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THE WORKS OF
PAUL H. COOTNER:
A REVIEW ESSAY

BY
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THE WORKS OF PAUL H. COOTNER: A REVIEW ESSAY

by

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I am grateful to James Hoag and William Sharpe for help in preparing this review. The final draft of this paper was written while I was visiting at the Division of Banking Research and Economic Analysis, Comptroller of the Currency, Washington, D.C.; I am grateful for their support. Patricia Murphy prepared the typescript.
THE WORKS OF PAUL H. COOTNER: A REVIEW ESSAY

The essays in this book were written to honor Paul Cootner, but it is Paul's scholarship and the scholarship that he encouraged that will be his best memorial. Paul's interests in economics and finance were broad. In his varied professional contributions one finds a consistent pattern: the insistence on a sound theoretical basis for the analysis and a careful consideration of all of the important evidence on the subject, both historical data and the details of informed practice.

Paul's view of the proper relationship between economic theory and business practice was captured in the introduction to one of his Stanford course descriptions:

This course is aimed at what I would call innovative managers: the people who...want to know how things might be done optimally so that they might devise innovative policies--profitable to them and to their firms--that would change the way things are done. What I plan to teach is not what is often derogatorily known as "pure theory"--i.e., stuff too abstract to be useful--but instead a useful picture of how things would be done if stoginess and inappropriate wisdom could be overcome.

Theory is not the problem in unrealistic courses: it is bad theory which causes difficulties.

This comment to MBA students came rather late in Paul's lamentably shortened career. The attitude it reflects is apparent in his earliest professional work.

Economic History

Paul Cootner's unpublished thesis (1953) and two published papers flowing from that thesis (1963d, 1965b) dealt with innovation and economic development based on a detailed analysis of railroad investment in the
United States from 1826 through 1886. This work was in the spirit of the "new economic history" in developing an explicit economic model—one founded in neoclassical economic theory—with which to confront the historical record. Paul's virtually encyclopedic knowledge of the history of U.S. railroads suggested to him that U.S. railroad investment in the 19th century could not reasonably be viewed as a continuous process of expansion. Rather the economic model had to be capable of explaining the repetitive swings between passenger and general freight traffic investment in the East and bulk traffic and trunk-line investment in the West and South.

By incorporating adjustment lags (for reasons of technology and uncertainty) into a neoclassical investment model and by considering worldwide shifts in the demand for those final goods and services that could be produced efficiently in this country, Paul developed a coherent and effective challenge to the prevailing, Schumpeterian view that railroad innovation had played a critical role in initiating economic cycles.²

It is clear, I think, from what has gone before that I find no evidence anywhere in the process of railroad development of anything that would constitute a technical jump great enough to generate an exogenous railroad boom, the reverberations of which might cause a business cycle to develop.... Partly because railroads were steadily improved and partly because American economic development gradually filled up the land-masses which could be reached by cheap water routes, successive business cycles were marked by increasing railroad investment. The process is not, however, one in which railroads are continually breaking into new uses from which they had been barred by either ignorance or conservatism. Instead, we see them built in the East... then neglected in that role when interest shifts West, only to be revived again.... It is demand rather than supply which seems to dominate railroad history, and the demands...[were] international in scope.

Paul's views on the role of economic theory in understanding economic data are further illustrated in the context of economic history by his reviews of two books on railroad history by Fogel (1961a, 1965c) and his
review of the classic study of U.S. monetary history by Friedman and Schwartz (1966b). Although he found areas of disagreement with these authors (indeed, quite a lot to disagree with regarding the selection of tests and the standards of testing in the Friedman-Schwartz study), Paul was unstinting in his praise of "good analysis, not papier mache formalism" and "the end to the artificial distinction between the principles taught in economic theory courses and the data-gathering or idle speculation that used to be called economic history." It is a hallmark of Paul Cootner's subsequent work that the underlying economic principles were stated and used.

