

## BREAKTHROUGHS IN FINANCE THEORY



Stewart C. Myers,  
Gordon Y Billard  
Professor of Finance  
and author of this  
chapter.

*For years, Principles of Corporate Finance, the book that Stewart C. Myers, Gordon Y Billard Professor of Finance, wrote in 1981 with Richard A. Brealey that is now in its sixth edition, has been the definitive textbook for MBA finance classes worldwide. Myers is very very good with numbers. He is also very very good with words. Even alumni/ae who carefully circumvented the “f” word while they were at Sloan will enjoy his insightful review here of the importance and influence of finance theory that Sloan faculty have developed over the past fifty years – theory that is, “once understood, common sense.” Myers wrote this review specifically for this Fiftieth Anniversary publication, but it could stand alone anywhere in the annals of finance theory.*



Professors Fischer  
Black and Myron  
Scholes, both former  
members of the  
Sloan faculty and  
both powerful influ-  
ences on financial  
practice today.

“FINANCE HAS BEEN a central strength in teaching and research at the MIT Sloan School of Management since the School was founded in 1952. Finance theories developed at Sloan have set the foundations of the modern field of financial economics. At the same time, these theories have fundamentally altered financial practice. Here is a recollection of some of the innovations in finance that originated at Sloan. Unless otherwise identified, all the researchers mentioned are current or former Sloan faculty. Sloan alumni/ae are identified by degree and year.

### OPTION PRICING

“Mention ‘MIT finance,’ and the first thought is usually the Black-Scholes valuation formula for call options. In 1970, Fischer Black and Myron Scholes at MIT solved the problem of valuing options and derived their famous formula. Robert Merton published an important complementary paper on ‘Rational Option Pricing’ and worked out the tools for modeling the behavior of risky financial assets in continuous time; these tools were essential to the full development of option-pricing theory. Merton and Scholes received the Nobel Prize in Economic Sciences in 1997. Black would have joined them but for his death in 1995.

“But Black, Merton and Scholes were not starting from scratch in finance at MIT. Paul Samuelson had already published a partial solution to the problem of valuing warrants, which are call options issued by corporations.’ Samuelson, with Sidney Alexander and Paul Cootner, were leaders in developing the random-walk hypothesis – the proposition that successive rates of return on traded securities are uncorrelated, and therefore stock prices evolve randomly. They realized that a random walk is a property

## ACCOUNTING FOR IT

Early graduates of Course XV, years before it became MIT's fifth School, became so proficient in accounting that many of them entered the world as cost accountants. When the Course became a School, Dean Brooks was firm that "the fundamental tools for grappling with management problems consist of thorough grounding in accounting as a control device." The new School's small faculty included five professors in the field of accounting, one of them Robert Robnett, the School's first associate dean. The first School of Industrial Management graduate to join the faculty was Zenon S. Zannetos, appointed instructor in Accounting in 1954. When Robnett died that same year, Gordon Shillinglaw came to fill his place, raising the number of Accounting faculty in the small school to six.

But from the beginning, the accounting that School of Industrial Management students learned was not exactly the accounting practiced by men and women with green visors. Professors Thomas Hill and Myron Gordon called their text for first-year graduate students and Sloan Fellows *Accounting: A Management Approach* (1959). This is not to say that their "management approach" skipped the basics. Students with previous training in accounting aced the subject.

Early research topics reveal the breadth of the School's management approach to accounting. Hill and Gordon participated in a study of hospital operation that resulted in major changes in practices in the field of public health. With Professor Edwin Kuh, Gordon also studied investment theory and the valuation of corporations. Shillinglaw researched how firms measured internal profit. His *Cost Accounting: Analysis and Control* (1961) became something of a classic in its field, unfortunately not before he left for Columbia University.

How best to teach accounting became a focus early in the 1960s, when Dean Howard Johnson real-

ized that "we are no longer willing to assume, given our entrance requirements, a basic mathematical competence on the part of our students." The realization forced revisions throughout the curriculum. Zannetos took the lead in redesigning subjects that dealt with management information and control, giving more emphasis to accounting concepts and covering many more topics that interested management students. "There are many paths to a good management education," Dean Johnson noted. His curriculum revision was the first of many in the ongoing search for subjects that link management theory and practice more closely. The search continues to this day.

