The Institute for Quantitative Research in Finance®

1996 - 2000

SUMMARY OF PROCEEDINGS

"The Q - Group"  
FOUNDED 1966
"The Q-Group®

THE INSTITUTE FOR QUANTITATIVE RESEARCH IN FINANCE®

Founded 1966 -- Over 30 years of Research and Seminars Devoted to the State-of-the-Art in Investment Technology

Summary of Proceedings

Volume 5

1996 - 2000
SUMMARY OF PROCEEDINGS
Preface to Volume 5

It is with great pleasure that I introduce Volume 5 of the Summary of Proceedings, which stands as another milestone in the work of The Q-Group, now beginning its 35th successful year. As we have done in the past, the index for Volume 5 covering the five year period 1996 to 2000, also references all Q seminar presentations dating back to 1976. Again, as we have offered in the past, we would be pleased to provide you with copies of Volume 1 through 4 as a part of our ongoing support of Institute sponsors.

We wish once again to acknowledge the invaluable, unique and continuing contribution of our author, Dr. J. Peter Williamson. Since 1976, Peter Williamson, Professor of Business Administration at the Amos Tuck School at Dartmouth College, has diligently labored to provide the Institute with the excellent summaries of each and every seminar. He is always in attendance – never missing a talk. Over the years, Peter has demonstrated a superb grasp of the meaning of each speaker’s presentation, no matter how difficult or technical, a truly unique ability in the field of financial theory and practice. 

For those of you who are unfamiliar with the Institute, now in its 35th year of operation, let me provide you with a brief overview of its structure and activities. The Institute for Quantitative Research in Finance (also known as The Q-Group) is a specialized non-profit professional organization whose prime purpose is to help its sponsors stay abreast of the latest developments in theoretical finance that affects investment management practice. In many instances, Sponsors of The Q-Group have actively participated in the development of new investment techniques and their application. Currently, there are over 100 Sponsor organizations in The Q-Group from a broad range of financial institutions, public and private pension funds, consulting firms and university endowment funds. The Q-Group conducts seminars twice each year, funds research projects and periodically distributes research papers to its sponsor organizations. The seminars provide Q-Group Sponsors with the research results of practitioners in the field as well as those of the academics representing the world’s leading graduate business schools. In addition, the results of research projects funded by The Q-Group are presented to the seminar audiences.

The Q-Group concept has expanded beyond the confines of the United States. In 1987 The Institute for Quantitative Investment Research (INQUIRE) was founded in the United Kingdom. In 1991, INQUIRE-Europe was launched and followed in the footsteps of The Q-Group. Both of these organizations employ the same seminar, research and corporate membership format that was pioneered by The Q-Group and are now more than ten years old with strong support from their Sponsors.

In 1997, the first Joint Seminar was held in London with INQUIRE-UK serving as the host organization. The Program was planned by participants from all three organizations who selected topics of mutual interest for presentation to the delegates.

In 2000, the second Joint Seminar was held with the US Q-Group inviting all the UK and European INQUIRE Sponsors to the US Q-Group regularly scheduled Autumn Seminar. A Representatives of all three organizations participated, making this Seminar the largest gathering ever held by a Q organization. We are delighted to have these joint presentations incorporated in this Volume as an integral part of our summaries.

Dale Berman
Secretary-Treasurer
The Q-Group
January, 2001
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1. Portfolio Advice for a Multi-Factor World (Fall 2000)

John H. Cochrane, the Sigmund E. Edelstone Professor of Finance, Graduate School of Business, University of Chicago, distributed two papers reprinted from *Economic Perspectives*, published by the Federal Reserve Bank of Chicago. One was entitled: "New Facts in Finance", and the other was entitled: "Portfolio Advice for a Multi-factor World."

He introduced his presentation as focused on a second revolution in finance. In the following table he identified for each of five subject matters, an element of the first revolution in finance, and an element in the second.

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The CAPM, summarizing all stock risk in the single beta measure, was justified for a quarter of a century by empirical analysis. This even though Harry Markowitz whose mean/variance propositions underlay the CAPM, had pointed out that a complete model should take account of such things as the investor's earned income. More recent empirical work seems to identify size as an important factor, and Fama and French offered the book/market ratio as another. Hence multi-factor models.

Similarly, the random walk hypothesis is being replaced by long-horizon predictability of returns. Low prices – relative to dividends, book value, earnings, sales or other divisors – predict higher subsequent returns. Annual returns are only slightly predictable and month-to-month returns are still strikingly unpredictable, but returns at 5-year horizons seem very predictable. Cochrane showed the successful results of an investment strategy making use of this predictability. What makes the predictability possible is the fact that when the price ratio, price to dividend for example, adjusts it is always the price, rather than the other variable, that changes. The price adjustment can be taken as evidence that an unexpectedly high or low equity premium has been earned. On this basis, Fama and French would argue that the achieved premium needs adjustment before it represents an expected premium.
Cochran next considered a conditional equity premium forecast, taking account of the present price to earnings ratio, book to market ratio, and dividend to price ratio. Do current high prices indicate a low expected equity premium, or do they reflect a very high earnings growth expectation? Risk premiums do seem to vary over time. And almost all variation in the cost of capital is attributable to variation in the risk premium.

Turning to bonds, Cochran showed that the expectations hypothesis seems to do poorly at short horizons, but much better at long horizons. So there is short-term predictability that can be profitably exploited.

Similarly, uncovered interest parity does not always work in the short term for foreign exchange. One can apparently earn more by holding bonds from countries whose interest rates are higher than usual, over short horizons. It is possible, of course, that high risks are associated with these high returns.

Before turning to the portfolio implications of the "new" facts, Cochran expressed some doubts about the longevity of these facts. He observed that the size premium disappeared in the 1970s, perhaps because once investors had discovered it they exploited and eliminated it.

Turning to portfolio decisions, Cochran showed how the mean/variance model turns into a model reflecting an investor preference for high returns, for low standard deviation, and for low recession sensitivity. The logic here is that an investor for whom earned income is important and sensitive to recessions, would like a portfolio that will not also be hard hit by recession. There are some important implications of such a model. If there are enough investors who are concerned about recession-proof securities, then the "market portfolio" will reflect those concerns, and will be appropriate as the best portfolio (to be combined with a risk free investment) for those who share the recession concern. But it will not be the most efficient portfolio for those who are not concerned about recession proof securities.

Turning to the predictability of long-horizon returns, Cochran showed a graphic portrayal of the optimal allocation to stocks, rising with the time horizon of the investor and also with the dividend/price ratio.

But the average investor must hold the market portfolio. The new facts cannot have long-term portfolio implications for the average investor. And if all investors are simply mean/variance investors then there are no "new facts."

Where the new facts have value, is in showing opportunities to separate investors with differing factor references. Some investors can achieve extra returns by in effect selling insurance to other investors. There seem to be opportunities for the development of new managed funds to facilitate these kinds of transactions.

2. Stock Returns and Portfolio Choice: The Importance of Entrepreneurial Risk (Fall 2000)

Deborah Lucas, Donald C. Clark/Household International Distinguished Professor of Finance, Kellogg Graduate School of Management, Northwestern University, presented a paper by John Heaton and herself entitled: "Portfolio Choice and Asset Prices: The Importance of Entrepreneurial Risk."

Lucas began with the motivation for her research: Investor participation in the stock market seems too low to be
consistent with the very high returns that have been achieved. Is the low participation the result of a risk not accounted for in Cochrán’s first revolution? And if it is, could the risk be related to labor income or to proprietary business income? Some research had been done on the possible role of labor income risk, indicating rather low correlation between stock returns and growth in labor income. Lucas believed entrepreneurial risk to be a much more promising explanation. For one thing, the variance in growth in entrepreneurial income is far larger than that in wage income growth. A proprietary business involves idiosyncratic risk. The owner must invest in the business. It seems logical then that the owner of a significant business would take this idiosyncratic risk into account when deciding how much to invest in stocks.

The research had made use of two sets of data. One, the Survey of Consumer Finances (“SCF”) for 1992 was the primary source for static analysis of portfolio behavior. The other, (the “Tax Model”) is based upon individual tax return data. The Tax Model has an annual time series and panel dimension for both income and assets, and hence can yield measures of income variability and correlations. A number of tables presented results according to net worth ($10,000-$100,000, $100,000-$1,000,000 and over $1,000,000) and for households in different age groups, chiefly those under and over 65. Only households with stock holdings greater than $500 were considered. The 1992 SCF embraced about six million households in the lowest net worth class, close to twelve million in the middle class, and close to two million in the wealthiest class.

When only stocks, bonds, and cash (liquid net worth) were considered, all three net worth classes had about half their liquid assets in stocks. But when net worth was expanded to include business ownership, real estate, and the value of pensions, for the wealthiest group business ownership about equaled stocks at roughly 20% of assets, while for the middle and lower net worth groups business assets were quite small and stock ownership was on the order of 17-18% of total net worth.

When net worth was further expanded to include capitalized labor and pension and social security income, and further categorized by households under and over age 65, the wealthiest group had the largest percentage holdings in stock, larger for those over 65 than those under 65, with business investments higher for those under 65 and the total of stocks and business investments not very different between the two age groups. For the middle and lowest net worth groups, the older households had more in stocks than the younger households, but always less than the wealthiest households. Capitalized labor income was high for the lowest net worth and low for the highest net worth households, and of course higher for the under 65 than for the over 65 households.

Lucas identified a number of preliminary conclusions. Stock holdings are far more important for older households than for younger households. For the younger households, only the wealthiest group have much invested in stocks. Capitalized labor income is the most important single source of wealth for young households except in the wealthiest group. Significant stock holdings generally go with unimportant capitalized labor income.

Next she turned to the question whether holding risky business investments leads to lower stock holdings. When we consider net worth represented by liquid assets, the answer is yes. It also turns out that the average share of stocks in each household’s
portfolio is negatively correlated with the standard deviations of wage income and proprietary income, and with the covariances of wage and proprietary income with the S&P 500 Index. But the only significant variable is the standard deviation of proprietary income. It seemed fairly clear that the risk in proprietary income was an important determinant of the extent to which the household invested in stocks.

The next question was whether this relationship affected equilibrium asset returns. To answer this question, Lucas turned to a model set out by Jagannathan and Wang which adds stock market wealth to human capital computed as the capitalized value of labor income, to give aggregate wealth. For human capital, Lucas substituted the value of future wage income and the value of future proprietary income. So long as she followed the J&W convention of capitalizing lagged income, it appeared that wage income variability was more important than proprietary income variability as a determinant of expected returns on the stock market. But when income was not lagged in what she called "contemporaneous" timing, the wage income element became much less important and the proprietary income element more important.

In an extension of what she had reported so far, Lucas discussed the incorporation of entrepreneurial income in the Fama and French Model, to discover that while the size factor remained important, the proprietary income factor took the place of the Fama and French book-to-market factor.

3. News Related to Future GDP Growth as Risk Factors in Equity Returns (Fall 2000)

Maria Vassalou, Assistant Professor of Finance, Columbia University, distributed a paper entitled: "News Related to Future GDP Growth As Risk Factors in Equity Returns."

Vassalou began with the Fama and French Model, proposed as an alternative to the Capital Asset Pricing Model, and including a factor related to book/market ratio (HML) and a factor related to size (SMB). Although their model appears to do well empirically in explaining equity returns, both in the U.S. and internationally, there is little evidence that their proposed factors are related to fundamental risk in the economy. Vassalou undertook to find a fundamental risk factor that might explain the empirical success of the model. What she found was that news related to future GDP growth is an important factor in equity returns. Further, much of the ability of the Fama/French factors to explain the cross section of equity returns is due to the news they contain related to future GDP growth. Once this information is removed from HML and SMB, the Fama/French model cannot explain the cross section of equity returns substantially better than the domestic CAPM.

At any point in time, news related to future GDP growth is unobservable. But this information can be extracted from asset returns that are affected by it. The six portfolios that Fama and French used to create HML and SMB contain such news and can be used as base assets for the construction of mimicking portfolios of news related to future GDP growth. It turns out that mimicking portfolios created from assets grouped on the basis of their book/market characteristics explained the cross section of equity returns best. In fact they can explain the cross section of equity returns as well as the Fama/French model does.

Those same mimicking portfolios can explain large proportions of the time series variations in HML and SMB. This is so despite the fact that HML and SMB
are not linear combinations of the mimicking portfolios. Vassalou suggested that the reason news related to future GPD growth is contained in HML and SMB is that companies characterized by high book-to-market ratios or small size are highly vulnerable to significant shifts in the growth of GDP and their stock prices are therefore highly affected by news of such changes.

Vassalou made use of the twenty-five U.S. equity portfolios constructed by Fama and French. The portfolio returns are value weighted and are formed from the intersection of five size portfolios and five book-to-market portfolios. In addition, she used the six value weighted portfolios constructed by Fama and French (using the same assets as the twenty-five portfolios) from the intersections of two size and three book-to-market portfolios.

She constructed her mimicking portfolios by regressing the macroeconomic variable of interest (GDP growth over the next four quarters) on a set of portfolio returns. The regression model estimated is: \( y_{t+4} = bB_t + cZ_{t+1} + e_{t+4} \) where \( y_{t+4} \) is the realized future value of the macroeconomic variable of interest, \( B_t \) denotes the realized excess returns on a vector of base assets at time \( t \). The base assets are zero-investment portfolios. Therefore, the coefficients from the regression can be interpreted as portfolio fractions even if they do not add up to one. \( Z_{t+1} \) denotes a set of control variables which have the ability to predict the returns on the base assets, and, \( e_{t+4} \) are the regression residuals. This mimicking portfolio tracks news of the macroeconomic variable \( y_{t+4} \) using as base assets the vector of returns \( B_t \).

Six mimicking portfolios were created. The first uses only excess returns on the two small size portfolios. The second uses only excess returns on the two large size portfolios. Similarly the third, forth and fifth mimicking portfolios use only excess returns on the high, low and medium market-to-book portfolios, respectively. Finally, a sixth mimicking portfolio uses the excess returns on all six base assets. This procedure permitted some testing to see which of the six portfolios is the most useful.

The excess returns on the twenty-five Fama/French portfolios were regressed on each of the mimicking portfolios. Each of the mimicking portfolios captures a substantial fraction of the time series variation in returns. It turns out that TRALL the mimicking portfolio using all base assets can explain the cross section of returns about as well as the domestic CAPM. And the combination of TRALL and the market factor proved to be better than the CAPM alone.

Vassalou next tested the ability of combinations of mimicking portfolios to explain equity returns. It turns out that the combination of the three mimicking portfolios formed from assets grouped on book-to-market can price equities better than TRALL and as well as the Fama/French model. Vassalou suggested a possible explanation is that each of the three mimicking portfolios captures slightly different shocks that affect equity returns and determine future GDP growth.

Next she tested whether the ability of news related to future GDP growth to explain equity returns can be improved by the inclusion of the market factor portfolio. It turns out that the market factor appears to be embedded in the three mimicking portfolios and does not need to be included separately. Finally, Vassalou explored the question can the mimicking portfolios explain Fama and French's HML and SMB. It turns out that the combination of the three mimicking portfolios can almost fully describe the time series variation in HML and a substantial proportion of the time series variation in SMB.
4. The Behavioral Finance - Efficient Market Debate: Where Do We Stand? (Fall 1999)

Richard H. Thaler, Robert P. Gwinn Professor of Behavioral Science & Economics, Graduate School of Business, University of Chicago, described his presentation as a limited history of finance in four chapters. The first chapter encompassed the 1930s and 1940s. In this period finance was behavioral. The classic advice of Benjamin Graham for "value" investing was a good example. Chapter two embraced the 1950s through the 1970s, a period during which financial economists discovered mathematics and data. We had Harry Markowitz, Modigliani and Miller, the capital asset pricing model and Eugene Fama's discovery of efficient markets, as well as Michael Jensen's famous mutual fund study.

Supporters of all of these discoveries busied themselves finding confirming data. This was the period when event studies became popular. The chapter ended in 1978 when Jensen concluded that the efficient market was the best established fact in social science.

Chapter three began in 1978, continues to the present, and has become the period of anomalies and rebirth of behavioral finance. It has turned out that returns are predictable in ways the efficient market theory says they are not. Characteristics including low price to earnings ratios, small versus large capitalization, dividend changes, share issues, share repurchases, the January effect, have all demonstrated some reliability as predictors of returns.

Other anomalies are less discussed, but may present an even greater challenge to the theory. Trading volume appears to be too high to be consistent with efficient markets. Active management appears to be alive and well, with the number of mutual funds actually exceeding the number of stocks to buy and sell. Volatility of markets is higher than it should be in the context of efficient markets.

Those who still affirm efficiency of markets have offered a number of responses to the apparent contradictory evidence. Some of the testing may have been wrongly devised. Some of the results come from data mining and nothing more. But there is too much evidence that is the result neither of data mining nor of incorrect testing methodology. It is argued that there is no theory to explain these anomalies, and it may be true that no real theory has emerged yet, but the camp of behavioral finance researchers is doing more all the time to make sense of anomalies.

And so we come to Chapter four: the future. Thaler offered a number of predictions. One is that the efficient market will remain the standard null hypothesis. Another is that once again finance will be behavioral. While we are depending heavily at the present time on psychology, new theories will be cognitive. Someday someone will write a paper as good as John Lintner's paper on the dividend behavior of corporations, but this paper will not be labeled "behavioral finance".

5. Behavioral Finance: Past Answers and Future Questions (Fall 1999)

Meir Statman, Glenn Klimek Professor of Finance, Leavey School of Business, Santa Clara University, distributed a paper entitled: "Behavioral Finance: Past Answers and Future Questions".

Statman began with the proposition that we would understand our financial industry better if we took a look at other industries and products. In other industries, and with other products, we
find price to be a function of both utilitarian and value expressive factors. The Rolex watch, for example, compared to the Timex watch, may have essentially the same utilitarian value: it provides the correct time of day. But its price, at many times the price of the Timex watch is largely determined by its value-expressive characteristics. The theorems of Modigliani and Miller, and Harry Markowitz, on the other hand, are based upon an exclusive focus on the utilitarian features of investments. This focus implies an absolute preference for generic products over branded products, the substitution of “rational” for “normal” motivation, and exclusive preoccupation with the professional, rather than the combination of business and professional behavior of those in the industry. He quoted from a statement by Merton Miller in 1986 essentially urging that we must discard all but the strictly utilitarian elements in our economic models. Statman’s position is that Miller was wrong and that we should be going in the opposite direction. In the world of behavioral finance, people are normal rather than rational. They do commit cognitive error. They do experience pain of regret. They do possess less than perfect control over their actions.

Turning to market efficiency, he observed that it can be defined in two ways. The first is essentially that one cannot hope to beat the market. The second is that prices reflect only rational (utilitarian) characteristics. Hence value-expressive characteristics are not priced. We should accept the first of these meanings and reject the second. We need to expand our asset pricing models to include and value the value-expressive elements of normal people. The expected value of a “value” stock may be higher than that of another “non-value” stock, but both stocks may be correctly priced based on both utilitarian and value-expressive characteristics. Similarly, the market for watches can be described as inefficient if market efficiency implies “rationality” where prices reflect only utilitarian characteristics: we have two equally accurate watches that sell for vastly different prices. But the market for watches can be described as efficient in the beat-the-market sense.

Good theories of investor behavior are crucial to good theories of capital asset pricing models. The Behavioral Capital Asset Pricing Model features the market interaction of two groups of traders: information traders and noise traders. Information traders are the ones that populate the standard CAPM, investors who are free of cognitive errors and have mean-variance preferences. Noise traders, however, commit cognitive errors. The BCAPM mean-variance efficient portfolio is not the market portfolio since noise traders affect security prices. For example, the preference of noise traders for glamorous stocks might raise the prices for glamour (growth) stocks relative to those of low-class (value) stocks, so that the mean-variance efficient portfolio will be tilted toward value stocks.

Charles Ellis has distinguished the profession of investment management from its business. The investment business is doing well, but the investment profession is down. Ellis saw two services of the investment profession: beating the market and counseling investors. Since professional investment managers are not beating the market, they should concentrate on investment counseling. Counseling is more than advice; it is also helping investors maintain the self-control needed to put good advice into practice. Statman’s comment was that value-expressive characteristics are mixed with utilitarian characteristics and business is mixed with profession. The mix may make us uncomfortable but we can understand neither the investment business nor its profession unless we understand them as one.
Market makers are an interesting element in the securities industry because it is volume, not rate of return, that determines their incomes. Brokers and market makers understand the link between investor confidence and trading volume, and do what they can to increase confidence. The focus here is on the characteristics that can be used to increase sales of services and profits, and not on a utilitarian standard. Similarly, the design of securities follows the principle that successful financial products, like all successful products, are those that meet the needs of customers. The marketing of securities by brokerage firms and the marketing of themselves by mutual funds is guided by what customers appear to want, rather than what they ought to want.

Investment clubs form an interesting topic for study. Their money making record is miserable, yet they are popular. It may be that the members care more about the value-expressive features of investment than they do about the utilitarian features of risk and return. There may be a lesson here for investment management.

The BCAPM of the future will not be as beautiful as the CAPM but it will be more robust. It will be the old economic model of demand and supply. It will begin with an identification of the preferences of buyers and sellers, continue with the characteristics that capture preferences, both utilitarian and value-expressive, and conclude with equilibrium prices.


Andrew Lo, Harris & Harris Group Professor of Finance, Sloan School of Business, Massachusetts Institute of Technology, distributed a paper entitled: "Behavioral Models of Financial Risk Processing".

Beginning with behavioral issues in risk management, Lo introduced his three Ps: Prices (meaning the cost of reducing risk, by hedging for example), Probability (the chance of loss) and Preferences (how much risk to hedge). The analytic models in finance focus on the first two, and say little or nothing about the level of risk that is appropriate.

There are important differences in the development of theory in psychology and theory in economics. Psychologists begin primarily with empirical research and from the results develop theory. Many theories may appear to fit behavior observations, and mutual consistency among these theories is not seen as critical. Economics, on the other hand is primarily theoretical and is based on abstractions and idealizations. Here theory leads to empirical analysis rather than the other way around. Experiments, however, are harder to construct than in the case of psychology. We have few theories of economic behavior, as opposed to many theories in psychology, and mutual consistency is critical. Finance has had a revolutionary impact on the development of economic theory.

Comparing behavioral finance with traditional finance, Lo started with the proposition that irrationality is very hard to define. We have, for example, an intuition that separates reason from emotion. But Lo described research that appears to have demonstrated that the ability to respond to emotional stimuli is critical to important kinds of rational behavior. He went on to discuss bounded rationality, and the development of mental models to simplify decision making and achieve satisficing where optimization is simply not worth the time and energy.
There are also limits to irrationality. He described the Dutch Book Theorem, that demonstrates that the attachment to mutually exclusive cases of probabilities that sum to more than one is eliminated by arbitrage. How do we determine the boundaries of rationality? Lo’s answer is to examine the power of evolution. Anticipating a more detailed discussion of the role of evolution to be presented in a later paper presented by Martin Nowak, Lo offered a brief discussion of a computer exercise demonstrating an evolutionary process.

The challenge for risk management practice is to integrate the three Ps into a single and complete risk management protocol. The first research agenda involves revisiting the field of preferences, clearly the most fundamental and least understood aspect of risk management. Are there reliable methods for measuring risk preferences? How are risk preferences related to other aspects of personality and temperament and can they be measured in the same way? What is the role of memory in determining risk taking behavior? Are risk aversion and loss aversion learned traits that are acquired, or are we born with them? If we are to understand the roots of risk preferences, it must be in the context of the survival instinct and how that has shaped economic institutions. “Behavioral Ecology” and “Evolutionary Psychology” offer possibilities for determining the true nature of risk preferences and separating those aspects that are learned from those that are inherent and may be impossible to change. The combination of evolutionary biology and molecular genetics, leading to a new discipline known as “Behavioral Genetics” may be particularly worth pursuing.

A second research agenda is motivated by the fact that risk is a common feature of many human endeavors, so we may learn much from considering how other disciplines deal with risk measurement and management.

The two research agendas, cutting across economics and finance, statistics, biology, and the brain and cognitive sciences, may be a manifestation of the notion of consilience. Described by Wilson in a 1998 book, consilience is a “jumping together of knowledge by the linking of facts and fact based theory across disciplines to create a common groundwork of explanation”.

7. A Psychological Framework for Behavioral Finance: Theory and Early Experimental Evidence (Fall 1999)

Sanjiv Das, Associate Professor, Harvard Business School & Visiting Professor, University of California, Berkeley, distributed a paper by himself and Priya Raghubir entitled: “The Psychology of Financial Decision Making: A case For Theory-Driven Experimental Inquiries.” The thesis of the paper and presentation is that the field of behavioral finance must expand its focus to complement the inductive explanation of errant data patterns with a deductive prediction of behavior. An experimental inquiry based on psychological theoretical models is the route to follow. Das introduced a table of anomalies and biases reported in the literature, with the psychological antecedent for each. This rich array of phenomena could be traced to multiple causes from which the authors arrived at a generic cognitive process model of financial decision making with motivational moderators. The steps of financial decision making were seen to be (1) perception of stimuli in context, (2) retrieval of information from memory, (3) integration of information, (4) judgment, leading to (5) behavior, with each of the five steps influenced by motivational factors.
The experiments were designed to explore sources of bias at each of the five stages of decision making, and in each case the impact of motivational factors. The first set of experiments was related to perceptual biases. 138 subjects were asked to forecast the value of the Dow Jones Industrial Index as of the first of January 2000. They were presented with historical data in graphical form. Six different graphs were used. The time period shown was either twenty years or two years, and the scaling for the index itself showed a maximum of 12, 20, or 40 thousand. It turned out that for both novice and expert subjects, use of the 20-year graph lead to significantly higher guesses for the future value of the Index than did use of the 2-year graph. The guesses were also dependent on the scaling of the historic levels of the Index. From this beginning it was possible to draw some conclusions with respect to why the variations in format lead to different perceptions. Further replications and variations of the testing were needed to refine the explanations.

An exploration of biases at the next stage, retrieval of information, was aimed at accessibility and diagnosticity of information in memory as well as the importance of contextual factors including the wording of questions given to subjects, the response alternatives available, the use of double-barreled questions, and the order of questions. Das worked through the five stages of decision making, describing the tests, the results, and the interpretation. Summarizing the results of these theory-based experiments, Das described the new biases that had been identified and the causes that had been established for well known effects. He also reviewed the limitations of the model and remaining unanswered issues. His conclusion is that an information processing theory is a good start to identify types of causes. Experimental methods help us to establish causes with their different remedies, as well as robustness, size of effects and boundary conditions.

Ultimately the approach Das described should help to develop controls to manage risk, training and support systems to reduce cognitive limitations, and checks and balances to identify potential problem areas.

8. Behavioral Finance: A (Somewhat) Skeptical View (Fall 1999)

Jay Shanken, Frontier Corporation Professor of Finance, William E. Simon Graduate School of Business Administration, University of Rochester, distributed a paper by himself, Ray Ball, and S. P. Kothari entitled: “Problems in Measuring Portfolio Performance: An Application to Contrarian Investment Strategy.”

He began with the question: Is there a behavioral finance paradigm? His final conclusion, after examining a number of anomalies and apparent strategies for beating the market, is that there is not.

He first turned to the observation of Shiller in 1990 that speculative asset prices show excess volatility relative to simple present value efficient market models. He observed first that variance bound tests reject not the single hypothesis of market efficiency but the joint hypothesis of market efficiency and constant expected returns. The tests involve complicated statistical problems, and the models ignore uncertainty about the parameters of the cash flow or return processes. The proposition that empirical analysis had shown that movements in stock prices are not driven by fundamentals had been disproven some years back by Shanken and a co-author with models relating stock prices to information about future dividends, rather than relating annual stock returns to contemporaneous changes in
dividends. An expanded dividend growth model explains 72% of aggregate return variation. However, since dividend expectations as well as prices may respond to fads, the high correlation need not imply rational pricing.

Shanken turned next to the proposition that investors overreact to unexpected and dramatic news events, and that contrarians can profit from this overreaction. The evidence supporting this proposition is questionable for a number of reasons. The research had made no risk adjustment. It had also found that it takes about five years to find significant evidence of overreaction, and in fact over the first of the five years the results of a contrarian strategy turn out to be negative, indicating momentum effects, the opposite of overreaction. But Shanken had gone further. It turns out that the losers in the past (the stocks the contrarian will now buy) are often small capitalization, low-priced stocks. Adding 1/8th of a dollar (to allow for low liquidity and the likelihood of selling at the bid price) to the purchase price of these stocks, in the data bank, reduced the 5-year contrarian return significantly (although the superiority was not eliminated). Excluding all stocks with prices below one dollar had a similar effect. It also turned out that if the years ended in June rather than in December, the five year portfolio returns dropped even more significantly.

Examining risk-adjusted contrarian returns, it turns out not surprisingly that winners have higher betas in up markets than in down markets, and losers have higher betas in down markets than up markets. Allowing for the differing betas, the contrarian strategy showed a 5-year alpha of 4.3% per year, where the years end in December, but -2.5% per year where they end in June. Overall then, Shanken concluded that support for the long-term contrarian strategy is at best weak.

Momentum strategies are the converse of the contrarian strategies, and as noted above they seem to work over very short time horizons while the contrarian strategies work over long horizons. When firms are ranked on the past 6-month returns and the momentum strategy is followed for the succeeding 6 months, the risk-adjusted return spread between winners and losers is about 1% per month, a respectable profit. The cumulative returns peak after 12 months at 9.5%, and then decline for the next 18 months to a statistically insignificant 3.7%. This was for the period 1965-89. For 1941 through 1964 the results were positive but smaller. For the period 1927 through 1940, the returns to the strategy were always negative. Why this was so, Shanken could not say but it raises some questions about momentum strategies.

Shanken also discussed ratio-based value strategies. Risk-adjusted returns on stocks have been found positively related to earnings-to-price ratios, even after controlling for size. This is consistent with the overreaction hypothesis. But there is also evidence supporting the view that returns to strategies based on earnings-to-price, and book-to-price, ratios are due to expectational errors, rather than compensation for risk. Fama and French have argued that their 3-factor model results can be explained by risk. But there is not much theory to support this hypothesis.

At this point, Shanken's conclusion was that risk-adjusted contrarian evidence is weak at best and period specific. It is especially difficult to find any theory to explain the long-term time horizon for contrarian success and the short-term time horizon for momentum success. At the same time, momentum and book-to-market effects have been observed in a variety of countries, so one can hardly attribute the findings to data mining.
Shanken discussed the Barberis, Schleifer, and Vishny 1998 model that reconciles momentum effects with contrarian strategies, with earnings following a random walk but with investors mistakenly believing the process switches between two regimes. In the first, earnings are believed to be mean-reverting, so an earnings shock this period is likely to be reversed next period. This belief generates underreaction to earnings changes since they are viewed as less permanent than they really are. In the second regime earnings are believed to follow a trend with a shock likely to be followed by another of the same sign. This belief generates an overreaction to earnings changes. The probability of switching between regimes is believed to be low. And the probability of being in regime one is relatively high. The trouble with all of this, Shanken observed, is that investors update their beliefs about future earnings by applying Bayes Rule with this wrong model and never notice that actual earnings contradict their beliefs.

Another model, that of Daniel, Hirshleifer, and Subramanyam of 1998, also undertook to explain the momentum effect and the contrarian strategy. Prices are assumed to be set by informed investors, who are overconfident about their valuation and therefore overweight the private information in updating their beliefs. This leads to overreaction to private information and underreaction to subsequent public information. Further, the informed investors are also subject to biased self-attribution, such that confirming public evidence increases their confidence while contradictory evidence is dismissed as due to chance. Eventually the weight of public information moves price toward fundamental value. The end result is short-term momentum, because of continuing overreaction to the private information when public information arrives, but ultimately to reversals when the weight of public information moves price toward fundamental value. Shanken’s comment was that the hypothesis assumes investors never notice that the evidence repeatedly contradicts their initial overreaction. And a strange consequence is that informed investors are assumed to be irrational while uninformed investors are assumed to be rational.

Finally, Shanken described the Hong and Stein Model (forthcoming in the Journal of Finance). This model assumes two types of investors. The first is news watchers who condition their beliefs on fundamental information. Private information is assumed to diffuse gradually across the population of news watchers to generate short-term momentum. Momentum traders, on the other hand, condition on the previous past price change but ignore fundamental information. Since momentum traders do not know whether news has recently arrived, sometimes their trading pushes price past fundamental value, and induces long-term overreaction. Each type of investor appears to be rational. But if momentum traders could observe information arrival, they would refine their strategies accordingly. Hence one would not expect overreaction to public news, only to private information.

Shanken observed that in the DHS Model, informed investors overreact to their private information and momentum is generated by the continuing short-term overreaction. In the HS Model, informed investors collectively underreact to private information and momentum is generated by this underreaction. It is certainly true that a fair amount of evidence attacking the CAPM has been produced, but it is very difficult to see here a real behavioral paradigm.
Shanken and his co-author Lewellen proposed in 1999 an equilibrium model of asset pricing in the presence of estimation risk. That is, investors show uncertainty and a learning process about the true return/cash flow process. The model assumes independent and identically distributed future dividends from a distribution with unknown mean. In this model rational mispricing will lead to apparent underreaction to new information and this in turn will look like a momentum phenomenon.


R. Duncan Luce, Distinguished Research Professor, Departments of Cognitive Sciences & and Economics, University of California, Irvine, distributed a paper entitled: “Rationality in Choice Under Certainty and Uncertainty.”

There is wide agreement that a “rational” person will abide by expected utility (EU) under risk, and by subjective expected utility (SEU) under uncertainty. However, if one alters the domain formulation in two ways, by distinguishing gains from losses and by adding a binary operation of joint receipt, then equally rational arguments lead in the case of binary mixed gambles to predictions quite different from those of SEU. Luce’s presentation dealt with the effects of these two alterations.

We begin with a series of certain consequences, \( x_1 \) corresponding to a series of events, \( E_1 \) arising from some chance experiment \( E \). A gamble is represented by \( (x_1, E_1; \ldots; x_k, E_k) \) of event-outcome pairs. A numerical utility function is defined such that

\[
U(x_1, E_1; \ldots; x_k, E_k) = \sum_{i=1}^{k} U(x_i)S(E_i)
\]

where \( S \) is a finitely additive probability function.

SEU implies accounting indifference, meaning that a rational person should be indifferent between two alternative formulations of situations that have the same “bottom line” or end result for the decision maker. We focus on binary gambles, with two mutually exclusive events, each with its own consequence. Luce continued with a discussion of various other properties of the SEU. He introduced the rank dependent utility model (RDU) which modifies the binary SEU in two ways: the weights are not probabilities (and so are not finitely additive) and the weighted utility representation of \( (x, C : y, not C) \) depends on whether \( x \) is preferred or equivalent to \( y \) or \( y \) is preferred to \( x \). (That is, the utility representation of \( (x, C : y, not C) \) depends on whether \( x \geq y \) or \( x < y \).) RDU becomes SEU under certain conditions, and the succeeding discussion was essentially in terms of modifying SEU. The SEU model fails to distinguish between what are perceived as incremental gains and as losses, and there is no natural zero for utility. So Luce added what he called a first “primitive” which is that of the status quo, the concept of no change which means that we now distinguish gains from losses. And he added his second primitive, which is the operation of joint receipt. Joint receipt is a common occurrence in everyday life, and corresponds in economics to commodity bundles.

Luce continued to develop characteristics of his utility function, and added a value function as well. With value \( V \) additive, utility \( U \) in the case of mixed joint receipt (that is when some payoffs are positive and some are negative) is no longer linear. Next, he described various relationships between utility and value, and developed the utility functions for mixed gambles, with \( U \) concave for gains and convex for losses (as well as concave for both gains and losses or convex for both). Where
the function is concave in one region and convex in the other, we get a non-linear utility function different from that of SEU. When a gamble is perceived as a gain, the weight assigned to the loss term is increased by an amount dependent on the utility of the loss in the concave/convex case. When the gamble is seen as a loss, the change is in the weight assigned to the gain term; it is increased in the concave/convex case.

A non-rational but plausible link between mixed joint receipt and gambles is duplex decomposition. Despite its non-rational character, it is supported by empirical data, and under certain assumptions it leads to cumulative prospect theory. This model form seems to be important, because a very broad class of bilinear models are not supported by observed data.

Luce concluded with a consideration of the distinction between the SEU model, and the model he had developed by adding the status quo and joint receipt features. It has been widely claimed that SEU is the rational theory for individual decision making under uncertainty. But there is another equally rationally-based theory with quite different predictions in cases of mixed gains and losses. Since the major distinction between the two approaches is whether or not one includes the status quo (in terms of which gains and losses are defined) and joint receipt, the choice comes down to answering the question: Is there a rational argument for either excluding or including the status quo and joint receipt? Luce could think of no such rational argument.

The discoveries he had reported are too new and insufficiently absorbed and criticized by the field for anyone—even their author—to have full confidence about them. The only reasonable stance at the moment is caution in basing prescriptive recommendations solely on EU or SEU. He would like to see systematic research evaluating the recommendations from SEU and the present non-linear forms for mixed gains and losses.

10. The Courage of Misguided Convictions: The Trading Behavior of Individual Investors (Fall 1999)

Terrance Odean, Assistant Professor of Finance, Graduate School of Management, University of California, Davis, distributed a paper by himself and Brad M. Barber entitled: "The Courage of Misguided Convictions: The Trading Behavior of Individual Investors."

He began with three habits of individual investors: they trade too often, they hold on to losers, and they chase the action. And he followed with three psychological motivations: over confidence, regret avoidance, and attention. In reporting empirical research, he began with excessive trading, working with data from a national discount brokerage house, including trading and position records for 10,000 randomly selected accounts with 163,000 trades from January 1987 to December 1993. Each record included an account identifier, a buy-sell indicator, the number of shares traded, the commission paid, and the principal amount. He presented a table of average rates of return in excess of the CRSP value weighted index. The table showed that as of 84 trading days after a transaction, the stocks sold had shown a positive excess while the stocks purchased had underperformed the index. The same was true at 252 trading days after the purchase or sale and at 504 trading days. The difference at 504 trading days, was 3.57%.

Odean considered the non-speculative reasons that might have led to these transactions, and presented a table based on trades that were believed
to exclude non-speculative trades. The results here were even worse, with the excess returns on stocks sold 504 days after the sale exceeding those on stocks purchased by 8.6%. A graph of monthly turnover and annual performance of individual investors showed that investors who trade more actively earn less.

Further analysis of the data showed that the turnover in men’s accounts exceeded the turnover on women’s accounts, and the turnover in single men’s accounts exceeded the turnover in single women’s accounts. (Tests for single men and women were introduced because of the likelihood that for married couples at least, the account might be in the name of one spouse and the trading might be done by the other.)

Odean turned next to evidence that individual investors are reluctant to realize their losses. A graph showing the proportion of stocks with gains that were sold divided by the proportion of stocks with losses that were sold showed a ratio of about 2:1 in January, dropping fairly steadily to a little below 1 by December. It appeared that investors preferred to sell stocks with gains rather than stocks with losses, but became more sensitive as the year went on to the tax benefits of realizing losses. It also turned out that the winning stocks sold went up more after they were sold than did the unsold losing stocks. The rate of return differences were on the order of 3% at 252 trading days and 504 trading days after the sales.

Exploring the question: what prompts the decision to buy, Odean pointed out that individual investors are confronted with far more information than they can possibly process. There is evidence that they use some fairly simple decision rules and one is that they buy stocks that happen to catch their attention. Reports of stocks that have recently done extremely well or extremely badly are likely to catch their attention. Odean presented a graph showing the number of purchases less the number of sales plotted against the previous day’s percentile return rank. That is, from their data bank they tracked for each stock daily the number of purchases less the number of sales and observed the percentile rank rate of return of that stock for the previous day. The result is a U-shaped graph. The number of purchases exceeded the number of sales for stocks that had done extremely poorly or extremely well the day before. Purchases minus sales for stocks that had done nothing special the day before were very low. It turns out that this pattern of investor behavior was rather unprofitable.

The database included approximately 160 investment clubs, and Odean compared the performances of the clubs with the performances of individuals, and again with the performance of the index. Overall, on a gross return basis individuals had outperformed the index somewhat, although on a net basis, after commissions and spreads, they had under-performed. The clubs, on the other hand, had under-performed on a gross basis and substantially under-performed on a net basis.

Finally, Odean turned to some data for on-line investors. For 1600 “early” on-line investors (1991-1996), it turns out that investors who go on-line have generally done quite well before their on-line trading. They accelerate trading after going on-line and trade more speculatively and perform poorly. Odean attributed their results to over-confidence with an illusion of knowledge and an illusion of control.
11. Behavioral Finance in Practice  
(Fall 1999)

William F. Sharpe, Nobel Laureate, Fellow of the Institute & Professor Emeritus, Stanford University, moderated a panel consisting of Russell J. Fuller, President, Fuller & Thaler Asset Management and Mark Kritzman, Managing Partner, Windham Capital Management of Boston.