Economic Development

The insights that Paul gained from the study of innovation and economic growth in 19th century America supported his analysis of economic development in a broader context (1963c). In "Social Overhead Capital and Economic Growth," which was first presented in 1960, Paul considered the existing theories of the role of social overhead capital in the process of economic growth and found them wanting. In the existing theory it was suggested that "pecuniary external economies" would lead to under-investment in important types of capital (such as transportation and electric power generation) and hence to the need for governmental intervention to insure the appropriate investment in social overhead capital. Paul was able to show that the existing theory depended crucially on imperfect foresight. He proposed an alternative model in which it was assumed that "...entrepreneurs forecast future prices and their mean expectations about the future are always correct...that these forecasts are subject to some variance, and that entrepreneurs are risk averse." In short, in 1960 Paul
used what would now be called a rational expectations viewpoint to model a problem in economic development. In doing so, he was able to show that the prevailing view of pecuniary external economies was equivalent to no risk taking by entrepreneurs while the standard neoclassical view, in which social overhead capital poses no problem, was equivalent to risk neutrality. Using this richer model of entrepreneurial behavior, he developed the view that is now generally accepted that "...the concept of pecuniary external economies includes all situations in which imperfect knowledge of the future reduces the scale of investment and the responsiveness of the economic process to the signals of a price system...." This implied a concomitant reduction in the special role assigned to social overhead capital in economic development.

Speculation and Hedging

Paul's work on railroad investment caused him to consider the shifting demand for U.S. products—and in particular agricultural products—in the 19th century. Knowledge of commodity price behavior gained in this manner and his strong interest in the economics of uncertainty led to an abiding interest in commodity price behavior and in speculation and hedging. His published work on this topic began with the famous exchange with Lester Telser (1960a, 1960b) on the nature of returns to speculators. The original analysis presented in this note, along with interpretations of the major contributions by other scholars, were incorporated in a major paper that he read at a Food Research Institute Symposium at Stanford (1967a) and in a succinct, but highly informative, article for the International Encyclopedia of the Social Sciences (1968a).
Paul's work on speculation and hedging is one of his major contributions to the economic literature. No one who reads the Food Research Institute study can fail to be impressed by his masterful summary of a difficult literature. He also developed two major ideas that all serious students of speculation and hedging have had to consider.

An appreciation of the role of hedging in managing the risk faced by the holders of commodity inventories plus careful observation of informed practice led Paul to conclude that optimal hedging strategies need not result in hedgers being short commodity futures over the entire harvest cycle. After the harvest, when inventories are large, holders of inventories can reduce the per unit risk of holding those inventories by going short in the futures market for that commodity (or a related commodity). However, if inventories become sufficiently small before an uncertain harvest, producers and merchants can reduce their risk by going long in the futures market. Paul argued that failure to take this potential shift in hedgers' strategies (and hence in the risk premium available to speculators) into account would result in smaller perceived profits than those that would actually be obtainable by informed speculators. He presented considerable empirical evidence in support of this view. In the International Encyclopedia this result and its implications for futures prices were summed up as follows:  

If speculators do make money, futures prices must rise during the period [hedgers] are short futures. Since hedgers are usually short and speculators usually long, Keynes argued that futures prices will normally rise over the lifetime of each contract. More recently Cootner has shown that in agricultural commodities hedgers are frequently long (and speculators are short) in the period prior to harvest when inventories are low. In cases where that pattern usually obtains, if speculators are to profit, futures prices must fall prior to harvest and rise thereafter. In short, payment of risk premiums would imply a seasonal pattern for futures prices.
Paul's work played a major part in developing a second important concept in the theory of speculation: the role of related futures contracts in limiting the risk premium that has to be paid on any given contract. That is to say, he brought the concept of nondiversifiable risk to bear upon the question of speculator's risk. Paul noted that when a speculator could obtain a futures contract that was positively correlated with another futures contract, a spread position (long one contract and short the other) would have less risk than either contract alone. The empirical evidence that he brought to bear on this question suggested that risk premiums were only paid for the nondiversifiable risks of commodity speculation.

