food; or again, that two typical American workingmen's families which have the same housing accommodation (assuming there has been opportunity to reach adjustment or equilibrium) will also have the same want-for-one-more unit of housing." Modern readers would take these passages from Fisher (1927) as dealing with empirical demand functions and the variables that might be posited as arguments in them, not with utility functions. Fisher's conclusion that it would be unfair to tax workingmen at an income tax rate as high as levied on millionaires, because everyone would recognize that as unfair (p. 181), is an appeal to a generally accepted convention of fairness, not, as Fisher thought, to an interpersonal comparison of utility. Fisher (1927) and Frisch (1926, 1932) obtained a utility function that would be unique up to a positive linear transformation by assuming that commodity classes can be defined such that the marginal utility of one class of commodities is independent of the consumption of other classes of commodities (but if people have

utility functions that are unique only up to a linear positive transformation, there is still no interpersonal comparability—one person may still feel everything five times as intensely as a second person). Vickrey (1945) found that by using reactions to risk, such a utility function could be derived without the assumption made by Fisher and Frisch.

The Influence of Gibbs

Philip Mirowski (1989, p. 223) notes that "Fisher's thesis was the first (and last) published work [of neoclassical economics] to explore the physical metaphor in great detail [and] the first to implement a vector characterization of an economy … Both attributes can be traced to the influence of Josiah Willard Gibbs, the great American thermodynamicist, who was one of Fisher's thesis advisers." More debatably, Mirowski then takes Fisher's thesis as the "canonical neoclassical model" to argue, from the table of mechanical analogies in Fisher (1892, pp. 85–86), that neoclassical economists were obsessed with rigid, inappropriate analogies to physics, and to out of date Nineteenth Century physics at that (specifically energetics), and furthermore, that they failed to keep to the analogies with which they were supposedly obsessed. Even with Fisher (1892), "the first (and last)" neoclassical work to emphasize physical analogies, Mirowski (1989, p. 229) accepts that "most of [Fisher's] analogies were taken from hydrostatics rather than from fields of force" but sees this just as evidence that "his appreciation of the full physical content of the field concept was deficient." Mirowski feels that Fisher should have extended his table of mechanical analogies on pages 85–86 by assuming that the sum of money values plus utility is constant, which (at the cost of being inconsistent with Fisher's central point that total utility may not exist, and is not a necessary concept anyway) would have supported Mirowski's criticism of such an inappropriate and "absurd" analogy to conservation of energy: instead, Fisher's "chosen tactic was to *avoid discussion of the conservation of energy* at all costs, even if it meant some misrepresentation of the model appropriated from physics," that is, from energetics, rather than from the hydrostatics that inspired Fisher's hydraulic models (Mirowski 1989, p. 230).

The influence of Gibbs was crucial in a quite different way. Where someone with a Bourbakist training like Debreu would naturally look for a mathematical proof that nonexistence of a solution to a system of equilibrium equations would imply a logical contradiction (see Weintraub and Mirowski 1994; Mashaal 2006 on the Bourbaki approach to mathematics), Fisher's background in Gibbsian physics led him to construct a physical model to see what the equilibrium of an example of such a system would look like.

Fisher's Hydraulic Machine

Fisher's construction of an actual mechanism to solve for the equilibrium of a simple economic system won the acclaim of one well-qualified reviewer, the Italian military engineer Enrico Barone (1894, p. 413): "L'originalità di questo notevole contributo all scienze consiste in cio ezzenzialmente, che per alcuni problemi di economia pura, l'autore ha immaginato – ed ha realmente fatto costurre – un apparecchio che ne dà meccanicamente la soluzione" (the originality of this notable contribution to science consists essentially in that, for the problems of pure economics, the author has imagined—and actually constructed—a mechanism for their solution). Although Barone (1894, p. 428) insisted that "L'apparecchio del Fisher, come dicemmo, è tutt'altro che una mera curiosità scientifica," (Fisher's apparatus, as I have said, is entirely other than a mere scientific curiosity), Fisher's apparatus came to be regarded as a mere scientific curiosity by generations of economists for whom actual mechanical computation of equilibria seemed a fantasy divorced from reality. Given Barone's 1894 praise of Fisher's hydrostatic mechanism for solving a simple example of a general equilibrium system, it is noteworthy that Barone is best known today for an article, translated into English by Friedrich Hayek in 1935 as part of the socialist calculation debate, in which Barone (1908) raised the question whether a socialist state would have any means of solving the system of equations describing general economic equilibrium.

Encouraged by Edgeworth, the editor of the *Economic Journal*, Fisher (1894) published a description of a hydraulic model illustrating the

workings of bimetallism, and used that devise to illustrate Gresham's Law (that bad money drives good money out of circulation), bimetallism, and the equation of exchange in *The Purchasing Power of Money* (Fisher with Brown 1911). This hydraulic representation of the quantity theory of money was simpler than the mechanism of his dissertation, since it dealt only with one equilibrium equation rather than with a system of equations for general equilibrium. Fisher's hydraulic models of the monetary system were taken up by Dalgairns Arundel Barker of the Indian Civil Service (Barker 1906, 1913), and are examined by Mary Morgan (1997, 1999). Unlike the hydraulic model illustrating the general equilibrium analysis of Fisher (1892), the three hydraulic models described in *The Purchasing Power of Money* seem not to have been actually constructed.

Before electronic computers, a few others followed Fisher is devising hydraulic mechanisms to simulate economic processes, though (aside from Barker 1906, 1913) without any awareness of Fisher. Herbert Simon (1969, pp. 14–15) recalled, "One of my vivid memories of the Great Depression is of a large multicolored chart in my father's study that represented a hydraulic model of an economic system (with different fluids for money and goods). The chart was devised, I believe, by a technocratically[4] inclined engineer named Dahlberg. The model never got beyond the pen-and-paint stage at that time, but it could be used to trace through the imputed consequences of particular economic measures or events – provided the theory was right! As my formal education in economics progressed, I acquired a disdain for that naïve simulation, only to discover after the Second World War that a distinguished economist, Professor Abba Lerner, had actually built the Moniac, a hydraulic model that simulated a Keynesian economy. Of course, Professor Lerner's simulation incorporated a more nearly correct theory than the earlier one, and was actually constructed and operated – two points in its favor. However, the Moniac, while useful as a teaching tool, told us

[4]Fisher had more contact than most of his academic peers with economic heresies such as Technocracy in the 1930s (Dimand 1991), so some knowledge in Technocratic circles of Fisher's hydraulic apparatus is possible.

nothing that could not be extracted readily from simple mathematical versions of Keynesian theory, and was soon priced out of the market by the growing number of computer simulations of the economy."

A. W. H. Phillips (1950) and Walter Newlyn (1950) described a hydraulic model of Keynesian income-expenditure analysis, of which several copies were built and used for classroom demonstrations (including, at the London School of Economics, two hydraulic machines connected to represent circular flows of income and spending in a two-country, open-economy model). Leeds, Cambridge, Oxford, Birmingham, Manchester, and Melbourne Universities bought Phillips Machines, and, through Abba Lerner of Roosevelt College in Chicago, machines denominated in dollars were bought by Roosevelt College, Harvard, the Ford Motor Company, and the Central Bank of Guatemala, and some machines were sold to Japan (Nicholas Barr in Leeson 2000, p. 106). Phillips was inspired by a remark in Kenneth Boulding's introductory textbook about an imaginary hydraulic analogue of how equilibrium was established in a market for one economy and did not know Fisher's hydraulic models of general equilibrium or of money. Although *A. W. H. Phillips: Collected Works in Contemporary Perspective* (Leeson 2000) includes six essays on the history of the Phillips Machine and its place in the history of computing and of economic modeling, by Walter Newlyn, David Vines, Nicholas Barr, Graeme Dorrance, Richard M. Goodwin, and Doron Swade (as well as reprinting Phillips 1950), no mention is made of Fisher's hydraulic models.[5]

Influence, Neglect, and Rediscovery

Fisher (1892) was ahead of its time. His work in mathematical economics was warmly received by Francis Y. Edgeworth (1893), Enrico Barone (1894), and Vilfredo Pareto (1897), but most economists of

[5]Fisher's name appears once in Leeson (2000, p. 337), when Basil Yamey imagines that Phillips would have been amused at finding Fisher (1926) among the "supposed precursors" of the Phillips Curve.

his time and of the next two generations of economists could no more read and understand his dissertation than they could read and understand Edgeworth (1881). Only a handful of Yale's mathematics students were drawn to Fisher's course on "The Mathematical Theory of Prices." Fisher's *Brief Introduction to the Infinitesimal Calculus* (1897), at eighty-four pages an aptly named work intended for economics students, was much more widely read than his thesis (it was reprinted as late as 1943, and translated into French, German, Italian, and Russian). But Fisher's thesis was not completely forgotten. The Yale University Press republished *Mathematical Investigations in the Theory of Value and Prices* in 1925, with a brief preface by Fisher and with photographs of the 1893 and 1925 versions of Fisher's hydraulic machine, selling enough copies to warrant reprinting the book in 1937. Augustus Kelley reissued Fisher (1892) in his Reprints of Economic Classics series in 1960, with a reprint in 1965. A Japanese translation by Hisatake Masao was published in Tokyo in 1933, and a French translation by Jacques Moret in Paris in 1917. The French edition, briefly reviewed in the *Economic Journal* by Edgeworth and in the *American Economic Review* by Fisher's student Chester Arthur Phillips (both reprinted in Dimand 2007, Vol. 1), linked what Moret (1915, p. 136) termed Fisher's "remarquable étude" to a brief spate of books on mathematical economics published in French in Paris and Lausanne by French, Swiss, Italian, and Polish followers of Walras and Pareto (Leseine and Suret 1911; Boven 1912; Osorio 1913; Antonelli 1914; Zawadzki 1914; Moret 1915; Fisher 1917). Giard et Brière, the publishers of Osorio (1913), Moret (1915), and Fisher (1917), also brought out French translations of Jevons (1871) and Auspitz and Lieben (1889). The First World War ended this series of publications, which had almost no influence in francophone universities and economics journals outside Lausanne (Zylberberg 1990).[6]

[6]Etienne Antonelli's praise of Walras and the use of mathematics in economics caused his failure in the 1910 competition for university positions (*concours d'agrégation*). Outside the university system, at the Collège Libre des Sciences Sociales from 1911 he was able to teach the first course in France on mathematical economics, using Walras's own abridgement of his *Éléments* (later published as Walras 1938), which Antonelli received from Walras's daughter Aline. Antonelli (1914) was based on his lectures. Antonelli had a university and legislative career after succeeding in the 1919 *concours* and lived until 1971, but his post-1914 economic publications were nonmathematical (Zylberberg 1990, pp. 83–86).

In an *Encyclopaedia of the Social Sciences* article surveying the history of the mathematical school in economics, Oskar Morgenstern (1931) mentioned Fisher only twice, remarking in passing that Carl Menger appeared in Fisher's bibliography of mathematical economics on the basis of having used a few symbols,[7] and that Pareto introduced into general equilibrium analysis "the concept of indifference curves adapted from Edgeworth and Irving Fisher." Fisher's name did not appear in *The Theory of Games and Economic Behavior* (von Neumann and Morgenstern 1947), where ordinal utility theory was discussed very much in the spirit of Fisher (1892) but citing only Pareto.

Despite Fisher's crucial role as founding president of the Econometric Society in encouraging Alfred Cowles to found the Cowles Commission for Research in Economics (which became the Cowles Foundation for Research in Economics when it moved from the University of Chicago to Yale University in 1955), Fisher (1892) did not attract the attention of Kenneth Arrow and Gerard Debreu, whose Nobel Prize-winning work on general equilibrium theory was conducted at the Cowles Commission in Chicago[8] and, in the case of Debreu, continued at the Cowles Foundation at Yale. Neither Arrow and Hahn (1971), nor Debreu's Cowles Monograph *Theory of Value: An Axiomatic Analysis of Economic Equilibrium* (1959), nor Hicks's *Value and Capital* (1946) cite Fisher. Fisher's name appears only twice in Arrow's *Collected Papers* on general equilibrium (1983). Arrow's *International Encyclopedia of the Social Sciences* entry on general equilibrium mentions that "Important contributions were made by Walras' contemporaries, Edgeworth, Pareto, and Irving Fisher," citing Edgeworth's contract curve but without indicating what Pareto's or Fisher's contributions were or why they

[7]Morgenstern presumably the later, fuller bibliography of mathematical economics that Fisher appended to his brother-in-law's 1897 translation of Cournot, rather than the earlier version in *Mathematical Investigations*. Fisher (1892, p. 120) stated that "Menger, though his writings are not explicitly mathematical, is included for he founded the 'Austrian School' which has ever since been allied with the mathematical method." Austrian or neo-Austrian economists, although marginalist like Fisher, have remained skeptical of the use of mathematics in economics.

[8]Fisher's dissertation was highly regarded by Charles Roos and Harold Davis, research directors at the Cowles Commission in Colorado Springs before its 1939 move to Chicago (Dimand and Veloce 2007, p. 523), but neither Roos nor Davis influenced the post-1939 Cowles Commission.

were important (Arrow 1983, p. 111), while Arrow's Nobel Lecture notes that the "'ordinalist' view of preferences was originally due to Pareto and Irving Fisher, about 1900" but only gained wide currency with the work of Hicks, Hotelling, and Samuelson in the 1930s (Arrow 1983, p. 203). J. R. Hicks (1946, p. 3) stated that because "the works of Walras and Pareto are not available in English and are not, on the whole, very familiar to English readers, I shall summarize such parts of their work as I need in the course of my own argument." Introducing Anglophone readers to general equilibrium analysis, Hicks was apparently unacquainted with Fisher (1892) or with Walras (1892), which was translated into English under Fisher's supervision.

As the subtitle of Debreu's 1959 monograph indicates, his mathematical roots were in the axiomatic tradition of pure mathematics associated with the Bourbaki group (see the interview with Debreu in Weintraub 2002). Fisher's mathematical training was in the applied mathematics of the physicist J. William Gibbs, emphasizing computability rather than axiomatic rigor. Faced with a system of equations describing general economic equilibrium, Fisher's training led him to build a physical model and see what equilibrium it displayed, while Debreu's training inclined him to seek a formal mathematical proof that nonexistence of a solution to the system of equations would imply a logical contradiction. Debreu's lack of acquaintance with Fisher's work on general equilibrium might seem surprising, not so much because of Debreu's involvement with the Cowles Commission, Econometric Society, and Yale University, but because he was a student of Fisher's admirer Maurice Allais and was attracted to mathematical economics from pure mathematics by reading Allais (1943). Maurice Allais dedicated his magnum opus *Économie et Intérêt* (1947) to Fisher, wrote the memorial article on Fisher in the *Revue d'économie politique* that year, and contributed the entry on Fisher in the *International Encyclopedia of the Social Sciences* in 1968. But the many and glowing references to Fisher in Allais (1947) are all to Fisher's writings on monetary economics and the theory of capital and interest, notably to French translations of *The Nature of Capital and Income* (1906), *The Rate of Interest* (1907) and *The Purchasing Power of Money* (1911). Allais (1947) cited Moret (1915), but Allais, an engineer self-trained in economics (in which he had a

Nobel Prize, but not a degree), seems not to have known Fisher's dissertation in the 1940s (when Debreu studied with him), either in the original or in Moret's 1917 translation, although of course he was familiar with it by the time of his 1968 encyclopedia article about Fisher.

Although the hydraulic models illustrating the quantity theory of money in Fisher's "Mechanics of Bimetallism" (1894) and *Purchasing Power of Money* (1911) derived from the hydraulic apparatus simulating the much more complex general equilibrium analysis of his dissertation, the general equilibrium analysis of *Mathematical Investigations* had little apparent influence on Fisher's later work. Neither his exposition of the quantity theory of money nor his monetary theory of economic fluctuations were explicitly set in a general equilibrium framework of simultaneous determination of equilibrium prices and quantities across markets linked by budget constraints, nor did Fisher integrate his monetary economics with his neoclassical theory of real interest and intertemporal allocation. The attempted integration of monetary and value theory, the project of Don Patinkin's *Money, Interest and Prices* (1965), can be viewed as the integration of Fisher (1892, 1907, 1911, 1926) that Fisher never undertook himself. Patinkin's critique of Fisher implies a possible answer to the question: Why didn't Fisher (1892) influence even the later Fisher?

Patinkin argued that Fisher, like other leading classical and neoclassical economists, invalidly dichotomized the real and monetary sectors of the economy, believing that the supply and demand equations for commodities determine the relative prices of goods independently of money supply and demand, which determine the absolute price level (see Dimand 2002, pp. 310–312, on which this paragraph draws). But Patinkin pointed out that changes in the quantity of money affect the absolute price level only by first changing the real money balances held by individuals and hence their demands for goods and assets. The price level is equilibrating through changes in real balances and demands for commodities and assets. The monetary analysis of economists holding what Patinkin termed the invalid dichotomy lacked the stability analysis characteristic of their value theory. Patinkin (1965, pp. 184–185, 600–602) cited Fisher (1911, pp. 174–177; 1912, Chapter XV) to argue that "Fisher confused the valid dichotomy between money and accounting prices with the invalid one between relative and money prices" (1965,

p. 601) and that in the concluding paragraph of Fisher (1912, Chapter XV), "the valid intuitive feeling that different forces determine absolute and relative prices slips imperceptibly into the invalid identification of these forces with separate equations."

Fisher (with Brown 1911, pp. 174–175) rebuked those "slothful analysts in economics" who denied that the factors in the equation of exchange (quantity of money and velocity of circulation) could determine the price level because "supply and demand" already determined all prices: "They will find that there are always just one *too few equations* to determine the unknown quantities [i.e. money prices] involved.* The equation of exchange is needed in each case to supplement the equations of supply and demand," where the asterisk indicates a footnote reference to Fisher (1892, p. 62). Patinkin (1965, pp. 184, 601) noticed that the equation added in the cited passage of Fisher's dissertation was the definitional setting of the price of a *numéraire* good to one (determining accounting prices in terms of that good), not the equation of exchange (determining money prices). Fisher failed to integrate his monetary economics into the general equilibrium framework of his dissertation because the invalid dichotomy misled him into thinking that would be unnecessary.

The importance of Fisher's computational approach to general equilibrium was recognized in 1967, when Herbert Scarf of Yale's Cowles Foundation announced his fixed-point algorithm for computing equilibrium prices in his contribution to *Ten Economic Studies in the Tradition of Irving Fisher*, nine essays by Yale economists plus a paper by Paul Samuelson of MIT, honoring Fisher on the centenary of his birth. Scarf's algorithm approximating fixed points of a continuous mapping is the foundation of the flourishing field known variously as computable general equilibrium (CGE), numerical general equilibrium (NGE), or applied general equilibrium. But in Scarf's Cowles Monograph, *The Computation of Economic Equilibria* (Scarf with Hansen 1973), Fisher's name appears only in the bibliographic entry for Scarf's 1967 paper. Later, Scarf became involved in trying to specify exactly how Fisher's hydraulic model of general equilibrium actually worked (Brainard and Scarf 2005), a project that, with luck, will eventually result in a physical reconstruction of the apparatus.

In keeping with the lack of acquaintance with Fisher's dissertation by Arrow, Debreu, and Hicks, the historical appraisal of the neo-Walrasian research program in general equilibrium analysis from the 1930s onward by E. Roy Weintraub (1985, pp. 80–82, 167–168) notes Fisher's role in founding the Econometric Society and the Cowles Commission, but not his direct involvement in general equilibrium theory. The closest approach to mention of Fisher on general equilibrium is a remark that "Irving Fisher has a photograph of a complicated piece of hydraulic machinery as a model in his book on value theory," in a list of examples of economists using analogies to other disciplines (Weintraub 1985, p. 37), without noting that Fisher's book on value theory concerned general equilibrium or that the complicated piece of hydraulic machinery was something that Fisher had built. Weintraub does not mention Fisher in *How Mathematics Became a Mathematical Science* (2002). In the Blackwell *Companion to the History of Economic Thought* (Samuels et al. 2003), the nearest thing to a definitive summary of the state of the art, Fisher's name is absent from Donald Walker's chapter on "Early General Equilibrium Economics" and from Mark Blaug's chapter on the formalist revolution. Fisher's thesis receives two brief mentions in other chapters: William Barber's chapter on "American Economics to 1900" states that Fisher's dissertation "was a pioneering statement in mathematical economics and was to be recognized as a classic in that genre" (p. 243), and Roger Backhouse, writing on "The Stabilization of Price Theory, 1920-1955" (p. 310) remarked that Pareto "accepted Fisher's (1892) demonstration that sets of indifference curves could not, in general, be integrated to obtain utility functions." Otherwise, Fisher appears as a monetary, capital, and index number theorist, not as having a place in the history of general equilibrium.

Frisch's claim that it would be hard to find a more influential work in economics than Fisher's dissertation was made at a gathering celebrating Fisher's eightieth birthday (Frisch 1947), and generalized too much from Frisch's own experience: Frisch (1926, 1932) was influenced by Fisher's thesis, but Arrow, Debreu, Hicks, and John von Neumann and Oskar Morgenstern did not know what Fisher had written about general equilibrium and utility theory, and Phillips did not know of Fisher's hydraulic models (or Fisher's 1926 anticipation of the Phillips

curve). Hutchison (1953, p. 274) suggests that, "Their, for that time, severely mathematical exposition as well as, no doubt, their forbidding mechanical illustrations of cisterns and levers was fatal to the influence of Fisher's *Investigations*, which for several decades received very little attention."

Conclusion

In his doctoral dissertation, Irving Fisher independently discovered the equations for general equilibrium prices and quantities in a competitive economy, whether an exchange economy or one with production, without knowing that Walras (1874–1877) and Edgeworth (1881) had preceded him (although by the time he published his thesis, Fisher was able to include a thorough survey of the literature of mathematical economics). Like them, he believed that having the same numbers of unknowns and independent equations guaranteed the existence of a solution, overlooking nonnegativity constraints on quantities. If that was all he had accomplished in his thesis, it would stand as a monument to unnecessary originality. But Walras's analysis depended on cardinally measurable utility functions and Edgeworth, although he drew versions of indifference curves, viewed utils as the smallest increment of pleasure than can be observed by measuring electrical impulses along the nervous system. Like Pareto a few years later (see Wilson 1912), Fisher's indifference curve analysis required only that the ratios of marginal utilities (that is, marginal rates of substitution) be observable, not the subjective marginal utilities themselves (although in 1927 Fisher held that measurement of marginal utility was needed, and possible, for normative rather than positive purposes). Unlike Walras or Pareto, Edgeworth or Marshall, Fisher envisioned a model to simulate the determination of equilibrium prices and quantities, by analogy to a body of liquid finding its level of rest, and actually built such a model and used it for classroom demonstrations, providing an example of equilibrium being achieved in a simplified system half a century before electronic computers were available.

Annotating his dissertation in 1946 in preparation for an intended new edition, Fisher (1997, Vol. 1, pp. 172–173) identified seven chief

points of the book, for each of which he claimed at least partial originality: "(1) A concept of utility and marginal utility which is based on desire and not, as Jevons and others attempted, on pleasure (gratification of desire) and which lends itself to possible future statistical measurement." (2) Hydrostatic and other mechanical analogies. (3) Distinctive price determining equations (acknowledging partial anticipation by Walras). (4) Application to economics of Gibb's vector concept. (5) Indifference curves (acknowledging partial anticipation by Edgeworth). (6) Reversal of cause and effect (that is, the price level is taken as given by each individual but is endogenous for the system as a whole). (7) An "example of, also a plea for, and historical sketch (including bibliography) of, mathematical method applied to economics." The hope for eventual statistical measurement of utility, expressed in the first point, suggests that Fisher never fully embraced the implications of his indifference curve analysis (in which he preceded Pareto and provided a version that is closer than Edgeworth's curves to modern usage). Fisher's hydrostatic apparatus, mentioned second among his contributions, was distinctively his own, not anticipated even in part by any other economist: a physical model, not only imagined but actually constructed, to simulate and demonstrate the achievement of equilibrium for a particular example of a general equilibrium system.

References

Allais, M. 1943. *À la recherché d'une Discipline Économique, Première Partie: L'Économie pure*. Saint-Cloud, Seine et Oise: Ateliers Industria; 3rd ed., Paris: Editions Clement Juglar, 1994.

Allais, M. 1947. *Économie et Intérêt*. Paris: Impremerie Nationale et Librairie des Publications Officieles; 2nd ed., Paris: Editions Clement Juglar, 1998.

Allen, R.L. 1993. *Irving Fisher: A Biography.* Cambridge, MA and Oxford: Blackwell.

Antonelli, G.B. 1886. *Sulla teoria matematica della economia politica*, trans. and ed. J. Chipman, L. Hurwicz, M. Richter, and H. Sonnenschein. *Preferences, Utility and Demand*, 333–363. New York: Harcourt Brace, 1971.

Antonelli, E. 1914. *Principes d'économie pure.* Paris: Marcel Rivière.

Arrow, K.J. 1983. *Collected Papers of Kenneth J. Arrow, Volume 2*: *General Equilibrium.* Oxford: Basil Blackwell.

Arrow, K.J., and F.H. Hahn. 1971. *General Competitive Analysis.* San Francisco: Holden-Day and Edinburgh: Oliver & Boyd.

Auspitz, R., and R. Lieben. 1889. *Unterschungen über die Theorie des Preises*. Leipzig: Dunkler und Humblot. Translated as *Recherches sur la théorie des prix*. Paris: M. Giard et E. Brière, 1914.

Barker, D.A. 1906. An Hydraulic Model to Illustrate Currency Phenomena. *Economic Journal* 16: 461–466.

Barker, D.A. 1913. *The Theory of Money.* Cambridge: Cambridge University Press.

Barone, E. 1894. Review of *Mathematical Investigations in the Theory of Value and Prices* by Irving Fisher. *Giornale degli Economisti* (May): 413–428.

Barone, E. 1908. "Il Ministro della produzione nell stato colletivista," *Giornale degli Economisti*, trans. as "The Ministry of Production in the Collectivity State." In *Collectivist Economic Planning*, ed. F.A. Hayek, 245–290. London: Routledge, 1935.

Boven, P. 1912. *Les applications mathématiques en économie politique.* Lausanne: Pache-Varidel et Bron.

Brainard, W.C., and H.E. Scarf. 2005. "How to Compute Equilibrium Prices in 1891," with comments by D. Brown and F. Kubler and by K.R. Sreenivasan, *Celebrating Irving Fisher: The Legacy of a Great Economist*, ed. R.W. Dimand and J. Geanakoplos. Malden, MA and Oxford, UK: Blackwell (also published as Annual Supplement to *American Journal of Economics and Sociology*), 57–92.

Brown, D.J., and C. Calsamiglia. 2007. *Marshall's Theory of Value and the Strong Law of Demand*. Cowles Foundation Discussion Paper No. 1615 (July). New Haven, CT: Cowles Foundation for Research in Economics, Yale University.

Bryson, B. 2003. *A Short History of Nearly Everything*. New York: Broadway Books.

Debreu, G. 1959. *Theory of Value: An Axiomatic Analysis of Economic Equilibrium*, Cowles Foundation Monograph 17. New York: Wiley.

Dimand, R.W. 1990. Alfred Marshall and the General Equilibrium Theory of Value and Distribution: An Examination of Notes XIV and XXI. In *Alfred Marshall in Retrospect*, ed. R. McWilliams Tullberg, 49–59. Aldershot and Brookfield, VT: Edward Elgar.

Dimand, R.W. 1991. Cranks, Heretics and Macroeconomics in the 1930s. *History of Economics Review* 16: 11–30.

Dimand, R.W. 1998. Fisher and Veblen: Two Paths for American Economics. *Journal of the History of Economic Thought* 20: 449–465.

Dimand, R.W. 2002. Patinkin on Irving Fisher's Monetary Economics. *European Journal of the History of Economic Thought* 9: 308–326.

Dimand, R.W. (ed.). 2007. *Irving Fisher: Critical Responses*, 3 vols. London and New York: Routledge.

Dimand, R.W., and R.H. Koehn. 2002. From Edgeworth to Fisher to Vickrey. *Atlantic Economic Journal* 30: 205–208.

Dimand, R.W., and W. Veloce. 2007. Charles F. Roos, Harold T. Davis and the Quantitative Approach to Business Cycle Analysis at the Cowles Commission in the 1930s and Early 1940s. *European Journal of the History of Economic Thought* 14: 519–542.

Dorfman, R. 1995. Austrian and American Capital Theories: A Contrast of Cultures. *Journal of the History of Economic Thought* 17 (1): 21–34.

Edgeworth, F.Y. 1881. *Mathematical Psychics*. London: C. Kegan Paul; reprinted New York: Augustus M. Kelley, 1967.

Edgeworth, F.Y. 1893. Review of Irving Fisher's *Mathematical Investigations in the Theory of Value and Prices*. *Economic Journal* 3: 108–112; reprinted in Dimand, ed. (2007).

Fisher, I. 1892. *Mathematical Investigations in the Theory of Value and Prices*. New York: Macmillan; also published in *Transactions of the Connecticut Academy of Arts and Sciences*, Vol. IX (July 1892), pp. 1–124; reprinted in Fisher (1997), Vol. 1.

Fisher, I. 1894. The Mechanics of Bimetallism. *Economic Journal* 4: 527–537; reprinted in Fisher (1997), Vol. 1.

Fisher, I. 1897. *A Brief Introduction to the Infinitesimal Calculus, Designed Especially to Aid in Reading Mathematical Economics and Statistics.* New York: Macmillan.

Fisher, I. 1906. *The Nature of Capital and Income*. New York: Macmillan; reprinted in Fisher (1997), Vol. 2.

Fisher, I. 1907. *The Rate of Interest*. New York: Macmillan; reprinted in Fisher (1997), Vol. 3.

Fisher, I., with Brown, H.G. 1911. *The Purchasing Power of Money*. New York: Macmillan; reprinted in Fisher (1997), Vol. 4.

Fisher, I. 1912. *Elementary Principles of Economics*. New York: Macmillan; reprinted in Fisher (1997), Vol. 5.

Fisher, I. 1917. *Recherches mathématiques sur la théorie de la valeur et des prix*, trans. Jacques Moret. Paris: M. Giard et E. Brière.

Fisher, I. 1926. A Statistical Relation Between Unemployment and Price Level Changes. *International Labour Review* 13: 785–792; reprinted in Fisher (1997), Vol. 8, and as Lost and Found: I Discovered the Phillips Curve, *Journal of Political Economy* 81 (1973): 496–502.

Fisher, I. 1927. A Statistical Method for Measuring 'Marginal Utility' and Testing the Justice of a Progressive Income Tax. In *Economic Essays Contributed in Honor of John Bates Clark*, ed. J.H. Hollander, 157–193. New York: Macmillan; reprinted in Fisher (1997), Vol. 12.

Fisher, I. 1997. *The Works of Irving Fisher*, 14 vols., ed. W.J. Barber assisted by R.W. Dimand and K. Foster, consulting ed. J. Tobin. London: Pickering & Chatto.

Frisch, R. 1926. Sur une problème d'économie pure. *Norsk Matematisk Forenings Skrifter* 16.

Frisch, R. 1932. *New Methods of Measuring Marginal Utility*. Tübingen: J. C. B. Mohr (Paul Siebeck).

Frisch, R. 1947. Irving Fisher at 80. *Econometrica* 15: 71–74; also published as Tribute to Irving Fisher. *Journal of the American Statistical Association* 42: 2–4; reprinted in Dimand (2007).

Gibbs, J.W. 1909. *Vector Analysis: A Text-Book for the Use of Students of Mathematics and Physics, Founded on the Lectures of J. Willard Gibbs by Edwin Bidwill Wilson*, 2nd ed. New York: Charles Scribner's Sons; reprinted New York: Dover, 1960.

Gibbs, J.W. 1961. *Scientific Papers*, 2 vols. New York: Dover.

Hicks, J.R. 1946. *Value and Capital: An Inquiry into Some Fundamental Principles of Economic Theory*, 2nd ed. Oxford: Clarendon Press.

Hutchison, T.W. 1953. *A Review of Economic Doctrines 1870–1929*. Oxford: Clarendon Press.

Jevons, W.S. 1871. *The Theory of Political Economy*. London: Macmillan; as reprinted with introduction by R. D. C. Black, Harmondsworth: Penguin, 1970.

Jevons, W.S. 1890. *Pure Logic and Other Minor Works*, ed. R. Adamson and H. A. Jevons. London: Macmillan.

Launhardt, W. 1885. *Mathematische Begründung der Volkswirthschaftslehre*. Leipzig: Engelmann; trans. Hilda Schmidt as *Mathematical Principles of Economics*, ed. with introduction by J. Creedy, Aldershot, UK, and Brookfield, VT: Edward Elgar, 1993.

Leeson, R. (ed.). 2000. *A. W. H. Phillips: Collected Works in Contemporary Perspective.* Cambridge: Cambridge University Press.

Leseine, L., and L. Suret 1911. *Introduction mathématique à l'étude de l'économie politique.* Paris: Félix Alcan.

Marshall, A. 1890. *Principles of Economics*. London: Macmillan; variorum edition, ed. C.W. Guillebaud, 2 vols. London: Macmillan for the Royal Economic Society, 1961.

Mashaal, M. 2006. *Bourbaki: A Secret Society of Mathematicians.* Providence, RI: American Mathematical Society.

Mirowski, P. 1989. *More Heat Than Light: Economics as Social Physics, Physics as Nature's Economics.* Cambridge: Cambridge University Press.

Moret, J. 1915. *L'emploi des mathématiques en économie politique.* Paris: M. Giard et E. Brière.

Morgan, M.S. 1997. The Technology of Analogical Model Building: Irving Fisher's Monetary Worlds. *Philosophy of Science* 64: S304–S314.

Morgan, M.S. 1999. Learning from Models. In *Models as Mediators*, ed. M.S. Morgan and M. Morrison, 347–388. Cambridge: Cambridge University Press.

Morgenstern, O. 1931. Economics: The Mathematical School. In *Encyclopaedia of the Social Sciences*, ed. E.R.A. Seligman and A. Johnson. New York.

Newlyn, W.T. 1950. The Phillips/Newlyn Hydraulic Model. *Yorkshire Bulletin of Economic and Social Research* 2: 110–127.

Osorio, A. 1913. *Théorie mathématique de l'échange*. Paris: M. Giard et E. Brière.

Pareto, V. 1897. A Letter from Vilfredo Pareto to Irving Fisher, January 11, 1897. *Metroeconomica* 10: 57–59; reprinted in Dimand, ed. (2007).

Patinkin, D. 1965. *Money, Interest and Prices*, 2nd ed. New York: Harper & Row.

Phillips, A.W.H. 1950. Mechanical Models in Economic Dynamics. *Economica*, New Series, 18: 283–305; reprinted in Leeson (2000).

Samuels, W.J., J.E. Biddle, and J.B. Davis (eds.). 2003. *A Companion to the History of Economic Thought.* Malden, MA: Blackwell, Blackwell Companions to Contemporary Economics.

Samuelson, P.A. 1966. *The Collected Scientific Papers of Paul A. Samuelson*, vols. 1 and 2, ed. J. Stiglitz. Cambridge, MA: MIT Press.

Samuelson, P.A. 1967. Irving Fisher and the Theory of Capital. In *Ten Economic Studies in the Tradition of Irving Fisher*, ed. W. Fellner et al., 17–38. New York: Wiley.

Samuelson, P.A. [1947] 1983. *Foundations of Economic Analysis*, enlarged ed. Cambridge, MA: Harvard University Press.

Scarf, H.E. 1967. The Computation of Equilibrium Prices. In *Ten Economic Studies in the Tradition of Irving Fisher*, ed. W. Fellner et al., 207–230. New York: Wiley.

Scarf, H.E., with the collaboration of Hansen, T. 1973. *The Computation of Economic Equilibria.* New Haven, CT: Yale University Press, Cowles Foundation Monograph 24.

Schumpeter, J.A. 1948. Irving Fisher's Econometrics. *Econometrica* 16: 219–231; as reprinted in Joseph A. Schumpeter, *Ten Great Economists, from Marx to Keynes*, 222–238. New York: Oxford University Press, 1951.

Schulz, N. 1999. Comment on Schwalbe. In *The Economics of Irving Fisher*, ed. H.-E. Loef and H.G. Monissen, 304–308. Cheltenham and Northampton, MA: Edward Elgar.

Schwalbe, U. 1999. Irving Fisher's Mathematical Investigations in the Theory of Value and Prices. In *The Economics of Irving Fisher*, ed. H.-E. Loef and H.G. Monissen, 281–303. Cheltenham and Northampton, MA: Edward Elgar.

Simon, H.A. 1969. *The Sciences of the Artificial.* Cambridge, MA: MIT Press.

Stigler, G.J. 1971. "Introduction" to F. H. Knight. *Risk, Uncertainty and Profit*. Chicago: University of Chicago Press.

Vickrey, W.S. 1945. Measuring Marginal Utility by Reactions to Risk. *Econometrica* 13: 319–333.

von Neumann, J., and O. Morgenstern. 1947. *Theory of Games and Economic Behavior*, 2nd ed. Princeton, NJ: Princeton University Press.

Walras, L. 1874–1877. *Eléments d'économie politique pure*. Lausanne: Corbaz, Paris: Guillaumin, and Basel: H. Georg; definitive edition of 1926 trans. W. Jaffé as *Elements of Pure Economics*, Homewood, IL: Richard D. Irwin for the American Economic Association and the Royal Economic Society.

Walras, L. 1892. The Geometrical Theory of the Determination of Prices. Trans. under the supervision of I. Fisher, *Annals of the American Academy of Political and Social Science* 3: 45–64; reprinted in James A. Gherity (ed.), *Economic Thought: A Historical Anthology*. New York: Random House, 1965.

Walras, L. 1938. *Abrégé des Ėléments d'Ėconomie pure*, ed. G. Leduc. Lausanne: Pichon et Durand-Auzias.

Weintraub, E.R. 1985. *General Equilibrium Analysis: Studies in Appraisal.* Cambridge: Cambridge University Press.

Weintraub, E.R. 2002. *How Economics Became a Mathematical Science.* Durham, NC: Duke University Press.

Weintraub, E.R., and P. Mirowski. 1994. The Pure and the Applied: Bourbakism Comes to Mathematical Economics. *Science in Context* 7 (2): 245–272.

Wilson, E.B. 1912. Review of *Manuale di economia politica* by Vilfredo Pareto. *Bulletin of the American Mathematical Society* 18: 462–474.

Zawadzki, W. 1914. *Les mathématiques appliquées à l'économie politique.* Paris: Marcel Rivière.

Zylberberg, A. 1990. *L'économie mathématique en France 1870–1914.* Paris: Economica.

3

Revitalizing the Quantity Theory of Money: From the Fisher Relation to the Fisher Equation

Introduction

According to J. Bradford De Long (2000, pp. 83, 85), "The story of 20th century macroeconomics begins with Irving Fisher" because "the transformation of the quantity theory of money into a tool for making quantitative analyses and predictions of the price level, inflation, and interest rates was the creation of Irving Fisher." The two key components of Fisher's revitalization of the quantity theory were the Fisher relation between interest rates in any two standards (real and nominal, gold and silver, dollars and yen) and Fisher's equation of exchange, $MV + M'M' = PT$ elating the money supply (currency, M, and bank deposits, M') to the price level (P) and nominal volume of transactions (T) with different velocities of circulation for currency and bank deposits. Expected appreciation or depreciation of money had been noted as an element in the money rate of interest in a single-sentence paragraph by John Stuart Mill and a brief note by Alfred Marshall and in numerical examples in articles by Jacob de Haas in 1889 and John Bates Clark in 1895 (all cited and acknowledged in Fisher [1896]), but it was Fisher's *Appreciation and Interest* (1896) that gave the concept traction,

R. W. Dimand, *Irving Fisher*, Great Thinkers in Economics,
https://doi.org/10.1007/978-3-030-05177-8_3

that wrote it as an equation (and included the compounding term), that used it to explain uncovered interest arbitrage parity between currencies, the term structure of interest rates and, through slow adjustment of expectations, a monetary theory of economic fluctuations, and that attempted statistical verification of the concept. The quantity theory of money, the argument that a change in the quantity of money would, in the long run, change the price level in the same proportion, goes back to Martin de Azpilcueta (Navarrus) in Salamanca in the 1550s and 1560s, to Jean Bodin in 1576, and David Hume in 1752, and the first English-language single-velocity version of the equation of exchange (what would in Fisher's terminology be $MV=PT$) was by Simon Newcomb in 1885 (hence Fisher's dedication of *The Purchasing Power of Money* to Newcomb's memory). Fisher introduced the two-velocity version of the equation of exchange in an *Economic Journal* article in 1897, and he made it the centerpiece of *The Purchasing Power of Money* (Fisher with Brown 1911a), where he transformed the equation of exchange from a tautology to an operational equation by devising methods of independently estimating V and V'.

Fisher's achievement in monetary economics has often been garbled in the literature, in ways that have confused the history of monetary economics from the mid-1890s to 1930, in large part because of the mis-dating of his contributions. Crowder (1997) is the only example of articles about the Fisher relation that attribute to Fisher the first recognition of the distinction between real and nominal interest, and that assert that he first presented the Fisher relation in his *Theory of Interest* (1930) rather than in *Appreciation and Interest* (1896). The Fisher relation, expressed as an equation in Fisher (1896) and in an appendix to Fisher (1907), is presented only verbally, supplemented with diagrams, in Chapters 2 and 19 of Fisher (1930). Similarly, the two-period Fisher diagram of consumption smoothing is typically attributed by macroeconomics textbooks to *The Theory of Interest* (necessarily without a page number, since the Fisher diagram does not appear anywhere in his 1930 book) rather than to *The Rate of Interest* (1907, p. 409).

Failure to know that Fisher's equation of exchange $MV+M'V'=PT$ appeared in the *Economic Journal* (Fisher 1897) fourteen years before *The Purchasing Power of Money* (and lack of knowledge of citations in

Fisher 1896 of Alfred Marshall's evidence to official enquiries or of Marshall's citations of Fisher 1896) led John Maynard Keynes (1911) to declare that Fisher's version of the quantity theory was simply a late, although independent, reinvention of the oral tradition of Cambridge monetary theory. Not knowing Fisher (1897) also led Thomas Humphrey (1984) to present John Pease Norton (1902) and Edwin W. Kemmerer (1907) as having discovered Fisher's equation of exchange before Fisher—even though both Norton (1902) and Kemmerer (1907) cited Fisher (1897) repeatedly, and Norton (1902) was a Yale doctoral dissertation by one of Fisher's students. The literature on the monetary debates leading to the Federal Reserve Act of 1913 has denied Fisher any role on the grounds that his proposal for a price level rule (Fisher's compensated dollar plan) was the subject of Fisher's *Stabilizing the Dollar* (1920) and thus too late to be relevant—yet Fisher devoted the concluding chapter of *The Purchasing Power of Money* to that plan in 1911 along with many journal articles and speeches in 1912 and 1913, generating enough discussion so that already in 1914 Fisher compiled a bibliography of 344 journal and newspaper articles about his compensated dollar plan, and, working with Fisher, Senator Robert L. Owen inserted price level stabilization in the Senate draft of the Federal Reserve Act, only to have it struck out by the House Banking and Currency Committee. So, sorting out what Fisher did and when he did it matters for understanding both the development of monetary theory and the monetary policy debates of his time.

Fisher and the Quantity Theory of Money

Irving Fisher's *The Purchasing Power of Money* was received in 1911 as a forceful restatement and statistical verification of the quantity theory of money. The quantity theory, going back to the Salamanca School and Jean Bodin in the sixteenth century, David Hume on the price-specie flow mechanism of international adjustment in 1752, and, for inconvertible paper money when Britain suspended gold convertibility of bank notes during the Napoleonic Wars, David Ricardo in 1810, holds that changes in the quantity of money explain changes in the price level

(the inverse of the purchasing power of money) and that, in the long run once all adjustments have occurred, a change in the quantity of money will change all prices and money wages in the same proportion, with no lasting effect on real variables such as output, employment, or real interest. "Why was it," asked Joseph Schumpeter (1948, p. 234), "that friends and foes of *The Purchasing Power of Money* saw nothing in it but another presentation, statistically glorified, of the oldest of old quantity theories—that is, a monument of an obsolescent theory that was to become obsolete before long? The answer is simple: because Fisher said so himself—already in the Preface and then repeatedly at various strategic points." And Fisher did just that, announcing in his preface that "The main contentions of this book are at bottom simply a restatement and amplification of the old 'quantity theory' of money" (Fisher with Brown 1911a, p. vii). Fisher presented his work that way in response to attacks on the quantity theory by American economists who derided the quantity theory as an irrefutable tautology or as an empirically refuted theory that gave aid and comfort to soft-money bimetallists (the view taken by such hard money, gold standard stalwarts as J. Laurence Laughlin of the University of Chicago).

If there had been nothing more to *The Purchasing Power of Money* than that, the book would not be a landmark in the history of monetary economics. But Fisher (assisted by his younger colleague and former student Harry Gunnison Brown) did much more than rehash and illustrate a centuries-old theory (see Ryan [1987] on Brown, and see Brown [1909, 1910a, b] as indications of contributions by Brown that were incorporated into the book). Fisher developed a monetary theory of fluctuations in real interest and output—although Schumpeter (1948, pp. 234–235) had grounds to complain that Fisher "shoved all his really valuable insights mercilessly into chapters IV, V, VI, and disposed of them semi-contemptuously as mere disturbances that occur during 'transition periods' when indeed the quantity theory is 'not strictly true'." To deal with "The Problem of Making Purchasing Power More Stable" (the title of Chapter XIII) and thus stabilize real output, Fisher proposed his "compensated dollar" plan, a monetary policy rule that would stabilize the price level, rather than just stabilizing one price, the dollar price of gold. To choose the right price index to be stabilized,

Fisher considered the merits of various index number formulas, so the Fisher ideal index (the geometric mean of the Paasche and Laspeyres indices), like the "compensated dollar" policy rule, made its first appearance in *The Purchasing Power of Money* in 1911. Even the equation of exchange, drawn from Simon Newcomb (to whom Fisher dedicated *The Purchasing Power of Money*), was transformed in Fisher's hands, with different velocities of circulation for currency and bank deposits and with elaborate statistical efforts (drawing on work by David Kinley, see Kinley 1904, 1910) to measure those velocities independently of the equation of exchange. Fisher's transformation of the quantity theory resonated with later macroeconomists, so that Milton Friedman (1972, p. 12), after quoting extensively from Fisher's December 1910 exchange with Laughlin (in the discussion following Laughlin [1911] and Fisher [1911a]), stated, "And now I must cease quoting from Fisher, with whom I am in full agreement, and proceed instead to plagiarize him – albeit with modifications to bring him down to date."

The Context of *Appreciation and Interest* and of *The Purchasing Power of Money*

Fisher (with Brown 1911a, p. viii) lamented that "since the 'quantity theory' has become the subject of political dispute, it has lost prestige and has even come to be regarded by many as an exploded fallacy. The attempts by promoters of unsound money to make an improper use of the quantity theory– as in the first Bryan campaign– led many sound money men to the utter repudiation of the quantity theory." In 1896, William Jennings Bryan mounted the first of his three presidential campaigns on a platform of adopting bimetallism to raise the price level by increasing the quantity of money, reversing the downward trend of prices since 1873 (when gold convertibility of the "greenback" was restored) and lightening the burden of debt, especially on farmers. Bryan's Populist supporters combined the quantity theory of money, holding that a larger money supply would lead to a higher price level, with a claim that such a price increase would provide permanent real benefits, a lasting stimulus to real economic activity. William H. Harvey's bimetallist tract *Coin's Financial School* ([1894] 1963)

sold perhaps a million copies (including bulk purchases by silver mining interests), reaching a wide public with its ridicule of academic defenders of sound money and the gold standard, notably a "Professor Laughlin" who is soundly defeated in debate by the fictional Coin. J. Laurence Laughlin, founding head of the Economics Department of the University of Chicago, did rather better when he faced Harvey in a real public debate in May 1895 (see Laughlin 1895; Harvey 1895; Skaggs 1995; André-Aigret and Dimand 2018), but never forgot how Harvey and Bryan appealed to the quantity theory for support. Ironically, 1896 was the end of the era of declining prices under the gold standard, due to Klondike and Witwatersrand gold discoveries and especially the introduction of the cyanide process for extracting gold from lower grade ores, so that by the time of Bryan's second presidential campaign in 1900, Bryan accepted that "increased production of gold since 1896 had reduced the importance of question" of the burden of falling prices on debtors because prices ceased to decline (quoted by Dorfman 1949, p. 231).

There was some support within the American Economic Association for international bimetallism (to be achieved by international agreement), although not for Bryan's and Harvey's proposed unilateral adoption of free coinage of silver. General Francis Amasa Walker, the founding president of the AEA as well as president of MIT and the American Statistical Association, was an ardent defender of the quantity theory (Walker 1895) and proponent of *International Bimetallism* (the title of Walker 1896).[1]

[1]Milton Friedman (1992) gave high marks to Walker's analysis, noting that even if international bimetallism proved to be in practice an alternating monometallic standard, that would result in a more stable price level than either a gold standard or a silver standard. The problem of alternating monometallic standards, resulting from trying to peg the relative price of two metals (whether one ounce of gold to sixteen ounces of silver or another ratio) would be avoided by the symmetallism tentatively suggested by Alfred Marshall in 1886 testimony and an 1887 article. Joseph Dorfman (1949, p. 19) discovered that symmetallism was proposed, a few years before Marshall, in New Haven, Connecticut, in 1879, when Walker was teaching at Yale's Sheffield Scientific School and Sumner at Yale College and just five years before Fisher became a Yale undergraduate: "John Philip Phillips, wealthy New Haven physician and lawyer and former Greenbacker, advanced in *A Primer of Political Economy* (1879) the idea that the principle of the bimetallic standard be obtained by requiring that in all future contracts gold and silver be made semi-legal tenders; that is, coin debts should be legally payable only by delivering one-half their amount in gold dollars and one-half in

Had it not been for Walker's sudden death at the age of fifty-six in January 1897, disentangling the quantity theory from bimetallism in the minds of American economists would have been even more difficult. The excitements of the 1896 campaign led university trustees and the press to harsher scrutiny of some previously tolerated international bimetallists. The Reverend Elisha Benjamin Andrews, professor of history and political economy at Brown University and then of political economy and finance at Cornell University, had returned to Brown University as president in 1889, the year he advocated international bimetallism in a fifty-page monograph "An Honest Dollar" in the *Publications of the American Economic Association*. This opinion, uncontroversial at the time, was in 1897 equated with support for free coinage of silver, economic immorality and discouraging potential donors[2] by a Brown trustee who chaired the Banking and Currency Committee of the US House of Representatives (in two private communications with Brown alumni, Andrews had not rejected the possibility that other countries might follow if the United States acted first on bimetallism). Amid much commotion in the press, Andrew resigned, but later became chancellor of the University of Nebraska where, in 1903, he endorsed the gold standard (Donnan 1952; Dorfman 1949, 179–180). Edmund J. James, then director of the Wharton School of Finance and Economy at the University of Pennsylvania and later president of Northwestern University, the University of Illinois and, in 1910, the American Economic Association, expressed bimetallist sentiments when writing about "The Legal-Tender Decisions" in *Publications of the American Economic Association* in 1888 and "Views of the Economists on the Silver Question" in *Science* in 1886, but, as Joseph Dorfman (1949, 161) remarked, "James did not carry these thoughts very far or champion them vigorously for long."

silver dollars." Phillips's 80-page 1879 pamphlet is available at the Yale University Library (as is Phillips [1878], a 32-page pamphlet of which it is an expanded revision) but is not in the Library of Congress catalogue, which does, however, list Phillips (1888, 1896).

[2]Specifically, John D. Rockefeller, benefactor of the University of Chicago, had not volunteered a large donation to Brown even though his son was a member of that year's graduating class.