The first presentation was by Russell Fuller. He began with a discussion of the three pillars of modern portfolio theory. With respect to the mean/variance Markowitz Model, it seems clear that virtually everyone agrees diversification pays. Similarly, the CAPM may be in good shape. It is an ex ante model, and can only be properly tested by the use of ex-ante data. The only real test of the model that made use of such data, in Fuller’s opinion, was performed by Bill Fouse and others and reported in the Financial Analysts Journal in 1976. That test confirmed the model. Finally, the efficient market hypothesis may be in good shape. It is at least a good null hypothesis. While there are appearances of anomalies that could be exploited, active managers generally under-perform the market.

Anomalies do not necessarily indicate behavioral biases. For example, the small firm effect may simply reflect liquidity preferences which may change over time. Nine years ago Fuller & Kling reported variation through time in the small firm effect, but were unable to explain the variation. It might be worth undertaking research on why liquidity preferences vary through time.

Turning to underreaction, Fuller attributed it to two common cognitive errors: over confidence on the part of investors causing them to underreact to new information, and anchoring, by which individuals are tied to their previous view or opinion. To capitalize on underreaction (by taking long positions) we need new positive information, information that is permanent in nature, and we need a market that underreacts to this positive, permanent information. Fuller’s firm has generated attractive returns based on expected earnings per share information.

Turning to overreaction, it again results from two common cognitive errors. One is representativeness, with investors tending to infer that a single observation is representative of the entire population. The second error is saliency, with investors tending to over-estimate the probability of a truly low frequency event if they have recently heard that such an event has occurred. To capitalize on overreaction, again by way of long positions, we need a long string of disappointing news, typically resulting in a long period of price under-performance, so that investors become so conditioned to prior poor performance that they naively extrapolate that poor performance into the future. Fuller showed the success of such capitalizing with small-cap value stocks.

Turning to mispricing in large-cap stocks, it turns out that the mispricing is mostly on the short side. (For small-cap stocks, the mispricing is roughly equal on short sale and long purchase candidates. Large-cap stocks are different.) He described stock selection and weighting, for long-purchase and short-sale candidates. The alphas for the long portfolios were substantially lower than those for the short portfolios. Imposing size and sector risk controls reduced the alphas for the short portfolios but they still outperformed the long portfolios. Why should the short portfolios outperform the long? Fuller’s answer was that the majority of professional investors simply do not practice short selling.

He spoke on two behavioral considerations for portfolio optimization. The first was that investors care simultaneously about absolute and relative performance. The second was the observation that investors’ risk aversion varies with different market environments. Simultaneous concern about absolute and relative performance is shown by the common imposition of constraints in the optimizing process. Investors fear being both wrong and alone. Constraints are an inefficient mechanism for dealing with this problem. It can be dealt with directly and more efficiently within the optimization process.

We have optimization algorithms for mean/variance optimization and for mean/tracking error optimization. Applied together, the two optimizations produce an efficient surface in three dimensions. Kritzman showed graphically the probability of absolute failure, relative failure, and concurrent failure. Comparing mean/variance tracking error optimization with mean/variance optimization subject to constraints, the former almost always produced better expected results.

Turning to his second behavioral issue, Kritzman observed that risk parameters estimated from full samples are not reliable measures of portfolio risk during periods of financial stress. Event measured risk parameters may be more useful during periods of stress, and it is possible to identify and eliminate multivariate outliers in the process of measuring risk. Finally, it is possible to combine an inside sample covariance matrix with an outlier sample covariance matrix and identify portfolios that meet long-term objectives yet are also robust to periods of financial stress.

He demonstrated the process of outlier identification and showed optimal portfolios for quiet and stressful environments. Investors can then make choices based on the environment they anticipate.

12. Behavioral Finance in Practice — Part II (Fall 1999)

The first of two speakers for this session was Richard O. Michaud, President & CIO, New Frontier Advisors. He began with the question: Why are we concerned with behavioral finance? Claims have been made that rational finance is invalid: the CAPM does not work, the efficient market hypothesis (EMH) is invalid, the expected utility hypothesis (EUH) is invalid, market behavior is paradoxical, and individuals constantly make decision errors. But although there is evidence challenging the CAPM, there is also evidence supporting it. With respect to the efficient market hypothesis, a number of anomalies seem to have been discovered, although it is not clear to what extent they are the result of irrational investor behavior. Further, the practical value of market anomaly studies to institutional investors must take into consideration a number of characteristics of the institutional setting.

In his 1999 monograph, “Investment Styles, Market Anomalies, and Global Stock Selection,” Michaud presented results of analysis using his new global equity database to conclude that his results were not consistent with the irrational behavioral hypothesis, but were often consistent with a market culture or a sociologically based rational behavioral hypothesis. He said this new rationale helps to support a limited market inefficiency prior and may increase confidence in the out-of-sample
significance and reliability of some factors. But at the same time the perception that large active returns are available from constant factor weighting with little business or investment risk, something promoted by some earlier behavioral finance papers on market anomalies, appears to be largely a hoax.

Considering the expected utility hypothesis, Michaud observed that prospect theory, which offers a challenge to EUH, has drawbacks of its own and whether the theory is of significance to finance remains to be seen. He noted that Luce (1999) showed that a rational theory for explaining the behavior patterns of prospect theory could be devised.

With respect to paradoxical market behavior, for a variety of reasons many apparently paradoxical results may not be paradoxical at all. In other cases we simply do not know whether there are rational explanations. With respect to decision errors by individuals, Michaud discussed the effect of prior information or “frames,” and observed that while framing skills and perceptual priors can be fooled, they are not irrational and unlikely to be gamed.

The balance of his presentation concerned rational decision making. Statisticians have developed statistical tools for rational decision making under uncertainty. Can a rational framework suitable for asset management be derived from statistical decision theory principles? We begin with admissible estimates. An estimate is admissible if nothing is always better; i.e., no other estimate has uniformly less average loss. Bayes methods are generally admissible and span all admissible decisions. Consequently they can form the basis for rational decision making. Describing the benefits of a Bayes framework for rational asset management, Michaud noted that investors typically have priors. A Bayes approach features the proper use of prior information, is consistent with the semi-strong EMH and can be used when the return generating process is not stationary.

Behavioral finance offers us the ability to identify paradoxical behavior patterns, and gives us insights into the return generating process. However, rational alternatives are often ignored. Rational finance offers us the CAPM beta when more powerful statistical estimation methods are used, rational explanations for many apparent market anomalies and crazy markets, and an EUH with limitations that are likely repairable.

In conclusion, the market anomaly paradigm of asset management — profitable constant factor weighting — may be a hoax. Reliable outperformance is likely to rest on superior information and appropriate methods for using the information Bayesian methods can provide a practical rational framework of choice for modern asset management.

Arnold S. Wood, President and CEO, Martingale Asset Management, established as the primary objective of his presentation to identify four potential behavioral categories in plan sponsor decision making. The secondary intent was to provide a framework for matching Plan Sponsor tasks to these categories. First he listed four behavioral conditions (traps) that can arise when one is confronted by the task of setting objectives. As part of the category of overconfidence, anchoring is a common handicap for making predictions. A second category, asymmetric framing or Prospect Theory is dominated by loss aversion. This flaw highlights the extent to which the prospect of potential losses is outweighed relative to potential gains. Peer group pressure is a condition of social imitation, a third category. One illustration is that simple physical appearance can influence the decisions of counter-parties. And fourth, Agency
Theory, which broadly relates to the structure of relationships, can include hindsight bias. This condition invariably leads us to selective recall, believing that we said or did things (always good or prophetic) that simply were not said or done.

Turning to another Plan Sponsor task, asset allocation, a condition called illusory correlation can lead people to associations that may be misleading. Growth is good; Value is bad may be a generalization arising out of recent performance. Mental accounting has to do with the "pocketing" of ideas that, in turn, can affect the recognition of covariant relationships. Bounded rationality, the inability to process too much information, is the primary cause of mental accounting. Stocks are stocks; bonds are bonds. To think of their relationship in a portfolio construction context, à la Markowitz, is nearly impossible for mortals without a computer. Status quo bias is a condition of no change generally driven by the prospect of error. Again the regret of a potential loss is a powerful incentive to do nothing. And finally, a tendency to equal weight portfolio holdings because you cannot distinguish which you like more than others does also confounds allocation relative to benchmarks. This gives rise to the underweighting of large capitalization stocks and fund structure dislocations that have been very costly.

Turning to manager evaluation, Wood identified extrapolation of the past as a well-known problem. Even knowing that past and future seldom are correlated, extrapolation creates temptation that cannot be constrained. Although investment horizons are long-term, the time horizon for a 60/40 balanced stock/bond structure is about one and one half years. The fear of short-term losses (your job’s on the line) and frequent performance reviews can lead to the "bad dog" characterization of a manager (his job’s on the line). This in turn can prevent the manager applying the judgements for which they may have been hired. Such incentives can damage a relationship beyond repair.

As a generic prescription for bias prevention, Wood recommended:

- Always ask what you don’t know that you need to know when making a decision
- Give your full attention to contrary opinion, i.e., encourage it
- Document decisions so hindsight bias doesn’t distort original intentions
- Don’t confuse competence with chance over too short a time period
- Curb your enthusiasm (especially for men!)
- Say "Good Dog" when it’s deserved, a.k.a., positive reinforcement

13. Price Momentum and Trading Volume (Spring 1999)

Charles M. C. Lee, Henrietta Johnson Louis Professor of Management, Johnson Graduate School of Management, Cornell University, distributed a paper entitled: “Price Momentum and Trading Volume” by himself and Bhaskaran Swaminathan, also on the faculty of the Johnson Graduate School. Lee described the motivation for the paper as stemming from two questions: How does trading volume interact with price momentum in predicting future returns? and Why does trading volume predict returns? From the practitioner point of view, he appreciated that the "How" may be the more important, but he stressed that for academic research it is the answer to the "Why?" question that is the more important.
Reviewing the literature, he commented that there had been no satisfactory reconciliation of momentum and value strategies, and he suggested that volume may be an important bridge between the two. The reported research made use of rates of return and trading volume for New York Stock Exchange and American Stock Exchange listed firms from 1965 to 1995, excluding closed end funds, REITS, ADRs, as well as stocks priced at less than $1.00 and stocks for which insufficient information was available. At the beginning of each month over the test period, all stocks were ranked independently on the basis of past returns and past trading volume. The stocks were then assigned to one of ten portfolios based on returns over the previous J months (the estimation period). J took the values 3, 6, 9, and 12. The stocks were also assigned to one of three portfolios based on the trading volume over the same period. The result then was 30 price momentum-volume portfolios. To test price momentum, attention was then focused on the monthly returns of the extreme winner and loser deciles over the next K months (the holding period), where K = 3, 6, 9, or 12 and over the next five years. To test the effect of volume, attention was focused on the monthly returns of extreme volume winners and losers. And finally attention was focused on the monthly returns of combinations of extreme momentum and volume winners and losers.

Clear that in the first year the price momentum carried over, but by the end of the fifth year the gains of that first year had been largely eliminated as the portfolios that were losers in the estimation period performed better than those that were winners in the estimation period.

When price momentum and trading volume were combined, to test volume-based price momentum portfolios, it turned out that conditional on past returns, low-volume stocks generally did better than high-volume stocks over the next 12 months. However, the effect becomes smaller as we go from the momentum losers to the winners.

Lee next checked for robustness, finding that the effect he had discovered was not driven by a few small firms as might have been suspected.

Turning to price momentum strategies over the long term, as we saw with the price strategies alone, the effects are dissipated by the end of 12 months. We also find that low-volume losers outperform high-volume losers in years 1-5. Low-volume winners are slower to outperform high-volume winners, but they start outperforming in year 2 and continue to do so through year 5. At this point we have found that past trading volume does predict future price momentum and that as a rule momentum strategies are more successful among high-volume stocks. Buying low-volume winners and shorting high-volume losers is profitable. The converse is also profitable but much less so. Finally, a volume-enhanced momentum strategy outperforms a simple price momentum strategy by 200 to 700 basis points per year over the following five years.
Lee now turned to the question "Why is the strategy profitable?" There are three possible explanations. One is that trading volume is a proxy for fundamental risks. A second is that low-volume firms are less liquid and therefore command a higher expected return. The third explanation lies in a behavioral pattern. The researchers satisfied themselves that trading volume was not a proxy for firm size, price, industry, or beta. They also found the results were robust to the Fama-French three-factor model. The results therefore did not appear to be driven by differences in fundamental risk.

Nor were the results highly correlated with liquidity variables. This left the behavioral explanation and Lee turned to the "momentum-life cycle hypothesis." The idea he credited to Richard Bernstein. We picture a more or less perpetual cycle. At some point high-volume stocks are overpriced and become losers. Once they have been established as losers they become low-volume losers. At this point contrarians begin to buy and the stocks become low-volume winners. Once they are established as winners they become high-volume winners. As high-volume winners they become overpriced and the cycle begins again. This means that for winners, a high-volume is a sign of late-stage momentum while for losers high volume is a sign of early stage momentum. Successful investing calls for selling high-volume losers and buying low-volume winners. In summary, Lee concluded that what the analysis had revealed was consistent with the MLC hypothesis. Stock prices are constantly adjusting to information. Prices initially under-react but ultimately over-react to information. Momentum winners eventually become losers (and losers become winners) and trading volume helps to predict how long it will be before the reversal takes place.


Brad M. Barber, Graduate School of Management, University of California, Davis, distributed a paper by himself, John D. Lyon and Chih-Ling Tsai entitled: "Improved Methods for Tests of Long-Run Abnormal Stock Returns."

He introduced his presentation as a discussion of the ways in which biases come into analyses of long-run abnormal stock returns, and ways in which we can deal with them. A typical event study turns up in the literature examines initial public offerings and tests for abnormal returns in a period from one to five years following the event. It often turns out that the test statistics used to determine whether the abnormal returns are statistically significant have serious problems in them, problems that the authors of the research are sometimes unaware of or at least do not deal with adequately. Barber identified five sources of trouble in long-run event studies tests of significance. They are: the new listing bias, the rebalancing bias, the skewness bias, cross-sectional dependence, and a poor model of asset pricing (the benchmark problem). The new listing bias arises because in event studies on long-run abnormal returns, sampled firms are tracked for a long post-event period, while the set of firms that constitute the index or reference portfolio typically include firms that begin trading subsequent to the event month. The rebalancing bias arises because the compound returns of the reference portfolio are typically calculated assuming periodic rebalancing, while the returns of sample firms are compounded without rebalancing. The skewness bias arises because the distribution of long-run abnormal stock returns is positively skewed. In general, the new listing bias is positive, while the rebalancing and skewness biases are negative.
Cross-sectional dependence arises because the returns of the sample (IPOs for example) are not independent. Finally, the most serious problem is reliance on a model of asset pricing. All tests of the null hypothesis that long-run abnormal returns are zero are implicitly a joint test of both the long-run abnormal returns and the asset pricing model used.

Barber described the data and the construction of reference portfolios to minimize bias. The data included returns for NYSE/AMEX/Nasdaq listed firms in the monthly CRSP file for July 1973 through December 1994, limited to common stock. Reference portfolios were formed on the basis of firm size and book-to-market ratios in July of each year. The object was to identify the effects of the biases, and Barber displayed and discussed these. He distinguished the effects of the biases between two methodologies: the buy- and-hold abnormal return calculation and the cumulative abnormal return calculation. For the latter the new listing bias is positive, there is no rebalancing bias and there is a small negative skewness bias. For the former, the new listing bias is positive, and there is a negative rebalancing and skewness bias.

The paper describes methods for dealing with each of the biases. A particularly interesting one was the "bootstrapped skewness-adjusted t statistic." The conventional t statistic is adjusted for the estimated coefficient of skewness. Also of particular interest was a methodology making use of "Pseudo-Portfolios." For each sample firm with an event month t we randomly select with replacement a firm that is in the same size/book-to-market portfolio in event month t. The process continues until each firm in the original sample is represented by a control firm in the Pseudo-Portfolio. After forming a single Pseudo-Portfolio, we estimate long-run performance using the buy-and-hold size/book-to-market reference portfolios as was done for the original sample. This yields one observation of the abnormal performance obtained from randomly forming a portfolio with the same size and book-to-market characteristics as the original sample. The process is repeated to create 1,000 Pseudo-Portfolios and thus 1,000 mean abnormal returns observations. This set of 1,000 mean observations is used to approximate the empirical distribution of mean long-run abnormal returns.

Tests of the proposed methodologies seem to indicate that the new listing and rebalancing biases can be removed. The skewness bias is more difficult, but the bootstrapped procedure and the Pseudo-Portfolio procedure appeared to do a good job.

Cross-sectional dependence and a poorly specified asset pricing model present different problems. The authors proposed here to deal with the cross-sectional dependence by constructing a calendar-time event portfolio and calculating returns on a calendar-time portfolio. What happens here is that an event period of interest is chosen, say five years. For each calendar month we calculate the return on a portfolio comprised of firms that had an event within the last five years of the calendar month. The calendar time return on this portfolio is used to estimate a regression of the return premium on the portfolio against the return premium on a value weighted market index, the difference in returns of value weighted portfolios of small stocks and big stock, and the difference in returns of value weighted portfolio of high book-to-market stocks and low book-to-market stocks. The estimate of the intercept provides a test of the null hypothesis that the mean monthly excess return on the calendar-time portfolio is zero.

Unfortunately, there appears to be no solution to the problem of the poor asset pricing model. Further, while the
methods worked quite well for random samples they did not work so well in non-random samples (for example, in samples with unusual pre-event returns or samples concentrated in one industry.)

The authors' central message was that the analysis of long-run abnormal returns is treacherous. They recommend that such a study be subjected to stringent out-of-sample testing, for example in different time periods or across many financial markets. In addition, they recommend that such studies be strongly rooted in theory.

15. The Alpha Factor Asset Pricing Model: A Parable (Spring 1998)

Wayne E. Ferson, Pigott-PACCAR Professor of Finance, School of Business Administration University of Washington, distributed a paper by himself and Sergei Sarkissian and Timothy Simin entitled: "The Alpha Factor Asset Pricing Model: A Parable."

The presentation consisted of three parts. The centerpiece was the "parable," an imaginary discovery and presentation of an "anomaly" for which the discoverer cleverly devised a series of tests designed to justify his discovery as a newly established asset pricing model. An introduction explained the reason for the parable, and a concluding section revealed the fallacy in it.

The motivation for the parable lies in the frequent discovery, on the basis of historical data, of attribute-sorted portfolios that would have offered superior rates of return. That the attribute sorting may have value in achieving high rates of return in the future becomes plausible if the attribute can be classified as a risk factor rather than simply as an anomaly. It is helpful to those presented with attributes masquerading as risk factors to be able to identify them as truly anomalies.

Preparation of data to be presented in the parable involved the creation of artificial data for 100 alphabet-sorted stock portfolios. An average return premium was created for each stock, with the largest premium for the stocks with names beginning with the letter A and the smallest for stocks with names beginning with the letter Z. Care was taken that the return patterns were unrelated to any known risk factors. To begin the parable, Ferson played the role of the academic who has discovered the magic of ranking portfolios alphabetically and discovering that rates of return are correlated with the ranking. At the same time this professor discovers that the return rankings are quite uncorrelated with the conventional beta coefficient and also with standard deviation of returns. He explains that what he has discovered is not simply an anomaly but a risk factor.

He performs a cross-sectional regression test in the method of Fama and MacBeth (1973), finding a highly significant coefficient of .0033 (representing a premium of 1/3 of 1% per month) on what he designates "alpha risk factors." The Fama-MacBeth coefficient is a "mimicking portfolio." It is represented by zero net investment, no systematic risk, and minimized variance. The coefficient then can serve to proxy the risk factor.

But there is more. A spread portfolio, long in "A" firms and short in "Z" firms is established. The spread portfolio can be used to proxy the risk factor. For each stock portfolio a time-series regression on the spread portfolio will produce a spread portfolio beta and on the Fama-MacBeth coefficient, will produce an alpha beta.

Finally, the portfolio rate of return is regressed on the market beta, the alpha beta, the spread portfolio beta, and the alphabetic attribute itself. Not surprisingly, the market premium beta is
insignificant, the alpha beta used itself is significant, the spread portfolio beta used itself is significant, and the attribute premium used itself, as we have already seen, is significant. In other words, the standard tests for establishment of a risk factor have performed admirably, and the case is apparently proved. The professor has come up with a successor to the capital asset pricing model.

Why does the parable appear to work? Ferson demonstrated the answer can be found in the way the Fama-MacBeth regressions work. Combining the cross-sectional regression on the attribute with the alpha beta regression over time, one can see that the alpha beta is likely to be very close to the attribute itself. So long as the attribute works, there will be a respectable alpha beta.

The parable also lends itself to a portfolio interpretation. The anomaly presents a substantial arbitrage opportunity, one with zero investment and no systematic risk. Again, this is consistent with perceptions of anomalies as economic factors.

What is the significance of the explanation for why the parable works? Ferson answered that for academic asset pricing model proposals, it is important to know the weaknesses in the standard tests. Confusing anomalies with economic causes is very easily done!


The research presented was in many respects an update of presentations made by Hagin at Q-Group® seminars in 1984 and in 1991. Those presentations had focused on what Hagin called the "torpedo effect," which is the result of earnings turning out to be well below investor expectations. The current presentation discussed the latest news about the "torpedo effect," among other phenomena.

He began with a number of what have been recognized in the past as anomalies. In addition to the torpedo effect, are the size effect, the price/earnings effect, and the estimate revision effect. To the question: have the rewards of attempting to exploit these effects changed over the years, the answer is yes. Throughout his examination of these effects, Hagin pointed out that while over the past twenty years on average the effects appear to have offered opportunities for superior performance, their usefulness over the most recent five years has declined, and in some cases has apparently disappeared. This suggests that in examining evidence of the value in exploiting a supposed anomaly it is very important not to rely on its average success over a long period of history, but to examine carefully whether it appears to have lost its power. This latter examination is particularly appropriate if there is any reason to think that markets have become more efficient in recent years.

Hagin made clear that the database with which he has worked includes between 500 and 800 of the largest capitalization companies with December fiscal years and for which I/B/E/S earning forecasts have been available since March 1977. The nature of the database is important, because it does not include small capitalization sectors.

The first relationship examined was between earnings growth and rates of return. The positive correlation has persisted over the past twenty years, but for the past five years it clearly weakened.
The second investigation was of the torpedo effect. Over the fifteen years 1977–1992, a strategy of selecting before-the-fact, the companies that currently have the lowest expectations for earnings growth, paid off. This was a way to minimize the torpedo effect. For the most recent five year period, however, the effect is essentially gone.

With respect to the size effect, success in investing in the smallest companies was highly dependent on getting high earnings growth. But on average, even absent this advantage, the smallest size outperformed the largest. This result appears to have reversed in the most recent five years.

Next was the price/earnings effect. The lowest price/earnings portfolio outperformed the highest, but not by very much, over the most recent twenty years. The results were stronger during the first decade of the period, but weakened considerably during the second decade. The effect does not appear to be entirely gone.

The estimate revision effect, which depends upon analysts’ recent revisions of earnings estimates, had proved to be very strong from 1977 through 1981. It decreased somewhat but remained strong from 1982 through 1991, but over the past five years the effect has vanished.

In conclusion, Hagin believes that at least for this set of large capitalization stocks increased market efficiency has eliminated or substantially weakened the effectiveness of a number of strategies that at one time appeared quite substantial, and over a fairly long historical period showed evidence of success. The moral is that persistence, rather than average success over a long historical period, is the key to deciding whether the strategies have value today.

17. Equity Style Timing: A Primer
(Fall 1997)

The first speaker was Tony Kao, Director, Investment Research, General Motors Investment Management Corporation. He began with a definition of equity styles. Plan sponsors and equity portfolio managers recognize the importance of investment styles to performance attributes. Active management often involves style tilts. Style comes in many forms. It can include one or a combination of return factors such as beta, size, growth/value and quality. Active equity style management falls somewhere between traditional active management and passive management. It resembles tactical asset allocation with two asset sub-classes. Most of Kao’s presentation was concerned with the sub-classes value and growth.

Practitioners who exploit short-term benefits in the value/growth spread generally believe that value/growth is a natural split of the stock universe and is driven by economic fundamentals. They believe that return spreads exist and will likely persist. They believe that style spreads in the short-term can be effectively forecasted. And they believe that business cycles and trends in earnings will create opportunities. However, style switching strategies generally require a hit rate in excess of 60% to overcome transaction costs.

Kao presented a number of tables to demonstrate the potential for accurate forecasting of superior styles. The information ratios, particularly for monthly timing, were quite impressive.

He turned to the use of macro-economics to predict style spreads. Among these were yield curve spreads, real bond yields, estimated GDP growth, corporate credit spreads (AA to BBB) high yield bond spreads, and the gap between the earnings yield and the bond
yield. Some of these factors were quite highly correlated. For example, the earnings yield gap was highly correlated with the yield curve spread and the real bond yield. And the real bond yield was highly correlated with the yield curve spread.

Kao described the use of a recursive partitioning algorithm (RPA), originally developed for credit risk modeling, in the form of a binary decision tree as a classification technique in using macro-economic factors to make style decisions. He warned that for all of the convenience of the RPA, it is easily misused and is particularly susceptible to data mining.

Turning from U.S. examples to global equity style spreads, he showed that these spreads vary substantially among different countries, and that Japan for some reasons stands out as a very special case. Correlations of style spreads from country to country are generally very low. Diversification benefits, therefore, are significant.

Robert Shumaker, Equity Portfolio Manager, General Motors Investment Management Corporation, took over the presentation to discuss implementation of style timing. The modeling techniques include multi-factor regression, vector auto regression, and logistic regression. There are different kinds of factor weighting, and different trading rules. Most models produce monthly forecasts, and trading frequency can be up to four times per year. Turnover can exceed 100%. Switch magnitude may reach 100%, when the strength of the signal apparently justifies this extreme.

Implementation vehicles include futures contracts, index funds, and mutual funds. The best futures contracts are probably the S&P/BARRA Growth/Value Indices traded on the Chicago Mercantile Exchange. There is still some question about the liquidity of these contracts, however.

Implementation strategies include a total fund overlay, cash equitization using futures as an overlay, the use of a completion fund, style-alone funds, and long/short strategies.

18. Momentum Investing (Spring 1997)

Louis K. C. Chan, Associate Professor of Finance, Department of Finance, University of Illinois at Urbana-Champaign, distributed a reprint of an article from The Journal of Finance by himself, Narasimhan Jegadeesh and Josef Lakonishok entitled: “Momentum Strategies.”

Momentum strategies are based upon the proposition that past returns are a predictor of the cross-section of future returns. Simply stated, the principle is to buy stocks that have done well in the recent past and sell those that have done badly. The strategy clearly is in conflict with an efficient market hypothesis. Research on the use of past returns to predict future returns appears to support three apparently inconsistent phenomena: long-horizon reversals, short-horizon reversals and intermediate-horizon continuations. It is the third of these that we think of as price momentum.

Chan referred to a number of explanations that have been offered for long-horizon reversals and short-horizon reversals. The intermediate-horizon continuations, however, appear harder to explain. In seeking an explanation, Chan and his co-authors went beyond the use of returns to forecast returns. They looked for evidence related to earnings information, including possible market under-reaction to earnings, earnings momentum, and revisions in analysts’ earnings forecasts. Specifically, the earnings momentum variables they used to try to explain price momentum were standardized unexpected earnings (SUE), abnormal returns around earnings
announcements, and revisions in analysts’ forecasts of earnings.

The database included all NYSE, AMEX, NASDAQ stocks with coverage on CRSP and COMPSTAT files. The sample period was January 1977 to December 1993. As of the month of April in each year, all of the stocks were ranked on the basis of their return over the preceding six months, and then divided into deciles with the first decile the lowest performers and the tenth decile the highest. The assumption was that the stocks were purchased after the first five days of the ensuing six month period, and held to the end of that period. The rates of return on those deciles, then, indicated the success of the price momentum strategy.

The SUE variable was the difference between the most recently reported quarterly earnings and the quarterly earnings reported four quarters previously, divided by the standard deviation in quarterly earnings. The abnormal return around earnings announcement was measured as the sum of the daily returns of a stock over four days, beginning two days before the most recent earnings announcement and ending one day after. The variable for revisions in analysts’ forecasts of earnings was measured as a six month moving average of past changes in earnings forecasts by analysts reported by IBES, divided by the prior month’s stock price.

Correlations among the three earnings momentum variables were generally low, the highest being 0.44 between SUE and analysts’ revisions. And the correlations between each of the earnings momentum variables and the prior six-month stock return were low.

Chan turned next to summaries of his results. The comparisons reported were generally between the average return on the first two deciles and the average on the ninth and tenth deciles, both for the six-months after formation of the portfolios and for the first year after formation. There was clear evidence of price momentum: the ninth and tenth deciles, established on the basis of the preceding six-months returns, clearly outperformed the first and second. The difference was even greater over the first year after formation of the portfolios than over the first six months. The same was true for portfolios ranked by SUE. The effect was close to the same for portfolios ranked by revision in analyst forecasts and a little smaller for those ranked by abnormal return around earnings announcements.

Bearing in mind that much of the observed momentum effects might be due to small capitalization stocks, the analysis was repeated for the largest 50% of the firms and the earlier results were confirmed.

All of the tests so far had rested on the use of a single variable to rank the stocks, and Chan summarized the use of these one-way classifications as:

- Sorting on past returns and earnings surprises gives rise to large spreads in future returns.
- Spreads in returns associated with earnings momentum strategies tend to be small and shorter-lived, compared to spreads associated with price momentum.
- Results were consistent with markets’ sluggish adjustment to news in past prices and past earnings.
- Security analysts are slow in revising their expectations especially when news is unfavorable.
Chan next reported the results of ranking portfolios on the basis of two classifications. Stocks were ranked on the basis of their return over the prior six months and assigned to one of three equal-sized portfolios. The stocks were also independently ranked by SUE and assigned to one of three equally-sized portfolios. The result was three sets of nine portfolios each, with all stocks equally-weighted in a portfolio. The differences between the subsequent returns for the high-high portfolios and the low-low portfolios were substantial over the first six months and even greater over the first year after formation of the portfolios. The same was true when revision on analysts’ forecasts was substituted for SUE. And there was some effect even in the second and third years after formation.

Chan next considered the possibility that his results could be explained by risk differences. He estimated coefficients and t-statistics for three-factor monthly regressions on portfolios formed from the two-way classification by prior return and analysts revisions. In the regressions the dependent variable was the monthly return in excess of the Treasury Bill rate from the momentum strategy. The explanatory variables were the monthly returns from the Fama and French mimicking portfolios for size and book-to-market factors and the monthly return in excess of the Treasury Bill rate on the value weighted market portfolio of all the component stocks from the mimicking portfolios. The theory here was that past winners, if they are riskier than past losers, should have worse (better) performance in bad (good) states of the world, irrespective of the identity of the underlying risk factors. To the extent that bad and good states correspond to low and high excess returns, respectively, on a broad stock market index, the tests would check to see if this is the case. The results indicated that strategies exploiting high momentum in stock prices seemed to do especially well in up-markets and there was no evidence that the winner portfolio was exposed to larger downside risk.

In concluding, Chan observed that prior return and prior earnings surprise each predict future drifts in returns. It appears there is a slow adjustment by the market to recent news. These show up in drifts in abnormal returns around subsequent earnings announcements, sluggishness in analysts’ revisions, and a prolonged decline in the poorest performers. And each of the momentum variables has marginal predictive power for future returns.

19. Earnings Manipulation to Exceed Thresholds (Spring 1997)

Primer on Agency Theory: (Spring 1997)

Arnold S. Wood, President, Martingale Asset Management introduced the topic of agency theory as an aspect of behavioral finance. He congratulated the Q-Group® on venturing into presentations on behavioral finance and commented on the importance of the structure of the agent and principal relationship. There are difficulties involving loyalties as well as difficulties in a shared understanding of what is best for the principal. At the same time behavioral finance is so flexible and so difficult to pin down that it is a very frustrating subject for those trained in the rigorous testing of financial hypotheses.

Jayendu Patel, Professor, School of Management at Boston University, distributed a paper by himself, François De George, of the HEC School of Management, and Richard Zeckhauser, of the John F. Kennedy School of Government, Harvard University, entitled: “Earnings Manipulation to Exceed Thresholds.”

He began by observing that earnings manipulation by corporate management is by no means a new topic. And it will
come as no surprise that the researchers found evidence of manipulation. What is new in this work is evidence that earnings are manipulated around three distinct thresholds. Hence the term threshold-based earnings manipulation (TEM). There is not only strong evidence of the existence of these three threshold and their roles, there appears to be a clear hierarchy among them. Their existence is also consistent with probable agency relationships. The importance to corporate managers of corporate earnings is fairly clear. Earnings are also of great importance to security analysts, investors, and boards of directors, for a variety of reasons. And Patel discussed the feasibility of earnings manipulation in terms of managerial discretion over a variety of income statement and balance sheet items.

Why should thresholds exist? Patel discussed at some length the propensity of the human mind to focus on distinct points in a distribution. We focus on the zero in a range of earnings figures, and draw a huge distinction between positive and negative numbers, although they may in fact be very close together. So it is important that earnings be greater than zero rather than less. It is also natural to focus on improvement over time, again drawing a major distinction between an increase in reported earnings and a decrease. Finally, it is easy to focus on analysts' forecasts of earnings and see success in surpassing the forecasts and failure in not meeting them. There are then three thresholds: zero reported quarterly earnings, zero improvements in quarterly earnings over the earnings four quarters earlier, and zero difference between reported quarterly earnings and analysts' forecasts of earnings for the quarter. All three were characterized by the researchers as "bright-line thresholds."

The model of TEM, reflecting the main findings of the research, had four elements:

1) Earnings will be manipulated beyond bright-line thresholds.

2) When thresholds are too difficult to achieve, large losses will be reported in anticipation of the ability to surpass thresholds in the future.

3) When thresholds are easily surpassed there will be a tendency to manipulate earnings downward in order to "store up" earnings to meet future thresholds.

4) After upward manipulations to meet or surpass thresholds, a price will be paid in the form of reduced future earnings.

The empirical evidence, based on quarterly data for 4720 firms providing partial or complete data over the 1974 - 1996 period confirmed that the most important threshold is zero quarterly earnings. Histograms of reported earnings per share showed a large frequency jump from reports of -1 cent per share to reports of zero cents per share. There was a further substantial jump to reports of 1 cent per share. The latter Patel interpreted as the result of manipulation to achieve at least zero cents per share with some margin for error. The second threshold in importance was zero increase in quarterly earnings over four quarters. Here the histogram showed an even larger jump in the number of reports showing zero increase over the number showing a 1 cent decrease. Similarly, the number reporting earnings matching the analysts' forecast was much greater than the number reporting earnings 1 cent below forecast.

The relative importances of the three thresholds were shown by conditional distributions of reported earnings. As expected, manipulation of earnings to meet thresholds involved a price in terms of reduced future earnings. In the absence of manipulation, one would
expect firms that surpassed their thresholds would show better earnings in subsequent periods than those that just met their thresholds, which would in turn do better than those that missed their thresholds. In the presence of manipulation in order to meet thresholds, one might expect that those that met their thresholds would do worse in subsequent periods than those that missed their thresholds. And indeed, this is what the researchers found.

Evidence of manipulation not surprisingly was strongest for fourth quarters, where one would expect attention to be focused.

In summarizing, Patel said:

- Perceptual factors, rule of thumb behaviors, and natural reward schemes make the three thresholds important.

- Managerial rewards are linked to earnings in non-linear fashion, so that there are very strong incentives around thresholds.

- Three thresholds are important:
  - Avoid Losses
  - Sustain Recent Performance
  - Meet Analysts’ Expectations

- Earnings falling just short of thresholds are manipulated beyond them.

- Firms that just cross thresholds report worse earnings in the next period relative to firms that missed or surpassed thresholds

- Fiscal year effects are displayed in pathological fourth quarter behavior.

Finally, Patel discussed ongoing research. Formal statistical tests of TEM have yet to be performed. It would be interesting to learn more about the nature of firms that engage in TEM. It would be interesting to know whether analysts decode TEM. And finally, it would be interesting to know whether the stock market decodes TEM.

20. Investment Styles, Market Anomalies and Global Stock Selection (Fall 1996)

Richard O. Michaud, Senior Vice President and Director of Research, Acadian Asset Management distributed a paper entitled: “Investment Styles, Market Anomalies and Global Stock Selection.” His focus was on global stock selection within developed country equity markets. And his research was based upon a very large new global equity factor-return database.

He began with style analysis, the key to which rests on whether a set of factors can be identified that reliably represents the active return generating process in a given equity market. Style analysis can be valuable in the selection and management of active managers, and may be much more informative than a simple peer group comparison. The sources of style factors are what are commonly thought of as market anomalies.

The economic significance and persistence of market anomalies depends on their rationale, and the rationales differ according to whether markets are perceived as efficient or inefficient. Michaud discussed both. The principal rationales supporting inefficiency have to do with ephemeral effects and irrational behavior. Those supporting efficiency have to do with mis-estimated systematic risk, methodological errors, data snooping, misinterpretations and index inefficiency.
Michaud turned next to his analytical model. Multivariate linear regression is generally the statistical method of choice for measuring stock factor relationships or attributions for active stock selection. This index-relative framework mandates a number of design principles. These include: (1) the index has no active factor risk; (2) benchmarks of practical interest are generally capitalization weighted; (3) the actual distribution of factor values may have little investment content and may interfere in regression estimation; (4) monthly time horizons are generally of most practical investment interest. All of his reported regressions satisfied the conditions that: (1) regressions are based on equity market index-relative returns; (2) factor values are redefined so that the index-weighted value is zero, the factors are normally distributed, and the standard deviation of each factor equals one; (3) capitalization weighted regressions are applied to capitalization weighted indexes; (4) only investment grade stocks are used; and (5) the time horizon is monthly. His work was based on an international equity market database developed in December, 1990 to "forward test" market anomalous factors for their practical investment value. Designing the database without making use of backtesting was intended to minimize data snooping, although Michaud conceded that in selecting the data he was mindful of what others had done to identify and define market anomalies. Sixteen candidate stock forecast factors plus beta and sector and index membership were tabulated at the beginning of each monthly period and their relationships with subsequent monthly ex post index-relative returns were estimated with regression analysis. In late 1990 and early 1991, no prospective information on factor-return relationships was known.

He showed a table of stock factor attributions for Japanese stocks for the months of October, November and December 1995 as well as for the five year period January 1991 to December 1995. The B/P ratio was statistically significant over the five year period but also changed substantially over the three months, and was actually negative in October. From the univariate he turned to a multivariate analysis. For Japanese stocks, for the same time periods, a set of seven macrofactors were identified, aggregating the sixteen microfactors. It turned out that return reversal was a particularly significant multivariate factor and normalized earnings yield was quite significant. Again, there was considerable month-to-month variability in the coefficients.

Extending his tables to cover France, Germany and the U.K., Michaud pointed out that while return reversal was important in all four markets, there was considerable variation among the markets in the significance of other macrofactors. What was particularly interesting is that for these multivariate regressions there appeared to be no January effect in any of the four markets, and in the U.S.

Michaud concluded that the results provide limited evidence of long-term inefficiencies in global equity markets suitable for active stock selection. They do argue against a belief in irrational behavior, unless psychological laws for decision making vary by country. The fact that earnings trend is important in explaining active return in the U.K. but not in Japan is consistent with a view that brokerage earnings estimates have been more supportive of the corporate view in Japan but have been more investor oriented in the U.K.

The real challenge posed for active management is that most factor relationships are dynamic and are not consistently related to active returns even when they are significant. Successful active management may be
due less to the identification of anomalies than to managing their dynamic character.

If asset managers have insights on relatively short-term factor-return relationships that are independent of long-term historical data, a dynamic factor-weighting active management process makes sense. However, Michaud observed, this process may be considered simply as market timing, with a dubious reputation among many institutional investors and consultants.

Finally, then, he turned to Theil mixed estimation, which is a generalization of least squares linear regression combining historical data and unbiased prior information. This, he believed is the method of choice for managing a dynamic multiple factor global stock selection forecast process. He illustrated the Theil estimation for Japanese stocks, using this strategy: 50% positive weighting of all value macrofactors, minus 25% underweighting of all earnings growth macrofactors, with zero weight on remaining macrofactors. Assume the forecasts all have a 25% standard error for a three month investment horizon. He showed a table of the resulting historical weights and Theil weights, as well as the prior weights (the plus 50%, minus 25% and zero weights).

His final conclusion was that some statistically significant factor-return relationships may reflect rational characteristics of the investment culture of the given global equity market and, consequently, may have economically significant and persistent forecast value. However, even anomalous factors are unlikely to be sufficiently consistent and persistent over institutionally investment relevant periods not to benefit from dynamic factor weight management.