Paul also wrote a series of papers drawing analogies between commodity speculation and hedging and these operations in financial markets (1961b, 1963a, 1972a). When he died, Paul left drafts of work in progress extending his ideas about the determinants of commodity price behavior and going further in drawing together his insights into the relationships between real and financial markets. The economics literature is poorer because these manuscripts are incomplete.

Financial Institutions

Paul Cootner's interest in the economics of financial institutions developed along with his interest in financial speculation and hedging. The explicit model used in "Speculation in the Government Securities Model" (1963a) is a model of bank liquidity. A study of commercial banking, "The Structure of Competition in Commercial Banking in the United States" (1963b), carried out with Deane Carson, combines a short review of U.S. banking history with an extensive policy analysis of commercial banking structure and competition as they found it in 1960.
The paper, "The Liquidity of the Savings and Loan Industry" (1969), was part of a larger study that was undertaken after the 1966 liquidity crisis in this industry. In this paper Paul discussed the initial attempts by the Federal Home Loan Bank to use its advances policies to induce savings and loan associations to limit the rates they paid on savings deposits. This ill-fated policy which was started in early 1965 began to fail later that year. In December 1965, the Federal Reserve Board permitted an increase on the rate payable on certificates of deposit at member banks. As most readers know, this was just the beginning of the attempts at savings interest rate controls and the concommitant strains on the liquidity of savings institutions. Paul would surely be pleased that the Congress in 1980 has finally started to dismantle the controls that he argued against more than 10 years earlier: 8

Whatever merits one may find in rate regulation, it cannot be accomplished by one sector of a highly competitive market. It is true that when the regulation was first attempted, neither the commercial bank sector nor the debt securities markets were as competitive as they gradually became, and so the prospects for success were more sanguine at the outset than they were in retrospect—but that is an outstanding characteristic of partial price regulation.... There is some serious question about the merits of attempting to control soundness by...rate controls because of its tremendous impact on liquidity problems. Only an a priori unlikely combination of [events] could have caused the strain on associations that occurred [in 1966]. The occurrence of this strain, however, indicates how sensitive a tool rate controls are, and how important it would be to find other means of solving the problems of association soundness.

The paper on savings and loan liquidity includes a discussion of the liquidity problem of financial institutions which carefully distinguishes this problem from the problems of association soundness and the stability of the supply of intermediation services. Many current discussions of financial institutions would benefit if the spokesmen and writers on the topic had read Paul's paper.
The book that Paul Cootner wrote with William Baxter and Kenneth Scott on *Retail Banking in the Electronic Age* (1977b) contains a model of retail banking that should provide the basis for much of the future analysis of this sector of financial markets. A major insight in this study was the realization that the production of retail banking services requires substantial inputs by the user of those services and that the neoclassical theory of the firm would have to be modified to take this fact into account in order to provide a suitable model of the retail banking firm. The simple model the authors developed using this insight goes a long way toward meeting this goal. In the process the model helps explain some existing empirical anomalies in bank cost studies and in the pricing of deposit balances.

The book begins with a review of banking history. After developing a model of the retail banking firm, the authors use it to analyze electronic funds transfer as an innovation in the provision of deposit services. This discussion includes the same skepticism about the "EFTS Revolution" that Paul had developed earlier regarding the revolutionary nature of innovation. His insistence in his thesis that canals and turnpikes were important in limiting the scope and pace of railroad innovation is surely echoed here in the discussion of competitive means of payment (checks, credit cards) as limits on the pace and scope of innovation in the provision of deposit services: "Nothing in history suggests that any of these innovations [in means of payment], once adopted, immediately displaced its predecessor methods."9 There is little doubt that this small book is more important than its narrow scope might imply, both as a model of how to study a problem in banking and for the theory of the banking firm that it contains.
Industry Studies