American economists were acutely aware that monetary arrangements mattered for economic activity and for income and wealth distribution: one of the two papers in the first issue of the Association's second series of publications in 1896 was Francis Amasa Walker on "The Relation of Changes in the Volume of the Currency to Prosperity" while the final issue of that series (in 1899) was a ninety-one-page monograph by F. S. Kinder on "Effects of Recent Changes in Monetary Standards upon the Distribution of Wealth" (Fisher [1896] was the final issue of the first series of AEA publications). Such concerns did not extend to sympathy with populist agitation for unilateral free coinage of silver: in 1896, the third bimonthly issue of the AEA's second series of publications was an eighty-one-page monograph on "The Populist Movement" by Frank L. McVey, economics professor at the University of Minnesota (and later president of the University of North Dakota and then the University of Kentucky), characterized by Joseph Dorfman (1949, p. 335) as "so strong an opponent of the Populist movement as Frank LeRond McVey."

The fierce monetary controversies surrounding the Bryan campaign of 1896, and then those following the crisis of 1907 and leading up to the creation of the Federal Reserve System (which began operation on January 1, 1914), left Fisher with the task of making a case in *Appreciation and Interest* and in *The Purchasing Power of Money* that the quantity theory of money was empirically sound as an explanation of the movement of prices (contrary to Laughlin and his students), that changes in the quantity of money would be neutral in the long run (contrary to Harvey and Bryan), that the equation of exchange was operationally useful and not just a tautology defining the velocity of circulation, and that the short-run non-neutrality of monetary changes, temporarily affecting the real interest rate, explained economic fluctuations (contrary to views of fluctuations as true cycles, such as Jevons's sunspot theory of the trade cycle). He also set himself the further task of devising a monetary policy rule that would eliminate the fluctuations in real economic activity caused by monetary shocks, and to persuade the world to adopt that rule. To make such a rule operational, he also proposed to reform the calculation of index numbers. Being Fisher, he never doubted that he would succeed in all this.

Appreciation and Interest

Fisher's dissertation had involved constructing a hydraulic model of general equilibrium. Francis Ysidro Edgeworth, an admirer of Fisher's dissertation (despite its harsh remark about Edgeworth foisting psychology upon economics), invited Fisher to apply a simplified version of his hydraulic model to "The Mechanics of Bimetallism" for presentation to the Section F of the British Association for the Advancement of Science and publication in the *Economic Journal*, which Edgeworth edited. Fisher's first four journal articles, from 1894 to 1897, all appeared in the *Economic Journal*, thanks to Edgeworth's appreciation of Fisher as a fellow pioneer of mathematical economics. By July 1895, Fisher was writing to a friend that he was "working on an essay which will either be a long article or a short book on bimetallism *against* its expediency or necessity … I never was so morally aroused I think as against the 'silver craze'" (Fisher 1997, Vol. 1, 7, Fisher's emphasis). In December 1895, Fisher addressed an annual meeting of the American Economic Association for the first time. The revised and expanded version of his paper was published as a monograph entitled *Appreciation and Interest* by the American Economic Association in August 1896, both as the fourth issue[3] of that year's volume of *Publications of the American Economic Association* and a book from Macmillan in New York, who were to publish most of Fisher's major scholarly works (the exception being *The Making of Index Numbers*). The title featured the appreciation of the purchasing power of money during deflation (such as the United States experienced from 1873 to 1896), rather than its depreciation in a period of price inflation. Fisher had two goals in his 1896 monograph: to show the fallacy of bimetallist claims of permanent gains, while rescuing the quantity theory of money from populist misuses.

[3]The other three issues of that year's volume were, regrettably, devoted to "Race Traits and Tendencies of the American Negro" by Frederick L. Hoffman (1896), a 330-page work of racist pseudo-science by the statistician to the Prudential Insurance Company of America. Fisher was also a strident eugenicist (see Fisher [1997], Vol. 13, pp. 160–207; Cot 2005; Dimand 2005), and Fisher's *Rate of Interest* (1907) expressed strong views on racial and ethnic differences in rates of time preference, which he considerably toned down in *The Theory of Interest* (1930).

Fisher's monograph *Appreciation and Interest* (1896), published at the time of the first Bryan campaign, pointed out that any expected deflation (appreciation of the purchasing power of money) would have been reflected in nominal interest rates, so that inflation or deflation, if correctly anticipated, would neither help nor harm debtors or their creditors. Further, he argued that expectations of price level changes would adjust to reflect actual changes, so that real effects of monetary shocks would be temporary. Fisher's careful analysis of expected inflation as the difference between the real and nominal interest rates did not have the public appeal of Bryan's refusal, in his speech accepting the Democratic presidential nomination that year, to let mankind be crucified on a cross of gold, but it had greater long-run impact on economic thinking. Fisher (1896) was the first to write down the equation relating real and nominal interest rates (now called the Fisher equation), but he drew attention to previous recognition of the relationship in verbal statements by others ranging in length from a single-sentence paragraph in John Stuart Mill's *Principles* in 1848 and a three-sentence note in Alfred Marshall's *Principles* in 1890 to a journal article by Jacob de Haas (1889), and to numerical examples by William Douglass ([1740] 1897) in an anonymous colonial pamphlet and John Bates Clark in 1895 (both omitting the compounding term)—and also cited a larger number of examples of eminent nineteenth century economists such as Thomas Tooke, W. Stanley Jevons, and Bonamy Price who did not grasp the relation of money interest to price changes. More generally, Fisher (1896) moved beyond the effect on money interest of anticipated changes in the purchasing power of money to formulate a general statement invoking arbitrage to explain the difference between interest rates expressed in any two standards as due to the expected change of the exchange rate between the two standards: money and commodities, gold and inconvertible paper money, the currencies of two countries, gold and silver, gold and wheat. For the currencies of two countries, Fisher (1896) stated what is now called the uncovered interest parity condition. Attributing differences in nominal interest rates on loans of different duration to expectations about inflation, Fisher (1896) advanced what became known as the expectations theory of the term structure of interest rates. Setting the stage for the monetary theory of fluctuations in Chapter 4 of

The Purchasing Power of Money and for his lifelong insistence that the "so-called business cycle" was really a "dance of the dollar" (Fisher 1923, 1925, 1926), Fisher argued in *Appreciation and Interest* that money interest only adjusted gradually, so that it reflected long-term price movements more closely than short-lived swings in prices.

Fisher (1896) stressed that an appreciating value of money redistributed wealth from debtors to creditors only to the extent that the appreciation was a surprise. If the appreciation was expected, it would have been taken into account when the debts were incurred, and the interest rates were negotiated. A higher rate of interest need not harm trade, nor need a low rate of interest encourage activity. What matters is whether the interest rate is high or low relative to the rate of appreciation of some standard. If i is the interest rate expressed in some standard I, j is the interest rate expressed in some other standard J, and a is the rate at which standard I (say, money) is expected to appreciate in terms of standard J (say, commodities) over the relevant time period, then the equilibrium condition is $(1+j)=(1+i)\ (1+a)$, which offers no opportunity for profitable arbitrage. Falling prices need not harm farmers who owe mortgages, as long as expectations of the falling prices were reflected in the interest rates on the mortgages: "It is clear that if the unit of length were changed and its change were foreknown, contracts would be modified accordingly … To alter the mode of measurement does not alter the actual quantities involved, but merely the numbers by which they are represented" (Fisher 1896, p. 1). "We thus see that the farmer who contracts a mortgage in gold is, *if the interest is properly adjusted*, no worse off and no better off than if his contract were in a 'wheat' standard or a 'multiple' standard" (Fisher 1896, p. 16, Fisher's italics). Appreciation or depreciation of the purchasing power of money only matters if expectations are wrong, and such expectations will not be wrong in the long run, because people learn from experience, gather and process information, and adjust their expectations.

If that was all that Fisher (1896) had to say, it would have undermined the bimetallist argument for long-run non-neutrality of money and drawn attention to a crucial factor overlooked in monetary discussions by many leading economists. Fisher (1896, pp. 67–70) gleefully cited unsound passages written by luminaries of nineteenth century

economics such as William Stanley Jevons, Thomas Tooke, William Newmarch, and Bonamy Price and could have provided many more examples. He observed that, "The views here put forward … differ radically from those expressed by Mr. Giffen and many other eminent economists" (1896, ix). But, except for writing the relation as an equation, he would simply have been drawing attention to a relation already understood by Jacob de Haas and by such well-known figures as John Stuart Mill, Alfred Marshall, and John Bates Clark, as Fisher acknowledged.

However, Fisher did much more. Viewing Marshall's terms "real" and "nominal" interest as inadequate, Fisher applied his formula to any two standards: gold and silver, money and goods, two national currencies, two commodities (like wheat and barley). From the principle that asset prices and returns will move to eliminate any profitable opportunity for arbitrage, he derived what is now called the uncovered interest parity condition: that is, the difference between interest in any two currencies (say, dollar interest rates in New York and pound sterling interest rates in London) is, allowing for the cross-product term, equal to the expected rate of change of the exchange rate between the two currencies.[4] To show this empirically, and to show that money interest reflects the rise or fall of prices, Fisher (1896) assembled and published a wide variety of tables: interest rates on Indian silver and gold bonds; Berlin, Paris, Calcutta, Tokyo, and Shanghai interest rates in relation to falling and rising prices; New York interest rates in relation to rising and falling prices and wages; London interest rates in relation to rising and falling prices, wages and incomes; and US interest rates on "coin" bonds (payable in gold coin) and "currency" bonds (payable in greenbacks) before the US economy returned to the gold standard. He also examined interest rates in the same standard for loans of differing duration, explaining the term structure of interest rates by expectations of what would happen to the purchasing power of money.[5]

[4]More than a quarter of a century later, John Maynard Keynes (1923) added the covered interest parity condition that the spread between forward and spot exchange rates equals the difference between interest rates in the two currencies.

[5]Fisher (1896) did not consider the effect of risk, other than riskiness of price changes, on the term structure of interest rates. His main contribution to analysis of risk in financial markets came a decade later, in Fisher (1906).

Fisher and the Equation of Exchange

The following year, Fisher (1897) first used the equation of exchange to present his version of the quantity theory of money. The equation had been used by earlier writers, sometimes correctly but sometimes omitting the velocity or price variable (see Humphrey 1984). Fisher (1897; Fisher with Brown 1911a) drew attention to the "equation of societary circulation" in Simon Newcomb's *Principles of Political Economy* (1885, Chapter XV), dedicating *The Purchasing Power of Money* "To the memory of Simon Newcomb, great scientist, inspiring friend, pioneer in the study of 'societary circulation'." Fisher (with Brown 1911a, p. 25n2) also noted subsequent expressions of the quantity theory equation by Edgeworth (1887) and in an 1896 textbook by Yale president Arthur Twining Hadley. Fisher (1897, p. 517) went beyond Newcomb in allowing money in circulation M and bank deposits D to have different velocities of circulation, so that the equation of exchange became $MV + DU = PT$ where P is the price level, T an index of the volume of transactions, and V and U the velocities of circulation. In 1911, Fisher rewrote this equation as $MV + M'V' = PT$, to emphasize that bank deposits (M') are another kind of money.

In an article on "Algebraic Quantity Equations before Fisher and Pigou," Humphrey (1984, p. 285) attributes the MV and DU notation to John Pease Norton's *Statistical Studies in the New York Money Market* (1902), without mentioning the earlier appearance of that equation and notation in Fisher (1897)—or mentioning that Norton (1902) was a Yale doctoral dissertation by one of Fisher's students and junior colleagues, who repeatedly cited Fisher on velocity of circulation (Norton 1902, pp. 2, 6, 7, 11). Taking notice of Fisher's [1897] *Economic Journal* article also disposes of Humphrey's citation of a 1907 book by A. de Foville as "evidence that French monetary theorists had fully developed algebraic quantity equations before Fisher and Pigou" (Humphrey 1984, p. 284), since Fisher used the equation of exchange with different velocities for currency and deposits in print fourteen years before *The Purchasing Power of Money* and ten years before de Foville's *La Monnaie*. Léon Walras had previously used quantity equations, but not with

Fisher's two velocities: Walras's 1874 version had a velocity of circulation for each commodity while his 1886 version had only one velocity, for metallic money (see Marget 1931; Humphrey 1984). As Humphrey (1984, p. 285) notes, Edwin Kemmerer's *Money and Credit Instruments in their Relation to General Prices* (published 1907, accepted as a Cornell PhD dissertation 1903) used the equation of exchange with different velocities for currency and deposits before *The Purchasing Power of Money*, but Kemmerer (1907, pp. 11, 75, 115, 133, 150) repeatedly (and positively) cited or quoted Fisher, especially Fisher (1897), as well as citing Newcomb (1885, Book IV) and Norton (1902). In turn, Fisher (with Brown 1911a, Preface, p. x) stated that, "Most of the statistical results review and confirm the conclusions of Professor Kemmerer in his valuable *Money and Credit Instruments in their Relation to General Prices*, which appeared while the present book was in course of construction. I am greatly indebted to Professor Kemmerer for reading the entire manuscript and for much valuable criticism throughout." Even the index of Fisher (1911a, p. 508), departing from the laconic neutrality expected of an index, referred warmly to "Kemmerer, E. W. … pioneer work of, in testing statistically the quantity theory of money, 276-278, 430-432" (see Gomez Betancourt 2010).

Norton (1902) and Kemmerer (1907) are thus not anticipations of Fisher (with Brown 1911a) on the equation of exchange. Rather, like Fisher (with Brown 1911a), they built upon Fisher (1897), which has been overlooked in the history of the quantity theory of money (e.g. it is not cited by Patinkin 1965; Laidler 1991, or any contributor to Blaug et al. 1995), perhaps because of the title of Fisher's article, "The Role of Capital in Economic Theory"—and it cannot have helped that the only time Fisher cited his article in *The Purchasing Power of Money* (with Brown 1911a, p. 25n2) he garbled the reference, giving 1899 instead of 1897 as the year of publication.

The appearance in the *Economic Journal* in the 1890s of two Fisher articles on the quantity theory of money (Fisher 1894, 1897) is also relevant to the celebrated claim by John Maynard Keynes (1911, pp. 393–394) that Fisher's *Purchasing Power of Money* should be viewed as a lucid, accurate, but rather late in the day, exposition of matters

already independently developed in the Cambridge oral tradition[6]: most English economists of that era may be assumed to have read the *Economic Journal*—but not necessarily back issues from before they began to study economics. Keynes, who was born in 1883, would not have been reading the *EJ* in 1897. Pigou, who was born in 1877 and graduated in 1901, took the History Tripos before taking Part II of the Moral Sciences Tripos, and so was presumably not yet reading the *EJ* in 1897. Fisher, in turn, knew and warmly acknowledged important contemporary English contributions to monetary theory in Edgeworth's British Association reports and Marshall's evidence to official inquiries. Keynes's 1911 statement that "there seems good reason to suppose that [Fisher] is not acquainted with" Alfred Marshall's evidence before the Gold and Silver Commission of 1887 is refuted by the citation in Fisher's *Appreciation and Interest* (1896, pp. 78, 79, 86, 90) of Marshall's evidence before the 1887 Gold and Silver Commission and the 1886 Royal Commission on the Depression of Trade and Industry (both reprinted in Marshall 1926, edited by Keynes)—even though the references to Marshall in Fisher's *Purchasing Power of Money* (with Brown 1911a, pp. 71–72, 328, 423) happen to cite Marshall's suggestion for symmetallism or quote Marshall's *Principles* rather than his official testimony. In turn, Marshall's evidence to the Indian Currency Committee of 1899 referred enthusiastically to Fisher's *Appreciation and Interest* (see also Marshall 1920, p. 493n). The long squabble about priority of the Cambridge over the Fisher version of the algebraic statement of the quantity theory (in which Fisher has been considered a late-coming

[6]While Fisher, like Newcomb before him and Norton and Kemmerer afterwards, presented the quantity theory of money in terms of the velocity of circulation (V in the transactions version of the equation of exchange $MV=PT$or in the income version of the equation of exchange, $MV=PY$), the Cambridge monetary theorists Marshall, Pigou and Keynes used variants of the equation $M=kPY$, which related desired cash balances M to nominal income. The income version of the equation of exchange is equivalent to the Cambridge cash balance equation, with velocity of circulation V as the inverse of the Cambridge cash balance coefficient k, with the differences between the two approaches being more of exposition than of substance (see Patinkin 1965; Laidler 1991; Dimand 1995). Fisher and Marshall are appropriately pictured together (along with Knut Wicksell) on the cover of David Laidler's *Golden Age of the Quantity Theory* (1991).

interloper who neither knew nor influenced pre-1911 English monetary theory) was due to Keynes (1911) and A. C. Pigou (1917) overlooking Fisher's pre-1911 writings (see Laidler 1991; Dimand 1995). Neither Fisher nor Marshall—nor Fisher's friend Edgeworth—contributed to that dispute. Fisher knew, cited, and praised Edgeworth's British Association reports and Marshall's official evidence. Edgeworth, as editor of the *Economic Journal*, made Fisher's early quantity theory articles available to British readers (Fisher 1894, 1897). Marshall cited and praised Fisher's *Appreciation and Interest*.

Fisher's organization of *The Purchasing Power of Money* around the equation of exchange $MV + M'V' = PT$ as a conscious choice of expository strategy. A then-recent American presentation of the quantity theory of money, David Kinley's *Money* (1904), stuck to a purely verbal account of the theory, eschewing any explicit writing down of the equation, perhaps as likely to frighten away non-mathematical readers (Kinley 1904, pp. 322–326, discussed Fisher's *Appreciation and Interest*, but did not cite Fisher [1897], Newcomb [1885], or Norton [1902]). Fisher's use of the equation enabled him to show clearly how Laughlin and Laughlin's University of Chicago graduate students Sarah McLean Hardy[7] (1895), Wesley C. Mitchell (1896), and H. Parker Willis (1896) had gone astray in their attempts at statistical refutation of the quantity theory of money. Laughlin and his students had argued that the price level P had not moved in step with the money supply M in the United States since the Civil War—but they had not allowed for the upward trend of T, which would increase the demand for real money balances. Fisher's attempt to persuade Laughlin of the error of his ways was not well received (see Laughlin 1911, Fisher 1911a), and the *Journal of Political Economy*, edited by Laughlin, was unusual among economics journal in not reviewing *The Purchasing Power of Money* (see reviews reprinted in Dimand 2007, Vol. 2).

[7]Sarah McLean Hardy, one of the first female graduate students in economics in the United States, published as S. McLean Hardy.

Fisher and the Velocity of Circulation

Fisher also needed to respond to the widespread view that the equation of exchange was not a useful framework for organizing empirical research, but only a tautology that defined the velocity of circulation V as PT/M. Indeed, his expanded equation of exchange, separating currency M and bank deposits M', would not even suffice to define the two velocities V and V'. Accordingly, Fisher attempted to obtain measures of the two velocities distinct from the equation of exchange. He insisted that, except for transition periods, changes in the velocity of circulation reflected such influences as improvements in payment systems and were independent of changes in the quantities of currency and deposits, the price level and the volume of trade. To measure V, Fisher persuaded Yale undergraduates to keep track of their currency holdings and spending, reporting that "A hundred such returns among students at Yale University indicate an average velocity of forty-five times a year, making the average length of time a dollar rests in one man's hands about eight days" (Fisher 1897, p. 520). Fisher (with Brown 1911a, pp. 379–382) provided a fuller account in an appendix on "Statistics of Turnover at Yale University," which he based on 116 people who kept careful accounts (out of 246 whose records were collected). Those 116 included 113 students, a professor, a librarian, and a stenographer—115 men and one woman (the stenographer). Their "average annual rate of expenditure was $660 and an average cash on hand was almost exactly $10, giving the quotient 66 times a year" (1911, p. 379). Fisher did not explicitly address the possibility that his sample might not be strictly representative of the entire American population with regard to occupation, rate of expenditure or gender.

For V', the velocity of circulation of bank deposits, Fisher (with Brown 1911a, p. 448) provided an impressive (or at least impressive-looking) series of numbers, giving V' and $M'V'$ for each year from 1896 to 1909. He created these series by linear interpolation between exactly two observations: estimates of bank deposits (M') and clearings ($M'V'$) for one day, July 1, 1896, that David Kinley of the University of Illinois had made for the Office of the Comptroller

of the Currency, and estimates of M' and $M'V'$ that Kinley had made for one day, March 16, 1909, for the National Monetary Commission (Kinley 1910). Fisher (with Brown 1911a, p. 441) attempted to correct the figures for the fact that the two days were not comparable, since only one of them was the first of the month, but the situation remains that the whole table of figures for velocity from 1896 to 1909 derives from estimates for just two days—which are not comparable. After David Kinley (1913) devoted his American Economic Association presidential address to "Objections to a Monetary Standard Based on Index Numbers"—that is, his vehement objections to Fisher's compensated dollar plan—Kinley's name appeared only infrequently in Fisher's later writings, which tended to attribute the 1896 estimate to the Office of the Comptroller of the Currency and the 1910 estimate to the National Monetary Commission.

Fisher (1911a, pp. 74–89) considered at length how the velocities of circulation depend on tastes, technology, and endowments. As David Laidler (1991, p. 72) remarks, "It is hard to square Fisher's placing the 'habits of the individual' at the top of his list of factors affecting velocity with the view that his version of the quantity theory is 'mechanical'. Whether or not the 'tale' to this effect is, as Patinkin … has suggested, Cantabrigian in origin, it is certainly a tale." There is one surprising omission from Fisher's 1911 list of factors affecting the velocity of circulation: the author of *The Rate of Interest* (Fisher 1907) neglected to mention the rate of interest. This omission is even more remarkable in view of a footnote in Fisher (1897, p. 518n—italics in the original): "Pierre Des Essars, in the *Jour. Soc. Statistique, Paris*, April, 1895, shows that the velocity of circulation of bank deposits, U, varies with *crises*. They will also be found to vary with the *rate of interest*." The first clear and correct statement of the nominal interest rate as the opportunity cost of holding real money balances was not published until 1930—by Irving Fisher, in *The Theory of Interest* (1930, p. 216). John Maynard Keynes (1936) went on to write the money demand function (liquidity preference) as an explicit function of income and the interest rate (but did not cite Fisher in that connection, although Keynes [1936, pp. 140–141], acknowledged the rate of return over cost, as presented by Fisher [1930], in connection with Keynes's marginal efficiency of capital).

The Dance of the Dollar—And Its Remedy

Fisher devoted Chapter 4 of *The Purchasing Power of Money* to a monetary theory of economic fluctuations, restricting the non-neutrality of money shocks to "transition periods" in which the quantity theory of money (changes in the quantity of money affect prices, not velocity or the volume of trade) is "not strictly true." Since Fisher guessed that the transition period after each monetary shock might be ten years, and that monetary shocks were much more frequent than that, the economy would always be in a transition period, moving from one equilibrium price level towards another. The idea that changes in the quantity of money are neutral in the long run, but not in the short run, has a long history in the quantity theory of money, going back to David Hume in 1752 and Henry Thornton in 1802 (Blaug et al. 1995). Fisher advanced the monetary theory of short-run economic fluctuations beyond such earlier insights by grounding it in his theory of the slow adjustment of money interest rates to monetary shocks and price level changes, first propounded in Fisher (1896) and culminating in Fisher (1930) with elaborate correlations between money interest rates and a distributed lag of price-level changes (an adaptive expectations approach to estimating expected inflation), making use both of the Fisher ideal index of the price level and of Fisher's invention of distributed lags. Fisher's continuing development of Chapter 4 of *The Purchasing Power of Money* led him to offer empirical evidence that the "so-called business cycle" was not really a cycle with stable periodicity (Fisher 1923) and that instead fluctuations in real economic activity were a "dance of the dollar" driven by monetary shocks (Fisher 1925). Fisher (1925, p. 191) remarked that "the luck at Monte Carlo" necessarily fluctuated around its mean without justifying talk of "the Monte Carlo cycle." To further support Chapter 4's monetary theory of fluctuations, Fisher (1926) correlated unemployment with a distributed lag of price-level changes in an article reprinted in 1973 in the *Journal of Political Economy* (the only economics journal not to review *The Purchasing Power of Money*) as "Lost and Found: I Discovered the Phillips Curve – Irving Fisher." Indeed, Fisher's (1926) article, with causality running from inflation to unemployment, is closer to the

textbook Phillips curve than is A. W. H. Phillips's famous 1958 article, in which causality ran from unemployment to changes in money wages (Leeson 2000).

In Chapter 4 of *The Purchasing Power of Money*, Fisher (with Brown 1911a, pp. 59n, 60n) made only passing mention of Knut Wicksell, his great contemporary in monetary economics (whose picture appropriately appears with those of Fisher and Marshall on the cover of Laidler's *Golden Age of the Quantity Theory*, 1991), citing only Wicksell (1897), one of the articles leading to Wicksell's *Interest and Prices* (1898). Fisher (with Brown 1911a, p. 59n) remarked that "This article, while not dealing directly with credit cycles as related to panics, points out the connection between the rate of interest and bank loans and changes in the level of prices due to the resulting expansion and contraction of such loans." While correct, that footnote hardly did justice to Wicksell's analysis of how cumulative inflation or deflation could occur in a pure-credit economy due to a divergence between the natural rate of interest and the market rate of interest as innovations and other shocks change the natural rate. Fisher (1930, p. 443n) acknowledged that "Prof. Knut Wicksell was one of the first to recognize the influence of interest rates on prices. See his book, *Geldzins und Güterpreise* [1898]; Prof. Alfred Marshall, Prof. Gustav Cassel, Rt. Hon. Reginald McKenna, Chairman of the Midland Bank of London, Mr. R. G. Hawtrey, of the Treasury of Great Britain, and many other well-known economists, bankers, and business men have emphasized that business activity is influenced and may be largely controlled by manipulation of the discount rate." Fisher (1930, pp. 449–450) also stated, too optimistically as events were to show, that "At present, the Federal Reserve System exerts a normalizing influence and seems to be groping to apply the stabilizing principles which for many years have been suggested by Wicksell, Cassel, and other economists." Wicksell's brief English summary of his theory in the *Economic Journal* (Wicksell 1907) was listed in the bibliography of Fisher (1930) but not cited in the text. These passing remarks show Fisher invoking Wicksell's name in support of his approach, but not facing the crucial differences between his view of economic fluctuations and Wicksell's view: Fisher emphasized the effects of monetary shocks

(changes in the market rate of interest in Wicksell's terminology) while Wicksell emphasized real shocks (changes in the natural rate of interest), although both saw a crucial role for discount rate policy to stabilize the economy. Fisher (1896) stressed the effect of expected changes in the price level on the nominal rate of interest, while Wicksell (1897, 1898, 1907) focused on the effect on the price level of a gap between the natural and market rates of interest.

Fisher's emphasis on slow adjustment of interest rates to monetary shocks and price level changes left him vulnerable to the counter-claim by Minnie Throop England (1912) that it would be equally plausible to emphasize slow adjustment of wages or raw material prices to changes in the purchasing power of money: "Taking up [Fisher's] first statement, that interest lags behind prices in the upward movement, I hold that it may, on the contrary, take the lead," as shown by data on interest rates and commodity prices preceding five crises in Germany and six crises in England (see Dimand 1999). Fisher ingenuously sidestepped this critique in the preface to his second edition in 1913: "In particular I should have liked to modify somewhat the statement of the theory of crises in Chap. 4 and in Chapter XI to make use of the helpful criticism of Miss [*sic.*] Minnie Throop England, of the University of Nebraska, in *The Quarterly Journal of Economics*, November, 1912; also to meet a criticism of Mr. Keynes' to the effect that, while my book shows *that* changes in the quantity of money do affect the price level, it does not show *how* they do so." Concluding a one-paragraph review of the second edition (reprinted in Dimand 2007, Vol. 2, p. 139), Edwin B. Wilson of Harvard tartly remarked, "With characteristic candor Professor Fisher expresses regret that the difficulty of altering [printing] plates has prevented him from taking advantage of certain criticism of the first edition by Mrs. M. E. [*sic.*] England and Mr. Keynes. It is to be hoped that the demand for this revision will be great enough to wear out the plates and give Professor Fisher occasion to issue a third edition just to his mind."

Fisher (with Brown 1911a) recognized that transition periods could be triggered by shocks to any element of the equation of exchange, but he went on to treat such shocks as normally occurring in M or M'.

In contrast, Joseph Schumpeter's *Theory of Economic Development* ([1911] 1934), published in the autumn of the same year, argued that the clustering of innovations (changing the volume of trade *T*) is the propagating mechanism in economic fluctuations.

Having identified imperfectly anticipated changes in the purchasing power of money as the cause of economic instability, Fisher (with Brown 1911a, pp. 337–348) proceeded to try to eliminate such changes. In the context of the debates leading to the creation of the Federal Reserve System at the start of 1914 and of Fisher's call for an international conference on the rising cost of living, Fisher (with Brown 1911a and many subsequent publications) and Senator Robert Owen proposed a monetary policy rule requiring the monetary authority to peg an index of commodity prices, rather than just the dollar price of one commodity, gold. Fisher tried to disguise this "compensated dollar" plan as a version of the gold standard, by having the monetary authority peg the dollar price of gold, altering that dollar price of gold at regular intervals to offset changes in the price index. Such a fixed exchange rate, subject to regular changes, would be vulnerable to speculative attack, and defenders of the gold standard or of the gold exchange standard (whether quantity theorists such as Kemmerer or opponents of the quantity theory such as Laughlin) were not fooled into mistaking it for a slightly fine-tuned gold standard. But, leaving aside the pegged dollar price of gold, Fisher (with Brown 1911a) is noteworthy for proposing a monetary policy rule targeting the price level. Fisher (1914, p. 818) was pleasantly surprised to discover that Simon Newcomb, the dedicatee of *The Purchasing Power of Money*, had proposed a similar rule (Newcomb 1879). Fisher (with Brown 1911a) went on to consider the merits and demerits of various price index formulae, including the one that he adopted eleven years later as the ideal index (Fisher 1922). As with his other reform schemes, Fisher remained mildly perplexed that the world did not let him reform it even when he explained clearly and firmly why his plan would be desirable.

Recent literature on the origins of the Federal Reserve System largely ignores Fisher's 1911 proposal of a price level rule and does not mention that Senator Owen managed to insert such a mandate to target the price level in the Senate version of the Owen–Glass Bill that became the Federal Reserve Act, only to have Representative Carter

Glass persuade the House of Representatives to strike it out (see Owen 1919; Fisher 1934). R. H. Timberlake (1993, p. 407) firmly declares that "The first comprehensive proposal for a stable price level policy was made by Irving Fisher in his book *Stabilizing the Dollar*, published in 1920," and Alan Meltzer (2003), who pays careful attention to discussions in the 1920s about Fisher's compensated dollar plan, also insists that it originated in Fisher (1920), seven years after the passage of the Federal Reserve Act. But *Stabilizing the Dollar* (1920) was only Fisher's first complete book on his plan, which had already been the subject of the concluding chapter of *The Purchasing Power of Money* (1911a) and of many journal articles (one reprinted from the March 1913 *American Economic Review Supplement* as an appendix to the 1913s edition, pp. 494–502). Similarly, although the economic ideas of Carter Glass have often been minutely examined, Senator Robert L. Owen has largely vanished from the history of the creation of the Federal Reserve apart from the name of the Owen–Glass (or Glass-Owen) Bill.

Fisher's Contribution to Monetary Economics

Irving Fisher extended Simon Newcomb's equation of exchange to allow currency and bank deposits to have different velocities, and, building on empirical work by David Kinley and Edwin Kemmerer, worked to make the quantity theory operational, with independent estimates of velocities. He followed *The Purchasing Power of Money* with annual *American Economic Review* articles on changes in the elements of the equation of exchange each year from 1911 to 1919, beginning with Fisher (1911b). But he did far more than that. In *The Purchasing Power of Money*, Fisher (assisted by Harry Gunnison Brown) advanced a monetary theory of economic fluctuations due to slow adjustment of the money rate of interest, leading on fifteen years later to his empirical article that was rediscovered and republished in 1973 as "Lost and Found: I Discovered the Phillips Curve" (Fisher 1926). To stabilize an economy subject to the real effects of monetary instability, Fisher (with Brown 1911a, 1920) proposed to a new monetary policy rule, the "compensated dollar" plan to target the purchasing power of money (the inverse of the price level), rather than

pegging the dollar price of just one commodity, gold—but he undermined his proposal by trying to disguise it as a form of the gold standard (and did not even mention the quantity of money in the plan). He proposed to target the price level indirectly by keeping the dollar convertible into gold on demand but varying the dollar price of gold at fixed intervals in response to observed changes in the price level, a scheme vulnerable to speculative attacks. When Fisher (1935) finally proposed a monetary policy rule to stabilize the price level by varying the quantity of money through open market operations, with a flexible exchange rate, a quarter of a century after his first statement of the compensated dollar plan, he had lost the attention of his audience. To make his price level rule operational, Fisher needed to select a suitable formula for calculating the price index, and it was in 1911 that he first considered the formula, now known as the Fisher ideal index, that Fisher, in *The Making of Index Numbers* (1922), later adopted as the best index number for all purposes. Characteristically, he put his ideal index into practice with a weekly price index produced by an Index Number Institute located in Fisher's house and with an annual *Journal of the American Statistical Association* article on the year's index numbers, each year from 1923 to 1930 (except in 1929, when he was otherwise occupied). Fisher's extension of the equation of exchange, to allow for bank deposits to have a different velocity of circulation from that of currency, made it more suitable for an economy in which a smaller share of transactions was made in cash. The Fisher ideal index only became widely used in the 1990s. Though Fisher and Senator Robert Owen were unable to mandate price level stabilization as a goal in the Federal Reserve Act of 1913, targeting the price level (or, rather, its rate of change, inflation) is now widespread. Together with the Fisher relation between expected inflation and the nominal interest rate (propounded in Fisher [1896], reiterated in Fisher [1907] and Fisher with Brown 1911a) and the Fisher diagram for intertemporal consumption smoothing (Fisher [1907, p. 409], including the Fisher separation theorem between the time pattern of income and the time pattern of consumption, given perfect credit markets), the contributions of *The Purchasing Power of Money* became crucial building blocks of modern macroeconomics, decades after Fisher's public reputation was devastated by his disastrous optimism about the stock market in October 1929.

References

André-Aigret, C., and Dimand, R. 2018. Populism versus Economic Expertise: J. Laurence Laughlin Debates William (Coin) Harvey. *Forum for Social Economics* 47: 164–172.

Blaug, M., Eltis, W., O'Brien, D., Patinkin, D., Skidelsky, R., and Wood, G. 1995. *Quantity Theory of Money from Locke to Keynes and Friedman*. Aldershot and Brookfield, VT: Edward Elgar.

Brown, H.G. 1909. A Problem in Deferred Payments and the Tabular Standard. *Quarterly Journal of Economics* 23 (August): 714–718.

Brown, H.G. 1910a. Commercial Banking and the Rate of Interest. *Quarterly Journal of Economics* 24 (August): 743–749.

Brown, H.G. 1910b. Typical Commercial Crises Versus a Money Panic. *Yale Review* 19 (August): 168–176.

Clark, J.B. 1895. The Gold Standard of Currency in Light of Recent Theory. *Political Science Quarterly* 10: 389–403.

Cot, A.L. 2005. 'Breed Out the Unfit and Breed in the Fit': Irving Fisher, Economics and the Science of Heredity. *American Journal of Economics and Sociology* 64 (3): 793–826.

De Haas, J. 1889. A Third Element in the Rate of Interest. *Journal of the Royal Statistical Society* (Series A) 52: 99–116.

De Long, J.B. 2000. The Triumph of Monetarism? *Journal of Economic Perspectives* 14 (Winter): 83–94.

Dimand, R. 2005. Economists and the Shadow of 'The Other' Before 1914. *American Journal of Economics and Sociology* 64 (3): 827–850.

Dimand, R.W. 1995. Irving Fisher, J. M. Keynes, and the Transition to Modern Macroeconomics. In *New Perspectives on Keynes,* ed. A. F. Cottrell and M. S. Lawlor. Annual Supplement *to History of Political Economy* 27: 247–266.

Dimand, R.W. 1999. Minnie Throop England on Crises and Cycles: A Neglected Early Economist. *Feminist Economics* 5 (3)(November): 107–126.

Dimand, R.W. (ed.) 2007. *Irving Fisher: Critical Responses*, 3 vols. London and New York: Routledge.

Donnan, E. 1952. A Nineteenth Century Cause Célèbre. *New England Quarterly* 25 (March): 23–46.

Dorfman, J. 1949. *The Economic Mind in American Civilization*, Volume 3: *1865–1918*. New York: Viking.

Douglass, W. [1740] 1897. A Discussion Concerning the Currencies of the British Plantations in America. In *Publications of the American Economic Association,* ed. C.J. Bullock, Second Series (Economic Studies), vol. II, no. 5, pp. 1–228; reprinted in A. M. Davis, ed., *Colonial Currency Reprints 1682–1751*, vol. 3. New York: A. M. Kelley.

Edgeworth, F.Y. 1887. Memorandum by the Secretary, Attendant to Report on Variations in the Value of the Monetary Standard. *Report of the British Association for the Advancement of Science*, pp. 254–301; reprinted in A. F. Darnell, ed., *Early Mathematical Economics: Journal Articles and Pamphlets from 1800–1900*. London: Pickering & Chatto, 1991.

England, M.T. 1912. Fisher's Theory of Crises: A Criticism, *Quarterly Journal of Economics* 27 (November), pp. 95–106; reprinted in Dimand (2007), Vol. II.

Fisher, I. 1894. The Mechanics of Bimetallism. *Economic Journal* 4 (September): 341–355; reprinted in Fisher (1997), Vol. 1.

Fisher, I. 1896. *Appreciation and Interest*. New York: Macmillan for the American Economic Association; also as *Publications of the American Economic Association*, First Series, Vol. XI, No. 4, pp. 1–110; reprinted in Fisher (1997), Vol. 1.

Fisher, I. 1897. The Role of Capital in Economic Theory. *Economic Journal* 7 (December): 511–537; reprinted in Fisher (1997), Vol. 1.

Fisher, I. 1906. *The Nature of Capital and Income*. New York: Macmillan; reprinted in Fisher (1997), Vol. 2.

Fisher, I. 1907. *The Rate of Interest*. New York: Macmillan; reprinted in Fisher (1997), Vol. 3.

Fisher, I. assisted by H.G. Brown. 1911a. *The Purchasing Power of Money*. New York: Macmillan (2nd ed., 1913); reprinted in Fisher (1997), Vol. 4.

Fisher, I. 1911b. Recent Changes in Price Levels and Their Causes. *American Economic Review: Supplement* 1 (April): 37–45.

Fisher, I. 1914. Objections to a Compensated Dollar Answered. *American Economic Review* 4 (December): 818–839; reprinted in Fisher (1997), Vol. 4.

Fisher, I. 1920. *Stabilizing the Dollar*. New York: Macmillan; reprinted in Fisher (1997), Vol. 6.

Fisher, I. 1922. *The Making of Index Numbers*. Boston: Houghton Mifflin, 3rd ed., 1927; reprinted in Fisher (1997), Vol. 7.

Fisher, I. 1923. The Business Cycle Largely a "Dance of the Dollar". *Journal of the American Statistical Association* 18 (December): 1024–1028; reprinted in Fisher (1997), Vol. 8.

Fisher, I. 1925. Our Unstable Dollar and the So-called Business Cycle. *Journal of the American Statistical Association* 20 (June): 179–202; reprinted in Fisher (1997), Vol. 8.

Fisher, I. 1926. A Statistical Relationship Between Unemployment and Price Level Changes. *International Labour Review* 13 (June): 785–792; reprinted in Fisher (1997), Vol. 8, and as 'Lost and Found: I Discovered the Phillips Curve—Irving Fisher'. *Journal of Political Economy* 82 (1973): 496–502.

Fisher, I. 1930. *The Theory of Interest*. New York: Macmillan; reprinted in Fisher (1997), Vol. 9.

Fisher, I., assisted by H.L. Cohrssen. 1934. *Stable Money: A History of the Movement*. New York: Adelphi.

Fisher, I. 1935. *100% Money*. New York: Adelphi; 2nd ed. (1945); reprinted in Fisher (1997), Vol. 11.

Fisher, I. 1997. *The Works of Irving Fisher*, 14 volumes, ed. W.J. Barber assisted by R.W. Dimand and K. Foster, consulting ed. J. Tobin. London: Pickering & Chatto.

Friedman, M. 1972. Have Monetary Policies Failed? *American Economic Review: AEA Papers and Proceedings* 62 (May): 10–18.

Friedman, M. 1992. *Money Mischief: Episodes in Monetary History*. New York: Harcourt Brace Jovanovich.

Gomez Betancourt, R. 2010. E. W. Kemmerer's Contribution to the Quantity Theory of Money. *European Journal of the History of Economic Thought* 17 (February): 115–140.

Hardy, S. McL. 1895. The Quantity Theory of Money and Prices, 1860–1891: An Inductive Study. *Journal of Political Economy* 3 (March): 145–168.

Harvey, W.H. [1894] 1963. *Coin's Financial School*; reprinted with introduction by R. Hofstadter. Cambridge, MA: Harvard University Press.

Harvey, W.H. 1895. *The Crime of 1873 and the Harvey-Laughlin Debate*. Chicago: Coin Publishing Company.

Hoffman, F.L. 1896. Race Traits and Tendencies of the American Negro. *Publications of the American Economic Association*, First Series, 11 (1–3): 1–330.

Humphrey, T.M. 1984. Algebraic quantity equations before Fisher and Pigou. *Federal Reserve Bank of Richmond Economic Review* 70 (September/October); reprinted in T. M. Humphrey, *Essays on Inflation*, 5th edition, Richmond, VA: Federal Reserve Bank of Richmond, 1986.

Kemmerer, E.W. 1907. *Money and Credit Instruments in their Relation to General Prices*. New York: Henry Holt and Co.; reprinted New York and London: Garland Publishing, 1983.

Keynes, J.M. 1911. Review of *The Purchasing Power of Money* by I. Fisher, *Economic Journal* 21 (September): 393–398; reprinted in Dimand (2007), Vol. II.

Keynes, J.M. 1923. *A Tract on Monetary Reform*. London: Macmillan.

Keynes, J.M. 1936. *The General Theory of Employment. Interest and Money*. London: Macmillan.

Kinley, D. 1904. *Money: A Study of the Theory of the Medium of Exchange*. New York: Macmillan.

Kinley, D. 1910. *The Use of Credit Instruments in Payments in the United States*. Washington, DC: National Monetary Commission, 61st Congress, 2nd session, Document No. 399.

Kinley, D. 1913. Objections to a Monetary Standard Based on Index Numbers. *American Economic Review: Supplement* 3 (March): 1–19; reprinted in Dimand (2007), Vol. II.

Laidler, D. 1991. *The Golden Age of the Quantity Theory*. London: Philip Allan, and Princeton, NJ: Princeton University Press.

Laughlin, J.L. 1895. *Facts about Money*. Chicago: E. A. Weeks.

Laughlin, J.L. 1911. Causes of the Change in Prices since 1896. *American Economic Review: Supplement* 1 (April): 26–36 (followed by Fisher (1911b), pp. 37–46, and by Fisher, Kemmerer, Laughlin and others, 'Money and Prices: Discussion,' pp. 46–70).

Leeson, R. ed. 2000. *A. W. H. Phillips: Collected Works in Contemporary Perspective*. Cambridge, UK: Cambridge University Press.

Marget, A.W. 1931. Léon Walras and the "Cash-Balance Approach" to the Problem of the Value of Money. *Journal of Political Economy* 39 (October): 569–600.

Marshall, A. 1920. *Principles of Economics*, 8th ed. London: Macmillan.

Marshall, A. 1926. *Official Papers*, ed. J.M. Keynes. London: Macmillan.

Meltzer, A.H. 2003. *A History of the Federal Reserve*, Vol. 1: *1913–1951*. Chicago: University of Chicago Press.

Mitchell, W.C. 1896. The Quantity Theory of the Value of Money. *Journal of Political Economy* 4 (March): 139–165.

Newcomb, S. 1879. The Standard of Value. *North American Review* 124: 234–237.

Newcomb, S. 1885. *Principles of Political Economy*. New York: Harper; reprinted New York: A. M. Kelley.

Norton, J.P. 1902. *Statistical Studies in the New York Money Market*. New York: Macmillan.

Owen, R.L. 1919. *The Federal Reserve Act*. New York: The Century Company.

Patinkin, D. 1965. *Money, Interest, and Prices*, 2nd ed. New York: Harper & Row.

Pigou, A.C. 1917. The Value of Money. *Quarterly Journal of Economics* 32 (November): 38–65; reprinted in F.A. Lutz and L.W. Mints, eds. (for the American Economic Association), *Readings in Monetary Theory*, Philadelphia: Blakiston, 1951.

[Phillips, J.P.] 1878. *Fundamental Principles: The Currency Question in a Nutshell*. New Haven, CT: Glebe Building.

Phillips, J.P. 1879. *A Primer of Political Economy*. New Haven, CT: Kirschener & Guldener.

Phillips, J.P. 1888. *Social Struggles: The Fundamental Facts and Principles Relative to Values, Prices, Money and Interest; National Banks, Franchises, the Silver Question, Socialism, Capital and Labor; and Business Derangement*. New Haven, CT: Tuttle, Morehouse & Taylor.

Phillips, J.P. 1896. *Value and the Money Question*. New Haven, CT: author.

Ryan, C.K. 1987. *Harry Gunnison Brown, Economist*. Boulder, CO: Westview Press.

Schumpeter, J.A. [1911] 1934. *The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest, and the Business Cycle*, trans. R. Opie. Cambridge, MA: Harvard University Press.

Schumpeter, J.A. 1948. Irving Fisher's Econometrics. *Econometrica* 16 (July): 219–231; as reprinted in J.A. Schumpeter, *Ten Great Economists*, New York: Oxford University Press, 1965.

Skaggs, N.T. 1995. The Methodological Roots of J. L. Laughlin's Anti-Quantity Theory of Money and Prices. *Journal of the History of Economic Thought* 1 (Spring): 1–20.

Timberlake, R. 1993. *Monetary Policy in the United States: An Intellectual and Institutional History*. Chicago: University of Chicago Press.

Walker, F.A. 1895. The Quantity Theory of Money. *Quarterly Journal of Economics* 9: 372–379.

Walker, F.A. 1896. *International Bimetallism*. New York: Holt.

Wicksell, K. 1897. Der Bankzins als Regulator der Warenpreise. *Jahrbücher für Nationalökonoie* 68: 228–243.

Wicksell, K. 1898. *Geldzins und Güterpreise*, Jena: Gustav Fischer; trans. as *Interest and Prices*, trans. R.F. Kahn with introduction by B. Ohlin. London: Macmillan, 1936.

Wicksell, K. 1907. The Influence of the Rate of Interest on Prices. *Economic Journal* 17: 213–220.

Willis, H.P. 1896. Credit Devices and the Quantity Theory. *Journal of Political Economy* 4 (June): 281–308.

4

The Fisher Diagram and the Neoclassical Theory of Interest and Capital

Introduction: Impatience and Opportunity to Invest

Irving Fisher's *The Rate of Interest* (1907) is a classic work of Twentieth-Century economics. Together with its later revised version, *The Theory of Interest* (1930), it articulated the neoclassical theory of interest and capital, drawing together earlier strands of argument in a presentation that provided one of the most influential diagrams in economics, the "Fisher diagram" showing the allocation of consumption across two periods. Donald Dewey (1965, p. v) prefaced an introduction to neoclassical capital theory with the statement that "there is no finer individual achievement in modern economics than Fisher's exposition of capital theory…. In all important respects, modern capital theory is Fisher's capital theory, which is right and proper." Ironically, Fisher's critique of Boehm-Bawerk's concept of an average period of production was a precursor of the reswitching of techniques, which was to figure in later Cambridge critiques of neoclassical capital theory (Velupillai 1975). *The Rate of Interest* also recapitulated Fisher's

R. W. Dimand, *Irving Fisher*, Great Thinkers in Economics,
https://doi.org/10.1007/978-3-030-05177-8_4

treatment of the real and nominal interest rate from his American Economic Association monograph, *Appreciation and Interest* (1896), the relationship famous as "the Fisher relation" (see Dimand 1999) and added further empirical evidence on the relationship.

The Rate of Interest (1907) and its companion volume, *The Nature of Capital and Income* (1906a), appeared in the middle of Fisher's life: he turned forty in 1907, and died at the age of eighty in 1947. These works on capital and interest marked his return to scholarly activity after a successful struggle with tuberculosis (see Allen 1993). Tuberculosis had killed Fisher's father, and Fisher's doctors had not expected him to survive. From 1898 to 1901, Fisher was on leave from Yale University, recovering in Colorado, and for another two years he taught only part-time. For five years, he published no economics articles, though he was usually such a prolific author that the bibliography compiled by his son exceeds six hundred pages (Fisher 1961–1972). His work on capital and interest suffered another setback: "One day in 1905 when he was making a call from a telephone booth in Grand Central Station, he put his brief case down between his legs while talking on the telephone, leaving the door of the booth open. While he was standing thus, facing the inside of the booth, absorbed in talking on the telephone, someone stole the brief case as he concentrated on his telephone conversation. The brief case contained the only copy of the full manuscript of his book, *The Nature of Capital and Income*, nearly ready to go to press. It took him nearly a year to rewrite the manuscript" (Allen 1993, p. 93).

Fisher persevered with his project, and produced two books that established him as an outstanding theorist of capital and interest. (He also took to closing the doors of telephone booths.) *Moody's Magazine*, in a January 1908 editorial quoted by Fisher's publisher in their advertising, held that *The Rate of Interest* "contains some conclusions of great value to financiers, bankers, underwriters, etc.—knowledge that puts millions of dollars in the pockets of some who possessed it and the lack of which costs others (bond houses,[1] for instance) more millions. It may be said, in passing, that this recent book is easily not only the most

[1]Investment banks specialized in underwriting and trading bonds.

complete but the most valuable treatise in the English language on the very important, but little understood, subject of interest rates. In fact it is, perhaps, both the latest and most scientific discussion of the subject in any language."

The nature of the theory presented in Fisher's *The Rate of Interest* is made clear by the full title of his 1930 reworking of the book, *The Theory of Interest as Determined by Impatience to Spend Income and Opportunity to Invest It*. Fisher (1907, pp. 6–7) rejected "the supply and demand of loanable money" as an adequate explanation of what determines the rate of interest: "It was once wittily remarked of the early writers on economic problems, 'Catch a parrot and teach him to say 'Supply and demand,' and you have an excellent economist.'… The real problem is what causes make the demand for loans, and what causes make the supply?" Underlying the demand for loans and the supply of loanable funds, Fisher perceived two fundamental causes: the opportunity to invest income that is not spent (the expected rate of return over cost on investment) and the impatience to spend income (the marginal rate of time preference). Other economists, as Fisher noted, had identified these causes: the eminent Austrian academic and Finance Minister Eugen von Böhm-Bawerk, the Scottish-Canadian outsider John Rae (whose memory Fisher helped rescue from obscurity), and, although Fisher did not fully appreciate it, the eighteenth-century French statesman Anne Robert Jacques Turgot. Fisher synthesized these ideas in a distinctive way, introduced indifference curve analysis to the problem, explored the implications of his synthesis, and produced a remarkable diagram that drew the two underlying causes together and shaped the trained intuition of the economics profession.

Fisher chose to adopt "impatience" as a more popular term than time preference. To his surprise, his coining of a new name for one factor in his theory led some critics, notably Henry Seager (1912), to label Fisher's approach "the impatience theory of interest," as though it emphasized only time preference, to the neglect of the productivity of capital, in supposed contrast to Böhm-Bawerk's theory, which depended on both. While Böhm-Bawerkian critics such as Seager criticized Fisher for concentrating excessively on impatience, other critics such as Frank A. Fetter of Cornell University chastised Fisher for not accepting time

preference as the exclusive explanation of interest. Fetter (1977) criticized both Böhm-Bawerk and Fisher for deviating from Carl Menger's Austrian subjective economics by invoking the technical productivity of capital. Fisher responded to this misunderstanding (Fisher 1913) and tried to forestall it in the revision of his work by putting both impatience and opportunity to invest in the subtitle of *The Theory of Interest* (1930). Although the 1930 work carried a clearer subtitle, Dewey (1965, pp. 11–12) is right that "For Fisher on Interest, the economist should go back to the earlier books" because since "Fisher undertook the revision mainly to gain a wider audience for his ideas, [*The Theory of Interest*] excluded much and added little" (cf. Dewey 1982). *The Nature of Capital and Income* was reduced to a single chapter in the revision, and, although several related diagrams appear in Chapters X and XI of *The Theory of Interest*, even what is now famous as the Fisher diagram was dropped. A reader already familiar with the diagram could discern its substance in the 1930 diagrams, but the powerful clarity of the 1907 presentation was gone.