Then instruction in accounting seemed to fall through the cracks. Former faculty developed stronger allegiances to Management Science and to Corporate Strategy, Policy and Planning. By the mid-1970s (this was still the age of pen and pencil, not yet the time of computer-generated spreadsheets) the subject had settled into a dreary requirement serviced by visiting lecturers that any Master's student with any qualification and imagination could waive out of, and did.

In the early '80s, Dean Siegel grouped the many faculty disciplines into just three, and assigned Accounting to Management Sciences along with Marketing, Operations Management and Management Information Systems – a "time honored field undergoing changes as new technology emerges." It wasn't a good fit. A few years later, he reassigned Accounting to Economics, Finance and Accounting, three disciplines with a common grounding but different applications. ("Applied economics is mostly concerned with the firm's economic environment. Finance works to understand capital markets. Accounting seeks to understand the flow of information from the firm's operations to its management, investors and customers.") Accounting was now, once again, regarded as an essential "basic skill."



Professor Thomas M. Hill taught the required subject in Accounting at Sloan for years.

When several faculty took up research in accounting, the field entered a renaissance. Professor Peter Brownell studied managerial participation in the budgeting process. Professor Morris McInnes studied productivity and financial measures in managerial control and budgetary control. Professor R.T.S. Ramakrishnan focused on how information affected intermediaries and markets. And so on.

Accounting in 2002 is a robust field of a dozen subjects including a seminar designed primarily for doctoral students in accounting and related fields. Professor S. P. Kothari teaches and researches management accounting and control with a contagious enthusiasm. Professor Paul Asquith, a six-time winner of a Sloan Teaching Excellence Award, engages students in his classes in corporate finance and accounting in ways that sometimes seem as though they were meant for the movies. An auditor was known to do the homework so that she could raise her hand. Accounting – today it's called Financial Accounting – is now integral to every Sloan educational program. Its perspective on management employs both theory and practical tools to help prepare students to begin, relaunch or return to their careers. And no one waives out.

LESLIE RAHL SB '71, SM '72  
President, Capital Market Risk  
Advisors

"The thing I remember most from my freshman year was 6.251. It was Computer Science, the most exciting thing I had ever been exposed to. Then I found out what that *really* meant. By the end of my senior year, I had taken all the required first-year subjects at Sloan as electives, so I finished Sloan in one year. I went to work at Citibank because they sent me a telegram to interview, and I was very impressed with that.

"The older I get, the more respect I have for how wonderful my education was. What I learned in terms of how to solve problems has been invaluable. I keep in touch with Stew Myers and Andy Lo and Stephen Ross through the advisory board for the Financial Engineering track, and with Bob Merton and Myron Scholes through my professional work. The whole experience was wonderful."

of a rational market, in which all available information relevant to value is immediately incorporated in prices.<sup>2</sup> The random-walk hypothesis is an excellent first approximation of the behavior of stock prices and a natural starting point for financial models, including the Black-Scholes analysis.

"In 1964, Paul Cootner edited *The Random Character of Stock Market Prices*, a collection of research articles. It included a translation of 'Theory of Speculation,' a doctoral dissertation submitted by Louis Bachelier to the Faculty of Sciences of the Academy of Paris in 1900. This remarkable paper provided the mathematical tools for describing random walks and their consequences years before similar work by Einstein and others. Bachelier introduced the 'position diagrams' used to describe option payoffs and proposed formulas for valuing options on bonds. These formulas are not far behind the work of Samuelson and others in the 1950s and 1960s. 'So outstanding is [Bachelier's] work,' Cootner wrote, 'that we can say that the study of speculative prices had its moment of glory at its moment of conception.' Cootner was right, but with more hindsight, several more moments of glory are evident.