Paul's research also included studies of other non-financial industries. The published record contains a study with George Lof on the demand for and supply of thermal efficiency in steam electric generation (1965a), a major study with Daniel Holland of risk and rate of return as it relates to utility regulation (1963f, 1970), a comprehensive econometric model with Franklin Fisher and Martin Neil Baily of the world copper industry (1972b), and a study of inefficiency in the modern university (1974). Perhaps of equal importance, Paul made major contributions to legal and regulatory deliberations on security regulation, utility regulation, drug pricing (1968b), and other topics. This included influential testimony that helped eliminate cartels in commodity and security brokerage. As a former MIT colleague has noted Paul also had considerable influence on other scholars concerned with markets and their regulation:10

In the tradition of George Stigler at Chicago or John Meyer at Harvard, Paul Cootner used his analytical skills on all kinds of market phenomena—indeed he was the first to do so at MIT with sustained rigor on both the theoretical and empirical sides. His work on gas pipeline, pharmaceutical, and copper prices set governmental policies in those industries. His abilities to move from finance to economic theory, between MIT and the Harvard Business School, which stirring the pot at both places, has not been equalled.

Investments

For many readers of this book, Paul Cootner will be best known for his work on investments even though his bibliography is not dominated by works on this topic (1962a, 1964a, 1964b, 1966a, 1967b, 1972c, 1977a, 1978). Paul's interest in investments followed naturally from his early work on commodity price speculation and hedging. As a result of that work, he was one of the first economists to recognize the importance of what was then
largely statistical analyses of stock price movements and to begin to provide a theoretical foundation for the apparently random behavior of stock price changes. In his first paper on stock market prices (1962a) Paul provided an operational definition of market efficiency:

The stock market is not a random walk...and I think I have enough evidence to demonstrate the nature of its imperfections. But, I do not believe that the market is grossly imperfect. In fact, I do not know why the process...is not worthy of the name perfection. It strays from perfection only to the extent that it defines...profitless speculation.

Paul's initial contribution to the investments literature was followed by the collection of essays that he edited, and in many cases inspired, The Random Character of Stock Market Prices (1964a). It would be hard to overstate the impact that this book had on the field for academics and professionals alike. This book includes the basis for the efficient markets approach to security prices and much of the early scientific work on option pricing. For many professionals the ideas in the book were initially an anathema although Paul lived to see them accepted and applied by "innovative managers." The Random Character of Stock Market Prices established Paul Cootner as one of the pioneers of modern finance, a somewhat unusual outcome for an editor. A valedictory comment made by Robert Merton helps explain why:

Paul was present at the creation of what we now routinely call modern finance theory. He made major contributions to it through his own research and encouraged and guided basic research by graduate students, colleagues, and academic visitors, who came to MIT because Paul was there.... The Random Character of Stock Market Prices, the book which Paul put together, is full of papers by students whose research he directed. That this volume is a classic is a tribute to Paul's early recognition of the importance of this research and the high standard he applied to the research performed under his direction.

These seminal contributions to the literature on stock price behavior
are one example of Paul's pioneering efforts in finance. He was also an innovator in the theory of bond prices, although this work is less well known because Paul was never sufficiently satisfied with the work to publish it. In December 1966, he released a working paper entitled "The Stochastic Theory of Bond Prices." In this study Paul recognized the need for a theory of bond price behavior to accompany the emerging efficient market theories of stock and option prices. In the 1966 working paper bond yields were modelled as a Weiner process, an approach to bond yield analysis that has become increasingly important since the mid-1970s. Paul did not carry his analysis through to an equilibrium yield structure relationship. However, he did use his results to place upper and lower bounds on the value of a finite term call on a bond (using Samuelson's rational theory of warrant pricing), to estimate liquidity risk on bonds, and to examine the implications for hedging in bond portfolios. Although this paper was not published, it was clearly a pioneering effort and was so recognized by the students and colleagues with whom he discussed the ideas it contains.