The Fisher Diagram

The celebrated Fisher diagram appears on page 409 of *The Rate of Interest*, as part of his "second approximation" to the theory of interest in which income is variable across periods (unlike the first approximation) but not uncertain (unlike the sketchy third approximation). For the case of two periods, Fisher drew the opportunity curve WZ, showing the attainable combinations of first-period income and second-period income, what in latter adaptations of the diagram would be called the transformation curve or production possibility frontier. (Pareto had used transformation curves in 1906 but given that Pareto's book was published in Italian and just the year before Fisher, Fisher may well have invented the curve independently.) An interest line AB with a slope of $-(1 + i)$ is tangent to the opportunity curve WZ, at point P, where the present discounted value of income, calculated at the market interest rate i is maximized. Assuming that credit markets are perfect, the consumer can borrow or lend at the same interest rate, i, and so

can afford to consume at any point along the line AB. Convex iso-desirability curves (the indifference curves that Fisher had introduced into American economics in his 1891 doctoral dissertation, although Edgeworth had used them ten years before) each represents a certain level of satisfaction, with higher curves representing greater satisfaction, but the numbers associated with these indifference curves indicate only an ordinal ranking. The most desirable of the attainable points is point Q, where an indifference curve is tangent to line AB (the budget constraint). The gain from being able to save, earning interest on the savings, is shown by point Q lying on a higher indifference curve than point S, the tangency of the production possibility frontier to an indifference curve.

Figure 4.1 is an integral part of the trained intuition of all economists. As Warren Young (1987) said of Sir John Hicks's IS-LM diagram, Fisher "did a Marshall." Like Hicks's IS-LM diagram, the

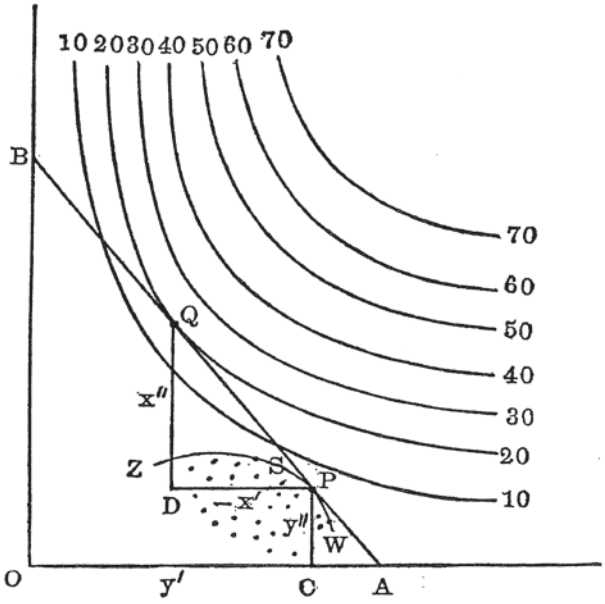


Fig. 4.1 The Fisher diagram, from Irving Fisher, *The Rate of Interest* [1907, p. 409, Figure 29]

Edgeworth-Bowley box, and Alfred Marshall's scissors of supply and demand, Fisher's two-period consumption diagram pulls together a body of analysis in a memorable, teachable, and convenient manner. As Thomas Humphrey (1988, p. 4) notes, "Irving Fisher in his 1907 classic *The Rate of Interest* was the first to combine indifference and transformation curves together with market price lines in a single diagram and to use it to illustrate the gains from exchange." Time preference (impatience) is shown by the curvature of the indifference curves, whose slope at any point is the (diminishing) marginal rate of substitution between present and future consumption. Opportunity to invest is indicated by the slope of the budget constraint AB, which shows the rate at which the individual can transform present income into future income by lending at interest (a straight line, because each individual takes the interest rate as given) or conversely transform expected future income into present income by borrowing at interest.

Fisher diagram showed, given production possibilities and the indifference maps of individuals, how much each individual would wish to borrow or lend at a particular interest rate. Adding up across individuals would then yield the supply of and demand for loanable funds at different interest rates, with supply and demand balancing at the market equilibrium rate of interest. With the assumption of a perfect credit market, Fisher diagram showed the present discounted value of expected lifetime disposable income as the relevant budget constraint for consumption decisions, an idea underlying the leading modern theories of consumption: the permanent income hypothesis of the consumption function, cited in the award of the Nobel Memorial Prize in Economic Science to Milton Friedman, and the life-cycle theory of consumption, cited in the award of the Nobel Prize to Franco Modigliani. If credit markets are imperfect, however, so that the individual pays a higher interest rate when borrowing than he or she would receive on savings, the budget line would be kinked. For liquidity-constrained consumers whose highest attainable indifference curve touched the kink of the budget line, each period's consumption would be determined by that period's disposable income (as in the simple Keynesian consumption function).

With a commodity instead of a time-period on each axis, the Fisher diagram of 1907 is the origin of Jan Tinbergen's 1945 diagram that Robert Baldwin termed "the sacred diagram of the international trade economist" (quoted by Humphrey 1988, p. 3). In that version, a country maximizes its national product valued at world prices by choosing the output mix that lies at the tangency of its production possibility curve and a world price line, and then trades along the world price line to the point of tangency between that line and one of the country's taste indifference curves. Thomas Humphrey (1988) traces the fascinating development of the diagram from Fisher in 1907, through its first extension to international trade by Enrico Barone in a footnote in 1908, to Tinbergen and subsequent applications of the diagram in international trade theory (see also Peter Lloyd on the trade theory diagram and Humphrey on the Fisher diagram, both in Blaug and Lloyd, eds. [2010, pp. 311–316, 421–425]).

The Fisher Equation

The empirical literature of monetary economics is replete with statements such as: "The Fisher hypothesis represents one of the oldest and most basic relationships in financial economics…. The Fisher equation encapsulates the simple relationship hypothesized to exist between nominal interest rates and expected inflation first delineated by Irving Fisher (1930), whose name has been associated with the equation ever since" (Crowder 1997, pp. 1124, 1127). Fisher's name is justly associated with the equation, usually expressed in continuous time as $i = r + \pi$ where i stands for the nominal interest rate, r for the real interest rate, and π for the expected rate of inflation, although Fisher originally wrote the discrete-time version of the relation. However, Fisher's contribution on this topic appeared well before 1930, in his 1896 American Economic Association monograph, *Appreciation and Interest*, and the celebrated equation does not appear in *The Theory of Interest*, where the treatment of the relation in Chapters II and XIX is verbal, supplemented with diagrams but no equation. Furthermore, the quoted statement (like many

similar remarks in the empirical literature) credits him with one of the few innovations in the area for which he does not deserve (and emphatically disclaimed) credit (see Dimand 1999; Dimand and Gomez Betancourt 2012).

As Fisher (1907, p. 387), "The major part of the material contained in this monograph [Fisher 1896] is reproduced in Chapters V, XIV, and this Appendix" of *The Rate of Interest*. Fisher (1896; 1907, pp. 356–358) drew attention to statements by William Douglass in 1740 and by John Stuart Mill, Jacob de Haas (1889), John Bates Clark (1895), and Alfred Marshall, among others, about how expected inflation affects the nominal interest rate (cf. Humphrey 1983). Fisher was the first to write down the equation, not the first to articulate the relation. He pioneered empirical testing of the relation and provided a more general statement involving multiple own-rates of interest expressed in different commodities. It is sometimes forgotten that Fisher believed that the proposition that real interest was unaffected by inflation held true only in the long run. Indeed, Fisher's theory of the "so-called business cycle" as "a dance of the dollar" depended on the incomplete short-run adjustment of the nominal interest rate to inflation (see Dimand 1993). In the long run, Fisher's explanation of real interest depended only on real factors of time preference and productivity (in contrast to Keynes's later monetary theory of the interest rate), but in the short run, monetary shocks drove economic fluctuations by altering real interest, as the nominal interest rate adjusted slowly.

Fisher (1907, pp. 285–287) held that "periods of speculation are the result of *inequality* of foresight… It… happens that when prices are rising, borrowers are more apt to see it than lenders. *Inequality* of foresight produces overinvestment during rising prices and relative stagnation during falling prices" (Fisher's italics) and quoted Marshall's statement that "When we come to discuss the causes of alternating periods of inflation and depression of commercial activity, we shall find that they are intimately connected with those variations in the real rate of interest which are caused by changes in the purchasing power of money." In *The Rate of Interest*, Fisher relied on tables and diagrams to present his empirical evidence. In later work,

Fisher (1930, pp. 407–438; cf. articles in Fisher 1997, Vol. 8) represented the lagged adjustment of expected inflation by correlating the nominal interest rate with a distributed lag of price level changes (a precursor of adaptive expectations, but with arithmetically rather than geometrically declining lag weights), having invented distributed lags for the purpose. Appropriately, he became the founding president of the Econometric Society in the year that *The Theory of Interest* was published.

While Marshall referred to real and nominal interest rates, Fisher (1896, 1907, 1930) provided a more general treatment relating interest rates expressed in any standards whose relative value might be expected to change. Only if relative prices were unchanging would these own-rates coincide. Letting i stand for the rate of interest in gold and j for the rate of interest in wheat, and assuming that the amount of gold that buys one bushel of wheat at the beginning of the year is expected to trade for $1 + a$ bushels at the end of the year, Fisher (1907, pp. 358–359) gave the result that

$$1 + j = (1 + a)(1 + i)$$

$$\text{or} \quad j = i + a + ia$$

"or in words: *The rate of interest in the relatively depreciating standards is equal to the sum of three terms,* viz. *the rate of interest in the appreciating standard, the rate of appreciation itself, and the product of these two elements*" (Fisher's emphasis). Fisher (1907, 264n) acknowledged in a footnote that $j = i + a$ applies in continuous time and is a tolerable approximation in discrete time.

Chapter VIII, "Gold and paper," of *Appreciation and Interest* (1896; 1907, Chapter XIV, Sections 2 and 3) applied uncovered interest parity to interest rates in inconvertible US paper currency and in US gold coin in the post-Civil War era, investigating how well the gold premium forecast price changes, while Chapter IX, "Gold and silver" (1896; 1907, Chapter XIV, Section 4), explicitly applied uncovered interest parity internationally to bonds in Indian rupees (on a silver standard) and in pounds sterling (on the gold standard). Only

with Chapter X, "Money and commodities" (1896; 1907, Chapter XIV, Sections 5, 6, and 7), did Fisher turn to money interest, "virtual interest" (real interest, measured in commodities as a whole), and the expected appreciation of the purchasing power of money (appreciation rather than depreciation, because 1896 was at the end of more than twenty years of declining prices). Fisher (1896, p. 91) also briefly explained the term structure of interest rates by the expected appreciation of the purchasing power of money over different periods. He thus pioneered empirical testing of the Fisher equation, uncovered interest parity, and the expectational theory of the term structure of interest rates but made clear that he was not the first economist to suggest that expected inflation affects the nominal interest rate, nor did he believe that, in the short run, the real interest rate would be unaffected by inflation.

Sir Ralph Hawtrey, in a 1961 foreword to a reprint of his *Good and Bad Trade* (1913, p. vii), recalled that in 1909 his reading of the 1886 Report of the Royal Commission on the Depression of Trade led him to the reflection that "A falling price level makes a given market rate of interest more onerous, and a rising price level less so. Here, I thought, was a discovery, but I was disillusioned when I learnt from an economist friend that the principle was one already recognized, and had been expounded in Irving Fisher's work, *The Rate of Interest*. But I was not discouraged, for at any rate its application to the explanation of the trade cycle would be new." Hawtrey evidently had missed the later sections of Chapter IV of *The Rate of Interest* (notably Section 12, "Application of theory to 'credit cycles'"), so he was not discouraged from embarking on a long and fruitful life in economics. One can only speculate as to the identity of Hawtrey's unnamed economist friend. Hawtrey had been a wrangler at Cambridge (that is, had achieved a first on the Mathematics Tripos), rather than taking the Economics Tripos, but was close to a younger contemporary at Cambridge, his fellow Apostle and wrangler John Maynard Keynes.

Sources: Rae, Turgot, Böhm-Bawerk, and Landry

a. John Rae

Fisher dedicated *The Rate of Interest* "To the Memory of John Rae Who Laid the Foundations Upon Which I Have Endeavored to Build" and later wrote that "Every essential part of [Fisher's theory of interest] was at least foreshadowed by John Rae in 1834" (Fisher 1930, p. ix). Fisher thus paid homage to an extraordinary figure. John Rae (1796–1872), previously a medical student in Scotland, was a village schoolmaster in Hamilton, Upper Canada (what is now Ontario), when his *Statement of Some New Principles on the Subject of Political Economy Exposing the Fallacies of Free Trade and Some Other Doctrines Maintained in the "Wealth of Nations"* was published in Boston in 1834. Rae was later a doctor in Central America, a teacher in California during the Gold Rush, and a teacher, medical officer, and district judge in the Kingdom of Hawaii, but died on Staten Island in 1872 (see James 1965, Vol. 1). Rae was forgotten by the economics profession, which confused him with two other authors of the same name (one a biographer of Adam Smith), until his work was rediscovered by a Harvard graduate student, Charles Whitney Mixter (1897), at the suggestion of Frank Taussig. Fisher (1897) published an unsigned note in the *Yale Review* (of which he was an editor) drawing attention to Mixter's discovery, and favorably reviewed *The Sociological Theory of Capital*, Mixter's reorganized and reordered edition of Rae's *New Principles* (Rae 1905; Fisher 1905b). Fisher's support of the rediscovery of Rae was in keeping with his attitude at the same toward the neglected French mathematical economist Antoine Augustin Cournot, whose great work of 1838 was translated into English in 1897 by Fisher's wife's brother-in-law Nathaniel Bacon, with introduction, notes and bibliography by Fisher, followed by a journal article by Fisher on Cournot (Cournot [1838] 1897; Fisher 1898). Walras (1892) also appeared "Translated under the supervision of Irving Fisher", even before the publication of Fisher's dissertation, as Fisher

worked in the 1890s to broaden the canon of economic theory known to American readers. Such careful attention to Rae, Cournot, Walras, and other predecessors made amends for the unnecessary originality of Fisher's 1891 dissertation, in which he independently reinvented general equilibrium analysis before reading Walras and Edgeworth (Dorfman 1995; Brainard and Scarf 2005; Dimand and Ben-El-Mechaiekh 2012).

Rae (1834, p. 100) ranked instruments (capital goods) as "part of a series, of which the orders are determined by the period of time at which instruments placed in them, issue, or would issue, if not before exhausted, in events equivalent to double the labor expended in forming them." This period would be n in the expression $(1 + r)^n = 2$, where r is Fisher's rate of return over costs (the internal rate of return or marginal efficiency of capital), with a decrease in n being equivalent to an increase in r. Instruments with a shorter period of producing double their cost (equivalently, with a higher internal rate of return) belong to the more quickly returning orders, in Rae's terminology.

Rae (1834, p. 119) also held that "Measured by the length of the period, to which the inclinations of its [society's] members to a yield up a present good, for the purpose of producing the double of it at the expiration of that period, will extend…. [T]he determination to sacrifice a certain amount of present good, to obtain another greater amount, at some future period, may be termed the *effective desire of accumulation*." That is, effective desire of accumulation is m in the expression $(1 + s)^m = 2$, where s is the rate of time preference, so that a higher effective desire of accumulation is equivalent to a lower rate of time preference. The stock of instruments (capital goods) will be increased as long as the effective desire of accumulation, m, exceeds n, the order of the available instruments (that is, as long as the rate of return over costs on investment exceeds the rate of time preference). Rae criticized Adam Smith and his followers for their emphasis on the role of thrift in capital accumulation, to the neglect of the role of invention in increasing the capital stock by reducing n, creating more quickly returning instruments (creating investment opportunities, raising the rate of return over costs). Rae stressed improvements in investment opportunities, rather than changes in savings propensities, as the driving force in economic growth and the expansion of the capital stock

(see Dimand 1998a). Although Fisher (1930, p. 345 n31) agreed that "The economic effects of invention, and particularly its effects upon the rate of interest, were well treated by John Rae," he placed less stress on invention than Rae had (even though he devoted Chapter X of *The Rate of Interest* to the effects of invention). Apart from that difference of emphasis, Rae's account of the order of instruments and effective desire of accumulation strikingly prefigures Fisher on investment opportunity (expected rate of return over costs) and impatience (time preference). Unlike Fisher, Rae discussed investment opportunity within a labor theory of value.

Fisher followed Rae in his treatment of social and cultural influences on provision for the future, using several of Rae's examples. As Mark Aldrich (1975) has documented, Fisher, like other writers of his time, indulged in disparaging, prejudiced comments about groups culturally or ethnically alien to him (see also Dimand 2005). In *The Rate of Interest*, Fisher (1907, pp. 291–292) wrote that "The communities and nationalities which are most noted for the qualities mentioned above—foresight, self-control, and regard for posterity—are probably Holland, Scotland, England, France, and the Jews, and among these peoples interest has been low… among communities and peoples noted for lack of foresight and for negligence with respect to the future are China, India, Java, the negro communities in the Southern states, the peasant communities of Russia, and the North and South American Indians, both before and after they had been pushed to the wall by the white man." Fisher repeated this statement in *The Theory of Interest* (1930, pp. 374–375) and *Elementary Principles of Economics* (1912, p. 404). He supported this view by quoting at length from Rae (1834), four passages on China, one on North American Indians, one on South American Indians, and three on ancient Rome, with one on Holland for contrast (1907, pp. 291–297), also referring to two *Yale Review* articles by Fisher's wife's brother-in-law Nathaniel T. Bacon, the translator of Cournot. While presenting such sweeping characterizations of entire communities (despite a neoclassical emphasis on individual choice based on subjective, individual preferences!), Fisher moved toward environmental rather than hereditarian explanation of attitudes toward saving. According to Fisher (1907, p. 298), "The American negro is regarded by nature as a happy-go-lucky

creature; but recent experience with industrial schools has demonstrated the fact that these characteristics can be largely reversed by training, if in fact they have not been entirely created by the lack of training under the conditions of slavery. There is now accumulating much testimony to show that there is more error than truth in the common opinion as to the relatively great importance of heredity as compared with environment." He suggested that tradition rather than heredity promoted accumulation by Scots and Jews and went on to cite how the supposedly inherent lack of thriftiness of the English working class changed when postal savings banks became available to them (Fisher 1907, p. 298; 1930, p. 378). "In fact, it would be a serious mistake to assume that the characteristics of man as to foresight, self-control, and regard for his own and his children's future are fixed racial or national qualities" (Fisher 1907, p. 298). By *The Theory of Interest*, Fisher had distanced himself further from Rae on supposed racial, ethnic, or class characteristics, dropping all the quoted passages from Rae except the one on Holland, and stating that "the high interest rates of China are probably not due, as Rae seemed to think, to any native lack of industry, frugality, or parsimony on the part of the Chinese people, as is evidenced by the large accumulations of capital made by Chinese living abroad where they are freed from the exactions of arbitrary governors and the tyranny of the clan-family system. Presumably the wastefulness and high interest so evident in China are most largely due to the action of poverty and uncertainty" (Fisher 1930, p. 378) and reporting that "studies of negro life in Africa indicate that under favorable conditions the negro is self-denying" (1930, p. 377). Fisher had not paused in 1907 to wonder how much Rae could have known about China in 1834. That Fisher shared, at least in part, the racial preconceptions of his time and milieu is less surprising than that he did not bring a comparable lack of sympathy to gender differences: in 1943 the National Woman's Party issued a leaflet headed "Irving Fisher Political Economist and Author Endorses the Equal Rights Amendment."

Böhm-Bawerk had not known Rae's work when he published the first edition of his history of interest theories in 1884 but borrowed a copy of Rae (1834) from Carl Menger after reading Mixter (1897). In response to Mixter (1897), Böhm-Bawerk (1959, Vol. 1, pp. 208–240)

devoted a chapter to Rae in the second edition in 1900, praising Rae's prescience: "It was on the subject of capital… that Rae held a number of exceedingly original and remarkable views, and those views exhibit unmistakable similarity to views which were developed about half a century later by Jevons and myself" (von Böhm-Bawerk 1959, Vol. 1, p. 208). He also made some criticisms of Rae, to which Mixter (1902) responded, as did Fisher (1905a):

> In our opinion, Böhm-Bawerk's criticisms of Rae are only partially deserved, and some of the faults which he finds will prove on examination to be virtues. He takes issue with Rae for making two determinants of the rate of interest, the first, a psychological one, 'the effective desire of accumulation,' and the second, a technical one, 'the order of instruments,' i.e., the rate of their return on their cost of production. According to Böhm-Bawerk, Rae has failed to show how these two regulators of the rate of interest cooperate. He admits that the first is valid and that it is practically identical with his own 'preference for present over future goods.' He therefore concedes to Rae full credit for having anticipated him in the statement of this part of the agio theory. But he maintains that, so far as the influence of the technical factor is concerned, not only is Rae's treatment at variance with his own, but that Rae's is wrong and his own right. In our own opinion, Rae's treatment, although not entirely free from the defects mentioned by Böhm-Bawerk, is actually nearer the truth than Böhm-Bawerk's. The latter's theory of the so-called 'technical superiority of present over future means of production' will prove on close examination, to be entirely illusory. We shall ourselves attempt later in a book on capital to justify this view. (Fisher 1997, Vol. 3, p. 6)

Fisher, like his French contemporary Adolphe Landry, rejected Boehm-Bawerk's "third ground for a positive rate of interest," the technical superiority of present over future means of production, and the associated concept of a period of production, although both Fisher and Landry were strongly influenced by Böhm-Bawerk. What

Böhm-Bawerk found missing from Rae (1834) was precisely that part of Böhm-Bawerk's theory that Fisher wished to discard. One should note, however, that Böhm-Bawerk's position regarding Rae has been defended in a clerihew by Rae's biographer, R. Warren James (1998, p. 33):

Charles Whitney Mixter
Conceived an incorrect picture
Of Rae and the classical work
Of Eugen von Böhm-Bawerk

b. Anne Robert Jacques Turgot

Fisher (1907, pp. 11–12) wrote that "The first writer who attempted to explain natural or implicit interest, as distinct from contractual or explicit interest, appears to have been Turgot. His explanation consisted simply in shifting the onus of the problem on to land." According to Fisher, Turgot explained interest as the ratio of the value of the perpetual series of crops to the market value of land, which is so many "years' purchase" of those crops: "This number of years' purchase, he said, was determined by 'supply and demand'; but back of this convenient phrase he did not penetrate. Turgot's shifting the problem to land might naturally have revealed the true theory of interest as lying in the preference for present over future goods; for when one asks why land does not have an infinite value, equal to the entire value of its infinite future crops, the answer becomes at once obvious, namely, that no one would prize crops to accrue a million years' hence on an equal footing with crops of today. Yet this explanation was never made." This passage failed to appreciate the full extent of Turgot's contribution. Rather than just comparing the market value of annual crops with the market value of land, Turgot based the productivity side of his analysis on natural rates of return on different sorts of agricultural investment set by the natural rates of increase of livestock and seed corn, invoking factor mobility to equalize factor returns, so that capital would receive interest even outside agriculture (see Dewey 1965, pp. 36–37). Unless investment in manufacturing and commerce received a positive return, the manufacturers

and merchants would abandon these pursuits to invest all their wealth in agriculture. However unsatisfactory one may find such an agricultural explanation of interest, it is not the same as neglecting to ask what explains the market value of land. Fisher also erred in denying that Turgot considered time preference.

Fisher's lack of appreciation of Turgot may reflect reliance on the history of interest theories that forms the first volume of Böhm-Bawerk's *Capital and Interest*. Fisher had cited William Ashley's translation of a work by Turgot in *The Nature of Capital and Income* (Fisher 1906a, p. 60, following an 1896 article by Fisher on uses of the word "capital," Fisher 1997, Vol. 1, p. 301) for Turgot's use of the word "capital" to mean a stock of wealth, but made no citation in *The Rate of Interest* of anything by Turgot, suggesting reliance on a secondary source, presumably Böhm-Bawerk (except in 1896, when Fisher was looking only for the usage of a particular term). He did not identify Turgot or even state his given names. Fisher thus missed what, according to Murray Rothbard in *The New Palgrave*, was "the remarkable development of a full-scale time-preference theory of interest by the French statesman, Anne Robert Jacques Turgot (1727–1781), who, in a relatively few hastily written contributions, anticipated almost completely the later Austrian theory of capital and interest…. One of the notable injustices in the historiography of economics was Böhm-Bawerk's brusque dismissal in 1884 of Turgot's anticipation of his own time-preference theory of interest as merely a 'land fructification theory' (von Böhm-Bawerk 1959, Vol. I)…. The unfairness is particularly glaring in the case of Turgot, because we now know that in 1876, only eight years before the publication of his history of theories of interest, Böhm-Bawerk wrote a glowing tribute to Turgot's theory of interest in an as yet unpublished paper in Karl Knies's seminar at the University of Heidelberg" (Rothbard 1987, citing Peter Groenewegen's introduction to Turgot 1977, pp. xxix–xx). Böhm-Bawerk devoted a chapter to criticizing "Turgot's Fructification Theory" (1959, Vol. 1, pp. 39–45), which he evaluated without referring back to the single paragraph (1959, Vol. 1, p. 36) in which he acknowledged that Turgot's memoir defending interest on loans "concludes with some very remarkable passages… emphasizing the influence of time on the valuation of goods."

In that paper defending usury, Turgot (1977, pp. 158–159) wrote that what mattered was not the amount of metal borrowed and repaid but the "difference in usefulness which exists at the date of borrowing between a sum currently owned and an equal sum which is to be received as a distant date… [the] value of the *promise* of a sum of money compared to the value of the money available now." Quoting the aphorism "a bird in the hand is better than two in the bush," Turgot stated that a sum of money owned now "is preferable to the assurance of receiving a similar sum in one or several years' time." Beyond this statement of time preference, Turgot also anticipated capitalization, the concept central to Fisher's *Nature of Capital and Interest* that the market value of a capital asset (land, in Turgot's case) is the stream of expected returns, discounted at the rate of interest. What Fisher, following Böhm-Bawerk's published account, thought was Turgot's misguided attempt to derive the rate of interest from a stream of rents and an unexplained value of land can be read instead as Turgot's explanation of the market value of land as the present discounted value of the expected stream of rents, given the rate of interest. Turgot also noted that increasing thrift in Europe had lowered interest rates. Given Fisher's meticulous care for justice to the memories of Cournot and Rae, one cannot doubt that he would have been more generous to Turgot's contribution had he known more about it.

c. Eugen von Böhm-Bawerk

When he came to dedicate his *Theory of Interest* in 1930, Fisher achieved a better balance in his intellectual debts than he had in the dedication of *The Rate of Interest*. *The Theory of Interest* was dedicated "To the Memory of John Rae and of Eugen von Böhm-Bawerk Who Laid the Foundations Upon Which I Have Endeavored to Build." Böhm-Bawerk did not live to see Fisher's revised dedication, having died in 1914. When they met first in Vienna in January 1894, Fisher was an assistant professor of mathematics, whose only major publication was his doctoral dissertation, while Böhm-Bawerk, his elder by sixteen years, was already a leading figure. The two core volumes of his *Capital and Interest* were already published by 1889, when the thirty-eight-year-old

Böhm-Bawerk was called from his professorship at the University of Innsbruck to the Austrian Finance Ministry (where he rose to serve as Minister of Finance in 1895, in 1897, and from 1900 to 1904), and by 1891 both books had appeared in English. He had a high profile among American economists, for he published on the Austrian economists, by invitation, in the first volume of the *Annals of the American Academy of Political and Social Science* in 1891 and contributed seven articles to the *Quarterly Journal of Economics* from 1890 to 1896 (and another three in 1906–1907). Even more than Fisher, Böhm-Bawerk was an ardent polemicist: Paul Samuelson (1994, p. 203) wrote that "After a hard day's work at the office, Böhm-Bawerk would examine with his microscope every single criticism the book evoked—however minute. He seems not to have been able to take Yes as an answer. It had to be Yes! Yes!" Böhm-Bawerk responded to Fisher at length (von Böhm-Bawerk 1959, Vol. 2, pp. 39–45, 57–62, 65–66, 400–411; Vol. 3, pp. 39–56, 68–71, 162–193) without yielding anything to Fisher's arguments. Fisher (1907, p. viii) and Böhm-Bawerk (1959, Vol. 3, p. 220) reported corresponding about the manuscript of *The Rate of Interest*'s chapter on Böhm-Bawerk before its publication, with Böhm-Bawerk reporting that Fisher had deleted passages of his text to make his discussion of Böhm-Bawerk's capital theory less polemical.

Much of the foundations of *The Rate of Interest* followed from Böhm-Bawerk's *Capital and Interest*. Both works stressed the interaction of time preference (impatience) and the return on investment. Fisher's superstructure benefited from his ability to use diagrams and mathematics—as an assistant professor of mathematics in the 1890s he had written a textbook on calculus and coauthored one on geometry. "Fisher's mathematical ability contrasts strikingly with Böhm-Bawerk's limitations," observes Robert Dorfman (1995, pp. 24–25). "Though he had an essentially mathematical thesis to advance, he could express it only by means of arithmetic examples, which can be misleading (and Böhm-Bawerk was misled, as Fisher, [Ladislaus] Bortkiewicz, and others pointed out), and are exceedingly constraining." This difference helped Fisher to achieve a more lucid presentation, but it was more than just a matter of exposition. Fisher's facility with diagrams enabled him to produce the famous "Fisher diagram" for optimal consumption over two

periods, which pulled together the two sides of the theory (time preference and return on investment) in a way that Böhm-Bawerk never managed, and a major source of illumination to generations of economists. Fisher's greater ease in quantitative reasoning showed in his construction of a telling counterexample to Böhm-Bawerk's concept of an average period of production. Fisher also went beyond Böhm-Bawerk by incorporating aging in his analysis.

Böhm-Bawerk offered three reasons for the existence of a positive rate of interest, none of which involved the exploitation (unpaid labor, surplus value) that Karl Marx claimed was the source of interest, profit, and rent. One ground for a positive rate of interest was the time pattern of incomes: in a growing economy, with rising incomes over time and with marginal utility of income as a decreasing function of the level of income, income today represents more utility than the same amount of income in the future. Böhm-Bawerk's second ground was undervaluation of future benefits (that is, a positive marginal rate of time preference). Böhm-Bawerk was criticized within the Austrian school for apparently attributing an irrational myopia to individuals, but, for example, uncertainty about life expectancy is sufficient to account for such time preference, without any implication of irrationality. Fisher (1907, 1930), and the French capital theorist Adolphe Landry (1904), accepted Böhm-Bawerk's first and second grounds for a positive rate of interest, the ones involved impatience. However, Fisher and Landry both rejected Böhm-Bawerk's formulation of his third ground, the technical superiority of present over future goods, that is, the productivity of investment.

As Böhm-Bawerk expressed the technical superiority of present over future goods in *The Positive Theory of Capital* in 1889 (von Böhm-Bawerk 1959, Vol. 2), an increase in the amount of capital invested as measured by an increase in the average period of production (what Friedrich Hayek termed the average period of investment) causes an increase in output. That is, a longer average period of production leads to greater output, which is equivalent to the marginal product of capital being positive. Fisher (1907), as befitted an economist who a few years later wrote extensively about appropriate index number formulae, objected (as did Landry) to the arbitrariness of the choice of a weighted

arithmetic average to compute the period of production. Why not the harmonic or geometric mean or unweighted arithmetic average (Fisher 1907, p. 351)? Samuelson (1994) noted that Böhm-Bawerk's weighted arithmetic average is appropriate for the special case where the interest rate is so close to zero that compounding may be ignored—an ironic result for Böhm-Bawerk, whose great work was about why the interest rate would be greater than zero.

Of two techniques for producing output at different times from an initial input of labor (or for producing a given output from inputs of labor at different times), the one that was most capital intensive (that is, had the longer period of production), would be chosen at a lower rate of interest. As K. Velupillai (1975, 1995) noticed, Fisher (1907) demonstrated that paradoxical results can occur when the analysis moves beyond a simple point-input, point-output case. Fisher supposed two alternative techniques, (a) applying a certain amount of labor today to yield $5 ten years from today and $100 one hundred years from today and (b) applying the same amount of labor today to yield $15 twenty-five years from today. Fisher (1907, pp. 352–353) found that "it is not true that one of the alternatives will be chosen if the rate of interest is high, and the other if the rate of interest is low…. The application of labor which issued in the $5 and $100 would, oddly enough, be the most economical if the rate of interest was either very high or very low, whereas the other alternative would be chosen in case the interest were at a more moderate level."

Fisher demonstrated this by calculating the present discounted values of the alternatives for three different interest rates, showing that (a) is preferable for an interest rate of 1% per annum or 25%, while (b) is preferable for an interest rate of 5%. As Velupillai (1975, p. 680) notes "The PDV at 1 percent for alternatives (a) and (b) are, respectively, $41.28 and $11.70. The values are transposed in the book, due obviously to a printing error; a similar transposition is involved in the PDV calculations for 25 percent, the correct values being $0.54 and $0.06 for alternatives (a) and (b), respectively. Finally, the PDV at 5 percent for alternative (a) is $3.83 and that for alternative (b) is $4.43." Alternative (b) has a period of production of twenty-five years, but it is unclear whether alternative (a) has a longer or shorter period

of production. That is, it cannot be determined whether alternative (a) represents more or less capital than alternative (b). This finding by Fisher undermined what he termed "Böhm-Bawerk's chosen concept," the average period of production. It is a precursor of the discovery of reswitching of techniques and other capital paradoxes in the Cambridge capital controversies of the 1950s and 1960s chronicled by Harcourt (1972).

Böhm-Bawerk failed to grasp the implication of what he called "Fisher's ingenious example" (von Böhm-Bawerk 1959, Vol. 3, p. 220, n14), and responded by industriously constructing numerical examples in which no such problem arose. "However," remarks Velupillai (1975, p. 680), "what is more perplexing is the fact that the usually perspicacious Fisher failed to observe that his remarkable example was detrimental to his own general equilibrium approach" (see also Velupillai 1995). Calculations of Fisher's rate of return over costs, like those of Böhm-Bawerk's average period of production, could yield multiple roots outside the simple point-input, point-output case.

d. Adolphe Landry

Another leading figure in the historical context of Fisher's theory of capital and interest is much less well known, at least among English-speaking economists. In his *L'Intérêt du Capital* (Landry 1904), the French economist and demographer Adolphe Landry (1874–1956) took the same position relative to Böhm-Bawerk that Fisher adopted three years later in *The Rate of Interest* (see Dimand 2012). Like Fisher, Landry accepted Böhm-Bawerk's first two grounds for a positive rate of interest, agreed that interaction of time preference and productivity of investment determined the interest rate, and rejected Böhm-Bawerk's concept of the average period of production. Fisher (1906b) reviewed Landry (1904) very favorably in the *Yale Review*, of which Fisher was an editor. In *The Rate of Interest* Fisher (1907, pp. 72–73) stated that "So far as the writer knows, Landry [1904, pp. 61–90] is the first to have set forth clearly and definitely the fallacy contained in Böhm-Bawerk's theory of 'technical superiority' [of present over future goods]."

Fisher (1907, pp. 159–161) gave examples of a farmer choosing an income-stream equating marginal rate of return on sacrifice to the interest rate, as exemplifying both Landry (1904, Chapter 3) and Rae (1834). Fisher (1907, p. 38) stated that "No objection is here offered to the general reasoning of Rae and Landry. Their results and those shown in the present book are for the most part in agreement. The chief difference, in so far as the present topic is concerned, grows out of the fact that neither Rae nor Landry made use of any definite theory of income, the relation of cost to income, and the distinction between labor-costs and 'interactions'." Fisher (1907, 92n) qualified even that limited criticism, writing that "It is noteworthy that, though lacking any definite theory of income, those writers who have made the most successful analysis of the rate of interest have, in substance, made it depend, to some extent, at least, on income. Thus, Böhm-Bawerk, as has been observed, gives as one of the 'three circumstances' affecting the 'preference for present goods' the 'relative provision for present and future'; and Landry virtually states the same relation, on p. 55 of *L'Intérêt du Capital*." Fisher (1930, p. 73) referred readers to Landry (1904, pp. 311–317) on the time shape of the income stream, while Fisher (1930, p. 471) held that the "'productivity of capital', in the peculiar sense that [Landry 1904, pp. 66–95; 1909b] gives to this phrase" was, in effect, Fisher's rate of return over costs (which John Maynard Keynes [1936, pp. 140–141], later identified with his own concept of marginal efficiency of capital, an identification subject to later controversy).

Similarly, Landry, who took the chair of the history of economic doctrines at the Ecole Pratique des Hautes Etudes in 1907, introduced Fisher's capital and interest theory to readers of the *Revue d'Economie Politique*, including a brief account of *The Nature of Capital and Income* in a review article on recent contributions to economic theory (Landry 1907b) and reviewing *The Rate of Interest*. Landry (1909a, p. 159) concluded that *The Rate of Interest* "est extremement riche en vues de detail, et que ces vues de detail sont nouvelles très souvent, justes presque toujours, et toujours pénétrantes ou ingénieuses. Je tiens à dire que sous le rapport des qualités d'observation qu'il manifeste, de l'habilité dans la construction théorique, de la rigeur dans la raisonnement, de la lucidité et de la precision dans l'exposition, il est digné pour le moins des travaux anterieurs

du meme auteur, et de la place eminente que celui-ci occupe parmi les économistes contemporains."[2] Landry (1909a, p. 156) found Fisher's criticism of Böhm-Bawerk on the technical superiority of present over future goods "lumineuse," although he regretted that Fisher conceded too much to Böhm-Bawerk. For his part, Böhm-Bawerk (1959, Vol. 3, pp. 71–73, 194–196, 201–210) conceded nothing to Landry's criticism.

Landry (1907a) greeted Mixter's edition of Rae's *New Principles* with an enthusiasm equal to that of Fisher: "En lisant Rae on ne sera pas seulement frappé de la richesse des apercus, de l'ingeniosité et de la fertilité d'esprit de cet auteur on sera frappé surtout du caractère moderne de l'ouevre."[3] Not only did Fisher and Landry stand together on the theory of interest and capital, but in *The Purchasing Power of Money*, Fisher (1997, Vol. 4, pp. 84–85, 477) praised and drew upon a study by Landry (1905) on factors influencing the velocity of circulation of money. In January 1913, Fisher and Landry both participated in a discussion at the Statistical Society of Paris of a paper by a French economist on Fisher's compensated dollar plan for stabilizing the price level, which led Fisher (1997, Vol. 6, pp. 275, 294–295) to later list Landry as a supporter of his compensated dollar proposal. Such intellectual interaction and mutual support faded after Landry was elected to the Chamber of Deputies from his native Corsica in 1910 as a Radical Socialist (that is, an anticlerical republican, not a Marxist socialist). Landry served as a senator, then as a deputy again, as Minister of Marine in 1920, Minister of Education (briefly) in 1924, and Minister of Labor 1931–1932, President of the Conseil Général de la Corse, and as senator from 1946 until his death in 1956. Landry achieved the political influence that was sought without success by Fisher, a life-long supplier of (often unsolicited) advice to public figures, but he did so at

[2]Fisher (1907) "is extremely rich in views of details, and these views of details are very often new, almost always just, and always penetrating and ingenious. I hold that the in the qualities of observation he manifests, of ability of theoretical construction, of rigor in reasoning, of lucidity and precision in exposition, he is distinguished by the paucity of works preceding him, and by the eminent place he holds among contemporary economists."

[3]"In reading Rae one will be not only struck by the richness of the insights, the ingenuity and fertility of spirit of this author, one will be struck most of all by the modern character of the work."

the cost of abandoning an active role in the further development of capital theory and monetary economics. Until then, Landry was Fisher's closest ally among interest rate theorists, independently reaching a similar position relative to Boehm-Bawerk's theory.

Institutionalist Critics: Commons and Veblen

Reviewers of *The Rate of Interest* in some important journals, while somewhat daunted by Fisher's thoroughness, praised the book's scientific value (Allen 1993, pp. 99–100). Thomas Nixon Carver of Harvard University, writing in the American Economic Association's *Economic Bulletin* (predecessor of the *American Economic Review*), found that *The Rate of Interest* "throughout is 'Fisheresque' and therefore difficult to summarize, that is to say, it is worked out with the author's well-known and unflinching thoroughness and his merciless marshalling of details. It is also characterized throughout by a certain scientific hardheadedness which is not always found today in writings upon capital and allied topics" (Carver 1908, pp. 25–26). In the *Economic Journal*, C. P. Sanger (1908, p. 66) agreed that "Everything that Dr. Irving Fisher writes is distinctive. His work has a quality which—alas!—is very rare: that of extreme accuracy of expression and exposition. No attempt is made to slur over a difficulty; no pains are spared to make a point clear." In contrast, Fisher's whole analysis was vigorously critiqued, in sharply contrasting ways, by two central figures of American institutionalist, John R. Commons and Thorstein Veblen, who took Fisher's work as an exemplar of what Veblen disliked about neoclassical economics.

Commons (1907) criticized Fisher for substituting "business economy," concerned only with the capitalized value of income streams, for the older "political economy," whose practitioners "were working on a serious social problem—that of earned and unearned incomes" (see Ross 1991, p. 181). Commons argued that Fisher was concerned only with individual interests and observable market outcomes, while the institutionalist economics pioneered by Commons and his students at the University of Wisconsin dealt with social welfare, emphasizing

"reasonable income" on "reasonable value of property" interpreted as "its costs of reproduction, less depreciation, plus its value 'as a going concern'." Fisher (1909a, pp. 536–537) responded to Commons, defending his focus on observed market valuations as a hardheaded concern for facts: "The capital invested in a blackmailing newspaper, in a counterfeiting establishment, in a shop for the manufacture of burglar's tools, in a bureau for the corruption of legislatures, in an opium den, or in other enterprises injurious to society, will always be capital as long as it renders its 'services' to the owners who benefit thereby. The fact that they render disservices to others is of vital consequence, but does not directly concern the subject-matter of my books, which is to follow the causes which actually determine market valuations. The truth is that market valuation seldom, if ever, exactly registers utility to society…. The proper place for a study of social pathology and therapeutics seems to me to be at the end and not at the beginning of economic analysis. We shall reach sounder conclusions in regard to the best remedies to be applied to social conditions if first we study those conditions exactly as they are and not as we should prefer to have them. Our analysis should be as complete and as faithful to the facts as possible."

Thorstein Veblen mounted his critique of Fisher on a larger scale, taking Fisher's books on capital and interest as prime examples of neoclassical economics (a term coined by Veblen to describe economic analysis by Alfred Marshall and others that emphasized rational choice by individuals, coordinated efficiently by markets). Like Fisher (in political economy and mathematics), Veblen had taken his Ph.D. (in philosophy) at Yale with William Graham Sumner (to whom Fisher dedicated *The Nature of Capital and Income*) as one of his two dissertation supervisors. Veblen's sharp critiques of neoclassical economics and especially his conflicts with university administrations and their benefactors in the business community later established him as an outsider in American academic life, but this was not yet clear at the time of his exchange with Fisher (see Dimand 1998b). Veblen had been managing editor of the *Journal of Political Economy* and a member of the council of the American Economic Association while at the University of Chicago, although he did not become an associate professor until he moved to Stanford University in 1906. The scale of Veblen's critique of Fisher was

Veblen's choice: when E. R. A. Seligman of Columbia University asked Veblen to write a brief review of *The Nature of Capital and Income* for the *Political Science Quarterly*, Veblen proposed a full-scale review article instead, and when Seligman asked Veblen to include *The Rate of Interest* in the review, Veblen offered a second review article instead.

Veblen (1908, p. 148) charged that "*The Nature of Capital and Income* is of that class of books that have kept the guild of theoretical economists content to do nothing toward 'the increase and diffusion of knowledge' during the past quarter of a century. Of this class Mr. Fisher's work is of the best—thoughtful, painstaking, sagacious, exhaustive, lucid, and tenaciously logical. What it lacks is the breath of life." Fisher's work was an exercise in taxonomy, starting from definitions of "capital" and "income" instead of observing how usage of those terms had evolved: "'Capital,' in the usage of current business, undoubtedly has not precisely the same meaning as it had in the corresponding usage of half a century ago; and it is safe to say that it will not retain its present meaning, unimpaired and unimproved, in the usage of ten years hence; nor does it cover just the same details in one connection as in another. Yet business men know what the terms mean to them" (Veblen 1908, pp. 150–151). In Veblen's view, neoclassical economists such as Fisher pursued a chimera when they sought a theory or terminology applicable to all times, cultures, and institutional environments.

To Veblen (1909, p. 139), *The Rate of Interest* was an incoherent mixture of two incompatible theories: "The problem of the rate of interest in the marginal-utility system is a problem of applied psychology, more precisely a problem of the hedonistic calculus; whereas the alleged greater productivity of the roundabout process is a technological phenomenon, an empirical generalization concerning the mechanical efficiency of given industrial ways and means. As an explanation of interest the doctrine of the roundabout process belongs among the productivity theories, as Mr. Fisher has indicated; and as such it cannot be admitted as a competent, or indeed a relevant, explanation of interest in a system of theory whose purpose is to formulate a scheme of economic conduct in terms of the hedonistic calculus." Although as a marginal-utility theorist, Fisher was debarred (in Veblen's eyes) from introducing empirical generalizations, he was also wrong in reasoning

from utility maximization instead of from observation of actual business practice: "The day when Bentham's conception of economic life was serviceable for the purposes of contemporary science lies about one hundred years back, and Mr. Fisher's reduction of 'income' to 'psychic income' is late by that much" (Veblen 1908, p. 160).

Fisher (1909b) rejected these criticisms, firmly and at length. He found no good reason why, merely because he made use of marginal utility, he should be limited to purely psychological explanations of interest: "Instead of restricting economic studies in any direction, instead of prescribing rigid metes and bounds, why not encourage every student who has the slightest spark of the explorer's spirit to follow out any chosen chain of causation ad libitum, even to the extent of studying, as did Jevons, the possibly effect of sunspots on economic crises?" (1909b, p. 505). "No definition which does *not* go beyond or behind the pecuniary concept (or concepts) can be a serviceable definition for modern use, especially use in economic analysis. Would Professor Veblen wipe out of economic literature all study—analysis and statistics alike—of, for instance, 'real' wages as distinct from pecuniary or nominal wages?" Recalling the critique by Commons, Fisher (1909b, p. 504) remarked that "Having recently replied to a critic who objects that my books, while correct from the standpoint of business economy, do not pay sufficient attention to social utilities, I must now face about to meet criticism from precisely the opposite quarter." Commons's criticism thus served Fisher as a rebuttal to Veblen's complaint that Fisher ignored actual business practice.

To Veblen's objection that "The whole matter lies within the range of a definite institutional situation which is to found only during a relatively brief phase of civilization" (Veblen 1909, p. 142), Fisher (1909b, p. 506) protested that "a study of the historical development of the institutions of private property and industrial organization, particularly the organization of the money market… is certainly legitimate, but forms no necessary part of the field chosen for my book, which had to do primarily with analysis and only secondarily with history." In 1909 the right to engage in formal theory instead of a historical account of the evolution of institutions required a defense. Fisher (1930, pp. 489–490) returned to the issue, quoting from Veblen's review article, and

going beyond his 1909 defense of formal theorizing to insist that institutions are to be explained as the result of rational choice by optimizing individuals: "These man-made, man-operated institutions are merely tools devised by man to create for him gratifications more readily and more abundantly." Institutions were not an explanation, but phenomena to be explained.

Fisher (1909b, pp. 512–513) also denied that he had followed Bentham in treating utility analysis as the calculus of pleasure and pain. He was concerned only with desire and aversion, not with explanation of preferences in terms of pleasure and pain, and quoted the preface of his dissertation as stating that "The foisting of Psychology on Economics seems to me inappropriate and vicious." Fisher (1909b, p. 516) also protested that "Professor Veblen seems to misconceive my attitude toward the older school of *laissez-faire*. My views on this subject are largely based on John Rae's stimulating book, and are not unlike those of Professor Veblen in his *Theory of the Leisure Class*." Fisher overstated his claim that his view of *laissez-faire* resembled those of Veblen: his later defense of Prohibition diverged from Sumner's *laissez-faire* but was far removed from Veblen's speculations about a "soviet of engineers" or the implications of the social satire in *The Theory of the Leisure Class*. Veblen's reaction to Fisher's sentence about Veblen's book is not recorded, but Veblen was sensitive about comparisons of *The Theory of the Leisure Class* (which did not mention Rae) to Rae's *New Principles*, which discussed conspicuous consumption (with a religious and moralistic tone remote from Veblen). Joseph Dorfman (1973) reported that a student told John Maurice Clark in 1924 that when Veblen was asked at a party if he knew Rae's book, he said that he did and that "some people have accused me of stealing my ideas from him" (cf. Edgell and Tilman 1991; Mason 1998).

Fisher replied more briefly to other critics, dissenting (Fisher 1908) from Achille Loria's claim that Fisher's theory of capitalization suited only the special case of land and (Fisher 1909a) from a critique of Fisher's innovations in terminology by A. W. Flux (1909), recently returned from the chair at McGill University to the British Board of Trade. These exchanges, however, were minor compared to Fisher's encounter with critiques from the founders of American institutionalist

economics, John R. Commons and, especially, Thorstein Veblen. That encounter raised the key issue whether formal neoclassical economic theorizing is culture-bound and history-bound, relevant only to a specific institutional setting, or whether the institutional setting is itself endogenous and subject to explanation as the result of rational choices by optimizing individuals. It also raised the issue of whether economic theory can go beyond analysis of observable market events to make judgements about social welfare. Commons and Fisher later collaborated in the American Association for Labor Legislation and the Stable Money Association, and shared an interest in index numbers, although Commons remained severely skeptical of formal economic theory. Veblen and Fisher never achieved even that limited meeting of minds. They represented two sides of the legacy of their teacher William Graham Sumner, Yale's upholder of Social Darwinism and *laissez-faire*. Veblen shared Sumner's bent for social satire, folkways and evolutionary explanations of social institutions, while Fisher was the heir of Sumner the free trader and hard-money man who had originally suggested mathematical economics as a topic for Fisher's dissertation (Dimand 1998b). Their exchange over capital theory presented two rival paths for American economics: today, the mainstream of economics bears a much closer resemblance to Fisher's work, while Veblen and Commons inspire institutionalist critics of the mainstream.

Keynes's Marginal Efficiency of Capital and Fisher's Rate of Return Over Cost

John Maynard Keynes (1936, pp. 140–141) approvingly quoted the definition of "the rate of return over cost" given by Fisher (1930, p. 168) as "that rate which, employed in computing the present worth of all the costs and the present worth of all the returns, will make the two equal" and Fisher's statement that to induce new investment "the rate of return over cost must exceed the rate of interest" (Fisher 1930, p. 159). Keynes (1936, p. 141) concluded that "Thus Professor Fisher uses his 'rate of return over cost' in the same sense and for precisely the same purpose as I employ 'the marginal efficiency of capital'."

The following year, in a volume of essays marking Fisher's 70th birthday, Keynes (1971–1989, Vol. 14, p. 101n) acknowledged that, "The meaning of 'marginal efficiency of capital' of which I make use—and which is, in my opinion, the only definition of the term which makes good sense—was first introduced into economic theory by Irving Fisher in his *Theory of Interest* (1930), under the designation 'the rate of return over cost.' This conception of his is, I think, the most important and fruitful of his recent original suggestions."