"Black, Scholes and Merton did not start with a clean slate, but the impact of their formula was nevertheless staggering. First, it was a major intellectual achievement – an inspired solution to a truly difficult problem. Second, it was a necessary foundation for the growth of options markets, not only for common stocks but also for dozens of other assets, including foreign exchange, stock market indexes, commodities and government debt. You can hardly trade options if you can't value them. Third, the methodology embodied in the Black-Scholes formula had much broader applications, for example to the behavior of interest rates and bond prices. Fourth, option-valuation methods found many applications in corporate financial management.

"Before proceeding to these applications, I will offer a hint about why valuing options was so difficult. In the end it came down to risk. Call options are riskier than the underlying asset that the call holder has the option to buy. An option on a stock is riskier than the stock it is written on. A rational investor should demand a higher expected rate of return from the option than the stock. In other words, the investor should discount the option's payoffs at a higher rate than the payoffs from the stock. It was not clear how to calculate that higher rate. Worse still, that rate is not a constant: the risk of an option changes constantly as the stock price fluctuates and the option's maturity approaches.

"Black and Scholes realized that the investor could replicate the payoffs to a call option by purchasing the underlying asset, financed in part by borrowing. They figured out how much to purchase and how much to borrow, and also how to revise the amounts purchased and borrowed as time passes and the stock price follows its random walk. In the limit of continuous trading, this dynamic replication strategy generates exactly the same payoff as the option.

## CELEBRATING A NOBEL LAUREATE

Champagne flowed at Sloan one day in October 1985 when Institute Professor Franco Modigliani won the Nobel Memorial Prize in Economic Sciences. The prize carried a cash award of 1.8 million Swedish kronor, worth about \$225,000. Modigliani said he might spend some of the money to upgrade his sailboat and “ease my old age.” He was the second MIT Economics professor to win a Nobel prize in Economic Sciences. Paul A. Samuelson, now Institute Professor Emeritus, won it in 1970.

Long before and long after Modigliani won the Nobel, his contributions to Economics and Finance earned him many honorary degrees and awards. Just two months after he won the Nobel, Italian President Francesco Cossiga presented him with the Knight of the Great Cross of the Italian Republic's Order of Merit, Italy's highest civilian award. The ceremony was at the presidential palace in Rome. Modigliani was born in Rome in 1918.

Modigliani's best-known works include the theory, known as the life-cycle hypothesis, that explains household savings-consumption behavior (published in 1954), and two theorems, developed with Merton Miller in the late 1950s, that provide analytical frameworks for understanding firms' capital structures. He has also been at work on

the solution to a classic problem: measuring and comparing the “risk-adjusted” performance of different investment portfolios such as those of investment funds and those recommended by brokers.

Modigliani joined the MIT faculty in 1962 after stints at Northwestern, Carnegie Institute of Technology, Harvard and the University of Illinois, and earning advanced degrees from the University of Rome (1939) and the New School for Social Research (1944). He was appointed Institute Professor in 1970 and in 1985 MIT awarded him its James R. Killian, Jr., Achievement Award for his “extraordinary professional accomplishments.” The award was prescient. The Nobel Prize came just months later. A life-size photograph (right) of Modigliani accepting his Nobel from King Carl Gustaf of Sweden hangs in the Dean's Conference Room.

Modigliani's sphere of influence is large and long. At a gala reception and dinner in March 1995 at the MIT Museum, many of his colleagues, family and friends celebrated establishment of the Franco Modigliani Chair in Financial Economics at Sloan. So many of the contributors to the chair were Italian that there was another celebration that spring in Rome.

Modigliani became Institute Professor Emeritus in 1988 when he turned seventy, but for years he con-



Franco Modigliani receiving the 1985 Nobel Prize in Economic Sciences from King Carl Gustaf of Sweden.

tinued to teach Capital Markets and Financial Institutions in the spring term. He still has his office in e52 and comes in regularly (if he's not traveling or at his vacation home on Martha's Vineyard).

“The Nobel Prize hasn't changed the way I conduct my life,” Modigliani once told a reporter. “It has, however, made my life more pleasant: people are much nicer to me.”

Therefore the cost of replication must equal the value of the option. If the value differed from the cost of replication, there would be an opportunity for arbitrage, that is, sure profits.