The Cootner-Holland study of risk and return (1963f, 1970) provides another example of the innovative nature of Paul's work in finance. This study was begun in 1961 and is one of the first quantitative studies of the relationship between risk and return. The authors set out to study "business risk" in the context of utility regulation and using accounting data in the estimations. Their basic hypothesis for company rates of return was that the average rate of return for a firm would vary with the standard deviation of the firm's rate of return around the mean of the industry to which it belonged and the standard deviation of the firm's rate of return around its own average rate of return. They found both of these risk measures to be positively and significantly related to the realized average
rate of return. Finance has shifted away from the "business risk" concepts employed by Cootner and Holland in their study to take up the "financial risk" concepts developed by Sharpe and others. The profession clearly considered the Cootner-Holland risk-return study to be important; its circulation and quotation as an unpublished monograph was so extensive that the editors of the *Bell Journal* asked the authors in 1970 to publish a report on the 1963 monograph.

Paul's last publications were on capital market equilibrium. In this work he began to report on ideas that he has been considering and discussing for a number of years with his students and colleagues. From conversations with Paul, it is clear that he expected this work to be his most important contribution to economics and finance. The invited paper presented at the 12th Annual Conference of the Western Finance Association (1977a) was a preview of a more comprehensive work on equilibrium asset pricing. The paper entitled "Capital Asset Pricing in a General Equilibrium Framework" (1978) that appears in this volume was read as part of a memorial to Paul at the 1978 Western Finance Association Conference. This paper is a posthumous attempt to bring some of his work on capital asset pricing together in one publication. Since this involved combining and condensing incomplete drafts of three papers, it is clear that the 1978 paper does not do justice to the ideas that Paul tried to develop.

The central idea in Paul's work on asset pricing is the need to move beyond the partial equilibrium results of the existing capital asset pricing model. The existing model fell short in Paul's view, since risk was exogenous to the model and since real quantities did not appear anywhere in the model. In the more comprehensive model that he was developing, equili-
Equilibrium is studied by examining the optimal consumption problem. Uncertainty is introduced through exogenous supply forces and price uncertainty is endogenous. In this framework, Paul assumed a Markov process for the supply of real goods and obtained an equilibrium price function with one-to-one correspondence between a given state of the world and an equilibrium price. This insures intertemporal consistency since each time a given state of the world occurs the same equilibrium price will be observed. The importance of Paul's work on asset pricing was noted by Stephen Ross:  

This paper is a pioneering effort in the examination of the workings of rationality and efficiency in capital markets. The central theme of the paper is the notion of informational efficiency in markets for durable assets.... The work Paul Cootner was involved in here insures intertemporal consistency by developing rational anticipations intertemporal asset pricing models in a stochastic diffusion setting....But, Paul was not interested in simply building a consistent model, and it is the special contribution of this paper to go beyond a characterization of the equilibrium to obtain meaningful economic results.

The meaningful economic results begin with the demonstration that "the optimal consumption plan implies the complete market futures prices implied in the Arrow-Debreu economic models of uncertainty."  Using these equilibrium price relationships Paul demonstrates that, with homogenous consumer expectations and a set of assets that allow consumers to invest their wealth to equate the marginal rates of substitution for consumption over them, a Pareto-optimal equilibrium is obtained. Furthermore, in such an economy the optimal portfolio is a pro rata share of ownership of physical stocks and the facilities (plants, farms, etc.) that produce them. In the absence of external economies or diseconomies to wealth holding due to risk (i.e., with multiplicative uncertainty), the value of aggregate wealth is shown to appreciate at the "riskless rate" (i.e., the intertemporal interest rate that would have prevailed in the absence of production uncertainty). Prices of
assets may rise at uncertain rates, but the negative correlation between 
price and quantity makes,\textsuperscript{15}

...the "risk" of a price decline the mirror image of the "benefit" 
of a quantity increase....The riskless return on risky assets 
arises because the risk that remains after optimization is asso- 
ciated with the irreducible uncertainty of nature....The burden 
of that risk falls on expected indirect social utility but not on the 
storage of goods from one period to the next.