Notwithstanding Keynes's generous acknowledgement of Fisher's definition of the rate of return over cost, Robert Bryce's notes on Keynes's Cambridge lecture on November 26, 1934 quotes Keynes declaring that "Fisher's solution is just nonsense" (underlined in the lecture notes) because Fisher "confuses m.e.c. [marginal efficiency of capital] with r. of i. [rate of interest]" by having expected inflation act directly on the rate of interest rather than on the marginal efficiency of capital (Rymes 1989, p. 150). Indeed, Keynes's praise of Fisher's 1930 definition of the rate of return over cost (Keynes 1936, pp. 140–141) immediately preceded his criticism (without naming Fisher there) of the Fisher relation between real and nominal interest rates, because expected inflation would act directly on the marginal efficiency of capital, and would act affect the interest rate indirectly by shifting the marginal efficiency of capital schedule (Keynes 1936, pp. 141–142, see Kregel 1988; Dimand 1995).

Conclusion

In the preface to *The Theory of Interest* (1930, p. viii), Fisher declared that he "was encouraged to write this new exposition of the theory of interest by various economists and leading business men and especially by Mr. Oswald T. Falk, one of the representatives of Great Britain at the Versailles Peace Conference, who was kind enough to say that he had gained more insight into economic theory from *The Rate of Interest* than from any other book." Falk was closely associated with Keynes in the wartime Treasury and at Versailles, and then in the Independent Investment Trust until that Trust (like Fisher) lost everything in the

1929 Wall Street crash. Falk was right about the insights into economic theory that can be gained from *The Rate of Interest*. The intertemporal allocation diagram, the analysis of interest rates in different standards (extending to uncovered international interest parity and to the expectations theory of the term structure of interest rates), and the counterexample undermining Böhm-Bawerk's average period of production are landmarks in the development of economic analysis (see Samuelson 1967). In an anticipation of later views (and following earlier writers from Sir William Petty to Joseph Shield Nicholson), Fisher took a broad view of capital, going beyond physical capital to cite an estimate by Louis Dublin finding "the total value of the 'human capital' of the United States to be 1500 billion dollars, or about five times the value of all other capital" (Fisher 1930, 34n). As Robert Dorfman (1995, pp. 33–34) writes, "The remarkable thing is that the theory as it left Fisher's hands remains pertinent and helpful eighty-seven years later." It is another remarkable thing that Fisher also anticipated subsequent challenges to the neoclassical theory of interest and capital: his counterexample to Boehm-Bawerk's average period of production foreshadowed the Cambridge capital controversies, while he qualified his belief that the real interest rate is an exclusively real phenomenon in the long run by allowing for short-run monetary influences on the real interest rate in transition periods. While Fisher (1896, 1906a, 1907) used the Fisher relation and the Fisher diagram to show coordination working, his debt-deflation theory, written amid the carnage of the Wall Street crash and Great Depression, analyzed how such coordination could fail (Fisher 1933). Indeed, the unifying theme of his career as a monetary economist was that the "so-called business cycle" was really "a dance of the dollar," driven by the short-run impact of monetary shocks on the real interest rate and by what Fisher termed "money illusion" (Fisher 1997, Vol. 8; Dimand 1993). His exchanges with Veblen and Commons brought out the institutional presuppositions of the analysis. *Appreciation and Interest* (1896), with its stress on expectations as the link between interest rates in different standards, *The Rate of Interest* (1907), with the Fisher diagram at its core, and *The Nature of Capital and Income* (1906a), with its emphasis on maximization of net present value as the criterion for investment decisions, stand as brilliant

achievements by an extraordinary economist (achievements that textbooks, and even specialist works on interest theory such as Lutz [1968] and Rogers [1989], often misattribute to *The Theory of Interest* [1930], which restated Fisher's earlier contributions, without mention of Fisher [1896, 1906a, 1907]), and as a representation of smooth coordination of saving and investment decisions that was challenged by Fisher's own work on slow adjustment to monetary shocks, on debt-deflation, and on capital theory paradoxes.

References

Aldrich, Mark. 1975. Capital Theory and Racism: From Laissez Faire to the Eugenics Movement in the Career of Irving Fisher. *Review of Radical Political Economics* 7 (3) (Fall): 33–54.

Allen, Robert Loring. 1993. *Irving Fisher: A Biography*. Cambridge, MA: Blackwell.

Blaug, Mark, and Peter Lloyd (eds.). 2010. *Famous Figures and Diagrams in Economics*. Cheltenham and Northampton, MA: Edward Elgar.

Brainard, William C., and Scarf, Herbert E. 2005. How to Compute Equilibrium Prices in 1891. In Dimand and Geanakoplos, ed. 57–83, with comments by Donald J. Brown and Felix Kubler, 85–87, and by K. R. Sreenevasan, 89–92.

Carver, Thomas N. 1908. Review of Fisher, *The Rate of Interest*, American Economic Association. *Economic Bulletin* 1 (1) (April): 25–26; as reprinted in Dimand, ed. (2007).

Clark, J.B. 1895. The Gold Standard of Currency in Light of Recent Theory. *Political Science Quarterly* 10: 389–403.

Commons, John R. 1907. Political Economy and Business Economy: Comments on Fisher's *Capital and Income*. *Quarterly Journal of Economics* 22 (November): 120–125; as reprinted in Dimand, ed. (2007).

Cournot, Antoine Augustin. [1838] 1897. *Researches into the Mathematical Principles of the Theory of Wealth*, trans. Nathaniel T. Bacon, with introduction, notes and bibliography by Irving Fisher. New York: Macmillan; as reprinted Homewood, IL: Irwin, 1963.

Crowder, William J. 1997. The Long-Run Fisher Relation in Canada. *Canadian Journal of Economics* 30 (4): 1124–1142.

De Haas, J. 1889. A Third Element in the Rate of Interest. *Journal of the Royal Statistical Society* (Series A) 52: 99–116.

Dewey, Donald. 1965. *Modern Capital Theory*. New York: Columbia University Press.

Dewey, Donald. 1982. Introduction to Reprint of Irving Fisher, *The Rate of Interest*. New York: Garland Press, Accountancy in Transition Series.

Dimand, Robert W. 1993. The Dance of the Dollar: Irving Fisher's Monetary Theory of Economic Fluctuations. *History of Economics Review* 16 (Summer): 161–172.

Dimand, Robert W. 1995. Irving Fisher, J. M. Keynes and the Transition to Modern Macroeconomics. In *New Perspectives on Keynes*, ed. Allin F. Cottrell and Michael S. Lawlor. Annual Supplement to *History of Political Economy* 27, 247–66.

Dimand, Robert W. 1998a. Rae and International Trade. In *The Economics of John Rae*, ed. Omar F. Hamouda, Clive Lee, and Douglas Mair, 177–184. London and New York: Routledge.

Dimand, Robert W. 1998b. Fisher and Veblen: Two Paths for American Economics. *Journal of the History of Economic Thought* 20 (3): 449–466.

Dimand, Robert W. 1999. Irving Fisher and the Fisher Relation: Setting the Record Straight. *Canadian Journal of Economics* 32 (3): 744–750.

Dimand, Robert W. 2005. Economists and the Shadow of 'The Other' Before 1914. *American Journal of Economics and Sociology* 64 (3): 827–850.

Dimand, Robert W. (ed.). 2007. *Irving Fisher: Critical Responses*, 3 vols. London and New York: Routledge.

Dimand, Robert W. 2012. Adolphe Landry and Irving Fisher on Circulation and Interest. *History of Economic Thought and Policy* 2: 115–123.

Dimand, Robert W., and Hichem Ben-El-Mechaiekh. 2012. How General Equilibrium Came to North America: Irving Fisher's *Mathematical Investigations in the Theory of Value and Prices* (1891) and his Hydraulic Model of General Equilibrium. *Journal of Economic and Social Measurement* 37: 97–118.

Dimand, Robert W., and John Geanakoplos (eds.). 2005. *Celebrating Irving Fisher: The Legacy of a Great Economist*. Malden, MA: Blackwell; also published as *American Journal of Economics and Sociology* 64: 1.

Dimand, Robert W., and Rebeca Gomez Betancourt. 2012. Retrospectives: Irving Fisher's *Appreciation and Interest* and the Fisher Relation. *Journal of Economic Perspectives* 26 (4): 185–196.

Dorfman, Joseph (ed.). 1973. *Thorstein Veblen: Essays, Reviews and Reports*. Fairfield, NJ: Augustus M. Kelley.

Dorfman, Robert. 1995. Austrian and American Capital Theories: A Contrast of Cultures. *Journal of the History of Economic Thought* 17 (1): 21–34.

Edgell, S., and Rick Tilman. 1991. John Rae and Thorstein Veblen on Conspicuous Consumption: A Neglected Intellectual Relationship. *History of Political Economy* 23 (4) (Winter): 731–744.

Fetter, Frank A. 1977. *Capital, Interest, and Rent: Essays in the Theory of Distribution*, ed. Murray N. Rothbard. Kansas City: Sheed Andrews and McMeel.

Fisher, Irving. 1896. *Appreciation and Interest*. New York: Macmillan, as reprinted in Fisher (1997), Vol. 1.

Fisher, Irving. 1897. A Neglected Economist: John Rae (Note). *Yale Review* 6 (February): 457 (unsigned).

Fisher, Irving. 1898. Cournot and Mathematical Economics. *Quarterly Journal of Economics* 12 (January): 119–138, 238–244.

Fisher, Irving. 1905a. Review of Eugen von Böhm-Bawerk, *Recent Literature on Interest*. *Yale Review* 14 (August): 221–223 (signed I. F.).

Fisher, Irving. 1905b. Review of John Rae, *The Sociological Theory of Capital*, ed. C. W. Mixter. *Yale Review* 14 (November): 333 (signed I. F.).

Fisher, Irving. 1906a. *The Nature of Capital and Income*. New York: Macmillan; as reprinted in Fisher (1997), Vol. 2.

Fisher, Irving. 1906b. Review of Adolphe Landry, L'Intérêt du Capital. *Yale Review* 15 (May): 103–105.

Fisher, Irving. 1907. *The Rate of Interest: Its Nature, Determination and Relation to Economic Phenomena*. New York: Macmillan; as reprinted in Fisher (1997), Vol. 3.

Fisher, Irving. 1908. Reply by Professor Irving Fisher to Professor Achille Loria's Criticism of *The Rate of Interest*. *Journal of Political Economy* 16 (October): 532–534; as reprinted in Dimand, ed. (2007).

Fisher, Irving. 1909a. A Reply to Critics. *Quarterly Journal of Economics* 23 (3) (May): 536–541; excerpted in Fisher (1997), Vol. 3, 473–475 and reprinted in Dimand, ed. (2007).

Fisher, Irving. 1909b. Capital and Interest. *Political Science Quarterly* 24 (3) (September): 504–516; excerpted in Fisher (1997), Vol. 3, 475–480 and reprinted in Dimand, ed. (2007).

Fisher, Irving. 1912. *Elementary Principles of Economics*. New York: Macmillan; as reprinted in Fisher (1997), Vol. 5.

Fisher, Irving. 1913. The Impatience Theory of Interest. *American Economic Review* 3 (September): 610–618; as reprinted in Fisher (1997), Vol. 3.

Fisher, Irving. 1930. *The Theory of Interest as Determined by Impatience to Spend Income and Opportunity to Invest It*. New York: Macmillan; as reprinted in Fisher (1997), Vol. 9.

Fisher, Irving. 1933. The Debt-Deflation Theory of Great Depressions. *Econometrica* 1 (3): 337–357; as reprinted in Fisher (1997), Vol. 10.

Fisher, Irving. 1997. *The Works of Irving Fisher*, 14 vols., ed. William J. Barber assisted by Robert W. Dimand and Kevin Foster, consulting ed. James Tobin. London: Pickering & Chatto.

Fisher, Irving Norton. 1961–1972. *A Bibliography of the Writings of Irving Fisher*, with supplement. New Haven, CT: Yale University Library.

Flux, A. W. 1909. Irving Fisher on Capital and Interest. *Quarterly Journal of Economics* 23 (February): 307–323; as reprinted in Dimand, ed. (2007).

Harcourt, G.C. 1972. *Some Cambridge Controversies in the Theory of Capital*. Cambridge: Cambridge University Press.

Hawtrey, Ralph G. 1913. *Good and Bad Trade: An Inquiry into the Causes of Trade Fluctuations*. London: Constable; as reprinted with 1961 foreword by Hawtrey. New York: A. M. Kelley, 1970.

Humphrey, Thomas M. 1983. The Early History of the Real/Nominal Interest Rate Relationship. *Federal Reserve Bank of Richmond Economic Review* 69; as reprinted in T. M. Humphrey, *Essays on Inflation*, 5th ed. Richmond, VA: Federal Reserve Bank of Richmond, 1986.

Humphrey, Thomas M. 1988. The Trade Theorist's Sacred Diagram: Its Origin and Early Development. *Federal Reserve Bank of Richmond Economic Review* 74 (1) (January/February): 3–15; as reprinted in Thomas M. Humphrey, *Money, Banking and Inflation: Essays in the History of Economic Thought*. Cheltenham: Edward Elgar, 1993.

James, R.Warren. 1965. *John Rae, Political Economist: An Account of His Life and a Compilation of His Main Writings, 2 volumes*. Toronto: University of Toronto Press.

James, R.Warren. 1998. Birthday Greetings to John Rae. In *The Economics of John Rae*, ed. O.F. Hamouda, C. Lee, and D. Mair, 23–37. London and New York: Routledge.

Keynes, John Maynard. 1936. *The General Theory of Employment, Interest and Money*. London: Macmillan.

Keynes, John Maynard. 1971–1989. *The Collected Writings of John Maynard Keynes*, 30 vols., General eds. D. E. Moggridge and E. A. G. Robinson, Volume eds. Elizabeth S. Johnson and D. E. Moggridge. London: Macmillan; New York: Cambridge University Press for the Royal Economic Society.

Kregel, Jan. 1988. Irving Fisher, Great-Grandparent of the *General Theory*: Money, Rate of Return Over Cost and Efficiency of Capital. *Cahiers d'Economie Politique* 14–15: 59–68.

Landry, Adolphe. 1904. *L'Intérêt du Capital*. Paris: Giard & Briere.

Landry, Adolphe. 1905. La Rapidité de la Circulation Monétaire. *Revue d'Economie Politique* 19: 155–174.

Landry, Adolphe. 1907a. Review of John Rae, *The Sociological Theory of Capital*, ed. C. W. Mixter. *Revue d'Economie Politique* 21: 380–381.

Landry, Adolphe. 1907b. Quelques Travaux Recents de Théorie Economique. *Revue d'Economie Politique* 21: 687–711 (review of Irving Fisher, *Nature of Capital and Income*, 688–689).

Landry, Adolphe. 1909a. Irving Fisher, *The Rate of Interest*. *Revue d'Economie Politique* 23: 156–159.

Landry, Adolphe. 1909b. On the Returns of Productive Agents and on the Productivity of Capital in Particular. *Quarterly Journal of Economics* 23 (August): 557–592 and "A Correction." *Quarterly Journal of Economics* 24 (November): 198.

Loria, Achille. 1908. Professor Achille Loria on Professor Irving Fisher's *Rate of Interest*. *Journal of Political Economy* 16 (October): 531–532; as reprinted in Dimand, ed. (2007).

Lutz, Friedrich A. 1968. *The Theory of Interest*. Dordrecht: Reidel; Chicago: Aldine.

Mason, Roger. 1998. John Rae and Conspicuous Consumption. In *The Economics of John Rae*, ed. O.F. Hamouda, C. Lee, and D. Mair, 95–107. London and New York: Routledge.

Mixter, C.W. 1897. A Forerunner of Böhm-Bawerk. *Quarterly Journal of Economics* 11 (January): 161–190.

Mixter, C.W. 1902. Böhm-Bawerk on Rae. *Quarterly Journal of Economics* 16 (May): 385–412.

Rae, John. 1834. *New Principles of Political Economy*. Boston: Hilliard Gray; as reprinted in James (1965), Vol. 2.

Rae, John. 1905. *The Sociological Theory of Capital*, ed. C.W. Mixter. New York: Macmillan.

Rogers, Colin. 1989. *Money, Interest and Capital*. Cambridge: Cambridge University Press.

Ross, Dorothy. 1991. *The Origins of American Social Science*. Cambridge and New York: Cambridge University Press.

Rothbard, Murray N. 1987. Time Preference. In *The New Palgrave: A Dictionary of Economics*, ed. John Eatwell, Murray Milgate, and Peter Newman. London: Stockton Press.

Rymes, T.K. (ed.). 1989. *Keynes's Lectures, 1932–35: Notes of a Representative Student*. Basingstoke: Macmillan; Ann Arbor: University of Michigan Press.

Samuelson, Paul A. 1967. Irving Fisher and the Theory of Capital. In *Ten Studies in the Tradition of Irving Fisher*, ed. William Fellner et al., 17–37. New York: Wiley.

Samuelson, Paul A. 1994. Two Classics: Böhm-Bawerk's *Positive Theory of Capital* and Fisher's *Rate of Interest* Through Modern Prisms. *Journal of the History of Economic Thought* 16 (2) (Fall): 202–228.

Sanger, C. P. 1908. Review of Fisher. *The Rate of Interest*. *Economic Journal* 18 (1) (March): 66; as reprinted in Dimand, ed. (2007).

Seager, Henry R. 1912. The Impatience Theory of Interest. *American Economic Review* 2 (December): 834–851.

Turgot, Anne Robert Jacques. 1977. *The Economics of A. R. J. Turgot*, ed. and trans. Peter D. Groenewegen. The Hague: Martinus Nijhoff.

Veblen, Thorstein. 1899. *The Theory of the Leisure Class*; as reprinted New York: Viking, 1967.

Veblen, Thorstein. 1908. Fisher's *Capital and Income*. *Political Science Quarterly* 23 (1) (March): 112–128; as reprinted in Veblen (1934): 148–172; also reprinted in Dimand, ed. (2007).

Veblen, Thorstein. 1909. Fisher's *Rate of Interest*. *Political Science Quarterly* 24 (2) (June): 296–303; as reprinted in Veblen (1934), 137–147; also reprinted in Dimand, ed. (2007).

Veblen, Thorstein. 1934. *Essays in Our Changing Order*, ed. Leon Ardzrooni. New York: Viking.

Velupillai, K. 1975. Irving Fisher on 'Switches on Techniques': A Historical Note. *Quarterly Journal of Economics* 89 (4) (November): 679–680.

Vellupillai, K. 1995. Irving Fisher on a 'Fundamental Theorem' in Neo-Austrian Capital Theory. *Journal of Institutional and Theoretical Economics* 151 (3): 556–564.

von Böhm-Bawerk, Eugen. 1959. *Capital and Interest*, 3 vols., trans. George D. Huncke and Hans F. Sennholz from the posthumous 1921 4th ed. of *Kapital und Kapitalzins*. South Holland, IL: Libertarian Press.

Walras, Leon. 1892. The Geometrical Theory of the Determination of Prices, trans. Irving Fisher, *Annals of the American Academy of Political and Social Science* 3, 45–64; as reprinted in James A. Gherity, ed., *Economic Thought: A Historical Anthology*. New York: Random House, 1965.

Young, Warren. 1987. *Interpreting Mr. Keynes: The IS-LM Enigma*. Boulder, CO: Westview Press; Cambridge: Polity Press.

5

Taming the "Dance of the Dollar": From the Compensated Dollar to 100% Money

Rejecting the "So-Called Business Cycle"

From *Appreciation and Interest* (1896), Fisher argued that if changes in the purchasing power of money were correctly anticipated, they would have no effect on the real interest rate or on any other real variables—but he viewed the adjustment of expectations to monetary shocks as gradual and imperfect, so that money was neutral in the long run but not in the short run. In *The Purchasing Power of Money*, Fisher (with Harry G. Brown 1911) again argued for the long-run neutrality of money. However, in Chapter IV, about "Disturbances of Equation and of Purchasing Power During Transition Periods," "transition periods" of ten years or so in which the economy moved from one equilibrium to another after a monetary shock, Fisher attributed fluctuations in real economic activity to the slow and imperfect adjustment of expectations and the nominal interest rate to monetary shocks. Emphatically, Fisher did not accept that economic fluctuations could validly be described as business cycles, as they were called in North America, or as trade cycles, the British term. His opinion was clearly expressed in the titles

R. W. Dimand, *Irving Fisher*, Great Thinkers in Economics,
https://doi.org/10.1007/978-3-030-05177-8_5

of his articles in the *Journal of the American Statistical Association*, "Our Unstable Dollar and the So-Called Business Cycle" (Fisher 1925) and "The Business Cycle Largely a 'Dance of the Dollar'" (Fisher 1923). Fisher was not content to merely diagnose the cause of economic instability. He wished to cure it, by educating the public out of *Money Illusion* (Fisher 1928) so that price level changes would be correctly perceived and anticipated. Alternatively, if the public would not learn, the price level (measured in Fisher's ideal index number, the geometric mean of the Paasche and Laspeyres price indexes) should be kept from changing, through the "compensated dollar" proposed in the concluding chapter of *The Purchasing Power of Money*. If the public would not learn and the world would not adopt his compensated dollar, then Fisher proposed to render financial upheavals innocuous by separating the medium of exchange from risky financial intermediation (Fisher, *100% Money* 1935) and through indexation, pioneering the issuance of indexed bonds.

The term "business cycles" is now used in macroeconomics to mean aggregate fluctuations without implying that the fluctuations are periodic, just as "sunspots" now denotes any intrinsically irrelevant variables that affect economic activity because people take them into account when forming their expectations. Economic responses to real or monetary shocks may be oscillatory, but economists no longer decompose fluctuations into a multiplicity of superimposed cycles of differing periodicity and amplitude. Excepting seasonality, oscillations in economic variables are very rarely attributed to physical cycles. Economists have absorbed the message, attributed to Knut Wicksell by Ragnar Frisch (1933), that when a rocking-horse is struck with a stick, the motion of the rocking-horse does not resemble the motion of the stick. But it was not so in the nineteenth century or the first third of the twentieth century. In the nineteenth century, the spreading quest for statistical regularities in the physical world and then in the social world led economists to look for more or less regular rhythms in economic activity and to find a receptive audience for such research in the wider scientific community. Clément Juglar (1862) identified a cycle of nine or ten years in an essay that won a prize competition of the Académie des Sciences Morales et Politiques. W. Stanley Jevons (1884), in papers presented to

the British Association for the Advancement of Science, developed a theory of the trade cycle building on the work of physicists and meteorologists who had ascribed cycles in weather and harvests to sunspot cycles.[1] Jevons's now-famous work on marginal utility analysis and utility maximization had aroused little (if any) interest in the British Association, but his linkage of economic fluctuations to a recognized periodicity in the physical world persuaded the British Association that there was a place in a scientific association for the economists and statisticians of Section F.

Business cycle research institutes proliferated after World War I, and business cycle analysts achieved eminence in the economics profession. Wesley Clair Mitchell presented a statistical, largely atheoretical, leading-indicators approach to cycles in influential books on *Business Cycles* (Mitchell 1913, 1927) and founded the National Bureau of Economic Research (NBER) in 1920. His approach, although displaced after World War II by structurally identified econometric models grounded in formal economic theory, has strong affinities with the more recent vector autoregression (VAR) approach used by Christopher Sims to model economic fluctuations, although of course Sims's VAR approach uses more modern statistical techniques. A president of both the American Economic Association (AEA) and the American Statistical Association (ASA), Mitchell was the first recipient of the AEA's Francis Amasa Walker Medal in 1947. Among his prominent associates at Columbia University and the NBER were Frederick Mills, also a president of both AEA and ASA, and Arthur F. Burns, AEA president, Mitchell's successor as research director of the NBER and his coauthor on *Measuring Business Cycles* (Burns and Mitchell 1946). Another Columbia statistical economist, Henry Ludwell Moore, stressed cycles in the physical world (such as in rainfall) as an influence on business cycles as strongly

[1]In fairness to Jevons, it should be recognized that it was reasonable for an economist to accept the conclusion of meteorologists about what caused weather fluctuations, and that, in another part of his work on cycles, his pioneering study of seasonality in the London money market has proven of lasting value. But when astronomers changed their mind about the average length of the sunspot cycle, Jevons recalculated the average length of the trade cycle so that the lengths of the two cycles still coincided to the second decimal point (see Mitchell 1927).

as Jevons had, and was, along with Mitchell, one of the most-cited economists in the 1920s (see, e.g., Moore 1926). Moore differed from Jevons in finding a cycle of eight years rather 10.5 or 11, and in emphasizing the influence of the planet Venus on rainfall rather than solar activity. The role of Venus was received with polite skepticism, but Moore's articles continued to be accepted in the 1920s by the *Quarterly Journal of Economics* and the *Journal of the Royal Statistical Society*, as well as by respected journals in other fields such as the *Geographical Review* and the *Monthly Weather Review*. The business barometer of Warren Persons's Harvard Committee on Economic Research, adapted to Britain by the London and Cambridge Economic Service with the support of William Beveridge and of Keynes, also modeled economic fluctuations as the summation of truly periodic cycles. Business cycle research institutes or conjuncture institutes, funded in part by the Rockefeller Foundation, were established in Vienna (directed by Friedrich Hayek and then by Oskar Morgenstern), Berlin, Warsaw (where Michal Kalecki worked, directed by Edvard Lipinksi), Louvain, and Sofia, Bulgaria. The Moscow Business Cycle Research Institute vanished in Stalin's purges when its director N. D. Kondrate'ev was arrested in 1930 (and executed in 1938, upon the expiry of his eight-year sentence) as the leader of a non-existent opposition party (see Dimand 2003 for references for this paragraph). Although the first twenty-one chapters of the *General Theory* were not presented in terms of cycles, Keynes (1936, p. 314) recognized that "there is some recognizable degree of regularity in the time-sequence and duration of the upward and downward movements" of economic activity, which he attributed to cyclical fluctuations of the marginal efficiency of capital schedule. In his "Notes on the Trade Cycle" (Keynes 1936, Chapter 22), he discussed "reasons why, in the case of a typical industrial trade cycle in the nineteenth-century environment, fluctuations in the marginal efficiency of capital should have had cyclical characteristics" (1936, p. 314).

In addition to the Juglar cycle of nine or ten years, the business cycle literature paid close attention to the short, 40-month Kitchin cycle (Kitchin 1923), to the medium-length Kuznets cycle of 18–25 years (Kuznets 1926), and the long-wave of 55–60 years

(Kondratieff [1925] 1979). Joseph Schumpeter, in his monumental *Business Cycles* (1939) and earlier articles, explained the Great Depression as the coincidence of the troughs of several such cycles of different length. Sir William Beveridge (1921, 1922), the director of the London School of Economics, used periodogram analysis (an early form of spectral analysis) to decompose wheat prices into the summation of nineteen cycles varying from 2.7 to 68 years, eleven of them very prominent, a multiplicity which he attributed to the complexity of the weather (see Cargill 1973; Dimand 1999). The number of superimposed cycles of different period and amplitude needed to explain Beveridge's wheat price data led the Harvard epidemiologist E. B. Wilson (a student of J. Willard Gibbs, like Fisher) to doubt that Beveridge's data, or economic fluctuations in general, were truly cyclical (Wilson 1934). Slutsky ([1927] 1937) showed that the filtering and averaging common in the business cycle literature would find serial correlation and apparent cycles even in series that were white noise by construction, taking as his example the last three digits of the winning Moscow lottery numbers. The periodogram analysis culminated in the Cowles monograph on *The Analysis of Economic Times Series* by Cowles Commission research director Harold Davis (1941), which made eleven references, all positive, to Beveridge's 1921 and 1922 articles.

Even the sunspot theory of the trade cycle did not completely disappear from reputable economic and statistical journals. It was upheld most ardently by Jevons's son Herbert Stanley Jevons, who taught economics at the University of Sydney and held chairs in Allahabad, Rangoon and Wales (see Jevons 1909, 1933) but also by other researchers (Mukerjee 1929; Garcia Mata and Shaffner 1934). Beveridge (1940), after becoming director of the National Institute of Economic and Social Research upon leaving the London School of Economics, returned to the study of weather and harvest cycles as the cause of the trade cycle, and was dissuaded with great difficulty by his research assistant Harold Wilson (the future Labour Prime Minister of the United Kingdom) from publishing his rediscovery of the sunspot cycle as the ultimate driving force behind weather, harvest, and trade cycles (see Dimand 1999).

The Dance of the Dollar

Before Eugen Slutsky, Ragnar Frisch, and E. B. Wilson, Fisher rejected cycles as the explanation of economic fluctuations,[2] offering statistical verification of the monetary theory of fluctuations that he had advanced in Chapter IV (the chapter on "transition periods") of his *Purchasing Power of Money* (Fisher with Brown 1911). "Indeed, the chief object of this chapter is to show that the peculiar behavior of the rate of interest during transition periods is largely responsible for the crises and depressions in which price movements end," wrote Fisher (with Brown 1911, p. 56). As he had done fifteen years before (Fisher 1896, p. 79), Fisher (with Brown 1911, pp. 71–72) approvingly quoted Alfred Marshall's statement that "The cause of alternating periods of inflation and depression of commercial activity … is intimately connected with those variations in the real rate of interest which are caused by changes in the purchasing power of money." Most reviewers of *The Purchasing Power of Money*, including John Maynard Keynes, overlooked Chapter IV, but Minnie Throop England (1912, p. 97) objected that "An examination of five crises in Germany and six in England does not bring to light any uniform tendency for interest as a cost of production to lag behind prices."

Expanding on his remarks to the annual dinner of the American Statistical Association, Fisher (1923, p. 1024) declared, "Hitherto the effort to explain and forecast the 'Business Cycle' has been chiefly empirical. I suspect that we shall, in the future, make more progress by emphasizing more analysis … The various business services which have sprung up during the last decade all seem to recognize that the price level is of vital importance, but its real role has been missed because the *price level* has been looked to instead of its rate of change … Some of

[2]Fisher (with Brown 1911, p. 70) accepted that adjustments to shocks would be oscillatory but the oscillations would fade and there would be further shocks before adjustment was complete: "In most cases the time occupied by the swing of the commercial pendulum to and from is about ten years. While the pendulum is continually seeking a stable position, practically there is almost always some occurrence to prevent perfect equilibrium. Oscillations are set up which, though tending to be self-corrective, are continually perpetuated by fresh disturbances." Fisher (1925, p. 191) compared economic fluctuations to the fluctuation of "the luck at Monte Carlo" around its mean, which provided no valid reason to speak of "the Monte Carlo cycle."

these services, when the war wrought its havoc with prices, simply omitted the price curve altogether through the period of its greatest disturbance although it was precisely under such circumstances that its role in disturbing business was most important and, as we shall see, most evident." Fisher did not name the researchers and business forecasting services, but his listeners and readers would likely have thought of Wesley Mitchell and the NBER and, especially for forecasting, of Warren Persons and the Harvard Committee on Economic Research.

Fisher (1923, 1925) correlated indexes of economic activity with a distributed lag of the rate of change of prices. "As far as I know, this is the first attempt to distribute a statistical lag," remarked Fisher (1925, p. 183, see also Rutledge 1977). Using monthly data and an eight-period lag with linearly declining weights (now known as the Fisher lag, see also Fisher 1937), Fisher (1923) obtained a correlation of 0.79 between the American Telephone & Telegraph business barometer (adjusted for secular trend and seasonality) and a distributed lag of past rates of wholesale price change, while Fisher (1925), using Warren Persons's Harvard business barometer and a more complicated lag structure (derived from the effects of the largest one-month price shock during the war), managed to bring the correlation up to 0.94.

Fisher (1926) found a correlation of 0.90 between unemployment and a distributed lag of price changes in the United States from September 1915 to December 1924 in a paper on "A Statistical Relation Between Unemployment and Price Changes" in the *International Labour Review*. The article attracted little attention at the time and, because of the journal where it appeared, was not included in the *AEA Index of Economic Journals* when that index was compiled in the 1950s. It caused rather more of a stir in 1973, a quarter century after Fisher's death, when it was reprinted in the *Journal of Political Economy* as "Lost and Found: I Discovered the Phillips Curve – Irving Fisher."

David Hendry and Mary Morgan (1995, pp. 46–47) reported that "Fisher [1925] makes the following arguments: since the correlation obtained is so high, and the residuals show no apparent cycles, the business cycle as a normal set of ups and downs in the economy does not exist … Of course, as we know, with such a short time period,

he cannot really make any inferences about the trade or business cycle." Furthermore, when Hendry and Morgan tried to replicate Fisher's results, they found that, as long as they used a three-month moving average, "it seems impossible to remove residual correlation: this is clearly visible in Fisher's figure 27.4, and invalidates the coefficient standard errors and the significance tests … Such autoregressive residuals are at odds with his claim that they showed no cyclical tendencies."

A Remedy for the Dance of the Dollar: Fisher's Compensated Dollar Plan

Since Fisher the economic scientist had demonstrated to his satisfaction in Chapter IV of *Purchasing Power of Money* that economic instability was the result of unforeseen monetary shocks, Fisher the reformer felt obligated to find a remedy. Briefly in the concluding chapter of the book, and more fully in the 1913s edition where he reprinted an *American Economic Review* article as an appendix, Fisher advocated a "compensated dollar" whose purchasing power would be kept steady by varying the dollar price of gold (or, equivalently, the gold content of the dollar). Fisher's goal of price level stabilization contrasted with the views of the prime shapers of the Federal Reserve Act of 1913, who were committed to convertibility at an unchanging dollar price of gold and to the real bills doctrine. Fisher's goal had much more in common with the thinking of many modern central bankers, whose inflation targeting is just price level targeting raised by one derivative. But while Fisher's goal of a stable price level resonates with monetary economists a century later, his proposed method of achieving it by varying the price of gold does not. Fisher's attempt to make his proposal palatable to defenders of the gold standard by disguising it as a variant of the gold standard undermined his project.

David Kinley, A. Piatt Andrew, O. M. W. Sprague, and other prominent economists advised or wrote commissioned studies for the National Monetary Commission chaired by Senator Nelson Aldrich

(Republican—Rhode Island),[3] but Fisher was not among them. After control of Congress passed from Republicans to Democrats at the 1912 elections, the House Banking and Currency Committee dominated by Representative Carter Glass (Democrat—Virginia) relied on the advice of H. Parker Willis, who had taught Glass's sons at Washington and Lee University, and was influenced by the National Citizens' League for the Promotion of a Sound Banking System, chaired by Willis's teacher J. Laurence Laughlin (on a year's leave from the University of Chicago).[4] As seen in Chapter 2, Laughlin and Willis were strong opponents of the quantity theory of money, and Laughlin debated Fisher on the quantity theory at the 1904 and 1910 annual meetings of the American Economic Association. Having fought against bimetallism in the 1890s, Laughlin and Willis identified sound money with a monetary system in which the dollar was convertible into gold at an unchanging parity, in contrast to Fisher's view that a sound currency was one whose purchasing power did not change.

Perry Mehrling (2002), surveying the role of economists in the formation of the Federal Reserve System, properly emphasizes the influential role of Laughlin and Willis, but errs in arguing that Fisher's compensated dollar plan to stabilize the price level was irrelevant to the debates leading to the Federal Reserve Act of 1913 because Fisher proposed it too late, in his book *Stabilizing the Dollar* (1920). Richard Timberlake (1993, p. 407) also stated that Fisher (1920) was "the first comprehensive proposal for a stable price-level policy." Allan Meltzer (2003, pp. 181–192), in his history of the Federal Reserve System,

[3]Kinley of the University of Illinois wrote two National Monetary Commission studies, on statistics of bank clearings and on the history of the Independent Treasury System, Sprague of Harvard Business School wrote on the history of crises under the National Banking System, Andrew (formerly of Harvard and then at the Treasury) was Aldrich's main adviser, and other economists wrote studies of the banking systems of other countries.

[4]Despite anti-Aldrich rhetoric by Glass and other Democrats, the Glass-Owen Bill strongly resembled the Aldrich Plan, as Paul Warburg (1930) showed by a side by side comparison of the two bills. The main difference is that Aldrich envisioned a single central bank resembling the Bank of England or Banque de France, while the Glass-Owen Bill created a system of twelve regional banks with a Federal Reserve Board appointed by the President subject to Senate confirmation. In practice, the regional banks were unable to set different discount rates based on regional conditions because of arbitrage.

implicitly takes the same view, considering Fisher's compensated dollar as part of Fisher's testimony in support of a bill by Congressman T. Alan Goldsborough in 1922–1923 and other bills in the 1920s that would have mandated price level stability as a goal for the Federal Reserve. Michael Bernstein (2001, p. 49) went further, stating that "Professional economists were, in fact, infrequently consulted and thus became only a small voice in the momentous debate over the creation of a Federal Reserve System," omitting mention even of Andrew, Laughlin, Willis or the National Monetary Commission. But it was not so. What matters here is not that Fisher advocated the compensated dollar in 1920 and in 1920–1922, but when he *first* proposed it and first attracted widespread attention. That was in 1911, not 1920. The received view that price level stabilization was never seriously considered as a goal for the Federal Reserve also overlooks that Senator Robert Latham Owen, an associate of Fisher, placed just such a goal in the Senate version of the Glass-Owen Bill, only to have it struck out by the House Banking and Currency Committee led by Carter Glass (Owen 1919, 1934, p. ix; Fisher with Cohrssen 1934, pp. 148–149). While it is unsurprising that Glass (1927) told the story of the Glass-Owen Bill as it were the Glass-Glass Bill, it is striking that the voluminous literature on the creation of the Federal Reserve[5] makes so little mention of Senator Owen[6] (and, *a fortiori*, of the economist who advised him, Fisher) and largely neglects the role of the Senate after the departure of Nelson Aldrich (who, after thirty years in the Senate, did not run for re-election in 1912).

Fisher first presented his compensated dollar plan in *The Purchasing Power of Money* (Fisher with Brown 1911, Chapter XIII, pp. 340–346). As he was finishing the book, Fisher wrote to quantity

[5]See Dimand (2003) for references.

[6]Fisher first collaborated with Owen as founder of the Committee of One Hundred on National Health, in support of Owen's unsuccessful bill in 1908 to establish a federal Department of Health. Later, through the Committee of One Hundred and when he was president of the American Association for Labor Legislation, Fisher worked with Owen in support of national health insurance (Fisher 1997, Vol. 13). Their collaboration continued: in 1933 and again in 1937, after Owen left the Senate in 1925, Fisher and Owen collaborated in drafting price-stabilization bills (Fisher 1956, pp. 274, 304; 1997, Vol. 14, p. 57).

theorist Edwin W. Kemmerer[7] on January 11, 1911, that "I wish it might be possible before my book really appears to have a talk with you in regard to my suggested remedy for the ills of a variable gold standard. I restrained myself from putting in my remedy until the last moment; but felt so dissatisfied with having written a book on the problem without giving any better solution than the tabular standard, that I went over again the various solutions that had been offered; and it suddenly occurred to me that the gold-exchange standard was really a half-way step, to the method which I finally ventured to suggest" (quoted in Barber's introduction to Fisher 1997, Vol. 4, p. 9). Fisher restated his plan in articles in the *Economic Journal* in 1912, in the conference supplement of the *American Economic Review* (an article reprinted as an appendix to the 1913s edition of *The Purchasing Power of Money*), *Quarterly Journal of Economics* and *Revue d'Economie Politique* in 1913, and in "Objections to a Compensated Dollar Answered" in the *American Economic Review* in 1914. Fisher also responded at length to such objections in the *New York Times* (December 22, 1912, reprinted in Fisher 1997, Vol. 4, pp. 568–575) and the *Commercial and Financial Chronicle*. By 1913, journal articles about Fisher's compensated dollar plan had been published in Italian (by Corrado Gini and by Augusto Graziani), Danish (by Frederik Zeuthen), Swedish (by David Davidson and by Knut Wicksell), French (including a symposium published by the Statistical Society of Paris with Fisher participating), Dutch and German (see the list in Fisher 1920, pp. 294–296). Unknown to Fisher, there were so many articles in Japanese that Masao Kanbe of Kyoto Imperial University entitled a 1913 article "Comments on the comments on the comments on Fisher's compensated dollar plan" (Ikeo 2014, pp. 48–52). In the wake of Fisher's presentation to the International Congress of Chambers of Commerce in Boston in 1912, Fisher compiled a list of

[7]Kemmerer was not persuaded, and he continued to uphold the gold-exchange standard against the compensated dollar, for example as a discussant of Fisher's paper at the December 1912 AEA meeting.

344 articles about his compensated dollar plan, of which 305 were in newspapers. Fisher (1920) was the first time that Fisher devoted an entire book to the compensated dollar plan for a stable price level, not the first time that he made the proposal or that others took notice of his proposal.[8] His plan was made and actively discussed in the two years preceding the passage of the Federal Reserve Act.

Opposition to the compensated dollar, notably by AEA president David Kinley (1913), held that a fixed price of gold provided an anchor of stability, and preferred discretion to mechanical rules other than convertibility at a fixed gold parity. These criticisms echoed Robert Giffen's denunciation of "Fancy Monetary Standards" in Britain in 1892 (in response of a proposal by Aneurin Williams that Fisher cited as "practically identical" with his own), which had deterred Alfred Marshall from pursuing his tentative suggestion of symmetallism (see Laidler 1991; Fisher 1920, pp. 293–294). Kinley (1913, p. 1) politely referred to "that brilliant suggestion recently made by Professor Irving Fisher"—brilliant rather than sound. Kinley rejected price level stability as a goal because prices changed not just because of changes in the supply of gold, but also because of changes in the supply of goods. "But we do want any corrective of the latter," as welfare is improved when prices decline due to increased availability of goods. Deliberate stabilization of the price level was an unwarranted interference with market forces. Fisher's *Purchasing Power of Money* had drawn, with fulsome acknowledgment, on Kinley's empirical work. Fisher derived a monthly time series for the velocity of circulation of bank deposits by linear interpolation between two single-day estimates of bank clearings, one calculated by Kinley for a day in 1896 in a study for the Comptroller of the Currency (see Kinley 1897) and another in one of Kinley's studies for the National Monetary Commission (Kinley 1910). How deeply Fisher

[8]In 1914, Fisher discovered that Simon Newcomb, to whom he had dedicated *The Purchasing Power of Money* because of Newcomb's 1885 equation of exchange, had proposed a stable price level rule (Newcomb 1879), so Newcomb also shared, with two other precursors, the dedication of *Stabilizing the Dollar* (Fisher 1920). Kesterton (1996, p. 9) reports a suggestion that Newcomb was Arthur Conan Doyle's inspiration for Professor Moriarty, the Napoleon of crime: both Newcomb and Moriarty published papers on the binomial theorem at the age of twenty and later wrote about the orbits of asteroids.

was wounded by Kinley's criticisms is indicated by a change in how Fisher cited those studies. Fisher continued to rely on those two empirical studies of bank clearings and velocities even in his last studies of the quantity theory of money in the 1940s, but he took to attributing them to the Comptroller of the Currency and the National Monetary Commission without mentioning Kinley's name (see Dimand 2000).

Knut Wicksell (1915) objected that because gold was only a fraction of the money supply, and that flows of gold were only a fraction of the stock of gold, Fisher's plan was based on trying to change a fraction of a fraction, an objection which would also apply to open market operations (see Patinkin 1993). But the main problem with Fisher's plan stemmed from his attempt to market it as "A more stable gold standard" (the title of his 1912 *Economic Journal* article) rather than as an alternative to the fixed exchange rates of the gold standard. Instead of basing his argument on the quantity of money and the equation of exchange, Fisher's compensated dollar plan would try to adjust the price level by varying the dollar price of gold, as George F. Warren and Frank Pearson (1935) advocated two decades later. As Kevin Dowd (2001) has stressed, Fisher's proposal to maintain gold convertibility of the dollar at a fixed parity that would be changed periodically to offset changes in a price index would be vulnerable to speculative attack.[9] Such vulnerability could be avoided by dropping the fixed exchange rate, and just varying the quantity of money through open market operations to stabilize the price level, an approach more in keeping with the quantity theory of money. Fisher finally accepted that change in the 1920s, at some time between Congressman T. Allan Goldsborough's bill for a compensated dollar in 1922–1923 and Congressman James Strong's price stabilization bill in 1926. Fisher (1920, pp. 290–291) had been wary of irredeemable paper money: "This dangerous expedient has always had its advocates, and these have usually been inflationists" but recognized that some had proposed a paper money regulated to avoid inflation or

[9]Dowd (2001, p. 9) nonetheless held that "even the weaknesses in [Fisher's] scheme are very instructive … Fisher still has a lot to teach us and all modern monetary reformers should study him properly."

deflation, notably "Carl Menger, the Austrian economist, who suggested that the price level could be stabilized by the issue of paper money, as required to neutralize fluctuations of purchasing power." While Fisher reluctantly and belatedly abandoned the compensated dollar to adopt Menger's position, Scott Sumner (1990) has identified Fisher's compensated dollar, along with Aneurin Williams, as the forerunner of the "new monetary economics" proposals of Fischer Black, Eugene Fama and Robert Hall for a unit of account defined in terms of a comprehensive basket of commodities and separated from the medium of exchange.

A New Remedy for the Dance of the Dollar: Fisher and 100% Money

The waves of bank failures in the United States leading to the "Bank Holiday" of March 1933, together with the Austrian, German and Italian banking crises, focused attention on the macroeconomic consequences of runs on banks in a system of fractional-reserve banking. The United States legislated a separation between commercial banking (deposit-taking and lending) and investment banking (underwriting issues of securities). Advocates of deeper reform of the banking system regarded that separation as inadequate and sought to insulate the medium of exchange from the risks involved in lending and security-holding and from the danger of runs on deposits triggered by fears of such portfolio risks. Foremost among these reformers was a group of University of Chicago economists led by Henry Simons and including Garfield Cox, Aaron Director, Paul Douglas, Frank Knight, Lloyd Mints and Henry Schultz (Simons et al. 1933, which was not published until 1990 but was summarized in Simons 1934). This "Chicago Plan of Banking Reform" proposed a 100% reserve requirement on checkable bank deposits, as was independently advocated in Lauchlin Currie's Harvard doctoral dissertation (Currie 1934, Chapter XV). The fullest presentation of the plan for a 100% reserve requirement was in Irving Fisher's book *100% Money* (1935), which was circulated in mimeograph to a 150 bankers and economists for more than a year before publication, and was translated into German, Greek,

Italian, and Spanish (see Allen 1993; Dimand 1993; Phillips 1995; and Demeulemeester 2018 for similarities and differences among the Chicago, Currie and Fisher versions of 100% money, and Fisher 1997, Vol. 11, for extracts from Fisher's testimony to the House Banking and Currency Committee in February 1934 and March 1935). Fisher published articles on 100% money in autumn 1934 in the *Wall Street Journal*, *The Controller* (an address to the Controllers Institute of America on the "Monetary Cure for Depression") and *The American Banker* (which had published an editorial against "Professor Fisher's Funny Story") and later in *The Bankers Magazine*, *The Northwestern Banker*, *The Banker*, *Personal Finance News* and *Social Research*, often provoking replies, to which he responded (see the unpaginated addendum to the 1945 third edition of Fisher 1935 for references).

Fisher's concerns, and the extensive benefits he expected from his proposal, are shown in the full title of the first edition of his book: *100 Percent Money Designed to Keep Checking Banks 100 percent Liquid; To Prevent Inflation and Deflation; Largely to Cure or Prevent Depressions; and to Wipe Out Much of the National Debt*. According to Fisher, the Depression resulted from a contraction of the money supply made possible by fractional-reserve banking. What Fisher termed "pocket-book money," cash in the hands of the public, increased from $4 billion in the United States in 1929 to $5 billion in 1933, but "check-book money" shrank from $23 billion to $15 billion as households drew cash out of the banks and banks responded by raising their reserve/deposit ratios. The goal of 100% reserve requirements was not to protect depositors (deposit insurance, enacted in 1935, could take care of that) but to tame the "dance of the dollar" by controlling swings in the quantity of money.

In this new effort to tame the "dance of the dollar," Fisher was a follower, and not entirely a welcome follower. While tracing the idea of a 100% reserve requirement back to Thomas Joplin in Britain in the 1820s, Fisher (1935, p. xiii) gave credit in his preface to "the members of a group at the University of Chicago from whose 'memorandum' on the 100% plan I originally obtained many of the ideas embodied in this book. Professor Simons, in particular, has given generously of his time in personal consultation, as well as in going over parts of the manuscript." Relations between Fisher and the University of Chicago

had changed since the heyday of J. Laurence Laughlin, when Laughlin and his graduate students strenuously opposed the quantity theory of money and the *Journal of Political Economy*, alone among major economics journals published in English, did not review Fisher's books on monetary economics or publish articles by him on monetary topics. But while Simons gave generously of his time to consult with Fisher about his manuscript, neither he nor the other Chicago economists publicly reciprocated Fisher's acknowledgment about 100% money. By the mid-1930s Fisher, notorious for being wrong about the stock market and for his varied crusades from eugenics to Prohibition, was an ally of dubious value. Simons and Fisher shared a commitment to rules rather than discretion in monetary policy (Simons 1948, Chapter VII), and to a rule targeting the price level rather than, as was later advocated by Milton Friedman, the rate of growth of the money supply. But, without naming Fisher, Simons (1948, p. 177, written in 1936) criticized those who, like Fisher, wished to reflate the prices to their early level before stabilizing, to ease the burden on debtors. The few references to Fisher in Simons's collected essays were negative, disparaging other of Fisher's reform projects unrelated to the 100% reserve requirement on checkable bank deposits. "I have never liked the Gesell-Fisher-Dahlberg schemes [of stamp scrip which retains its value only with the periodic purchase of stamps]; if we must tax hoarding, steady increases in the price level, while dangerous, is the only elegant means," protested Simons (1948, p. 283, cf. Fisher 1933; Keynes 1936, Chapter 23). Rejecting a suggestion by Michal Kalecki for taxing consumption plus hoarding rather than income (in Kalecki's contribution to Balogh et al. 1944), Simons (1948, p. 306) remarked, "His colleagues (but not Beveridge) take this scheme very seriously—as will, perhaps, Professor Fisher and as anyone familiar with tax procedure or accounting will not" (see Fisher 1997, Vol. 12). Simons only cited Fisher on topics where they disagreed, not on 100% reserve requirements, where their views were allied: identification of a plan for drastic banking reform with Irving Fisher would be, in the aftermath of October 1929, decidedly unhelpful but also unavoidable given Fisher's vigorous campaigning for the plan in Congressional testimony, banking magazines, and the press.

Not only was fractional-reserve banking not abolished, but financial systems have evolved away from 100% money toward something closer to Wicksell's pure credit economy. The Federal Reserve's increases in reserve requirements in 1936 and 1937 (Meltzer 2003, pp. 502–503, 573) were not a step toward 100% reserve banking but a response to the level of excess reserves held by banks which caused concern that inflation would result if banks decided to lend out those reserves. Since risk-averse banks wanted to hold excess reserves, the increase in reserve requirements caused the money supply to contract, contributing to the recession of 1937–1938—not at all what Fisher had in mind.

Twenty-five to fifty years after Fisher (1935) and the Chicago plan for banking reform, 100% reserve requirements again attracted the positive attention of Yale and Chicago economists: Milton Friedman of Chicago, and James Tobin and Henry Wallich of Yale (see Dimand 1993; Phillips 1995). More recently, financial innovation has eroded or eliminated the role of reserve requirements, as financial institutions have created substitutes for financial instruments subject to such requirements. Nonetheless, financial crises, and especially the Global Financial Crisis of 2008, have drawn attention back to the issue of separating the macroeconomic function of the medium of exchange from the inherent riskiness of financial intermediation and speculation.

Fisher's proposals for monetary and banking reform, whether the compensated dollar, stamp scrip, indexation or 100% money, were motivated by his belief that aggregate economic fluctuations were a "dance of the dollar." He was a pioneer in empirical exploration of the monetary theory of economic fluctuations (including correlation analysis, distributed lags and a statistical relation between unemployment and price changes), in combining economic theory with empirical analysis, in proposing a price level rule in place of a fixed exchange rate, and in campaigning for separation of the medium of exchange from risky financial intermediation. He did not find the world as responsive to his plans as he hoped and perhaps expected, but while trying to rearrange the world Fisher made contributions to monetary economics of lasting value.

References

Allen, William R. 1993. Irving Fisher and the 100 Percent Reserve Proposal. *Journal of Law and Economics 36* (2): 703–717.