“Black and Scholes were able to specify the replicating strategy without knowing the expected rates of return on either the stock or the option. The only discount rate in their formula was the risk-free rate, which adjusts only for the time value of money. In fact, the Black-Scholes formula values a call option *as if* investments were not risk averse, and *as if* the expected return on the underlying stock were only the risk-free rate. This risk-neutral valuation principle was first derived generally by John Cox and



When Professor Stephen A. Ross joined the Sloan faculty in 1998, he was already a widely published author in finance and economics, best known as the inventor of the Arbitrage Pricing Theory.

Stephen Ross in 1976. The principle applies to any derivative security<sup>3</sup> that can be valued by a replicating strategy. Cox and Ross, working with Mark Rubinstein at the University of California, Berkeley, also showed how to apply the principle when the price of the underlying asset is assumed to evolve by random, but discrete, up and down movements. This 'binomial' setup is widely used to analyze complicated options that cannot be valued by the Black-Scholes formula. It is also a very effective expositional format; MBA students and practitioners typically learn option-pricing principles by working through 'binomial trees.'

"Once these principles were established, extensions and applications multiplied rapidly. Research at Sloan and elsewhere supported the rapid development of markets for derivative securities, and the markets in turn stimulated research. Cox and Ross, with Jonathan Ingersoll PhD '76 at Yale, were the first to apply the principle of valuation-by-replication to fixed-income securities. The Cox-Ingersoll-Ross (CIR) model was the first consistent theory of the uncertain evolution of interest rates. Merton, Black and Cox built the first models of the 'default option' in corporate bonds<sup>4</sup> – in other words, the first formal models of credit risk. Merton was the first to value loan guarantees and deposit insurance. These are only a few of many examples.

"In 1977, I pointed out the importance of *real options*. 'Real' distinguishes options on real assets – the tangible and intangible assets acquired by non-financial corporations – from the financial assets traded in financial markets or held by financial intermediaries. Real options are encountered in all facets of management: options to expand, to contract or abandon, to wait before investing or to shift assets from one use to another.

"The value of real options is not captured by conventional discounted cash flow. That valuation method assumes assets are held passively. In real life, managers adapt operating and investment decisions to exploit good fortune and to mitigate losses. Real options capture the value of active management.

"Once the concept of real-option valuation was established, research on applications began. Sloan faculty and alumni/ae took the lead. For example, I stressed the importance of real options for corporate strategy. Michael Brennan PhD '70, working at UCLA with Eduardo Schwartz, showed how to compute real-option values in natural resource industries, as did Henry Jacoby and David Loughton PhD '88 (now at the University



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of Alberta). Robert Pindyck and Saman Majd PhD '85 published an important paper on the timing of investment, as did Robert McDonald PhD '82 (Economics). Pindyck also applied real-option analysis to the macroeconomy. For example, he showed how increased uncertainty retards aggregate investment.

"The computation of real-option values can be daunting, but the importance of real options is widely accepted in practice. The leading formal text on real options is *Investment Under Uncertainty* (1994) by Pindyck and Avinash Dixit at Princeton.<sup>5</sup>

#### RISK AND RETURN

"The value of a call option is derived from the value of the underlying stock price. Option-pricing theory does not explain the stock price. To explain the prices of stocks or other risky assets, an asset-pricing model is required. An asset-pricing model derives a measure (or measures) of risk and relates risk to the expected rates of return demanded by investors. Best known is the Capital Asset Pricing Model (CAPM) developed by William Sharpe at Stanford and the late John Lintner at Harvard Business School.

"Although the CAPM was not invented here, MIT researchers made many important follow-up contributions to asset-pricing theory. For example, Robert Merton developed the Intertemporal CAPM, which demonstrates how risk changes in a dynamic setting, where the investor follows an investment strategy over many periods. (The ordinary CAPM considers a single period only.) Stephen Ross developed the CAPM's most significant competitor, Arbitrage Price Theory (APT). Ross showed how the same force of arbitrage (i.e., replication) that determines option prices can also be used to identify the risks and expected returns on common stocks.