This extension of the concept of "non-diversifiable risk" is one of the 
major contributions of Paul's work on asset pricing. The question of the 
"completeness" of the market portfolio for empirical testing of return and 
risk is shown by this result to be of vital importance. Paul suggested that 
this view of the nature of risk might help to explain some of the long 
periods of high rates of return on U.S. common stocks which occurred 
during periods when owners of land and natural resources did poorly (e.g., 
1953-1966) and periods during which the relative attractiveness of these 
types of assets were reversed (e.g., 1966-1978).

In suggesting extensions to this model of asset prices, Paul considered 
the effects of heterogenous consumer expectations, which have the same 
effects in his model as transaction costs do. With heterogenous expecta- 
tions, there is added uncertainty regarding future demand that is not 
present in the full equilibrium model with homogenous expectations. As 
Paul pointed out, it is this demand uncertainty that creates the positive 
risk-return relationship for aggregate wealth in partial equilibrium models. 
With heterogenous expectations, a positive risk return relationship is once 
again established, even in the full equilibrium, and "speculative" portfolios 
are something other than the market portfolio of that full equilibrium model. 
While these results may seem more consistent with the evidence regarding 
consumer portfolios and the risk-return trade-off, Paul pointed out that
they were bought at the cost of dropping the perfect market assumption of no transaction costs (or the equivalent thereof in terms of heterogeneous expectations) and we are warned of a number of other propositions of finance theory that would be compromised in the process. As suggested by Stephen Ross, the two papers on asset pricing are "rich in results and conjectures, and the profession will spend many profitable years developing the insights and intuitions that characterize this work."16

As a teacher and a colleague, Paul was a source of encouragement and enlightenment to many who continue to work in the profession to which he so ably contributed. We may hope that these students and friends will prove fertile ground in which Paul's ideas on asset pricing as well as those on other topics will continue to be developed and to influence economic thought. The essays in this book are evidence that this hope is well founded.
FOOTNOTES

1. Course description for B.S. 329 Financial Intermediation, Graduate School of Business, Stanford University, undated.


5. "Social Overhead Capital and Economic Growth" (1963c), 266.

6. Ibid., 281.


15. Ibid., 620.

16. Ibid., 626.
PAUL H. COOTNER

May 25, 1930    April 16, 1978

B.S., University of Florida, 1949
M.A., University of Florida, 1950
Ph.D., Massachusetts Institute of Technology, 1953

PROFESSIONAL EXPERIENCE

1955-1956    Ford Teaching Intern, Brown University
1956        Assistant Professor, Northwestern University
1956-1959    Research Associate, Resources for the Future
1959-1962    Assistant Professor of Finance, Massachusetts Institute of Technology (M.I.T.)
1962-1966    Associate Professor of Finance, M.I.T.
1966-1969    Professor of Finance, M.I.T.
1969-1970    Ford Visiting Professor of Finance, Harvard Business School
1970-1975    C.O.G. Miller Professor of Finance, Stanford University
1976        Visiting Professor of Finance, London Business School
1976-1978    C.O.G. Miller Professor of Finance, Stanford University

HONORARY AND PROFESSIONAL SOCIETIES

Phi Beta Kappa
Phi Kappa Phi
American Economic Association
American Finance Association
Econometric Society

BIBLIOGRAPHY


(1963f) "Risk and Rate of Return" (with Daniel M. Holland), a study sponsored by the American Telephone and Telegraph Company, DSR Project no. 9565 (Cambridge, MA: M.I.T.). Revised issue 1964.


(1967a) "Speculation and Hedging," *Stanford Food Research Institute Studies*, 7 (Supplement), 65-105.