Balogh, Thomas, F. A. Borchardt, Michal Kalecki, K. Mandelbaum, E. F. Schumacher, and G. D. N. Worswick. 1944. *The Economics of Full Employment*. Oxford: Basil Blackwell.

Bernstein, Michael A. 2001. *A Perilous Progress: Economists and Public Purpose in Twentieth-Century America*. Princeton, NJ: Princeton University Press.

Beveridge, William H. 1921. Weather and Harvest Cycles. *Economic Journal* 31: 429–452.

Beveridge, William H. 1922. Wheat Prices and Rainfall in Western Europe. *Journal of the Royal Statistical Society* 85: 412–459.

Beveridge, William H. 1940. The Trade Cycle in Britain Before 1850. *Oxford Economic Papers* 3: 74–109 and 4: 63–76.

Burns, Arthur F., and Wesley C. Mitchell. 1946. *Measuring Business Cycles*. New York: National Bureau of Economic Research.

Cargill, Thomas F. 1973. Early Applications of Spectral Analysis to Economic Time Series. *History of Political Economy* 5: 1–15.

Currie, Lauchlin. 1934. *The Supply and Control of Money in the United States*. Cambridge, MA: Harvard University Press; reprinted with Introduction by Karl Brunner. New York: Russell and Russell, 1968.

Demeulemeester, Samuel. 2018. The 100% Money Proposal and Its Implications for Banking: The Currie-Fisher Approach Versus the Chicago Plan Approach. *European Journal of the History of Economic Thought* 25: 357–387.

Dimand, Robert W. 1993. 100 Percent Money: Irving Fisher and Banking Reform in the 1930s. *History of Economic Ideas* 1 (2): 59–76.

Dimand, Robert W. 1999. Beveridge on Unemployment and Cycles Before the *General Theory*. *History of Economic Ideas* 7 (3): 33–51.

Dimand, Robert W. 2000. Irving Fisher and the Quantity Theory of Money: The Last Phase. *Journal of the History of Economic Thought* 22: 329–348.

Dimand, Robert W. 2003. Competing Visions for the US Monetary System, 1907–1913: The Quest for an Elastic Currency and the Rejection of Fisher's Compensated Dollar Rule for Price Stability. *Cahiers d'Economie Politique* 45: 101–121.

Dimand, Robert W. (ed.). 2007. *Irving Fisher: Critical Responses*, 3 vols. London and New York: Routledge.

Dowd, Kevin. 2001. *Money and the Market: Essays on Free Bank*. London and New York: Routledge.

England, Minnie Throop. 1912. Fisher's Theory of Crises: A Criticism. *Quarterly Journal of Economics* 27: 95–106; reprinted in Dimand, ed. (2007).

Fisher, Irving. 1896. *Appreciation and Interest*. New York: Macmillan for the American Economic Association; reprinted in Fisher (1997), Vol. 1.

Fisher, Irving, with Harry G. Brown. 1911. *The Purchasing Power of Money*. New York: Macmillan; reprinted in Fisher (1997), Vol. 4.

Fisher, Irving. 1920. *Stabilizing the Dollar*. New York: Macmillan; reprinted in Fisher (1997), Vol. 5.

Fisher, Irving. 1923. The Business Cycle Largely a 'Dance of the Dollar'. *Journal of the American Statistical Association* 18: 1024–1028; reprinted in Fisher (1997), Vol. 8.

Fisher, Irving. 1925. Our Unstable Dollar and the So-Called Business Cycle. *Journal of the American Statistical Association* 20: 179–202; reprinted in Fisher (1997), Vol. 8.

Fisher, Irving. 1926. A Statistical Relation Between Unemployment and Price Changes. *International Labour Review* 13: 785–792; reprinted in Fisher (1997), Vol. 8, and as Lost and Found: I Discovered the Phillips Curve—Irving Fisher. *Journal of Political Economy* 82 (1973): 496–502.

Fisher, Irving. 1928. *The Money Illusion*. New York: Adelphi and London: George Allen & Unwin; reprinted in Fisher (1997), Vol. 8.

Fisher, Irving. 1933. *Stamp Scrip*. New York: Adelphi.

Fisher, Irving, assisted by Hans L. Cohrssen. 1934. *Stable Money: A History of the Movement*. New York: Adelphi.

Fisher, Irving. 1935. *100% Money*. New York: Adelphi; 3rd ed., 1945; reprinted in Fisher (1997), Vol. 11.

Fisher, Irving. 1937. A Note on a Short-Cut Method for Calculating Distributed Lags. *Bulletin of the International Statistical Institute* 29: 323–328; reprinted in Fisher (1997), Vol. 8.

Fisher, Irving. 1997. *The Works of Irving Fisher*, 14 vols., ed. William J. Barber assisted by Robert W. Dimand, and Kevin Foster, consulting ed. James Tobin. London: Pickering & Chatto.

Fisher, Irving Norton. 1956. *My Father Irving Fisher*. New York: Comet.

Frisch, Ragnar. 1933. Propagation Problems and Impulse Problems in Dynamic Economics. In *Economic Essays in Honour of Gustav Cassel*. London: George Allen & Unwin; reprinted New York: Augustus M. Kelley, 1967, 171–205.

Garcia Mata, C., and F.I. Shaffner. 1934. Solar and Economic Relationships: A Preliminary Report. *Quarterly Journal of Economics* 49: 1–51.

Glass, Carter. 1927. *An Adventure in Constructive Finance*. Garden City, NJ: Doubleday, Page.

Hendry, David F., and Mary S. Morgan (eds.). 1995. *The Foundations of Econometric Analysis*. Cambridge: Cambridge University Press.

Ikeo, Aiko. 2014. *A History of Economic Science in Japan*. London and New York: Routledge.

Jevons, Herbert Stanley. 1909. The Causes of Unemployment: Changes in the Sun's Heat as Causes of Fluctuations in the Activity of Trade and Unemployment. *Contemporary Review* 96: 167–189.

Jevons, Herbert Stanley. 1933. The Causes of Fluctuations in Industrial Activity and the Price-Level. *Journal of the Royal Statistical Society* 96: 545–588.

Jevons, William Stanley. 1884. *Investigations in Currency and Finance*, ed. H.S. Foxwell. London: Macmillan; reprinted New York: Augustus M. Kelley, 1964.

Juglar, Clément. 1862. *Des crises commerciales et de leur retour périodiques en France, en Angleterre et aux Etats Unis*. Paris: Guillaumin; partly translated (from 2nd ed., 1889) as *A Brief History of Panics and Their Periodical Occurrence in the United States*. New York: Putnam, 1916; reprinted New York: Augustus M. Kelley, 1966.

Kesterton, Michael. 1996. *Social Studies*. Toronto: McClelland and Stewart.

Keynes, John Maynard. 1936. *The General Theory of Employment, Interest and Money*. London: Macmillan.

Kinley, David. 1897. The Use of Credit Instruments in Business Transactions. *Journal of Political Economy* 5: 157–174.

Kinley, David. 1910. *The Use of Credit Instruments in Payments in the United States*, Senate Document No. 399 (National Monetary Commission), 61st Congress, 2nd Session. Washington, DC: Government Printing Office and reprinted Fairfield, NJ: Augustus M. Kelley.

Kinley, David. 1913. Objections to a Monetary Standard Based on Index Numbers. *American Economic Review* 3: 1–19; reprinted in Dimand, ed. (2007).

Kitchin, Joseph. 1923. Cycles and Trends in Economic Factors. *Review of Economic Statistics* 5: 10–16.

Kondratieff, Nikolai D. [1925] 1979. The Major Economic Cycles. *Review* 2: 519–562.

Kuznets, Simon S. 1926. *Cyclical Fluctuations: Retail and Wholesale Trade, United States, 1919–25*. New York: Adelphi.
Laidler, David. 1991. *The Golden Age of the Quantity Theory*. London: Phillip Allan and Princeton, NJ: Princeton University Press.
Mehrling, Perry. 2002. Economists and the Fed: Beginnings. *Journal of Economic Perspectives* 16: 207–218.
Meltzer, Allan. 2003. *A History of the Federal Reserve*, Volume 1: *1913–1951*. Chicago: University of Chicago Press.
Mitchell, Wesley C. 1913. *Business Cycles*. Berkeley, CA: University of California Press.
Mitchell, Wesley C. 1927. *Business Cycles: The Problem and Its Setting*. New York: National Bureau of Economic Research.
Moore, Henry L. 1926. A Theory of Economic Oscillations. *Quarterly Journal of Economics* 41: 1–29.
Mukerjee, R. 1929. Agricultural Cycles and Sunspots. *Indian Journal of Economics* 10: 259–299.
Newcomb, Simon. 1879. The Standard of Value. *North American Review* 129: 234–237.
Owen, Robert L. 1919. *The Federal Reserve Act*. New York: The Century Company.
Owen, Robert L. 1934. Foreword to Gertrude M. Coogan. *Money Creators: Who Creates Money? Who Should Create It?* Hawthorne, CA: Omni Publications, 1971.
Patinkin, Don. 1993. Irving Fisher and His Compensated Dollar Plan. *Federal Reserve Bank of Richmond Economic Quarterly* 79 (3): 1–33.
Phillips, Ronnie J. 1995. *The Chicago Plan and New Deal Banking Reform*. Armonk, NY: M. E. Sharpe.
Rutledge, John. 1977. Recent Controversies in Monetary Theory: Irving Fisher and Autoregressive Expectations. *American Economic Review* 67: 200–205.
Schumpeter, Joseph A. 1939. *Business Cycles*, 2 vols. New York: McGraw-Hill.
Simons, Henry C. 1934. *A Positive Program for Laissez-Faire*. Chicago: University of Chicago Press; reprinted in Simons (1948), 40–77.
Simons, Henry C. 1948. *Economic Policy for a Free Society*. Chicago: University of Chicago Press.
Simons, Henry C., et al. 1933. Banking and Currency Reform. Manuscript published in Warren J. Samuels, *Research in the History of Economic Thought and Methodology* 11, Archival Supplement 4 (1993).

Slutsky, Evgeni. [1927] 1937. The Summation of Random Causes as the Source of Cyclic Processes. *Econometrica* 5: 105–146.

Sumner, Scott. 1990. The Forerunners of 'New Monetary Economics' Proposals to Stabilize the Unit of Account. *Journal of Money, Credit and Banking* 22: 109–118.

Timberlake, Richard H. 1993. *Monetary Policy in the United States: An Intellectual and Institutional History*. Chicago: University of Chicago Press.

Warburg, Paul M. 1930. *The Federal Reserve System, Its Origin and Growth, Reflections and Recollections*, 2 vols. New York: Macmillan.

Warren, George F., and Frank A. Pearson. 1935. *Gold and Prices*. New York: Wiley.

Wicksell, Knut. 1915. Note on Irving Fisher's Plan for Regulating the Purchasing Power of Money. In *Lectures on Political Economy*, Vol. II: *Money*, trans. E.M. Classen, 225–228. London: Routledge, 1935.

Wilson, Edwin B. 1934. The Periodogram of American Business Activity. *Quarterly Journal of Economics* 48: 375–417.

6

Fighting Money Illusion: The Fisher Ideal Index Number

Introduction

Although the Fisher relation attributed the difference between interest rates in any two standards to the expected rate of appreciation or depreciation of one standard against the other, and although Fisher held that expectations would adjust as people learned from experience, he did not believe that expectations or perceptions of monetary changes were generally correct or that they adjusted immediately. In a series of lectures at the Geneva Institute of International Studies in the summer of 1927, published the following year as *The Money Illusion*, Fisher (1928, p. 4) defined money illusion as "the failure to perceive that the dollar, or any other unit of money, expands or shrinks in value" and lamented its pervasiveness. Fisher (1928, pp. 5–6) recounted how he and other American economist, visiting Germany in 1922 during the hyperinflation,[1] "talked at length with twenty-four men and women whom we met by chance in our travels in Germany. Among these, only

[1]The German price level was already fifty times its prewar level when Fisher visited in 1922. A year later, German prices reached a trillion times their prewar level.

R. W. Dimand, *Irving Fisher*, Great Thinkers in Economics,
https://doi.org/10.1007/978-3-030-05177-8_6

one had any idea that the mark had changed. Of course, all the others knew that prices had risen, but it never occurred to them that this rise had anything to do with the mark. They tried to explain it by the 'supply and demand' of other goods; by the blockade; by the destruction wrought by the War; by the American hoard of gold; by all manner of other things, – exactly as in America when, a few years ago, we ourselves talked about the 'high cost of living,' we seldom heard anybody say that a change in the dollar had anything to with it." As the "most striking example of the Money Illusion," Fisher (1928, p. 66) quoted the President of the Reichsbank reassuring the Reichstag in August 1923 that soon he would be able to increase the note-issue by two-thirds in a single day, printing enough money so that the money supply would catch up with the soaring price level. Fisher attributed fluctuations in real economic activity to slow and imperfect adjustment of expectations and perceptions to monetary changes. The purchasing power of money fluctuated most dramatically with inconvertible paper currency, as in Germany in 1922 and 1923, *assignats* during the French Revolution or continental dollars during the American War of Independence. But the purchasing power of money also fluctuated under metallic standards, whether gold or silver or bimetallic, as with the appreciation of gold from 1873 to 1896 followed by its depreciation after 1896.

Fisher was by no means the first and did not imagine himself to be the first, to advocate a stable purchasing power of money rather than a stable dollar price of gold. The early nineteenth-century English parliamentarian G. Poulett Scrope, who coined the term "tabular standard"[2] (Scrope 1833, p. 424), wrote that "when a government sets about the regulation of the monetary system of a country, the very first object for consideration should be the means of rendering its money as invariable in value as possible. Unhappily this has been wholly neglected by governments in general, and more especially by that of this nation" (Scrope 1833, p. 404). But Fisher did not merely advocate stabilizing the purchasing power of money. He sought to select the ideal index number

[2]Fisher (with Brown 1911, p. 208n) traced the idea of a tabular standard to Joseph Lowe, in 1823, ten years before Scrope named the concept.

for a price-level rule or for indexation in a massive study of all purchasing power index number formulas, established an Index Number Institute in the basement of his house to compute such an index number on a weekly basis, wrote a weekly syndicated newspaper article to educate the public about what had happened to the purchasing power of money that week, and, in succession to his annual empirical articles about the equation of exchange in the *American Economic Review* from its first volume in 1911 until 1919, published an annual empirical article about his price index in the *Journal of the American Statistical Association* in the 1920s.

Measuring movements in the general level of prices was crucial for Fisher's monetary economics. His distinction between real and nominal interest rates depended on changes in the general price level. His statement in *The Purchasing Power of Money* of the quantity theory of money, holding that, other things being equal, a change in the quantity of money leads in the long run to a change in the price level of the same proportion, also depended on the concept and measurement of an index of the average level of prices, as did his educational campaign to eradicate money illusion. His compensated dollar proposal called for stabilization of an index of commodity prices by varying the dollar price of gold. The gold standard, the policy rule which Fisher's compensated dollar plan was intended to replace, created no comparable need for calculation of a price index since it pegged the price of only one commodity, gold. Fisher's schemes for neutralizing monetary shocks by indexation, such as the indexed bond that he persuaded Remington Rand to issue in 1925 (Fisher 1997, Vol. 8, pp. 336–339; McCulloch 1980; Dimand 1999) or the indexation of his secretary's weekly pay, also depended on a price index (although, inconveniently for Fisher's secretary, the secretary's rent did not). Fisher drew on his great energy and determination in his effort to decide upon and calculate an ideal index number for prices, along with the corresponding index for quantities. Although Fisher had predecessors whom he generously acknowledged (notably Francis Ysidro Edgeworth and Correa Moylan Walsh, who shared the dedication of *The Making of Index Numbers*), Arthur Vogt (1997) rightly states that one may call Fisher's *The Purchasing Power of Money* the old testament

and *The Making of Index Numbers* the new testament of statistical index theory.

The test approach to the statistical theory of index numbers, to which Fisher (1913, 1922) and Walsh (1901, 1921) contributed, sought to find an index number formula that would satisfy a list of statistical criteria. Walsh introduced the proportionality test, which Fisher included in a more comprehensive set of criteria. Fisher claimed, on the basis of these criteria, to have found an "ideal index," a particular formula that was best for all purposes. The economic theory of index numbers, exemplified by Bennet (1920) and Konüs (1924), sought a "true index" of the cost of achieving a constant level of utility. Unlike this approach, the criteria for Fisher's ideal index did not require knowledge of the utility function. Konüs and Byushgens (1926) linked the two approaches by showing that certain index number formulae are equivalent to assuming particular functional forms, in particular, that Fisher's ideal price and quantity indexes would be exact for a homogenous quadratic aggregator function (see Afriat 1987; Diewert 1993b, 2013). In the 1970s, W. Erwin Diewert (1993c) introduced the concept of superlative indexes, statistical indexes that are exact to flexible functional forms (functional forms providing a second-order approximation to an arbitrary twice-differentiable aggregator function).

The importance of index numbers for Fisher's monetary theory and policy set him apart from the Austrian approach exemplified by Ludwig von Mises's *Theory of Money and Credit*, first published in German in 1912, a year after *The Purchasing Power of Money*. Mises and later Friedrich Hayek were skeptical of reasoning in terms of aggregates such as the price level and, while adamantly against inflation, opposed price-level stabilization as a policy rule because they considered deflation a necessary part of the adjustment. J. Lawrence Laughlin of the University of Chicago, outspoken opponent of the quantity theory of money, also rejected aggregated theorizing about the price level, insisting that the exchange value of gold was determined like the exchange value of any other commodity, by its cost of production compared to the cost of production of each other commodity.

Toward an "Ideal Index"

Chapter X of *The Purchasing Power of Money* discussed "The Best Index Numbers of Purchasing Power" and had an appendix of 45 pages testing index number formulae for theoretically desirable properties (Fisher 1913, pp. 198–233, 385–429). Some reviewers found Fisher's coverage too comprehensive: John Maynard Keynes objected that "In the long appendix on index numbers, in which marks for different kinds of merit are given to 44 different formulae, it seems a waste of time to have demonstrated the unsuitability of numerous expressions which have never previously been suggested, far less advocated, by anyone" (Keynes 1983, XI, p. 381). Undeterred by such protests, Fisher went on to a deductive and empirical investigation of the properties of 134 index number formulae in *The Making of Index Numbers*.

Fisher's concern in Chapter X of *The Purchasing Power of Money* was with the appropriate index number for P, the price level in the equation of exchange $MV + M'V' = PT$, and with T, the corresponding index of trade. PT would be the value of transactions at actual prices, while T would measure what the value of transactions would have been had quantities been sold at base prices. P would then be a measure of general purchasing power suitable as a standard for deferred payments. The context of the equation of exchange shaped Fisher's choice of criteria for a useful index number, even though he was to make the controversial claim that his preferred index number was best for all purposes. While Fisher (1913, p. 200) accepted that "it seems theoretically impossible to devise an index number, P, which shall satisfy all of the tests we should like to impose," he held that it is "nevertheless, possible to construct index numbers which satisfy these tests so well for practical purposes that we may profitably devote serious attention to the study and construction of index numbers."

In a lengthy appendix, Fisher listed eight tests for a good index number and then examined how well 44 index number formulae satisfied them. The first six tests were in pairs, for the price index and the corresponding trade index. The proportionality tests held that if all prices (or quantities) changed by the same proportion, so should their index.

Determinateness tests held that the price index (or correlative trade index) should not become zero, infinite, or indeterminate if an individual price (or quantity) became zero. Tests of withdrawal or entry would be satisfied if the index was unaltered by adding or removing a price or quantity ratio whose value was the same as the index. The ratios between price indexes (and the correlative trade indexes) should be unaffected by reversing or changing the base. Finally, the index should be independent of units of measurement, so that it would not matter whether a quantity was measured in tons or in pounds.

These eight tests sounded intuitively appealing and not terribly restrictive, yet they were inconsistent with some of the best known and most widely used index number formulae. William Stanley Jevons's essays in the 1860s (collected posthumously in his *Investigations in Currency and Finance* in 1884) were saluted in Fisher's "Landmarks in the History of Index Numbers" (Appendix IV of *The Making of Index Numbers*), for "Jevons seems to have been the first to have kindled in others an interest in the subject and may perhaps be considered the father of index numbers." Jevons's geometric average of price ratios fails Fisher's determinateness test because the index would become zero if any of its components was zero. Perhaps the most common index was an arithmetic average of price ratios, simple or weighted, with the price indexes published by *The Economist* and *The Statist* (both of London) being simple arithmetic averages. Arithmetic averages are not invariant to the choice of the base year. Indeed, Fisher found no formula satisfying all his tests, and Swamy (1965) and Eichhorn (1976) have shown that no such formula can exist. Out of a possible score of seven (counting the withdrawal or entry test only for the price index), the highest score found by Fisher was 5.5, with six other formulae satisfying five tests. Four formulae even failed the unit-shifting test (changing the physical units of one commodity).

Since he did not consider the tests to be of equal importance, Fisher's choice of index number was not simply determined by the raw score. He attached little importance to the determinateness tests (regarding zero prices or quantities as of little practical significance) and placed most stress on the proportionality test. With proportionality, a change in M (currency) and M' (bank money) by the same proportion would,

if velocities of circulation and quantities were unchanged, cause each individual price and the price index to change in the same proportion.

If each year's price index was to be expressed on a common base, Fisher's preferred index was the total value of quantities sold in a year divided by what the value would have been reckoned at base prices. When each year was expressed in terms of the preceding year as a base (a chain index), Fisher considered price index formulae using the arithmetic or geometric average of the quantities in the two years as slightly superior in theory for year-to-year comparisons. Fisher (1913, p. 425) asserted that "Practically, however, there is little if any advantage" in these latter formulae as they are "practically far more laborious" to compute and "weighting is of little importance." Keynes (1983, XI, pp. 379–380) complained in his 1911 *Economic Journal* review of *The Purchasing Power of Money* that "Professor Fisher's theory, that the weights employed in compiling an index number seldom affect the result, naturally leads him to think that an index number made for one purpose is equally suitable for another and that the method of compilation can be safely determined by considerations of taste and convenience. … [W]hen Professor Fisher comes to the separate determination of P and T, he is content to publish what seem to the present reviewer to be unscientific guesses of the wildest character."

Fisher (1921) returned to the question of "The Best Form of Index Number" in talks to the American Statistical Association in Atlantic City in December 1920 and to the American Academy of Arts and Sciences in Boston in April 1921. As the paper had "not yet been completed in all the detail desirable for publication," the *Quarterly Publications of the American Statistical Association* for March 1921 published only a four-page abstract, followed by a very brief discussion by Wesley Clair Mitchell of Columbia University, editor of the *History of Prices During the War*, a little less than two pages of discussion by Warren M. Persons of Harvard University, seven pages of discussion by Correa Moylan Walsh, and a five-page rejoinder by Fisher. During revision for publication, "The Best Form of Index Number" grew into *The Making of Index Numbers*.

In his short abstract and long book, Fisher put aside several of the tests for a good index number proposed in his earlier book, not as

mistaken but as being of little quantitative importance (as well as dropping the so-called circular test as unsound in theory). While keeping a subordinate role for tests of determinateness, proportionality, and commensurability (independence of the units of measurement), he stressed two tests as most important, one from *The Purchasing Power of Money* and one new. The test from the earlier book was the time-reversal test: in comparing two years, an index calculated with one year as the base should be the reciprocal of the index calculated using the other year as the base. The new test was the factor-reversal test: the price index multiplied by the quantity index should give the correct figure for the index number of value. Few formulae conformed to both criteria. One that did satisfy both was proposed by Fisher as the ideal index number for all purposes. This was the square root of the product of an aggregative average weighted by base-year quantities (a Laspeyres index) and an aggregative average weighted by given-year quantities (a Paasch index), with the downward bias of the Laspeyres index offsetting the upward bias of the Paasch index. This formula, number 353 in *The Making of Index Numbers*, was formula 16 in *The Purchasing Power of Money*, but had not then been singled out by Fisher as the best formula. Fisher's ideal index does not, however, satisfy the circular test that a price index should be independent of the choice of another time point (decomposing it into the product of two similar price indexes).

Fisher's principal discussant at the American Statistical Association was C. M. Walsh. This was highly appropriate: Fisher dedicated *The Making of Index Numbers* "To F. Y. Edgeworth and Correa Moylan Walsh Pioneers in the Exploration of Index Numbers." The dedication to Walsh recognized Walsh's *The Measurement of General Exchange-Value* (1901), which Fisher had reviewed in the *Yale Review* in May 1902. Fisher's appendix to *The Making of Index Numbers* on "Landmarks in the History of Index Numbers" hailed Walsh (1901) as "the largest and best work, and the only general treatise on the theory of the subject up to the present time" (1922, p. 459). The only works of comparable stature were the reports from 1887 to 1889 of a British Association committee on index numbers, of which Edgeworth was a secretary (reprinted in Darnell 1991, VI, pp. 1–126). While Mitchell and Persons demurred at Fisher's claim that a particular index number formula was best for all purposes, rather than being simply a good

general-purpose index, Walsh largely accepted Fisher's view of the ideal price index. While acknowledging Fisher's priority and suggested that the index is known as Fisher's index number, Walsh drew attention to support for that index in his forthcoming short book, *The Problem of Estimation* (1921, pp. 102–103). Walsh was one of five people thanked by Fisher in the preface of *The Making of Index Numbers* for reading and commenting on the whole manuscript. A letter from Fisher to Mitchell inviting Mitchell to New Haven for a weekend to discuss index numbers mentioned that Walsh was coming (Fisher to Mitchell, June 24, 1921, Mitchell Papers, Columbia University). Another letter from Fisher to Mitchell mentions a conference Fisher held with several members of the American Economic Association's Committee on Index Numbers, which Mitchell (who chaired the committee) was unable to attend (Fisher to Mitchell, August 20, 1921).

Well before *The Making of Index Numbers* was published, and even before the manuscript was finished, Fisher's ideal index number formula was the subject of several articles. Warren Persons discussed it in the *Review of Economic Statistics* in May 1921, again holding it to be a good general-purpose index rather than ideal for all purposes. Royal Meeker of the International Labour Office in Geneva, formerly Commissioner of Labor Statistics and later a collaborator with Fisher in the Index Number Institute, also expressed doubt about the existence of a single ideal index in the *Quarterly Publications of the American Statistical Association* (1921).

Fisher sent a rough draft of his manuscript to Wesley Mitchell on November 10, 1921, asking Mitchell to return it to Fisher's New Haven address as soon as he had finished it, so that parts of it could be forwarded for Fisher to perfect in Europe, for which he would sail on November 23 (Fisher to Mitchell, Mitchell Papers, Columbia University). On the evening of March 30, 1922, Fisher made his first radio broadcast, about his European trip, just a few months after regular radio broadcasts began in the United States, then took the manuscript of *The Making of Index Numbers* to the Railway Express office: "I've been in a whirl with my book and so many other things. But the book is now really off! I took it down to the station and sent it myself, insured for $1,000! It seems too good to be true" (Fisher to Margaret Hazard Fisher, March 30, 1922, Fisher Papers, Yale University).

The Making of Index Numbers: A Study of Their Varieties, Tests, and Reliability, Fisher's fully worked-out version of his American Statistical Association paper, was finally three times as long as he had initially expected. With more than five hundred pages, 123 charts and 33 pages of tables of numbers, and what was expected to be a limited scholarly audience, it did not appeal to ordinary commercial publishers. Houghton Mifflin's Riverside Press agreed to publish the book for the Pollak Foundation for Economic Research, which made *The Making of Index Numbers* the Foundation's Publication no. 1. "Some of the work must have been abandoned had not the Pollak Foundation for Economic Research come to the rescue," paying for calculations as well as publication, wrote Fisher in the preface. The Pollak Foundation, which was directed by William T. Foster, a teacher of rhetoric and former president of Reed College, and which was financed by Waddill Catchings of the investment bankers Goldman Sachs & Company—provided a forum for the underconsumptionist views of those monetary heretics. Their sponsorship of major scholarly works such as Fisher's *Making of Index Numbers* and later a book on real wages by Paul Douglas (who had been an undergraduate at Reed College during Foster's presidency) provided Foster and Catchings with visibility and access to the economics profession rare for dissenting amateurs, as did their sponsorship of a $5000 prize for the best criticism of their book, *Profits* (1925). Foster was among those credited in the preface to *The Making of Index Numbers* with helping Fisher with the book and was thanked by Fisher in the acknowledgments for *The Money Illusion*. Foster and Catchings gave similar thanks to Fisher in the prefaces to their Pollak Foundation volumes on *Money* (1923) and *Profits* (1925). Another connection linking Fisher to Foster and Catchings was Hudson Bridge Hastings, Professor of Administrative Engineering at Yale and author of the third Pollak Publication, *Costs and Profits*. When Fisher thanked Hastings in the preface to *The Making of Index Numbers* as one of five people who had read the entire manuscript, he gave as the Pollak Foundation rather than Yale as an affiliation for Hastings.

To Fisher's "pleasant surprise," a second edition was called for within five months of the December 1922 publication. Only a few corrections were made in the second edition, and a detailed table of contents of

Appendix I was added. The third edition of 1927 added only Appendix IX, surveying recent literature on the subject. Franklin Ho, a former student of Fisher at Yale who went on to work for him before returning to China, translated *The Making of Index Numbers* into Chinese. The Central Statistical Office of the USSR published a Russian translation in 1928. Soviet interest in index numbers had been demonstrated by the Conjuncture Institute's publication of A. A. Konüs (1924), which sought to find bounds on a "true" constant-utility index of the cost of living, as distinct from Fisher's "ideal" index satisfying certain statistical tests, and Konüs and Byushgens (1926). Their techniques of proof for exact index number formulae developed the concept of duality and were to influence the work of Erwin Diewert (see Diewert 1993a, b, 2013). S. S. Byushgens (1925) and Konüs and Byushgens (1926) showed that Fisher's ideal index is exact if demand is governed by a homogenous quadratic utility function (see Afriat 1987, pp. 212–214). Soon thereafter such an interest in Western economics or economic conditions became dangerous in the Soviet Union: N. D. Kondrat'ev's Conjuncture Institute was closed in 1928 and the Central Statistical Office purged for "wrecking activities" with one of the allegations being that "Kondrat'ev with his staff of henchmen in the Conjuncture Institute was engaged in the study of the economy of foreign countries and described it in numerous bulletins and books" (Jasny 1972, p. 164). Kondrat'ev vanished in the purges: sentenced in 1930 to eight years in prison for leading the (non-existent) Working Peasants Party, upon the expiration of his sentence in 1938 he was sentenced to another ten years "without right of correspondence" and shot the same day. Slutsky became a meteorologist, but Konüs survived to resume writing about index numbers after Stalin's death and to become a Fellow of the Econometric Society in 1975.

Reception, Criticism, and Response

The Making of Index Numbers stimulated great debate in scholarly journals. Journal editors allocated space for substantial review articles by leading quantitatively inclined economists and to Fisher's extensive and

vigorous responses. In one journal, the *Journal of the American Statistical Association*, discussion of Fisher's tests for a good index number continued for some years, as Fisher's inability to find an index number that fully satisfied all his tests led to the conjecture that the tests were mutually inconsistent. Ragnar Frisch (1930, 1934, 1936) argued that Fisher's tests were mutually inconsistent, but S. Subramanian (1934) showed that a weakness in Frisch's attempted proof left the question of consistency of the tests open. Another proof of the inconsistency of Fisher's tests, by Abraham Wald (1937), also turned out to be flawed (see Swamy 1965). Subramanian Swamy (1965) offered a proof that no index number could satisfy all of Fisher's proportionality, circular, commensurability, and factor-reversal tests, and argued that the factor-reversal test was suspect. Eichhorn (1976) extended Swamy's proof, dropping the requirement of partial differentiability of the price index, and developed a weaker but consistent set of five tests (cf. Eichhorn and Voeller 1976; Jazairi 1972a, b; Diewert 1992, 2013).

The Statist sprang to the defense of its own price index, a simple arithmetic average that failed both the time-reversal and factor-reversal tests. *The Statist* compiled and published such a simple and theoretically unsound index even though the periodical's founder, Sir Robert Giffen, had served in the 1880s on Edgeworth's British Association for the Advancement of Science committee, which had recommended an aggregative average. *The Statist* defended its index editorially five times (January 27, February 3, February 10, April 14, and May 26, 1923) and published four letters to the editor from Fisher (March 31, April 7, May 26, and July 28, 1923, the second and fourth of which are quoted in Appendix IX). Fisher got the last word in the argument and had the stronger case. Felix Klezl of the Austrian Statistical Office, writing in the *International Labour Review* (August 1924), was the only supporter of *The Statist*'s stand on the simple arithmetic index. Fisher was forced, however, to admit in his April 7 letter to a clerical error that overstated the bias in the Sauerbeck-Statist index number (an error noted by A. L. Bowley, Carl Snyder, and G. Udney Yule in reviews), and to make the corresponding correction in the text and in Chart 55 in his second edition.

Apart from his controversy with the editors of *The Statist*, Fisher replied in print to reviews or review articles by the Harvard economist

Allyn Young in the *Quarterly Journal of Economics*, the London School of Economics statistician and mathematical economist A. L. Bowley in the *Economic Journal*, Carl Snyder of the Federal Reserve Bank of New York in the *American Economic Review*, and the British statistician G. Udney Yule in the *Journal of the Royal Statistical Society*. Fisher's replies amounted to thirty-three journal pages. In Appendix IX of the third edition of *The Making of Index Numbers*, Fisher noted major reviews of his book in Italy, Germany, and Switzerland, describing Ladislaus von Bortkiewicz of Berlin University as "my most constructive critic" for improving some of Fisher's formulae for the coefficient of correlation between price relatives and quantity relatives. The book captured international scholarly attention, all (except a few British critics) praising Fisher for an important and massive contribution to the field even when reviewers dissented from his down-grading of the circular test or his claim that his ideal index number formula was best for all purposes.

The first and longest review article of *The Making of Index Numbers* was by Allyn Young. Twenty-three pages long, it appeared in print in February 1923, a mere two months after the book was published. Young had corresponded with Fisher before publication, calling Fisher's attention to the appearance of his "ideal formula" along with other formulae in an 1899 article by Bowley in *Palgrave's Dictionary of Political Economy*. Frederick Macaulay noticed the "ideal formula" recommended (with the inadvertent omission of the square root sign) by A. C. Pigou in *Wealth and Welfare* (1912). Wesley Mitchell wrote to tell Fisher of its recommendation (with the square root sign) in Pigou's *Economics of Welfare* (1920), already spotted by Fisher (Fisher 1922, pp. xv, 241, Mitchell to Fisher, February 16, 1922, Fisher to Mitchell, February 18, 1922).

Young (1923, pp. 342, 345, 364) praised *The Making of Index Numbers* as "a notable scientific achievement. The book has the qualities of deft and finished workmanship one has come to expect in what Professor Fisher does. … The practical significance of this general winnowing of the whole field of index numbers can hardly be overestimated. … It is an important contribution to knowledge, and reflects honor on American scholarship." He found the factor-reversal test "ingenious and important" and Fisher's discussion of bias "one of the

most valuable, as well as the most original, parts of the work" (1923, pp. 350–351). Young (1923, p. 347) "agree[d] with Professor Fisher respecting the formulas which give the best year-with-year comparisons" but demurred at Fisher's abandonment of the circular test: "But I believe that in the practical construction of standard series of index numbers it is quite as important, on the whole, that the series should be self-consistent as that each number of the series should afford an impeccably accurate comparison with the base of the series." Consequently, Young could not accept that Fisher's ideal index was best for all purposes.

Young's review article led to the longest of Fisher's replies to critics of *The Making of Index Numbers*, a fourteen-page rejoinder in the August 1923 issue, in which Fisher (1923b, pp. 754–755) over-optimistically held that "it would seem that such discussions as Professor Young's, Professor Persons's, Professor Bowley's, the *Statist's*, and the present article mark the approach of the end, to all intents and purposes, of the age-long controversy over index number formulae." Fisher (1923b, p. 754) drew attention to Young's (1923, p. 363) "acceptance of the 'ideal' index number as 'beyond much doubt, the most accurate single index number of the movement of prices between any two years.' He gives no support to the common false belief that one formula is best for one 'purpose' and another for another."

In another very early review, in the *Economic Journal* for March 1923, A. L. Bowley omitted any initial praise of Fisher's book in general terms, and went straight into questioning whether the time-reversal and factor-reversal tests were in fact tests of universal validity, suitable regardless of the purposes for which the index number might be computed: "A test to which so much importance is attached, one which is used to condemn well-known index-numbers, ought not to have been put forward on so slender a basis" (Bowley 1923, p. 94). Fisher (1923a, p. 251) responded in June: "While thanking Professor Bowley personally both for his favourable expressions and for his criticisms, I confess to a regret that he seems to hesitate to throw his strong influence wholeheartedly in the direction of what might be called index-number reform, so much needed to-day in the interests of statistical science. This would seem especially appropriate, as the 'ideal' index-number which has been

associated with my name should, as shown in my book, be more properly associated with his." Bowley was not mollified: "My point about the factor-reversal test was that it had no theoretical justification; for this it is irrelevant to say that in fact index-numbers held to be good on other grounds satisfy it."

G. Udney Yule (1923) objected to Fisher's claim that "The purpose to which an index-number is put does not affect the choice of formula" (Fisher 1922, p. 229): "'Marry, that's a bountiful answer that fits all questions!' Professor Fisher's belief that he is able to give the correct answer to a question without knowing what the question is does not appear to me well founded. An unknown question cannot be answered at all. A vague and indefinite question cannot be answered definitely, and unless the purpose of an index-number - the question that it is intended to answer - is settled with complete precision, the correct formula to use cannot be stated. … The volume will serve as a useful encyclopaedia of formulae, and collection of arithmetical tests of such formulae. From the standpoint of principle it is wholly disappointing."

Fisher replied sharply in the January 1924 *Journal of the Royal Statistical Society*, at greater length than Yule's original review. Referring to his 1902 review of Walsh (1901), Fisher (1924, p. 91) noted that he had once believed that the purpose of an index number must have something to do with its measurement: "Having changed from Mr. Yule's position to (essentially) that of Walsh, I should be quite willing to change back if Mr. Yule had any real evidence to offer. But he offers none nor does he refute the evidence presented in my book. I am forced to the conclusion that he has here also missed the point. Mr. Yule is an able statistician and analyst, but, in his self-confidence, he seems hastily to have assumed that what was really a conclusion empirically reached is a 'basis' absurd a priori. The other reviewer [Fisher himself in 1902] fell into just this error." Fisher (1924, p. 94) also remarked that "Mr. Yule, while evincing a lively sympathy for the *Statist*, and, apparently, even resentment against me for my criticism of the *Statist's* index-number, does not venture to defend it; nor does he include in the above list of alleged different formulae for different purposes any case of the simple arithmetic."

R. G. Hawtrey (1930, pp. 152–153) objected that "If a price index has to be constructed to verify Professor Irving Fisher's Equation of

Exchange and for no other purpose, there is something to be said for including prices of securities. Professor Fisher includes in the totality of transactions all dealings in securities. But to my mind that is a defect in his formula, and it would be an improvement to exclude all dealings in stocks, shares, and pecuniary rights and to restate the Equation of Exchange, as Professor Pigou has proposed, in terms of transactions in goods and services only." Disregarding Fisher's argument for the geometric average of the Paasche and Laspeyres indexes as his ideal index, Hawtrey (1930, p. 131) argued that "much of that controversy [as to the ideal methods of averaging and weighting index-numbers] is, in reality, irrelevant to the selection of an index-number for Professor Fisher's Equation of Exchange. The equation of exchange itself determines its own type of index-number. Since the equation of exchange proceeds from a comparison of two aggregates of wealth, it must employ the type of index-number which arises from such a comparison, that is to say, the weighted arithmetic mean. The ambiguities inherent in that index, owing to the differences in weighting appropriate to the different periods to be compared, are inherent in the equation of exchange itself." Thus, the economist closest to Fisher's monetary theory of economic fluctuations was not only unpersuaded by Fisher's proposed ideal index but failed to see any purpose in Fisher's *The Making of Index Numbers*.

Conclusion

Although the US Bureau of Labor Statistics began to publish its index of wholesale prices in 1902 and to publish its cost of living index (later renamed the Consumer Price Index) in 1919, Fisher worked in an era of a limited compilation of statistics by the government. Consequently, he took it upon himself to carry his index number prescriptions into practice. Fisher founded the Index Number Institute in January 1923, a month after *The Making of Index Numbers* appeared. Beginning in that month, the *New York Times* and other papers published the Institute's weekly index number of commodity prices (a wholesale price index) every Monday. By 1929 the index was published in newspapers with

a combined circulation of seven million, and the institute published other indexes such as a weekly index of stock prices. Fisher wrote all the weekly articles accompanying the index until the end of 1930. Thereafter some were written by Royal Meeker, a former Princeton economics professor and Commissioner of Labor Statistics in the Wilson administration, hired by Fisher as president of the Index Number Institute. Fisher continued to write many himself until he sold the Index Number Institute to the Institute of Applied Econometrics, writing for example twenty-eight of the articles in 1932. This privately produced index was discontinued only in 1942, after which government statistics held the field (Allen 1993, pp. 173, 244).

Like his annual article in the *American Economic Review* on the equation of exchange, the weekly newspaper article and price indexes of the Index Number Institute show Fisher harnessing his great energy and power of perseverance for the empirical follow-up to his monetary theories. Unlike defenders of the gold standard or Austrian critics of aggregate reasoning, Fisher needed a meaningful price index for statistical verification of his quantity of money theory of the price level and of his monetary theory of economic fluctuations, for his proposed compensated dollar monetary policy rule, and for his proposed indexation of bonds. Fisher not only attempted the statistical verification of his version of the quantity theory of money and his monetary theory of economic fluctuations (see Dimand 1993); he also composed a monumental work on the best method of calculating the statistical indexes to be used for this purpose. As with the compensated dollar or 100% reserve banking, Fisher presented his ideal index number as a simple, definitive solution to an apparently complex problem. He undertook the daunting task of compiling these index numbers, without financial support from government or philanthropic foundations. He was determined not merely to add to knowledge, but to stabilize the economy by vanquishing money illusion and by persuading monetary authorities to stabilize a commodity price index rather than just the price of a single commodity, gold. This required reliable index numbers of prices. If these were lacking, Fisher would remedy the lack himself. Responsibility for producing such index numbers has since shifted to the public sector. Even so, the trail now followed is the one blazed by Fisher: in 1995, the

US Department of Commerce adopted Fisher's "ideal index number" for calculation of the GDP deflator and the associated quantity index.

What Fisher contributed to index number theory was the testing of a wide range of possible index number formulae for the degree to which each satisfied a list of desirable properties such as proportionality and independence of units of measurement, an approach continued by Eichhorn (1976) and Eichhorn and Voeller (1976). Inspired by the work of Correa Moylan Walsh, Fisher carried this test approach to index numbers much further than Walsh had. From this exhaustive testing, Fisher concluded in *The Making of Index Numbers* that a single formula, the geometric mean of the Paasche and Laspeyres indexes, was the ideal index number for all purposes. The reception of *The Making of Index Numbers* shows the deep-seated resistance to this idea of a single index number for all uses, typified in Bowley's review and in the title of Edgeworth's last article, "The Plurality of Index Numbers" (Edgeworth 1925b, see also Edgeworth 1925a). Over time, Fisher's notion of the same index number formula being suitable for different applications has become generally accepted in statistical index number theory, which deals with parameter-free statistical indexes, not dependent on the estimator or assumed functional form for the underlying utility, production or cost function. Moreover, Fisher's ideal index is still the index number formula that best satisfies the tests of this approach, with the Divisia index second (Serletis 1997, p. 324; Divisia 1925). However, Diewert (1993c) has shown that all known superlative indexes (indexes that are exact to flexible functional forms) are second-order approximations to each other, so that the choice of which superlative index to use in an application does not matter much. The journal discussion of Fisher's test approach, extensive both in terms of journal pages and of years, deepened understanding of why even Fisher's ideal index fully satisfied only five of his seven tests, and partially satisfied a sixth. Fisher's tests turned out to be inconsistent, so that no index number formula could meet all his criteria. One of Fisher's tests must be dropped to produce a mutually consistent set of criteria, but it remains an open question which one should go. The concept of exactness of an index emerged from the journal discussion of Fisher's book, with the demonstration by Byushgens and Konüs that

Fisher's ideal index is exact for a homogenous quadratic utility, production or cost function. Nearly a century after the first edition of *The Making of Index Numbers*, index number practice is catching up with Fisher's recommendations, and Fisher's claim that the index that best satisfied a set of statistical criteria is best for all purposes, so startling to many of his reviewers, no longer seems so controversial.

References

Afriat, S.N. 1987. *Logic of Choice and Economic Theory*. Oxford: Clarendon Press.

Allen, Robert Loring. 1993. *Irving Fisher: A Biography*. Cambridge, MA and Oxford: Blackwell.

Bennet, T.L. 1920. The Theory of Measurement of Changes in Cost of Living. *Journal of the Royal Statistical Society* 83: 455–462.

Bowley, A.L. 1923. Review of Fisher, *The Making of Index Numbers*. *Economic Journal* 33: 90–94.

Byushgens, S.S. 1925. Ob Odnom klasse giperpoverkhostey: po povodu 'idealnovo indeksa' Irving Fisher'a pokupatelnoi sili denig [On a Class of Hypersurfaces: Concerning the 'Ideal Index' of Irving Fisher]. *Mathematischeskii Sbornik* 32: 625–631.

Darnell, Adrian. 1991. *Early Mathematical Economics*, 6 vols. London: Pickering & Chatto.

Diewert, W. Erwin. 1992. Fisher Ideal Output, Input, and Productivity Indexes Revisited. *Journal of Productivity Analysis* 3: 211–248; reprinted in Diewert (1993c), 317–354.

Diewert, W. Erwin. 1993a. Overview of Volume 1. In Diewert (1993c), 1–31.

Diewert, W. Erwin. 1993b. The Early History of Price Index Research. In Diewert (1993c), 33–65.

Diewert, W. Erwin. 1993c. *Essays in Index Number Theory*, ed. W. Erwin Diewert and Alice Orcutt Nakamura (Vol. 1 of Diewert's *Collected Papers*). Amsterdam: North-Holland.

Diewert, W. Erwin. 2013. Irving Fisher and Index Number Theory. *Journal of the History of Economic Thought* 35: 199–232.

Dimand, Robert W. 1993. The Dance of the Dollar: Irving Fisher's Monetary Theory of Economic Fluctuations. *History of Economics Review* 20: 161–172.

Dimand, Robert W. 1999. Letter: Fisher and Indexed Bonds. *Journal of Economic Perspectives* 13: 224–225.

Dimand, Robert W. (ed.). 2007. *Irving Fisher: Critical Responses*, 3 vols. London and New York: Routledge.

Divisia, François. 1925. L'indice monétaire et la théorie de la monnaie. *Revue d'Economie Politique* 29: 980–1008.

Edgeworth, Francis Ysidro. 1925a. The Element of Probability in Index-Numbers. *Journal of the Royal Statistical Society* 88: 557–575.

Edgeworth, Francis Ysidro. 1925b. The Plurality of Index-Numbers. *Economic Journal* 35: 379–388.

Eichhorn, W. 1976. Fisher's Tests Revisited. *Econometrica* 44: 247–256.

Eichhorn, W., and J. Voeller. 1976. *Theory of the Price Index: Fisher's Test Approach and Generalizations*, Lecture Notes in Economics and Mathematical Systems. Berlin: Springer-Verlag.

Fisher, Irving. 1921. The Best Form of Index Number. *Quarterly Publications of the American Statistical Association* XVII: 533–551 (including discussion by W.C. Mitchell, W.M. Persons, C.M. Walsh, and reply by Fisher).

Fisher, Irving. 1922. *The Making of Index Numbers*. Boston: Houghton, Mifflin for Pollak Foundation for Economic Research; 3rd ed., 1927, reprinted in Fisher (1997), Vol. 5.

Fisher, Irving. 1923a. Professor Bowley on Index Numbers. *Economic Journal* 33: 246–251 (with reply by A.L. Bowley, 251–252).

Fisher, Irving. 1923b. Professor Young on Index Numbers. *Quarterly Journal of Economics* 37: 742–755.

Fisher, Irving. 1923c. Comment on Review of Fisher's *The Making of Index Numbers*. *American Economic Review* 13: 652–654.

Fisher, Irving. 1924. Mr. Udney Yule on Index Numbers. *Journal of the Royal Statistical Society* 87: 89–98.

Fisher, Irving. 1928. *The Money Illusion*. New York: Adelphi and London: George Allen & Unwin; reprinted in Fisher (1997), Vol. 8.

Fisher, Irving. 1997. *The Works of Irving Fisher*, ed. William J. Barber assisted by Robert W. Dimand and Kevin Foster, consultant ed. James Tobin, 14 vols. London: Pickering & Chatto.

Fisher, Irving, assisted by Harry G. Brown. 1911. *The Purchasing Power of Money*. New York: Macmillan; 2nd ed., 1913, reprinted in Fisher (1997), Vol. 4.

Fisher, I., with H.G. Brown. 1913. *The Purchasing Power of Money*, 2nd ed. New York: Macmillan; reprinted in Fisher (1997), Vol. 4.

Foster, William Trufant, and Waddill Catchings. 1923. *Money*. Boston: Houghton Mifflin, Riverside Press, for Pollak Foundation for Economic Research.

Foster, William Trufant, and Waddill Catchings. 1925. *Profits*. Boston: Houghton Mifflin, Riverside Press, for Pollak Foundation for Economic Research.

Frisch, Ragnar. 1930. Necessary and Sufficient Conditions Regarding the Form of an Index Number Which Shall Meet Certain of Fisher's Tests. *Journal of the American Statistical Association* 25: 397–406.

Frisch, Ragnar. 1934. Reply to Mr. Subramanian's Note. *Journal of the American Statistical Association* 29: 317.

Frisch, Ragnar. 1936. Annual Survey of General Economic Theory: The Problem of Index Numbers. *Econometrica* 4: 1–38.

Hastings, Hudson Bridge. 1923. *Costs and Profits: Their Relation to Business Cycles*. Boston: Houghton Mifflin, Riverside Press, for Pollak Foundation for Economic Research.

Hawtrey, Ralph G. 1930. Money and Index-Numbers. *Journal of the Royal Statistical Society* 93: 64–85, as reprinted in F.A. Lutz and L.W. Mints, eds., *Readings in Monetary Theory*. New York, Philadelphia and Toronto: Blakiston, 1951, 129–155.

Jasny, Naum. 1972. *Soviet Economists of the Twenties*. Cambridge: Cambridge University Press.

Jazairi, Nuri T. 1972a. Fisher's Ideal Index Reformulated. *International Statistical Review* 40: 47–51.

Jazairi, Nuri T. 1972b. Note on Fisher's Ideal Index. *Journal of the Royal Statistical Society*, C, 21: 89–92.

Jevons, William Stanley. 1884. *Investigations in Currency and Finance*, ed. H.S. Foxwell. London: Macmillan.

Keynes, John Maynard. 1983. *Collected Writings*, Vol. XI, ed. Donald E. Moggridge. London: Macmillan and New York: Cambridge University Press, for the Royal Economic Society.

Klezl, Felix. 1924. Methods of Calculating Index Numbers. *International Labour Review* 11 (August): 236–262.

Konüs, A.A. 1924. The Problem of the True Index of the Cost of Living (in Russian). *Economic Bulletin of the Institute of Economic Conjuncture* No. 9–10, 64–71, trans. *Econometrica* 7 (1939), 10–29.