"Jiang Wang has pioneered in modeling the linkages between asset pricing and the information efficiency of financial markets. His research examines the actual mechanisms by which prices capture information. Wang and Andrew Lo were the first to model fluctuations in trading volume and to use these fluctuations to infer investor's portfolio strategies and the factors determining risk and return in the stock market.

"A hallmark of finance is the close interaction between theory and empirical testing. Andrew Lo has pioneered here with his seminal work on 'data snooping,' which points out the statistical pitfalls in focusing too long on the same period of history as a source of data for empirical tests. Lo is co-author, with Craig MacKinlay of the Wharton School and John Campbell of Harvard, of *The Econometrics of Financial Markets*. This book immediately became the principal reference text for empirical researchers in finance.

#### CORPORATE FINANCE

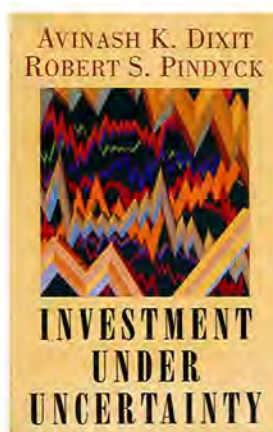
"Sloan research on the valuation of financial assets and options traces back to the work and influence of Paul Samuelson. Sloan research on corporate finance traces back to Franco Modigliani, who received the Nobel Prize in Economic Sciences in 1985.<sup>6</sup>

#### MICHAEL M. KAISER SM '77

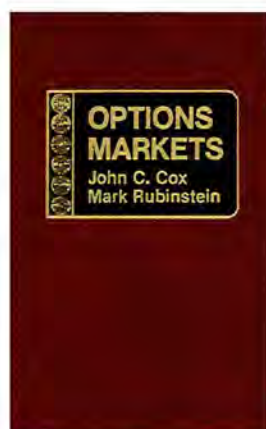
President

The John F. Kennedy Center  
for the Performing Arts

"My indelible memory of Sloan is sitting in Bob Merton's finance class and having him read through his printed notes with his dry wit. Somehow, magically, he reached a climactic conclusion just as class ended – every class. It was a virtuosic performance that convinced me, at least for the moment, that finance was the most interesting subject anyone could study."



*Investment under Uncertainty* (1994) by Professors Robert S. Pindyck and Avinash K. Dixit (at Princeton) is the leading formal text on real options.



For years, *Options Markets* (1985) by Professor John Cox has been one of the leading texts in the field.



Professor and Nobel Laureate Robert C. Merton was a member of the Sloan faculty until 1987.

“In 1958, Modigliani and the late Merton Miller<sup>7</sup> published the first MM paper, which argued that financing decisions are, or should be, irrelevant. Increased financial leverage (financing investment with more debt and less equity) should not change the firm’s overall cost of capital or make the firm more or less valuable. It may seem paradoxical to found a field on research showing that the field is irrelevant. The paradox is resolved as follows.

“First, MM showed a new approach to corporate finance. They stressed the objective of maximizing market value. Any financing or investment decision that increases the market value of the firm makes all stock-

holders better off, regardless of their personal tastes or preferences. MM realized that changes in the firm’s mix of financing could be replicated, or undone, by investors or financial intermediaries. Therefore the value added by corporate financing decisions could not exceed the cost of replication, which should be very small in well-functioning financial markets. (Note how this anticipates the Black-Scholes replication proof.)

“MM also took risk seriously. For example, the reason why substituting ‘cheap’ debt for more expensive equity does not reduce the overall cost of capital is that the additional debt makes remaining equity riskier and more expensive. The increased risk increases the rate of return required by stockholders by exactly enough to keep the overall cost of capital constant.

“Second, MM did not deny that taxes and other costs or imperfections could make financing matter. Their proofs really say that there is no magic in financial leverage. Do not assume that capital structure matters, *prove it* by identifying specific costs and imperfections and showing their practical importance.