21. Style and Market Anomalies
(Fall 1996)

Richard Roll, Allstate Professor of Finance and Insurance, UCLA, proposed the formation of “style” portfolios, in the form of index funds in which one could actually invest. He then proposed to investigate whether these portfolios really had statistically significantly different returns, and if so whether he could explain the differences by risk alone. His ultimate goal would be the establishment of a hedge fund offering risks virtually identical to those in a benchmark, but better returns. What was of particular interest was whether the style portfolio returns would be the result of risk premiums, or data mining, or genuine investment opportunities.

The style portfolios would be formed by three attributes: market capitalization, earnings/price ratio, and book/market ratio. Working with U.S. equities on the NYSE, the AMEX, and NASDAQ, Roll sorted all of these equities at the beginning of each calendar month by market capitalization, E/P and B/M. The book values and earnings figures used were those available at least four months prior to the portfolio formation month. Eight mutually exclusive groups of stocks were formed, according to each of the three attributes being in the higher or lower half. Portfolios were formed by value weighting within each of the eight groups.

It turned out that over the period March 1984 - March 1994, there were significant differences in return performance across the eight styles. The LLL (low size, low E/P and low B/M) style performed rather poorly with an average 5% per year return. The LHH style, on the other hand achieved 21% per year. The E/P effect was statistically significant, while the size and B/M effects were not. The E/P effect added 65 basis points per month.
The worst performing group — the LLL — had the highest beta, while the best performing — LHH — had a rather low beta. When Roll controlled for CAPM beta, the statistical significance of the E/P factor doubled, although the coefficient changed very little. The t-statistics for size and B/M increased somewhat, but did not reach a level of significance. Controlling for APT (arbitrage pricing theory) factors improved the t-ratios still more. The t-ratio for E/P increased by another 50% to over 6, while that for B/M improved to a value of 3. For the size factor, the t-ratio still indicated insignificance.

It now appeared that it was feasible to chose a benchmark, for example the S&P 500, and to construct a portfolio that would respond to five risk factors in the same way as the benchmark would respond, but with a tilt to high E/P and perhaps high B/M that would result in higher returns at the same risk. And Roll demonstrated that this could indeed have been done. The investment policy objective was to achieve a managed portfolio with risk exposures identical to those of the benchmark against all dimensions of risk, with minimal idiosyncratic risk, and with a specified target average return performance above that of the benchmark. Over the ten year period, the style portfolio achieved a mean 51 basis points per month advantage over the S&P 500 benchmark.

There was evidence that profitable styles changed over time. This lead Roll to a flexible least squares approach, fitting a sample path to movements in the risk coefficients and to movement in extra-risk return.

There still remained the possibility that style returns were due entirely to data mining. After all, the variables Roll had chosen were those that previous researchers had found to be effective in adding value. He turned therefore to a data base formed from Indonesian equities, never before studied. The stocks were divided into high and low B/M groups at the beginning of each calendar month. Value weighted portfolios were formed within each group. It turned out that the high B/M group substantially outperformed the low B/M group, convincing Roll that his results were achieved without data mining.


Sheridan Titman, Collins Chair Professor, School of Management, Boston College, distributed a paper by himself and Kent Daniel entitled: “Evidence on the Characteristics of Cross Sectional Variation in Stock Returns.” He started with the statement that there is now considerable evidence that the cross-sectional pattern of stock returns can be explained by characteristics such as capitalization size, leverage, past returns, dividend yield, earnings-to-price ratios and book-to-market ratios. A table displaying monthly returns over 1963 to 1992 arrayed by capitalization size and book-to-market ratio, showed that there was a small book-to-market effect on returns for large capitalization companies, and a much larger one for small capitalizations. There was also clearly a significant return effect from capitalization size. Two explanations have been offered in the literature for the capitalization size and B/M effects. One is that the size and B/M factors are proxies for risk. A second view is that the return effects are not related to risk. The presentation by Richard Roll had followed this latter view, leading to the conclusion that one can match the risk of the index but achieve returns in excess of the index returns. Titman commented that the investment manager does not really care what the explanation is. To the manager, the risk is in tracking error relative to the benchmark.
Titman continued with the second explanation for the return effects: a characteristics-based asset pricing model. In this model, stock returns are explained by characteristics but not by covariances. There is a behavioral explanation for the model: Some investors are overconfident in their own judgments. While Bayes’ theorem holds, and prior probabilities are adjusted as further information becomes available, overconfidence prevents the investor from making the appropriate adjustments. The second explanation is that the characteristics leading to extra return are naive proxies for risk. That is, although analytic methods fail to relate these factors to covariances, investors may believe they represent risk.

Fama and French suggested that the B/M ratio is a proxy for the firms’ loading on priced risk factors. They in fact found that the loadings on zero cost factor portfolios formed based on B/M ratios along with a value-weighted market portfolio explain the excess returns. Titman and Daniel investigated whether there really are pervasive factors that are directly associated with capitalization size and B/M and whether there are risk premia associated with these factors. In other words, they tested whether the high returns of high B/M and small capitalization size stocks can be attributed to their factor loadings. What they found was that a zero cost portfolio for which there were zero loadings on risk factors, but with the characteristics not balanced, showed significant positive returns, while a zero cost portfolio balanced in characteristics but loaded on sensitivities to risk factors showed insignificant positive returns. Their conclusion was that the Fama-French explanation was incorrect. It follows then that it should be possible to form portfolios no riskier than a benchmark such as the S&P 500 Index, with a “tilt” to high return characteristics that will produce an overall return in excess of that of that of the benchmark.

This was essentially what Richard Roll had demonstrated in his presentation. (see the preceding summary)

Titman continued with a discussion of the momentum and B/M strategies. It turns out that momentum is a very important characteristic for low B/M stocks (generally classified as growth stocks), but is not important for high B/M stocks (generally thought of as value stocks). The story here may be that growth managers tend to overconfidence in their own judgments, while value managers rely more on exogenous information. The excess return record when B/M and momentum strategies are combined using U.S. stocks is rather impressive from 1963 through 1980, but especially impressive since 1980. Excess returns were very rarely negative and on average were substantial.

Curiously, for Japanese stocks momentum appears not to work for growth stocks but works fairly well for value stocks.

23. Review of Empirical Research and New Methodologies (Fall 1996)

Jay Shanken, Professor, William E. Simon Graduate School of Business Administration, University of Rochester, distributed a paper by himself and S. P. Kothari entitled: “Book-to-Market, Dividend Yield, and Expected Market Returns: A Time-Series Analysis.” There is evidence that expected stock market returns vary over time. What Shanken offered that was new comprised three elements. His research examined predictability based on the Dow Jones Industrial Index Book-to-Market (B/M) ratio and dividend yield (D/P). He also tested for the economic significance of the relationship, identifying the change in expected returns for a standard deviation change in the B/M ratio and the D/P ratio. Finally, because of
statistical biases in least squares regression analysis, he introduced a simple bootstrap procedure for applying a Bayesian likelihood analysis.

Two time periods were examined: 1926 - 91, and 1941 - 91. For each period five variables entered into the analysis: an equally weighted return and a value weighted return for the stocks in the index, the book-to-market ratio, the equally weighted dividend yield and the value weighted dividend yield. Shanken began with a univariate OLS regression. It became apparent that the year 1933 was an "outlier" because inclusion of the data for that year led to an extraordinary beta coefficient on B/M. A one standard deviation in B/M moved the equally weighted rate of return by 20.2 percentage points. Dropping the 1933 data reduced this coefficient to 10.6 percentage points. A process Shanken referred to as "truncation," which substituted for the 1933 values the next highest sample values, gave a beta of 14.3 percentage points. For value weighted returns the effect of the 1933 data was less marked, and the beta was 8.6 percentage points reduced to 7.1 percentage points with the truncation. The beta on dividend yield was 6.7 percent equally weighted, and 7.1 percent value weighted, with the 1933 data included.

The OLS regression results, however, were suspect because of well established statistical biases in the methodology. Shanken therefore turned to a VAR (variable auto regressive) model, describing the joint evolution of returns and financial ratios over time. In what he called a "bootstrap procedure," Shanken estimated the historical VAR model, inserting a hypothesis about beta, to simulate an artificial 1926 - 91 time-series of returns, 2500 times. He then ran a regression of returns on financial ratios for each of these artificial time-series, and stored the beta estimates. The bootstrap p-value was the proportion of the 2500 artificial OLS betas greater than the historical beta, under the given hypothesis with respect to the true beta. The bootstrap likelihood was, for each possible value of the true beta, the proportion of the corresponding 2500 artificial OLS betas in a "small" neighborhood around the historical data. Shanken regarded the bootstrap likelihood as the most informative measure to use in estimating the true beta. Ultimately, the appropriate interpretation of the sample evidence depends on one's initial beliefs about the plausibility of different beta values. And one's beliefs will depend upon one's convictions with respect to the efficiency of the market. No two researchers are likely to draw identical conclusions with respect to the true beta.

Shanken focused on a graphical presentation showing the likelihood of each beta over a predetermined range of values, to apply to B/M and to D/P value. As already indicated, the ultimate selection of the most appropriate beta is a subjective process assisted by the likelihood statistics.

Shanken next presented in graphical form the expected returns for 1926 through 1991 resulting from the use of betas on B/M and on D/P that appeared plausible from the likelihood tables. An interesting result was that the expected returns based on B/M were negative for several years at both the beginning and end of the sample and for two years in between. The most negative expected return was -14.5% in 1929, when the market value for the Dow 30 was about 3.7 times book value. Expected returns based on dividend yield were always positive. To a firm believer in market efficiency, negative expected returns would be implausible. And such an analyst would presumably have made different estimates of beta, using the likelihood graphs.

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Richard O. Michaud, Senior Vice President and Director of Research, Acadian Asset Management, introduced the topic of market anomalies. He pointed out that these anomalies are the basis for active equity management and that it is appropriate to look for a rigorous explanation of them. One explanation is that markets are inefficient. Another is that investors behave irrationally. Finally, still another is that the anomalies simply proxy otherwise unmeasured systematic risk. Another claims that methodology errors make anomalies only appear to exist.

Donald Keim, Professor, The Wharton School, University of Pennsylvania, distributed a paper by himself and Gabriel Hawawini, entitled: "The Cross Section of Common Stock Returns: A Synthesis of the Evidence and Explanations." He described his presentation as a review of findings in the academic literature, a survey of evidence supporting the findings, and some new research of his own. In brief, a good deal of evidence has been produced that variables other than beta risk explain returns on common stocks. But there is no theory to support the significance of these variables.

The first anomaly he reviewed was the effect of size (measured as market capitalization) on rate of return. A number of researchers have documented the size effect in the United States and in most non-U.S. developed equity markets. Keim's own analysis indicated for the 1951 - 94 period, the average monthly U.S. size premium (that is, the difference between the average monthly return on the smallest market capitalization decile and the average market return on the largest) was 0.61% with a t-value of 2.57. Similarly, a substantial body of empirical research has documented a significant relation between the earnings to price ratio and average returns. For the 1962 - 94 period, Keim had found an average monthly U.S. premium of 0.38%, a result that was not statistically significant.

As an alternative to E/P, Keim proposed the ratio of cash flow to price. For the 1972 - 94 period, he had found the average monthly U.S. premium to be 0.67% with a t-ratio of 2.31. The next factor was the price to book effect. A good deal of research had demonstrated the relationship between average returns and this ratio, for the U.S. and a number of foreign markets. For 1962 - 94 Keim had found the average monthly premium to be 0.53% with a t-ratio of 2.31.

Finally, Keim considered the prior return (momentum) effect. The relationship here depends upon the time period tested. There is evidence of long term (3 - 5 year) return reversals as well as of very short-term reversals, but over medium terms (6 - 12 month periods), the performance of winners and losers tends to persist over the following six to twelve months. Keim's own research had indicated an average monthly U.S. momentum premium of 0.42%, with a t-ratio of 2.46.

Keim next turned to the question whether the five factors he had discussed may actually be measuring the same effect. It turns out that the monthly premia are highly correlated except for the small and negative correlations between momentum premia and premia for the other four factors. The negative correlations appear to be due to the January effect. The momentum effect was actually negative in January and positive for February through December, while the other four factors were much more powerful in January than in February through December. Keim also observed that the other four factors are all computed using a common variable price per share.
His next task was disentangling the effects of the factors. The published research indicated that there is a signification relationship between capitalization size and average returns, no matter which other variables are also used. Fama and French, in 1992, had concluded that capitalization size and P/B together subsumed any additional explanatory power of the E/P ratio. Keim’s conclusion was that three factors are sufficient to explain the cross-section of stock returns. This interpretation, however, has been challenged in a number of papers. It appears at least that the factors are not proxies for risk, because of the January effect. There seems to be no reason to believe that risk is dominant in January.

Exploring the risk proxy hypothesis further, Keim reported that over the period 1975 - 94 he had found significant capitalization size, E/P, cash flow/P and price to book premia in most countries with developed markets. However, the correlations of these premia across countries were approximately zero. This makes it difficult to claim that the factors are risk premia.

In summary, he concluded that variables like capitalization size, E/P, P/B and momentum appear to explain cross-sectional variation in average returns better than does beta. A possible interpretation is that these factors are proxies for at least unidentified risk factors. Alternatively, the results may be due to survivor biases. Or it may be that capitalization size, E/P and P/B are simply proxies for measurement error in estimating betas.

25. Size and Book/Price Anomalies (Fall 1996)

Jonathan Berk, School of Business Administration, University of Washington, distributed a paper entitled: "Does Size Really Matter?" and another entitled: "An Empirical Reexamination of the Relation Between Firm Size and Return." The latter paper was supported financially by the Q-Group®.

Berk’s presentation focused on the empirical finding by others, including Fama and French, that size, measured by the market value of outstanding equity, predicts returns. On average, small cap firms earn larger returns than large firms. But a theoretical prediction of any asset pricing model that assumes that physical size is unrelated to risk is that size as measured by the market value of the firm is always an inverse predictor of returns. In other words, if it is true that physical size is unrelated to risk, than it is a tautological result that market capitalization is a predictor of return and this result in no way challenges the validity of CAPM.

Berk’s argument was that market value is affected by at least two things: physically bigger firms have higher market values, and riskier firms have lower market values. Since the market value is the discounted present value of future cash flows, and high risk means a high discount rate, if all firms had the same expected cash flows we could expect market value to be a perfect or almost prefect predictor of expected returns. This in turn suggests controlling for physical size when testing for market value effect. Berk proposed that no asset pricing model can fully capture all factors that determine expected returns, and that in a test of any such model, capitalization size must have some additional explanatory power. So the finding of this additional explanatory power does not discredit the model.

Berk next turned to the empirical question whether physical size is related to return. Using a data set that matched as nearly as possible the data used in the Fama–French studies, Berk first controlled for book value by dividing the companies into quintiles on the basis of
book value of assets. He then looked at the return results for these quintiles sorted by market value. In other words, he controlled for book value and then tested the importance of market value. Within each book value quintile, market value was clearly related to average monthly return, with the small market value quintiles outperforming the large. Reversing the sequence, and sorting first by market value and then testing the return effects of book value, it turned out that book value of assets had little effect on average monthly return. Returns then appeared unrelated to physical size. Similarly, Berk reported tests using three other physical size measures: (1) total value of undepreciated property plant & equipment; (2) total value of annual sales; and (3) total number of employees. None of them showed a significant effect on average monthly returns.

A further step analyzed the market value residual, after allowing for physical size, as a predictor of stock returns. It turned out that after controlling for book value, the market value residual was a better predictor of returns than market value itself. This is consistent with the proposition that market value is a function of physical size and risk.

Berk's overall conclusion from the research he had reported is that there is no evidence of a relationship between physical size and return, and no evidence of the existence of what might be called a size anomaly in returns data. Theory tells us that market size and return are related but says nothing about the functional form. It would appear then that there is a theoretical basis for portfolio managers to use market size in selecting high return stocks, but it is not clear just how to use market size. Berk concluded by describing a new paper in which he and his co-author propose to develop a theory to explain the functional form.

Active Equity Management — Game Theory

26. The Evolution of Cooperation: Direct, Indirect and Spatial Reciprocity (Fall 1999)

Martin A. Nowak, Professor of Theoretical Biology, The Institute for Advanced Study, Princeton, New Jersey, distributed a paper entitled: “The Evolution of Cooperation: Direct, Indirect and Spatial Reciprocity”.

He began with Darwin’s theory of evolution. This is based on competition and survival of the fittest, and it therefore does not easily account for altruistic behavior. But many animals, most notably humans, do engage in cooperative interactions. Further, the emergence of cooperative behavior was a crucial step for the evolution of human societies. Theories of cooperation are based on kin selection, group selection, and reciprocal altruism. Nowak undertook to present three mathematical frameworks for the evolution of reciprocal altruism.

Cooperation can be described in algebraic terms. The donor pays a cost $c$, while the recipient gets a benefit $b$. So long as $b$ is greater than $c$, there is a benefit to cooperation. It is easy to see cooperation among relatives as a part of evolution. Kin selection is rooted in genetics. If a gene helps in promoting the reproductive success of close relatives of its bearer, it helps in promoting copies of itself. Within a family, a good turn is in this sense its own reward. But a good turn to an unrelated fellow-being has to be returned somehow in order to pay off.

At this point, Nowak introduced what is known as the Prisoner’s Dilemma. There are various scenarios for the Prisoner’s Dilemma, and Nowak’s was very simple. Two
prisoners who are unable to communicate with one another are asked to make a choice. The choice is between cooperating or defects (by not cooperating). If one elects to defect and the other chooses to cooperate, the first gets 5 points and the second gets none. If both choose to defect, than both get 1 point. And if both choose to cooperate than both get 3 points. We take the position of one player. If the other player defects, we will be better off defecting than cooperating. If the other player cooperates, we will be better off defecting than cooperating. And if the game is played only once, then natural selection would seem to dictate the choice to defect. If the game is repeated over and over, those who cooperate will disappear and those who defect will replace them. The consequence is not an attractive state of nature. If the game is to be repeated over and over, however, the players will realize that a choice always to defect is not the best strategy. There is no way to determine of all possible strategies which is best. But one is Tit-For-Tat. With this strategy, each player simply repeats the other player's choice in the previous game. So long as the sequence begins with a cooperative move, subsequent choices for both players will be cooperation. The total points scored in each repetition of the game will then be 6 rather than the 2 points that would be achieved if the players always defected. Again in terms of evolution, those who cooperated with Tit-For-Tat tended to produce more offspring than those who had not. The composition of population would turn still more in favor of Tit-For-Tat, and from generation to generation Tit-For-Tat shapes a more congenial environment. Nowak pointed out a number of examples in the non-human animal and fish world, where something like Tit-For-Tat seems to be practiced.

But there is a problem with Tit-For-Tat. The strategy is particularly vulnerable to errors. One inadvertent defection starts a run of alternating defections. The average payoff per round drops drastically. A solution is for the Tit-For-Tat players to forgive occasionally. This should not be on a predictable pattern since this would make them exploitable, but on a random basis. The random choice process can be described by probabilities. We can imagine one party cooperating 99% of the times following cooperation on the part of the other player, and cooperating 1% of the times after a defection by the other player.

All three strategies: always defect, Tit-For-Tat, and generous Tit-For-Tat can be turned into computer simulations. We assume that each member of a population adopts one of the three strategies. The payoff for each interaction of two players determines the number of offspring of each player and the offspring are presumed to inherit the strategy of the parent (at least approximately, with some allowance for mutations). As the simulations proceed through round after round of interactions, the all defector strategy can be seen to predominate. But after a time, Tit-For-Tat begins to replace all defector as the dominant strategy. But Tit-For-Tat may not prove a stable strategy. Generous Tit-For-Tat will prove more stable, but there is yet another strategy that will be better than Generous Tit-For-Tat.

The fourth strategy is Win-Stay Lose-Shift. The player who follows this strategy will behave in an interaction in the same way he or she behaved in the prior interaction if the result was a high payoff, but will change his or her choice in the second interaction if the previous choice brought about a low payoff. One trouble with Generous Tit-For-Tat is that it is vulnerable to an invasion by those who always defect. And when the population is invaded by players who never retaliate, exploiters are able to gain a foothold. The Win-Stay, Lose-Shift
strategy is not destroyed by an always-defect invader and therefore offers greater stability. A mistaken defection between two of the Win-Stay Lose-Shift players will lead to one round of mutual defection and then back to cooperation. And faced with someone who never defects, a Win-Stay Lose-Shift player keeps defecting.

The computer simulations also show that against a strategy of always defecting, the Win-Stay Lose-Shift strategy does not do well. It is necessary that an unyielding strategy like Tit-For-Tat twist evolution away from defection and pave the way for Win-Stay Lose-Shift.

All of this supposes, of course, that there are repeated interactions between the same pairs of individuals. These are cases of direct reciprocity. Indirect reciprocity involves one party cooperating with a second party in anticipation that a third party will cooperate with the first. The benefit to the first party of cooperating is then seen as enhancing the reputation of the first party in order to raise the likelihood that some third party will cooperate. Cooperation requires that when the cooperator incurs cost \( c \) and the beneficiary derives a benefit \( b \), \( q \) must exceed \( c/b \), where \( q \) is the probability that the cooperator’s reputation will be enhanced. Reputation requires communication, and Nowak observed that the development of language must have been important to the evolution of cooperation.

Spatial games are games played with very limited sets of population. The simulation results can now be quite different from those described above. Mixtures of pure cooperators and pure defectors can co-exist indefinitely, in fluctuating proportions about predictable long-term averages. But many other patterns may evolve as well. The possibilities are particularly interesting in the context of the development of very early life forms.

In a final comment, Nowak reported that the maximum fraction of beginning participants in a simulation who can be always defectors and yet have everyone a cooperator in the end is .7380.


William Poundstone, science journalist, spoke on game theory, and distributed two papers entitled: "Are Traders Rational? Applying Game Theory to the ‘Real World,’” and “The Dollar Auction: Avoiding the Winner’s Curse”. He began with the question what is game theory good for. It is clear that game theory has been found helpful in the design of military strategies and in some business situations, including the government’s auction of cellular phone rights. And indeed the principal motivation for the development of game theory had to do with its military use during World War II. There are two problems, however, in applying game theory in business situations. First, supposedly game theory involves decision making by perfectly rational people, and we know that few people are perfectly rational. Second, there are problems, and Poundstone discussed a few, where game theory simply will not deliver a clear strategy.

He presented some examples of price competition and in each case identified the equilibrium point, a concept devised by John Nash, a younger colleague of the inventor of game theory, von Neumann. An equilibrium point is an outcome where there are no regrets. More specifically, the equilibrium point is an outcome where no one would want to unilaterally change his or her strategy after finding out what the other player(s)
did. For a zero sum game, with rational players, von Neumann concluded there was always a clear-cut rational solution. Even in non zero sum games of two rational players, Nash showed that an equilibrium point would be reached.

A number of tests have been carried out to determine just how rational most people are. Some of this work was sponsored by the U.S. military in an effort to establish the usefulness of game theory. The results of the testing were not encouraging. At least college students, confronted with games involving modest financial rewards, did not behave rationally. There is still an expectation that where large amounts of money (or other valuable outcomes) are concerned, rationality will prevail.

More difficult problems arise in cases involving "splitting." Here two parties are negotiating to divide a financial benefit. Failure to agree means that neither party will derive any benefit. An equal sharing of the benefit may appear "fair," but one party may be able to persuade the other to accept less than a half share as the alternative to nothing at all. There is no necessary solution to this problem but the party who is more unreasonable often gets the better deal.

The "prisoner's dilemma" is a particularly interesting problem and is game theory's classic example of irrational behavior. Poundstone posed the problem this way: one criminal has a stolen diamond for sale and another criminal wishes to purchase it. Neither criminal has any reason to trust the other. The criminal with the diamond is supposed to place the diamond in a particular bus locker in Miami, while the criminal with the money is supposed to place the money in a locker in New York. They are then supposed to exchange information as to how each can retrieve what has been placed in the lockers. The buyer is to go to Miami to retrieve the diamond and the seller is to go to New York to retrieve the cash. If the deal goes as planned, both parties are satisfied. However, if the seller does not actually place the diamond in the designated locker, but collects the cash then he gains both the diamond and the cash and the buyer receives nothing. On the other hand, if the buyer places nothing in the designated locker and retrieves the diamond he gains both diamond and cash, and the seller has nothing. Given this realization on the part of both buyer and seller, and the fact that neither can be trusted, it could be expected that both will cheat and in the end nothing will have been accomplished. The point here is that one would think a logical conclusion ought to be an exchange of the diamond for the money, bringing about the end result that both parties desire. Yet it would appear that if both parties are rational their decisions must lead to complete frustration of the transaction.

Poundstone discussed some business situations that are analogous to the prisoner's dilemma. The problem is always that logical behavior by the parties leads to something worse than the solution that produced the greatest shared value. Collective rationality would have maximized the shared value; individual rationality leads to a lower shared value although one party may indeed end up with more than half of the maximum shared value. It appears that game theory simply cannot deal in an entirely satisfactory way with the prisoner's dilemma.

Poundstone referred to the most common type of prisoner's dilemma in everyday life as the "free rider dilemma." The free rider is able to avoid paying for goods and services in the knowledge that those goods and services will continue to be provided and paid for by someone else.

In concluding the first part of his presentation, Poundstone presented two
items of bad news and one of good news. First, people are often irrational and in such a case it is difficult to use game theory effectively. Second, there are situations where even game theorists cannot come up with an indisputably rational outcome. Third, the real world is far more complicated than the neat diagrams drawn by game theorists and by establishing appropriate rules for this real world game, one may indeed find a best solution.

In the second part of his presentation, Poundstone discussed the dollar auction, and the winner’s curse. A dollar bill is auctioned with two rules: the dollar bill will go to the highest bidder and this bidder will pay whatever his or her high bid was. The second highest bidder has to pay the amount of his or her last bid, and gets nothing in return. The winning bid may then involve a loss or gain, depending upon whether the bid is greater than or less than one dollar. The second highest bid will always involve a loss.

In practice, the bidding generally goes well above one dollar. The reason is that when the highest bid reaches one dollar and the highest bidder therefore stands to gain or lose nothing, the second highest bidder very likely stands to lose close to a dollar. This second highest bidder therefore has a motive to bid more than a dollar in order to cut his or her loss. But that only leads to another second highest bidder who once again is motivated to bid still higher in order to cut his or her loss. And so the bidders escalate. The problem appears to be that there is no obvious place to draw the line between a rational and an irrational bid.

The dollar auction is a frequent occurrence in real life. Poundstone suggested a number of examples, all involving the making of further commitments in the hope of minimizing losses. An arms race is an example from the military.

Poundstone next discussed the largest number game. In this case a prize is offered to be awarded by the random drawing of an entry. Participants may submit as many entries as they wish, and there is no fee charged for entries. The prize, however, is a significant sum of money divided by the total number of entries received. The individual participant then is motivated to submit a very large number of entries in order to improve his or her chances of winning the prize. But the more entries that are submitted, the smaller the prize will be. And indeed, as a practical matter it is quite likely that enthusiastic participants will drive the value of the prize down to zero. There is indeed a theoretical optimal behavior which if followed by all of the participants will maximize the expected prize. But it is highly unlikely that the participants will all follow this behavior, and it only takes one participant to reduce the prize to zero.

Real life examples of the largest number game include runaway inflation and the “tulipmania” of seventeenth century Holland.

In conclusion, game theory can be helpful when participants are rational or close enough to it. The theory tells you what you ought to be doing and also predicts what other people will do. In the absence of rationality, however, game theory may or may not be helpful. It may at least help us to understand what is going on even if it cannot bring about change.

28. Implications of Game Theory For Investing. Introduction: The Importance of Game Theory (Spring 1996)

Jack Treynor introduced the topic by observing that risk embraces two concepts: danger and opportunity. The statistical measures of risk, so familiar in the world of investments, focus on the
danger. Benjamin King, some years ago, found the broad sources of investment risk were threefold: systematic macro risk, a part of the economy, micro risk related to the individual firm, and in the middle, industry risk. Although we rarely consider the sources of industry risk, Treynor suspects that they represent primarily fluctuations in the consensus expectation with respect to the two great disasters that can befall an industry: overcapacity and over-competition. Competitors seek to take market share from each other, yet all are anxious not to plunge their industry into either of these two disasters. And so we have a complicated situation involving both competition and cooperation.

Treynor introduced Barry Nalebuff, Professor at the Yale School of Management, who distributed a paper entitled: "Co-opetition," the first chapter in a book of the same title to be published in June, 1996.

He began with two conflicting views of what business is all about. The expression "business is war," is commonly used to describe the competitive aspects of business, but one might also use the expression "business is peace" to describe cooperation and symbiotic relations in business. Which is the more apt? His response was that business is both war and peace, involving both cooperation and competition. Hence the term co-opetition.

Turning to game theory, Nalebuff observed that it can offer important assistance in devising business strategy, but that the focus of game theory has tended to be on how to play a particular game when changing the game may be more important. Fortunately, the theory is also useful as the guide to changing the game.

There are five basic elements of the business game: players, added values of players, rules, tactics, and scope, each of which Nalebuff would discuss in some detail. The "value net" is a diagram of the principal players. Imagine a diagram with our company at the center. Above us are our customers and below us our suppliers. To our left our competitors and to our right our complementors. Only the complementor class may seem unfamiliar. Complementors are those whose presence enhances our opportunities. They may aid us with our customers or with our suppliers. Nalebuff offered these definitions:

A player is your complementor if customers value your product more when they have the other player's product than when they have your product alone.

A player is your complementor if it is more attractive for a supplier to provide resources to you when it is also supplying the other player than when it is supplying you alone.

Computer hardware and software suppliers are generally complementors. More and better hardware offers opportunities to software suppliers, and vice versa.

The definition of a complementor leads to a useful definition of competitors:

A player is your competitor if customers value your product less when they have the other player's product than when they have your product alone.

A player is your competitor if it is less attractive for a supplier to provide resources to you when it is also supplying the other player than when it is supplying you alone.
It quickly becomes clear that some players are simultaneously competitors and complementors. On the customer side, Nalebuff offered the example of antique dealers and booksellers tending to cluster in cities. While the dealers and booksellers are competing among themselves, the clustering tends to bring more customers to the group, so that the total value of the market is enhanced even though competition may be heightened by the proximity of the sellers. Wal-mart and K-Mart, on the other hand, are likely to view one another as purely competitors. On the supplier side, both Compaq and Dell compete for the limited supply of Intel’s latest microprocessor chip. But both benefit from the lower prices that can go with Intel’s expanded production and sales. Nalebuff pointed out that while we generally recognize competitors, we may tend to overlook the importance of complementors. It is especially easy to miss understanding the complementary nature of a competitor. To illustrate his point, he drew the value net for a university, and identified customers, suppliers, competitors and complementors. Drawing the value net is useful because it helps to clarify who is in each of the four groups, what their perspectives are, and how each can be dealt with such as to maximize our own effectiveness. Nalebuff offered examples of companies that seem to understand and make good use of a value net, and others that appear not to understand.

Success of complementors will generally enhance success for us. But there are even occasions when the best strategy is to let competitors succeed as competitors. These include cases where price competition can turn destructive, and where customer loyalty to our competitors may head off just such destructive competition, and therefore should be seen as a benefit to us. It may even be worthwhile to let a competitor prosper, even though that means accepting lower profits ourselves. A prosperous competitor is often less dangerous that a desperate one.

It is important that a business understand its added value, that is, the extent to which it enlarges the “pie” from which it extracts its slice of business. The value added by a firm is the magnitude of the pie including the firm, less the value of the pie with the firm excluded. Game theory can help to establish the value added. Understanding our added value is important. Nalebuff described situations in which a company enters a business perceiving that large profits are being made and expecting to participate in those profits, without realizing that its own value added is zero and that it could therefore only lose money. Sometimes the value added lies entirely in the threat of competition. In such a case, the trick is to sell the threat without ever competing.

Engaging in price competition may appear an obvious way to gain entry into a market and an obvious way to retain market share. Nalebuff described a number of “hidden costs” of price competition. He went on to discuss competitive strategies that not only do not involve cutting prices but make it less likely that competitors will cut prices.

Building loyalty, particularly customer loyalty but also supplier loyalty, is a good way to get a large slice of the pie. Nalebuff discussed a number of ways to enhance loyalty, and used examples to illustrate effective and ineffective strategies.

The rules of the game are important. We need to understand how the rules affect the behavior of all of the parties, how the rules can be changed, and who will be in a position to bring about changes. Here “allocentrism,” putting oneself in the position of others, is especially important. Too often we attribute the behavior of other parties to
irrationality, when in fact “irrational” behavior is simply behavior for which we do not understand the rationale.

Turning to tactics, the fourth of the five basic elements of any game, Nalebuff defined them as actions taken to shape other players’ perceptions. Perceptions of the world, regardless of whether they are accurate, drive behavior. He devoted some time to a discussion of the perceptions we would like other parties to have of us. It may even be desirable to lead others to think that we are “irrational.”

Finally, the last of the five elements is scope. Here we consider links between games, together with the opportunities and dangers in those links. Once again, Nalebuff used examples to illustrate both.

He closed with a warning: four mental traps. These are seeing only a part of the game, failing to think methodically about changing the game, believing that success must come at the expense of others, and accepting the game as it is.

Analyst Behavior

29. Leaders, Followers and Rebels: A Classification Scheme for Analysts (Spring 1998)

Ronald Kahn, Director of Research, BARRA, Inc., distributed a paper by himself and Andrew Rudd, Chairman & Chief Executive Officer, BARRA, Inc. entitled: “Modeling Analyst Behavior.”

Kahn’s presentation was in the nature of a progress report on a substantial on-going research project. He began with the process by which the analysts and the CFO (he used the CFO, probably the principal contact of the analyst with the company management, to represent management) interact in a process that leads the analyst to an earning forecast. An interesting question is what incentive an analyst has to do a good job, and the subsidiary question how one defines “a good job.” A good job may entail accurate earnings prediction, accurate predictions of consensus earnings (which some have said are more important than predicting actual earnings), or being first to revise an earnings forecast, and there may be other activities.

The discussion of incentives led to how the “All-Americans” are chosen. The criteria are apparently earnings estimates, written reports, industry knowledge, accessibility and responsiveness, and useful and timely calls.

On the other hand, what are the CFO’s incentives? The primary incentive is probably to market the company. There is little to be gained by exaggerating expectations, and something to be gained by consistently slightly outperforming analysts’ forecasts. The natural inclination of the CFO will be to smooth earnings into a steady growth pattern, and the CFO has plenty of opportunity to manage earnings within limits.

In the interchange between the CFO and the analyst, the CFO knows more about the company than anyone else. No analyst has the time or knowledge to outsmart the CFO. At the same time, since the analyst covers many similar companies he or she may have a breadth of perspective that the CFO does not have. The analysts does bring a unique skill to the interchange of information and judgment.

Kahn offered a simple model of an analyst’s forecasts as: $CFO = a \times signal + b \times noise$. He expected that the consensus would mirror the CFO forecast. An active forecast by an analyst would differ
from the consensus by \( a \times \text{signal} + b \times \text{noise} \). Analyst behavior would divide analysts into independent and dependent, with the independent further subdivided into leaders and rebels. The leaders would be the opinion setters, the first to change forecasts, and \( a \) would be > 0. For the rebels, or contrarians, \( b \) would be > 0. The dependent analysts, or followers, would tend to have a zero \( a \) and \( b \).

The next question was how to identify leaders. One characteristic of a leader would be an observation that the stock price reacts when the leader changes a forecast. Other criteria by which one might identify leaders have to do with the type of forecasts and the frequency of forecasts.

Kahn has been working with a set of data covering analysts in the UK, Europe, Japan, Latin America, Australia and Africa. Estimates are collected by broker, so far over the period March 1996 through February 1998. Current year estimates are collected at least one month prior to fiscal year end. A measure to identify independent analysts is a score calculated as twice the number of revisions away from the consensus divided by the total number of revisions. Within the group of independent analysts, leaders are those who actually move the consensus. The following statistics were derived:

<table>
<thead>
<tr>
<th>Statistics</th>
<th>UK</th>
<th>Europe</th>
<th>Japan</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td># of analysts*</td>
<td>7668</td>
<td>12808</td>
<td>8037</td>
<td>15110</td>
</tr>
<tr>
<td>Independence:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>0.504</td>
<td>0.495</td>
<td>0.474</td>
<td>0.520</td>
</tr>
<tr>
<td>St. Dev.</td>
<td>0.414</td>
<td>0.431</td>
<td>0.456</td>
<td>0.419</td>
</tr>
<tr>
<td>Mode</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

*Actually this counts all analyst/company pairs

Kahn also presented a table of the independence statistic for major brokers in the UK, Europe, Japan and other countries.

Turning to frequency of revisions as a measure of independence, Kahn expected analysts who revise more frequently to be more independent, hence:

\[
\text{Independence} = a + b \times \text{Revisions/year}
\]

He also expected average independence per company to decrease as analysts are added:

\[
\text{Independence} = c + d \times \text{analysts/company}
\]

He would expect \( b \) to be positive and significant, and \( d \) to be negative and significant. The regression results follow:

<table>
<thead>
<tr>
<th>Region</th>
<th>( b )</th>
<th>(t-b)</th>
<th>( d )</th>
<th>(t-d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK</td>
<td>0.098</td>
<td>(25.2)</td>
<td>-0.0046</td>
<td>(-4.7)</td>
</tr>
<tr>
<td>Europe</td>
<td>0.110</td>
<td>(34.6)</td>
<td>-0.0044</td>
<td>(-5.8)</td>
</tr>
<tr>
<td>Japan</td>
<td>0.113</td>
<td>(25.8)</td>
<td>-0.0037</td>
<td>(-2.4)</td>
</tr>
<tr>
<td>Other</td>
<td>0.065</td>
<td>(30.6)</td>
<td>0.0010</td>
<td>1.6</td>
</tr>
</tbody>
</table>

Kahn continued with a discussion of other factors influencing leadership, and the characteristics of the "All-American" analysts, and concluded with a brief review of some of the existing literature on the subject.
Asset Allocation

30. Duration Dependence in Stock Prices: An Analysis of Bull and Bear Markets (Fall 2000)

Allan Timmerman, Department of Economics, University of California at San Diego, distributed a paper by himself and Asger Lunde entitled: "Duration Dependence in Stock Prices: An Analysis of Bull and Bear Markets."

Timmerman observed that although we encounter constant references to bull and bear markets we are generally lacking in definitions that are useful in helping us toward a conditional distribution of future price movements. He suggested a good general definition is that given by Sperandeo: a bull market is a long-term upward price movement characterized by a series of higher intermediate highs interrupted by a series of higher intermediate lows, and a bear market is a long-term down trend characterized by lower intermediate lows interrupted by lower intermediate highs. Timmerman offered something rather more specific. A full data sample through time is partitioned into exclusively and exhaustively bull and bear market subsets. The switch from a bull to a bear market takes place when the market declines by a specified percent from its previous local peak, and a bear market turns to a bull market when the market rises a specified percentage from its previous local trough. The market here is represented by a daily index of real stock prices (the nominal stock price is divided by the consumer price index). For the work presented by Timmerman the triggering percentage was generally 15%, although using 10% or 20% does not apparently have much effect on the results. A trigger of 15% produces enough switches between bull and bear markets to make quantitative analysis feasible. Using 20% leads to a perhaps unsatisfactory small number of switches. The triggering process means that for much of the time we do not know whether we are in a bull or a bear market.

The series analyzed made use of daily stock prices in the U.S. from February 17, 1885 to December 31, 1997. For the periods up to February 7, 1962 a stock price index from Schwert was used, and from that date to the end of 1997 the S&P 500 Index was used.

Volatility clustering caused some problems. In periods of high volatility there are likely to be rapid switches between bull and bear markets as defined above, and indeed the length of some of these markets can become much too short to be of any significance. Hence the authors turned to a component ARCH model to construct a new price index adjusted for short-run autocorrelation and ARCH effects in volatility and drift. The end result for bull markets was a mean duration of sixty-eight weeks, with a median of fifty weeks, a minimum length of ten weeks and a maximum of three hundred fifty-four weeks. For bear markets the mean duration was forty-one weeks with a median of thirty-six and one-half weeks, a minimum of seven weeks and a maximum of ninety-nine weeks. Overall, the stock market spent roughly two-thirds of the time in the bull state and one-third in the bear state. Mean returns are 2.6% and -3.3% per week in bull and bear markets. Median returns are 0.7% and -1.2% per week. Although bear periods are much shorter than bull periods, the downward drift in bear markets is stronger than the upward drift during bull markets. The random walk model does not capture the basic properties of the stock price data.

The focus of the study is on duration of bull and bear markets, and Timmerman introduced what he called the discrete hazard function.
• The indicator, \( I_n \), defines a random variable, \( T \), measuring the duration of bull or bear markets.

• Measurement of \( T \) is divided into \( A \) intervals: \([a_0, a_1), [a_1, a_2), \ldots, [a_{q-1}, a_q), [a_q, \infty)\), \( q = A-1 \).