Konüs, A.A., and S.S. Byushgens. 1926. K probleme pokupatelnoi cili deneg [On the Problem of the Purchasing Power of Money]. *Voprosi Konyunkturi*

2:1 (supplement to *Economic Bulletin of the Institute of Economic Conjuncture*), 151–172.
McCulloch, J. Huston. 1980. The Ban on Indexed Bonds. *American Economic Review* 70: 1018–1021.
Meeker, Royal. 1921. On the Best Form of Index Number. *Quarterly Publications of the American Statistical Association* 17: 909–915.
Persons, Warren M. 1921. Fisher's Formula for Index Numbers. *Review of Economic Statistics* 3: 103–113.
Pigou, A.C. 1912. *Wealth and Welfare*. London: Macmillan.
Pigou, A.C. 1920. *The Economics of Welfare*. London: Macmillan.
Scrope, G. Poulett. 1833. *Principles of Political Economy*. London: Longman, Rees, Orme, Brown, Green & Longman; reprinted New York: Augustus M. Kelley, 1969.
Serletis, Apostolos. 1997. Index Numbers. In *Business Cycles and Depressions: An Encyclopedia*, ed. David Glasner, 323–325. New York: Garland.
Subramanian, S. 1934. On a Certain Conclusion of Frisch's. *Journal of the American Statistical Association* 29: 316–317.
Swamy, Subramanian. 1965. Consistency of Fisher's Tests. *Econometrica* 33: 619–623.
Vogt, Arthur. 1997. *The Making of Tests for Index Numbers* (Published in Honour of the 50th Anniversary of the Death of Irving Fisher). Vienna: Physica-Verlag.
von Bortkiewicz, Ladislaus. 1924. Review of Fisher's *The Making of Index Numbers*. *Archiv für Sozialwissenschaft und Sozialpolitik* 51: 848–853.
von Mises, Ludwig. [1912] 1934. *Theory of Money and Credit*. London: Routledge.
Wald, Abraham. 1937. Zur Theorie der Preisindexziffern. *Zeitschrift fur Nationalokonomie* 8: 179–219.
Walsh, Correa Moylan. 1901. *The Measurement of General Exchange-Value*. New York: Macmillan.
Walsh, Correa Moylan. 1921. *The Problem of Estimation*. London: P. S. King.
Young, Allyn A. 1923. Fisher's *The Making of Index Numbers*. *Quarterly Journal of Economics* 37: 342–364.
Yule, G. Udney. 1923. Review of Fisher, *The Making of Index Numbers*. *Journal of the Royal Statistical Society* 86: 424–430.

7

Hubris, Nemesis, and Analysis: "Stock Prices Appear to Have Reached a Permanently High Plateau"

A Black Mark of Infamy

Irving Fisher became famous far beyond the economics profession for his remarks to the Purchasing Agents Association in New York City on October 15, 1929, that stock prices had reached "what looks like a permanently high plateau" and that "I expect to see the stock market a good deal higher than it is today within a few months" ("Fisher Sees Stocks Permanently High," *New York Times*, October 16, 1929, p. 8, quoted by, inter alia, Galbraith [1955] 1988, p. 94; Friedman 2014, p. 80), and similarly incautious statements on other occasions (e.g. Fisher 1929). The *New York Times* (October 22, 1929, p. 24) reported that "Fisher says prices of stocks are low" (quoted by Friedman 2014, p. 80). From Edward Angly's *Oh, Yeah!* (1931, p. 37; quoted by Galbraith [1955] 1988, p. 86) to Christopher Cerf and Victor Navasky's *The Experts Speak* (1984, pp. 47, 49, 50), snappy quotations from Fisher in 1929 and 1930 about the stock market have served populists seeking to demonstrate that supposed experts know nothing. The *Sunday New York Times Magazine* (October 16, 2005) marked the anniversary of the "black mark of infamy … worn by the Yale professor Irving Fisher." John Kenneth Galbraith ([1955] 1988, pp. 70–71)

R. W. Dimand, *Irving Fisher*, Great Thinkers in Economics,
https://doi.org/10.1007/978-3-030-05177-8_7

took care to remind readers that "Irving Fisher was the most original of American economists. Happily there are better things – his contributions to index numbers, technical economic theory, and monetary theory – for which he is remembered."[1] In contrast, the only mention of Fisher in Paul Strathern's *Dr. Strangelove's Game: A Short History of Economic Genius* (2001, p. 268) is for the "permanently high plateau" of stock prices. Fisher suffered in more than reputation from his overconfidence in the bull market. In the 1920s, he amassed a fortune of ten million dollars (largely through Rand Kardex, later Remington Rand, to which Fisher sold his invention of the Index Visible, an early version of Rolodex), of which he then lost eleven million, as Remington Rand shares fell from $58 to $1 (see Allen 1993; Fisher 1956). As John Kenneth Galbraith (1977, p. 192) remarked, "This was a sizeable sum, even for an economics professor."[2]

Fisher's Contributions to Understanding Financial Markets

Nonetheless, Irving Fisher made major contributions of lasting value to financial economics, including the understanding of stock markets, both directly and through his guidance and encouragement of his graduate students and of Alfred Cowles (see Dimand 2007). The "Fisher relation" of Fisher (1896), equating the difference between interest rates in any two standards to the expected rate of appreciation or depreciation of one standard against the other, provided the uncovered interest arbitrage parity condition; defined expected inflation as the difference between real and nominal interest rates; the expectations theory of the term structure of interest rates, and, through his argument that inflation

[1]Galbraith (1977, p. 195) added that "What is now called the Keynesian Revolution began with Irving Fisher. This Keynes himself affirmed. Writing to Fisher in 1944, he referred to him as one of his earliest teachers on these matters." See also Dimand (1995).

[2]Had Fisher stepped in front of a bus in the summer of 1929, he would now be cited as an example of how an ivory-tower economist could prosper in the financial world, like Keynes, who made three fortunes and only lost two.

expectations adjusted to monetary shocks only with a lag, provided the kernel of his monetary theory of economic fluctuations. Fisher (1906), viewing capital as simply the net discounted present value of the expected stream of income (including income from human capital), was fundamental to accounting valuation (Chambers 1971; Burton 1980) and to the valuation of equity (see the "dividend discount model" of John Burr Williams 1938; following Fisher 1906; Fisher 1930c, Chapter 1, in valuing stocks at the net present value of the expected dividend stream)—and sidestepped some of the capital theory paradoxes that might arise in valuing capital considered as a stock of heterogeneous capital goods. The two-period "Fisher diagram" of intertemporal allocation and consumption smoothing (Fisher 1907, p. 409) brings together the roles of the marginal rate of time preference and the expected rate of return on investment in coordinating saving and investment (textbooks almost always attribute the Fisher diagram to Fisher 1930c but always without a page number—since the diagram does not actually appear anywhere in that book, but only in the 1907 volume). Fisher (1906) also included a pioneering analysis of the role of risk in the pricing of financial assets, including a "coefficient of caution" as a measure of risk aversion (see Crockett 1980; Stabile and Putnam 2002; Stabile 2005, Chapter 3). Fisher (1925b) pioneered indexed bonds and, more than three quarters of a century before US Treasury Inflation-Protected Securities or British Government real return bonds, he persuaded Rand Kardex to issue an indexed bond (and indexed his secretary's pay to Fisher's weekly wholesale commodity price index, to the annoyance of his secretary, whose rent was not indexed). The table of contents of *How to Invest When Prices Are Rising* (Fisher et al. 1912) identified Fisher as a professor of economics and finance, not just economics.

Stocks Versus Bonds

Notwithstanding his 1929 disaster, Fisher's contributions to financial economics included notable contributions to the understanding of common stocks as financial assets, particularly the comparison between stocks and bonds. Fisher (e.g. 1925a) railed at the supposed distinction

that stocks are risky because their prices fluctuate while bonds are supposedly riskless apart from the chance of default (so that government bonds denominated in the national currency would be completely riskless). Fisher's *Appreciation and Interest* (1896) and *Purchasing Power of Money* (Fisher with Brown 1911) stressed the ill effects of imperfectly anticipated changes in the purchasing power of money, disrupting income distribution, allocation signals, and macroeconomic stability. Together with Senator Robert L. Owen, Fisher tried without success to have Congress mandate the projected Federal Reserve System to stabilize the purchasing power of money rather than the dollar price of gold. Writing of the post-World War I hyperinflations in Germany, Austria and elsewhere in Central and Eastern Europe, Fisher's *Money Illusion* (1928) showed in vivid detail how the legal restriction of pension funds and trust funds to investing only in supposedly riskless titles to money had ruined them and their beneficiaries. Fisher tried to educate the public to understand changes in the price level (the reciprocal of the purchasing power of money) so that expectations of inflation would be correct and so inflation would have no real effects, starting with *Appreciation and Interest* (1896) and continuing through advocacy of the Fisher ideal index (the geometric mean of the Paasche and Laspyres price indexes) to the production in the 1920s of a weekly price index by the Index Number Institute, which, despite its grand name, was located in the basement of Fisher's home. As an alternative to educating the public, Fisher (1925b) tried to persuade policy-makers to hold the price level constant, and to promote indexation (including indexed bonds) to neutralize the appreciation or depreciation of money. And Fisher (e.g. Fisher et al. 1912; Fisher 1925a) argued eloquently, repeatedly and at considerable length that the widespread misperception of titles to money as riskless led to underpricing of common stocks, so that real rates of return on common stock exceeded real rates of return on bonds by more than could be justified by the actual difference in risk between stocks and bonds—what was later termed the "equity premium puzzle" (Mehra and Prescott 1985).

In his introduction to *How to Invest When Prices Are Rising* (Fisher et al. 1912, p. 6) Fisher wrote that

> The trustee has assumed gilt-edged bonds are safe and has preferred such investment to stocks, since all stocks involve the risks of business. Yet, as every reader of this book will clearly see, the man or woman who invests in bonds is speculating in the general level of prices, or the purchasing power of money. There is not much to choose between the risks run by investing in stocks and risks run by investing in bonds. The two risks are, it is true, of different kinds, one being the risks of particular industries, and the other the risks of changes in the value of the gold dollar. But they are both real risks.

Trustees did not merely prefer gilt-edged bonds and other titles to money during the German, Austrian or Hungarian hyperinflations, but were required by law to do so: better to lose everything than to take risks (see Fisher 1928, passim, for Fisher's attempts to explain to people in Germany and Austria during the hyperinflation that something was happening to money, not just to the price of this or that good).[3] *How to Invest When Prices Are Rising* (1912) was a collaborative work to which Yale assistant professor Harry Gunnison Brown, a Yale Ph.D. who had assisted Fisher with *The Purchasing Power of Money* (1911), contributed a chapter on "Rising Prices and Investments", and John Pease Norton, Yale Ph.D. and former assistant professor, author of *Statistical Studies in the New York Money Market* (1902), and by 1912 the full-time vice-president of the American Association for the Advancement of Science, wrote a chapter on "Stocks as an Investment When Prices are Rising" (pp. 77–101). In addition to Fisher's former doctoral students, Princeton quantity theorist Edwin Kemmerer contributed, and the book's publisher, G. Lynn Sumner, editor and publisher of the *Securities Review*, wrote the conclusion. The book coincided with Fisher's proposal for an International Conference on the High Cost of Living (which Fisher reported in his introduction to Fisher et al. [1912], was endorsed by President William Howard Taft and the US Senate, but not the House of Representatives), with his

[3]As the opportunity cost of holding money soared, demand for real money balances M/P collapsed, but Reichsbank president Dr. Rudolf Havenstein promised that, with 38 new high-speed printing presses, the Reichsbank would print money fast enough to catch up with the price level.

attempt with Senator Robert L. Owen to write Fisher's goal of price stabilization into the Federal Reserve Act (blocked by Representative Carter Glass and the House Banking Committee), and Fisher's attempt, aided by Norton's AAAS post, to create an international group or society to promote mathematical and statistical methods in economics. Fisher's simultaneous attempts to hold a world conference, change the US monetary system, reform the methodology of economics, and later how portfolio investments were made were not entirely separate in the eyes of onlookers, and probably not in Fisher's mind either. None of that multiplicity of forward-looking endeavors succeeded at the time.

Edgar L. Smith (1924) and Kenneth Van Strum (1925), in studies welcomed by both Fisher (1925a, 1929, pp. 15–16, 1930a, p. 95) and John Maynard Keynes (1925; see Keynes 1924, 1925; Keynes 1971–1989, Vol. XI; Davenport 1975), presented statistical evidence for the excellent performance of common stocks as long-term investments in a world in which the purchasing power of money fluctuates, as Fisher had previously argued. According to Fisher (1925a, p. 230), "during the falling prices following the Civil War stocks and bonds were about equal as to yield, while during the rising prices since 1896 the real yield on stocks is about four times the real yield on bonds" (notice that Fisher, like Smith and Van Strum, came to this opinion before the bull market of 1925–1929). This view was not generally accepted until much later. In the aftermath of the Wall Street crash, Chamberlain and Hays's authoritative book on *Investment and Speculation* (1931) insisted that only bonds could be bought for investment while purchase of stocks was speculation. A Federal Reserve Board survey of public opinion in 1948 discovered that 90% of Americans were opposed to owning common stocks, split about evenly between those who considered stocks "not safe, a gamble" and those unfamiliar with stocks (Graham 1973, pp. 1–3).

So, Fisher was led into disaster by what would later have been considered a valid recognition of the equity premium puzzle. Over very long periods of time, the real return on common stocks in the United States has exceeded the real return on government bonds by more than can

plausibly be attributed to differences in risk. The Dow Jones industrial average closed at 177 in 1948, compared to its 1929 peak of 381, so the respondents to that Federal Reserve Board survey in 1948 might reasonably have replied to studies of how well common stocks performed as investments for the long run by recalling Keynes's maxim that in the long run we are all dead.

Kathryn Dominguez et al. (1988), comparing Fisher's forecasting record in the Crash and Depression with that of the Harvard Economic Society (on which see Friedman 2014, and quotations from the Society's overoptimistic weekly newsletter by Galbraith [1955] 1988, pp. 71, 144–146, 178), pointed out in Fisher's defense that the Great Depression was not an unavoidable consequence of the bursting of the Wall Street bubble but was at least in large part the result of mistaken policy responses. Ellen McGrattan and Edward Prescott (2004) went further in "The 1929 Stock Market: Irving Fisher Was Right", a title that ended with an exclamation mark in the NBER working paper version (perhaps the journal referees demurred). McGrattan and Prescott argued persuasively that available data on stock price/earnings ratios fully justified 1929 stock prices. But, like Fisher himself, they went too far: if the stock market was efficient in 1929, correctly taking account of all relevant information, what Fisher should have concluded was that stock prices were equally likely to move up or down, not that they could only move up. Fisher's "permanently high plateau" was not a claim that the stock market was working properly, but, even if Fisher did not think of it that way, an assertion that the market was wrong, underpricing stocks so much that they could change in one direction, and that Fisher knew better than the market. Fisher made an even stronger claim than that made by any stock forecaster who thinks stock prices are more likely than not, perhaps much more likely than not, to change in a stated direction: Fisher claimed in October 1929 that they could only go up, not that stock prices were more likely to rise than fall (although he thought he was being more moderate than the extreme bulls, by predicting a plateau of stock prices rather than a continued rise).

Falling off a Permanently High Plateau

Fisher, and the Harvard Economic Society of Warren Persons and Charles J. Bullock, were not the only forecasters humiliated by the 1929 stock market crash (Friedman 2014). The revised edition of Garfield V. Cox's *Appraisal of American Business Forecasts* ([1929] 1930) had a more muted tone than the first edition. In his presidential address to the American Statistical Association (meeting jointly with the Econometric Society, then a new, small organization of which Fisher was also president), Fisher (1933a, pp. 9–10) acknowledged:

> It was because practically all the would-be economic forecasters have for the last four years failed dismally to tell the business man what to expect that a business man, Mr. Alfred Cowles, III, has stepped forward to finance the Econometric Society in the hope that out of it might grow scientific prediction. He has also organized a statistical laboratory where he is trying to make us of the most promising methods. He has a paper to present here at a joint session of the Statistical Association and the Econometric Society on some of the failures of recent economic predictions [Cowles 1933]. It is well that we face these failures and that, when we fail, we confess it with due humility. I confess it.

Fisher was mistaken in believing that Cowles shared the goal of Fisher and Norton, scientific prediction of stock prices. Cowles, a pioneer of efficient markets, held that anyone who could predict movements of stock prices would act on that knowledge, not publish it. Fisher's uncharacteristic confession of failure and declaration of humility also require closer examination. What failure of prediction was Fisher acknowledging?

Fisher (1933a, p. 10) informed his audience that, "It is true that in September 1929, I publicly stated my belief that we were 'then at the top of the stock market' and that there would be a recession, this forecast being largely on the strength of the elaborate correlation work

of Karl Karsten. And this proved true. But unfortunately I also stated my belief that the recession would be slight and short; and this proved untrue" (cf. Karsten 1931). This unlikely recollection contrasts with the transcript of Fisher's address to the District of Columbia Bankers Association on the evening of Wednesday, October 23, 1929 (Fisher 1997, Vol. 10, pp. 2–26), in which, although "I understand there was quite a break today at the last hour," Fisher concluded by reassuring his listeners that "unless there is real panic tomorrow – and I do not know what did happen today -- unless there should be a very radical change in the psychology or unless this lunatic fringe is much larger than I have ever dreamed it was, we shall not see very much further, if any, recession in the stock market, but rather a ragged stock market in the next few weeks, and then, after the first of the year, a resumption of the bull market, not as rapidly as has been in the past, but still a bull rather than a bear market." There was a real panic on the following day. Nonetheless, the following February, Fisher concluded his instant book on *The Stock Market Crash—And After* (1930b, p. 269), "As a means of further present reassurance I trust that the book itself will be of some use, besides affording substantial reasons for practical optimism for the future … For the immediate future, at least, the outlook is bright." Fisher's (1933) claim to have predicted a bear market and recession was not evident in his speeches and writings of 1929 and 1930, and brings to mind Napoleon Bonaparte on St. Helena, dictating memoirs in which he claimed to have won the Battle of Waterloo and expressed sympathy for the distress of Londoners when they heard the news (Taylor 1967, p. 12). More usefully, Fisher's effort to understand why the 1929 downturn became a Great Depression while that of 1921 did not lead him to his debt-deflation theory of depressions (1933b), largely ignored at the time because he had lost his audience, but from 1975 onwards he was a key influence on Hyman Minsky, James Tobin, Ben Bernanke (Chairman of the Federal Reserve System, 2006–2014), and Mervyn King (Governor of the Bank of England, 2003–2013).

Fisher's Statisticians: Karsten and Sasuly

Fisher's citation of the statistician Karl Karsten in connection with Fisher's supposed 1929 prediction of a stock crash and recession is noteworthy. The preface of Karsten's *Scientific Forecasting* (1931, p. 6) acknowledged "the friendly assistance" of Professor Irving Fisher and "the never-failing encouragement shown by Professor Wesley Mitchell." Karsten (1931, p. 160) claimed to be able to forecast "speculative price-levels" but insisted piously that while "The temporary publication of such predictions may be justified by such circumstances as justify a public demonstration of any invention; but the regular and permanent use of any system whereby profit can be made in gambling or speculation will naturally be restricted to public use." Karsten (1931, p. 178), who published predictions of market events only after they had happened, claimed that "On December 17th, 1930, a small fund was placed at a New York brokerage house, to be managed by one of the officers of this laboratory [the Karsten Statistical Laboratory of New Haven, Connecticut] strictly in accordance with the indications of the six speculative barometers which had passed the various tests that have been described … The history of this fund is available at the [unidentified] broker's office." Karsten (1931) offered week by week figures on the supposed growth of the value of each unit of the demonstration fund from $1.00 on December 17, 1930, to $1.78 on June 3, 1931, "average payment of brokerage expenses," a rate of return of 2.44% per week compounded weekly, 11.02% per month compounded monthly, and 250.50% per annum compounded annually, over a period in which the Dow Jones industrial average declined by 21%. Even Bernard Madoff might have been impressed by Karsten and his record of steady, unverifiable above-market returns, if perhaps not the same way that Fisher was. Max Sasuly (1947, p. 267), wrote in his *Econometrica* obituary of Fisher to "the Edge-Karsten 'Quadrature' correlation hoax" (referring to Karsten 1924, a scholarly-looking but nonsensical journal article that was cited seriously by, among others, Wesley Mitchell).

Max Sasuly took Karsten's place as the statistician closest to Fisher (see Sasuly 1934, building on Fisher's work on distributed lags and smoothing of time series), working for Fisher's Index Number Institute

before joining the National Recovery Administration (under NRA research director Charles Roos, first research director of the Cowles Commission and first secretary-treasurer of the Econometric Society), and was collaborating with Fisher on a book about the velocity of circulation of money when Fisher died in 1947. Sasuly (1947, pp. 271–272) recalled collaborating with Fisher during

> three years of intensive work on the analysis of industrial common-stock trends of 1924-28 and earlier … Several studies made during this period, awaiting publication, are of continuing interest. Among these is an interesting 'Formulary for Anticipating Short-Time Changes in Market Action' [not found in the Irving Fisher Papers at Yale]. Most of its elements were derived by Fisher on the basis of long familiarity with the trading of seasoned Wall Street investors and speculators. Difficult as it may be for some to believe, this formulary actually worked with a definitely favorable margin. We succeeded in eliciting certain definite statistical regularities in the behavior of traders on the Board in industrial common stocks during the period 1925-28. Presumably the changes of subsequent years, especially under the regulations of the Securities and Exchange Commission, would require a modification of the details of the formularies. The principles, capable of wider application, appear quite likely to stand.

In a footnote, Sasuly added that "Made known – for public use – during the life of the National Recovery Administration, these principles were eagerly received by some of the statisticians come from Wall Street to 'help' in the Recovery effort. It appears that the procedure was later used with success in stock-market trading." It is indeed difficult to believe that Fisher and Sasuly believed, up to Fisher's death in 1947, that they had discovered a "Formulary for Anticipating Short-Time Changes in Market Action," based on studying a period of rising stock prices to derive the general scientific principle that it is profitable to bet on stock prices going up. Despite October 1929, despite his own impoverishment, Fisher continued to believe that he knew how to predict stock prices, and that others were improperly profiting from his scientific discovery.

Alfred Cowles

Beyond his own contributions to financial economics, Fisher continued contributing through the work of his doctoral students: John Pease Norton (1902), whose Yale dissertation on the New York money market was hailed by Judy Klein (1997, pp. 64–66, 115–118, 238–240) as a landmark in the history of time series analysis, the contributions of Norton and Harry G. Brown to Fisher et al. (1912), Chester A. Phillips's (1920) Yale dissertation on fractional-reserve banking, and James Harvey Rogers (1926, 1927) on the money market and stock speculation (see Dimand 2006). Foremost among the scholars whom Fisher encouraged was Alfred (Bob) Cowles III, *Chicago Tribune* heir turned Colorado Springs investment counselor, who had become gravely disillusioned with stock market forecasts, both those of his own investment letter (which he discontinued at the beginning of 1931) and those of other forecasters. Cowles (1933, 1944) applied sophisticated statistical techniques to test whether stock forecasters could do better than chance, finding (with one apparent exception in his 1944 follow-up study) that they could not (Brown et al. 1998, Dimand and Veloce 2010). Among the byproducts of Cowles's critique of the forecasters was his creation of a data set of US stock prices stretching back to 1871 (Cowles and Associates 1938). Another was his August 1931 letter to Fisher (whom Cowles's father and uncle had known as Yale undergraduates in the 1880s), offering to pay for a journal for the Econometric Society (of which Fisher was the founding president, from December 1930 to 1935) and a statistical research organization, an offer that led to the creation of *Econometrica* and the Cowles Commission for Research in Economics (now the Cowles Foundation). Cowles managed this with such tact that his efforts were warmly supported by Fisher, who might easily have taken Cowles's sweeping rejection of stock market prediction as a personal attack. Cowles not only provided funds for a journal, a research organization, and a summer conference, but also served as circulation manager for *Econometrica*, as treasurer of the Econometric Society from 1932 (and secretary from 1937), and a president of the Cowles Commission (with Fisher on the Advisory Council). His role in bringing many subsequently-famous econometricians and economic theorists to the Cowles summer conferences has attracted

notice. But another aspect of Cowles's tactful management has not been remarked: Karl Karsten and the Karsten Statistical Laboratory, and Max Sasuly despite his NRA connection with Charles Roos, never got a foot in the door at the Cowles Commission or Econometric Society.

Conclusion

Irving Fisher ruined his public reputation and his personal finances by his hubristic overconfidence about the stock market in 1929—and, although overtaken by nemesis, continued to believe that he knew how to predict stock movements, even when many people who knew nothing else about the economics profession knew that Irving Fisher could not predict the stock market. Yet he was led to this disaster by upholding some sound economic insights: that bonds and not only stocks were risky investments, that over long periods the real return on stocks exceeded that on bonds by more than could be justified by differences in risk (but to enjoy the long-run returns one must survive the short run). He made contributions of fundamental importance to the understanding of financial economics (the Fisher relation, the Fisher diagram, the Fisher ideal index number, the coefficient of caution) and to practical finance (indexed bonds), and promoted valuable work by his doctoral students Norton, Brown, Phillips, and Rogers, and by Cowles, as well as subsequently-discredited work by Karsten. Both the great analytical and empirical contributions, and the fatal lack of caution displayed by the inventor of the coefficient of caution, were characteristic of Irving Fisher and his legacy.

References

Allen, R.L. 1993. *Irving Fisher: A Biography.* Cambridge, MA: Blackwell.

Angly, E. 1931. *Oh, Yeah!* New York: Viking.

Brown, S.J, W.N. Goetzmann, and A. Kumar. 1998. The Dow Theory: William Peter Hamilton's Track Record Reconsidered. *Journal of Finance* 53: 1311–1333.

Burton, J.H. 1980. Irving Fisher, Father of the Income Approach. *Real Estate Appraiser and Analyst* 46 (September/October): 56–60.

Cerf, C., and V. Navasky. 1984. *The Experts Speak: The Definitive Compendium of Authoritative Misinformation*. New York: Pantheon.

Chamberlain, L., and W. Hay. 1931. *Investment and Speculation: Studies of Modern Movements and Basic Principles*. New York: H. Holt.

Chambers, R.J. 1971. Income and Capital: Fisher's Legacy. *Journal of Accounting Research* 1: 137–149.

Cowles III, A. 1933. Can Stock Market Forecasters Forecast? *Econometrica* 1 (2): 309–324.

Cowles III, A. 1944. Stock Marketing Forecasting. *Econometrica* 12: 206–214.

Cowles III, A., and Associates. 1938. *Common Stock Indexes, 1871–1937.* Bloomington, IN: Principia Press, Cowles Commission Monograph No. 3, 2nd ed., 1939.

Cox, G.V. [1929] 1930. *An Appraisal of American Business Forecast*, rev. ed. Chicago: University of Chicago Press.

Crockett, J.H. 1980. Irving Fisher on the Financial Economics of Uncertainty. *History of Political Economy* 12: 65–82.

Davenport, N. 1975. Keynes in the City. In *Essays on John Maynard Keynes*, ed. M. Keynes. Cambridge: Cambridge University Press.

Dimand, R.W. 1995. Irving Fisher, J. M. Keynes, and the Transition to Modern Macroeconomics. In *New Perspectives on Keynes*, ed. A.F. Cottrell and M.S. Lawlor. Durham, NC: Duke University Press. Annual Supplement to *History of Political Economy* 27: 247–266, with comment by D. Laidler, 267–271.

Dimand, R.W. 2006. Irving Fisher and His Students as Financial Economists. In *Pioneers of Financial Economics, Vol. 2*: *Twentieth-Century Contributions*, ed. G. Poitras with F. Jovanovic, 45–59. Cheltenham and Northampton, MA: Edward Elgar.

Dimand, R.W. 2007. Irving Fisher and Financial Economics: The Equity Premium Puzzle, the Predictability of Stock Prices, and Intertemporal Allocation Under Risk. *Journal of the History of Economic Thought* 29 (2): 153–166.

Dimand, R.W., and W. Veloce. 2010. Alfred Cowles and Robert Rhea on the Predictability of Stock Prices. *Journal of Business Inquiry* 9 (1): 56–64.

Domingues, K., R. Fair, and M. Shapiro. 1988. Forecasting the Depression: Harvard Versus Yale. *American Economic Review* 78 (September): 595–612.

Fisher, I. 1896. *Appreciation and Interest.* New York: Macmillan for the American Economic Association; reprinted in Fisher (1997), Vol. 1.

Fisher, I. 1906. *The Nature of Capital and Income.* New York: Macmillan; reprinted in Fisher (1997), Vol. 2.

Fisher, I. 1907. *The Rate of Interest.* New York: Macmillan; reprinted in Fisher (1997), Vol. 3.

Fisher, I. 1925a. Stocks vs. Bonds. *The American Review of Reviews* 72: 44–46, as adapted in *Economic Problems: A Book of Selected Readings*, ed. F.R. Fairchild and R.T. Compton, 230–236. New York: Macmillan, 1928; and reprinted in Fisher (1997), Vol. 8.

Fisher, I. 1925b. The Stabilized Bond—A New Idea in Finance. *The Annalist* 12 (13 November), 1096ff., as extracted in *Economic Problems: A Book of Selected Readings*, ed. F.R. Fairchild and R.T. Compton, 236–239. New York: Macmillan, 1928; and reprinted in Fisher (1997), Vol. 8.

Fisher, I. 1928. *The Money Illusion*. New York: Adelphi and London: George Allen & Unwin; reprinted in Fisher (1997), Vol. 8.

Fisher, I. 1929. Transcript of an Address Delivered at a Meeting of the District of Columbia Bankers Association, 23 October 1929. In Fisher (1997), Vol. 10, pp. 3–26.

Fisher, I. 1930a. The Stock Market Panic in 1929. *Journal of the American Statistical Association* (Proceedings of the American Statistical Association) 25 (March), 93–96; as reprinted in Fisher (1997), Vol. 10, pp. 27–30 (talk to American Statistical Association, December 28, 1929).

Fisher, I. 1930b. *The Stock Market Crash—And After*. New York: Macmillan.

Fisher, I. 1930c. *The Theory of Interest*. New York: Macmillan; reprinted in Fisher (1997), Vol. 9.

Fisher, I. 1933a. Statistics in the Service of Economics. *Journal of the American Statistical Association* 28 (1): 1–13.

Fisher, I. 1933b. The Debt-Deflation Theory of Great Depressions. *Econometrica* 1 (3): 337–357; reprinted in Fisher (1997), Vol. 10.

Fisher, I. 1997. *The Works of Irving Fisher*, 14 vols., ed. W.J. Barber assisted by R.W. Dimand and K. Foster, contributing ed. J. Tobin. London: Pickering & Chatto.

Fisher, I. with H. G. Brown. 1911. *The Purchasing Power of Money.* New York: Macmillan; 2nd ed., 1913, reprinted in Fisher (1997), Vol. 4.

Fisher, I., E.W. Kemmerer, H.G. Brown, W.E. Clark, J.P. Norton, M. Rollins, and G.L. Sumner. 1912. *How to Invest When Prices Are Rising: A Scientific Method for Providing for the Increased Cost of Living*. Scranton, PA: G. Lynn Sumner & Company, Publishers of *Securities Review*.

Fisher, I.N. 1956. *My Father Irving Fisher*. New York: Comet.

Friedman, W.A. 2014. *Fortune Tellers: The Story of America's First Economic Forecasters*. Princeton, NJ: Princeton University Press.

Galbraith, J.K. 1977. *The Age of Uncertainty*. Boston: Houghton Mifflin.
Galbraith, J.K. [1955] 1988. *The Great Crash 1929*, with New Introduction. Boston: Houghton Mifflin.
Graham, B. 1973. *The Intelligent Investor*, 4th rev. ed. New York: Harper & Row.
Karsten, K.G. 1924. The Theory of Quadrature in Economics. *Journal of the American Statistical Association* 19 (1): 14–29.
Karsten, K.G. 1931. *Scientific Forecasting: Its Methods and Applications to Practical Business and to Stock Market Operations*. New York: Greenberg.
Keynes, J.M. 1924. Investment Policy for Insurance Companies. *Nation and Athenaeum* 35 (May 17): 226.
Keynes, J.M. 1925. An American Study of Shares Versus Bonds as Permanent Investments. *Nation and Athenaeum* 36 (May 2); reprinted in Keynes (1971–1989), Vol. XI.
Keynes, J.M. 1971–1989. *The Collected Writings of John Maynard Keynes*, 30 vols., General eds. D.E. Moggridge and E.A.G. Robinson, Volume eds. D.E. Moggridge and E.S. Johnson. London: Macmillan and New York: Cambridge University Press, for the Royal Economic Society.
Klein, J.L. 1997. *Statistical Visions in Time: A History of Time Series Analysis 1662–1938*. Cambridge: Cambridge University Press.
McGrattan, E.R., and E.C. Prescott. 2004. The 1929 Stock Market: Irving Fisher Was Right. *International Economic Review* 45: 991–1009.
Mehra, R., and E.C. Prescott. 1985. The Equity Premium. *Journal of Monetary Economics* 15: 145–161.
Norton, J.P. 1902. *Statistical Studies in the New York Money Market, Preceded by a Brief Analysis Under the Theory of Money and Credit, with Statistical Tables, Diagrams, and Folding Chart*. New York: Macmillan for the Department of Social Sciences, Yale University; reprinted New Haven, CT: Tuttle, Morehouse and Taylor, 1903.
Phillips, C.A. 1920. *Bank Credit*. New York: Macmillan.
Rogers, J.H. 1926. The Effect of Stock Speculation on the New York Money Market. *Quarterly Journal of Economics* 40: 435–462.
Rogers, J.H. 1927. *Stock Speculation and the Money Market*. Columbia, MO: Lucas Brothers.
Sasuly, M. 1934. *Trend Analysis of Statistics.* Washington, DC: Brookings Institution.
Sasuly, M. 1947. Irving Fisher and Social Science. *Econometrica* 15: 255–278.

Smith, E.L. 1924. *Common Stocks as Long-Term Investments.* New York and London: Macmillan.

Stabile, D. 2005. *Forerunners of Modern Financial Economics: A Random Walk in the History of Economic Thought, 1900–1950*. Cheltenham and Northampton, MA: Edward Elgar.

Stabile, D., and B. Putnam. 2002. Irving Fisher and Statistical Approaches to Risk. *Review of Financial Economics* 11: 191–203.

Strathern, P. 2001. *Dr. Strangelove's Game: A Brief History of Economic Genius*. New York: Random House.

Taylor, A.J.P. 1967. *Europe: Grandeur and Decline*. Hardmondsworth: Penguin Books.

van Strum, K. 1925. *Investing in Purchasing Power*. Boston: Barron's.

Williams, J.B. 1938. *The Theory of Investment Value*. Cambridge, MA: Harvard University Press; reprinted Amsterdam: North-Holland, 1956.

8

The Debt-Deflation Theory of Great Depressions

Irving Fisher is now recognized in the economics profession mainly for the equation of exchange, the Fisher relation between real and nominal interest rates, and the Fisher diagram of intertemporal allocation, but in the outside world, and for a long time also among economists, he was known for being spectacularly wrong about the stock market in October 1929 (see, for example, his address to the District of Columbia Bankers Association on October 23, 1929, in Fisher 1997, Vol. 10, pp. 3–26). Citations to Fisher in journal articles in monetary economics and macroeconomics dwindled in the 1930s and vanished in the 1940s. Fisher's explanation of what had gone wrong, how the US and world economy had slumped into a Great Depression rather than recovering quickly after a sharp recession as in 1921, fell on deaf ears. Yet Fisher's debt-deflation theory of depression (Fisher 1932, 1933), belatedly rediscovered by Hyman Minsky (1975), Charles Kindleberger (1978), and James Tobin (1980), deserves consideration—and received it, notably from Ben Bernanke (1995, 2000) and Mervyn King (1994), whose

This chapter uses material that originally appeared in an article published in *Review of Social Economy* 52 (1): 97–107, online 2 November 2006. It is available open access under a CC BY license at https://doi.org/10.1080/758524602.

R. W. Dimand, *Irving Fisher*, Great Thinkers in Economics,
https://doi.org/10.1007/978-3-030-05177-8_8

responses to the Global Financial Crisis of 2007–2008 were shaped by their prior study of debt-deflation in the Great Depression. It was Fisher's misfortune, as well as that of the profession, that his analysis of the debt-deflation process, now seen as one of his most insightful contributions to macroeconomics, received little notice from his contemporaries.

Fisher has acquired lasting and unenviable fame for his predictions in September and October 1929 that "stock prices have reached what looks like a permanently high plateau" (Barber 1985, p. 77) and for the consequences to Fisher of his predictive error. As John Kenneth Galbraith (1977, p. 192) remarked, "In the late nineteen-twenties Fisher went heavily into the stock market and in the Crash lost between eight and ten million dollars. This was a sizable sum, even for an economics professor." Fisher was known for this even to those, such as Robert Sobel (1968, pp. 97, 132), whose direct knowledge of Fisher and his work was vague enough to identify him as "Irving Fisher of Harvard." Kathryn Dominguez et al. (1988) have now shown that even using modern statistical techniques, and even adding some retrospectively compiled time series to those available to Fisher and to the Harvard Economic Society, it would not have been possible to predict the onset, length or depth of the Great Depression by time-series analysis.

Dominguez, Fair, and Shapiro have done much to redeem Fisher's reputation as a forecaster relative to that of, for example, Roger Babson, whose successful prediction on September 5, 1929, of a break in stock prices must be balanced against his prediction of a stock price boom in 1931, and his repeated premature predictions of bear markets from 1926 onward (see Friedman 2014, pp. 43–48). If one views the bull market of the 1920s as a speculative bubble, all that could be predicted is that the bubble would eventually burst, not when.

Indeed, Fisher's formal statistical forecasting method, as distinct from his more subjective statements about future stock prices, held up quite well. In a series of journal articles, Fisher (1923, 1925, 1926) sought empirical verification of his monetary theory of economic fluctuations by correlating output and unemployment with a distributed lag of past changes in the price level (see Dimand 1993). He was an innovator in the use of correlation analysis and distributed lags, and he constructed his own price indices. His 1926 article was republished in 1973 as "I Discovered the Phillips Curve." Fisher (1925) found a

correlation of 0.941 between a trend-adjusted measure of the volume of trade and a distributed lag of monthly inflation rates for the 114 months ending January 1923. Scott Sumner (1990) has found that, using the lag weights from Fisher's 1925 paper, Fisher's equation yielded a correlation of 0.851 for the period from January 1923 to July 1933, a close out-of-sample fit. The stable relationship between output and inflation collapsed only with the economic policy regime change after Franklin Roosevelt's March 1933 inauguration, when the United States left the fixed gold value of the dollar for what Maynard Keynes termed "a gold standard on the booze" and U.S. output recovered sharply. Thus "updating Fisher's model to the 1923-35 period," Sumner (1990, p. 721) found that "The correlation between the predicted and the actual output series was only 256" because of the structural change in 1933.

Fisher's Audience

Apart from the regrettable impact on his personal finances, the stock market crash and subsequent depression had two important consequences for Fisher as a theorist of economic fluctuations. Fisher's attention was focused on a gap in his analysis in the 1920s of the business cycle as "a dance of the dollar": the need to explain why sometimes a deep and lasting depression occurred. He offered a brilliant solution of this puzzle in *Booms and Depressions* (1932), "The Debt-Deflation Theory of Great Depressions" (1933) and "The International Transmission of Booms and Depressions Through Monetary Standards" (1935). Secondly, his mistaken stock market predictions and the attention attracted by books by Keynes (*A Treatise on Money*, 1930, and especially *The General Theory of Employment, Interest and Money*, 1936) and Friedrich Hayek (starting with *Prices and Production*, 1931) combined to take away Fisher's audience, both professional and general, just when he had something important to tell it.

Patrick Deutscher (1990, pp. 188–194) analyzed citations in articles listed under "Aggregative and Monetary Theory and Cycles" and the non-historical categories of "Money, Credit and Banking" in the American Economic Association *Index of Economic Journals*. Fisher was

the most cited macroeconomist in 1920–1930, cited in 30 articles, compared to 24 citations for second-ranked Wesley Clair Mitchell and 9 for tenth-ranked John Maynard Keynes (mostly references to *A Tract on Monetary Reform*, 1923). In 1931–1935, after the publication of *A Treatise on Money* by Keynes (1930) and *Prices and Production* (1931) by Hayek, Fisher was tied with Ralph Hawtrey for fourth most cited macroeconomist with 30 citations, behind Keynes (66), Dennis Robertson (44), and Hayek (33). The temporary seizure of the profession's attention by Keynes's *Treatise* has been discussed by Dimand (1989). For 1936–1939, after Keynes's *General Theory* (1936), Fisher was tied with Ragnar Frisch, Simon Kuznets, and Gunnar Myrdal for sixteenth most cited macroeconomist with 13 mentions, compared to 125 articles citing Keynes. Fisher did not make Deutscher's list of the ten most frequently cited macroeconomists of 1940–1944 (actually eleven because of a tie for tenth place between Kuznets and Abba Lerner). The effect of Keynes's books in diverting attention from Fisher is ironic, in view of the ten references to Fisher in the index of the *Treatise* (two to passages of six or seven pages) and three in the index of the *General Theory*. Keynes, writing from Bretton Woods in July 1944 in reply to Fisher's praise of his world clearing union proposal, told Fisher that "You were one of my earliest teachers on these matters and nothing is more satisfactory to any of us than to satisfy one of those from whom we have learned" (Fisher 1956, p. 326).

Fisher's decline from first place to disappearance from the list is even more striking when it is noted that Deutscher's tabulation excludes the *IEJ* categories of index numbers and interest. In Deutscher's first period, in which Fisher published *The Making of Index Numbers* (1922a), the *Index of Economic Journals* records an article by Warren Persons on "Fisher's Formula for Index Numbers" in the *Review of Economic Statistics* (1921), a 23-page review article of Fisher (1922a) by Allyn A. Young in the *Quarterly Journal of Economics*, a review article by Carl Snyder in the *American Economic Review*, and replies by Fisher to Young (in 14 pages), to Snyder, and to reviews by A. L. Bowley in the *Economic Journal* (with a reply by Bowley) and by G. Udney Yule in the *Journal of the Royal Statistical Society*. Fisher's *The Theory of Interest* (1930), a revision of his *The Rate of Interest* (1907), received an 18 page review

essay by Gottfried Haberler in the *Quarterly Journal of Economics*, one of 37 pages by Frank Knight in the *Journal of Political Economy*, and one of 14 pages by Arthur W. Marget in German in the *Zeitschrift für Nationalökonomie*, all in 1931. After 1931, there were no more review articles on Fisher, apart from six pages by B. P. Adarkar on "Fisher's Real Rate Doctrine" (concerning Fisher 1930) in the *Economic Journal* in 1934 (all these reviews of Fisher's books are reprinted, together with Fisher's replies, in Dimand 2007).

This extensive attention to slightly earlier writings of Fisher contrasts sharply with the reception of his *Booms and Depressions*. Harold Barger, of University College, London, reviewed it jointly with another book in the *Economic Journal* (1933, p. 681), allotting one paragraph to each. Barger rejected Fisher's debt-deflation theory in a single sentence as being at once nothing new and a deplorable innovation: "What little theory it contains is in no way novel, while Professor Fisher's contentment with price stability as a policy, and emphasis on over-indebtedness rather than over-investment as the root of all evil, are not encouraging." In place of Fisher's concern with debt, Barger took it to be obvious that analysis should focus on overinvestment, the neo-Austrian/London School of Economics concept of the lengthening of the average period of production during a boom. Since Fisher (1907) had already shown that there may be multiple solutions for the average period of production and given a numerical example of reswitching of techniques (see Velupillai 1975), this alternative would have had little appeal for him.

The Lessons of Monetary Experience, a volume of essays presented to Fisher on his seventieth birthday in 1937, offered an opportunity to offset the lack of attention given to Fisher's post-1930 work, but the letter of invitation to contributors specified, presumably in accordance with the wishes of Fisher: "All contributors are asked merely to present scientific opinions on the lessons of recent monetary policies. Under no circumstances is it contemplated to include any eulogies of Professor Fisher's work. The only reference to him will be in the dedication of this book" (Gayer 1937, p. vi). Fisher was not mentioned in A. L. Macfie's *Theories of the Trade Cycle* (1934). Fisher's writings, including those on the debt-deflation theory of depressions, were listed in the select bibliography of Raymond Saulnier's *Contemporary Monetary Theory* (1938),

but his name did not appear in the index to the book, and appeared in the text only in a footnote appended to the discussion of Hawtrey (Saulnier 1938, 77–78n).

Diagnosis of the Depression

Fisher addressed the American Association for the Advancement of Science in New Orleans on the first day of 1932 on the subject of "The Debt-Deflation Theory of Depressions," on which he had lectured at Yale in the autumn of 1931 (see Fisher 1997, Vol. 10, p. 32, for extracts of Fisher's AAAS address, as reported in the *New York Times*, January 2, 1932). With the word "Great" inserted before "Depressions" in the title, a revised version of this paper appeared in the first volume of *Econometrica* in October 1933 and in the *Review of the International Statistical Institute* the following January. As Fisher was the founding president of the Econometric Society, this paper took the place of a presidential address. In these journals the theory would be offered for the consideration of the most technically sophisticated segment of the economics profession. Extended into a book with historical material, a literature survey, and appendixes, Fisher's theory was presented to the public as *Booms and Depressions* in the fall of 1932.

Even before publishing his theory, Fisher expounded "the debt disease" to the House Ways and Means Committee at the end of April 1932 (testimony extracted in Fisher 1997, Vol. 10, pp. 32–35). As an exposition to an official body of a new theory aimed at understanding and curing current economic problems, Fisher's presentation can be compared only to Keynes's private evidence on his forthcoming *Treatise on Money* to the Macmillan Committee in 1930. Fisher explained to the Congressmen that "When you have this overindebtedness, and people try to get out of debt by liquidating, … it causes distressed selling and the contraction of the currency, and therefore a fall in prices," increasing the real burden of debts. In the absence of a policy of reflation through monetary expansion, the economy lacked any automatic mechanism to stop the debt-deflation (Barber 1985, pp. 160–161).

Even before he tried to explain his debt-deflation theory of depressions to the House Ways and Means Committee, Fisher tried to educate policy-makers about the contraction of the money supply and its implications for price deflation. In a letter to Clark Warburton in 1946 (published by Thomas Cargill 1992, pp. 1275–1276), Fisher recalled:

> In the summer of 1931 I called on Eugene Meyer, the chairman of the Federal Reserve Board. I said: "I am getting alarmed to see demand deposits diminish. It seems to me this may cause trouble." He said: "What do you call the figure?" Amazed, I said: "The full name is individual deposits subject to check without notice." He rang a bell and asked his assistant to bring in the last controller's report open to the page where the figures were given for individual deposits subject to heck without notice. In a few minutes the report came in and I pointed and said: "You see that during the last several call dates there has been a continuous reduction" He said, "Yes, I see it." Of course his main object should have been to see it all along and long before his attention was called to it.

Fisher (1933, pp. 338–341) rejected "The old and apparently still persistent notion of 'the' business cycle, as a single, simple, self-generating cycle (analogous to that of a pendulum swinging under influence of the single force of gravity)" as "a myth." He found some grain of truth in most of the cycle theories (which he had reviewed in Fisher 1932, Ch. VI), but often only a small one: "as explanations of the so-called business cycle, or cycles, when they are really serious, I doubt the adequacy of over-production, under-consumption, over-capacity, price-dislocation, maladjustment between agricultural and industrial prices, over-confidence, over-investment, over-saving, over-spending, and the discrepancy between saving and investment." Instead, he stressed two dominant factors in serious depressions: "*over-indebtedness* to start with and *deflation* following soon after." Over-investment and over-speculation mattered when carried on with borrowed money, over-confidence "when, as, and if, it beguiles its victims into debt." He held that this was the explanation of why business contractions occasionally became deep depressions: "if debt and deflation are absent, other disturbances are powerless to bring on crises comparable in severity to those of 1837, 1873, or 1929-33."

Changes in the real value of inside debt would generally be neglected in later discussions of what came to be known as the Pigou-Haberler real balance effect, as being transfers which do not affect aggregate wealth. Fisher, in contrast, emphasized the effect of the real value of nominal debt of changes in the price level that had not been anticipated when the debt was contracted. The possibility of bankruptcy created an asymmetry between the effect of falling prices and of rising prices. The bankruptcies and, even more, the fear of bankruptcy and loan default induced by falling prices and excessive nominal debts would increase risk premia on loans, lead to withdrawal of uninsured deposits from banks with loan portfolios considered in danger of default, and cause liquidation of assets and repayment of loans, all of which would depress asset prices and contract the money supply. The attempt to restore liquidity by selling assets to repay loans and increase bank reserves would be self-defeating, warned Fisher (1933, p. 346): "By March, 1933, liquidation had reduced the debts about 20 per cent, but had increased the dollar about 75 per cent, so that the *real* debt, that is debt measured in terms of commodities, was increased about 40 per cent."

Fisher (1933, p. 342) summarized the process expounded in Chapters II and III of *Booms and Depressions* in nine links. First, debt liquidation, resulting from some random shock such as the bursting of a bubble in stock prices, "leads to *distress selling* and to (2) *Contraction of deposit currency*, as bank loans are paid off, and to a slowing down of velocity of circulation", so that (3) the price level drops, causing "(4) *A still greater fall in the net worths of business*, precipitating bankruptcies." Profits are reduced (5), so that firms curtail production and employment (6). "These losses, bankruptcies, and unemployment, lead to (7) *Pessimism and loss of confidence*, which in turn lead to (8) *Hoarding and slowing down still more the velocity of circulation*." The ninth link was "a fall in the nominal, or money, rates [of interest] and a rise in the real, or commodity, rates of interest."

It is noteworthy that Fisher's analysis predicts contraction of the money supply during the debt-deflation process without the monetary base having fallen, due to repayment of bank loans and loss of confidence, which causes both banks and the public to hoard cash.

This is consistent with US experience during the Great Depression, in which the money supply fell by about a third while the monetary base rose.

These things would only occur "Assuming, as above stated, that this fall of prices is not interfered with by reflation or otherwise." Turning to the policy implications of his analysis, Fisher (1933, pp. 346–347) insisted that

> Those who imagine that Roosevelt's avowed reflation is not the cause of our recovery but that we had "reached the bottom anyway" are very much mistaken. … If reflation can now so easily and quickly reverse the deadly down-swing of deflation after nearly four years, when it was gathering increased momentum, it would have been still easier, and at any time, to have stopped it earlier. In fact, under President Hoover, recovery was apparently well started by the Federal Reserve open-market purchases, which revived prices and business from May to September 1932. The efforts were not kept up and recovery was stopped by various circumstances, including the political "campaign of fear."

Fisher's support for reflation (raising the price level back to its 1926 level) and price stabilization was opposed to the neo-Austrian view of Lionel Robbins (1934), Murray Rothbard (1975), and James Grant (2014) which argued that falling prices would bring about needed readjustment, lower wage rates would restore full employment, and, particularly in the case of Rothbard, that a growing economy should have falling prices. Rothbard (1975, pp. 157–163, 272–274) is particularly critical of Fisher's views on reflation and stabilization, although it was Hawtrey rather than Fisher whom he named as "one of the evil geniuses" of the stabilizationists. Fisher's emphatic endorsement, in his 1933 article and in several other publications, of Roosevelt's monetary expansion, which raised the price of an ounce of gold from $20.67 in several erratic jumps to $35, contradicts the claim by Fisher's associate Hans Cohrssen (1991, p. 827) that Fisher was an opponent of what Cohrssen regards as "Roosevelt's Marxist economic measures." Fisher's opposition to the National Recovery Administration's scheme of raising prices by restricting output (Sumner 1990, p. 724) was offset by his support for devaluing the dollar against gold. Among Yale's full professors of

economics, Fisher and his closest former student, James Harvey Rogers, a special adviser to the Roosevelt administration, stood apart from the anti-New Deal views of Fred Fairchild, Edgar Furniss, and Norman Buck (see Fairchild et al. 1935; Allen 1977).

Fisher's concern about deflation causing bankruptcy and the fear of bankruptcy parallels that expressed by Maynard Keynes (1931b, p. 33; 1973, Vol. XIII, p. 361) in his Harris Foundation lectures at the University of Chicago in 1931 (see Dimand 1991). Keynes opposed the wage and price deflation advocated by O. M. W. Sprague of Harvard, then economic adviser to the Bank of England and later to the US Treasury, because "all this financial structure would be deranged by the adoption of Dr Sprague's proposal. A widespread bankruptcy, default, and repudiation of bonds would necessarily ensue." A drastic rise in the real value of inside debt would have depressing consequences, such as higher risk premia, increased liquidity preference (increased hoarding in Fisher's terms), and disruption of the financial structure. These effects would be likely to exceed the stimulative real balance effect of a higher real value of outside money (of which Keynes was well aware by 1925 at the latest—see Presley 1986).