“This approach has dominated research on corporate financing decisions ever since. This was the tack taken by MM’s most thoughtful early critic, David Durand. It has also been a constant theme of my work. My first publications, joint with the late Alexander Robichek of Stanford, proposed that firms would have target debt ratios reflecting a tradeoff between the tax advantages of debt,<sup>8</sup> which are maximized at high-debt ratios, and the threat of costs of financial distress. Later I analyzed the incentive effects of too-aggressive borrowing – the ‘debt-overhang’ or ‘underinvestment problem’ – and the incentive for highly levered firms to shift into excessively risky investments. These adverse incentives are additional costs of financial distress.

“In the late 1970s, attention turned to the effects of the limited information available to investors. (Investors cannot know as much as managers about the firm’s value and prospects.) Stephen Ross was the first to analyze how financing decisions can reveal managers’ information to investors. I worked with Nicolas Majluf PhD ’79 (now at Catholic University in Santiago, Chile) to show how differences in information could lead to a ‘pecking-order’

theory of financing. This theory explains why firms prefer internal to external financing, and why they usually turn to debt rather than equity if external financing is needed. Thus the firm's debt level should reflect its cumulative requirement for external financing. Paul Asquith, working with David Mullins PhD '75, confirmed one of the key predictions of the pecking-order theory, that is, the drop in stock price at the announcement of a planned stock issue.

"Back to MM. Their third contribution was to show that investment decisions are *much* more important than financing decisions. Value comes mainly from the left-hand side of the balance sheet. Financing may be interesting, even challenging, but its impact on firm value is second order. (As Enron demonstrated, financing is most important when you screw it up.) From that comes one of the principles of practical corporate finance, the separation of investment and financing decisions. First find good investments, and then consider financing separately.

"My textbook *Principles of Corporate Finance*, written with Richard Brealey of the London Business School, was based on MM's ideas. The book attempted to make the research of the 1950s, 1960s and 1970s accessible and useful to the financial manager. It has been a great success worldwide. Stephen Ross's textbook, written with Randolph Westerfield, dean of the USC Business School, and Bradford Jordan of the University of Kentucky, came a few years later and was likewise a best-seller. Together, these two Sloan-based texts dominate the market in MBA programs. One may brag about that, but my real point is to show the practical relevance of financial research. Practicing managers who have never read MM's articles are nevertheless following their precepts.

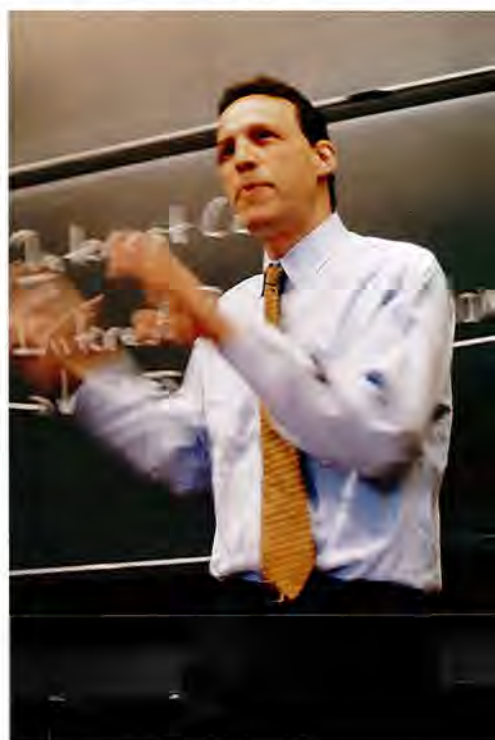
"Of course the practice of corporate finance has developed far beyond the MM proofs. There were four further key ingredients. First, the CAPM provided an elegant and practical formula for estimating the cost of capital and valuing risky capital investments.<sup>9</sup> Second, theory actually simplified life for the financial manager. The analysis of financing would be much more complicated but for MM's 'no magic in leverage' proof. Theory also showed that diversification to reduce risk did *not* affect the market value of the firm. Present values 'add up,' regardless of the risks or the correlations between the returns on the firm's capital investments.<sup>10</sup>

"Third, the new theories were followed by a large volume of applied, 'how-to-do-it' research. Practical applications were worked out in a consistent overall valuation framework. Examples include my work on 'Adjusted Present Value' (APV) and the valuation of financial leases,



Brealey and Myers' *Principles of Corporate Finance*, a description of the theory and practice of corporate finance, has been a great success worldwide.