• The durations are characterized by the discrete hazard function
\[
\lambda_i(t|X_{it}) = P(T_i = t|T_i \geq t, X_{it}) \quad t = 1, \ldots, A,
\]
\( X_{it} = \{x_{it1}, \ldots, x_{itin}\} \) are variables, affecting the hazard rate.

• Hazard models take the form:
\[
\lambda_i(t|X_{it}) = F(x_{it}\beta) = \frac{\exp(x_{it}\beta)}{1 + \exp(x_{it}\beta)}.
\]

• Discrete survivor function: Probability that a bull or bear market survives beyond
\[
[a_{i-1}, a_i]: S_i(t|X_{it}) = P(T_i > t|X_{it})
\]
\[
= \prod_{t=1}^{A} (1 - \lambda_i(t|X_{it})), t = 1, \ldots, A,
\]

Timmerman demonstrated the estimation of unconditional hazard rates of bull and bear market durations and then moved to conditional models, controlling for interest rate and interest rate change effects. Once interest rates are included, for bull markets the baseline hazard drops sharply from 6% to 2% per week. Young bull markets are substantially more at risk of termination than bull markets that have lasted for about six months. After forty weeks the hazard rate remains fairly constant at about 1% per week. Interest rate levels are mostly positively correlated with bull market hazard rates. That is, as interest rates rise the end of a bull market becomes more likely, something that seems intuitively reasonable.

For bear markets the baseline hazard drops but later rises, so that the plot of hazard rate against weeks of bear market takes roughly the shape of a U. Interest rate changes are negatively correlated with hazard rate. Not surprisingly, a decline in interest rates portends the end of a bear market.

Summarizing his results, Timmerman observed that the longer a bull market has lasted, the lower is the probability of termination. This clearly contradicts some of the conventional wisdom to the effect that some sort of mean reversion should be at work. In contrast, the longer a bear market the higher its termination probability, once the bottom of the U has been reached. Further, interest rates have an important effect on hazard rates: increasing interest rates are associated with an increase in bull market hazard rates and decreasing rates in bear market hazard rates.

31. Strategic Asset Allocation: Portfolio Choices for Long-Term Investors (Spring 2000)

John Y. Campbell, Otto Eckstein Professor of Applied Economics, Harvard University and Arrowstreet Capital, LP, distributed a paper entitled: “Who Should Buy Long-Term Bonds?” He began his presentation with a quick review of modern finance theory with respect to portfolio choice, and observed that what we find in practice is asset allocation that differs significantly from what the theorists have told us. Taking the perspective of the investor, individual or institution, that ultimately consumes the product of the investment, he said that this investor is likely to be more concerned with the level of consumption (or spending) than with the level of wealth per se. His analysis would focus on three broad asset classes: cash, bonds and stocks. The bonds would be dividend into those that are inflation protected and those that are not.

The classic portfolio model of Markowitz and Tobin makes use of
mean variance optimization, and recommends a single appropriate bond/stock portfolio for all investors with risk adjustment taking the form of an allocation to cash. Given the history of bond returns and variances and the very poor Sharpe ratio for bonds as compared to stocks, it is hard to understand why bonds should play a significant role in an efficient portfolio. Yet bonds are clearly a substantial component of many portfolios, especially those of long-term conservative investors. Perhaps, then, the theory is more appropriate for short-run than for long-run investors. One problem with it is that the assumed conditions may not be realistic. Campbell observed that risk aversion seems to be much greater than one. Investment opportunities seem to vary over time, particularly with respect to real interest rates and risk premia. Labor income is important for many investors.

All of this brings us back to the question of demand for bonds. Bond returns are random because interest rates vary. Some of this variation is in expected inflation and some in real interest rates. Bond demand therefore can only be understood using an intertemporal model. The model proposed by Campbell is an affine term-structure model. There are two correlated factors, real and nominal. We assume log normality and constant variances. We imagine an investor with infinite life, appropriate for charitable and educational endowments, and not a bad approximation for some individuals investing for retirement. We use the Epstein-Zin utility function and we choose optimal bond and stock portfolios. The utility function is appropriate because it treats risk aversion as independent of scale. That is, risk aversion is not related to wealth. The elasticity of intertemporal substitution (deferring consumption to invest when interest rates are apparently high) is separated from the coefficient of risk aversion. The characteristics of the real term structure model are:

- Real investment opportunities are described by a state variable $x_t$.
- $x_t$ follows an AR(1) process with persistence $\Phi_x$, normally distributed with constant variance.
- The one-period log real interest rate is $x_t$ adjusted by a constant.
- Longer-term log real bond yields are linear in $x_t$: $Y_m = A_n + B_n x_t$.
- Term premia on real bonds are constant through time. A parameter $\beta_{ms}$ determines their magnitude, and hence the slope of the real yield curve.

For the nominal term structure model:

- Inflation $\pi_{t+1}$ is the sum of expected inflation $z_t$ and a shock $\nu_{t+1}$.
- $z_t$ follows an AR(1) process with persistence $\Phi_z$, normally distributed with constant variance.
- The one-period log nominal interest rate is $x_t + z_t$ adjusted by a constant.
- Longer term log nominal bond yields are linear in $x_t$ and $z_t$.
- Term premia on nominal bonds are constant through time. Their magnitude is determined by the term premia on real bonds, and the risk premia for inflation shocks.
- Stocks can also be introduced. The equity premium is assumed constant.

Campbell set out the utility maximization problem, the optimal portfolio choice, and the solution. An immediate interesting conclusion is
identification of the riskless asset. For a one-period investor, a one-period indexed bill is riskless. For an n-period investor, an n-period indexed bond is riskless. For an infinitely lived investor, an indexed perpetuity provides a known consumption stream and in this sense is riskless. Under circumstances such that the future inflation risk is believed to be minimal, long-term bonds that are not indexed may seem almost as attractive as indexed bonds. We should then expect to find substantial use of long-term indexed bonds (when available) when inflation risk appears high, and long-term non-indexed bonds when inflation risk is low. We are beginning now to see an explanation for the popularity of long-term bonds especially in long-term conservative portfolios. Indeed, Campbell suggested that for some investors, in the usual graph of efficient portfolios the spot we normally identify with bonds, at the lower end of the optimal curve, should be associated with bills, while the point on the tangent to the curve normally identified as the risk free rate should be identified with long-term indexed bonds.

Campbell displayed diagrams showing indicated asset allocation among equities, long bonds, and short bonds, for long-term and for short-term investors, over a range of risk tolerances. The diagrams were significantly different depending upon whether the data were gathered from the period from 1952 – 1982, when inflation posed significant risks, and 1983 – 1996 when inflation appeared much less threatening. The latter diagrams appeared consistent with the asset allocations that investment advisors are recommending.

Campbell's' conclusions were:

- An infinitely lived, infinitely risk-averse investor who is infinitely unwilling to substitute intertemporally should hold a bond portfolio that is equivalent to an indexed perpetuity. In this sense long-term indexed coupon bonds, not short-term bills, are riskless for long-term investors.

- Optimal bond portfolios and investor welfare can be very different when indexed bonds are available. Welfare gains are particularly large for conservative investors. Short-horizon analysis understates the importance of indexation.

- The asset allocation puzzle can be solved if investors have long horizons, bonds are indexed (or inflation uncertainty is low as estimated in the U.S. in 1983-96), and short-sales and borrowing are constrained.

32. Modeling Stock Market Returns: An Error Correction Model (Spring 1999)

Hélène Harasty, Quantitative Analyst, Lombard Odier & Cie., Geneva, presented a paper entitled: "Modeling Stock Market Returns: An Error Correction Model," by herself and by Jacques Roulet, Head of Quantitative Unit, Lombard Odier & Cie., Geneva. The presentation was given by Harasty, who began by describing the purpose of the work. First, there was a desire to understand and forecast stock market returns and the level of the market. A further purpose was to provide objective factors upon which asset allocation decisions could be based. Providing support to portfolio managers in investment decisions and facilitating communication with clients was a further objective. The model had to be simple and clear enough to serve these
purposes, but also sophisticated enough to provide genuine predictive value.

The starting point was the traditional dividend discount model. This is a model based on economic theory, but it employs assumptions that are far from justified and it has low forecasting ability. From the DDM beginning, the authors had developed an econometric model to identify stable relationships between the market and the variables that drive it, with a solid economic grounding. The theory behind the model is that in the long run the DDM is valid, and that the "fair value" of a stock market depends upon earnings and interest rates. At the same time, in the short run, the market value will deviate above and below this fair value. The short run market performance was fitted empirically with a reversion factor working to bring the market back to fair value, a dynamic adjustment to the fair value itself, and a variety of additional variables (not the same for all markets) having a transitory but significant impact on the market.

For the long run equilibrium, that is for the fair value, the model is: \( \log(P_t) = a + b \log(\text{EPS}_t) + c \, r_t + e_t \), where \( P_t \) is the market price, \( a, b, \) and \( c \) are coefficients, \( \text{EPS}_t \) is the 12-month forward earnings estimate, and \( r_t \) is the 10-year risk-free interest rate. Consistency with the DDM suggests that the coefficient \( b \) should be close to 1, and indeed for the major stock markets it was 0.90 or greater and for the U.S. it turned out to be 0.99. In at least one respect the model is unfortunate in that it does not reproduce the non-linear effect of interest rates on stock prices. This defect, however, has the benefit of making the coefficient \( c \) the semi-elasticity of the market price to interest rates. Fitting the model to monthly data for 1981 through 1998 for the U.S., gave the following results:

\[
\log(\text{S&P500}) = 3.4 + 0.99*\log(\text{EPS}) - 8.83 \times 10 \text{ year-rate.}
\]

The simple interpretation is that a 10% increase in the 12-month forward earnings per share leads to a 10% increase in the market price, and a 100 basis point increase in the 10-year interest rate leads to an 8.8% decrease in the market price.

The choice of variables must rest on the expectation of stable, long-run, relationships between the price series and the earnings series and between the price series and the interest rate series. The test of "co-integration" as described in the paper, and discussed briefly by Harasty, was applied to verify that their choice of variables indeed passed the test.

The model described above determines the fair value of the market value. The second model deals with the short-run dynamics, explaining deviations from the fair value. This model is: \( \Delta p_t = \alpha (L) \Delta x_t + \theta (L) \Delta p_{t-1} - \beta (p_{t-1} - \alpha x_{t-1}) + \gamma (L) \Delta z_t \), where \( x_t \) is a vector of EPS and the risk-free rate, the basis for the fair value, \( L \) indicates lags, \( \theta \) is the coefficient of price momentum, \( \beta \) is the coefficient of reversion, and \( \gamma \) is the coefficient of a set of additional factors \( z_t \) that modify the risk premium in the short run. These can include short interest rates, spreads, the value of the dollar, oil prices, and other parameters that are found to be useful.

The models were applied to 17 stock markets (not including Japan, for which they did not seem to work at all). Data were monthly, for 1981-98 for the U.S., for the late 1980s to 1998 for large European markets, and from the early 1990s to 1998 for smaller European markets.
Harasty showed a chart of the fair value and the actual level of the S&P 500 Index, the EPS and the 10-year yield, and discussed deviations from 1960 through 1999 of the actual Index from its fair value in the context of interest rate and EPS changes. She pointed out that there were substantial time periods, particularly in the 1970s, when the actual Index deviated significantly from fair value. So that while the coefficients indicated that on average the deviation from fair value is reduced by 10% each month, investors may wait for a matter of years before the Index line crosses the fair value line. She also presented some recent statistics, suggesting that the S&P 500 was about 25% above fair value at the end of July 1998, fell to only 4% above fair value in October of the same year, but was back up more than 30% above fair value in January and February 1999. As of February 1999, there was a considerable range of over- and undervaluation in the indexes for European markets. For Germany, for example, the index was 10% undervalued while for The Netherlands it was 17% overvalued.

The combination of the models, and particularly the short-run model, are useful in converting analysts forecasts of underlying parameters into a market forecast. Harasty showed for a European index of five countries, and for the S&P 500, forecasts out to the year 2000 reflecting consensus and firm forecasts of interest rates and EPS.

33. Asset/Liability and Pension Plans (Fall 1996)

Michael Peskin, Principal, Morgan Stanley & Co., Inc. distributed a paper entitled: “Asset Allocation and Funding Policy for Corporate Sponsored Defined Benefit Pension Plans Under U.S. Tax Rules.” His theme was that funding policy and investment policy for a pension fund must be determined jointly. The economic cost of a pension plan is the present value of future contributions less the value of the corporation’s call on the revertible surplus from the plan. The future stream of contributions can be considered equivalent to unsecured debt, because those contributions must be paid only if the company remains solvent. What is particularly important is that the present value of contributions is an asymmetric function of funded status. That is, each additional dollar added to surplus saves the company less in terms of present value of contributions.

Minimizing the present value of future contributions can be achieved in five ways. First, designing the assets to move in tandem with the liabilities reduces cost because of the asymmetric payoff. Second, one of the ways of achieving the synchronization is to increase the dollar duration of the fixed income portion of the portfolio. Liabilities, like long duration bonds, are extremely interest sensitive. Peskin demonstrated the use of a stochastic simulation model to determine for a particular pension fund with a particular equity exposure the optimal duration.

Third, optimizing equity exposure can make a significant difference. Peskin’s work had uncovered plans where the optimal equity exposure was less than 30% and others where the optimum was approximately 90%. And again he showed the use of stochastic simulations to identify the optimal exposure. When liabilities look least like bonds, it turns out that adding equity exposure increases returns more than it increases risk. This would be the case, for example, where the liabilities consist primarily of final pay active liabilities, rather than retiree liabilities. The optimal equity exposure also depends on the value to the corporation of surplus and upon the funded status of the plan. Poorly funded plans and well funded plans lead to higher optimal equity
exposures than do moderately funded plans. Finally, the higher the equity risk premium, the higher the optimal equity exposure. However, the equity premium is considerably less important in Peskin’s framework of analysis than in a return-variance framework.

The fourth source of savings comes from selection of an appropriate rule for rebalancing the portfolio’s optimal asset allocation. The rebalancing rule is based upon the sensitivity of the optimal asset allocation to each of the previously described factors influencing equity exposure.

Finally, funding policy is important. Over-funding a plan uses up valuable capital that probably cannot be recovered. Under-funding fails to take advantage of the tax arbitrage that is available through the tax-free buildup of the pension trust.

Peskin’s conclusion was that corporations can usually reduce the present value of future contributions to their defined benefit pension plans by more than 20%. And the risks associated with the corporation’s cost of contributions can be reduced by a similar magnitude.


Thomas K. Philips, Managing Director at Rogers, Casey & Associates distributed a paper by himself, Greg T. Rogers and Robert E. Capaldi, respectively Director and Associate Director of Rogers Casey and Associates, entitled: "Tactical Asset Allocation: 1977 - 1994." He began his presentation by defining tactical asset allocation (TAA) as systematic, risk controlled market timing with the emphasis on systematic and risk controlled. Managers are normally working from a passive benchmark (for example over weighting plus or minus 20%). Institutions are currently committing about 49 billion dollars to TAA managers.

Over the period 1980 through 1994 the opportunities for successful TAA were substantial. Perfect quarterly forecasts of the stock and bond markets would have almost doubled the average returns on a 60:40 portfolio. And perfect monthly forecasts would have almost tripled them, all with relatively constant variability of returns. Philips observed that the TAA manager must rely on time diversification because no asset diversification is possible.


The performance study reported by Philips covered eleven managers with close to 95% of total institutional TAA assets. Two subperiods were examined: from the inception of the TAA program to 12/87 and from 1/88 through 9/94. And the results of the study highlighted the different results for these two sub periods. Three statistical tests were performed. The first made use of manager’s excess returns over a benchmark. Each manager was measured against a benchmark specific to its mandate. The benchmark varied from manager to manager, but ranged from 50 to 65% in equities, 20 to 50% in bonds and 0 to 45% in cash. In each case the benchmark was a passive portfolio. The following table shows the value added for the two time periods for 11 (unidentified) managers.
Table 1: Value Added by TAA Managers Relative to Their Benchmarks, Net of Fees

<table>
<thead>
<tr>
<th>Manager</th>
<th>Value Added From Inception to 12/87 (Per Annum)</th>
<th>Value Added From 1/88 to 9/94 (Per Annum)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>+250 bp</td>
<td>-54 bp</td>
</tr>
<tr>
<td>B</td>
<td>+110 bp</td>
<td>+17 bp</td>
</tr>
<tr>
<td>C</td>
<td>+415 bp</td>
<td>-165 bp</td>
</tr>
<tr>
<td>D</td>
<td>*</td>
<td>-41 bp</td>
</tr>
<tr>
<td>E</td>
<td>*</td>
<td>+275 bp</td>
</tr>
<tr>
<td>F</td>
<td>+734 bp</td>
<td>+20 bp</td>
</tr>
<tr>
<td>G</td>
<td>+323 bp</td>
<td>-1 bp</td>
</tr>
<tr>
<td>H</td>
<td>+388 bp</td>
<td>-40 bp</td>
</tr>
<tr>
<td>I</td>
<td>+262 bp</td>
<td>-137 bp</td>
</tr>
<tr>
<td>J</td>
<td>+367 bp</td>
<td>+46 bp</td>
</tr>
<tr>
<td>K</td>
<td>+686 bp</td>
<td>+11 bp</td>
</tr>
</tbody>
</table>

* Did not manage money prior to 12/88

The sequence of excess returns, and the information ratio (the ratio of the excess return to the tracking error) were plotted and the graphs examined to see how managers had performed through time.

The second statistical analysis was a Henriksson Merton Test. The parameters in this test were estimated using the following regression:

\[ I_{t-1} = \alpha_0 + \alpha_1 y_t + \epsilon_t \]

where \( I_{t-1} \) is 1 if the manager forecasts that stocks will outperform bonds in month \( t \), and 0 otherwise; \( \alpha_1 \) is an estimate of \( p_1 + p_2 - 1 \), where \( p_1 \) is the probability that a manager's forecast is right, conditioned on stocks outperforming bonds in the subsequent month and \( p_2 \) is the probability that the manager's forecast is right, conditioned on stocks underperforming bonds in the subsequent month; and \( \epsilon_t \) is the error term in the regression. To test if the manager has timing skills, we perform a one tailed test of the hypothesis \( \alpha_1 > 0 \).

The following table shows the results:

Table 2: Results of a Henriksson Merton test for timing ability

<table>
<thead>
<tr>
<th>Manager</th>
<th>Inception to 12/87</th>
<th>1/88 to 9/94</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>B</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>C</td>
<td>1.241/.993</td>
<td>0.957/.286</td>
</tr>
<tr>
<td>D</td>
<td>*</td>
<td>0.801/.045</td>
</tr>
<tr>
<td>E</td>
<td>*</td>
<td>1.142/.880</td>
</tr>
<tr>
<td>F</td>
<td>**</td>
<td>**</td>
</tr>
</tbody>
</table>
returns in month t; \( t_{i-1} \) is 1 if the manager forecasts that stocks will outperform bonds in month t, and 0 otherwise; and \( \mu_i \) is the error term in the regression. To test if the manager has timing skills, we perform a one tailed test of the hypothesis \( \beta_i > 0 \). Once again, this is automatically done as part of the regression, and any error made by an assumption of normality is minuscule.

The results are shown below:

Table 3: Results of a Cumby Modest test for timing ability

<table>
<thead>
<tr>
<th>Manager</th>
<th>Inception to 12/87</th>
<th>1/88 to 9/94</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>B</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>C</td>
<td>2.29/.968</td>
<td>-0.558/.322</td>
</tr>
<tr>
<td>D</td>
<td>*</td>
<td>-1.427/.035</td>
</tr>
<tr>
<td>E</td>
<td>*</td>
<td>0.474/.665</td>
</tr>
<tr>
<td>F</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>G</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>H</td>
<td>3.897/.999</td>
<td>-.535/.227</td>
</tr>
<tr>
<td>I</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>J</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>K</td>
<td>3.21/.803</td>
<td>-1.295/.034</td>
</tr>
</tbody>
</table>

* Did not manage money prior to 12/88
** Explicit forecasts unavailable

The tables and the graphs (not shown here) all show that managers did extremely well during the first time period and with one exception (Manager E) performed in poor or mediocre fashion during the second period. The question then was why this shift in quality of performance. Philips showed that the value of perfect foresight substantially declined from the first to the second time period. The correlation between equity and fixed income
markets increased from about 0.2 before the 1987 crash to about 0.6 after the crash, allowing TAA fewer opportunities to add value. In addition, volatility declined substantially (from 17% to 12% for stocks and from 6% to 4% for bonds), exacerbating this problem. In sum, the opportunity to add value declined substantially. The unanswered question was whether this decline in opportunity for TAA is likely to persist.

In closing, the recommendations Philips offered were these:

- Do not commit additional assets to a TAA program at the present time.
- Limit TAA programs that are underway to less than 20% of assets.
- Benefit from professional TAA management as an alternative to ad hoc timing by an investment committee.
- Use passive management for the assets underlying a TAA program.
- Use a futures overlay for a TAA program, rather than incurring the transaction costs of actually shifting between stocks and bonds.

35. Tactical Asset Allocation Panel Discussion (Spring 1996)

The panel discussion consisted essentially of responses by TAA managers to the paper presented by Philips. William L. Fouse, Chairman of the Executive Committee Mellon Capital Management, introduced the other participants. The first speaker was Donald Young, Managing Director, Chancellor Capital Management. He described tactical asset allocation (TAA) as an option, with an expected value equal to the product of the opportunity to add value and the percent capturability. The fair value (that is the opportunity) of the option depends on the standard deviation of each asset class, correlations among asset classes, the yield on cash, and the time to expiration. He used volatility in the change in industrial production as the measure of stock volatility and inflation volatility as the measure of bond volatility, justifying the choice with tests of correlation. Opportunity for TAA turned out to be about twice as high in periods of high volatility in inflation and industrial production growth than in periods of low volatility for each. His conclusion was that lackluster results would continue under four conditions: low industrial production growth volatility, low inflation volatility, low predictive ability on the part of managers, and high implementation efficiencies. He did not think that the conditions for such a poor TAA environment were likely to be met, and even if they are, he concluded TAA managers should be able to add modest value.

The second speaker on the panel was Charles J. Jacklin, Director Asset Allocation Strategies, Mellon Capital Management. He believes it is wrong to lump together all of the TAA managers in drawing the comparison Philips had shown. Statistics as of the end of 1995 show for 29 such managers a very wide range of allocation among stocks, bonds, cash and other domestic assets. It appeared that 1988-1989 had been an especially poor period for TAA, and he therefore believed the 1988-1994 period (that is the second sub-period shown in the Philips' analysis) was not representative of TAA performances. During that period, Mellon Capital Management had produced an alpha of .6%. And for the most recent 3, 5, and 7 year periods the alpha had been 1.6%, 1.9%, and 1.3%. He also felt that the risk reduction results of TAA were important and had not been recognized in the Philips paper. Finally, while TAA models had generally made use of stocks and bonds in the early years, cash was introduced in the mid 1980s and the low return on cash may have hurt the performance of TAA managers.
Robert D. Arnott, President & CEO, First Quadrant Corporation, began by pointing out the conflict between the successful corporate culture and the policies of the successful investor. The corporation rewards success (that is past results) and punishes failure. The successful investor, on the other hand, pares back recent winners and favors recently disappointing markets. The portfolio manager is subject to a hierarchy of pressures from corporate management, making it more difficult to follow the prescription for investment success. TAA may provide a useful reaction to the pressures. In assessing the results of TAA managers, he commented that the strategy tends to produce fairly steady total returns rather than to produce a steady alpha.

In examining the conditions under which TAA adds value, his conclusions were similar to those of Philips. The value added is greatest in weak and turbulent markets. This makes it particularly important that the TAA client be a long-term patient investor. And he distinguished the kind of investors for whom TAA is appropriate and those for whom it is not.

In addition to lack of investor patience, he identified among the risks in tactical asset allocation the possibility of disappearing inefficiencies necessary to make the process work, and changing equilibria. All active management must depend on inefficiency in markets. And wide exploitation of market inefficiencies will tend to reduce them. However contrarian strategies tend to persist because they are inherently uncomfortable.

Perhaps his most important conclusion, and one in which Philips concurred, was that professional TAA is superior to ad hoc timing on the part of investment committees. And if there is a serious risk of the latter, that alone may present a strong argument for professional TAA. His most significant criticism of the Philips paper was directed to the suggestion in that paper that someone might in effect attempt to time the use of TAA. Since the returns to TAA do appear episodic, with opportunities arising and disappearing, the ability to forecast these episodes would clearly be valuable. But if the use of TAA is questionable, than attempting to time its usefulness is probably even more questionable.

Bonds

36. Testing Proposed Solutions to the Muni Puzzle: Evidence From Municipal Bonds That Are Secured By U.S. Treasury Obligations (Fall 1997)

John M. R. Chalmers, Assistant Professor of Finance, Lundquist College of Business, University of Oregon, distributed two papers, one entitled: “Systematic Risk and the Relations Between Tax-Exempt and Taxable Yields” and one entitled: “Default Risk Cannot Explain the Muni Puzzle: Evidence from Municipal Bonds That Are Secured By U.S. Treasury Obligations.” His starting point was the question: How do taxes affect asset prices? It appeared that municipal securities provide a natural experiment with differential taxation. It turns out, however, that it is very difficult to explain the difference in yields between Munis and U. S. Government bonds solely in terms of the tax-exempt feature of the Munis.

One might expect the yield on Munipar bonds with maturity $T$, $y_{mp}(T)$ to be equal to $(1 - t) \times$ the yield on governments with the same maturity, $y_g(T)$. Given observed yields, we can
calculate the implied tax rate \( t = 1 - \frac{y_m(T)}{y_c(T)} \).

What we discover is that the implied tax rate declines with the maturity \( T \). For example, Chalmers showed a graph indicating an implied tax rate of about 34% for a 1-year maturity and an implied rate of about 15% for a 20-year maturity. The downward trend in the implied tax rate is quite persistent, for year after year of observations.

Two explanations have been offered for this puzzle: differential default risk and differences in standard call provisions. It is true that in general Munis do have more default risk than U. S. Treasuries, and it is also true that a number of Munis have call provisions that U. S. Treasuries do not have. Chalmers had therefore prepared a data set of pre-refunded municipal par bond yields. The pre-refunded Munis, because they are essentially defeased by U. S. Government bonds and are non-callable, present no differential default risk and no differences in call provisions from U. S. Treasuries. An analysis of the data made clear that neither default risk nor call provisions could explain the decline in the implied tax rate with maturity.

A third possible explanation is differential systematic risk. This hypothesis requires that long-term Munis must bear significantly higher levels of systematic risk than long-term Treasuries, and short-term Munis must exhibit similar levels of systematic risk to short-term Treasuries. Chalmers' testing provided no evidence that the Muni portfolios of any maturity expose investors to greater overall risk than do comparable maturity U. S. Treasury portfolios. The results seemed odd given that the average duration of the bonds comprising the Muni portfolios was greater for every maturity portfolio than the average pre-tax duration of the Treasury portfolios. However, calculating the durations of the Treasuries on the basis of after-tax coupons indicated that the "tax-adjusted" duration for the Treasuries was very close to the duration of the Munis. Chalmers followed the standard deviation and duration tests with market-model beta estimates, using the monthly returns from the value weighted N.Y. Stock Exchange Index. The null hypothesis that systematic risk is equal for the Treasury and Muni maturity portfolios could not be rejected.

Chalmers went further, in substituting a combination of returns on stocks, returns on government bonds and returns on Munis for the N.Y. Stock Exchange Index returns and repeated his market model regressions. The differences of the total market betas for the Treasury and Muni maturity portfolios were very close to zero. There seemed to be no evidence to support the hypothesis that municipal bonds of increasing maturity bear an increasingly disparate level of systematic risk relative to taxable Treasuries.

His conclusion at this point was: long-term municipal bonds often sell at what appears to be a substantial yield premium to the after-tax yields available from taxable bonds. This premium does not appear to be due to default risk, systematic risk, or differences in the call provisions attached to long-term bonds. What remains to be investigated includes: the possibility of significant liquidity differences between the markets (although Chalmers believes the yield spread differences are too large to be explained by liquidity differences), the possible effect of the option the U. S. Government has to extinguish the tax exemption for municipal securities, tax-timing options that are available for Treasuries and not for Munis, and clientele (or "preferred habitat") effects.
37. Modeling Term Structures of Interest Rates with Multifactor Models (Fall 1997)

Kenneth Singleton, C. O. G. Miller Distinguished Professor of Finance, Graduate School of Business, Stanford University, distributed a paper by himself and Quing Dai entitled: “Specification Analysis of Affine Term Structure Models.” He began his presentation with an introduction to “affine” models for the determination of the term structure of interest rates. These are attractive models chiefly because they accommodate stochastic volatility while preserving analytic tractability. Two approaches to developing affine models have been pursued: $AY$ and $Ar$ models.

In the $AY$ model, the instantaneous short rate is a linear function of an unobserved state vector $Y$:

$$r(t) = \delta_0 + \sum_{i=1}^{N} \delta_i Y_i(t) = \delta_0 + \delta'_Y Y(t).$$

A well known example is the case of independent square root diffusions:

$$dY_i(t) = \kappa_{Y_i}(\theta_Y - Y_i(t))dt + \sigma_{Y_i} \sqrt{Y_i(t)}dW_i(t),$$

$$dY_N(t) = \kappa_N(\theta_N - Y_N(t))dt + \sigma_N \sqrt{Y_N(t)}dW_N(t),$$

where the Brownian motions $dW_i$ are independent. This is the “CIR” model. The model is rooted in the risk management literature where researchers have found it convenient to decompose term structure movements into “level”, “slope”, and “curvature” factors. The unobserved $Y$s are the dynamic counterparts to these factors.

In the $Ar$ model, the instantaneous short rate $r$ is itself a state variable that follows an affine diffusion:

$$dr(t) = \kappa_r(\theta_r(t) - r(t))dt + \sigma_r(t)dB_r(t).$$

Where $\theta_r(t)$ and $\sigma_r(t)$ are stochastic processes.

A widely studied example is:

$$dr(t) = \kappa(\theta(t) - r(t))dt + \sqrt{\nu(t)}dB_r(t),$$

$$d\theta(t) = \nu(\bar{\theta} - \theta(t))dt + \sqrt{\alpha + \nu^2(t)}dB_\theta(t)$$

$$d\nu(t) = \mu(\bar{\nu} - \nu(t))dt + \sqrt{\eta^2 \nu(t)}dB_\nu(t),$$

where $dB_r$, $dB_\theta$, and $dB_\nu$ are independent. In this formulation, $\theta(t)$ is the stochastic long-run mean and $\nu(t)$ is the stochastic volatility of $r$.

Singleton started by showing that, if one has $N$ risk factors, then there are $N+1$ different families of affine models. The families are distinguished by their assumptions about volatilities. A three-factor, CIR-style $AY$ model (the $Y$s follow square-root diffusions) and the three-factor $Ar$ model described above are examples of two of the four possible formulations of three-factor models. Moreover, he showed that each of these examples imposes potentially strong restriction on the implied term structure dynamics that are not necessary to have a well-defined term structure model. For instance, he argued that it is not necessary to assume that the state variables are independent in multi-factor models in which the risk factors follow square-root diffusions.

To illustrate this point, the preceding three-factor $Ar$ model with stochastic mean and volatility of $r$ was examined empirically. The data used were yields on six-month LIBOR and two- and ten-year fixed-for-variable rate swap yields. All three yields were used simultaneously in estimating the model in order to test the model-implied restrictions on the joint distribution of short and long-term rates.

The estimation strategy used was “simulated method of moments.” We compute a set of sample moments of functions of current and past swap yields (means, covariances, auto correlations, kurtosis, etc.). Then, for a conjectured set of parameter values for the model, yields are simulated and the corresponding
sample moments for the simulated data are computed. These moments are compared to those for the historical sample. Then the parameters of the model are adjusted until the two sets of moments (sample and simulated) are as close as possible.

Singleton first estimated a model in which the “shocks” to \( r \) and its long-run mean \( \theta(t) \) and volatility \( v(t) \) were independent, and found that it could not simultaneously explain the historical changes in the short and long ends of the yield curve. He then examined a model in which \( dB_r \) was allowed to be correlated with \( dB_s \) and with \( dB_r \), and found that the model passed several goodness-of-fit tests for his sample period.

An interpretation of these findings was presented in two steps. First, this \( A_r \) model was shown to be equivalent to a three-factor \( AY \) model in which the second and third risk factors were well proxied by the long-term swap rate and the slope of the swap curve, respectively. Using this equivalence, it was then argued that the assumption of independent shocks in extant \( A_r \) models amounts to assuming that \( r \) is conditionally uncorrelated with the level and slope of the swap curve, which is counter-factual. Another striking implication of the analysis was that the volatility factor \( v \) was well-proxied by the slope of the swap curve. While perhaps surprising at first glance, this result was shown to be a natural implication of the assumptions that the long-run mean \( \theta(t) \) and volatility \( v(t) \) factors are uncorrelated.

38. Conceptual Issues in Pricing Defaultable Bonds and Credit Derivatives (Fall 1997)

Darrell Duffie, Professor of Finance, Graduate School of Business Stanford University, distributed a paper by himself and Kenneth J. Singleton entitled: "Modeling Term Structures of Defaultable Bonds." The paper describes the theory underlying his presentation.

He began the presentation observing that he and his co-author were interested in how credit risk affects bond prices and how bond prices can give us insights into credit risk. He described an application he and his co-author have been working on. Banks and derivative dealers need to know their credit exposure to the contracts on their books, and he offered as an example a chart from an annual report of Salomon Brothers showing dollar credit exposure for swap and foreign exchange contracts for eight different risk classes. In order to make such a determination, we need derivative valuation models, simulators to produce scenarios of rates and prices, counter-party data bases, and a counter-party default simulator. It was the last of these that was the focus of Duffie's presentation.

There are three principal methods for estimating counter-party default probabilities. The most popular makes use of credit ratings and observed changes in credit ratings. Duffie presented data confirming that the rating agencies appear to be doing a good job and that ratings are highly correlated with probability of default. The second approach is based on the Black-Scholes option model with an assumption that default will occur when assets cease to exceed liabilities. This is a model popular among financial institutions and is commercially available. It is, however, lacking a market value link. Further, we don't know at what relationship between assets and liabilities the issuers will actually choose to default. And the approach is not a good long-term predictor of default. The third approach is based on hazard rates estimated from bond yield spreads, and this was the approach taken by Duffie and his co-author.
A graph of the yield spread for an A issuer over U.S. Treasuries from 1991 through 1994 showed how substantially the spread had come down in recent years. It is clearly important, in using the yield spread at a particular point in time as a measure of credit risk, to keep a historical perspective in mind. A similar lesson could be seen from a graph showing speculative grade default rates from 1970 through 1995. Following the spectacular Penn Central collapse in 1970, default rates were very low until the early 1980s, then rose and rose still further in 1990 and 1991. Knowing that a bond is of speculative grade is not enough to know the default risk, when the state of the economy is clearly important.

The reduced form model posed by Duffie and his co-author is very simple.

\[
(1 - L) \frac{E(V_t + 1)}{1 + r}
\]

The likelihood of default in the first period to come is \( h \). The fractional loss, if there is a default at the end of the first period, is \( L \). \( V_t \) is the value of the bond at time \( t \), simply a weighted average of the expected value at time \( t + 1 \) for the default case and the non-default case. The discount rate \( r \) is the rate for a default-free bond. The default-adjusted short rate is simply \( R = r + hL \). That is, in the case of the bonds subject to default, we substitute the short rate \( R \) for \( r \).

Duffie next introduced some descriptive statistics for defaulted bonds. For example, for senior secured debt, for the period 1/1/70 through 12/31/95, the average price of the defaulted bond was $53.80, the standard deviation was $26.86, the tenth percentile was $18.80 and the ninetieth percentile was $95.00. For junior subordinated debt, the four numbers were $17.09, $10.90, $3.74, and $29.70. In pricing bonds, we need only expected recovery values. However, in pricing derivatives the uncertainty is also important.

So far, it was easy to see that the term structure for defaultable bonds can be arrived at simply by adding \( hL \) to the term structure for default-free bonds. For bonds, it is enough to know \( hL \). But for derivatives we have to separate \( h \) and \( L \). Doing so is not easy. Duffie discussed the use of four kinds of credit derivatives: default swaps, spread based products, total return swaps, and credit-linked notes. In a default swap, one party pays LIBOR plus a spread until default takes place and then the other party pays a fee. A spread based product might be a put option at a particular spread. An example of a total return swap has one party paying the return on a U.S. Treasury and the other paying the return on a speculative corporate bond. A credit-linked note passes credit risk to an investor. The issuer pays an investor LIBOR plus a spread so long as none of the notes defaults. But when the first defaults, the investor takes over the defaulted note and the payments cease.

Duffie went through an example of a yield spread option. The option is a put at a "spread strike." That is, the strike price is the price of the bond at a specified spread over Treasuries. As might be expected, an important parameter in pricing the option is the yield spread volatility. Further, some estimate must be made of the recovery rate ((1 - \( L \)) in our terminology).
Duffie proceeded to describe the Hayne Leland model for estimating the likelihood of default, a model that assumes perfect information, and showed the effect of combining that model with his and his co-author's handling of noisy information (in the form of accounting reports). Comparing the term structures of credit spreads, one with perfect and one with imperfect information, suggested that the latter presents a more realistic picture. Finally, he showed the importance of lagged accounting data in determining credit spreads.


Frank S. Skinner, Director, Academic Programs, ISMA Centre, University of Reading (U.K.), distributed a paper entitled: "Hedging Corporate Bonds: An Evaluation of Alternatives," by himself and Michalis Ioannides.

Skinner described his work as an extension beyond the paper he had presented at the Q Group® Seminar in London in July 1997. In that presentation he described his object as developing and improving methods for hedging interest rate risk for bonds subject to credit risk. A cash asset $B_c$ is hedged with a hedge instrument $B_h$ to arrive at a hedge portfolio $V_h$ as follows: $V_h = B_h - NB_{hr}$, where $N$ is the hedge ratio, that is the ratio of price sensitivities. To date, only treasury and stock index futures contracts have been examined as alternative hedging instruments for corporate bonds. Skinner's challenge was to find a better hedging instrument, one that reduced credit and maturity basis risk, to choose a better hedge ratio, one that models both credit and interest rate risk, and to find a better hedging strategy, one that reduces hedging error.

For his empirical work, Skinner used data for bonds rated AAA, AA, A and BBB, for January 1990 to March 1996. Within each rating category the sample was further subdivided into maturity classes of 3 - 7 years, 8 - 12 years, and 13 years and above. The final corporate bond portfolios were formed by random selection from the culled corporate bond sample. In total, 900 bond portfolios were formed during the period. For each selected bond the flat price and accrued interest were calculated at the beginning and end of each month. Assuming equal weight, the holding period return was calculated over the monthly interval for each portfolio of ten bonds. The total return series became the dependent variables in a series of regressions.

The independent variables consisted of monthly holding period returns from 5, 10, and 15 year treasury futures contracts, the S&P 500 futures contract, Lehman Brothers intermediate and long AAA, AA, A, and BBB bond indexes, and finally, the 5 and 10 year U. S. dollar swap rates.

The hedging effectiveness, for example, of treasury futures contracts was measured as the R$^2$ from an ordinary least squares regression of the corporate bond portfolio returns $R_c$ on the treasury futures returns $R_f$. In this regression, the slope parameter $\beta$ is a measure of the minimum variance hedge ratio.

$$R_c = \alpha + \beta R_f + \mu$$  \hspace{1cm} \text{Eq (1)}

Using the R$^2$ measure as the test of superiority, the corporate hedges dominate all but the treasury futures contract hedges, and even the treasury futures are better in only three out of twelve cases. However, in order to test for statistical significance of the superiority of the corporate hedge it was necessary to carry out some further steps. We run the regression represented by equation (1) twice, once using the
treasury contract hedge and a second time using the corporate hedge. For each regression we extract the residuals. Each set of residuals is of course a time series of errors in the regressions. We form two other time series, one consisting of the sums of the residuals and the other of the differences. Then we run a further regression of the series representing the sums on the series representing the differences. The slope coefficient of this regression tells us which hedging instrument is better in reducing residual risk.

It now became clear that the use of corporate indexes for hedging dominated S&P 500 futures and swaps. As between treasury futures and a corporate based hedging instrument, the latter proved the more effective.

Skinner next tested the use of composite hedges, combining first the corporate and treasury, second the best single hedge (corporate or treasury) and the S&P 500 index, and third the best single hedge and the swap hedge. It turns out that the composite hedge offers little improvement over the use of a single asset hedge.

Finally, Skinner investigated the effect of re-weighting the composite hedge as we move through the business cycle. Using dummy variables to distinguish time periods of recession and periods of expansion, Skinner found that improvements in hedging effectiveness through use of a time varying composite hedge can be large, particularly for the lower rated A and BBB portfolios.