Keynes argued, in Chapter 19 of the *General Theory*, that increased downward flexibility of wages and prices would not eliminate unemployment, and drew attention to the failure of falling money wages in the United States in the early 1930s to end mass unemployment. Even though an economy with a given stock of (outside) money and a given price level would have a larger real aggregate effective demand for output than another economy with the same money stock and a higher price level, it does not follow that swiftly falling prices will stimulate aggregate demand. Keynes and Fisher agreed on the contractionary effect of deflation when there are nominal debts, and on the role of fear of bankruptcy in raising real interest rates and disrupting the financial system. In addition, as emphasized by Robert Mundell (1963), the higher real return on holding money during deflation would cause a contractionary increase in demand for real money balances. James Tobin (1980, p. 10) noted what he termed the Fisher effect on spending of transferring wealth from debtors to creditors through lower prices: "Debtors have borrowed for good reasons, most of which indicate a

high marginal propensity to spend from wealth or from current income or from any liquid resources they can command." Fisher's account of the debt-deflation process (1932, 1933) and Keynes's analysis of the contractionary potential of deflation (1931a, b; 1936, Ch. 19) have been taken up by contemporary macroeconomists, with Tobin (1975, 1980) and J. Bradford De Long and Lawrence Summers (1986) emphasizing the implications for aggregate demand and Hyman Minsky (1975, pp. 64, 126; 1982a, b; 1986, pp. 172, 177) stressing the fragility of the financial system (see Dimand 2014 on Tobin). Surprisingly, Fisher's only appearance in *The Elgar Companion to Hyman Minsky* (Papadimitriou and Wray 2010, pp. 72–73) is for having urged reflation and monetary expansion upon Franklin Roosevelt, without mention of debt-deflation or of Minsky's references to Fisher (the phrase "debt deflation" appears on page 227, without Fisher's name).

The Experience of the 1920s and 1930s

The experience of the 1920–1921 deflation and recession helped shape analysis of the Great Depression. Britain began a contractionary monetary policy to raise the pound sterling from its 1920 low of $3.20 towards its pre-war parity of $4.86 (which was finally reached in 1925), even though the United States was itself undergoing a sharp deflation at the time. A. W. Phillips (1958, p. 115) records that in the United Kingdom unemployment rose from 2.6% in 1920 to 17.0% in 1921 and 14.3% in 1922, while wage rates declined by 22.2% in 1921 and 19.1% in 1922, and the cost of living index fell by 12.8% in 1921 ("largely a result of falling import prices") and 17.5% in 1922, substantially less than the decline in money wage rates in those years. Phillips was concerned to explain changes in wage rates by unemployment and cost of living changes. From the point of view of Fisher (1926), concerned with explaining unemployment, these figures suggest that the unemployment of this period cannot be blamed on downward rigidity of either money or real wages. Rapid wage deflation did not eliminate British unemployment in the early 1920s, contrary to what the analysis of Edwin Cannan (1932, 1933) and Robbins (1934) would have

predicted. This experience was also inconsistent with the argument in Keynes's *General Theory* (1936, Ch. 2) that real wages are countercyclical, a claim that Keynes (1939) abandoned in the face of evidence advanced by John Dunlop (1938), Michal Kalecki (1939), and Lorie Tarshis (1938, 1939). Because the 1921 drop in the cost of living largely reflected lower import prices (as the exchange value of sterling rose), the decline in the product wage (the real wage cost to firms) would have exceeded the decline in the purchasing power of money wages. The 1921–1922 British experience of high unemployment and falling real wages recurred in many countries in the Depression: real weekly earnings in manufacturing in 1932 were 15% lower than in 1929 in Germany, 14% lower in the United States (Temin 1989, p. 121).

If rapidly falling British wage rates in 1921 and 1922 did not prevent high unemployment during deflation, what was the link from deflation to output and employment? Keynes drew attention in his *Tract on Monetary Reform* (1923) to the inability to reduce money interest rates below zero, if money is costless to store, so that deflation raises real interest rates, and to the existence of outstanding nominal contracts. On the latter point, he drew attention to an article by Fisher (1922b) estimating the average maturity of outstanding nominal contracts (about a year). Fisher's article had appeared in the *Manchester Guardian Commercial*'s series of supplements on "Reconstruction in Europe." Keynes had edited the supplements and based his *Tract on Monetary Reform* on four of his articles in the series. Keynes (1936, Ch. 2) considered one particular type of unexpired nominal contract, staggered money wage bargains when workers care about relative wages, so that workers were unable to bargain for real wages without affecting relative wages, as one explanation of involuntary unemployment and of the real effects of demand stimulus (in Chapter 19 he emphasized that even if money wages were flexible downwards, wage cuts would likely fail to reduce unemployment). Fisher (1932, 1933) went further in exploring how the existence of unexpired contracts in money terms, typified by debts, provided a channel for price changes to affect real spending. The larger the outstanding volume of nominal debts and other contracts in money terms, the more sensitive real spending would be to changes in expected prices, and hence changes in the perceived real burden of debts and real value of assets.

This dependence of the sensitivity of real spending to price changes on the extent of nominal indebtedness is the key to the debt-deflation theory of great depressions. Peter Temin (1989, p. 59) expressed skepticism about the "premise that the deflation caused the Depression" because the United States experienced a decline of wholesale prices by about one quarter over each of the two-year periods 1920–1921 and 1929–1930, yet the Depression did not begin in 1921. (Britain did experience high unemployment throughout the 1920s, dipping below 10% in only one year, but the British deflation in 1921–1922 was more severe than that in the United States because of the exchange rate appreciation.) Fisher's predictions in 1929 and 1930, as well as those of the Harvard Economic Service, reflected recollection of the briefness and mildness of the 1921 American recession. Fisher (1932, 1933) was able to explain why his earlier predictions were wrong and why the deflation of 1929–1930 was followed by so much more economic disruption than a similar amount of deflation in 1920–1921: the growth of nominal indebtedness associated with the intervening stock boom.

Fisher (1932, Ch. VII) attempted to measure "The over-Indebtedness that led to the World Depression." He found (1932, pp. 72–73, 81) the growth of debt closely linked to the margin buying of stocks beginning in 1923, and he noted that "All security loans [loans with negotiable securities as collateral] increased from October 3, 1928, to October 4, 1929, by 36 per cent and reached on that date a peak just under 17 billions." Urban mortgages tripled to $37 billion from 1920 to 1929, and commercial bank loans rose 50% to $39 billion from 1922 to 1929, even though commodity prices remained roughly constant from 1923 to 1929, after their sharp drop in 1921. The deflation following the stock market crash of October 1929 had a greater effect on real spending than the deflation of 1921 had, because nominal debt was much greater in 1929, including debt secured by stocks.[1]

[1]That the stock crash of October 1987 was not followed by a depression may be explained by the concerted central bank response to the crash, in an institutional setting of deposit insurance and restrictions on margin buying of stocks.

Fisher (1933) was published by the International Statistical Institute as well as in *Econometrica*. Fisher addressed the Institute with a follow-up paper, "The International Transmission of Booms and Depressions through Monetary Standards" (Fisher 1935), in which he analyzed a 29-country data set to show that the fixed exchange rates of the gold exchange standard had transmitted the Great Depression from country to country, and that nations had begun to recover only as each abandoned the gold exchange standard (as Great Britain did in August and September 1931), after which exchange depreciation allowed monetary expansion and price reflation. This pioneering empirical study anticipated the journal literature of the 1980s and 1990s on the role of the gold standard in propagating the Great Depression (see Temin 1989) but was ignored at the time (and was published by the International Statistical Institute only in its *Bulletin*, not in its main journal, the *Review of the International Statistical Institute*, where Fisher 1933 had appeared).

A Fisher Model of Deflation and Depression

For Fisher, the sensitivity of real expenditure to deflation depended on the extent of nominal indebtedness. The importance of his approach can be seen clearly in the context of a three-equation model used by James Tobin (1975). Tobin called the model the Walras-Keynes-Phillips (or WKP) model, but, although it captures the concern of Keynes (1936, Ch. 19) that increased wage and price flexibility might be destabilizing, it has more to do with Fisher than with Keynes or Phillips. Tobin (1975, p. 198) posited desired real aggregate expenditure E as a function, given the money stock M, of the price level p, expected inflation x, and real income Y, so that $E = E(p, x, Y)$. He included in the model a "Phillips curve" equation relating the output gap $(Y–Y^*)$ to the gap between actual and expected inflation, and he assumed that expected inflation adjusts adaptively to the difference between actual and expected inflation. (Expected inflation affects real expenditure through the "flow Pigou effect," the consumption effect of expected capital gains on money holdings, $-xM/p$). He remarked that "I do not mean necessarily to

associate myself - much less Keynes! - with the natural-rate hypothesis in all its power and glory." Fisher, however, as a believer in the long-run neutrality of money, would not have objected to association with the natural-rate hypothesis (that $Y = Y^*$ when inflation is correctly expected, and Y^* is independent of the inflation rate). Tobin's Eq. 2.2.1 (the numbering of equations in Tobin 1975 is retained here), the "Phillips curve" linking the output gap to unexpected inflation, recalls the correlation of output and a distributed lag of price changes in Fisher (1923, 1925), not the dependence of wage changes on unemployment in Phillips (1958). The adaptive expectations hypothesis, Tobin's Eq. 2.3.1, is consistent with the practice of Fisher, who, after explaining the dependence of money interest rates on expected inflation, correlated money interest rates with a distributed lag of past price changes in *The Theory of Interest* (1930). Neither Keynes nor Phillips used adaptive expectations. The Walrasian aspect of Tobin's WKP model was Eq. 2.1.1, which made the rate of change of output a function of excess demand E–Y, in place of the more Marshallian assumption that the rate of change of prices depends on E–Y. Since the "Phillips curve" (2.2.1) and adaptive expectations (2.3.1, for expected inflation π) are Fisherian, and the choice of variables to explain E in 2.1.1 fits Fisher (1932, 1933), the Walras-Keynes-Phillips model would be better termed a Fisher model.

$$dY = A_y(E(p, x, Y) - Y) \tag{2.1.1}$$

$$\pi = A_p\left(Y - Y^*\right) + x \tag{2.2.1}$$

$$dx = A_x(\pi - x) \tag{2.3.1}$$

Tobin investigated the local stability of his WKP model around its equilibrium at potential output ($Y = Y^*$, so that $p = p^*$ and x is zero), at which $E(p, x, Y) = E\left(p^*, 0, Y^*\right) = Y^*$. If the model was stable, Y would automatically move back toward Y^* after a perturbation. He found that the "critical necessary condition for stability is":

$$p^* E_p + A_x E_x < 0 \tag{3.4}$$

The second term would be positive: a higher expected rate of inflation would increase spending (that is, $E_x > 0$) both because of the "flow Pigou effect" named by Tobin (1975) and because of the reduced demand for real money balances discussed by Mundell (1963). Tobin suggested that E_p, and hence the first term of the stability condition, would be negative because of the "stock Pigou effect" (the wealth effect on consumption of lower M/p due to higher p) and the "Keynes effect" of higher interest rates.[2] Discussion in the literature of Tobin's stability condition 3.4 has concentrated on its implication that more rapid adjustment of expectations (larger A_x) makes instability more likely, and on the related question "Is Price Flexibility Destabilizing?" (see Driskill and Sheffrin 1986; De Long and Summers 1986, 1988; Dimand 2005, and, for a formal derivation of Tobin's stability condition, Bruno and Dimand 2009).

Fisher's debt-deflation theory has implications for both terms of Tobin's stability condition (Eq. 3.4 above, following the numbering of equations in Tobin 1975). With sufficient inside debt denominated in money, what Tobin (1980, pp. 9–11) termed the Fisher effect on inside debt could dominate the stock Pigou effect on outside money, so that E_p would be positive (a higher price level would increase real expenditure, a lower price level reduce it), the model would necessarily be unstable: Y and p move further away from their equilibrium values after an initial shock. (The Keynes effect would cease once deflation reduced nominal interest rates nearly to zero—as with the US Treasury bill rates of three-eighths of one per cent in the 1930s.) The size of E_x, the derivative of desired expenditure with respect to expected inflation, could also be expected from Fisher's analysis to depend on the amount of nominal indebtedness. The larger the amount of nominal debt in this model relative to the scale of other variables, the less likely it is that the model is stable. This interpretation of the model captures Fisher's explanation of why the US economy returned to potential output quickly after the deflation of 1921, but why it did not do so after the deflation

[2]The lower M/p implies an LM curve further to the left, and higher interest rates reduce investment.

of 1929–1930 due to overindebtedness. Unfortunately, these implications of Fisher's debt-deflation theory have not been brought out in the literature proceeding from Tobin (1975). De Long and Summers (1986), for instance, cited Fisher's 1923 and 1925 articles, but not his 1932 book or 1933 article. Their discussion led to an exchange between Sumner (1990) and De Long and Summers (1990), in which Sumner very usefully extended Fisher's 1925 analysis to the period 1923–1935 as a by-product of arguing that price rigidities due to New Deal policies, especially the National Industrial Recovery Act, depressed output from July 1933 to August 1935 (with some mention of reflation and a nearly 50% rise in industrial output in the first half of 1933; Sumner 1990, pp. 723–725; 2015).

Bernanke and King Read Fisher (1933) and Study the Debt-Deflation of the 1930s

Fisher's analysis of debt deflation attracted the notice of Ben Bernanke in a series of papers leading to his Money, Credit and Banking Lecture (1995; 2000, Ch. 1) and of Mervyn King in his presidential address to the European Economic Association (1994). Bernanke wrote his MIT doctoral dissertation (Bernanke 1981, 1983) on the breakdown of financial intermediation in the US culminating in the "Bank Holiday" of March 1933, a banking crisis so severe that Bernanke concluded that the US banking system was unable to resume its role in financial intermediation for the rest of the decade. He would have encountered Fisher (1933) through the MIT economic historian Charles Kindleberger, who in turn was led to Fisher (1933) by the writings of Hyman Minsky. Bernanke (2000, p. 43) cited Minsky (1975, 1982b) and Kindleberger (1978) in addition to Fisher (1933), but distanced himself from their acknowledgement of deviations from rational behavior: "I do not deny the possible importance of irrationality in economic life; however it seems that the best research strategy is to push the rationality principle as far as it will go"—a very suitable sentiment for an MIT dissertation.

In 2002, as soon as he was appointed to the Federal Reserve Board, Bernanke spoke at a 90th birthday celebration for Milton Friedman. Referring to Friedman and Schwartz (1963), which had excoriated the Fed for allowing the US money supply to decrease by a third in the early 1930s, Bernanke wittily concluded, "Let me end my talk by abusing slightly my status as an official representative of the Federal Reserve System. I would like to say to Milton and Anna: Regarding the Great Depression. You're right, we did it. We're very sorry. But thanks to you, we won't do it again" (quoted by Bragues 2009, p. FP19). After he returned to the Federal Reserve Board as chair in 2006, Bernanke was acutely aware of who was responsible for seeing that the Fed did not "do it again," and for avoiding another breakdown of the system of financial intermediation. Whereas Eugene Meyer had not even been aware of the shrinkage of demand deposits until Fisher drew his attention to the figures (taking advantage of his Yale position to obtain access to Yale alumnus Meyer), Bernanke's dissertation topic and academic research made him sensitive to the risk of another banking crisis. He was determined not to share Meyer's reputation for failing to prevent economic disaster. The Federal Reserve responded to the upheavals of 2007 and 2008 by pouring liquidity into the financial system, preventing the Global Financial Crisis from becoming another Great Depression.

Mervyn King (1994) also studied the debt-deflation of the early 1930s, citing Keynes (1931a), Fisher (1933), Minsky (1975, 1982b) and Tobin (1980). Even though King studied the same historical episode of debt-deflation that Bernanke (1995) examined, and read much of the same literature as Bernanke, he drew a different lesson, which illuminates why King's response to the initial stages of the Global Financial Crisis was quite different from that of Bernanke. Both Bernanke and King recognized two channels through an unanticipated decline in the price level, increasing the real value (and real burden) of inside debt fixed in nominal terms, and a collapse of asset prices can reduce the level of real economic activity. First, the scramble for liquidity disrupts the system of financial intermediation, causes bankruptcies and defaults, increases risk premia, and reduces the availability of credit.

Secondly, the increased real value of inside debt transfers wealth from debtors to creditors. Since debtors presumably became debtors because their propensity to spend exceeds that of lenders, such a wealth transfer lowers aggregate expenditure, and since there is much more inside debt than outside money, this destabilizing effect can overwhelm the Pigou (or Pigou-Haberler-Patinkin) real balance effect of a lower price level. Bernanke's dissertation was on the first channel, as seen in the collapse of the US banking system in the early 1930s. King's presidential address concentrated on the second channel and concluded that plausible differences in spending propensities were too small for this channel to be of crucial importance.

Unlike the United States (and unlike Austria, Germany and Italy), Britain did not suffer a banking crisis in the 1930s. American central bankers, and American students of monetary history, are haunted by the role of the Federal Reserve in the collapse of the banking system in the early 1920s, just as German central bankers, and German students of monetary history, are haunted by the role of the Reichsbank in the hyperinflation of the early 1920s (see Fisher 1928). The central historical episode for British central bankers and British students of monetary history is the role of Montagu Norman and the Bank of England in the return to the gold exchange standard at the pre-war parity in 1925, the "Norman conquest of $4.86" that necessitated wage and price deflation accompanied by prolonged unemployment. So, the lesson that Bernanke drew from the 1920s and 1930s was that the liquidity of the banking system must be maintained and the collapse of the system of financial intermediation must be averted, a lesson on which he acted as chair of the Federal Reserve, with prompt expansionary policy. King, emphasizing the other channel through debt-deflation affects aggregate expenditure and influenced by a different national experience, drew the different lesson, the need to pursue a stable aggregate demand policy. As governor of the Bank of England, King maintained such a stable policy in the initial stages of the crisis until the collapse of Northern Rock and the near-collapse of HBOS and the Royal Bank of Scotland forced a change of policy and massive injections of liquidity into the banking system.

Fisher's Debt-Deflation Theory and the Literature

As often happened with Fisher, he was overly enthusiastic about the reception and acceptance of his theory. He reported (1933, p. 337) that "Since the book [*Booms and Depressions*] was published its special conclusions have been widely accepted and, so far as I know, no one has yet found them anticipated by previous writers, though several, including myself, have zealously sought to find such anticipations. Two of the best-read authorities in this field assure that those conclusions are, in the words of one of them, 'both new and important.'" In fact, published contemporary discussion of his debt-deflation theory was very limited, the most important being the summary in 1937 in Gottfried Haberler's League of Nations survey of theories of *Prosperity and Depression* (1946, pp. 113–116).

In the final footnote of his *Econometrica* article, Fisher (1933, 350n) reported that Wesley Mitchell, to whom Fisher dedicated *Booms and Depressions*, had drawn his attention to Thorstein Veblen's *Theory of Business Enterprise* (1904, Ch. VII) as the work that "probably comes nearest to the debt-deflation theory. Hawtrey's writings seem the next nearest." While Veblen (1904, pp. 100–101, 105) stressed the importance of outstanding nominal debt in explaining fluctuations, this was not a recurrent theme in his writing and, unlike Fisher, he did not view monetary shocks as the source of instability (see Dimand 1998, 2004, on Fisher and Veblen).

Ralph Hawtrey of the British Treasury was the only prominent interwar economist with a theory of economic fluctuations as thoroughly monetary as that of Fisher. His account of the "vicious circle" of distress selling increasing the real burden of debt by depressing asset prices, although not at the heart of his theory, was closely related to Fisher's debt-deflation process. Fisher's acknowledgement of affinity to Hawtrey failed to satisfy (or even be noticed by) Raymond Saulnier (1938, 77–78n) who, in his only mention of Fisher in the text of his survey volume on *Contemporary Monetary Theory*, criticized Fisher (1933, 350n) for failing to remark that his complaint of the absence of the word

"debt" from the indexes of monetary treatises did not apply to Hawtrey's *Currency and Credit* (1927). The affinity of the two approaches was not noted by Hawtrey, who in 1950 cited Fisher in the fourth edition of *Currency and Credit* only for the equation of exchange and *The Making of Index Numbers*. In his 1961 foreword to a reissue of *Good and Bad Trade*, his first book, Hawtrey ([1913] 1970, p. vii) recalled concluding that "a falling price level makes a given market rate of interest more onerous, and a rising price level less so. Here, I thought, was a discovery, but I was disillusioned when I learnt from an economist friend that the principle was one already recognized, and had been expounded in Irving Fisher's work, *The Rate of Interest*" but Hawtrey's economist friend (perhaps his fellow Cambridge Wrangler, Keynes) evidently did not mention chapter IV of Fisher's *Purchasing Power of Money* because Hawtrey "was not discouraged, for at any rate its application to the explanation of the trade cycle would be new" (Hawtrey [1913] 1970, p. vii). So, even though Fisher was the only economist cited by Hawtrey in *Good and Bad Trade* in 1913, as late as 1961 Hawtrey did not appear to know either Fisher's monetary theory of economic fluctuations (not of cycles, since Fisher did not believe the fluctuations to be truly cyclical) or his debt-deflation theory of depressions.

Fisher's debt-deflation theory enabled him to explain why some deflations, such as that of 1929–1930, were followed by severe depressions, while others were not, as in 1921, which has been described by James Grant (2014) as "the crash that cured itself." In contrast to Grant's argument that the difference between the two depressions was that wages were allowed to decline in 1920–1921 (he does not draw attention to the 30% decline in US money wage rates from 1929 to 1932), Fisher's emphasis on the importance of unanticipated changes in the real value of inside debt and on the asymmetry created by the risk of bankruptcy was shared by later macroeconomic theorizing, notably by Minsky and Tobin. His theory of the debt-deflation process gave Fisher a powerful insight into the nature and remedy of the Great Depression, and of his personal financial disaster, just when his audience had walked out on him, repelled by his mistaken stock predictions and attracted elsewhere by the spectacularly successful new books of Keynes and Hayek.

References

Allen, William R. 1977. Irving Fisher, F. D. R. and the Great Depression. *History of Political Economy* 9 (4): 560–587.

Barber, William J. 1985. *From New Era to New Deal: Herbert Hoover, the Economists, and American Economic Policy, 1921–1933*. Cambridge: Cambridge University Press.

Barger, Harold. 1933. Review of Fisher (1932) and *Money* by Francis Hirst. *Economic Journal* 43: 681.

Bernanke, Ben S. 1981. Bankruptcy, Liquidity and Recession. *American Economic Review: AEA Papers and Proceedings* 71 (2): 155–159.

Bernanke, Ben S. 1983. Nonmonetary Effects of the Financial Crisis on the Propagation of the Great Depression. *American Economic Review* 73 (3): 257–276.

Bernanke, Ben S. 1995. Money, Credit and Banking Lecture: The Macroeconomics of the Great Depression: A Comparative Analysis. *Journal of Money, Credit and Banking* 27: 16–29.

Bernanke, Ben S. 2000. *Essays on the Great Depression*. Princeton, NJ: Princeton University Press.

Bragues, G. 2009. Ben's Blunders: No One Seemed to Notice That the More the U.S. Fde Chairman Dd, the Worse Things Got. *Financial Post*, January 28, FP19.

Bruno, Ryan, and Robert W. Dimand. 2009. The Corridor of Stability in Tobin's Keynesian Model of Recession and Depression. *International Journal of Applied Economics and Econometrics* 17: 17–25.

Cannan, Edwin. 1932. The Demand for Labour. *Economic Journal* 42: 357–370.

Cannan, Edwin. 1933. Unemployment. In *Economic Scares*, ed. E. Cannan. London: King.

Cargill, Thomas. 1992. Miscellany: Irving Fisher Comments on Benjamin Strong and the Federal Reserve in the 1930s. *Journal of Political Economy* 100 (6): 1273–1277.

Cohrssen, Hans. 1991. Working for Irving Fisher. *Cato Journal* 10 (3): 825–833.

De Long, J. Bradford, and Lawrence Summers. 1986. Is Increased Price Flexibility Stabilizing? *American Economic Review* 76 (5): 1031–1044.

De Long, J. Bradford, and Lawrence Summers. 1988. Is Increased Price Flexibility Stabilizing? Reply. *American Economic Review* 78 (1): 273–276.

De Long, J. Bradford, and Lawrence Summers. 1990. Price-Level Flexibility and the Coming of the New Deal: Reply to Sumner. *Cato Journal* 9 (3): 729–735.

Deutscher, Patrick. 1990. *R. G. Hawtrey and the Development of Macroeconomics*. Ann Arbor: University of Michigan Press.

Dimand, Robert W. 1989. The Reception of Keynes's *Treatise on Money*: A Review of the Reviews. *Perspectives on the History of Economic Thought*, Vol. II, ed. D.A. Walker. Aldershot: Edward Elgar.

Dimand, Robert W. 1991. Keynes, Kalecki, Ricardian Equivalence and the Real Balance Effect. *Bulletin of Economic Research* 43 (3): 289–292; reprinted in *Pioneers of Economics*, ed. Mark Blaugvol, Vol. 39, *Michal Kalecki (1899–1970)*. Aldershot: Edward Elgar, 1992.

Dimand, Robert W. 1993. The Dance of the Dollar: Irving Fisher's Monetary Theory of Economic Fluctuations. *History of Economics Review* 20: 161–173.

Dimand, Robert W. 1998. Fisher and Veblen: Two Paths for American Economics. *Journal of the History of Economic Thought* 20: 449–466.

Dimand, Robert W. 2004. Echoes of Veblen's *Theory of Business Enterprise* in the Later Development of Macroeconomics: Fisher's Debt-Deflation Theory of Great Depressions and the Financial Instability Theories of Minsky and Tobin. *International Review of Sociology* 14: 461–470.

Dimand, Robert W. 2005. Fisher, Keynes and the Corridor of Stability. In *Celebrating Irving Fisher*, ed. Robert W. Dimand and John Geanakoplos, 185–199. Malden, MA: Blackwell (also as *American Journal of Economics and Sociology* 64 (1)).

Dimand, R. (ed.). 2007. *Irving Fisher: Critical Responses*, 3 vols. London and New York: Routledge.

Dimand, Robert W. 2014. *James Tobin*. Basingstoke and New York: Palgrave Macmillan.

Dominguez, Kathryn M., Ray C. Fair, and Matthew D. Shapiro. 1988. Forecasting the Depression: Harvard Versus Yale. *American Economic Review* 78 (4): 595–612.

Driskill, Robert A., and Steven M. Sheffrin. 1986. Is Price Flexibility Destabilizing? *American Economic Review* 76 (4): 802–807.

Dunlop, John. 1938. The Movement of Money and Real Wage Rates. *Economic Journal* 48: 413–434.

Fairchild, Fred R., Edgar S. Furniss, Norman S. Buck, and C.H. Whelden Jr. 1935. *A Description of the 'New Deal'*, rev. ed. New York: Macmillan.

Fisher, Irving. 1907. *The Rate of Interest*. New York: Macmillan; reprinted in Fisher (1997), Vol. 3.

Fisher, Irving. 1922a. *The Making of Index Numbers*, Publication No. 1 of the Pollak Foundation for Economic Research. Cambridge, MA: Houghton, Mifflin; reprinted in Fisher (1997), Vol. 7.

Fisher, Irving. 1922b. Devaluation Versus Deflation. *Manchester Guardian Commercial*. "Reconstruction in Europe", Section 11, December 7.

Fisher, Irving. 1923. Business Cycle Largely a 'Dance of the Dollar'. *Journal of the American Statistical Association*, New Series 18.144: 1024–1028; reprinted in Fisher (1997), Vol. 8.

Fisher, Irving. 1925. Our Unstable Dollar and the So-Called Business Cycle. *Journal of the American Statistical Association*, New Series 20.150: 179–202; reprinted in Fisher (1997), Vol. 8.

Fisher, Irving. 1926. A Statistical Relation Between Unemployment and Price Changes. *International Labour Review* 13.6; reprinted in Fisher (1997), Vol. 8, and as Lost and Found I Discovered the Phillips Curve—Irving Fisher. *Journal of Political Economy* 81 (1973): 496–502.

Fisher, I. 1928. *The Money Illusion*. New York: Adelphi and London: George Allen & Unwin; reprinted in Fisher (1997), Vol. 8.

Fisher, Irving. 1930. *The Theory of Interest*. New York: Macmillan; reprinted in Fisher (1997), Vol. 9.

Fisher, Irving. 1932. *Booms and Depressions*. New York: Adelphi; reprinted in Fisher (1997), Vol. 10.

Fisher, Irving. 1933. The Debt-Deflation Theory of Great Depressions. *Econometrica* 1 (3): 337–357; also, in the *Review of the International Statistical Institute*, January 1934; reprinted in Fisher (1997), Vol. 10.

Fisher, Irving. 1935. The International Transmission of Booms and Depressions Through Monetary Standards. *Bulletin of the International Statistical Institute* 28 (2): 609–637; reprinted in Robert W. Dimand. 2003. Irving Fisher on the International Transmission of Booms and Depression Through Monetary Standards. *Journal of Money, Credit and Banking* 35 (1): 49–90.

Fisher, Irving. 1997. *The Works of Irving Fisher*, 14 vols., ed. William J. Barber, assisted by Robert W. Dimand and Kevin Foster, consulting ed. James Tobin. London: Pickering & Chatto.

Fisher, Irving Norton. 1956. *My Father, Irving Fisher*. New York: Comet.

Friedman, Milton, and Anna J. Schwartz. 1963. *A Monetary History of the United States, 1867–1960*. Princeton, NJ: Princeton University Press for the National Bureau of Economic Research.

Friedman, Walter A. 2014. *Fortune Tellers: The Story of America's First Economic Forecasters*. Princeton, NJ: Princeton University Press.
Galbraith, John Kenneth. 1977. *The Age of Uncertainty*. Boston: Houghton Mifflin.
Gayer, Arthur D. (ed.). 1937. *The Lessons of Monetary Experience*. New York: Farrar & Rinehart.
Grant, James. 2014. *The Forgotten Depression 1921: The Crash That Cured Itself*. New York: Simon & Schuster.
Haberler, Gottfried. 1946. *Prosperity and Depression*, 3rd ed. Lake Success, NY: United Nations.
Hawtrey, Ralph G. [1913] 1970. *Good and Bad Trade*. New York: Augustus M. Kelley.
Hawtrey, Ralph G. 1927. *Currency and Credit*, 3rd ed. London: Longmans.
Hayek, Friedrich A. 1931. *Prices and Production*. London: Routledge.
Kalecki, Michal. 1939. *Essays in the Theory of Economic Fluctuations*. London: G. Allen and Unwin.
Keynes, John Maynard. 1923. *A Tract on Monetary Reform*. London: Macmillan.
Keynes, John Maynard. 1930. *A Treatise on Money*. London: Macmillan.
Keynes, John Maynard. 1931a. *Essays in Persuasion*. London: Macmillan.
Keynes, John Maynard. 1931b. An Economic Analysis of Unemployment. In *Unemployment as a World Problem*, ed. Quincy Wright, 1–42. Chicago: University of Chicago Press.
Keynes, John Maynard. 1936. *The General Theory of Employment, Interest and Money*. London: Macmillan.
Keynes, John Maynard. 1939. Relative Movements of Real Wages and Output. *Economic Journal* 49 (1): 34–51.
Keynes, John Maynard. 1973. *Collected Writings*, Vol. XIII, ed. D.E. Moggridge. London: Macmillan and New York: Cambridge University Press, for the Royal Economic Society.
Kindleberger, Charles P. 1978. *Manias, Panics and Crashes*. New York: Basic Books.
King, Mervyn. 1994. Presidential Address: Debt Deflation: Theory and Evidence. *European Economic Review* 38: 419–445.
Macfie, A.L. 1934. *Theories of the Trade Cycle*. London: Macmillan.
Minsky, Hyman P. 1975. *John Maynard Keynes*. New York: Columbia University Press.
Minsky, Hyman P. 1982a. Debt-Deflation Processes in Today's Institutional Environment. *Banco Nazionale del Lavoro Quarterly Review* 143: 375–393.

Minsky, Hyman P. 1982b. *Can "It" Happen Again? And Other Essays on Instability and Finance*. Armonk, NY: M. E. Sharpe.

Minsky, Hyman P. 1986. *Stabilizing an Unstable Economy*. New Haven, CT: Yale University Press.

Mundell, Robert A. 1963. Inflation and Real Interest. *Journal of Political Economy* 71 (3): 280–283.

Papadimitriou, Dimitri B., and L. Randall Wray (eds.). 2010. *The Elgar Companion to Hyman Minsky*. Cheltenham and Northampton, MA: Edward Elgar.

Phillips, A.W. 1958. The Relation Between Unemployment and the Rate of Change of Money Wage Rates in the United Kingdom, 1861–1957. *Economica* 25: 283–300; reprinted in *Macroeconomic Readings*, ed. John Lindauer, 107–119. New York: The Free Press, 1968.

Presley, John R. 1986. J. M. Keynes and the Real Balance Effect. *The Manchester School* 54 (1): 22–30.

Robbins, Lionel. 1934. *The Great Depression*. London: Macmillan.

Rothbard, Murray. 1975. *America's Great Depression*, 3rd ed. Kansas City, MO: Sheed and Ward.

Saulnier, Raymond. 1938. *Contemporary Monetary Theory*. New York: Columbia University Press.

Sobel, Robert. 1968. *The Great Bull Market*. New York: Norton.

Sumner, Scott. 1990. Price-Level Stability, Price Flexibility, and Fisher's Business Cycle Model. *Cato Journal* 9 (3): 719–727.

Sumner, Scott. 2015. *The Midas Paradox: Financial Markets, Government Policy Shocks, and the Great Depression*. Oakland, CA: Independent Institute.

Tarshis, Lorie. 1938. Real Wages in the United States and Great Britain. *Canadian Journal of Economics and Political Science* 4: 362–375.

Tarshis, Lorie. 1939. Changes in Real and Money Wages. *Economic Journal* 49: 150–154.

Temin, Peter. 1989. *Lessons from the Great Depression, Lionel Robbins Lectures*. Cambridge, MA: MIT Press.

Tobin, James. 1975. Keynesian Models of Recession and Depression. *American Economic Review* 65 (2): 195–202.

Tobin, James. 1980. *Asset Accumulation and Economic Activity*. Yrjo Jahnssen Lectures. Chicago: University of Chicago Press.

Veblen, Thorstein. 1904. *The Theory of Business Enterprise*. New York: Charles Scribner's Sons; reprinted New York: Mentor Books, no date.

Velupillai, K. 1975. Irving Fisher on 'Switches of Techniques'. *Quarterly Journal of Economics* 89: 679–680.

9

Changing Economics: Irving Fisher, the Cowles Commission, and the Econometric Society

Introduction

With the striking but isolated exception of the Paris-trained civil engineer Charles Ellet Jr. ([1839] 1966) and Cambridge-trained Toronto mathematics Professor John Bradford Cherriman's review article on Cournot (Cherriman 1857), Irving Fisher was the first mathematical economist in the Western Hemisphere (on Ellet, see Ekelund and Hebert 1999 and references given there). Fisher's *Mathematical Investigations in the Theory of Value and Price* (1892), which Paul Samuelson (1967, p. 22) modestly "hailed as the greatest Ph.D. dissertation ever written in economics," independently developed indifference curves, ordinal utility, and general equilibrium analysis (and constructed a hydraulic model to simulate the general equilibrium determination of prices and quantities), and the course on "The Mathematical Theory of Price" that Fisher taught at Yale in the 1890s (in the Mathematics Department until 1895, then in Political Economy), were entirely out of step with contemporary styles of political economy at a time when even the marginal utility analysis of W. Stanley Jevons ([1871] 1957) was disdained as mathematical, abstract, and formal by such influential

R. W. Dimand, *Irving Fisher*, Great Thinkers in Economics,
https://doi.org/10.1007/978-3-030-05177-8_9

scholars as J. Laurence Laughlin of the University of Chicago (Laughlin 1892). Fisher's course on "The Mathematical Theory of Price" was quite unlike what his teacher William Graham Sumner was teaching at the time using Laughlin's Americanized edition of John Stuart Mill's *Principles*, let alone the course on "Economics Factors in Civilization" that a slightly earlier Sumner Ph.D. student, Thorstein Veblen, was giving in Chicago in the 1890s (Dimand 1998). A century and a quarter after Fisher's dissertation, graduate courses and textbooks in microeconomics and econometrics resemble Fisher's thesis and course, and his subsequent work on correlation analysis, index numbers, and intertemporal equilibrium, much more closely than they resemble the writings and teaching of his contemporaries. Fisher participated in that transformation of economics, not just through his own research and writing but through his involvement in the creation of the Econometric Society and the Cowles Commission, institutions that fostered the use of formal mathematical and statistical techniques in economics.

Fisher Encounters Mathematical Economics

Fisher was a student of Yale physicist and mathematician Josiah Willard Gibbs, but also took four graduate courses in political economy with William Graham Sumner, the Social Darwinist and pioneer sociologist who was a campus celebrity. "While I was still studying for a mathematical career, I took courses under Sumner, not because I ever expected to enter economics but because I wanted to meet such a personality before leaving Yale … when the time came to select my thesis, I found I had devoted nearly half my time to his courses … outside my field of mathematics," recalled Fisher in 1942 at the celebration of his 75th birthday[1] (quoted by his son Fisher 1956, p. 45). Sumner "said 'Why don't

[1]The celebration was at Harvard, organized by Joseph Schumpeter, because by then Fisher's Yale colleagues thought of him primarily as the man who stated in October 1929 that stock prices appeared to have reached a permanently high plateau. Fisher's 1942 recollection of taking economics courses only because of Sumner neglects courses in corporations, railroads and the history of political economy that he took with Arthur Twining Hadley, then first dean of Yale Graduate School and later president of the university from 1899 to 1921 and of the American Economic

you write on mathematical economics?' I replied, 'I have never heard of such a subject.' He said, 'That is because I myself have never studied it enough to use it, but I can put you on to the literature.'"

The literature to which Sumner introduced Fisher was the 1888 posthumous third edition of W. Stanley Jevons ([1871] 1957), which included a bibliography of mathematical economics extended by Jevons's widow, and an 1889 volume in German by Rudolf Auspitz and Richard Lieben. Neither of these covered general equilibrium analysis or indifference curves, which Fisher independently developed in his 1891 dissertation (published 1892). Fisher had substantially completed his thesis before he managed to obtain copies of the writings of Francis Ysidro Edgeworth and Léon Walras, listed in the Jevons bibliography—which is why Samuelson's view of Fisher (1892) as the greatest Ph.D. dissertation in economics is balanced by Robert Dorfman's opinion that Fisher was lucky his examiners did not reject the thesis for inadequate knowledge of the literature and unnecessary originality, reinventing Walrasian general equilibrium and Edgeworth's indifference curves.[2] "Three days after Part II was finished I received and saw for the first time Prof. Edgeworth's *Mathematical Psychics*," reported Fisher (1892, p. 4). "I was much interested to find a resemblance between his surface on page 21 and the total utility surfaces described me." Fisher (1892) went beyond Walras and Edgeworth in not only positing, but constructing and using, a hydraulic mechanism to find equilibrium prices and quantities (see Ulrike Schwalbe in Loef and Monissen 1999; Dimand and Ben-El-Mechaiekh 2012). "Speaking for myself," wrote Samuelson

Association in 1898–1899, and in the principles of public finance and the history of labor organizations with Henry W. Farnam, the New Haven Railroad heir who was longtime secretary of the university and AEA president in 1909 (and funder of Fisher's hydraulic mechanism).

[2]See Dorfman (1995). Fisher's version was of course not identical with equilibrium economics of Walras or Edgeworth, for example regarding Walras's specification of initial endowments of agents, but Fisher (1892, p. 4) acknowledged that "These equations are essentially those of Walras … That similar results should be obtained independently and by separate paths is certainly an argument to be weighed by those skeptical of the mathematical method." Max Sasuly (1947) claimed that Fisher's thesis "probes with mature grasp in the best available thought in the sciences and humanities of the '90s … a full panorama of the relevant culture" but Walras and Edgeworth were even more relevant than the authors listed by Sasuly.

(1967, p. 22), "I find the hydraulic tanks that serve as analogue computers less exciting than did the author and many of his readers"—yet the volume of *Ten Economic Studies in the Tradition of Irving Fisher* in which he gave that opinion included Herbert Scarf's first presentation of a fixed-point algorithm for the computation of equilibrium prices, offered as a more modern and general version of Fisher's mechanism.

The shock of discovering Walras and Edgeworth, and that he had to some extent reinvented the wheel, led Fisher to explore and celebrate the literature of mathematical economics and the incipient community of mathematical economists, starting with the translation under his supervision of Walras (1892), followed by the translation by Fisher's brother-in-law, Nathaniel Bacon, of Cournot ([1838] 1897), with introduction, notes and bibliography by Fisher (see also Fisher 1898, 1938). Fisher drew attention to the work of other mathematical economists from Cournot onwards, he presented the methodological case for the usefulness of mathematics in economics (e.g. Fisher 1930, 1941),[3] he tried to demonstrate that usefulness by the example of his own theoretical and empirical work, and as early as 1912, when Fisher's friend and former doctoral student and junior colleague John Pease Norton[4] was vice-president of the American Association for the Advancement of Science (AAAS), Fisher proposed forming a group or society under the AAAS aegis to promote quantitative and mathematical economics, attracting the interest of Wesley C. Mitchell and Henry L. Moore, both

[3]Fisher's foreword to the 1927 reprint of Cournot ([1838] 1897) reported that "the mathematical method has become so general in economic and statistical studies that no attempt has been made to bring the bibliography down to date by adding the many items which would be necessary" (p. vii of the 1927 reprint, quoted on p. v of the 1963 reprint). He further claimed that "there is today little need, as there was then, to emphasize the value of the method, as it is now seldom, if ever, challenged" but Fisher (1930, 1941) show that the growth of the mathematical literature of economics and statistics did not imply general acceptance or remove the need, in Fisher's view, to make the case for the legitimacy and usefulness of such methods. In addition to celebrating the centenary of Cournot's book (see Fisher 1938), the Cowles Commission, Econometric Society followed Fisher in the 1930s in drawing attention to earlier mathematical economists, with articles by Akerman (1933) on Wicksell, Schneider (1934) on von Thünen, Hicks (1934) on Walras, and Amoroso (1938) on Pareto.

[4]Norton's Yale Ph.D. dissertation, *Statistical Studies of the New York Money Market* (1902), has been belatedly recognized, notably by Judy Klein (1997), as a landmark of time series analysis (although without mention of Yale or Fisher). Fisher's son and biographer bore the middle name Norton. Norton's AAAS position was full-time and permanent.

of Columbia University (Christ 1952, p. 5; Bjerkholt 1998, p. 31—both of whom give Norton's AAAS position to Fisher, who had chaired the social sciences section of AAAS in 1906). However, too few other economists expressed interest at the time, and, as with his proposal the same year for an international conference on the cost of living (Allen 1993, pp. 126–127), which was endorsed by President William Howard Taft (in a special message to Congress on February 2, 1912[5]) and the US Senate but never came to a vote in the House of Representatives, Fisher's multiple, nominally separate proposals might well engender suspicion that Fisher was seeking another forum to promote his (and Senator Robert L. Owen's) "compensated dollar" plan to stabilize the price level instead of pegging the dollar price of gold.

Some Mainstream Reactions to Fisher's Mathematical Economics

In contrast to Fisher's dissertation, and after he moved from Yale's Department of Mathematics to a permanent appointment in the Department of Political Economy in 1895, Fisher's next few books followed the example of Alfred Marshall's *Principles of Economics* by using mathematical symbols only in appendices where they need not disturb general readers. Fisher's colleague Fred Rogers Fairchild, reviewing Fisher's *Nature of Capital and Income* (1906) in the *Yale Alumni Weekly*, felt it necessary to offer reassurance "for those who have not had a mathematical training, or who flee in dismay at the first appearance of a mathematical symbol, the book need present no terrors. The mathematical material is collected in several appendices; so arranged as to be easily accessible, and at the same time easily omitted without destroying the continuity of the text" (reprinted in Dimand 2007, Vol. 1, p. 70). In contrast, C. P. Sanger, reviewing Fisher (1906) in the *Economic Journal*, expressed the less common opinion that "the important series

[5]According to Fisher (1934, quoted by Fisher 1956, p. 189), Fisher helped draft Taft's message to Congress. Taft, while a Yale law professor between being President and Chief Justice, accepted the chairmanship of Fisher's Life Extension Institute in 1913.

of mathematical appendices, though of little interest to actuaries, will probably be held by many readers to be the most valuable part of this important book" (reprinted in Dimand 2007, Vol. 1, p. 106). The "one complaint" of Sanger's *Economic Journal* review of Fisher's *Rate of Interest* (1907) was against Fisher's Marshall-like relegation of mathematics to appendices: "Surely most economists have a good general education, and could easily follow the mathematics, which is never of an advanced kind, which is in some of the appendices. In fact, the appendix to Chapter III contains the essential part of the argument, namely, that the conditions stated *are* sufficient to determine the unknown. This should certainly form part of the text, as it is the kernel of the book" (reprinted in Dimand 2007, Vol. 1, p. 111). But Edgeworth's assignment of those two book reviews to Sanger, a statistician and former Cambridge Second Wrangler rather than an economist, suggests doubt that most economists of the time could easily follow Fisher's mathematics, even if not advanced and confined to appendices. In *The Theory of Interest* (1930), Fisher used some mathematical notation in the text "in view of the increasing use of mathematics and the increasing numbers of students equipped to read mathematical economics and statistics." Yet even there, as Charles Roos noted in his review in the *Bulletin of the American Mathematical Society* (reprinted in Dimand 2007, Vol. 3, pp. 21–22), where there was material "best handled by means of the calculus … because of the unprepared state of most expected readers, the author relegates the derivation of the necessary conditions to an appendix."

Fisher's enthusiasm for the cause of mathematics in economics did not win universal approval, even in memorial articles, which usually accentuate the favorable. Fisher's Yale colleague Ray B. Westerfield, in his 1947 *American Economic Review* memorial to Fisher, complained that Fisher's "liberal use of mathematics and physics not only delimited his audience but also led to many misunderstandings, for it minimized the psychological factor and his similes did not fit the facts too well" (reprinted in Dimand 2007, Vol. 3, p. 380). G. Findlay Shirras, in his 1947 *Economic Journal* obituary of Fisher (reprinted in Dimand 2007, Vol. 3, p. 390), objected that "In the treatises on Capital and Income and on Interest I frequently found the kernel of the doctrine expressed in mathematical garb, sometimes in an appendix or

a footnote. This leads to tediousness, as mathematics in economics should be used as a shorthand language rather than as an engine of inquiry" as recommended by Alfred Marshall. Shirras then quoted John Maynard Keynes's review of Fisher's *Purchasing Power of Money* as stating that "some of the mathematical appendixes can hardly assist any readers except those who feel a special confidence in a proposition which is expressed algebraically" but did not deem it relevant to mention anything else that Keynes ever wrote about Fisher (except a remark from the same review about Fisher's attempts to measure the price level and volume of transactions being "unscientific guesses of the wildest character"), or that all eight editions of Marshall's *Principles* included a Mathematical Appendix. Fisher's use of mathematics, even in appendixes, was a blemish that in 1947 leading mainstream economics journals could not countenance or pass over in silence even in memorials when, as Dr. Johnson remarked, one is not speaking upon oath.[6]

Fisher and the Origins of the Econometric Society

Olav Bjerkholt (2017, pp. 176–177) reports that a series of fourteen letters between François Divisia and Ragnar Frisch from September 1926 to January 1927 about the possibility of an informal circle of mathematical economists and perhaps eventually a journal (which might be called *Oekonometrika*), but notes that Joseph Schumpeter persuaded Frisch that a European econometric society would "remain small and

[6]On occasion, instead of an economist disapproving of Fisher for using mathematical economics, the opprobrium went in the other direction. Carl Goldenberg (1975, p. 49) recalled that Stephen Leacock, head of McGill University's Department of Economics and Political Science from 1908 to 1936, "had his prejudices, particularly against mathematical economists. I always suspected that this was in part due to the fact that Irving Fisher of Yale was one of the first of this breed. He was a teetotaler [and Prohibitionist] and so Leacock had no use for him or his approach to economics. I remember buying Keynes's *General Theory of Employment, Interest and Money* when it appeared in 1936 and proudly showing it to Leacock. He opened the book but, unfortunately, at one of the few pages with algebraic equations. He thereupon threw it down and, in disgust, as he walked away, said: 'Goldenberg, this is the end of John Maynard Keynes.'"

anemic persuaded Frisch" without "US blood and money for worldwide success and influence" (Bjerkholt 2017, p. 178) even if US mathematical economists were rare apart from Fisher. Frisch visited the United States as a Rockefeller Fellow in 1927–1928, meeting Schumpeter at Harvard in autumn 1927 (Schumpeter was then a visiting professor, and did not move permanently from Bonn to Harvard for another five years), Fisher at Yale in February 1928, and shortly afterwards, at Princeton, Charles F. Roos, a postdoctoral fellow in mathematics who had studied at Rice University with Griffith Evans, a mathematician interested in economics. Roos was about to become an assistant professor of mathematics at Cornell and secretary of the newly organized Section K, the economics, sociology, and statistics section of the AAAS, holding both positions from 1928 until he became permanent secretary of the AAAS in 1931. Whereas Evans's articles on mathematical economics appeared only in mathematics journals, Roos had also published in the *Journal of Political Economy* in 1927 and did so again in 1930 (Dimand and Veloce 2007). Roos (1948) and Christ (1952, p. 5; 1983) wrote that Frisch, Roos and Fisher met at Fisher's home in New Haven in April 1928 and considered possible members of a new society. However, Bjerkholt (1998, p. 36) found no documentary evidence of such a meeting in 1928 and suggested that it was a mistake for the June 14–15, 1930, weekend meeting of Fisher, Frisch and Roos at Fisher's home. That 1930 meeting produced the June 1930 letter to thirty-one potential members of a new society for the "advancement of economic theory."[7]

Thanks to Fisher, Frisch returned to Yale in early 1930, delivering the lectures eventually published as Frisch (2010), and in the spring of 1931 was offered a full professorship (with a yearly grant for travel and other research expenses), an offer he finally declined in October to stay at the University of Oslo where a personal chair was created for him (Andvig and Thonstad 1998, p. 3). Andvig and Thonstad (1998)

[7]Walter Friedman (2014, p. 79), claiming to follow Christ (1952), dates the visit of Frisch and Roos to Fisher to April 1929 (when Frisch was in Europe) and limits Fisher's role to agreeing to become a founding member of the Society.

discuss how the subsequent history of economics and econometrics at the University of Oslo would have been different if Fisher had succeeded in keeping Frisch at Yale. Such a move would also have transformed economics at Yale, where Fisher's interests in formal economic theory and such empirical techniques as correlation analysis and distributed lags, together with his public advocacy of causes ranging from diet reform through eugenics, Prohibition, and the League of Nations to price level stabilization, isolated him from his (mostly now forgotten) colleagues (excepting James Harvey Rogers). Frisch's year at Yale in 1930–1931, for which Fisher was responsible,[8] was crucial for the creation of the Econometric Society.