Professor David Scharfstein teaches and researches entrepreneurial finance, corporate finance in Japan and other current finance topics.





and research by Kenneth Froot, David Scharfstein and Jeremy Stein on the objectives and methods of risk management by corporations.

“Fourth, researchers can test the effects of corporate decisions, thereby learning how, or whether, the theory works in practice. Paul Asquith has been the leader here, with key papers on the effects of stock issues, dividend policy, mergers and takeovers and the valuation and default rates of junk bonds.

“The modern theory of corporate finance focuses on the valuation effects of financing and investment decisions. But corporate finance is also about structure – financial architecture, as I call it. How the firm is owned and controlled makes a difference, so does the legal and institutional structure of the corporation’s home country – corporate finance in Italy, India, Germany or Japan is very different than in the United States or the UK (David Scharfstein’s pioneering research on corporate finance in Japan showed this clearly). A more general theory of corporate finance – reaching beyond ‘Anglo-Saxon finance’ and incorporating architecture as well as valuation – is in the making. This theory is too young to evaluate, but MIT will surely contribute to it.

#### CONCLUDING COMMENT

“This is a personal recollection, not historical research. I have concentrated on intellectual advances where I had a personal interest or involvement. Consequently I have probably overweighted my own research and passed by important contributions by my colleagues. I have not systematically reviewed the contributions of Sloan alumni/ae to research or to innovations in practice.

“Because I have taken the long view, I have underweighted recent or current research at Sloan. I have thus not mentioned Sloan’s junior finance faculty: Leonid Kogan, Jonathan Lewellen, Jun Pan, Anna Pavlova, Antoinette Schoar and Dimitrios Vayanos. There are more breakthroughs cooking, but they will have to wait, say for Sloan’s sixtieth.”

#### FOOTNOTES

1 The holder of a warrant has the option to purchase shares from the corporation. Traded call options are sold by one investor to another; the corporation is not involved.

2 If all of today’s information is already in today’s price, then the change in price tomorrow can only reflect tomorrow’s new information. The value impact of new information must be unpredictable. If the impact of tomorrow’s information were predictable, that information could not be totally new. Samuelson later expressed this argument formally in a paper titled “Proof that Properly Anticipated Prices Fluctuate Randomly.”

3 “Derivative” means a financial instrument whose payoff depends solely on the future value of another, underlying asset. A call option is a derivative because its payoff depends on the future stock price.

4 Black and Scholes had noted that limited liability gave a corporation’s stockholders the option to default on its debt.

5 Princeton University Press, 1994. For a less technical, more managerial survey, see *Real Options: Managing Strategic Investments in an Uncertain Environment* (Harvard Business School Press, 1999) by Martha Amram PhD ’87 and Nalin Kulatilaka PhD ’82.

6 The following covers only a fraction of Modigliani’s research. For example, there is no space to cover his life-cycle hypothesis of saving or his research on dividend policy, on the term structure of interest rates and on monetary and macroeconomic policy. I have concentrated on financing because of its importance to financial management.

7 Modigliani and Miller were then colleagues at Carnegie-Mellon University. Modigliani came to MIT in 1962. Miller taught for many years at the University of Chicago.

8 In the United States, interest is tax deductible, dividends are not and stockholders are given no rebate of corporate income taxes paid on their behalf. MM’s original article pointed out the tax advantages of borrowing.

9 Research by Andrew Lo and others has now shown the deficiencies of the CAPM. The CAPM does not capture the complexity of actual markets, even on average and in the long run. In fact there are many anomalies that do not fit well with any existing asset-pricing model. Nevertheless, the CAPM is widely used in practical corporate finance. The model is logical, intuitive and seems to give sensible answers. I should add, however, that the framework of modern corporate finance does not stand or fall with the CAPM. The APT, or any linear asset-pricing model, works in that framework.

10 Diversification is accomplished in financial markets, so corporate diversification is redundant. I proved this in 1968. It is also a direct consequence of the CAPM and APT.