His final conclusion was that the invariant composite hedge is not worthwhile, nor is the use of S&P 500 futures. For single asset hedges, it is best to use corporate index futures. For time varying composite hedges, it is better to use corporates and swaps for AAA and AA rated portfolios, and corporates and Treasuries for A and BBB ratings.

40. Bond Prices: Yield Spreads and Optimal Capital Structure with Default Risk (Spring 1996)

Hayne E. Leland, Arno Rayner Professor of Finance & Management, Walter A. Hass School of Business, University of California, Berkeley, distributed a paper by himself and Klaus Bjerre Toft of the University of Texas at Austin, entitled: "Optimal Capital Structure, Endogenous Bankruptcy, and the Term Structure of Credit Spreads." The work was supported by the Q - GROUP®.

Leland began by setting up the factors on which the value of risky corporate debt depends. These are the underlying asset value of the firm, V, the risk free interest rate r, the asset risk σ, which is the standard deviation in V, the leverage ratio, the cost of bankruptcy α, which is the fraction of asset value lost in a bankruptcy, the corporate tax rate τ, the payout rate δ (dividends and interest as a fraction of asset value) and the debt maturity T. Some of these variables are clearly easy to identify, while others are more difficult. We assume a single class of debt, constantly rolling over, with uniform amortization over the maturity T, and an issue of new debt each year equal in principal value to the debt retired, and bearing the same coupon, but issued at a market price, d, reflecting changed interest and credit conditions. So the annual debt service is C+(P/T-d). Bankruptcy is triggered if V falls to V_B, where the firm cannot raise sufficient equity to pay the current debt service, and we assume the firm cannot liquidate assets to meet the debt service. If bankruptcy occurs, the value of the firm is (1-α)V_B all of which accrues to the debtholders. The capital structure once fixed remains unchanged, and we assumed that V is unaffected by capital structure.
Let $F(\tau, V, V_B)$ be the cumulative probability of bankruptcy at time $\tau$, given asset value $V$ at time $t=0; f=\text{density function}$. From this we establish the value of the debt issued at time $t$;

$$d(V; V_B, t) = \int_0^t e^{-\tau}c(t)[1-F(t; V; V_B)]d\tau$$

$$+\int_0^t e^{-\tau}p(t)[1-F(t; V; V_B)]$$

$$+\int_0^t e^{-\tau}\frac{(1-\alpha)V_B}{T}f(\tau; V, V_B)d\tau.$$

The value of all outstanding debt then becomes

$$D(V; V_B, T) = \int_0^T d(V; V_B, t)dt$$

$$= \frac{C}{r} + \left[p - \frac{C}{r}\right]\left[1 - e^{-rT}\right] - I(T)$$

$$+(1-\alpha)V_B - \frac{C}{r}J(T)$$

(Both $I(T)$ and $J(T)$ are integrals explained in the paper.)

Finally, we have an expression for the value of the firm $v$:

$$v(V; V_B) = V + \frac{\tau C}{r} \left[1 - \left(\frac{V}{V_B}\right)^{-\alpha}\right] - \alpha V_B \left(\frac{V}{V_B}\right)^{-\alpha}$$

where $x = a+z$, terms explained in the paper. The process here is based on the Black-Scholes option valuation model.

The value of equity is simply the value of the firm less the value of the debt:

$$E(V; V_B, T) = v(V; V_B) - D(V; V_B, T)$$

Next we have to determine the bankruptcy value, $V_B$. Bankruptcy is determined endogenously. Bankruptcy will be chosen to maximize the firm value $v(V)$, subject to the condition that the equity value can never be negative. This implies the "Smooth Pasting" condition, which has the property of maximizing (with respect to $V$) both the value of the equity and the value of the firm subject to the limited liability of equity. The equation is:

$$\frac{\partial E(V; V_B, T)}{\partial V} \bigg|_{V=V_B} = 0.$$

and from this we get the value of $V_B$:

$$V_B = \frac{C\left(\frac{A}{rT} - B\right) - AP - \tau Cx}{1 + \alpha - (1-\alpha)B}$$

$A$ and $B$ are defined in the paper, and incorporate standard normal density functions.

Having arrived at the value of $V_B$, we can go back to the earlier formulas to get closed form solutions for the value of the debt, equity, and the firm.

Leland presented a number of graphs, showing the implications of his model. In particular the value of junk bonds may actually increase with an increase in the risk free rate and the risk measure $\sigma$. This means that the effective duration (the derivative of price with respect to interest rate) will turn out to be very different from Macaulay's duration. The familiar convexity may turn to concavity. Graphs of optimal leverage show the familiar increase in firm value as leverage is introduced, but the point of optimality depends very much on the maturity of the debt, with firm value peaking at higher levels and at higher leverage as the maturity increases. Both reach a limit with perpetual debt.
Bonds — Credit Analysis

41. Credit Risk Modeling and Pricing: An Overview (Spring 1999)

Tony Kao, Managing Director, Fixed Income, General Motors Investment Management Corporation, described his presentation as "a review of modeling and pricing credit risk over the last three decades." A major motivation for credit risk pricing has been the growth of derivatives, with payoffs tied to credit related events. A further motivation has come from regulatory concern over counter-party default risk. Growing concern over capital adequacy of financial institutions has also added to the need for risk pricing. At the same time, there is a growing base of empirical data to support modeling. Pricing models tend to focus on the pricing of derivatives and swaps.

Kao commented on a number of important credit spread properties. The volatility of credit spreads increases as credit quality declines. Credit spreads show mean reversion. Credit spread changes are positively correlated with changes in the slope of the Treasury curve, with interest rate volatility, and with swap spreads. They are negatively correlated with changes in LIBOR, the level of Treasury interest rates and equity returns.

Credit spreads show higher volatility for short-term than for long-term bonds. The term premium itself is negatively correlated with the slope of the Treasury curve for both investment grade and high yield bonds.

Kao offered two approaches to the valuation of corporate bonds. The contingent claims approach sets the value of the risky bond equal to the value of a default-free bond less the value of a European put option on the market value of the firm. The actuarial approach relates the spread to the default rate and the recovery rate that can be expected, in the expression

\[ s = \frac{(1 + r) \cdot (1 - \Phi) \cdot q}{1 - (1 - \Phi) \cdot q}, \]

where \( s \) is the spread, \( r \) is the default-free rate, \( \Phi \) is the recovery rate after default, and \( q \) is the default rate. Here we assume a single period zero coupon bond.

Kao next discussed credit risk modeling, including some of the major methodologies, both statistical methods and market implied methods. The latter include use of the equation above.

Turning to credit risk pricing, Kao identified this as one of the most exciting and promising areas, combining credit research, term structure and capital structure theory. There are four building blocks to this pricing. One is the process by which interest rates change, and Kao described a diffusion process and a diffusion and jump process. A second is the process by which default occurs or there is a rating transition. Subsidiary to this is the process by which the value of the firm changes. Finally, there is a recovery process in which the bondholders are paid off. This last process is particularly difficult to model because there are so many variations in the treatment of bondholders following default. Two classes of valuation models are the structural or firm value approach, and the reduced form approach. The former was first formalized by Bob Merton in 1974, and is based upon the characterization of defaultable debt as a contingent claim on the value of the firm. Factors affecting the debt value are the initial value of the firm, the variability in firm value, the expected growth rate of this value, dividends and coupon payments, the term of the loan, and the hierarchy of debt structure. Merton's original model was limited by a number of strict assumptions. Variations on that model have modified these but there remain significant measurement
problems with firm value. Kao commented on other limitations of these models.

The reduced form model bypasses the firm's financial fundamentals and deals with market prices and spreads directly. The defaultable bond price is related to the default-free bond by an exchange rate or conversion factor depending upon default and recovery:

\[ B(t,T) = P(t,T) - P(t,T) \cdot (1-\phi) \cdot q(t,T) \]

where \( P(t,T) \) is the default-free bond price and \( \phi \) and \( q \) are the recovery and default rates. This model also lends itself to treating default as a transition over time rather than as a sudden occurrence. This is particularly useful when the payoff of certain credit derivatives depends on the occurrence of rating changes or similar credit events other than legal default.

Commenting on reduced form pricing, Kao observed that it is difficult to apply to private issues and loans, it suffers from a lack of extensive empirical studies, and there is no direct evaluation of the firm-specific risk. He added comments on rating transitions, noting that a rating is an imprecise measure of an issuer's credit/default risk, and the propensity for rating changes is rather different for "fallen angels" than for original issue high yield bonds.

Kao closed with a survey of the problems in both approaches to risk pricing, a caution that Macaulay duration is not a good risk measure for risky debt, and a selected bibliography on credit risk pricing.

42. Towards Measuring Default Loss Rate Distributions (Spring 1999)

Lea V. Carty, Managing Director, Moody's Investors Service, described some of the findings of a major research effort currently under way at Moody's. He began with the probabilities of default and loss in the event of default. He characterized ratings as statements about expected loss. The expected loss is the product of the probability of default and the severity of default (measured by recovery rates). The probability of default is an issuer-level characteristic, estimated statistically from historic corporate default rates. The severity of default is an issue-level characteristic. He showed the average one-year default rates, for ratings Aaa through Caa-C, based on Moody's statistics from 1970-1998. Not surprisingly, the default rates ranged from 0.00% for Aaa bonds to 13.79% for Caa-C bonds. Somewhat surprisingly, one Aa issue and one A issue had defaulted during this time period, and the reasons illustrated problems in predicting defaults. For the Aa bond, the rating analyst had anticipated government support for the issuer that in the end was not forthcoming, and in the case of the A bond, the company had filed for bankruptcy protection to deal with mounting legal problems unrelated to its debt, and all lenders were paid in full.

Carty presented a table of recovery rates in the form of average defaulted bond prices measured as market prices one month after the event of default. The recovery rate average ranged from $71 per $100 par for senior secured bank loans, to $6 per $100 par for preferred stock. However, the ranges around the averages were very substantial. For senior unsecured bonds, for example, the average recovery was $48 with a range of about $4 to $90.

The expected one-year loss rates, based on the 1970-1998 statistics can be calculated as the default rate multiplied by (1-the recovery rate), and Carty showed statistics for the Aaa through the Caa-C bonds. For below investment grade bonds, these rates were 0.62% for Ba, 3.11% for B, and 6.62% for Caa-C bonds.
He turned next to limitations on the value of the statistics and the calculations he had discussed. First, the ratings are issue-level risk indicators and ignore the correlation between default probability and loss in the event of default. For example, in some cases of defaults on investment grade bonds, lenders suffer no losses. In addition, ratings incorporate a broader notion of credit risk than expected loss.

Carty continued with a discussion of direct estimation of default losses for the defaulted bonds in his sample. The loss rate here is the promised rate of return taken as the yield to maturity without default, less the realized rate of return based on actual recoveries or prices near default resolution.

The sample of bonds used for analysis consisted of long-term corporate and sovereign bonds rated by Moody's at some point between January 1970 and February 1999. The total of bonds included approximated 67,000, of which 1200 defaulted. The earliest issue date represented by this set of bonds was 1920, so there was a wide range of periods during which individual bonds were under observation. Since some of the bonds were observed for only a very short period following their issue, the loss rates derived from the analysis will be biased downwards. Carty showed a table of bond defaults and losses by rating at issuance, ranging from 0.10% for Aaa bonds to 18.86% for Caa-C bonds. The average loss rate ranged from 0.0018% to 7.2182%, and the standard deviation in loss rate ranged from 0.0666% to 29.2926%.

A three dimensional graph of loss rate distributions by rating at issuance showed that for investment grade bonds the loss rate is highly concentrated at a very low level, while for the high yield bonds the loss rate is spread fairly evenly over a fairly wide range. This of course corresponds to the high standard deviation in loss rates for the high yield bonds.

Carty also showed that the loss distributions generated by the direct measurement of losses were greater than those obtained by multiplying default probability estimates by the estimates of severity of default. His conclusion was that the default probabilities and severity of loss statistics are not easily combined to create a useful loss distribution.

In closing, he emphasized that there is a great deal of work yet to be done before Moody's has fully exploited the usefulness of its statistics collection.

43. Market-Observable Basis for Credit Analysis (Spring 1999)

Dan Chen, Research Associate, Gifford Fong Associates, continued the theme of the preceding summaries with a description of the use of Moody's data collection to validate models for the pricing of risk and risky instruments.

He began by offering his own critique of the structural and reduced-form models that had been introduced in the first presentation by Tony Kao. (summary 41) He went on to summarize what we have learned through recent published research. We know that the Treasury term structure and credit spreads are correlated. We have a statistical model for credit spreads incorporating company and issue-specific variables as well as environmental variables. We have a statistical model for default, making use of macroeconomic variables. With this as a starting point he proposed a consolidated approach incorporating a term structure model for treasuries, a term structure model for credit spreads, and a model for default and recovery.

He set out the dynamics for the modeling of risk-free forward rates
incorporating a risk-neutral drift, volatility, and a random variable. Similarly, the dynamics for credit spreads incorporated risk-neutral drift, volatility, and a random variable correlated to the random variable in the dynamics for the risk-free forward rates. He continued by describing the model from which the default and recovery rates can be obtained. Having described the model and its use, he raised three key issues:

- Are Treasury curves and credit spread curves market observable?
- Can we estimate default rate and recovery rate using Treasury curves and credit spread curves?
- Is the model consistent with historical observations?

To answer these questions he set out a linear model of high-yield bond default.

\[ \lambda(t) = \frac{I}{1 + \exp[A + B \Delta Y(t) + C X S(t)]} \]

where

- \( \lambda(t) \) = default probability at time \( t \);
- \( \Delta Y(t) \) = slope of Treasury curve
- \( Y_{10}(t) - Y_{1}(t); S(t) \) = credit spread,
- and \( A, B, C \) are parameters.

The linear model lends itself to regression analysis for estimation of the parameters. Chen offered an example yielding the following results, with an \( R^2 \) of 75%.

<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
<th>Std. Error</th>
<th>T-Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>5.34</td>
<td>0.29</td>
<td>18.12</td>
</tr>
<tr>
<td>B</td>
<td>-38.55</td>
<td>8.80</td>
<td>-4.38</td>
</tr>
<tr>
<td>C</td>
<td>-33.82</td>
<td>6.25</td>
<td>-5.40</td>
</tr>
</tbody>
</table>

Both B and C are negative, and quite significant, indicating that as the credit spread widens it is more likely that the high-yield bond will default, and that when the Treasury curve becomes steeper the likelihood of default increases.

Chen moved from the linear model to non-linear fitting, which did not change the results of linear fitting for default probability and matched the general trend of recovery.

Next he offered examples of pricing a high-yield bond and a credit default swap. Taking as a specific example a credit default swap on a Bethlehem Steel obligation maturing in September 2003 and rated Ba3 by Moody's, the model gave a price very close to the market price.

In conclusion, Chen listed these features of the Consolidated approach:

- Arbitrage-free pricing
- Explicitly correlated dynamic processes for risk-free rates and credit spread
- Consistent with both historical default and recovery rates
- Valuation for risky debt and credit derivatives in a unified framework
- Flexibility to integrate with a market risk system

44. Pricing Credit Risks (Spring 1999)

Kenneth Singleton, C. Q. G. Miller Distinguished Professor of Finance, Graduate School of Business, Stanford University, distributed a paper by himself and Darrell Duffie, entitled "Modeling Term Structures of Defaultable Bonds." His was the last of four presentations on credit analysis, (including summaries 41, 42 and 43) and he undertook to draw together critical aspects of the models and their application. He began with the essential
ingredients of all credit pricing models. We need details on cash flows, instrument by instrument. We need the probability of default at each future date, given that the counter-party has not defaulted up to that date, for all relevant future horizons. We need the recovery or loss in the event of default. And we need a conceptual framework for pricing defaultable securities based on information described above and the appropriate discount rates.

The earlier speakers had discussed the two approaches taken in valuation models — the structural or firm value approach and the reduced form approach, and differences between the two. Singleton took a somewhat different position, pointing out that for the balance sheet model the probability of default is the probability that, for the first time, the value of the firm will drop below the value of the liabilities. Default becomes predictable. For the reduced form model, however, for each time period there is some probability of default. He described the reduced form as a "coin flip" model. However, since the firm value is subject to substantial measurement error, default in the structural model is not as predictable as it may have appeared. And if the reduced form default probability is expected to change over time, the difference between the two models begins to disappear.

Assuming the cash flow information is available, the first step in implementing a model is specifying the probabilities of default. The intensity of default is the mean arrival rate of default, given all current information, measured in expected number of events per year. For example, an intensity of 0.12% (the Baa average default frequency for 1970-97 reported in a previous presentation by Lea Carty, (summary 42) is an arrival rate of 12 per 10,000 years. The intensity can be constant over time until default (Poisson) or time-varying but deterministic, or randomly varying, as new information reaches the market. Almost every model of default can be viewed in terms of its intensity. He described how the intensity is best modeled.

Moving on from the probability of default, Singleton discussed the second step: recovery in the event of default. Lea Carty, had observed that as a proxy for recovery rates Moody's uses the trading price of defaulted debt, expressed as a percentage of par value and measured approximately one month subsequent to the default. Singleton pointed out, as Carty had, that the Moody's data show very wide distributions of recoveries for each bond rating or type of obligation. Some of the variation may be explained by the effect of business cycles. It may also be that the quality of bonds is changing over time. And other characteristics may differ within the class or rating. Fortunately, it is only the expected recovery, not the distribution of recovery values, that matters for corporate bonds. Unfortunately, this is not true for swaps.

There are two ways to measure the recovery. One is as a fraction of face or par value; the other is as a fraction of market value just before the default. Singleton discussed both. The expression for the value of a zero coupon defaultable bond where recovery value is related to face value looks complex but the value is not hard to calculate. By making some fairly strong assumptions we can easily back out survival probabilities and compute the credit spread. Singleton showed the sensitivity of the credit spread to volatility in the default likelihood, and to the correlation between default intensity and the short risk-free rate. He went on to show the sensitivity of the term structure of credit spread to the risk-free short rate and the correlation of changes in spreads with changes in six month Treasury bill
yields, 30-year Treasury bond yields, and returns on the S&P 500.

Turning to recovery as a fraction of market value (rather than par or face value) he compared the pricing formulae and the usefulness of the two models. The market value model is easier to use but the face value model is more realistic, and is required for valuing swaps. He showed that the implied mean default intensity is about the same for the two models unless we are dealing with a long-term bond of very low quality. The same conclusion is true for the term structure of spreads.

Finally, Singleton discussed extension of the models from a single credit class to portfolios of defaultable bonds with different credit ratings along with credit derivatives. This was but one example of the many applications to which he believes the models lend themselves.

Commodities

45. Equilibrium Forward Curves for Commodities (Spring 1998)

Chester S. Spatt, Mellon Bank Professor of Finance, Graduate School of Industrial Administration, Carnegie Mellon University, presented a paper by himself, Bryan R. Routledge and Duane J. Seppi, entitled: "Equilibrium Forward Curves for Commodities."

He began with a discussion of the shape of commodity forward price curves. The slope of the forward curve across maturity is often, but not always, negative. Considering the cost of carrying commodities, this is surprising, and the negative slope is generally attributed to "backwardation," which is explained as the convenience value of holding the physical commodity rather than the futures contract. Spatt suggested that the convenience factor has in the past been more or less a "fudge factor". It is generally also true that the volatility of forward prices at the short maturities is much higher than at long maturities, although there are exceptions. The degrees of backwardation and volatility appear to be correlated.

Spatt suggested that the key determinants of at least many commodity prices are weather and inventory levels, and a key element in the approach he proposed is the inventory level. Sample forward curves showed both upward slopes and downward slopes for crude oil, and a distinct seasonal pattern for natural gas.

Turning more specifically to the proposed model, key assumptions are that the spot price is determined by net demand for immediate use and demand is modeled to follow a Markov process with transition probabilities. The value of inventory is decreasing through time by the cost of storage. The spot price is determined by: price at time t = a demand state parameter + the change in the value of inventory at time t. The change in inventory is determined in equilibrium by the optimizing behavior of agents.

The inventory function is a significant innovation to the model Spatt described. In equilibrium when the current inventory is positive the spot price must equal the present value of the inventory after storage costs one period ahead multiplied by the expected price one period ahead, and can exceed this expression if the current inventory is zero. The equilibrium inventory function exists, is bounded, and follows a renewal process with a positive probability of no inventory.

Perhaps the most significant innovation of the model has to do with the modeling of the "convenience factor" that has been used to explain
backwardation. The researchers consider inventory to offer choices that forward contracts do not, choices involving immediate or delayed use of the commodity. One of the results of this modeling is that the volatility of the forward rate generally falls with maturity, consistent with observations, but also that the shape of the curve is sensitive to the level of storage costs. Spatt showed curves illustrating the dependence of volatility on inventory, and pointed out that the volatility of rates does not necessarily decrease monotonically with forward maturity. He went on to discuss the implied convenience yield, which is non-negative, and positive if and only if there is positive chance of a stock-out. Convenience yield is limited by the storage cost and interest rate. It turns out that the correlation between spot price and convenience yield is not constant and finally, the implied convenience yield can be calculated, as Spatt showed, from equilibrium forward prices.

Spatt next turned to hedge ratios and their properties, implementation of a seasonality measure (important for some commodities) and the effect of seasonality on the equilibrium inventory function, correlations of forward prices with the spot price and hedge ratios.

Finally, he showed the use of simulations to generate a complete range of forward curves, illustrating particularly the difference between those in states of high demand and those in states in low demand. Throughout the presentation many of the conclusions of the paper were illustrated in a binomial example.

Work in process includes empirical implementation, including the examination of multiple commodities, and the development of other embedded options, including those that may be geographically related.

Corporate Governance

46. Do Independent Directors Matter? (Spring 1997)

Sanjai Baghat, Professor of Finance, University of Colorado, distributed a paper by himself and Professor Bernard Black of the Columbia Law School, entitled: "Do Independent Directors Matter?" Financial support for the paper was provided by the Q-Group.

He began by reviewing the conventional wisdom to the effect that large company boards should consist mostly of independent directors and that institutional shareholders can improve corporate governments by strengthening independence of corporate boards. These statements raise the question whether greater board independence will produce better corporate performance. The study he and his co-author have performed is a large-scale long-term horizon analysis of the effect of independent directors on corporate performance. Their analysis was based upon stock price and accounting performance data for 950 large U.S. firms during 1983-1995. The data relied on for the makeup of the boards of directors of these firms were for 1991. Consequently, the period 1983-1995 was identified as the "sample period," the period 1983-1990 was identified as the "retrospective period," and the period 1991-1995 was identified as the "prospective period." The ultimate conclusion was that there was no consistent correlation between the proportion of independent directors and accounting or stock price measures of firm performance during the prospective period. It did appear that slower growing firms had more independent directors.

This conclusion persisted after controlling for board size, firm size, stock ownership by the chief executive officer, stock ownership by inside directors,
stock ownership by independent directors, and the number and size of outside 5% block holders.

Baghat discussed a number of alternative interpretations of their results, which might be regarded as criticisms of the validity of their testing. Among the claims that might be made were: the limited power of the tests, the possibility that today's "independent" directors are not independent enough, the argument that independent directors can add value only if they are embedded in an appropriate committee structure, an argument that board structure is endogenous, and one that there is too much heterogeneity among independent directors. Baghat believed that none of these claims invalidated the research findings, although the analysis itself could not prove they were unfounded.

He reviewed prior research that in some cases purported to show that independent directors did contribute to improved performance. He pointed out, however, that none of the prior studies had made use of multiple performance measures. A number of them had focused on particular claimed effects of independent directors, including replacement of the chief executive officer, response to take-over bids, and positions on poison pills. It did appear that inside stock ownership tended to correlate with improved performance, and hence it was important to control for ownership by insiders and outside block holders.

Some characteristics of the sample of firms were: the median firm had eleven board members, including seven independent directors, one affiliated outside, and three insiders; two-thirds of the sample firms had majority-independent boards; and 6% of the sample firms had majority-inside boards.

The first tests attempted to correlate stock price performance with the number of independent directors. Stock price performance was measured in three ways. Market adjusted returns were daily sample returns minus the return on the S&P 500 Index. Cumulative abnormal returns also treated the entire sample as a single portfolio, but with an adjustment for beta. Standardized abnormal returns made use of market model parameters alpha, beta and the standard deviations of the sample firms' abnormal returns. There was no consistent evidence that the proportion of independent directors affected stock price performance. It did turn out that companies with larger boards exhibited superior performance in the prospective 1991-1995 period.

The next testing had to do with the relationship between accounting performance measures and board structure. First, a number of growth variables, including growth in net income and growth in cash flow were correlated with board structure. For the retrospective period 1983-1990, there was a negative relationship between growth variables and the proportion of independent directors. For the prospective period 1991-1995 there was no relationship. Baghat felt that a possible explanation was that the board structure was endogenous. Fast growing firms might choose a higher proportion of inside directors to manage growth. And mature firms might employ more independent directors to restrain managers from indulging in unprofitable growth.

A second set of accounting performance measures included Tobin's Q. earnings per share, the ratio of operating income to sales, the ratio of operating income to assets, the ratio of sales to employees, cash flow to sales, and cash flow to assets. It turned out there was a positive correlation for the full sample period between the proportion of inside directors and Tobin's Q and other ratio variables with
assets in the denominator. There was no correlation with variables which used sales in the denominator. There was a negative correlation between the proportion of independent directors for the retrospective period 1983-1990 with Tobin’s Q and other ratio variables with assets in the denominator. For the prospective period 1991-1995 there was no correlation. And for both periods there was no correlation for variables with sales in the denominator.

Finally, Baghat reported the results when the firms’ ownership structure was controlled for. It turned out that corporations with greater insider ownership had more inside directors. After controlling for ownership structure there was no consistent relation between board structure and stock market measures of firm performance. An interesting but incidental finding was that companies with more outside 5% block holders underperformed in the 1983-1990 period, but exhibited superior performance in the 1991-1995 period.

Overall, the authors had found no convincing empirical support for the conventional wisdom that large company boards should consist predominantly of independent directors, at least as long as those directors continued to be cast from the current molds. The opposite effect could never be proved: There is always another test to run. The authors planned to measure board composition at an earlier date than 1991. This would allow them to test whether the correlation they found between slower growth in the 1988-1990 period and higher proportion of independent directors in early 1991 persists if board composition is measured at the beginning, rather than at the end, of the performance measurement period. The paper also cast doubt on the reliability of studies that rely primarily or exclusively on a single accounting measure of performance. It seems important to study multiple measures of firm performance.

Demographics — Asset Returns and Social Security

47. Population Age Structure and Asset Returns: An Empirical Investigation (Fall 1998)

James M. Poterba, Mitsui Professor of Economics, at the Massachusetts Institute of Technology, distributed a paper entitled: “Population Age Structure and Asset Returns: An Empirical Investigation.” His paper investigates the association between population age structure, particularly the share of the population in the “prime-savings years” 45-60, and returns on stocks and bonds. The work was motivated by the popular notion that the aging of the “Baby Boom” cohort in the United States is a key factor in explaining the rise in asset values, and a prediction that asset returns will be relatively poor in the decades when this large cohort reaches retirement age and begins to reduce its asset holdings. He commented that the subject is of importance to both financial managers and those responsible for public policy, including provision for adequate retirement income by way of Social Security.

It is quite true that substantial demographic change is underway, largely as a result of the Baby Boom following the second world war. What is not at all clear is the effect of this change on asset returns. Poterba observed that there are three key ingredients for the predicted effect of the Baby Boomers on asset prices and returns. First, age must be an important predictor of asset demand. Second, the demographic and asset market system must be “closed.” This means that there must be no
significant international effects on the U.S. securities market. Finally, the demographic effect must not have been forecastable, otherwise one would expect it to be fully impounded in asset prices.

A theoretical approach to the demographic effects on asset returns must consider both steady effects and transition effects. We have relatively little evidence upon which to base conclusions for either. Theory does tell us that as the capital/labor ratio rises, capital is less productive and equilibrium rates of return should decline.

Poterba reviewed a number of studies that have some relevance. Some evidence has been found of increased risk aversion with age, but the analysis was based on very few observations. Studies of inflows and outflows for defined benefit pension plans have led to a prediction that between 1990 and 2040, an inflow rate of 3% of payroll will shift to a payout rate of 3% to 4%. This might have a significant effect on asset values. Studies have also been done on the effect of changing demographics on house prices, but forecasts based on those studies have been rather inaccurate.

Poterba described the objective of his study as: presenting new evidence on the age structure of asset holdings in the United States, investigating the historical correlation in U.S. data between demographic structure and asset returns, and clarifying the assumptions that are needed for the claimed "asset meltdown" in the next century. It is important to distinguish two strategies for analyzing the "age effect" on asset demand. Cross-sectional comparison of assets held by individuals of different age at a given time is the easier analysis. However, it is likely to be less robust than cohort analysis that tracks the asset holdings of a particular birth cohort as it ages. The cohort method is not contaminated by differences in asset holdings at all ages that arise from differences in lifetime wealth of different cohorts. That is, the asset holdings of a 40 year old born in 1930 may be rather different from the asset holdings of a 40 year old born in 1950. Obtaining the data for cohort analysis is somewhat more difficult than obtaining the data for cross-sectional comparison. Poterba relied on the Survey of Consumer Finances, sponsored by the Federal Reserve Board and undertaken every three years. The most recent for which data are available is the survey of 1995.

Both the cross-sectional and the cohort analyses show a substantial rise in individual net worth and corporate stock holdings from about age 30 to about age 54, with a leveling off over the next 20 years. What is significant is little evidence of disposal of assets, including corporate stocks, at older ages. At the same time, there is evidence that risk tolerance declines somewhat after about age 64, and more so after about age 74.

The demographics are fairly clear. The median age of the population can be expected to rise about 6 years over the period 1990 through 2050, about the same increase experienced from 1930 to 1990. The population share of those aged 40 through 64 is scheduled to peak in 2010. Poterba showed aged based prediction for asset demand, where asset holdings are assumed to be a function of age, showing a steady rise in net worth through 2030 but slowing after 2010.

Poterba then turned to what he called the heart of his paper: empirical tests of how demographic structure affects asset returns. His analysis took the form of a number of regressions with demographic summary statistics as the independent variables, including median age, average age of persons over 20, percent of population aged 40-64, the
ratio of population aged 40-64 to the population over 65, and the ratio of population aged 40-64 to the total population over 20. The key findings from his regressions were that most demographic variables are statistically insignificantly different from zero, although there is some evidence for negative association between percentage of population 40-64 and rates of return on U.S. Government bills and bonds. When changes in demographic variables rather than levels were used in the regressions, most explanatory variables were still statistically insignificantly different from zero. But now the change in the population share aged 40-64 had a positive and marginally significant relation to bond and bill returns. Further, when the regression results were combined with demographic projections from the census bureau, to make out-of-sample predictions for asset returns, the results appeared to make no sense.

Poterba observed that some empirical analysis for Canada and Britain indicate no evidence that equity returns are affected by the level of, or differences in, demographic variables, although as in the U.S. there are some links between levels and differences of demographic variables and returns on governments bills and bonds.

Summarizing his empirical findings, Poterba said there was no evidence of a robust empirical relationship between population age structure and the average returns on bills, bonds, or stocks. His conceptual reasons for doubting the predictions of such a relationship have to do with the open economy and the ability of Baby Boom households to sell assets to investors outside the United States, as well as the rational expectations argument that if returns are expected to be low in the future then prices should be lower now.

48. Projected U.S. Demographics and Social Security (Fall 1998)

Selahattin Imrohoroglu, Marshall School of Business, University of Southern California, distributed a paper by himself and Mariacristina De Nardi of the University of Chicago and the Federal Reserve Bank of Chicago and Thomas J. Sargent of Stanford University and the Hoover Institution, entitled: “Projected U.S. Demographics and Social Security.”

Projections from the Social Security Administration (SSA) have raised serious concerns about the future of the social security system. Even with the legislated increase in the retirement age from 65 to 66 in 2008 and to 67 in 2026, SSA projects a rise in the dependency ratio (the ratio of workers entitled to social security retirement benefits to those paying payroll taxes) from 20% in 1990 to 50% in 2060. In order to hold the ratio at 20%, it would apparently be necessary to move the retirement eligibility age to 76. The large fiscal adjustment implicit in these projections becomes even larger when Medicare and Medicaid spending is taken into consideration. The response of the authors as described by Imrohoroglu is to show the economic consequences of eight alternative fiscal adjustment packages. The model for the eight “experiments” is a general equilibrium model of overlapping generations of long-lived people (the maximum age considered is 90). In reviewing previous research, including his own, Imrohoroglu observed that the present paper introduces a labor-augmenting technical progress, assumes time-varying survival probabilities and demographic patterns, activates a life-long bequest motive, and lets labor supply choices respond to how retirement benefits are related to past earnings. The bequest motive is especially important in boosting savings above what would be produced by pure life-cycle households, and leads to more
realistic capital-output ratios and age-savings profiles. During the first \( t_r + 1 \) periods of life, a consumer supplies labor in exchange for wages that she allocates among consumption, taxes and asset accumulation. During the final \( T - t_r \) periods of life, the consumer receives social security benefits. In addition to life span risk, agents face different income shocks that they cannot insure. They can smooth consumption by accumulating two risk free assets: physical capital and government bonds. The government taxes consumption from capital and labor, issues and services debt, purchases goods, and pays retirement benefits. There is a constant returns to scale Cobb-Douglas aggregate production function, constant labor-augmenting technical progress, and no aggregate uncertainty.

Among the eight experiments are different proposed retirement ages, and it is assumed that all workers retire at the specified ages. Individuals are characterized by modest risk aversion, which changes over the lifecycle. The model computes an initial steady state as of 1975. Backward induction is used to compute an agent’s value functions and policy functions, taking as given government policy, bequests and prices. The model then iterates until convergence on (1) social security benefits to match the desired replacement rate (using the SSA figures as a guide to that rate), (2) bequests, so that planned bequests coincide with received ones, (3) the labor income or consumption tax to satisfy the government budget constraint, and (4) factor prices, to match the firms’ first order conditions.

To compute the final steady state the model uses the same procedure described for the initial steady state, but also iterates on the government debt level to match the debt to GDP ratio from the initial steady state. (In the initial steady the debt to GDP ratio was calibrated; in the second steady state it is fixed).

Finally, the model computes the transition dynamics by solving backwards the sequence of value functions and policy functions, taken as given the time-varying transition policies, prices and bequests. Iteration continues until convergence on a parameterized path for the tax rate to match the final debt to GDP ratio, and on factor prices.

In the first experiment social security benefits are kept at their levels in the first steady state and the entire burden of adjusting to the demographic changes is absorbed by scheduled increases in the tax on labor income from about 30% to about 60%. There is a substantial increase in bequests, a significant decrease in the labor supply and in consumption, and GDP declines 17%.

In Experiment 2, the cost burden is borne by a tax on consumption from 5.5% in the initial steady state to 37%. Bequests increase substantially, capital investment rises, while labor supply and consumption decline modestly.

In both Experiments 3 and 4, the mandatory retirement age is increased by 1 year in 2032 and 1 in 2036, to eventually reach 69. The remaining burden of adjustment is absorbed by increases in the labor income tax rate in Experiment 3 or the consumption tax rate in Experiment 4. For Experiment 3 the labor income tax rises to 53%, bequests increase substantially, and mean consumption, GDP and the labor supply fall modestly. For Experiment 4, the tax on consumption rises to 31%, bequests rise very substantially investment rises, and consumption and labor supply fall modestly.

In Experiment 5, all social security retirement benefits are fully subjected to the labor income tax rate and the rate is
increased to 43%. Bequests rise substantially, capital investment rises modestly, and consumption and labor supply fall modestly.

In Experiment 6, benefits are made dependent on past earnings for people retiring in year 2000 or later. The labor income tax is raised to 51%. Experiment 7 is the same, except that it is the consumption tax that is increased to 30.5%. For Experiment 6, bequests rise very substantially, but other variables do not change much. For experiment 7, capital investment rises significantly, bequests increase enormously, and mean asset holdings rise significantly.

Finally, in Experiment 8 there is an uncompensated phase-out of the current system, in which all retirement benefits are reduced to zero over a 50 year horizon starting in the year 2000. Bequests, asset holdings, and capital investment rise substantially and wages increase significantly but other variables are not much affected.

Before turning to the obviously important inter-generational gains and losses for the eight experiments, Imrohoroglu pointed out that while the SSA states that a 2.2 percentage point addition to the 12.4 OASDI payroll tax will restore the financial balance in the Social Security trust fund over the 75 year horizon, the authors computed an additional 30 percentage points in the payroll tax rate and large welfare losses associated with maintaining the current unfunded system and Medicaid and Medicare payments.

A convenient summary measurement of the inter-generation effects in the course of the transition from the old to the new steady states, is the compensation in terms of percentage of assets that would have to be given to a person entering the labor force in a particular year to make that person accept Experiment 1 rather than one of the others. For those entering the labor force before 1975, Experiment 1 is generally more attractive than all of the other Experiments except number 6 which bases retirement benefits on earnings. So these individuals should be willing to pay to live under Experiment 1 rather than any other Experiment other than 6, and in some cases the payments could be quite substantial. For those entering the labor force after 1975, however, Experiments 2 through 8 make them better off than Experiment 1, and they would require compensation to be made as well off under Experiment 1. The amounts of compensation that would be required demonstrate, for each year of entrance into the labor force, the different impact of the different experiments. As noted, the one experiment number 6 is unambiguously beneficial to all generations. It also happens to offer a sizable welfare gain. At the same time, it could be expected to introduce significant welfare shifts within the members of any generation.

Privatization through a gradual, uncompensated phase-out is the most welfare enhancing policy of the eight experiments. However, the transitional cohorts stand to suffer a great deal in the absence of any intertemporal redistribution of benefits and losses. This policy especially hurts the younger baby-boomers and the children of the older baby-boomers. These transitional generations not only see their benefits phase-out, but they share in the burden of financing the retirement of a succession of larger than before cohorts.

In conclusion, the experiments indicate that the projected demographic transition will induce a transition to a new stationary equilibrium at which a large fiscal adjustment in the form of a much higher labor income or consumption tax rate may have to be made. Reducing benefits, either by taxing them or by postponing the normal retirement age, or imposing a
Consumption tax, will go far toward reducing the rise in the rate of taxation of labor that will be required to sustain the unfunded social retirement system, but will certainly hurt some generations during the transition. An uncompensated phase-out of benefits towards eventual privatization delivers the largest welfare gains for future generations but at the same time imposes the largest welfare costs on current and transitional generations. And finally, a simplification of the social security structure that makes clear the linkage between the agents' past contributions and their future pensions eliminates a labor/leisure distortion and improves the welfare of all cohorts.

**Derivative Securities**

49. Recovering Probabilities and Risk Aversion From Options Prices and Realized Returns (Spring 1998)

Mark Rubinstein, Paul Stephens Professor of Applied Investment Analysis, University of California at Berkeley, presented a paper by himself and Jens Jackwerth entitled: "Recovering Probabilities and Risk Aversion From Options Prices and Realized Returns." Rubinstein described his presentation as combining the research of at least four papers on the subject. Most previous work has moved from assumptions with respect to subjective probabilities and risk aversion to conclusions about risk-neutral probabilities. His work takes the opposite direction, using market data to recover the probabilities and risk aversion.

A state contingent price is the price today of a dollar to be received only at a specific date in the future and given a specific description of the state of the economy at that time. The price will be arrived at by a discount rate that includes a subjective probability of the state arising, and risk aversion peculiar to that state. The sum of the state-contingent prices for dollars received at a single date over all possible states must be the current price of a dollar received for sure at that date, which is 1 divided by the current riskless return for that date. Multiplying the state-contingent prices by this return converts those prices into probability measures over the states, which we define as risk-neutral probabilities. The presentation concerned ways of recovering these probabilities from the current riskless return, the current observed prices of traded assets, and the current prices of traded derivatives on those assets. Once the risk-neutral probabilities have been obtained, the next task is to separate them into their two components: the subjective probabilities and the risk aversion.

The data used in the research were prices for the S&P 500 Index, and prices for options on the Index. If prices were set according to the Black-Scholes formula, the entire risk-neutral probability distribution could be summarized by its volatility, since its mean must equal the riskless return. Before the market crash of 1987, the Black-Scholes formula fitted the market prices of S&P 500 Index options very well. But since that time, the formula has performed very poorly. So another model must be found.

Rubinstein turned to graphs of the "implied volatility smile" for S&P 500 Index options. The smile is a graph of volatility implied by the Black-Scholes formula, against the ratio of strike price to current value of the Index. Up to the date of the 1987 crash, this smile was essentially flat. That is, the implied volatility did not vary with the strike price to index value ratio. And this was entirely consistent with the Black-Scholes formula which assumes the distribution of the underlying index is lognormal.
However, since the crash the graph has altered its shape, and for ten years has consistently shown a downward sloping line. Rubinstein observed that the pricing deviation from Black-Scholes is striking because it has existed more or less continuously for ten years, because it resides in one of the most liquid and active options markets with a very large open interest, and because it is found in a market which one might argue on theoretical grounds is most likely to be the one for which the Black-Scholes formula works best.