Fisher (1941, p. 183) recalled "his own skepticism, only eleven years ago, when Ragnar Frisch and Charles F. Roos suggested to him the formation of the Society" but over that June 1930 weekend Frisch and Roos persuaded Fisher that there were enough potential members. Bringing together scholars interested in promoting mathematical and statistical methods in economics followed naturally from Fisher's J. Willard Gibbs Lecture given to the AAAS and American Mathematical Society at the end of December 1929, which he devoted to the role, and potentially greatly increased future role, of mathematics in the social sciences (Fisher 1930). Both Frisch and Roos were admirers of Fisher's dissertation and later work. Both Roos's 1927 *JPE* article and his 1934 Cowles Monograph on *Dynamic Economics* quoted Fisher (1892) when explaining the motivation for Roos's studies, along with quotations from the 1897 translation of Cournot supervised by Fisher (Dimand and Veloce 2007), while Frisch's 1922 purchase of the 1917 French translation of Fisher's dissertation marked a notable step in Frisch's

[8]James Harvey Rogers, a Fisher and Pareto student who was the only other Yale economist interested in (or capable of understanding) Frisch's work, did not join the Yale faculty as Sterling Professor of Economics until the summer of 1930, after Frisch's visiting professorship had begun, although he undoubtedly had a role along with Fisher in the 1931 offer to Frisch of a permanent position. Rogers published in the first volume of *Econometrica* in 1933. Oystein Ore, a Norwegian mathematician affiliated with Yale from 1929, was a friend of Frisch, but, as Bjerkholt (1998, pp. 26, 46–47) notes, his interests were in number theory and algebra, not mathematical economics or statistics. Fisher also persuaded Yale to offer Schumpeter a chair, but Schumpeter opted for Harvard.

intellectual development (Bjerkholt 1998, p. 30). In his "Tribute to Irving Fisher" at the American Statistical Association dinner celebrating Fisher at the ASA annual meeting in Atlantic City in January 1947, a month before Fisher's 80th birthday (published in both *Econometrica* and the *Journal of the American Statistical Association*), Frisch stressed "the crucial contribution" and the "monumental importance" of Fisher's *Mathematical Investigations*: "I remember the intensity with which, in my younger days, I dug into Fisher's dissertation, and the same can undoubtedly be said about many other economists of our generation … When we are speaking … about [the ideas] that are responsible for the really long-time trend of our science, then it will be hard to find any single work that has been more influential than Fisher's dissertation. It will be standing there as a milestone long after our great grandchildren are dead and forgotten" (reprinted in Dimand 2007, Vol. 3, pp. 367–368). Whether or not Fisher's thesis made as deep an impression on many other economists of Frisch's generation, Frisch left no doubt about his own feelings concerning Fisher as a pioneer of mathematical economics and econometrics.

Schumpeter, writing to Frisch in September 1930 (quoted by Bjerkholt 2017, p. 189), regretted not having followed up on his "pleasant talks" with Frisch at Harvard in 1928 about the possibility of an econometric society, but was "very glad that you have now secured a more efficient ally … our eminent friend Fisher," whom Schumpeter planned to visit soon in New Haven. Schumpeter had known Fisher since Schumpeter, then a thirty-year-old Austrian Exchange Professor at Columbia University, had spent Thanksgiving 1913 at Fisher's home in New Haven where "Fisher and the young professor from the University of Graz talked of economic theory, statistics, and mathematics, and the prospects for the science of economics" (Allen 1993, p. 130). Schumpeter, memorializing Fisher in *Econometrica* in 1948 (reprinted in Dimand 2007, Vol. 3, pp. 419–420), deemed Fisher "the most important of the pioneers of econometrics since William Petty. It is this which I should answer were I asked to press into a single sentence the reasons I have for applying the epithet 'great' so unhesitatingly to his work." Paul Samuelson (1982, p. 6) recalled that his teacher

Schumpeter "found Irving Fisher amusing for his solemn do-goodism and health faddisms, but that never diminished his reverence for Fisher's theoretical innovations in value theory and interest determination."

Discussions among Fisher, Frisch, and Schumpeter led to the June letter being followed by a more specific November 29, 1930, letter of invitation from Fisher, Frisch,and Roos to a meeting to organize a society for the "advancement of theory in relation to statistics and mathematics." Accordingly, sixteen economists and mathematicians, including ten recipients of the letter, met in Cleveland on the evening of December 29, 1930, after an afternoon joint session of the American Mathematical Society, American Statistical Association, and Sections A and K of the AAAS, at which Griffith Evans, Ragnar Frisch, and Harold Hotelling gave papers (see Bjerkholt 2017). Five of the six speakers and discussants from the afternoon session attended the evening session (Evans was the exception). The meeting, chaired by Schumpeter with Roos as recorder, declared the Econometric Society founded, elected the absent Fisher as president (he served until 1935), and elected a council of ten (seven Europeans and three Americans), of whom only Frisch, Roos, Schumpeter, and Harvard statistician and epidemiologist E. B. Wilson were present (Wilson, who was giving the Gibbs Lecture the next day, left the meeting before the election of the council). Fisher, although not present (Allen 1993, p. 234, was mistaken in saying Fisher attended), was considered the obvious choice for first president, a rarity as a well known, senior American economist committed both to the usefulness of mathematics in economic theory and to the use in empirical economics of formal statistical methods such as correlation analysis and his own invention, distributed lags: for example, Wesley Mitchell of Columbia and the National Bureau of Economic Research propounded a statistical approach to business cycle analysis but was wary of formal economic theory, Roos's teacher Griffith Evans was an eminent mathematician who served as president of the American Mathematical Society and had an interest in mathematical economics but was an outsider to the economics profession, Schumpeter was a patron of and an advocate for mathematical economics but not a practitioner. Edgeworth, Pareto, and Walras, the outstanding mathematical economists of the generation before Fisher,

all European, were gone, the last being Edgeworth, who passed away in 1926. The American Statistical Association was well represented: five of the sixteen men at the meeting were president of the ASA between 1928 and 1934 (as was Fisher, ASA president in 1932). No one then prominent in the American Economic Association attended, even though the AEA was having its annual meeting jointly with the AMS, ASA, and AAAS (Fisher had been AEA president in 1918, but in the 1920s turned to publishing in the *Journal of the American Statistical Association* instead of the *American Economic Review*). Some of Fisher's Yale colleagues were prominent in the AEA in the 1920s (Ray Westerfield as secretary-treasurer, Thomas S. Adams as president) but they were not sympathetic to Fisher's work or to the new society. However, Fisher persuaded seven of his Yale colleagues to join as members of the Econometric Society in May 1932, although for most of them their involvement consisted only of paying $2 a year (see *New Haven Register*, May 15, 1932, "New Haveners Join Econometric Society").

Fisher and Cowles

The Econometric Society recruited members and held conferences in Europe and the United States, but was initially a small, poorly funded organization with limited influence, with an annual membership fee of $2 in the United States and $1 elsewhere. It might have remained such had not Alfred (Bob) Cowles III, a *Chicago Tribune* heir[9] turned Colorado Springs investment counselor, not had his faith in stock market forecasts shaken by the Wall Street crash than began in October 1929. Cowles (1931) assembled evidence that stock market forecasters (including himself) could not forecast the market. As Robert Rhea remarked in one of his *Dow Theory Comments*, Cowles had been a forecaster "but now pitches for the other team" (see Dimand and Veloce 2010; Read 2016). In using multiple correlation analysis to test whether

[9]Alfred Cowles Sr., was business manager, treasurer and one of the incorporators of the *Chicago Tribune*, of which he owned one third.

stock forecasters had done better than chance, Cowles enlisted the help of Harold T. Davis, an Indiana University mathematics professor who summered in Colorado Springs, where he and his wife had graduated from Colorado College. Davis told Cowles about the Econometric Society. Cowles, a Yale graduate (class of 1913),[10] wrote to Irving Fisher in August 1931, offering to pay for both a journal and a research organization with ample resources and academic freedom—finally providing the money half of the "US blood and money" that Schumpeter had felt the Econometric Society would need for worldwide success and influence.

An excited Fisher read Cowles's letter over the telephone to Roos (secretary-treasurer of the Econometric Society as well as permanent secretary of AAAS), who understandably asked whether it was a crank letter (Christ 1952, p. 8). Fortunately, Fisher had befriended Cowles's father and uncle when the three of them were Yale undergraduates in the 1880s (Alfred Cowles Jr., was born in 1865, a year before William H. Cowles and two years before Fisher). Like Fisher, both Alfred Cowles Jr., and Alfred Cowles, 3rd, had been members of Skull and Bones, Yale's most prestigious senior society.[11] Fisher vouched for Cowles's

[10]Cowles had remained in close contact with Yale since graduating, even if not with Fisher: the story in the *New Haven Register* on eight Yale economics professors joining the Econometric Society ("New Haveners Join Econometric Society," May 15, 1932) stated that "The research director of the Cowles Economic Commission is Alfred Cowles, 3rd, who joined with others in his family to establish the Cowles Foundation for the Study of Government at Yale." That first Cowles Foundation at Yale appears to have become the endowment for the Cowles professorship in political science. See Dimand and Veloce on the Cowles Commission in Colorado until 1939 and Hildreth (1986) and Christ (1994) on the Cowles Commission's years at the University of Chicago from 1939 until it moved to Yale as the Cowles Foundation for Research in Economics in 1955. Independently, a German-language journal for mathematical economic and social research was launched in 1935 (see von Stackelberg 1935, 1938, Tinbergen 1937, Schneider 1938), drawing contributions from scholars who also participated in the Econometric Society (see Schneider 1934, Tinbergen 1935), but that journal did not survive World War II.

[11]The *New York Times*, May 17, 1912, listed all forty-five Yale students tapped (chosen for membership) in Yale's senior societies (fifteen each for Skull and Bones, Scroll and Keyes, and Wolf's Head), including Alfred Cowles, 3rd, and future Presidential candidate, ambassador and New York Governor W. Averill Harriman for Skull and Bones and future popular composer Cole Porter for Scroll and Keys. The *Times* even discussed, by name, some students who were not chosen, although they had expected to be, and named one student who rejected Scroll and Keys, hoping for Skull and Bones, and five who rejected Wolf's Head.

seriousness of intent. Cowles met Fisher and Roos at Fisher's home in New Haven on a weekend in October 1931, and offered an initial budget of $12,000 a year, with the prospect of increases if the project flourished. Writing to Fisher on October 18, in a letter written in Fisher's home, Cowles stated that "I am ready to make up any deficit in the proposed journal, 'Econometrica', including all the expenses of editing, printing etc." and suggested Frisch as editor, presumably at the behest of Fisher and Roos since Cowles had never met Frisch (Bjerkholt 1998, pp. 42–43). Fisher wrote to Frisch the same day, "It is exceedingly wonderful to have an 'angel' suddenly fall down from the sky to supply us with the one thing needful to make our Society a huge success. Without financing we can never amount to a great deal" (Bjerkholt 1998, pp. 42–43). European members of the Society's council, notably Divisia, worried about Cowles's motives and how much control he would seek, and designated Frisch to meet with Cowles as their representative. "Cowles was favorably impressed by this cautious approach," reported Carl Christ (1952, p. 9), "and responded by inviting Frisch to come as his guest to Colorado Springs," where Frisch stayed for a week. Frisch reported favorably to the European members of the Council, and Cowles's offer was accepted in January 1932. Even before the Cowles Commission for Research in Economics was chartered in Colorado in September 1932 as a not-for-profit corporation, the Econometric Society appointed an Advisory Council in February 1932 to guide the Cowles Commission, consisting of Fisher, Frisch, Wesley Mitchell of the NBER, A. L. Bowley of the London School of Economics, and Carl Snyder of the Federal Reserve Bank of New York. The Advisory Council met, with Roos but without Bowley, at the 1932 Econometric Society summer sessions in Syracuse, New York, but gradually became less active in supervising the research organization ("dormant" according to Christ 1952, p. 26), leaving matters to Cowles as president of the Cowles Commission and to successive research directors, first Roos, then Harold Davis, and, in Chicago from 1939, Theodore Yntema and Jacob Marshak.

These early negotiations show Cowles bringing not only money to the Econometric Society and Cowles Commission, but also much-needed tact. Cowles declared himself "favorably impressed by this

cautious approach. Given that Cowles (1931, 1933) documented the failures of stock predictions, Cowles could easily have offended Fisher, who was notorious and humiliated for his hubris in declaring in October 1929 that stock prices had reached a permanently high plateau and who to the end of his life believed that he had a formula for predicting short-term movements in stock prices. Not grasping Cowles's efficient-markets challenge to the very possibility of stock forecasting, Fisher believed that Cowles was seeking improved mathematical techniques to profit from stock prediction. Christ (1952, p. 13) thought that Cowles (1933) "pointed strongly to the need for more reliable knowledge upon which to base economic forecasts" whereas Cowles's argument from 1931 onwards was that no-one who could successfully predict the movement of stock prices would be so foolish as to sell that knowledge to subscribers instead of acting on it (see Dimand and Veloce 2010).

In addition to money and tact, Cowles provided his labor: in addition to being president of the Cowles Commission, he was circulation manager of *Econometrica* from its first issue, treasurer of the Econometric Society from 1932, and was also secretary of the Society from 1937. This was characteristic of Cowles's hands-on approach as a donor: he was not only trustee or director of the Illinois Children's Home & Aid Society and the Passavant Memorial Hospital, but also treasurer of each. In the 1930s, before government funding of private economic research, Cowles's financial support for *Econometrica*, the Cowles Commission, and the Cowles Commission summer conferences was crucial in creating an institutional space for the "advancement of economic theory in connection with statistics and mathematics," the stated goal of the Econometric Society and Cowles Commission and of Fisher (1930, 1933a, 1941). Cowles's tact and firmness may also be seen in the absence from the Cowles Commission and Econometric Society of Karl Karsten, of the Karsten Statistical Laboratory of New Haven, Connecticut, until the early 1930s the statistician closest to Fisher, and the perpetrator of what Max Sasuly (1947) termed in his memorial of Fisher "the Edge-Karsten quadrature hoax" (see Karsten 1924 and Chapter 6).

Next to Cowles himself, the leading facilitator of the acceptance of Cowles's offer (as of the invitation letters to establish the Econometric Society) was Fisher, whose long acquaintance with Cowles's father and uncle helped him to appreciate Cowles's seriousness and trustworthiness, and who bonded with Cowles because a central event in each of their lives was surviving tuberculosis. The admiration of Frisch, Roos, and Schumpeter for Fisher as a pioneer in mathematical economics, particularly for his dissertation (and in Frisch's case also for Fisher's 1927 exploration of the possibility of measuring marginal utility), helped bring them together with Fisher to establish the Econometric Society. Despite their reservations about Fisher's varied enthusiasms and reform crusades from eugenics through Prohibition and a low-protein diet to proposing a new calendar and a new world map projection, reservations expressed in Schumpeter's 1948 memorial article about Fisher, and despite Fisher's public humiliation in the stock market crash, they looked beyond these distractions to Fisher the economic theorist and econometrician: "For whatever else Fisher may have been—social philosopher, economic engineer, passionate crusader in many causes that he believed to be essential to the welfare of humanity, teacher, inventor, businessman—I venture to predict that his name will stand in history principally as the name of this country's greatest scientific economist" (Schumpeter 1948, reprinted in Dimand 2007, Vol. III, p. 419).

Conclusion

In the 1930s, after Fisher's disastrously memorable predictions about the stock market and his personal financial debacle ruined his reputation with the general public, policy-makers, most economists and his Yale colleagues, the Econometric Society, and Cowles Commission (together with the American Statistical Association and International Statistical Institute) gave Fisher a respectful hearing. His now-famous but then largely ignored "Debt-Deflation Theory of Great Depressions" (1933b) appeared in the first volume of *Econometrica* (and in the *Review of the International Statistical Institute*), explaining

from Fisher's perspective what had gone wrong. That article by the founding president of the Econometric Society took the place of a presidential address (which the Society did not yet have) and, from 1975, greatly influenced Hyman Minsky, James Tobin, Ben Bernanke, and Mervyn King—a delayed impact but a major one. He spoke regularly at Cowles summer conferences: from July 7 to 10, 1936, he gave four talks on "Income in Theory and Income Taxation in Practice" (published in *Econometrica* as a 55-page article, Fisher 1937), plus an evening public lecture on July 10 on "The Depression, Its Causes and Cures." The month-long conference, devoting an entire day to presentation and discussion of each talk, also had three talks on significance tests and statistical inference by British statistician R. A. Fisher, three by Italian statistician Corrado Gini (of the Gini coefficient for income distribution), two by statistical quality control expert W. A Shewhart, four by Carl Snyder of the Federal Reserve Bank of New York, two by statistician and agricultural economist Elmer J. Working, and presentations by Cowles, Roos, A. J. Lotka (of the Lotka-Volterra predator-prey equations) and Swedish location theorist Tord Palander. Other notable names at Cowles summer conferences from 1937 to 1940 included R. G. D. Allen, Abba Lerner, René Roy (of Roy's Identity), Abraham Wald, Holbrook Working, Yntema, Marshak, and future Nobel laureates Frisch, Trygve Havelmo, Wassily Leontief, and Paul Samuelson. Fisher addressed the 1940 Cowles summer conference (the last one held in Colorado) and the 1946 and 1947 Econometric Society meetings in measuring the velocity of circulation of money, published abstracts of those three papers in the 1940 Cowles volume of conference abstracts and in *Econometrica*, the last appearing in April 1947, within weeks of his death at 80 (see Dimand 2000). After Fisher's post-1929 rejection by the public, press, politicians, the mainstream of economics, and his Yale colleagues, and his near-disappearance from journal citation counts, the Econometric Society and the Cowles Commission provided him with a welcoming intellectual space to the end of his life, and he, together with Alfred Cowles, in turn contributed crucially to the establishment of two institutions that were to become enormously influential for the spread and acceptance of formal theorizing and econometrics in economics.

References

Akerman, Johann. 1933. Knut Wicksell, a Pioneer of Econometrics. *Econometrica* 1 (1): 113–118.

Allen, Robert Loring. 1993. *Irving Fisher: A Biography*. Malden, MA: Blackwell.

Amoroso, L. 1938. Vilfredo Pareto. *Econometrica* 6 (1): 1–21.

Andvig, Jens, and T. Thonstad. 1998. Ragnar Frisch at the University of Oslo. In *Econometrics and Economics Theory in the 20th Century: The Ragnar Frisch Centennial Symposium*, ed. S. Strom, 3–25. Cambridge: Cambridge University Press, Econometric Society Monograph 31.

Bjerkholt, Olav. 1998. Ragnar Frisch and the Founding of the Econometric Society and *Econometrica*. In *Econometrics and Economic Theory in the 20th Century: The Ragnar Frisch Centennial Symposium*, ed. S. Strom, 26–57. Cambridge: Cambridge University Press, Econometric Society Monograph 31.

Bjerkholt, Olav. 2017. On the Founding of the Econometric Society. *Journal of the History of Economic Thought* 39 (2): 175–198.

Cherriman, J.B. 1857. Review of Cournot (1838). *Canadian Journal of Industry, Science and Art*, as reprinted in R.W. Dimand (1995), Cournot, Bertrand, and Cherriman. *History of Political Economy* 27 (3): 563–578.

Christ, Carl. 1952. History of the Cowles Commission, 1932–1952. In *Economic Theory and Measurement: A Twenty-Year Research Report, 1932–1952*, 3–65. Chicago: Cowles Commission for Research in Economics.

Christ, Carl. 1983. The Founding of the Econometric Society and *Econometrica*. *Econometrica* 51 (1): 3–6.

Christ, Carl. 1994. The Cowles Commission's Contributions to Econometrics at Chicago, 1939–1955. *Journal of Economic Literature* 32 (1): 30–59.

Cournot, Antoine Augustin. [1838] 1897. *The Mathematical Principles of the Theory of Wealth*, trans. Nathaniel Bacon with introduction and bibliography by Irving Fisher. New York: Macmillan; as reprinted Homewood, IL: Irwin, 1963.

Cowles, Alfred, 3rd. 1931. The Stock Market Barometer, Investment Supervisory Service Special Supplement. Colorado Springs, CO: Cowles & Company, Inc.

Cowles, Alfred, 3rd. 1933. Can Stock Market Forecasters Forecast? *Econometrica* 1 (2): 309–324.

Dimand, Robert W. 1998. Fisher and Veblen: Two Paths for American Economics. *Journal of the History of Economic Thought* 20 (4): 449–466.

Dimand, Robert W. 2000. Irving Fisher and the Quantity Theory of Money: The Last Phase. *Journal of the History of Economic Thought* 22 (3): 329–348.

Dimand, Robert W. (ed.). 2007. *Irving Fisher: Critical Responses*, 3 vols. London and New York: Routledge.

Dimand, Robert W. 2009. The Cowles Commission and Foundation on the Functioning of Financial Markets from Irving Fisher and Alfred Cowles to Harry Markowitz and James Tobin. *Revue d'Histoire des Sciences Humaines* 20: 79–100.

Dimand, Robert W., and Hichem Ben-El-Mechaiekh. 2012. How General Equilibrium Analysis Came to North America: Irving Fisher's *Mathematical Investigations in the Theory of Value and Prices* (1891) and His Hydraulic Model of General Equilibrium. *Journal of Economic and Social Measurement* 37: 97–118.

Dimand, Robert W., and William Veloce. 2007. Charles F. Roos, Harold T. Davis and the Quantitative Approach to Business Cycle Analysis at the Cowles Commission in the 1930s and Early 1940s. *European Journal of the History of Economic Thought* 14 (3): 519–542.

Dimand, Robert W., and William Veloce. 2010. Alfred Cowles and Robert Rhea on the Predictability of Stock Prices. *Journal of Business Inquiry* 9 (1): 56–64.

Dorfman, R. 1995. Austrian and American Capital Theories: A Contrast of Cultures. *Journal of the History of Economic Thought* 17 (1): 21–34.

Ekelund, Robert, and Robert Hébert. 1999. *Secret Origins of Modern Microeconomics: Dupuit and the Engineers*. Chicago: University of Chicago Press.

Ellet, Charles, Jr. [1839] 1966. *An Essays on the Laws of Trade in Reference to the Works of Internal Improvement in the United States*. Richmond, VA: P. D. Bernard; as reprinted New York: A. M. Kelley.

Fisher, Irving. 1892. *Mathematical Investigations in the Theory of Value and Prices*. New York: Macmillan; also published in *Transactions of the Connecticut Academy* 9 (1): 1–124; as reprinted in Fisher (1997), Vol. 1.

Fisher, Irving. 1898. Cournot and Mathematical Economics. *Quarterly Journal of Economics* 12: 119–138.

Fisher, I. 1906. *The Nature of Capital and Income*. New York: Macmillan; reprinted in Fisher (1997), Vol. 2.

Fisher, I. 1907. *The Rate of Interest*. New York: Macmillan; reprinted in Fisher (1997), Vol. 3.

Fisher, Irving. 1930. The Application of Mathematics to the Social Sciences. *Bulletin of the American Mathematical Society* 36 (4): 225–243.

Fisher, Irving. 1933a. Statistics in the Service of Economics. *Journal of the American Statistical Association* 28 (1): 1–13.

Fisher, Irving. 1933b. The Debt-Deflation Theory of Great Depressions. *Econometrica* 1 (3): 337–357; as reprinted in Fisher (1997), Vol. 10.
Fisher, Irving. 1937. Income in Theory and Income Taxation in Practice. *Econometrica* 5 (1): 1–55; as reprinted in Fisher (1997), Vol. 12.
Fisher, Irving. 1938. Cournot Forty Years Ago. *Econometrica* 6 (2): 198–202.
Fisher, Irving. 1941. Mathematical Methods in the Social Sciences. *Econometrica* 9 (2): 185–197.
Fisher, Irving. 1997. *The Works of Irving Fisher*, ed. William J. Barber assisted by Robert W. Dimand and Kevin Foster, consulting ed. James Tobin. London: Pickering & Chatto, 14 vols.
Fisher, Irving Norton. 1956. *My Father Irving Fisher*. New York: Comet.
Friedman, W.A. 2014. *Fortune Tellers: The Story of America's First Economic Forecasters*. Princeton, NJ: Princeton University Press.
Frisch, Ragnar. 2010. *A Dynamic Approach to Economic Theory: The Yale Lectures of Ragnar Frisch, 1930*, ed. Olav Bjerkholt and Duo Qin. London and New York: Routledge.
Goldenberg, H. Carl. 1975. Senator Goldenberg's Leacock Memories. In *The McGill You Knew: An Anthology of Memories 1920–1960*, ed. E.A. Collard, 47–50. Don Mills, ON: Longman Canada.
Hicks, J.R. 1934. Léon Walras. *Econometrica* 2 (3): 338–348.
Hildreth, Clifford. 1986. *The Cowles Commission in Chicago, 1939–1955*. Berlin and Heidelberg: Springer-Verlag.
Jevons, William Stanley. [1871] 1957. *The Theory of Political Economy*. London: Macmillan; 5th ed. with notes, preface and extension of bibliography by H.S. Jevons, New York: A. M. Kelley.
Karsten, K.G. 1924. The Theory of Quadrature in Economics. *Journal of the American Statistical Association* 19 (1): 14–29.
Klein, Judy L. 1997. *Statistical Visions in Time*. Cambridge: Cambridge University Press.
Laughlin, J. Laurence. 1892. The Study of Political Economy in the United States. *Journal of Political Economy* 1 (4): 1–9.
Loef, Hans-E., and Hans-Georg Monissen (eds.). 1999. *The Economics of Irving Fisher*. Cheltenham and Northampton, MA: Edward Elgar.
New Haven Register. 1932. New Haveners Join Econometric Society, May 15. https://cowles.yale.edu/newsletter/items/yale-professors-join-econometric-society.
New York Times. 1912. Yale Taps in Rain Amid Great Tension: Nervousness of the Marshaled Juniors Reflects Own Johnson's Attack on the System: Yale Grit Puts It Through: Recent Graduate Predicts Change Soon—Harriman

and Cortelyou Get Bones, Webb and Camp Keys, May 17, p. 8. https://nytimes.com/1912/05/17/archives/yale-taps-in-rain-amid-great-tension-nervousness-of-themarshaled.html.

Norton, John Pease. 1902. *Statistical Studies of the New York Money Market*. New York: Macmillan for the Department of Social Sciences, Yale University.

Read, Charles. 2016. *The Econometricians: Gauss, Galton, Pearson, Fisher, Hotelling, Cowles, Frisch and Haavelmo*. New York: Palgrave Macmillan; Great Minds in Finance—with a chapter about R. A. Fisher, not Irving Fisher.

Roos, Charles F. 1948. A Future Role for the International Statistics. *Econometrica* 16: 127–134.

Samuelson, Paul A. 1967. Irving Fisher and the Theory of Capital. In *Ten Economic Studies in the Tradition of Irving Fisher*, ed. William Fellner et al., 17–37. New York: Wiley.

Samuelson, Paul A. 1982. Schumpeter as an Economic Theorist. In *Schumpeterian Economics*, ed. H. Frisch, 1–27. London: Praeger.

Sasuly, M. 1947. Irving Fisher and Social Science. *Econometrica* 15: 255–278.

Schneider, Erich. 1934. Johann Heinrich von Thünen. *Econometrica* 2 (1): 1–12.

Schneider, Erich. 1938. Absatz, Produktion und Lagerhaltung bei einfacher Produktion. *Archiv für Mathematische Wirtschafts- und Sozialforschung* 4: 99–120.

Tinbergen, Jan. 1935. Annual Survey: Suggestions on Quantitative Business Cycle Theory. *Econometrica* 3: 241–308.

Tinbergen, Jan. 1937. Einige Grundfragen der mathematischen Konjunkturtheorie. *Archiv für Mathematischen Wirtschafts- und Sozialforschung* 3 (1–14): 83–97.

von Stackelberg, Heinrich. 1935. Die grundlegenden Hypothesen der neuren Preisanalyse. *Archiv für Mathematische Wirtschafts- und Sozialforschung* 1: 84–103.

von Stackelberg, Heinrich. 1938. Angebot und Nachfrage in der Produktionwirtschaft. *Archiv für Mathematicshe Wirtschafts- und Sozialforschung* 4: 73–99.

Walras, Léon. 1892. Geometrical Theory of the Determination of Prices, trans. with introduction by I. Fisher. *Annals of the American Academy of Political and Social Science* 3: 45–64.

10

Fisher's Legacy in Economics

Introduction: Fall and Rise

The history of economics includes several examples of scholars, such as Antoine Augustin Cournot or Johann Heinrich von Thünen or Louis Bachelier, whose work was largely ignored in their own time but was recognized by later generations as significant and noteworthy. The financial instability theory of the late Hyman Minsky has received much more attention in the wake of Global Financial Crisis of 2008 than in his lifetime; Clark Warburton was acclaimed in the early 1980s as a pioneering monetarist for his articles from 1945 to 1953 (collected in Warburton 1966). More often, economists who were eminent in their own time have faded in the profession's memory: the list of presidents of the American Economic Association in its first four decades includes more than a sprinkling of names that are today unfamiliar even to historians of economics, and more whose writings are infrequently cited or read.[1]

[1]Three other Yale economists were AEA presidents in Fisher's lifetime: Arthur Twining Hadley, Henry W. Farnam, and Thomas S. Adams. Another, Ray B. Westerfield, was AEA secretary-treasurer. The extent to which their contributions have been forgotten may be excessive or unfair

R. W. Dimand, *Irving Fisher*, Great Thinkers in Economics,
https://doi.org/10.1007/978-3-030-05177-8_10

The trajectory of Irving Fisher's reputation has been different. Once the most-cited monetary economist, honored in the economics discipline and widely listened to as a public intellectual (even if his advice was often not followed), Fisher received fewer citations in the 1930s and disappeared entirely from citation counts in economics journals in the 1940s as attention turned to Keynes and his followers and critics (see Deutscher 1990, pp. 189, 193). Only a handful of economists continued to respect his contributions, although, quality-adjusted, they were certainly a mighty handful (Allais, Friedman, Samuelson, Tobin; e.g. Allais 1947 was dedicated to Fisher). To the public at large, Fisher became an object of public ridicule for misjudging the stock market, an example showing that experts did not know what they were talking about (e.g. Cerf and Navasky 1984). His many and varied policy enthusiasms attracted derision: the compensated dollar, Prohibition of alcohol (from 1926 to 1930 he wrote three books opposing repeal), the League of Nations (two books advocating American entry), eugenics, low-protein diets, a new world map projection (his last book), a new calendar (equalizing the number of business days per month), posture reform, compulsory health insurance, even wild suggestions that smoking was unhealthy, and that mathematics could be useful in economics (see Fisher 1956, 1961). Fisher's best-selling book was not about economics, but was a guide on *How to Live*, which reached its twenty-first edition in 1946, not counting an abridgement of which Metropolitan Life distributed six to eight million copies (see Allen 1993). His campaigns for these causes were often rightly seen as immoderate,[2] insisting that

(as Melvin Cross has argued persuasively in the case of Hadley on the economics of transportation) but it is undeniable.

[2]In his AEA presidential address in December 1918, Fisher (1997, Vol. 13, p. 7) stated that "We now know that German professors in general, from theologian to chemist, have prostituted their professional services to serve Germany's criminal purposes," especially those economists who in "an economics professors' war… helped lay the foundations for the war … a predatory economics, the economics of a beast of prey, the economics of loot by war." He also denounced "the red flag of class warfare" and academic economists who were apologists for "trade unionism, socialism, and even Bolshevism, syndicalism or I.W.W.ism" yet Allen (1993, p. 158) held that in that address "he measured his words with care, his rhetoric was mild … He did not make rabble-rousing statements" (see Dimand 2013).

"a man who has drunk one glass of beer is one glass of beer drunk" and in 1919 characterizing the United States Brewers Association as "this octopus … this monster … with its terrible and insidious power … this corrupt influence has been organized with typical German brains and cunning" to oppose Prohibition (Fisher 1997, Vol. 13, pp. 122, 110, contrast Warburton 1932). His advice to Presidents and policy-makers, much of it unsolicited, was received politely (usually) but not acted upon (see Barber 1985, 1996). Fisher was self-confident enough that, when he wrote to Franklin Roosevelt suggesting William Trufant Foster or John R. Commons be named to the Federal Reserve Board, he promptly wrote to his nominees congratulating them, but none of them were appointed (Fisher 1997, Vol. 14, p. 105). Nor did Roosevelt agree to impose Fisher as Democratic candidate for US Senator from Connecticut in 1934,[3] any more than the Independent Republicans had agreed to nominate him in 1930 (although they let make the nominating speech for the candidate chosen).

Return from Obscurity

But then Fisher's standing in the economics profession dramatically recovered, decades after his death, as his contributions were increasingly recognized: the Fisher relation between interest rates in any two standards, uncovered interest parity, the two-period Fisher diagram for intertemporal optimization, the Fisher ideal index number, distributed lags to model inflation expectations, a statistical relation between unemployment and price changes, price level stabilization as a monetary policy rule, the debt-deflation theory of depressions, taxing consumption rather than income, computable general equilibrium modeling, indexed bonds. Fisher has been acclaimed by Friedman as an

[3]It is notable that Fisher approached FDR, but not Governor Wilbur Cross, who would have been his running mate on the Democratic ticket. Cross, the long-time dean of Yale's Graduate School and provost of the university before his four terms as governor, was perhaps too well acquainted with Fisher. Fisher had voted for Herbert Hoover and the Republican ticket in both 1928 and 1932.

influence on monetarism (Friedman 1972; Bordo and Rockoff 2013) and it has been noticed that Keynes recognized Fisher as his intellectual "great-grandparent" in treating money as a real factor (Keynes 1971–1989, Vol. 14, p. 203n; Kregel 1988; Dimand 1995). Fisher's 29-country empirical study anticipated a large, much later literature that independently rediscovered his findings about the role of the gold standard in spreading the Depression (Fisher 1935; see also Pavanelli 2003). His work on the statistical theory of index numbers remains of fundamental importance (see Boumans 2001; Diewert 2013). Fisher has been found to have given the first clear statement of the marginal opportunity cost of holding real money balances in his *Theory of Interest* in 1930 (p. 216, in Fisher 1997, Vol. 9), although, as Don Patinkin (1990, p. 26) remarked, it is striking that the author of *The Rate of Interest* had neglected to include the interest rate among the factors affecting velocity of circulation in *The Purchasing Power of Money* (1911, in Fisher 1997, Vol. 4; see also Morgan 1997, 2007). The Fisher diagram evolved into the "trade theorist's sacred diagram" (Humphrey 1988). Although Fisher gave the definitive formulation of the neoclassical theory of interest and capital, K. Velupillai (1975) discovered that Fisher gave a numerical example prefiguring the reswitching of techniques when explaining why he could not accept Böhm-Bawerk's average period of production because of the possibility of multiple roots. Fisher's debt-deflation theory of depressions influenced Ben Bernanke and Mervyn King in their responses as central bankers facing the Global Financial Crisis, and the crisis brought renewed attention to Fisher (*The Economist* 2009; Shiller 2013). It has even been claimed, in an article coauthored by a Nobel laureate (McGrattan and Prescott 2004), that "Irving Fisher Was Right" about the 1929 stock market (the title of the NBER working paper version ended with an exclamation point, but perhaps the referees demurred). The Barber edition of Fisher's *Works* (1997), together with the renewed attention to Fisher-related ideas in monetary economics, stimulated research on Fisher, for example in conference volumes[4] (Loef and Monissen 1999; Dimand and Geanakoplos

[4]Gayer (1937), the *Festschrift* in honor of Fisher's 70th birthday, had deliberately not included papers about Fisher.

2005), building upon the earlier work in Fellner et al., *Ten Economic Studies in the Tradition of Irving Fisher* (1967). However, far more than the fact that he went to his grave stubbornly believing that he had a formula for predicting short-run movements in stock prices (Sasuly 1947), Fisher's involvement in eugenics and immigration restriction, holding views shared by all too many of his contemporaries in economics, remains, and will undoubtedly remain, toxic to his reputation (see Fisher 1997, Vol. 13, pp. 160–207; Aldrich 1975; Cot 2005; Dimand 2005; Leonard 2016; compare Moss 1996). Because of that, the American Economic Association, while willing to finance an edition of the works of America's foremost pre-World War II economic scientist, did not wish to place the Association's name on the edition in the way that the Royal Economic Society sponsored the editions of Edgeworth, Keynes, and Ricardo.

Pillars and Arches of an Unbuilt Temple

Joseph Schumpeter (1948, p. 419), a great admirer of Fisher the economist yet wary of Fisher the public intellectual, held that "whatever else Fisher may have been – social philosopher, economic engineer, passionate crusader in many causes that he believed to be essential to the welfare of humanity, teacher, inventor, businessman – I venture to predict that his name will stand in history principally as the name of his country's greatest scientific economist." Schumpeter concluded his memorial article on his friend by describing six of Fisher's books, *Mathematical Investigations in the Theory of Value and Prices* (1892, in Fisher 1997, Vol. 1), *Appreciation and Interest* (1896, in Fisher 1997, Vol. 1), *The Nature of Capital and Income* (1906, in Fisher 1997, Vol. 2), *The Theory of Interest* (1930, in Fisher 1997, Vol. 9), *The Purchasing Power of Money* (1911, in Fisher 1997, Vol. 4), and *Booms and Depressions* (1932, in Fisher 1997, Vol. 10) as "the pillars and arches of a temple that was never built … he always remained outside the current and always failed to convince either his contemporaries or the rising generations. But these pillars and arches will stand by themselves. They will be visible long after the sands will have smothered much that

commands the scene of today." Both parts of Schumpeter's prediction, echoed by William Barber at the start of his general introduction to Fisher's *Works* (1997), have stood the test of time: the disciple of economics recognizes the still-standing pillars and arches of Fisher's major scientific works, while Fisher the passionate crusader has fared no better with later generations than with his own. In keeping with Schumpeter's metaphor of the pillars and arches of an edifice that was never built, James Tobin (1985, pp. 36–37) wrote that Fisher's monetary theory of economic fluctuations was not integrated with what his works on capital theory had to say about saving and investment, nor did Fisher cast his monetary economics in the general equilibrium framework of his dissertation: "Had Fisher pulled these strands together into a coherent theory, he could have been an American Keynes" but he did not and was not. Fisher's monetary economics, from real and nominal interest, equation of exchange, and the "dance of the dollar" through the compensated dollar price level rule and 100% reserve requirements to price indexes was drawn together by a concern with the destabilizing effect of changes in the purchasing power of money, but he never combined his monetary economics with his analysis of saving and investment or his general-equilibrium framework.

Much of modern monetary macroeconomics has links to Fisher's work (DeLong 2000). He was deservedly pictured with Alfred Marshall and Knut Wicksell on the cover of David Laidler's *Golden Age of the Quantity Theory* (1991). The Fisher relation between real and nominal interest and the Fisher diagram are fundamental. His account of fluctuations as the "dance of the dollar," with its emphasis on modeling expectations of inflation, leads to monetarism and New Classical economics, while his debt-deflation theory of depressions (together with Chapter 19 of Keynes's *General Theory*, 1971–1989, Vol. 7) inspired the approaches of Minsky (1975) and Tobin (1980) to considering breakdowns of the automatic macroeconomic adjustment. By no means does all modern macroeconomics have roots in Fisher's work. Financial innovation has moved the economy closer to the pure-credit economy imagined by Wicksell and away from one in which the quantity of money is of crucial importance. The use of vector autoregressions is a return, with more sophisticated statistical techniques, to the statistical

analysis of business cycle data by Wesley Mitchell (1927), once derided as "measurement without theory." Real Business Cycle theory emphasizes technology shocks rather than monetary shocks. Yet, allowing for this large and important exceptions, more of modern macroeconomics and monetary economics stem from Fisher than from any of his contemporaries, and from the Fisher relation to the Fisher diagram to the Fisher ideal index number, his contributions remain recognizable parts of modern economics.

Institutional Influence and Isolation

Fisher also had an institutional influence, through his involvement in the founding of the Econometric Society and the Cowles Commission, which promoted formal economic theory, mathematical economics, and econometrics and which provided an audience and supportive environment for Fisher after his public reputation and personal finances were devastated from 1929 onward. That Fisher should become an institution-builder is striking, given the absence, remarked by Schumpeter (1948) and Tobin (1985) among others, of Fisherians, as there were Ricardians, Marshallians, or Keynesians, of any New Haven Circus comparable to the Cambridge Circus or to Mises's seminar or Karl Menger's colloquium in Vienna. Fisher had students (and not all that many of those) rather than disciples. Frank Steindl (1995) perceived a "Yale School" monetary interpretation of the Great Depression, partially anticipating Friedman and Schwartz (1963), but it was a school of only three members: Fisher, Harry Gunnison Brown, and James Harvey Rogers, and perhaps not all of those (see also Steindl 2004). Brown, after assisting Fisher with *The Purchasing Power of Money*, had left Yale for the University of Missouri and left Fisher to become a Henry Georgist single-taxer long before the Depression and sharply criticized Fisher's 100% money plan (see Ryan 1987). Rogers, a student of Pareto as well as of Fisher, returned to Yale as Sterling Professor in 1930 after fourteen years elsewhere and was thereafter the only Yale economics professor sympathetic to Fisher and his research, but an independent figure (see Rostow 1940). Fisher was, in his time, a school of one, even

at the height of his professional eminence from *The Purchasing Power of Money* in 1911 through his AEA presidency in 1918 to the *Theory of Interest* in 1930.

Intellectual Roots

Even though Fisher had a distinctive position in the economics of his time, and an isolated position in his own department at Yale, he had deep intellectual roots in early traditions of economics, roots shown clearly by the dedications of his books: *The Purchasing Power of Money* to the memory of Simon Newcomb for his equation of exchange (and Newcomb also shared the dedication of *Stabilizing the Dollar* for his price level rule), *The Making of Index Numbers* to Francis Ysidro Edgeworth and Correa Moylan Walsh, *The Rate of Interest* to the memory of John Rae, and *The Theory of Interest* to the memory of Rae and Eugen von Böhm-Bawerk. *Booms and Depressions* was dedicated to Fisher's contemporary Wesley Mitchell in recognition of his stature as the leading researcher in the field, rather than because of any commonality of approach. Fisher was taken aback to discover Walras and Edgeworth when he had nearly completed *Mathematical Investigations in the Theory of Value and Prices* and thereafter he was careful to pay his intellectual debts (although perhaps Böhm-Bawerk should also have shared the dedication of *The Rate of Interest* while he was still alive to receive the dedication). Fisher could be oblivious to those whose approaches differed, notably Keynes's *General Theory* (see Dimand 1995), but he tried to discover and honor those who had blazed trails for him. Fisher and Alfred Marshall knew, admired and cited each other's monetary work, although Marshall's successors in Cambridge monetary economics, Keynes and Pigou, were not fully aware of that and over-stressed the differences between Fisher's equation of exchange and the Cambridge cash-balance approach (see Patinkin 1990; Laidler 1991; Dimand 1995). At the end of his career, Fisher (1940, 1946, 1947) returned to the quantity theory of money, working toward a never-completed major study on measuring the velocity of circulation (Dimand 2000; Steindl 2004).

Irving Fisher merits his place in a series on Great Thinkers in Economics. For all frustrations as a reformer and policy advocate and his disaster in the stock market (which ironically resulted from incautiously relying on the equity premium puzzle that stocks have a higher long-run real return than reflects risk), Fisher was an economic theorist and econometrician of importance, who took a distinctive approach to economics and helped shape later developments both his own writings and through his role in institution-building. From academic eminence, visibility as a public intellectual, wealth and being the most-cited monetary economist, Fisher descended to public ridicule, poverty and a near-total lack of citations, only to achieve posthumous recognition as a pioneering macroeconomist, econometrician and index number theorist.

References

Aldrich, Mark. 1975. Capital Theory and Racism: From Capital Theory to Eugenics in the Career of Irving Fisher. *Review of Radical Political Economics* 7 (3): 33–54.

Allais, Maurice. 1947. *Economie et intérêt*. Paris: Imprimerie Nationale.

Allen, Robert Loring. 1993. *Irving Fisher: A Biography*. Cambridge, MA and Oxford: Blackwell.

Barber, William J. 1985. *From New Era to New Deal: Herbert Hoover, the Economists, and American Economic Policy, 1921–1933*. Cambridge: Cambridge University Press.

Barber, William J. 1996. *Designs Within Disorder: Franklin D. Roosevelt, the Economists, and the Shaping of American Economic Policy, 1933–1945*. Cambridge: Cambridge University Press.

Bordo, Michael D., and Hugh Rockoff. 2013. The Influence of Irving Fisher on Milton Friedman's Monetary Economics. *Journal of the History of Economic Thought* 35: 153–177.

Boumans, Marcel. 2001. Fisher's Instrumental Approach to Index Numbers. In *The Age of Economic Measurement*, ed. Judy L. Klein and Mary S. Morgan, 313–344. Annual Supplement to *History of Political Economy* 33.

Cerf, Christopher, and Victor Navasky. 1984. *The Experts Speak: The Definitive Compendium of Authoritative Misinformation*. New York: Pantheon.

Cot, Annie L. 2005. 'Breed Out the Unfit and Breed in the Fit': Irving Fisher, Economics and the Science of Heredity. *American Journal of Economics and Sociology* 64 (3): 793–826.

DeLong, J. Bradford. 2000. The Triumph of Monetarism? *Journal of Economic Perspectives* 14: 83–94.

Deutscher, Patrick.1990. *R. G. Hawtrey and the Rise of Modern Macroeconomics*. London: Macmillan and Ann Arbor: University of Michigan Press.

Diewert, W. Erwin. 2013. Irving Fisher and Index Number Theory. *Journal of the History of Economic Thought* 35: 199–232.

Dimand, Robert W. 1995. Irving Fisher, J. M. Keynes, and the Transition to Modern Macroeconomics. In *New Perspectives on Keynes*, ed. Allin F. Cottrell and Michael S. Lawlor, 247–266. Annual Supplement to *History of Political Economy* 27.

Dimand, Robert W. 2000. Irving Fisher and the Quantity Theory of Money: The Last Phase. *Journal of the History of Economic Thought* 22: 329–348.

Dimand, Robert W. 2005. Economists and the Shadow of 'The Other' Before 1914. *American Journal of Economics and Sociology* 64 (3): 827–850.

Dimand, Robert W. (ed.) 2007. *Irving Fisher: Critical Responses*, 3 vols. London and New York: Routledge.

Dimand, Robert W. 2013. 'Perhaps I'm a Don Quixote but I'm Trying to Be a Paul Revere': Irving Fisher as a Public Intellectual. In *The Economist as Public Intellectual*, ed. Tiago Mata and Steven G. Medema, 20–37. Annual Supplement to *History of Political Economy* 45.

Dimand, Robert W., and John Geanakoplos (ed.). 2005. *Celebrating Irving Fisher*. Malden, MA: Blackwell (also as Supplement to *American Journal of Economics and Sociology* 64 (1)).

The Economist. 2009. Out of the Shadow of Keynes. February 14, pp. 72–73.

Fellner, William, et al. 1967. *Ten Economic Studies in the Tradition of Irving Fisher*. New York: John Wiley.

Fisher, Irving. 1935. Are Booms and Depressions Transmitted Internationally Through Monetary Standards? *Bulletin of the International Statistical Institute* 28 (3): 1–29; reprinted in Robert W. Dimand. Irving Fisher on the International Transmission of Monetary Standards Through Booms and Depressions. *Journal of Money, Credit and Banking* 35 (2003): 49–90.

Fisher, Irving. 1940. The Velocity of Circulation of Money. *Report of the Sixth Annual Conference, Colorado Springs*, 55–58. Chicago: Cowles Commission for Research in Economics.

Fisher, Irving. 1946. Velocity of Circulation of Money. *Econometrica* 14: 178–180.

Fisher, Irving. 1947. The Statistics of the Velocity of Circulation: A Progress Report. *Econometrica* 15: 173–176.

Fisher, Irving Norton. 1956. *My Father Irving Fisher*. New York: Comet.

Fisher, Irving. 1997. *The Works of Irving Fisher*, 14 vols., ed. William J. Barber assisted by Robert W. Dimand and Kevin Foster, consulting ed. James Tobin. London: Pickering & Chatto.

Fisher, Irving Norton. 1961. *A Bibliography of the Writings of Irving Fisher*. New Haven, CT: Yale University Library, with supplement 1972.

Friedman, Milton. 1972. Have Monetary Policies Failed? *American Economic Review: AEA Papers and Proceedings* 62 (2): 11–18.

Friedman, Milton, and Anna J. Schwartz. 1963. *A Monetary History of the United States, 1867–1960*. Princeton, NJ: Princeton University Press for the National Bureau of Economic Research.

Gayer, Arthur D. (ed.). 1937. *The Lessons of Monetary Experience: Essays in Honor of Irving Fisher*. New York: Farrar & Rinehart, Inc.

Humphrey, Thomas M. 1988. The Trade Theorist's Sacred Diagram: Its Origins and Early Development. *Federal Reserve Bank of Richmond Economic Review* 74: 3–15.

Keynes, John Maynard. 1971–1989. *The Collected Writings of John Maynard Keynes*, 30 vols., General eds. D.E. Moggridge and E.A.G. Robinson, Volume eds. E.S. Johnson and D.E. Moggridge. London: Macmillan and New York: Cambridge University Press, for the Royal Economic Society.

Kregel, Jan. 1988. Irving Fisher, Great-Grandparent of the *General Theory*: Money, Rate of Return Over Cost and Efficiency of Capital. *Cahiers d'Economie Politique* 14–15: 59–68.

Laidler, David. 1991. *The Golden Age of the Quantity Theory*. London: Phillip Allan and Princeton, NJ: Princeton University Press.

Leonard, Thomas C. 2016. *Illiberal Reformers: Race, Eugenics and American Economics in the Progressive Era*. Princeton, NJ: Princeton University Press.

Loef, Hans-E., and Hans G. Monissen (ed.). 1999. *The Economics of Irving Fisher*. Cheltenham and Northampton, MA: Edward Elgar.

McGrattan, Ellen R., and Edward C. Prescott. 2004. The 1929 Stock Market: Irving Fisher Was Right. *International Economic Review* 45: 991–1009.

Minsky, Hyman P. 1975. *John Maynard Keynes*. New York: Columbia University Press.

Mitchell, Wesley C. 1927. *Business Cycles: The Problem and Its Setting*. New York: National Bureau of Economic Research.

Morgan, Mary S. 1997. The Technology of Analogical Models: Irving Fisher's Monetary Worlds. *Philosophy of Science* 64: S304–S314.

Morgan, Mary S. 2007. An Analytical History of Measuring Practices: The Case of Velocities of Money. In *Measurement in Economics: A Handbook*, ed. Marcel Boumans, 105–132. Philadelphia: Elsevier.

Moss, David. 1996. *Socializing Security: Progressive-Era Economists and the Origins of American Social Policy*. Cambridge, MA: Harvard University Press.

Patinkin, Don. 1990. *Irving Fisher, the Cambridge School, and the Quantity Theory*. Seoul: Korea Development Institute.

Pavanelli, Giovanni. 2003. The Great Depression in Irving Fisher's Work. *History of Economic Ideas* 11 (1): 151–167.

Rostow, Walt W. 1940. James Harvey Rogers as an Economist. In *James Harvey Rogers 1886–1939 in Memoriam*, 13–28. Stamford, CT: The Overbrook Press.

Ryan, Christopher K. 1987. *Harry Gunnison Brown, Economist*. Boulder, CO: Westview Press.

Sasuly, Max. 1947. Irving Fisher and Social Science. *Econometrica* 15: 255–278.

Schumpeter, Joseph A. 1948. Irving Fisher's Econometrics. *Econometrica* 16: 219–231; as reprinted in Dimand, ed. (2007), Vol. 3.

Shiller, Robert J. 2013. Irving Fisher, Debt Deflation, and Crises. *Journal of the History of Economic Thought* 35: 179–183.

Steindl, Frank G. 1995. *Monetary Interpretations of the Great Depression*. Ann Arbor: University of Michigan Press.

Steindl, Frank G. 2004. *Understanding Economic Recovery in the 1930s: Endogenous Propagation in the 1930s*. Ann Arbor: University of Michigan Press.

Tobin, James. 1980. *Asset Accumulation and Economic Activity*. Oxford: Blackwell and Chicago: University of Chicago Press.

Tobin, James. 1985. Neoclassical Theory in America: J. B. Clark and Fisher. *American Economic Review* 75 (6): 28–38.

Velupillai, K. 1975. Irving Fisher on 'Switches of Techniques': A Historical Note. *Quarterly Journal of Economics* 89.

Warburton, Clark. 1932. *The Economics of Prohibition*. New York: Columbia University Press; reprinted New York: AMS Press, 1968.

Warburton, Clark. 1966. *Depression, Inflation, and Monetary Policy: Selected Papers, 1945–1953*. Baltimore: Johns Hopkins University Press.