He next discussed recovering risk-neutral probability distributions through an optimization method. We begin with a prior guess of the implied risk-neutral distribution, over all possible levels of the underlying asset price over all expiration dates. We also assume knowledge of the current bid and ask underlying asset prices, the current bid and ask of associated call options, the current annualized return on a riskless zero-coupon bond maturing on the expiration date, and the current annualized payout return on the underlying asset through the expiration date. From this information we determine the posterior risk-neutral probabilities which explain the current prices of the options as well as of the underlying asset. Among all the posterior distributions which satisfy a series of constraints, the distribution chosen is the one that is "closest" to the prior distribution in the sense of minimizing the average squared distance between these two probability distributions. Rubinstein showed the graph of a typical post-crash distribution recovered by this method. He compared the distribution with the distribution one would expect from the Black-Scholes formula. The recovered distribution showed significant left skewness, much higher leptokurtosis and slight bimodality. The most interesting feature was the large concentration of probability in the lower left-hand tail. It was here that the bimodality showed up. These features of the recovered distribution are continuously displayed from about mid-1988 to the present in the S&P 500 Options market. In addition, they carry over to other equity index option markets, and they present a sharp contrast to distributions prior to October 1987.

The research extended to testing alternative optimization criteria. All resulted in almost the same recovered probability distribution. However, while all of the approaches show more probability on the lower left tail than the normal, they do not agree about the distribution of probability in that tail.

Having obtained a good estimate of the risk-neutral probability distribution at the expiration date, the research proceeded to recover the stochastic process that leads to this distribution. The method chosen was to modify the binomial model, and Rubinstein discussed the modifications. It turns out that the derived stochastic process strongly suggests that at-the-money implied volatility should vary inversely with the underlying asset price. And indeed this was verified by regression analyses.

Rubinstein next discussed possible economic causes for this relationship that has developed only since the 1987 crash. And he commented on possible ways of disentangling them.

While the implied binomial tree model had correctly anticipated the negative relation between volatility and asset price, the research moved on to alternative option pricing models. Of the nine alternatives, the "absolute smile model," one of two "naïve trader" models, turned out to perform best. This model assumes that future implied volatilities will be equal to current implied volatilities of options with the same strike price. Rubinstein interpreted
this conclusion as throwing down a challenge to academic and professional theorists to provide an explanation.

The remaining task was to recover the risk aversion component of the risk-neutral probabilities. Unfortunately, the efforts reported by Rubinstein had not been successful. They had led to pictures of absolute risk aversion that made no sense. There were several possible explanations, one of which was that the use of historically realized returns was not a good basis for establishing the subjective probability component of the risk-neutral probabilities. In any case, it was difficult to explain why in the post-crash period out-of-the-money put option prices had been so high (and selling these options had proved so profitable).

50. Option Pricing with Infinitely Divisible Distributions (Fall 1997)

Steven L. Heston, Assistant Professor of Finance, Olin School of Business, Washington University, distributed a paper entitled: "Option Pricing with Infinitely Divisible Distributions." The work was supported by the Q -Group®. He explained that his work was motivated by defects in the Black-Scholes Option Valuation Model, one that assumes stock returns are independently distributed over time in a lognormal distribution. But the distribution is not lognormal, and the result is that actual option prices are higher than Black-Scholes prices for out-of-the-money puts and in-the-money calls. The bias is quite large for short maturity options, and tends to disappear as the maturity increases. One approach to using non-normal distributions is to drop the independence assumption and use serially dependent returns. Heston's work takes an alternative approach, dropping the lognormality assumption and allowing local non-normal probability distributions for stock returns. This approach admits general stochastic processes with jumps and non-diffusion behavior. The pricing indeterminacy is resolved by pricing all types of risk (jump and diffusion) identically.

Stochastic volatility creates "fat tailed" distributions. Positive correlation of volatility with stock returns creates fat right tails, while negative correlation creates fat left tails. The fat tails in turn affect option pricing.

Heston’s model does not restrict the future stock price to two values, as in the binomial model. As a result, one cannot replicate option payoffs with a stock and bond portfolio. There is, however, a natural family of path-independent homogeneous risk-neutral measures. And there is only one member of this family that is consistent with a given stock and bond price. Hence we obtain a formula for call option values as functions of stock and bond prices.

Let \( p(S_t \mid S_0) \) denote the probability density that the future value of a spot asset equals \( S_t \) given the current value, \( S_0 \). For convenience, our first assumption is that the density is continuous with bounded support. To avoid arbitrage, we require that the return on a riskless bond lies strictly within the range of this distribution. A call option with strike price \( K \) is a contingent claim that pays \( \max(0,S_t-K) \). Absence of arbitrage among call options implies the existence of a unique risk-neutral probability function, \( p^*(S_t \mid S_0) \), such that the value at time \( 0, V(S_0,0) \) of any contingent claim is:

\[
V(S_0,0) = B \int_0^\infty p^*(S_t \mid S_0) V(S_t,1) dS_t.
\]

where \( B \) is the price of a unit discount bond and \( V(S_t,1) \) is the value of the contingent claim at time 1.
Pricing is homogenous if \( p(S, t | S_0)S_1 \) and \( p^*(S, t | S_0)S_1 \) are homogeneous of degree zero in \( S_1 \) and \( S_0 \). In other words pricing is homogenous if the distributions of stock returns do not depend on the stock price level. The price of a call option with strike price \( K \), \( C(S, K) \) is homogeneous of degree one in \( S \) and \( K \) if and only if \( p^*(S_1, | S_0)S_1 \) is homogeneous of degree zero. This is a particularly convenient property for spot assets such as currencies, where the values of options should depend on the relative levels of the spot currency and strike prices, not on absolute levels.

The state price density is the ratio of the risk-neutral probability and the true probability, \( p^*(S_1 | S_0) / p(S_1 | S_0) \). The "marginal rate of substitution" between two future states \( X \) and \( Y \) is the ratio of the state price densities:

\[
\frac{p^*(X | S_0) / p(X | S_0)}{p^*(Y | S_0) / p(Y | S_0)}
\]

Pricing is path-independent if the marginal rate of substitution between future states \( X \) and \( Y \) is independent of the current stock price \( S_0 \). Intuitively, this second assumption states that the tradeoffs among future states do not depend on whether one measures current spot prices in dollars or in cents. This would be particularly appropriate for currency options or options on the market portfolio. Note that the assumption about pricing is independent of any assumptions about probability distributions or stochastic processes.

Given these two crucial assumptions, for a given stock, bond price and probability function \( p(S, t | S_0) \) there is a unique risk-neutral probability function \( p^*(S, t | S_0) \) such that pricing is homogeneous and path-independent. Next, one can extend the static results to a dynamic context by assuming independently and identically distributed spot returns. Negative and inverse binomial processes are good examples. It turns out that infinitely divisible Poisson, gamma, and inverse Gaussian processes are weak limits of binomial, negative binomial and inverse binomial processes. Heston produced some graphical representations of actual distributions and simulated distributions. All three of the Poisson, gamma and inverse Gaussian models can be used to deliver option prices that are better than the Black-Scholes prices, for out-of-the-money puts and in-the-money calls, and the differences from the Black-Scholes prices are almost the same for all three processes.

In order to compare different option formulas, one must select comparable parameters across models. For example, one can match volatility and skewness of the probability distributions. The Black-Scholes model assumes zero skewness. Incorporating skewness in that model will bring about better prices.

Equity Market Structure

51. Decimalization: Implications for Institutional Trading (Fall 1997)

Lawrence Harris, Professor of Finance, Marshall School of Business, University of Southern California, presented a paper entitled: "Decimalization: A Review of the Arguments and Evidence."

His theme was essentially one on which he has spoken at previous Q-Group® meetings: the effect on many aspects of stock trading of reducing the tick size. He began by reviewing developments involving reduction of tick sizes. The AMEX began trading in sixteenths in 1992; the Toronto Stock Exchange moved to decimal pricing in 1996; NASDAQ, the regional stock exchanges and the New York Exchange
moved to sixteenths in the Spring of 1997, and there is legislation that has been introduced in Congress to require quotations expressed in cents. Harris' conclusion is that the real issue is not whether trading should be in fractions or decimals, but the size of the minimum price increment (the tick size).

The tick of course sets the minimum spread. It also determines the value of time precedence and the power relationships among various types of traders. The first of these three statements is generally understood; the second two are not. Harris expanded on the matter of power relationships. The narrowing of NASDQ spreads benefits the small trader using market and limit orders, at the expense of the dealer. The specialist benefits from narrow spreads because the constraints on a specialist become less significant as the spread narrows. Given order precedence rules, fast and small traders have an advantage over large traders.

Harris described the kind of front running that is facilitated by a very small tick coupled with rules that demand the best bid or ask take precedence. There are defenses against this sort of front running, the chief of which is to manage the display of orders. And this in turn means that as the tick is reduced in size, the willingness of traders to display their orders decreases.

Fortunately, we do have some quite specific evidence on the effects of changing the tick size, both in the form of "before and after" studies and in the form of studies where tick size varies by stock price. It turns out that a lower tick size leads to significantly smaller displays of size at the best quote.

Harris identified the winners in a reduction of tick size as small traders, high frequency electronic proprietary traders, NYSE exchange specialists, front runners, floor brokers, electronic trading systems, and buy-side traders. The losers are limit order traders, dealers who pay for order flow, regional exchanges, and large buy-side institutions. The latter of course include mutual funds and retirement funds. In discussing the legislation now before Congress, he observed that the estimate of benefits from reduced spreads is grossly exaggerated, but the political appeal of a reduction in spreads appears to overwhelm all of the less well understood consequences. It seems likely therefore that decimalization will be forced on the stock markets of the United States.

52. The Specialist's Discretion: Stopped Orders and Price Improvement (Spring 1996)

Mark J. Ready, Assistant Professor of Finance, University of Wisconsin - Madison, presented a paper entitled: "The Specialist's Discretion: Stopped Orders and Price Improvement," a project supported by the Q - GROUP®. The research investigates what Ready referred to as "unadvertised liquidity" available on the New York Stock Exchange, due in part to the specialist "stopping" market orders. It is fairly common for public limit orders to represent the best bid or ask on the NYSE. But when a market order arrives, the specialist or a member of the trading crowd can offer a better price (usually by 1/8 of a dollar) to step ahead of limit orders on the book and take the other side of the market order. Alternatively, the specialists can "stop" the market order, guaranteeing that the order will be executed at at least the current quote, but providing the possibility of price improvement. What interested Ready were the frequency with which market orders are stopped, the reasons for stopping, and the consequences to traders and the specialist.
The data source from which Ready worked is the TORQ database, available from the NYSE. This database covers a 3 month period from November 1990 through January 1991 for a sample of 144 stocks. Included are intra-day consolidated trade and quote information, information on the parties on each side of a trade, a record of all orders submitted to the floor by way of the NYSE’s SuperDOT system, the time each order was submitted, the time it was executed and whether it was stopped. The following table shows for 3 bid-ask spreads, the percent stopped, the percent of stops “improved” by the specialist and the percent of others improved.

<table>
<thead>
<tr>
<th>Bid-Ask Spread</th>
<th>Percent Stopped</th>
<th>Percent of Stops Improved</th>
<th>Percent of others Improved</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/8</td>
<td>21%</td>
<td>41%</td>
<td>5%</td>
</tr>
<tr>
<td>1/4</td>
<td>40%</td>
<td>65%</td>
<td>54%</td>
</tr>
<tr>
<td>3/8</td>
<td>41%</td>
<td>68%</td>
<td>64%</td>
</tr>
</tbody>
</table>

In exploring the question why are stops used, Ready offered three reasons for wanting an answer. The first has to do with optimal market design. There is no place in an electronic limit book for stops. They are peculiar to the live specialist. Does stopping make the specialist system better in terms of market quality than an electronic limit book system? Second, trading strategies may be improved if traders know when stops are likely to lead to price improvement and when they are not. Finally, understanding the use of stops helps us to understand how information is impounded into stock prices.

One possibility is that the specialist stops orders in order to meet the NYSE objectives of price continuity and stabilization. The NYSE prefers trade-to-trade price moves of no more than 1/8. If specialist intervention is necessary to keep the price move to no more than 1/8, then stopping may help the specialist achieve this objective. The benefit of stopping to the specialist, rather than intervening when the order is received, is the opportunity to observe the order flow to see if the stopped order is only the first of a stream of orders suggesting “informed” trading. The following table presents data for 1/4 spreads:

<table>
<thead>
<tr>
<th>Absolute price change if exec. at quote</th>
<th>Immediate exec. price</th>
<th>Price imp.</th>
<th>Price Stopped</th>
<th>Memo: Stop pct. when quote is limit order</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0</td>
<td>No</td>
<td>73%</td>
<td>12%</td>
<td>15%</td>
</tr>
<tr>
<td>$1/8</td>
<td>18%</td>
<td>35%</td>
<td>47%</td>
<td>54%</td>
</tr>
<tr>
<td>$1/4</td>
<td>19%</td>
<td>46%</td>
<td>35%</td>
<td></td>
</tr>
</tbody>
</table>

The table indicates that the percentage stopped where the absolute price change would exceed 1/8 is indeed higher than the percentage stopped where there would be no price change if execution took place at the quote. However, the percentage stopped is even greater if the absolute price change would be 1/8, and as we have we seen the NYSE seems to have no concern over price changes of 1/8.
The model proposed by Ready for the strategic behavior of traders and specialists is the following:

- Stock is worth either $V_L$ with probability $\pi_o$ or $V_H$ with a probability $(1-\pi_o)$

- Some traders ("informed") may learn the true value in advance. They will try to profit from their trades.

- Some traders ("noise") need to trade for portfolio reasons.

- A buy order may indicate an informed trader knows $V=V_H$ or he may just be a noise buyer.

- Limit order traders position their orders to try to profit from their trades on average.

- The specialist gives price priority to limit orders, uses stops when they are optimal, and tries to profit from his trades on average.

An example of the specialist's strategic behavior is given by the following:

**Strategic Behavior — An Example**

(Model Parameters)

- Possible Values: $V_H =$ 5.375 $V_L =$ 4.75
- Probability that $V=V_L$: $\pi_o = .45$
- Probability of an information event: $\epsilon_o = .10$
- Unconditional expected value: $\pi_o V_L + (1-\pi_o)V_H =$ 5.094
- Two trading periods
- Order Arrival Probabilities (each period):

<table>
<thead>
<tr>
<th>Low</th>
<th>No</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sell</td>
<td>.75</td>
<td>.20</td>
</tr>
<tr>
<td>No Order</td>
<td>.05</td>
<td>.60</td>
</tr>
<tr>
<td>Buy</td>
<td>.20</td>
<td>.20</td>
</tr>
</tbody>
</table>

**Strategic Behavior — An Example**

(Results)

- Bid = $5.00, Ask = $5.25 (Limit orders)
- Value is $5.094$ so the specialist is interested in selling at $5.125$, BUT NOT if two market buy orders arrive in succession.

- Optimal policy: stop the market buy in the first period, and sell to it if there's no market order in the second.

- Note: Don't stop a sell order. The only thing that would do is make it impossible for the specialist to sell in the second period.

The example indicated that without stops, limit orders would trade more often, in which case limit order profits would be higher. Market orders, on the other hand, would be less likely to execute at the mid-point and so market order profits would decrease without stops. It is interesting that noise traders gain more from stops then do informed traders. Ready was not prepared to answer whether this was good or bad. There are arguments either way.
Turning to evidence of strategic behavior, Ready presented the following table:

**Strategic Behavior — Evidence**

- High stop probability for 1/8 price moves and higher likelihood of stop when a limit order is at the quote.

- Adverse Selection Impact of Stops on Limit Order Profitability:

<table>
<thead>
<tr>
<th>Market Order Handling</th>
<th>Limit Order Profit (or potential profit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exec. immed. at quote</td>
<td>5 min. 0.086</td>
</tr>
<tr>
<td>Stopped, then at quote</td>
<td>One day 0.048</td>
</tr>
<tr>
<td>Stopped and improved (cross with)</td>
<td></td>
</tr>
<tr>
<td>SuperDOT Market Order</td>
<td>0.076 -0.007</td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
<tr>
<td>Immediately Improved</td>
<td>0.120 0.091</td>
</tr>
<tr>
<td></td>
<td>0.135 0.100</td>
</tr>
<tr>
<td></td>
<td>0.140 0.146</td>
</tr>
</tbody>
</table>

Indexing

53. The Search for the Holy Grail (Spring 1998)

John C. Bogle, Founder and Senior Chairman, The Vanguard Group, presented a cautionary tale the theme of which was where mutual fund performance is headed. He suggested that the search for the Holy Grail of market-beating long-term returns for mutual funds is as frustrating as was the search for the Holy Grail of the Last Supper in the Fifteenth Century. He posed the central task of investing as to realize the highest possible portion of the return provided by the class of financial assets in which one invests, recognizing that that portion must be less than 100%. Investors as a group do not, cannot, and will not be able to “beat the market,” and the overwhelming odds are against any particular mutual fund doing so over an investment lifetime. Not only must we accept that funds, irrespective of their past performance, will gradually regress to the mean over time, but we must acknowledge that the mean is the market mean reduced by costs which, on an “all-in” basis can be upwards of 2% per year.
In fact, over the past fifteen years, coinciding with a great bull market, equity fund annual returns have averaged 2.4% below the return of the Wilshire 5000 Equity Index. An all-market index fund, operated at a cost of 0.2%, would have achieved nearly 99% of the market return during the same period. The differential between actively managed and index funds will become much more important if the future holds stock market returns to a lower level, say 8%. The index fund might be expected to turn $10,000 into $30,800 at the end of 15 years, while the managed equity fund would leave the investor with $17,900.

Bogle formed the first index mutual fund, modeled on the S&P 500 index, in 1975. (He gave credit for the concept to William E. Fouse, a long-time member of the Q-Group and active participant in its seminars.) That initial fund has now been joined by some 120 competitive index funds. Bogle commented that 42 of the funds have reasonable expense ratios (0.25% or less) but that most of those are the result of temporary fee waivers, while 20 funds have unacceptable ratios of 0.75% or more and an appalling 25 even charge sales loads or 12b-1 fees. All of this in the face of the fact that minimal costs account for virtually all of the advantage of the index fund.

Indexing is threatening to become the new Holy Grail for fund investors, and it should be. How then do sponsors of traditional funds compete? Fee reductions and reductions in portfolio transaction costs are both unlikely. The answer is likely to be to create a new Holy Grail, and Bogle predicted this will be active management of a portfolio of funds. And so the game changes from picking stocks to picking funds. What are the prospects for success? Bogle reviewed (1) the actual records of the funds that did beat the market for the past 15 years, (2) the actual records of investment advisors that recommended mutual fund portfolios, and (3) the actual records of “funds-of-funds” that invest solely in mutual funds. He concluded that very few funds had beaten the market over the last 15 years, they had done it by only a very small margin, and they were probably very difficult to identify in advance. With respect to advisors, Bogle concluded that the accumulated evidence regarding the ability of the experts to select winning funds remains negative. Finally, the record of “funds-of-funds” was “the most deplorable of the lot.” His conclusion was that the likelihood of successfully locating this new Holy Grail — identifying in advance superior mutual fund performers — seems dismal.

But do quantitative strategies offer the likelihood of a positive alpha, at the expense of money managers following traditional investment research and security analysis techniques? On the one hand, Bogle does not believe that over time quantitative strategies as a group will outperform traditional strategies. Despite this, however, funds and private clients have a good opportunity to outpace traditional approaches. This is because the investment costs accompanying quantitative analysis are only a fraction of the costs encountered by traditional firms. Success will require maintaining asset size that comports with trading strategies and holding fees to reasonable levels. So he is optimistic about “quants,” and pleased with the performance of Vanguard Quantitative Portfolios, recently renamed Vanguard Growth and Income, the first mutual fund managed on the basis of quantitative, disciplined, computer-directed investment techniques. He closed with the observation “the golden rule – putting the client first – is the eternal Holy Grail we should all be seeking.”
International Investing

54. The Global Pricing of Firms
(Fall 2000)

Bruno Solnik, Professor, HEC School of Management, distributed a paper by himself and Jeff Diermeier entitled: "Global Pricing of Equity." Solnik began by describing the paradigm for asset management ten years ago as being rather simple. For equities, country factors dominated industry factors and the correlation of these country factors was rather weak. The correlation between equity and currency was close to zero, so country exposure matched currency exposure. And indeed substantial research seemed to show that country factors explained most of the variability of security prices, with industry factors much less important. Global equity management therefore was structured primarily around country asset allocation. A two step procedure involved country allocation first, and then the selection of industries and stocks within a country. Further, securities were presumed to be 100% allocated to the country of corporate headquarters.

What has changed in the globalization of economic activities? While country factors still exist, a firm with foreign activities should be valued as a portfolio of activities in each of the countries where it does business.

The value of a firm can be thought of as the sum of the present value of earnings derived in each country: \( V_i = \sum_k S_k V_{ik} \) where \( V_i \) is the value of the firm expressed in its domestic currency, \( S_k \) is the exchange rate of currency (in units of domestic currency \( i \)), and \( V_{ik} \) is the value of the distributable earnings derived from country \( k \) expressed in currency \( k \).

Next, assume a simple one-country-factor model for a purely domestic firm, where the expected beta to country factors is one. The return of the country \( k \) component, \( R_{ik} \), is written as \( R_{ik} = \alpha_i + I_k + \epsilon_{i,k} \) where \( I_k \) is the country \( k \) index return measured in currency \( k \).

Next assume no correlation between the country and currency factor risks, so the currency return \( C_k \) adds to the local-currency stock market return, and the total return on firm \( i \) is given by \( R_i = \sum \alpha_{ik} R_{ik} + \sum \alpha_{ik} C_k \) where \( \alpha_{ik} = S_k V_{ik}/V_i \) is the relative importance of a country \( k \) in the total value of a firm. Hence for the globally diversified firm: \( R_i = \alpha_i + \sum \alpha_{ik} I_k + \sum \alpha_{ik} C_k + \epsilon_i \).

The exposure to each country factor should be equal to the relative importance of the country in economic activity of the firm. Solnik discussed a number of measures that might be used to determine this relative importance. Although it is difficult to arrive at accurate measures of revenues derived from activities in different countries, revenues turned out to be the measure most susceptible to such measurement.

Solnik next discussed testing of this global pricing model. Instead of using each country as a factor, they were grouped into three regional factors: Europe, Asia and North America. The three leading currencies associated with each region were also used: the Euro, the Yen and the U.S. Dollar. A domestic index for each country was established by identifying in each country the set of companies that were purely or close to purely domestic in their business activities.

To estimate factor exposures, the researchers conducted for each firm a time-series regression of the stock returns on the domestic market factor, the foreign country factors, and the foreign currency factors as shown in the equation above. However, instead of using each foreign country as a factor,
these were grouped into three regional factors: Europe, Asia and North America, and the three leading currencies were used: the Euro, the Yen and the U.S. Dollar.

The resulting regression takes the form $R_i = \alpha + \beta_1 f_{dom} + \gamma_{reg} + \delta_{reg} C_{reg} + e_i$ where the coefficients $\beta_1, \gamma_{reg}$ and $\delta_{reg}$ are the exposures to the various factors. The net international exposure is the sum of the three regional exposures. The net currency exposure is the sum of the three foreign currency exposures.

The next step is to perform a cross-sectional regression between the estimated international exposures and the extent of international activity for all firms listed in a given country. The authors compared the estimated exposures to the degree of internationalization of the firm's activities by a cross-sectional regression with each country of domicile. For each type of exposure (domestic, international and currency) estimate the cross-sectional regression: $Expo_i = \lambda_i + \lambda_i F_i + e_i$ where $Expo_i$ is the exposure of stock $i$ to a specific factor (e.g. domestic, international, currency), and $F_i$ is the degree of foreign activity of firm $i$ proxied by the foreign-sales ratio (foreign/total).

For all the firms in the sample, the authors estimated the exposures and computed the net international exposure by summing the exposures for the three regions. On average, the domestic beta of a purely domestic firm should be 1 and the international beta should be zero. A multinational firm with no domestic activities should have a domestic beta equal to zero and positive betas on international factors.

The cross-sectional regressions of domestic exposures on foreign sales ratios gave encouraging results. For the eight countries, the intercept was close to 1.0 (not significantly different from the value of 1 one would expect for a purely domestic firm), and the slope coefficient on foreign sales was negative for all countries except the U.S.. Solnik also showed tables of the regression results for international market exposure and foreign currency exposure. It was clear that exposure to the international factor was positive and significantly different from zero, indicating that for all countries foreign sales activity translates into international stock pricing. Foreign currency exposure is always somewhat less than the foreign stock market exposure, suggesting that firms do engage in some currency hedging. The U.S. does appear to be unusual in that international exposure and foreign currency exposure show very weak relationships. U.S. Multinationals are only slightly more exposed to international market factors and foreign currency than are domestic firms. One explanation is that the U.S. economy is large and open, where firms from all over the world compete, making it more international than other countries.

The results for the pooled regression of all firms for regional exposure to foreign sales and for currency exposure to foreign sales were positive and significant.
Solnik described a number of robustness checks, which added confidence to his results.

His conclusions and implications were:

- There is strong evidence that firms are priced globally with the market taking into consideration the portfolio of international and domestic value contained within a company's aggregate value.

- It would be incorrect to assume that the location of a firm's headquarters or its trading post captures the major determinant of its stock price behavior.

- A relationship exists between the degree of domestic/international firms stock exposure as inferred from return data and its domestic/international sales. The greater the proportion of international sales the greater the likelihood that the stock responds to foreign stock price movement. The results are less pronounced for U.S. firms.

- Foreign stock market exposures exceed foreign currency exposures suggesting that some smoothing or hedging activity takes place. However, international firms see their stock price strongly exposed to foreign currencies. As a result, fully hedging back to home currency the accounting currency exposure typically estimated on the part of investors should result in systematic over-hedging.

- Improved estimation will require more standardized and detailed reporting requirements on the part of the corporate community. The difficulties faced in obtaining reliable data for this study shows that there is a long way to go.

55. On the Increasing Importance of Industry Factors: Implications for Global Portfolio Management (Fall 2000)

Stefano Cavaglia, Brinson Partners, Inc., presented a paper by himself, Chris Brightman and Michael Aked, also of Brinson Partners, entitled: "On the Increasing Importance of Industry Factors: Implications for Global Portfolio Management."

Cavaglia began by noting that like Bruno Solnik's work reported in the preceding session (summary 54), his research indicated that industry factors have been growing in relative importance and may now even dominate country factors in determining equity returns. He did, however, note that there is no single best method to assess the relative importance of industry and country factors.

In reviewing the literature he referred to three sets of results. Some have found that the marginal contribution of industry factors, once country factors have been included in the model, adds little explanatory power. A second set of analyses has tested the frequency with which industry factors have been significant contributors to excess returns, generally indicating increased significance over time. A third set has examined measures of the volatility of the factor contribution of industries and of countries, concluding that country factors have been more volatile than global industry factors. Cavaglia concluded that the studies reviewed suggest that industry factors have been relatively less important than country factors. But the conclusions are sensitive to the model estimated, the countries considered, the industry definitions utilized, and the time period analyzed. The authors here estimated a factor model for twenty-one developed equity markets covering the period December 1985 through November 1999.
Their results suggest that industry factors are now economically more important than country factors.

Cavaglia noted that their choice of countries contrasted with those used in other recently published studies. Their twenty-one countries comprise the current MSCI world developed markets universe. He also believes that the FT/S&PS thirty-six industry classification provides a more homogeneous grouping of securities than the choice of industries used in previous studies.

The empirical analysis was conducted on weekly local excess returns. A factor model was utilized focusing on the industry and the country characteristics of asset returns. The factor model was:

\[ R_i(t) = A(t) + L_{S_j}(t) \cdot R_{S_j}(t) + L_{C_{ik}}(t) \cdot R_{C_{ik}}(t) + \epsilon_i(t) \]

where \( R_i(t) \) is the excess return on security \( i \) at time \( t \), \( A(t) \) is a global factor return common to all securities determined at time \( t \), \( R_{S_j}(t) \) is the factor return on industry \( j \) at time \( t \), \( R_{C_{ik}}(t) \) is the factor return on country \( k \) at time \( t \) and \( L_{S_j}(t) \) and \( L_{C_{ik}}(t) \) are the factor loadings on the respective factor returns for asset \( i \) at time \( t \). The factor loadings are fixed over time and can take values only of zero or one. This means that securities in the same country have similar exposures to domestic and global factors, something Cavaglia conceded is somewhat unrealistic. They also assume that industry effects are global in nature. The model is, however, a tractable one in determining the relative importance of country and industry factors driving securities returns. The cross-sectional regression above can be estimated over time to obtain a time series of the factor returns on industry and country.

Cavaglia noted that the industry definitions may be somewhat out of date, but were those in 1985, at the start of their data series. They therefore seemed most appropriate in tracking industries investors recognized from that date forward.

The measure of the relative importance of industry and country factors was of particular interest. This is one proposed by Rouwenhorst. The measure – the mean absolute deviation (MAD) – can be thought of as the capitalization weighted returns of perfect foresight strategies that are exclusively based on either industry or country tilts. The definition of the industry MAD is:

\[ MAD(t) = \sum_j W_j(t-1) |\hat{\beta}_j(t)| \]

where \( w_j(t-1) \) is the capitalization weight of industry \( j \) at time \( t-1 \).

It turns out that the MAD using industry factors was less effective than that using country factors until around the beginning of 1998, and has proved more successful since then. It also appears that country factors have become somewhat more correlated in the past two years, while industry factor correlations have been fairly constant, although higher than those of country factors, for several years.

Further comparisons show that from 1985 through 1994 for any given number of securities in a portfolio, country diversification was more effective than industry diversification in reducing portfolio variance. But as we move to the last two years the reverse has been the case.

Cavaglia concluded that the results he reported suggest that industry factors have become an increasingly important component of security returns. More important, diversification across industries now provides greater risk reduction benefits than diversification across countries. One implication of this is that unintended industry exposures resulting from equity benchmarks that are biased towards the home market may result in increasingly inefficient global
asset allocations. Another is that active
global equity investment management
will increasingly need to balance the
return to risk tradeoffs of global industry
allocations in addition to country
allocations. Finally, stock selection
opportunities may increasingly reside in
relative comparisons of stocks across
countries but within common global
industries.

56. Do Foreign Investors Destabilize
Stock Markets? The Korean
Experience in 1997 (Spring 1999)

Réné M. Stulz, Everett D. Reese
Professor of Banking and Monetary
Economics, Department of Finance, Ohio
State University, distributed a paper
entitled: "Do Foreign Investors
Destabilize Stock Markets? The Korean
Experience in 1997," by himself, Hyuk
Choe, and Bong-Chan Kho of the Séoul
National University. He began by
recounting the allegations made in the
second half of 1998 by a number of
political leaders and journalists that
foreign investors exert a destabilizing
influence on emerging economy stock
markets. The claim was that foreign
investors display both herding and
feedback trading and that these
characteristics are destabilizing. The
authors tested these allegations using
data from trading on the Korean stock
market from November 30, 1996 to the
end of 1997, a period that included
Korea's dramatic economic crisis in late
1997. A dollar invested in Korea's stock
market index on October 1, 1997 would
have been worth $.35 on the last day of
trading in that year. Korea is a
particularly good market to study,
because for each trade on the Korean
Stock Exchange it is possible to classify
the buying and selling investors as
Korean individual investors, Korean
institutional investors, or foreign
investors. Indeed, data of this kind are
not available for any other market.

The existing literature reported
evidence of a positive contemporaneous
relation between foreign trades and stock
returns using low-frequency data,
essentially annual data. The difficulty
with low-frequency data is that the
evidence could be consistent with
foreign investors being positive feedback
traders, or foreign investors having a
price impact, or foreign investors
anticipating rising prices. Stulz was able
to report the results of high frequency
trading. His results incorporated day-by-
day statistics as well as statistics by five-
minute intervals.

The study was complicated
somewhat because of foreign ownership
limits imposed by Korea, and limitations
on price movements to 8% per day, with
the market simply closed once the 8%
move had been achieved. The result was
that a number of trades had to be
excluded from the study.

Some initial statistics indicated that
over the full period of the study,
including the period of dramatic decline
in the market index, value weighted
foreign ownership for all stocks on the
exchange actually rose, and percentage
of foreign ownership of stocks included
in the sample studied changed very little
over the full time period. Hence there
was no basis to the argument that
foreigners had left the market as it sank,
although of course the value of their
holdings declined. It also turned out that
their percentage of daily trading volume
was not disproportionate to their
percentage ownership. The same was
true of their percentage of daily price-
setting volume. A price-setting buy trade
was defined as a trade where the buy-
side order was received at the exchange
later than the sell-side order. Similarly
for a price-setting sell trade.

Three questions to be explored were
whether foreign investors tended to herd
in their trading on the Korean exchange,
whether they showed feedback trading,
and whether either phenomenon led to destabilization. Stulz began with the herding question. The herding measure for a given stock day was computed as:

$$\frac{|p_{it} - E(p_{it})|}{E[p_{it} - E(p_{it})]}$$

where $p_{it}$ is the proportion of foreign investors buying stock $i$ on day $t$ among all foreign investors trading that stock on that day, $E(p_{it})$ is the expected proportion of foreign investors buying on day $t$ relative to all foreign investors. $E[p_{it} - E(p_{it})]$ is an adjustment factor computed assuming that in the absence of herding the number of foreign investors with net purchases follows a binomial distribution. It was clear from the tables presented by Stulz that the herding measures were uniformly positive before the Korean crisis. There was, however, no evidence that herding became more important during the crisis than it was before.

The next question was whether foreigners had proved to be positive feedback traders. Such traders will buy following positive returns and sell following negative returns. At the individual stock level, foreign investors were positive feedback traders in both the pre-crisis and the crisis periods. But at the market level they were positive feedback traders at the pre-crisis period but significantly contrarian during the crisis.

So there was some evidence of both herding and feedback trading, and the next step was to test whether either activity was destabilizing. The testing now took the form of event studies, and trading during five-minute intervals was observed. Interval zero was the five-minute period during which there was an order imbalance, either on the buy or sell side. The market returns for that five-minute interval and the five preceding and five subsequent five-minute intervals were tabulated. A buy (sell) order imbalance is destabilizing if it leads to succeeding price increases (decreases) that carry prices upward (downward) well beyond fundamental values. For each of the five-minute intervals for each of the 414 stocks in the sample over the sample period, foreign order imbalances (foreign buy volume less foreign sell volume) were computed and the five intervals for net buy imbalances and net sell imbalances with the largest foreign order imbalances in absolute value were identified. For each of these 10 events, stock returns were examined for the previous five and the subsequent five intervals surrounding the event. It turned out that foreigners were buying following price increases. The price increases continued for one period after the purchase by foreign investors, but then the returns became insignificantly different from zero. So if there was positive information in the foreign net buy imbalance, it was impounded in prices immediately since five minutes later prices seem to have adjusted. This was true for the pre-crisis period. During the crisis period there was no longer any evidence that foreign net buying imbalances followed positive returns. And the net buy event seemed to have no positive effect on subsequent returns.

For net selling events, the results were somewhat different. Before the crisis, the returns were not negative before the event, in fact they were significantly positive. There was a large negative return associated with the event, but there were significant positive returns for four periods after the event. As a result, the cumulative return associated with the event was small in absolute value and insignificant for mean-adjusted returns. During the crisis period, the event return was larger in absolute value, and as a result the reversals in subsequent periods offset about half the price impact of the sale.
The final conclusion then was that neither buying imbalances nor selling imbalances by foreign trading were destabilizing, either in the pre-crisis or in the crisis.

Stulz’s conclusions can be listed as:

Before the Korean crisis over the last months of 1997, foreign investors engaged in positive feedback trading and in herd trading. During the crisis, the evidence of positive feedback trading was much weaker with some evidence that herding was less important.

An investigation of the impact of episodes of heavy foreign trading on stock prices during the day or across days offered no convincing evidence that foreign equity investors played a destabilizing role in the equity markets of Korea.

57. Narrow Markets and Global Stocks (Spring 1999)

A paper was distributed entitled: "Global Stocks and Narrow Markets" by Vinod Chandrashakaran, Senior Consultant, Research, Ken Hui, Senior Manager Research, and Andrew Rudd, Chairman and CEO, all of BARRA, Inc. The presentation was begun by Andrew Rudd, who posed the hypothesis that a group of large multinational companies has evolved to present a global source of risk substantially unrelated to individual local country markets. Put another way, a new global factor has emerged and should be added to the local and industry factors commonly used in equity investment analysis.

A number of companies, and Rudd suggested some names, appear to have become disconnected from local market factors related to their base location. Their activities are widely diversified around the globe, and their local contact is largely a matter of history, culture, location of head office and currency of accounts. If we were to recognize a significant global factor, it might make sense to place global companies for purposes of analysis in a separate group. This would recognize explicitly the source of risk arising from the global common factors. And the local market factors, without these companies, would become more local and less correlated.

Rudd traced a body of research on the subject dating from as early as 1978. None of that research made a strong case for the recognition of global factors. The most recent, the work of Chaumeton & Coldiron, in 1999, said that "We find some — but still only limited — evidence that global companies represent a true asset class."

The presentation was taken over by Ken Hui to report on empirical results. The factor structure tested is based upon (1) the local market beta, so that the exposure is zero for assets not based in the host country, (2) a global industry group, again with exposure zero for assets not in the industry group, and (3) four global common factors: size, value, success, and volatility. The results shown by Hui indicated no evidence of a missing factor.

Next, testing was done explicitly for a global factor using the specific returns from BARRA’s G,R&S model. One hundred twenty-two global stocks were selected as of January 1994 and flagged with a dummy variable. A cross-sectional regression was then run over the FT-World Index. The significance of the parameter estimates were examined to test for a global risk factor and the significance of the time-series mean of the parameter estimates was examined to test for a global returns factor. There was no evidence of either factor. Limiting the sample to 85 global companies led to the same result.
Next came a principal components test. The 30 largest non-U.S. global companies were selected as of January 1994, and compared to another 30 "control" companies in the same country and industry. A principal components analysis was run on the specific returns of the 60 companies using data from January 1994 to December 1998. The first two principal components did appear to be weakly correlated with the identification of global companies, but the results were felt to be no more than suggestive.

The next test was independent of the G,R&S model. This was run over 14 countries. For each country the return was computed to an equal-weighted and currency-hedged global market portfolio. The portfolio consisted of up to 150 companies but excluded any companies from the particular country. The "pure" local market return was then computed, defined as the residuals of the local market returns to the global market portfolio. A time series regression was then run using data from January 1994 to December 1998 to estimate the exposure of an asset in a country to the global market and pure local market. Hui showed a table of the average global and local exposures in the 14 countries. The global market effect proved to be strongest in Finland and Switzerland, while the local market effect dominated the global effect in Japan, the U.S. and the U.K. The U.S., in fact, showed the lowest average global exposure of all 14 countries.

Summarizing the results so far, Hui observed that there had been no evidence shown of a missing factor. At the same time, the size effect had been substantial. On average, large companies had benefited indiscriminately of whether they were global or not. This led into a discussion of the narrow markets phenomenon and Rudd took over the presentation again.

A narrow market is generally defined to exist when relatively few stocks outperform the benchmark and a vast majority underperform. The situation is particularly important to active managers, who generally equally weight the stocks in their portfolios. Narrow markets can arise because a few stocks with relatively large weights in the index outperform by a small amount or because a few stocks with relatively small weights in the index outperform by large amounts. The empirical evidence reported by Rudd suggests the former explanation. This of course implies that a portfolio assigning equal weights to all assets will underperform the index. Rudd presented a substantial amount of evidence for the existence and persistence of narrow markets, which are most prominent in the U.S. and the U.K.

Further research on the performance of the top 50 cap stocks in the U.S. suggested that a part of the explanation for the recent occurrence of narrow markets rests with strong returns to the size factor. This in turn raises the question whether there exists a mega-cap factor that would explain the performances of these portfolios. It turns out that while there is some evidence of a mega-cap effect in the U.S. there is none to support such an effect in the U.K., and we have to conclude that there is no global mega-cap effect.

58. The Emerging Markets: A New Paradigm? (Spring 1999)

Dean S. Barr, Chief Investment Officer, Active Quantitative Investment Group, and Joshua Feuerman, Head of Active Emerging Markets, State Street Global Advisors, distributed a working paper entitled: "The Emerging Markets: A New Paradigm?"

Barr began the presentation by describing the economic motivation for investing in emerging markets. Risk
reduction benefits from diversification were anticipated and were certainly achieved in the early 1990s when emerging markets were added to domestic and non-domestic asset classes. Return enhancement was clearly also an objective. The expectation was that economic (GDP) growth would lead to stock market growth and that superior economic growth would lead to superior stock market growth. For the U.S., the correlation between real GDP growth and subsequent quarterly returns on the S&P 500 Index was consistent with this expectation. The potential for economic growth in emerging markets was seen to be substantial, since these markets are home to over 85% of the world's population and 25% of world GDP, but represent only 4.4% of the world's equity capitalization.

What appears to have gone wrong recently, particularly in 1998, is that the emerging markets have failed to deliver either the expected diversification or the return enhancements.

Barr presented comparisons of the minimum variance portfolios from 1992 through 1998, consisting of three asset classes: U.S. equities, non-U.S. equities in developed nations, and equities in emerging markets. For the first time, in 1998, there was a zero percentage of emerging markets equity in the minimum variance portfolio.

Joshua Feuerman picked up the presentation at this point, to expand on the rationale for expecting economic growth to lead to superior equity performance in emerging markets. The experience in the OECD was similar to that for the U.S., where equity returns clearly followed economic growth.

So the question was whether something happened in 1998 to contradict the picture of the three asset classes for equity allocation. His answer was that nothing had happened, but the original picture had been mistaken. The correct picture is one of a single equity asset class, allocated among approximately 50 countries, rather than one of three asset classes. The set of minimum variance portfolios for the years 1992-1998, where the task is to allocate among 50 countries rather than three markets, shows right through 1998 substantial allocations to individual countries that qualify as emerging markets, although some of these minimum variance portfolios would have been clearly impractical, certainly for institutional investors, because of liquidity limitations.

In conclusion, Feuerman maintained that the motivation to invest in emerging markets remains intact, despite the events of 1998. The problem is simply that the initial paradigm that supported emerging markets as an asset class was misspecified. There is, in fact, a single world equity class made up of many markets.

59. Re-Emerging Markets
(Spring 1998)

Philippe Jorion, Professor of Finance, University of California at Irvine, presented a paper by himself and William N. Goetzmann of the Yale School of Management, entitled: "Re-Emerging Markets."

The research represented a continuation of the analysis presented by Goetzmann at the Spring 1997 Q-Group Seminar. The theme was an investigation of survivorship bias on the apparent superior investment performance of emerging markets.

Jorion prefaced the discussion of his research with a number of graphs showing for the stock markets of Japan, Germany, Portugal and Peru very impressive real rates of return since
those markets were most recently established (in 1951 for Japan and Germany, in 1978 for Portugal and in the 1980s for Peru) compared to real returns for the United States stock market since about 1921. The earlier history of those foreign markets however, from 1921 for Japan and Germany, 1931 for Portugal, and 1956 for Peru, shows that real returns over the longer periods have been much lower than the U.S. real return, and in a couple of cases negative. These statistics suggest that the recent history of those foreign markets may be a poor predictor for the future.

Previous research had posed a simplified model where all markets start at the same time and are eliminated as they fall below a performance threshold, and showed that high ex-post mean rates of return are a direct consequence of survival. The present research differs by analyzing the effect of conditioning upon recent emergence rather than disappearance. The previous analysis can be thought of "down and out" conditioning and the current paper as exploring the effects of "last time up" data.

The research involved the use of simulations and the analysis of historical data. One hundred year histories of the global market annual return $R_{m,t}$ were simulated with returns with an annual mean of 10% and an annual standard deviation of 20%. Local factors, $\epsilon_{k,t}$, were drawn from a normal distribution with a mean of zero and a random standard deviation drawn from a uniform distribution between 10% and 30%. The constant loadings for the local markets, $\beta_{k,t}$, were drawn randomly from a uniform distribution between 0 and 2. Markets were assumed to begin randomly with starting dates drawn from a random uniform distribution over the interval $t=1$ to $t=99$. Capital appreciation returns were constructed for each market assuming no dividend payments, and each index was cumulated from its inception until the last period, to create stock market indices for 100 markets for 100 years. Finally, the local markets were "censored" by dropping those which were below a threshold at terminal date. Jorion pointed out that the basic assumption was that the market model applied to each local market, with its expected return dependent on the global index and the local market data. What matters to emerging market investors is the difference between the mean annual return of the series of returns for a local market since the time of last emergence, less the expected return of the series. This "bias" can be defined as:

$$Bias_{k} = \left[ \frac{1}{T-t} \sum_{t=t+1}^{T} R_{k,t} \right] - \beta_{k} \left[ \frac{1}{T-t} \sum_{t=t+1}^{T} R_{m,t} \right].$$

In addition to determining the bias in rate of return, the research was aimed at the relationship between conditional beta and emergence, $R^2$ and emergence, and finally, the additional information provided to investors by the start date of the series in relation to the emergence date of the series.

A graphic representation of the simulation results showed clearly the bias rising from about zero when the year of last emergence was close to 0, to about 5% when the year of last emergence was around year 95. This was quite consistent with the empirical observations Jorion had shown earlier. It also turned out the observed beta declined as the time since most recent emergence shortened and the $R^2$ did the same. In addition, it turned out that average returns just before the time of last market emergence were low and in fact negative, while those just after the market emergence were very high but tapered off.

Next he turned to market data. A plot of global market betas against year
of last permanent break in the continuity of a market showed that the old markets (in particular the U.S. stock market) showed high betas while the ones with the shortest histories since re-establishment showed the lowest, consistent with the simulation results. Actual real returns were also consistent, with those of the markets with the longest history lowest and those with the shortest history highest. Data for performance around the time of emergence were consistent as well.

In concluding, Jorion observed that emerging markets appear to offer high returns and low correlations with other markets. The simulations, which assume no mispricing of emerging markets, show that the high returns with low betas are due to recent emergence. The simulation results are confirmed by empirical analysis, which shows that average returns on markets that have just emerged are temporarily high. He suggested that in addition to survivorship bias there might be two other causes of the high returns in recently emerged markets. The availability of those markets, and their inclusion in indexes, could have attracted by themselves a surge of investment which, in a thin market, could drive prices up significantly. In addition, if the emergence of the market were due to economic progress including liberalization of opportunity, the surge in returns could be due to a surge in economic activity. In either case, however, there would be no reason to expect that the superior performance following recent emergence was a suitable basis for forecasting future performance.

60. Balance of Payments Crises (Spring 1998)

Rudi Dornbusch, Ford International Professor of Economics at the Massachusetts Institute of Technology distributed a paper entitled: "Asian Crisis Themes." He began with a number of provocative questions. Are there really crises in emerging markets? Are there really poorly managed economies? Why do we see entire countries subject to a sudden meltdown? Why these particular countries? Will China and Hong Kong follow Indonesia? Some of his answers were reassuring. He said that in asset and exchange markets, outside Indonesia, the Asian crisis is mostly over. At the same time, he suggested countries in which there may be crises to come. And he suggested that by reviewing a number of specific cases we might come to understand the combinations of factors that explain the crises we are seeing in Southeast Asia, and this will help us to predict crises to come.

Thailand is a particularly interesting example, from which there is much to be learned. A first look at the Thai economy would hardly have raised suspicions. The economy showed strong growth with negligible inflation, continued budget surpluses, a conservative fiscal policy, and a very high savings rate. The large current account deficit was one danger sign. The real exchange rate was high, but did not seem alarmingly so. Thailand also had very large reserves at least to begin with. The Thai problem was vulnerability. If something went wrong, then suddenly a great deal was likely to go wrong. A very shaky banking system was made more shaky by the dollar debts of its clients – a very large and short maturity foreign debt with the resulting risk of a funding crisis. The Bank of Thailand could not raise interest rates to attract external financing without making the loan problems of the banks much worse. And it could not reduce interest rates, to help the banks, without increasing the risk of an external funding crisis. The decision in May to cut interest rates created a free opportunity to bet against the Bhat. The central bank, encouraged by the illusion
of a strong reserve position, took on the defense of the Bhat and lost all of its reserves. From the experience of Thailand and some other countries, some of the danger signs can be discerned. A banking system that is simply making improvident loans is one. A mismatch of currencies, borrowing in hard currency because interest rates appear low and lending in the local currency because rates appear high, particularly when combined with short maturity borrowing, is a recipe for disaster. Bad supervision and regulation of banking add to the problem. When the same set of circumstances exists in a number of countries, as it did in Southeast Asia, it is easy for a financial crisis to spread. Institutional investors, having lost heavily as their assets in one country depreciate in value, will quickly turn to selling assets not in that country, but in one that has so far escaped the crisis and preserved asset values. And so the crisis spreads.

How does a country avoid a meltdown? Hong Kong has very strong banks with good credit standing. The currency board is strong and foreign exchange reserves are well above foreign debt. In addition, China would probably be ready to help. Those who sold the Hong Kong dollar short gave up fairly soon, realizing they could not create a devaluation. Taiwan has some of the same advantages. The central bank holds in reserves four times the foreign borrowing of the private sector. Singapore has the best banks in Asia.

Are the data available that would enable one to identify likely candidates for a crisis? The Bank for International Settlements publishes data from which one can determine the ratio of central bank reserves to short-term debt, although there appears to be relatively little interest in the use of these statistics. They suggest that Eastern Europe is at present very vulnerable, with Russia and the Czech Republic particular candidates for a crisis. Some might expect the IMF, with the detailed knowledge it possesses, to issue public warnings. But this is one thing the IMF cannot, as a practical matter, do.

Turning to steps that could be taken to avoid a crisis, Dornbusch suggested that the combination of a currency board and strong banks can be a good one. Currency boards, on the other hand, without strong banks, are likely to convert a currency crisis into a banking crisis. And capital controls are generally a poor idea.

China and Japan pose interesting risks. If China were to devalue, the Asian situation would take a turn for the worse. There would be a further round of currency depreciation and stock market decline, with a spill-over to Japan and even to Europe and the U.S. Devaluation, however, is not very likely. The Japanese situation is more serious. Japanese banks are being downgraded, the budget deficit is alarmingly large, the government’s debt is huge and if unfunded pension liabilities are included, reaches levels over 200% of GDP. Japan is teetering on the very verge of a 1930s style collapse of financial institutions, confidence and economic activity. Government officials do not know what to do. Japan is trapped. If all goes well, the country will putter along with near zero growth. If something goes wrong, and it may not take much, the economy will go over the cliff and pull down the Asian region in the process. Japan is the weakest link in the world economy, and Asia has the misfortune of being next door.

61. The Role of Country and Industry Effects in Explaining Global Stock Returns (Spring 1998)

Paul Pfleiderer, William F. Sharpe Professor of Finance, Stanford University distributed a paper by himself and Terry
Marsh entitled: "The Role of Country and Industry Effects in Explaining Global Stock Returns."

He confessed to begin with that his paper did not reach any very definitive conclusions. It is extremely difficult and perhaps impossible to reach definitive conclusions on his topic. Yet the results may be helpful in a number of ways. Investors seeking diversification in foreign markets may be guided in their selection of both countries and industries. And it may be helpful to know the extent of product and capital market integration.

He observed that if one wants to decompose variance in an unambiguous and meaningful way, the components must be both economically meaningful and orthogonal, or nearly so. His research assumes that the country and industry factors are orthogonal. Country factors will arise if industries are not global and firms are differentially influenced by local markets, and/or capital markets are segmented.

One model for the influence of industry and country factors is:

$$\tilde{r}_{k,t} = E(\tilde{r}_{k,t}) + \delta_{G,t} + \delta_{C(k),t} + \delta_{I(k),t} + \tilde{e}_{k,t}$$

Where $C(k)$ is the country that firm $k$ is in and $I(k)$ is the industry of firm $k$.

The assumption here is that all stocks in a particular country have the same sensitivity to that country factor, and all stocks in a particular industry have the same sensitivity to that industry factor. The alternative model, offered by Marsh and Pfeifer, allows firms to differ in their sensitivities and takes the form:

$$\tilde{r}_{k,t} = E(\tilde{r}_{k,t}) + \beta_{G} \tilde{g}_{t} + \beta_{C(k)} \tilde{c}_{(k),t} + \beta_{I(k)} \tilde{i}_{(k),t} + \tilde{e}_{k,t}$$

Whereas previous research had generally dealt with country market indexes, and the extent to which indexes can be explained by the industrial composition of the country market and how much is due to a country factor, the authors here worked with individual stocks. They had data for 239 local daily returns for the year ending July 10, 1997, for 2839 stocks. Companies in the Dow Jones Global Index (DJGI) had been classified using a 68 industry classification system. Companies in the Morgan Stanley Capital International (MSCI) World Index were classified in a 38 industry classification. Hence it was possible to see the difference in results between "coarse" and "fine" classifications.

The paper reported the percentage of total explained variation due to the country factor. When only country and industry factors were used, the percent explained by industry was simply the complement of the percent explained by the country. When a global factor was added, the paper reported the percent explained by industry in addition to the percent explained by country factor.

The first set of results were for the 2839 stocks in the DJGI. The percent of variance explained by the country factor was highest for the stocks in Switzerland at 93.0%, and lowest for Ireland at 30.7%. On average, it was 77.72%. It turns out that for Ireland there are only 11 stocks in the DJGI, and most of those stocks were "international" stocks. So the statistics for Ireland were probably meaningless. This case illustrated some of the problems in using individual stocks for the analysis.

A comparison of the analysis using the "coarse" and "fine" classifications had the surprising result that the "coarse" classification explains more of the fitted variation in returns. Pfeifer discussed some of the possible reasons for this.
When the global factor was introduced, not surprisingly the explanatory power of industry decreased substantially for a number of industries that tend to be quite global. For some industries that tend to be local, the industry factor explained relatively more of the variation in returns.

Pfleiderer compared the relative importance of country and industry effects estimated for the DJGI with estimates for the MSCI World Index, which partitions stocks into a different set of 38 industries across 22 countries. He had no reason to believe that the use of one set of stocks is superior to the other, and by and large the results were not very different. Still, there were significant differences for a few countries.

In summary, he observed that the general factor model approach (the 2nd equation) is warranted. Results are sensitive to industry classification and to the universe of firms included in the sample. Broader taxonomies (more detailed classifications) do not necessarily lead to dramatically different results. In closing, he observed that results must be interpreted with great care.

62. The Portfolio Flows of International Investors (Spring 1998)


He began with a quick review of the relatively small amount of published research on international portfolio flows. That research has shown positive contemporaneous correlations between inflows and dollar stock returns in country markets. Hypotheses have been suggested with respect to causation, without conclusive confirmation. For the most part, previous work has suffered from inadequate data.

In this case, a substantial new database was made available. The data come from State Street Bank and Trust (SSB), and record all the transactions into and out of every custodial security. The data cover cross-border flows for nineteen developed countries and thirty-five emerging markets. Daily purchases and sales of both equities and local-currency debt are recorded. For each country the researchers had available the dollar value of these four measures, plus the number of transactions, from July 1994 through January 1998. Total transactions came to over 705 billion dollars, averaging 820 million dollars per day from over 2.7 million transactions over the sample period. The largest number of cross-border transactions took place in Japan and the UK, then Hong Kong and France. Relatively small flows into and out of the U.S. were due to the fact that SSB’s clients are largely U.S. based.

First, cross correlations of flows and returns showed slight positive correlation across countries and stronger correlations within regions. Second, a common cross-country component was extracted from flows to each region. Principal components proved particularly useful in showing cumulated inflows. It appears that foreign investors held fast during the Mexican crisis and slightly withdrew assets in the midst of the Asian crisis.

Turning to the relationship between inflows and prices, Froot used the detrended principal component of emerging market inflows and
cumulative emerging market equity returns to show that the inflows and the equity prices tend to move together at low frequencies.

With the principal component analysis it is useful to distinguish the common factor from an idiosyncratic county-specific flow. The latter for a given country is the residual from a regression of the total flow on the principal component. It turns out that there is a considerable common component in the flows but the orthogonal country-specific components are important as well.

The research found that inflows and outflows are highly persistent. In the U.S., we find little auto-correlation in the S&P Composite Index, but in emerging markets there is substantial persistence. The persistence exists at lower as well as higher frequencies. The low frequency persistence is important because it implies that the findings are not an artifact of dating problems or imprecision about the trade versus settlement date. (The data are ordered by settlement date, although it is possible to make some estimates of the corresponding trade date.)

Equity market returns also gave evidence of high frequency persistence, particularly for the emerging markets. (In the U.S. today there is no such persistence and even some negative auto-correlation.)

The interaction between flows and returns was a particularly interesting topic. As well as being precise about the timing of the covariation of flows and returns, the researchers tried to be precise about whether the covariance is due to the common component of cross-country flows or to idiosyncratic country flows. To do this, they estimated what they called "covariance ratio" statistics. This statistic is made up of three components reflecting covariance between concurrent flows and returns, covariance between current flows and past returns, and covariance between past flows and current returns. Each of the components is estimated. The results demonstrated an increase in flow/return covariance with time horizon. In emerging markets, inflows predict on average positive future returns. The price increase does not occur over a few days. Prices seem to rise subsequent to inflows for weeks and a month or two. In developed markets, however, inflows do not forecast positive returns. In some instances, returns are negative and even statistically so. For the world overall, there is little predictability of future returns from past flows.

For emerging markets, it appears, despite the conclusions of some earlier published research, that international investors have a marginal informational advantage over local investors.

Further, the results suggest that idiosyncratic flows move prices less than common component flows. Idiosyncratic flows also seem unrelated to past returns and have little predictive power for future returns.

A further step concluded that returns predict flows over and above the prediction of lagged flows, and flows predict returns over and above the predictions of lagged returns.

A last finding was that while a positive flow has a positive impact on returns, if the flow proves to be transitory and declines, then returns decline. The elasticity here is quite high. A single basis point increase in inflows can increase prices by 300 basis points. A reduction in what proved to be a transitory inflow can reduce prices by 45% of the increase.
Long Term Capital Management
— LTCM

63. Long Term Capital Management: An Insider’s Perspective (Fall 1999)

David Modest, Former Principal of Long Term Capital Management, described the rise and fall of LTCM. He began with some of the lessons that can be learned from the LTCM experience. The efficient market hypothesis is the only sensible departure point for thinking about asset prices and financial market equilibrium. The financial markets are constantly out of equilibrium and the function of the financial services industry is to bring prices back to equilibrium. But this process takes time, and before equilibrium is attained a fresh shock is likely to disrupt it. Knowledge barriers are high, and the path to equilibrium is uncertain. The rewards to being different, and therefore helping to bring markets back to equilibrium, are small, the time horizon can be very long, and almost no long-run investors with the understanding and institutional freedom to maintain “value investments” can avoid worrying about and reacting to the mark-to-market risks. In sum, the amount of fungible “smart” capital is very small relative to transitory imbalances in supply and demand. The opportunities are there but taking advantage of them is extremely difficult.

Modest described LTCM’s type of relative-value investing as focused on those opportunities that arise from providing capital market intermediation services to the marketplace. Providing these services is profitable because of capital flows that are attributable to end-user demands, accounting regulations, and regulatory rigidities, and the fact that buyers and sellers of securities frequently do not appear in the marketplace simultaneously. Profits arise from buying assets below and selling assets above their long-run equilibrium prices where the equilibrium price is the value that would prevail if all capital were instantaneously available for its most productive use. The simplest example of LTCM’s investment strategy was shorting the on-the-run thirty-year treasury bond and buying a very similar treasury security (e.g., the previously issued thirty-year bond).

He stressed the point that LTCM was not significantly involved in buying lower-credit securities and selling or shorting higher-credit securities. LTCM did not claim any special expertise in assessing stock-specific or country-specific credit risk and avoided risks of that sort. LTCM claimed no informational advantage over its competitors, and indeed assumed that it probably was at an informational disadvantage. Prior to undertaking an investment, LTCM required an analytical model that identified a specific mispricing, placed it in an historical perspective, and provided an effective way to hedge the market risks of the trade. In addition, LTCM’s operations required an understanding of why the mispricing was occurring. So both market and economic analyses were involved, in addition to clever mathematical models for identifying mispricing.

Modest described the structure of LTCM, a single portfolio company with many feeder funds and three management companies, located in Greenwich, London & Tokyo. In order to be able to provide liquidity to the market and to be in a position to hold investments until convergence, investor capital was committed for an initial three years and the term financing of its positions required establishing financial rates and haircuts for extended periods.

The fund was registered off-shore, filed U.S. tax returns, and was subject to essentially the same regulatory regime as
if it were in the U.S. The three management companies were subject to the regulatory oversight of a primary regulator in each of three countries. Although LTCM did not disclose individual investments for competitive reasons, as a practical matter those with whom it did business — broker-dealers, lenders, credit and trading counter parties — were very familiar with its condition and activities.

Modest had provided in a brief handout descriptions of five typical strategies used by LTCM and he did not discuss them further. In addition to the strategy involving on-the-run and off-the-run treasuries, these included taking advantage of the oversupply of convertible bonds in the Japanese market and of abnormal swap spreads, benefiting from a discrepancy between the long German swap spread and the short UK Gilt swap spread, and taking advantage of large price discrepancies between different share classes of the same company, for example going long shares of Shell Transport and short shares of Royal Dutch. Modest described the risk management process, in which all fifteen partners participated in weekly meetings where all important decisions were made. Positions were sized based on expected gains, risks (volatility and stress loss), liquidity, concentration, and working capital required in stress situations.

The average leverage of LTCM was about 25 times capital. Given a return on assets over the cost of debt of about 1%, a lot of leverage was necessary to achieve a good return on capital. Modest did not believe that the leverage was unduly high. He considered that the overall size of LTCM and concentration of positions were both more important than leverage as a source of ultimate trouble. Had LTCM been only one tenth of its actual size, Modest believed it would have survived. Other financial institutions suffered at the same time from the same kinds of transactions in the Summer of 1998, but their activities were on a small scale and they were protected by a diversification of business that LTCM did not enjoy. The effect of size was amplified in Modest’s opinion by a failure to perceive sufficiently the impact on the market that LTCM would have.

He reviewed tables he had distributed of the monthly capital balance and monthly performance of LTCM from its inception in early 1994 through April 1999. Through April 1998, the annualized gross return was approximately 40%; LTCM’s worst monthly net performance was -2.9% and the fund had never experienced two consecutive negative months. The annualized standard deviation was approximately 11.5%, somewhat below the target volatility which was planned to approximate the volatility of the S&P 500 Stock Index.

As of the end of April 1998, the month-end value of one dollar invested in February 1994 was over four dollars. At the end of June that figure was $3.44, and at the end of September it was $0.33. Turning to what happened in August 1998, Modest observed that the financial crises in Asia and Latin America and the default in Russia caused major losses and forced many institutions to move en mass to liquidate their positions in many markets. What resulted was a downward spiral that fed upon itself, driving market positions to unanticipated extremes well beyond the levels incorporated in risk management and stress loss discipline in LTCM. Many institutions liquidated in weak markets, driving individual investment positions to extremes. With this global flight to liquidity, diversification of LTCM’s investments failed. Most convergence investments moved simultaneously and adversely, due to capital constraints of firms in similar investments rather than to fundamental linkages. Liquidity dried up as
institutions pulled back simultaneously, which precluded the rapid scaling down of LTCM’s positions, balance sheet and risk. As of the end of August, LTCM had $2.3 billion in equity capital with $1.6 billion in excess liquidity and was not experiencing serious difficulties in financing its operations. However, LTCM was at that point undercapitalized and involuntarily over-leveraged.

The firm’s attempts to restore capital adequacy were only partially successful. In September the market moved systematically against LTCM’s investment positions while negative rumors about the firm made fundraising difficult at the same time as some market participants were establishing positions offsetting their risk exposure to LTCM and in the process making LTCM’s survival more precarious. On September 21, the fund experienced its largest daily loss since inception and on September 23 a consortium of fourteen leading investment and commercial banks agreed in principle to invest $3.6 billion in the fund. The investment was completed on September 28.

The experience of the LTCM investors was mixed. Twenty five investors who were paid out prior to 1998 experienced substantial annualized returns, many close to 40%. Another fifteen investors earned returns in excess of 25%. Thirty-eight investors earned returns of around 18%. Ten investors earned returns ranging from 2% to 11%, and about twelve investors suffered losses, some severe.

Modest’s concluding observations from the experience included a recognition of the importance of market-generated self-fulfilling price dynamics that move financial markets and investment positions beyond any levels justified by fundamental economic events. Risk management itself engenders such market runs and higher risk control standards are necessary for a single-business to protect itself against such market-induced price deterioration, compared to the control standards for a diversified firm with inherent cushions from the earnings of other business lines. In the business of capital market intermediation, large negative returns should be expected to be associated with substantially reduced liquidity.

Mutual Funds

64. The Behavior of Mutual Fund Investors (Fall 2000)

Terrance Odean, Professor, Graduate School of Management, University of California at Davis, distributed a paper by himself, Brad M. Barber and Lu Zheng entitled: “The Behavior of Mutual Fund Investors.”

At the Autumn 1999 Q-Group® Seminar Odean had presented a paper on the behavior of common stock investors based on data obtained from a large discount brokerage firm. (See summary 10.) In the new paper he offered a similar analysis of the mutual funds transactions of 32,000 households over the period 1991 through 1996, involving 379,000 mutual fund purchases ($3.1 billion) and 168,000 mutual fund sales ($2.3 billion).

Some significant behavioral patterns derived from the data can be described briefly. When purchasing mutual funds it appears that investors use a representativeness heuristic. That is, investors believe that recent performance is overly representative of a fund’s future prospects. They predominantly chase past performance. When selling mutual funds, however, the disposition effect – the tendency to hold losers too long and sell winners too soon – dominates. Investors do not behave as though past returns predict the future. Investors
appear resistant to buying funds that incur salient fees such as brokerage commissions or front-end loads. However, they appear relatively insensitive to a fund’s operating expenses.

Turning back to purchasing behavior, Odean showed that the choice of funds to buy was heavily concentrated in the top quintile of performance over the prior year. Relying on past fund performance is not necessarily bad, since there is some evidence that past performance is useful in predicting future short-run returns. Odean, however, concluded that investors have exaggerated reliance on prior superior performance.

The sale decision is rather more interesting. It is clear that investors prefer to sell funds that have done well rather than funds that have done poorly. This is the "disposition effect." Odean calculated the proportion of gains realized on mutual fund sales (PGR) as realized gain divided by the sum of realized gains and paper gains. He calculated the proportion of losses realized on sales (PLR) as realized losses divided by the sum of realized and paper losses. For all of the accounts studied, PGR exceeded PLR. For taxable accounts, where one might expect investors to be interested in the tax advantages of selling losers, the gap was smaller than in tax deferred accounts. For the month of December, however, when the tax effect might be expected to play a larger role, the gap for both all accounts and taxable accounts was larger than it was for the entire year. The results had been somewhat different for the study of common stock transactions reported at the earlier Q-Group® conference. There the gap for taxable accounts had been greater than the gap for tax deferred accounts, but declined very substantially late in the year. Odean discussed the interesting question whether in disposing of mutual fund shares investors treat the transaction as similar to selling a stock or as similar to firing a manager. The evidence supported the conclusion that the disposition was similar to selling stock.

The next question was whether selling winners and holding losers was a profitable or unprofitable strategy. To answer the question two portfolios were compared: one comprised of those mutual funds purchased in the preceding twelve months and the other comprised of those sold. The returns in the succeeding month were compared, using four different measures of risk adjustment. The performances of the winners sold and of the losers held were not very different.

While investors tend to shy away from fund purchases that involve large fees and commissions, they seem indifferent to operating expenses. Indeed, investors appear more likely to buy funds with high operating expense ratios. Odean showed that over time sales loads have tended to decline but operating expenses have increased for mutual funds generally.

In conclusion, Odean declared that although buying past winners can be reasonably justified, selling winners rather than losers and neglecting operating expenses when buying a mutual fund cannot. The data seemed clearly to indicate patterns of behavior that were not conducive to investment success.

65. Factors in Mutual Funds (Spring 2000)

Edwin J. Elton and Martin J. Gruber, Nomura Professors of Finance, Leonard N. Stern School of Business New York University, distributed a paper by themselves and Christopher R. Blake entitled: "Factors in Mutual Fund
Returns." Gruber began the presentation with an explanation of why the authors had chosen to direct their research to mutual funds. Understanding the return-generating process is one of the key issues in finance today, and mutual funds offer an attractive vehicle for study of the process. The mutual fund industry has an incentive to offer an array of exposures to systematic factors in order to span investors' differing objective functions. The return generating process developed from mutual fund data can then be tested on common stocks formed into passive portfolios. An additional benefit is simply understanding the systematic influences that affect mutual funds.

The sample consisted of 267 funds, chosen to eliminate bond, option, precious metal, international and index funds. The funds were in existence from January 1979 and had monthly return data through December 1993. The 267 funds were divided into three 89-fund subsamples, facilitating testing of robustness of results and in particular to see whether results derived on one set of data are generally applicable. The funds were allocated across the three subsamples such that each subsample had the same number of funds with a given objective.

Monthly excess returns over a risk free rate were initially regressed on a single index — the S&P 500 total return index — and the correlations of residuals were tabulated. Next, the excess returns were regressed on four indices, and the correlations again tabulated. The three indices in addition to the S&P 500 were a bond market index (a par-weighted combination of the Lehman Brothers aggregate bond index and the Blume/Keim high-yield bond index in excess return form), a small cap minus a large cap index (the average of the Prudential-Bache small cap growth and value indices minus the average of their large cap and value indices), and a growth minus value index (the average of the Prudential-Bache large, mid and small cap growth indices minus the average of their large, mid and small cap value indices). What we are looking for is minimal correlation among the residuals. It was clear that for all three groups of mutual funds the average correlation and the average absolute correlation was reduced substantially moving from the single index to the four-index model.

Elton took over the presentation at this time and explained the next step was to determine whether there might be a fifth factor that would still further reduce the residual correlations. The first candidate for a fifth index was derived from the data themselves. For each of the three groups the authors performed a maximum likelihood factor analysis on the residuals from the four-index model and extracted the one-factor solution. For any group, this has to be the best index that can be found for explaining the residual covariances for that group. Of course, it does not necessarily have any economic meaning. To eliminate the effect of unique influences, the factor derived from group A was used to explained the correlation in group B, the factor from B to explain C, and the factor from C to explain A.

Where the fifth index was extracted via factor analysis, there was a large improvement in the residual correlation estimates. The results showed clear stochastic dominance over the four-index model. And the difference in average absolute values of the correlation coefficients was significant at the .01 level. The next question was whether an alternative fifth index might be found that worked as well as or better than the factor approximation and that had a real economic meaning. Three alternative factors were tried: a sentiment index, a momentum index, and an index based on the performance of growth mutual funds. The sentiment index was
developed by Lee, Schleifer & Thaler based on changes in the discounts of closed-end mutual funds. The momentum index came from Carhart. And the mutual fund growth index, referred to as MGO, was derived from the Morningstar growth mutual fund index.

Addition of the last of these resulted in a model outperforming the four-index base model significantly. Indeed the results were essentially the same as using the extracted factor discussed above as the fifth index. The sentiment index did not add to the explanation of the correlations when added as a fifth index and the momentum index was clearly dominated by the MGO index.

There remained the possibility that the reduction in covariance due to the introduction of a fifth index might be picking up an independent influence or it might simply be the effect of common holdings of stocks among the mutual funds. Elton described a procedure for removing the effects of common holdings. Data on the composition of the portfolio of each fund as of December 1992 were used to identify common holdings. An indication of the importance of common holdings was obtained by correlating the residual covariances explained by the fifth factor for each pair of funds against the amount of residual covariance explained by the common holdings. It turned out that the MGO index clearly introduced information not captured by common holdings.

The next question was whether five indices were sufficient or whether a sixth index should be sought. With the MGO as the fifth index, estimates of the residual covariances were low enough to suggest that five indices capture all common influences. Elton in fact showed four separate sets of evidence supporting this conclusion.

Finally, the five-factor model was tested on passive portfolios of stocks based on size and industry. Ten size deciles from the CRSP data file and twenty-eight industry portfolios selected by using two digit SIC codes were employed. The five-factor model, employing MGO proved highly satisfactory. And as in the case of the mutual funds, the sentiment and momentum indices had little value.

The conclusions set out in the paper are:

1. A four-index model based on widely available indices of securities with different characteristics explains a great deal of the correlation between mutual funds. All of the four indices have been used in some form in previous papers, although the particular form we use has not previously been tested against alternative specifications.

2. A value-growth index based on firm fundamentals is better in explaining covariance than an index based on market-to-book values.

3. Using factor analysis, there is very strong evidence that after removing the four indices a fifth index (a factor constructed from the residuals) has strong explanatory power. This is true whether the importance of the fifth index is judged by examining the number of significant betas or by examining its ability to explain the correlation of the residuals from a four-index model.

4. A fifth index representing an equally weighted portfolio of mutual funds with growth as a stated objective performs almost identically with the factor index mentioned above. This is due in part to the fact that the correlation between the two models is extremely high. It also means that we can identify the fifth factor.
5. Some of the residual correlation between mutual funds is due to common holdings. We have presented a methodology for removing this influence. This in itself is important for studying the effect of forming portfolios of mutual funds.

6. We find that part of the performance of our fifth index (whether formed by factor analysis or a portfolio of growth mutual funds) is accounted for by common holdings, but part is due to capturing a unique influence.

7. When we examine either sentiment or momentum as a fifth index, the results are different. There is no support for sentiment. Momentum does pick up part of the covariance among funds, but its importance is primarily due to it capturing the impact of common holdings.

8. Finally, we test our five-index model on passive portfolios of common stocks. This serves several purposes. It allows us to test the performance of the fifth index where its importance is not obfuscated by common holdings. It acts as a holdout sample. It allows us to test the fifth index on a sample where the results cannot be caused by some element of active management. It allows us to see if the influences studied earlier in the paper have significance for common stock returns. The results show that MGO is important. The passive portfolios provide no support for sentiment, and using momentum does not result in a reduction in the covariance between residuals.

66. Mutual Fund Style Performance Persistence (Fall 1997)


Investment objectives and style classifications are widely used in the financial industry to characterize differences among money managers. Mutual funds are typically grouped according to the type of securities in which they invest and the "style" of their managers. Brown asked the question do these styles help to explain differences among future fund returns, or even provide useful benchmarks for evaluating relative past performance? He and his co-author proposed a new method for determining a manager's style. The approach is simple to apply, but captures non-linear patterns of returns that result from virtually all active portfolio management styles. They believe their classifications to be superior to common industry classifications in predicting cross-sectional future performance, as well as past performance, and also to outperform classifications based on risk measures and analogue portfolios. Because management styles are so widely used as the basis for performance measurement and compensation, there is a great need for style classifications that are objectively and empirically determined, consistent across managers and related to the manager's strategy.

The algorithm proposed by the authors groups funds based on the cross-sectional time series of past returns as well as on the response to exogenously specified and endogenously determined stochastic variables. Using mutual fund data from 1976 through 1994, they found that equity funds fall broadly into some familiar and some not-so-familiar patterns of behavior. The derived classifications specified ex ante appear to do a better job of predicting cross-sectional variation in fund returns than do traditional mutual fund classifications.
Morningstar Inc. provided monthly returns of equity mutual funds for January 1976 through June 1995, together with its classification into fifteen categories. The Morningstar data were merged with annual Wiesenberger data through 1992. The data identify fund objectives, and changes in fund objectives through time. In addition, data from the Morningstar "On-disc" database provide information on the composition of each fund as well as summary statistics about the securities in the fund for years since 1993. The objective of the authors' analysis was to use past returns to determine a natural grouping of funds that has some predictive power in explaining the future cross-sectional dispersion in fund returns. Such groupings they refer to as styles. The ex-post return in a period for any fund can then be represented by an alpha, plus the sum of products of factors and factor loadings, plus an idiosyncratic return component. These loadings are allowed to change through time. The factors are regarded as returns on index portfolios so that the factor loadings can be thought of as equivalent portfolio weights associated with a dynamic portfolio strategy that might be associated with the style in question. The classification procedure assumes that we know the number of styles, and the authors simply proceeded to determine the minimum number of styles necessary to perform the analysis.

It turned out that eight styles met their needs. The eight indexes were: gold, the EAFE minus global equity index, the EAFA European equity index, the EAFA Pacific equity index, U.S. Treasury bills, commercial paper, long-term government bonds, long-term corporate bonds, high-yield bonds, the S&P 500, small stocks, and IPOs.

Cross tabulation of the eight categories with Morningstar categories, indicated that category 1 corresponded to growth & income, category 2 to growth, category 3 to income, category 4 to small-cap value, category 5 to global timing, category 6 to small-cap "glamour", category 7 to international and category 8 to commodities and metal. So the analysis confirmed the important Morningstar categories.

Exploring the consistency of style classifications, the authors found an average "switching" rate of 11%, using a single 24-month window.

The next question was how well estimated fund styles explain cross-sectional variation in out-of-sample fund returns. The categories explain about one third of the variation of returns, ex ante. The Wiesenberger categories, on the other hand, explain on average 16% of the variation.

In concluding, Brown stated that the new classification algorithm identifies a few major types of fund strategies. The results validate the use of traditional, self-reported categories such as equity income, growth & income and growth. But funds apparently do not always correctly categorize themselves. One somewhat surprising divergence from standard categorization consist of a separation of the small-cap group into "value" and "glamour" managers. They also found evidence that style involves dynamic strategies, rather than simply fixed portfolio weights. Finally, the new algorithm is a potentially useful tool for decomposing "styles" into more familiar measures such as time-varying factor loadings and risk premiums.

67. Survivorship and Mutual Fund Research (Fall 1997)

Mark M. Carhart, of Goldman Sachs Asset Management and on leave from the Marshall School of Business, University of Southern California,
distributed a paper entitled: "Mutual Fund Survivorship." Observing that survivorship affects almost every mutual fund study, he posed three important questions: How does survivorship affect estimates of average mutual fund performance? How does survivorship affect tests on persistence in mutual fund performance? And how does survivorship affect estimates of the relation between performance and fund characteristics?

He identified four kinds of bias. Survivor bias arises when only funds surviving until the end of the sample period are included. That is, funds that went out of business during the sample period are excluded. Look-ahead bias results from including only funds surviving a minimum length of time. For example, a fund may be included in a sample only if it is in business for five years. The bias can arise from a selection rule. A single period selection rule may require that in order to survive in the sample a fund must always achieve some minimum rate of return. A two-period selection rule will require that the average of the fund's performance over any two consecutive years must exceed some benchmark. Finally, backfill bias arises when a fund is incorporated in a database only after it has achieved superior performance, and that preceding superior performance is then added to the database retroactively.

It turns out that non-survivors exhibit slightly higher total risk than survivors, and disappear primarily because of multiple-year (not single year) underperformance. Carhart's analysis suggested a rule of thumb relating survivor bias to the sample time length. The bias is around 17 basis points for one year samples, 43 basis points for five year samples, and approximately 1% for sample periods longer than fifteen years. However, survivor bias does differ across fund objective groups. Survivorship attenuates performance persistence. Conditioning on survival at the end of the sample period upwardly biases the relation between performance and expenses, turnover and load fees, and downwardly biases its relation to fund size. Imposing a long-term look-ahead bias causes a downward bias in the performance relation to load fees and an upward bias in the relation to fund size.

The database used by Carhart covered diversified equity mutual funds monthly from January 1962 to December 1995, and excluded sector funds, international funds and balanced funds. The full set of data are free of survivor bias, since they include all known equity funds over the period. The sample was partitioned into three primary investment objectives using Wiesenberger and ICDI classifications: aggressive growth, growth and income, and long-term growth. All funds in the sample started as general equity funds in one of these three objectives. Funds frequently changed objectives during the sample but were not dropped or reclassified. The sample included a total of 2071 diversified equity funds, 1346 of them still in operation as of the end of 1995. In an average year, the sample included 545 funds with average total net assets of 179.5 million dollars and average expenses of 1.19% per year. In the average year 3.6% of funds disappeared. Aggressive growth funds disappeared at an annual rate of 4.5%, statistically significantly larger than 2.9% for long-term growth and 3.3% for growth and income funds. The annual disappearance rate was significantly negatively related to the previous year's rate of return.

The funds in the sample earned reported returns approximately 0.6% per year below the value-weighted CRSP index. These reported returns are net of all operating expenses and security-level transaction costs but do not include sales charges. On average, the funds held
only 83.2% of their portfolios in common stocks, with 10.2% in cash and 6.6% in preferred stocks and bonds. Carhart referred to his sample as probably the most complete survivor-bias-free mutual fund database available, and it is scheduled to be published by CRSP.

Not surprisingly, non-surviving funds exhibit considerably worse performance than surviving funds, underperforming survivors by 31 basis points to 36 basis points per month, or about 4% per year. Non-surviving funds are smaller and have higher expense ratios and turnover than surviving funds. Non-survivors underperform consistently over their last five years of existence, but especially in their final year. In their final twelve months, 62% of non-survivors report performance below the median and 24.8% report performance in the bottom decile of all funds. Similarly, over their last five years, almost 80% are below the median, 33% in the bottom decile, and 21% in the bottom 5%.

The effect of survivor bias on persistence in mutual funds performance was particularly interesting. Survivor bias appears to attenuate evidence of persistence. Mutual funds are sorted on January 1 each year into decile portfolios based on a lagged performance measure. The performance measures are one year return, five year return and four factor alpha measured over a three year period. (Carhart discussed his four factor model.) The portfolios are equal weighted monthly so the weights are readjusted whenever a fund disappears. Funds with the highest lagged performance measure comprise decile 1 and funds with the lowest comprise decile 10. The Spearman nonparametric test measures the correlation in rank ordering of post-formation portfolio performance measures. The null hypothesis is that the performance measures are randomly ordered. Using the full set of funds, the post-formation spread in monthly returns between deciles 1 and 10 is a sizable and statistically significant 63 basis points per month. For the survivor-biased sample, this differential drops to 52 basis points. Carhart commented that analysis of data sets with survivorship bias sometimes results in rejections of persistence, when the evidence would be statistically significant in the full sample. However, the evidence favoring persistence does not support the existence of skilled or informed portfolio managers. Persistence is mostly explained by investment expenses and common factors in stock returns, primarily the one year momentum effect.

68. Mutual Fund Performance Measures, Factor Models, and Fund Style and Selection (Fall 1997)

William F. Sharpe, STANCO 25, Professor of Finance, Graduate School of Business, Stanford University and co-winner of the 1990 Nobel Prize in Economic Science, began by describing his presentation as the response to a request that he make a survey of mutual fund performance measures. In the course of trying to understand the performance measures customarily reported, he also tried to think of what questions those performance measures were apparently intended to answer. The decisions one might expect the mutual fund investor to be making may involve the selection of a single mutual fund, or a single fund plus borrowing or lending, or a fund drawn from a given asset class or category, or the selection of a portfolio that might contain many funds. As a general matter, probably most mutual fund investors are selecting or should be selecting a portfolio of mutual funds, while the performance measures that are widely published are generally suited only to the selection of a single fund.
Sharpe contrasted the portfolio selection model of Markowitz, presumably the most appropriate model for selecting a portfolio of mutual funds, with the usual "hierarchic taxonomic procedures". In the latter case we begin with a set of asset classes and decide how to divide the total investment fund across those classes. Then we subdivide the classes into categories, perhaps different categories of mutual funds. Then within each category we rank funds and presumably select the best. This is far from the ideal portfolio process, but perhaps helps to explain why the available performance measures are not the most suitable for use in a Markowitz-type of portfolio model. The most commonly published return statistics are the average return, \( M \), the utility-based return, \( M - (k \times S) \), where \( S \) is a risk measure and \( k \) is a measure of the relative importance of risk, and the scale-independent measure, \( M / S \), which is simply the units of return per unit of risk. The use of scale-independent measures is illustrated in the familiar graph of expected return plotted against standard deviation for a two asset portfolio. A straight line traces out all of the combinations of expected return and standard deviation that one can expect to achieve by varying the proportions of the two assets (one of which may be borrowing).

Turning specifically to Morningstar, Sharpe observed that Morningstar divides its mutual funds into four asset classes, and subdivides asset classes into categories. For the domestic equity class, for example, there are twenty categories. These categories are based on portfolio composition. Morningstar examines the price/earnings ratio, the price/book ratio and market capitalization, averaging these over the past three years, and then fits the fund into categories (styles) ranging from large-cap value to small-cap growth. There are two distinct rating systems used by Morningstar. Category ratings rank funds within an asset category, such as large growth equity. Three years of history are taken into account; load charges are not taken into account. The allocation of stars (from one to five) on the other hand, is based upon rank within asset class. Performance over three years, five years, ten years, and weighted averages of three, five, and ten years are used, and performance is net of load charges.

For the three year category ratings, the return statistic is the compounded return on the fund less the compounded return on treasury bills, in other words an excess return measure. The risk measure is the average monthly loss over thirty-six months, which is simply the average of the negative excess returns. The risk adjusted rating of a fund is the mean return of the fund divided by the mean return of the peer group less the risk measure of the fund divided by the risk measure for the peer group. Now the mean returns are all excess returns, fund returns less treasury bill returns. But if the mean return for the peer group turns out to be less than the compound return on treasury bills — that is, for the peer group the excess return is negative — then Morningstar substitutes the compound return on treasury bills. In further explaining the Morningstar risk-adjusted ratings, Sharpe pointed out that the rankings depend upon \( M_f - (k \times S_f) \),
where \( k = \bar{M}/\bar{S} \). In other words, the importance of loss relative to return is not unique to the investor; it is a function of the average performance in terms of excess return and loss for the set of comparison funds, over the particular three-year period used for measurement.

It turns out that a comparison of Sharpe ratio rankings with Morningstar category rankings for the diversified equity funds, 1994–1996, shows a very high correlation between the two. However, one cannot expect this correlation when the peer group performs badly and Morningstar substitutes the treasury bill return for the peer group average excess return.

Turning to what might be a better method of mutual fund selection, Sharpe suggested an asset class factor model. One might adapt this model to at least improve upon the customary hierarchic taxonomic procedure. First, one selects asset classes represented by indexes or index funds, and then one regresses the excess return for a particular fund on the excess returns for each of these indexes or index funds. The measure of the superiority of the fund is the alpha from the regression divided by a risk measure such as variance. The funds can now be ranked overall or within categories. The ranking within categories, of course, will be a ranking against peer funds that cannot be expected to have the same factor loadings (or index loadings) as the subject fund. And of course this procedure does not allow for any incorporation of the relative qualities of difference categories. So it is substantially inferior to the ideal methodology proposed earlier. But it may be a considerable improvement over reliance on the simple Morningstar rankings.

In concluding, Sharpe observed that hierarchic taxonomic approaches will generally be sub-optimal. No universal single measure can provide a sufficient statistic for choosing either a single fund in each category or multiple funds in each category. What we need are good estimates of future asset exposures of a fund, and those for an appropriate benchmark portfolio. We need future fund selection risk and future fund selection expected return. All of this should be combined optimally with estimates of future asset risks, expected returns and correlations and investor risk tolerance and other characteristics peculiar to the investor.

While all useful predictors of future performance should be taken into account, probably the best predictors of future performance are expense ratios, turnover and other measures of performance handicaps.

69. Of Tournaments and Temptations: An Analysis of Managerial Incentives In The Mutual Fund Industry (Spring 1997)


Compensation for the management of mutual funds may include various forms of incentives for superior performance, but in any case the larger the fund the greater the compensation. Fund growth is therefore important to management, and fund growth is promoted by superior performance. So long as money is attracted by superior performance we have a tournament structure in the mutual fund industry.
Mutual fund investors focus primarily on published rankings of relative performance when making their investment decisions. This means that managers of funds most likely to be losers at the end of the tournament will have an incentive to increase the risk of their portfolios more than those managing funds likely to be winners. The central hypothesis of the research was:

\[
\text{Interim Loser} \left(\frac{\sigma_1}{\sigma_0}\right) > \text{Interim Winner} \left(\frac{\sigma_1}{\sigma_0}\right)
\]

where

- \(\sigma_0\) is a risk measure for the first part of the tournament;
- \(\sigma_1\) for the last part of the tournament

The data incorporated in the analysis were monthly returns for 334 growth-oriented equity mutual funds for the period 1976 to 1991. The source was the database maintained by Morningstar. The sample was subsequently updated through 1996, with 478 funds. Over the 1976-1991 period, the number of such funds more than tripled and the assets increased about thirteen fold. A tournament was assumed to take place each calendar year. The pre-assessment period ended in July and the post assessment period was the balance of the year. Cumulative monthly returns for each fund were calculated over the pre-assessment period, and the monthly variances were computed for the pre and post assessment periods.

For each year, the funds in the sample were ranked from highest to lowest by rate of return in the pre-assessment period. Winners and losers were classified by whether they were above or below the median. The risk adjustment ratio was the ratio of variance for the post assessment period divided by variance for the pre-assessment period. The interim winner and loser funds were classified again according to whether the risk adjustment ratio was above or below the median value. These classifications led to a 2 x 2 contingency table according to interim loser or winner and high or low risk ratio. The null hypothesis would put 25% of the funds in each box. The risk change hypothesis was that more than 25% would be in the box for interim loser-high risk ratio and less for interim loser-low risk ratio, as well as less than 25% in the interim winner-high risk ratio box and more than 25% in the interim winner-low risk ratio box.

These were indeed the results of the analysis based on 1980-1991. For the period 1986-1991 the deviations from the null hypotheses were even greater. Harlow observed that during this later period there was more competition among mutual funds and more widely published performance rankings. For the period 1989-91 the effect was still more pronounced.

A secondary hypothesis was that the effect that had been discovered would be even more pronounced in a comparison of extreme winners and losers. Working with the extreme upper and lower quartiles, it turned out that the effect was indeed greater than when the comparison made use of all funds.

A further hypothesis concerned window dressing effects. When the December returns were dropped from the analysis, the results were virtually unchanged, indicating an absence of window dressing.

A further hypothesis was that there might be a difference between the behavior of new and entrenched funds. The entrenched funds were the 109 growth funds that were in the database from inception in 1976. The results supported the hypothesis: the risk changes were more pronounced for new funds than for entrenched funds. A
similar comparison between small and large funds showed a greater risk shift for the small funds. One might expect that to a significant extent the new funds would indeed be the small funds.

It also turned out that no-load losers increased portfolio risk more than did load losers, although once again the no-load funds tended to be new funds.

The research next tested the influence of cumulative performance. In effect, the tournament period was extended and relative performance was calculated for both 2 and 4 years before the current period. These statistics were then used along with the current year’s partial return and the risk adjustment effect was greater, indicating that the tournament is indeed perceived to be longer term than one year.

An important question was whether the risk increase was an active decision by managers or whether loser portfolios are inherently riskier. Using control portfolio samples, the authors concluded that the risk shift was indeed the result of an active manager decision. Further tests confirmed that the results that had been found did not derive from misclassification of funds.

Finally, the authors investigated whether the risk adjustment shown by the interim losers did indeed improve their relative rankings for the entire year. The answer was yes, although over the period studied the market was generally rising, so that one would have expected an increase in volatility to result in higher returns. Harlow suggested that it might be useful to examine the question separately for years of market rise and years of market decline.

Optimizing
70. Multi-Period Financial Optimization (Fall 2000)

John M. Mulvey, Professor, Department of Operations Research and Financial Engineering, Bendheim Center for Finance, Princeton University, distributed a paper entitled: “Multi-stage Optimization for Long-term Investors.”

As the motivation for multi-period models, he proposed two situations: asset and liability management for individuals and pension plans, and risk management for a re-insurance company. The ingredients of the model are scenario generators, then decision simulators, and finally a stochastic optimizer.

In answering the question why multi-period, Mulvey offered the advantages of trade-off of short-term risk versus long-term gains, incorporation of transaction and market impact costs, and a measure of risk that involves the probability of the investor reaching his or her goals.

Turning to the specific example of a re-insurance company, he identified four decision variables: asset allocation, amount and type of business activities, retro-cessional insurance, and capital structure. There are a number of rules of thumb for sufficiency of capital, but Mulvey had proposed a model in which the need for additional capital was based on the likelihood of a deteriorating credit rating for the insurance company’s debt.

Scenario generators for insurance are available from a number of sources. They incorporate economic factors to produce asset class behavior and liability behavior, then incorporate company strategies and deliver financial results. Scenarios of particular interest in this case concern plausible catastrophes, such as earthquakes and hurricanes. For each
event, the damage to property is modeled and a loss/profit distribution is developed.

For each scenario, the decision simulator takes over. Decisions are made at the beginning of each stage, following a set of policy rules. These include investment and product pricing policy, dependent upon level of surplus and allocated capital. Allocated capital rules and rules governing the volume of business to be done are further elements of company policy. An important measure is a comparison of cash with surplus equity. A probability distribution of surplus at the time horizon is the result of the simulations.

Finally, comes optimization. Mulvey discussed three dynamic optimization approaches, and compared them in terms of practicality and whether they can be understood by the client company management. Lack of convexity can be a serious problem. This is the case where there are local optimum solutions that may obscure the global optimum.

The end product of the optimization is an efficient frontier in risk/return space, and Mulvey showed the superiority of the multi-period efficient frontier over a single period frontier.

71. Managing Risk Using Multi-Stage Stochastic Optimization (Fall 2000)

Gerd Infanger, Chief Executive Officer, Infanger Investment Technology, L.L.C., distributed a paper entitled: “Managing Risk Using Multi-stage Stochastic Optimization.” The example on which his presentation was based is the funding of mortgage pools through issuing debt. Freddie Mac and Fannie Mae purchase mortgages, form pools of mortgages, and then sell participations in those pools. In doing so, they collect a fee for organizing the pools, but have no further participation either in the risk or the return on those pools once they have been sold off. There is some interest in continued participation, taking interest rate and prepayment risk, but anticipating a return on that risk. Infanger modeled an alternative to the sale of participations, in which Freddie Mac and Fannie Mae would finance mortgage pools by issuing debt to public investors. Since the maturity of the mortgage pool is unknown because prepayments are unknown, there must be flexibility in debt repayment. This then leads to the use of callable debt.

Introducing his simulations, Infanger identified the decision rules as: what to do when a bond matures, when to call a callable bond, at what level to fund with equity, and how to manage profits and losses. A leverage ratio must be chosen and this will of course indicate the initial equity balance. When a bond matures or is called, refunding is carried out using short-term debt, each time at the level of the balance of the mortgage pool. At the end of each time period, after maintaining the leverage ratio, a positive sum of all payments is regarded as profits and a negative sum as losses. The net present value of the payment stream can then be calculated.

In explaining single-stage stochastic optimization, Infanger showed the similarity to the familiar mean/variance model. What is being optimized is the funding mix with respect to expected returns and risk. But the overall time horizon is 360 months, and in principle one could change the decision rules monthly. Infanger had simplified the optimization by selecting decision points at the end of 12 and 60 months. The problem then was to optimize the funding decision initially and at 12 and 60 months. So he moved to multi-stage (that is three stage) stochastic optimization of the funding mix. A comparison of efficient frontiers showed the superiority of the multi-stage over
the single-stage model. It was essentially the improved balance between callable and non-callable debt that led to the superiority.

Matching the duration of the debt to the duration of the mortgage pool reduces risk in the debt financing of the pool. It turns out that the multi-stage model does a better job of matching duration than does the single-stage model. And where callable bonds are used we can expect negative convexity, just as we can for mortgages that can be prepaid. Again, the multi-stage model showed its superiority in matching convexity over the single-stage model. It also turned out that a strategy of simply minimizing downside risk through minimizing the duration and convexity gaps (delta and gamma hedging) was less effective than the multi-stage stochastic programming in terms of providing a superior efficient frontier.

72. Multiple-Benchmark and Multiple-Portfolio Optimization (Spring 1999)

Ming Yee Wang, Senior Vice President & Director of Research, Investment Research Company, distributed a reprint from the January/February 1999 Financial Analysts Journal entitled: "Multiple-Benchmark and Multiple-Portfolio Optimization."

Wang's objective had been set out in the preface to his journal article:

Numerous real-life portfolio optimization problems require consideration of more than one benchmark and/or more than one portfolio. These problems are formulated in a way that seems to be more complicated than the standard problem of mean-tracking-error-variance optimization. In fact, however, these diverse problems can be reduced to the standard case and solved with the same algorithm.

The standard mean variance optimization problem is stated as:

Maximize $\Sigma w_i \mu_i - \lambda \text{var}(X),$

Where $w_i$ is the weight of the $i$th security, $\mu_i$ the expected return or alpha, $\lambda$ the risk-aversion parameter, and $X$ is the portfolio to be optimized. If the risk measure is not the variance in the portfolio itself, but the tracking error variance, where $B$ is a benchmark portfolio, then the formulation becomes:

Maximize $\Sigma w_i \mu_i - \lambda \text{var}(X-B)$

The model above is of particular interest because it can be generalized to:

Maximize $\Sigma w_i F_i - K \text{var}(X-B)$

The point is that this model can be solved just as the previous one is solved, without $F_i$ necessarily representing rates of return and without $K$ necessarily representing a risk parameter.

Wang moved on to a more complex problem. A portfolio manager constructs by one means or another a desirable portfolio $Q$. The manager wishes to construct a further portfolio that is as close as possible to $Q$ but is also as close as possible to a benchmark. The problem now is, given $Q$ as the most desirable portfolio,

Maximize $-k_2 \text{var}(X-Q) - k_3 \text{var}(X-B)$

This model no longer has the form of a linear term and a quadratic term. Both terms are quadratic. However, it can be turned into the standard model. Wang showed that it is equivalent to:

Maximize $\Sigma w_i F_i - K \text{var}(X-B)$

where $F_i = 2k_2 \text{cov}(I, Q-B) = 2k_2$ times covariance
between security I and difference between the two portfolios Q and B
and
\[ K = k_2 + k_3 \]

The dual benchmark problem can be set out as:

Maximize \[ k_i \sum w_i \mu_i - k_2 \text{var}(X-Q) - k_3 \text{var}(X-B) \]

This can be converted to:

Maximize \[ \sum w_i F_i - K \text{var}(X-B) \]

Where

\[ F_i = k_1 \mu_i + 2 k_2 \text{cov}(I, Q-B) \]

and

\[ K = k_2 + k_3 \]

Once again, we have taken an apparently complex optimizing problem and reformulated it in the familiar simple equation. Perhaps the greatest practical advantage of these conversions is that there are software packages to handle the standard optimization model.

Wang went on to point out some of the uses of the dual benchmark formulation. Q might be cash, so that the manager is simultaneously controlling relative risk (in relation to the benchmark portfolio B) and absolute risk (in relation to cash). Q might be a peer group average. Or it might be a factor bet portfolio. And this led Wang to a second part of his talk. If we imagine a manager having in mind a preferred set of factor bets (country bets, for example) and wishing to apply the optimization model to stocks in the context of those factor bets, it may be advantageous to establish the factor bet portfolio first, and then move to optimizing the stock selection, rather than attempting to put all of the raw data into a single optimization process. Wang showed three potential advantages of this procedure. One is to reduce the impact of estimation errors, something we know can be very troublesome in the use of optimizing models. A second advantage has to do with transparency of optimization goals. There are advantages to identifying clearly the important bets, rather than having the bets generated by the optimization process. Finally, there may be advantages to hierarchical construction of bets. As in the example, the portfolio manager may prefer first to establish the factor bets and then to select the stocks. Here, of course, the factor bets could well be established by the use of an optimizer, but then fixed as a benchmark portfolio before the manager proceeds to optimize the stock selection.

73. Chapter 12 and Its Implications (Fall 1998)

Harry Markowitz, Nobel Laureate and Fellow of the Institute, described his talk as a review of Chapter 12 of his 1959 book *Portfolio Selection*. Chapter 12 discusses the theory of rational behavior under uncertainty as developed by Leonard J. Savage and others. It deduces from a set of axioms the behavior of a rational decision maker (RDM). A supplement to Chapter 12, which Markowitz distributed, demonstrates that the RDM, acting under uncertainty so as to maximize expected utility, uses subjective probability beliefs updated by Bayes rule.

The RDM is an idealized character, operating with limited information but unlimited computational and deductive power. Our task is to approximate its behavior. Chapter 12 deals with a number of concepts, the first being strategy. The RDM chooses a strategy, which might be thought of as a set of decision rules, for its game-of-life. The next concept is the Nature of the World. A hypothesis of this Nature might be a particular stochastic process with
specified parameters. What is important is that we insist that there be only one true Nature of the World at any time.

The next concept is outcome. An example might be a sequence of consumption expenditures. We define outcome so that one and only one outcome will occur and we further assume a finite number of outcomes and possible natures of the world.

The assumptions of finiteness enable us to describe a strategy by a payoff table. For every possible Nature of the World, we have a vector of probabilities for each possible outcome.

More compactly, strategy \( k \) is characterized by its payoff matrix:

\[
\begin{pmatrix}
  p_{i1}^k & p_{i2}^k & \cdots & p_{im}^k \\
  \vdots & \vdots & \ddots & \vdots \\
  p_{m1}^k & p_{m2}^k & \cdots & p_{mm}^k
\end{pmatrix}
\]

Where \( p_{ij}^k \) is the probability that the \( i^{th} \) outcome will occur if the \( j^{th} \) Nature of the World is true and strategy \( k \) is followed.

We assume that the RDM has a preference ordering of strategies. When the RDM considers \( d^1 \) at least as good as \( d^2 \) we write \( d^1 \geq d^2 \). \( d^1 \sim d^2 \) means that \( d^1 \) and \( d^2 \) are equally preferred.

Now we move to the expected utility personal probability (EU/PB) rule. This says that the RDM orders the \( d \)-matrices as if for every outcome there is a number \( u_1, u_2, \ldots, u_m \) called its “utility” and for every Nature of the World there is a number \( \pi_1, \pi_2, \ldots, \pi_n \) called its subjective probability.

It turns out that \( d^1 \geq d^2 \) if and only if

\[
\sum_{j=1}^n \left( \sum_{i=1}^m u_i p_{ij}^1 \pi_j \right) \geq \sum_{j=1}^n \left( \sum_{i=1}^m u_i p_{ij}^2 \pi_j \right)
\]

i.e.

\[
(u_1 \ldots u_m)(p_{ij}^1) \pi_j^1 \geq (u_1 \ldots u_m)(p_{ij}^2) \pi_j^2
\]

This expression is the Subjective Expected Utility rule (SEU), where \( \pi_j \) is the subjective probability of State of the World \( j \), \( p_{ij}^1 \) is the probability that the \( i^{th} \) outcome will occur if the \( j^{th} \) Nature of the World is true and strategy 1 is followed. And \( u_i \) is the utility of that outcome.

Markowitz’s question at this point was why we should expect an RDM to act in accord with such a special rule. In answer, he moved on to a set of axioms that imply EU/PB. Three axioms come essentially from Chapters 10 and 11 of Markowitz’s book, chapters in which probabilities are assumed to be known. Chapter 12 deals with unknown probabilities, and he introduced a fourth axiom to deal with this.

Axiom IV can be stated as:

Let \( p_{ij}^1 \) be the \( j^{th} \) column of \( d^1 \), and \( p_{ij}^2 \) that of \( d^2 \).

IF \( p_{ij}^1 \geq p_{ij}^2 \) for every \( j \)

THEN \( d^1 \geq d^2 \)

Chapter 12 shows that Axioms I through IV imply EU/PB.

The important conclusions to all of this were summarized by Markowitz as: The “Supplement to Chapter 12” shows that at each move of a many move “game”, the EU/PB maximizing strategy for the game-as-a-whole

- chooses a strategy which maximizes EU/PB for the “remaining game” using probability beliefs updated by
Bayes rule.
- maximizes a one-period utility function \( u_{\mu,h}(h) \) using probability beliefs updated by Bayes rule (where \( h \) is the state of the game at time \( t+1 \))

These conclusions require no new axioms. They follow mostly from one basic fact about conditional expected value, namely

\[
EY = E(E(Y|x)).
\]

He went on to discuss some specific cases, including approximations to make the portfolio selection problem tractable. He stressed, however, that whatever method is chosen for implementation, the behavior of the RDM must be consistent with the axioms.

74. Efficient Asset Management: A Review (Fall 1998)

Richard O. Michaud, Senior Vice President & Director of Research, Acadian Asset Management, is the author of the book “Efficient Asset Management: A Practical Guide to Stock Portfolio Optimization and Asset Allocation,” published by the Harvard Business School Press in July 1998. His talk was essentially a summary of the proposals in that book for enhancing the investment value of optimized portfolios. His starting point was based on J. B. Jobson’s and Bob Korkie’s classic studies showing that the traditional mean-variance (MV) asset allocation model has little if any investment value. His task was to see what might be done to make MV optimization a useful tool in investment management. Michaud’s position is that the limitations of MV optimized portfolios are the result of a basic misunderstanding of the nature of portfolio efficiency. Portfolio optimization is not a computer algorithm but statistical estimation.

An important initial assumption to all of his proposals is that there be no short selling. This fits the requirements of most institutional investors, and adds enormously to the practicality of his proposals.

He began his talk with a classic MV optimization and asset allocation. He used eighteen years of monthly data for six stock indexes and two bond indexes. From these he computed an “MV return premium efficient frontier.” He showed a graph of the frontier and the points representing the eight assets, as well as three reference portfolios (Exhibit 2.5 in his book). These three were an index of the six equity markets, an equally weighted portfolio of all six, and a plausible current portfolio. He discussed the limitations of the MV optimization. These are:

- Results are unstable and ambiguous (small input changes produce large output changes)
- Allocations often make little investment sense
- The model requires many ad hoc constraints in practice

It seems clear that these limitations are serious and lead to optimized portfolios that are often far from true efficiency. Michaud’s solution is statistical MV efficiency, and he offered several proposals for accomplishing this.

His MV efficient frontier was traced out by 51 portfolios, with number 1 representing the minimum variance and number 51 the maximum return. (“Returns” here are actually return premiums.) The MV frontier itself has variance, and Michaud demonstrated this through what he called resampling. From the sample monthly data for the eighteen years, statistical moments are computed. These moments represent the
usual historical estimates of the “true” returns generating process. Michaud then performed 500 simulations from these moments, to determine 500 times the position on his graph for each of the 51 portfolios the simulation identified as efficient, but using the moments from the estimated return generating process to determine the return and variance parameters to be plotted for each. The result was a distribution of resampled efficient portfolios, points plotted under the initial efficient frontier, a distribution that bracketed a number of the individual asset classes, as well as the index, the equally weighted, and the current plausible portfolios. The distribution he termed the “statistical equivalence region.” Michaud went on to show that the results could be used to perform sign-constrained linear regression analysis of the optimized portfolio weights to test various characteristics of optimized and candidate portfolios.

An obvious question was what had been achieved in the MV optimization process, if the individual assets and intuitively selected portfolios in the region could not be identified as inefficient. There was no reason to think that the minimum variance portfolio, for example, initially selected as efficient was in fact any more statistically efficient than any of the other minimum variance portfolios derived from resampling. And in fact many reasonable asset allocations appeared nearly efficient.

Michaud went on to present a graph showing the “resampled efficient frontier,” (Exhibit 6.1 in the book) which is the average of the 500 resampled frontier portfolios. For example, the asset weights of the 500 minimum variance portfolios were averaged to arrive at the minimum variance portfolio on the resampled efficient frontier. The same was done for the maximum return portfolios, and for all of the efficient portfolios between the minimum variance and maximum return. The result was a frontier a little less efficient than the original MV efficient frontier, but not very different. It had the advantages of less extreme allocations, and being more robust relative to inputs. He had greatly reduced the impact of outliers. It seemed clear that the resampling approach showed a vast improvement over the simple initial MV optimization, and Michaud discussed the reasons for this.

The next step was to test the out-of-sample performance of the resampled frontier relative to the performance of the classic MV frontier, which required further resampling. We begin by assuming that the moments derived from historical data are the true but unknown moments. From these moments we perform as before a simulation of returns for the eight assets and from this simulation we derive an MV efficient frontier based on the new simulated set of moments. From these new moments we perform 500 simulations and average the weights of the minimum variance portfolios, the maximum return portfolios, and all of the intermediate efficient portfolios to arrive at a resampled efficient frontier corresponding to the initial simulation. We repeat the whole process 500 times, and end up with 500 MV efficient frontiers and 500 corresponding resampled efficient frontiers, 1000 frontiers in all. We now average the “true” means and variances for the minimum variance, maximum return and all intermediate efficient portfolios in the 500 MV efficient frontiers to arrive at the frontier that is the “average of mean-variance efficient portfolios” shown as the bottom curve in Exhibit 6.2 of the book. And we average the “true” means and variances of the 500 resampled efficient frontiers to arrive at the “average of resampled efficient frontiers” shown as the middle curve in Exhibit 6.2. Both curves lie somewhat below the original “true (but
unknowable) efficient frontier” curve.

What is significant in Exhibit 6.2, and is further analyzed in the associated tables in the book, is that the average resampled efficient frontier lies above the average mean-variance efficient frontier. We have performed an out-of-sample exercise to show that resampled efficiency on average reduces true risk relative to MV efficiency. This will be the case no matter what the “true” underlying returns generating process is, and resampling is a practical way to deal with the effect on MV optimization of estimation error. In addition, it turns out that resampled efficient portfolios are often more reasonable and more intuitive. They are likely to be most useful at higher levels of portfolio risk, where they deviate most from the original MV efficient portfolios. The resampled efficient frontier also lends itself, it turns out, to estimation of the resampled efficient region for testing portfolio efficiency.

Another important proposal from Michaud involved the use of Stein estimators for improving on historical means, variances and covariances. He illustrated the use of a James-Stein estimator based on the historical data. The result were startlingly different from those obtained by relying on traditional methods employing historical data. Michaud commented that there are other techniques for adjusting covariances such as those demonstrated by Ledoit in his presentation at the Spring 1997 Q* Seminar (see summary 78). Mixed estimation is still another method, in which exogenous forecasts independent of historical data are combined with historical data to improve results.

Still another approach was characterized by Michaud as benchmark optimization, and still a further method as investment policy benchmark optimization, where the benchmark is an economic model of fund liability. Results become more relevant, especially for making the investment policy decision for institutional investors like pension plans. The use of a liability model for the latter can change asset allocations dramatically.

Finally, Michaud offered some caveats on avoiding common errors when using optimizers.

Summarizing, he pointed out that while MV optimization is fine in theory, it is of little practical investment value. Statistical MV optimization offers the prospect of truly useful portfolio selection, that can be combined with methods for improving input data. Indeed, his closing comment was that truly satisfactory optimization must combine improvement in optimization technique with improved input data.

75. Statistical Portfolio Optimization (Fall 1998)

Mark Britten-Jones, Assistant Professor, London Business School, distributed a paper entitled: “Portfolio Optimization and Bayesian Regression”. Like Richard Michaud, the previous speaker (summary 74), Britten-Jones described some of the problems with the standard mean-variance portfolio selection model applied to historical data. He discussed some of the methods academics and practitioners had used to make the model more practical, and like Michaud he concluded they are far from satisfactory. In contrast to Michaud, he proposed a Bayesian regression approach with unconstrained asset weights. The regression approach focuses on portfolio weights rather than on mean returns and covariances. And this approach can incorporate stock characteristics such as size, price/earnings ratio etc., into the optimization.

Britten-Jones described three critical portfolios: the tangency portfolio, the
global minimum variance portfolio, and what he called the optimal tilt portfolio (OTP). The tangency portfolio is represented by the point at which the borrowing and lending line is tangent to the efficient frontier. The global minimum variance portfolio is the portfolio at the minimum variance point on the efficient frontier. The OTP is the tangency portfolio minus the global minimum variance portfolio. He described the regression approach for establishing the tangency portfolio. The form of the regression is:

\[ 1 = XB + e, \]

where \(1\) is a T-vector of ones, \(X\) is a \(T \times N\) matrix of excess returns, \(B\) is a \(N\)-vector of weights, and there is no constant term. This regression approach is based on minimizing the squared deviations between the excess return on a constructed portfolio and the excess return in the T-vector of 1. Britten-Jones showed how the regression approach facilitates the establishment of confidence intervals for the weights because standard statistical inference tests are valid.

The regression that establishes the global minimum variance portfolio is:

\[-X1 = constant + X \cdot w + e,\]

where \(X1\) is a T-vector of returns on asset 1, \(X\) is a \(T \times (N-1)\) matrix of returns on assets 2 through \(N\) in excess of the return on asset 1, and \(W\) is a \(N-1\) vector of weights on assets 2 through \(N\), with the remaining weight on asset 1.

For the OTP, the regression is:

\[ 1 = X \cdot w + e, \]

where 1 is a T-vector of ones, \(X\) is a \(T \times (N-1)\) matrix of returns on assets 2 through \(N\) in excess of return on asset 1, and \(W\) is a \(N-1\) vector of weights on assets 2 through \(N\), with the remaining weight on asset 1. The OTP is particularly useful if benchmark tracking is important, and it turns out that the OTP is the same for all benchmarks. It is also true that the efficient frontier is formed from the Global minimum variance portfolio +/- the OTP.

Britten-Jones next turned to the advantages of Bayesian regression. Bayes rule combines prior information and data in an optimal and non-linear way, resulting in robust estimates and adaptable to non-stationary environments in which optimal weights vary through time. He described the matrix weighted average that results in the Bayesian estimates.

The benefits of the Bayes estimators were demonstrated in a comparison of true return volatilities for five different estimators. First, a covariance matrix was constructed from actual returns on 25 size and book-to-market portfolios constructed by Fama and French. This matrix becomes the "true" but unknown covariance matrix. From this matrix sample data are generated using a random number generator. Data sets of length 12, 24, 36, and 60 months were constructed. Each of five estimation procedures was presented with the generated data (but not the underlying true covariance matrix) and estimates of optimal weight formed. The performance of the estimator was then judged by the true return volatility. Three non-Bayesian and two Bayesian procedures were used. The non-Bayes estimators were the sample GMV weights and optimal weights formed from a 1 factor and from a factor principal component analysis of covariance. The first of Bayes estimators was a pure Bayes estimator in which variance parameters were given diffuse priors and then integrated out. The second Bayesian estimator used an approximation in which modal estimates of the nuisance parameters were used to construct the mode of the posterior distribution of weights. Both Bayes estimators out-performed all non-Bayes estimators in all sample periods. The Bayesian estimators even dominated an estimator constructed as an optimal linear combination of the equally weighted portfolio and the sample covariance portfolio. This optimal linear
combination was constructed using the true covariance matrix and could not actually be implemented in practice.

Britten-Jones next turned to the use of stock characteristics. The hierarchical model combines return data with characteristic data to give improved performance, and he showed the benefit of the addition of characteristics in determining the OTP.

In conclusion, Britten-Jones itemized the benefits of Bayesian regression in portfolio optimization. It delivers robust, time-varying, good out-of-sample performance. It is easy to establish priors. Characteristics can be incorporated. And he closed with some suggestions for future research.

76. Taxable Portfolio Optimization (Fall 1998)

The presentation was made by the three authors of the draft paper that was distributed: Barr Rosenberg Managing General Partner, Hadi Taheri Senior Research Associate, and Joseph Leung, Portfolio Engineer, of Rosenberg Institutional Equities Management. The problem the three authors had undertaken was to accommodate taxation in order to achieve mean variance portfolio optimization on an after-tax basis.

Barr Rosenberg began the presentation with a discussion of the tax aspects of the model. The investor has three different taxable investment modes. In the tax-deferred mode, all taxes are deferred until distribution and all accumulations are taxed at the time of distributions at the same rate. In the bequest mode, normal tax law applies to taxable events, but unrealized gains will escape tax completely. In the liquid mode, normal tax law applies to all taxable events, and unrealized gains will be taxed when an investment is liquidated. The investor makes the decision how to allocate assets among the three modes. The optimization process then determines optimal portfolio composition within each of the three modes simultaneously. Single-period optimization is used. Rosenberg described the assumptions for the tax calculations, including the use of federal and California marginal tax rates, an average lifetime of liquid holdings of six years, an assumed period of 25 years until distribution of tax deferred assets, and a "scarcity premium" for tax-deferred assets of 1.37. The scarcity premium arises when the individual has taken full advantage of opportunity to add to the tax deferred mode, and would still like to place more in that mode. The returns in that mode are automatically left in it and are credited with a scarcity premium. In cases where taxes are deferred, each year until the year of payment is charged with a tax based on the present value of the tax that will ultimately be paid. Rosenberg showed graphically the benefits of delaying the realization of capital gains and of the tax deferred investment mode.

Hadi Taheri took over the presentation at the point of describing the optimization methodology. The algorithm flowcharts showed the merging, for each mode, of the tax adjustments and the portfolio optimization. For all three modes, twelve asset classes were treated. These consisted of four passive equity investments, four passive bond investments, two active equity strategies, an equity long/short strategy with Treasury Bills as benchmark, and an equitized long/short strategy. The different forms of returns (differing because of the different tax treatments) were taxable income, tax-free income, short-term gains, long-term gains, and unrealized gains.

Joseph Leung concluded the presentation with a discussion of the
results of the model. The asset mixes for the three modes, from low risk to high risk, made intuitive sense. For example, in the bequest mode passive assets have a relative advantage because most of the returns, at least for equity index funds, are unrealized capital gains which escape taxes completely. High returns are especially beneficial in the early years, while in the later years, approaching the time of taxation, low returns are favored.

A concluding table showed that the best reward to risk ratio was achieved by the long/short market-neutral asset; the best reward to risk ratio with equity exposure was achieved by the active international small cap asset tied with equitized long/short market-neutral. For the tax deferred mode the highest rewards were in the active international small cap asset. For the liquid mode, the highest came from the equitized long/short market-neutral asset, and for the bequest mode from the international small cap index fund.

77. The Early History of Portfolio Analysis (Fall 1997)

Harry M. Markowitz, co-winner of the 1990 Nobel Prize in Economic Science, discussed the development of portfolio management from the years 1600 to 1960. The earliest reference to portfolio diversification, pointed out by Peter Bernstein, came from Shakespeare’s Merchant of Venice, and a similar reference can be found in Don Quixote, where a wise man is observed not to venture all his eggs in one basket.

However, it was Markowitz in his “Portfolio Selection” article in the Journal of Finance in 1952, who first proposed expected return and variance of return on a portfolio as a whole, as the appropriate criteria for portfolio selection. There have been others who have ventured theories of portfolio selection. A. D. Roy proposed, also in 1952, selection of a portfolio maximizing the mean return less a “disaster” return, divided by standard deviation. In 1935, J. R. Hicks discussed diversification, but he assumed uncorrelated returns and concluded that risk reduction was limited only by the extent to which a portfolio could be as a practical matter divided among different assets.

The Markowitz model, of course, shows that there are limits to risk reduction not because of the impracticality of sufficient diversification, but because of covariance, or correlations among the returns of the securities in the portfolio. He demonstrated that even unlimited diversification will, as a practical matter, leave a substantial amount of risk. However, even a little diversification achieves a substantial part of the possible risk reduction.

In going back to the origins of his mean-variance model, Markowitz described his reading of the classic The Theory of Investment Value by John B. Williams, published in 1938. Williams asserted that the value of a stock should be the present value of its future dividends. Markowitz’s reaction was first, that Williams must mean expected present value, since the future dividends are unknown. Second, if one is only interested in the expected values of securities, then one must only be interested in the expected value of the portfolio. Third, one maximizes expected value by putting all resources into the single security with greatest expected value. But fourth, clearly investors seek return and avoid risk. So we need a trade-off between expected return and risk avoidance. Fifth, we want to focus on efficient rather than inefficient portfolios in this trade-off. Finally, the portfolio return is a weighted sum of security returns, and there is a formula for the variance of the weighted sum. The end result, then, was the mathematical model for selecting the set of efficient portfolios.
Markowitz went on to discuss the embellishments to his original theory in his 1959 book: Portfolio Selection: Efficient Diversification of Investments. This book provided an introduction for the non-mathematician to his theory of portfolio selection as well as some technical developments, including the "critical line algorithm." He noted that his model does not need to assume either normal distributions or quadratic utility in order to justify the mean-variance criterion. His conjecture is that for common utility functions and for distributions like those of portfolio returns, if we know the expected mean and variance we can estimate expected utility.

78. An Improved Covariance Matrix for Portfolio Selection and Factor Return Estimation (Spring 1997)

Olivier Ledoit, Assistant Professor of Finance, University of California, Los Angeles presented a paper entitled: "Improved Estimation of the Covariance Matrix of Stock Returns With An Application to Portfolio Selection."

The covariance matrix of stock returns is important for active quantitative portfolio managers. With a matrix of variances and covariances we can attempt to select portfolios that load on desired factors and minimize variance. The Markowitz Portfolio Selection Model is a good example. As a practical matter, however, large-dimensional covariance matrices pose a challenging estimation problem. The traditional estimator is the sample covariance matrix. But when the number of stocks N is of the same order of magnitude as the number of historical returns per stock T, the number of parameters to estimate is of the same order as the total size of the data set, which is clearly problematic. And when N is larger than T, which is generally the case, the sample covariance matrix is always singular, even if the true covariance matrix is nonsingular.

Ledoit's proposal is to impose a structure on the estimator. His method is to take a weighted average of the sample covariance matrix with Sharpe's single index model estimator. The weight that is assigned to the single index model will control how much structure is imposed: the higher the weight, the stronger the structure. This technique is called shrinkage; the single index model is the choice of shrinkage target and the weight given to that model is the shrinkage intensity. It is the estimation of that shrinkage intensity that was the chief contribution of the paper.

It is important that the optimal shrinkage intensity depends on the correlations between estimation error in the sample covariance matrix and in the shrinkage target.

According to Ledoit, it is critical to recognize that the market model covariance matrix has a lot of bias coming from a stringent and mispecified structural assumption, but little in the way of estimation error, and that the opposite is true of the sample covariance matrix: it is unbiased but has a lot of estimation error. We are then seeking an interior optimum in the tradeoff between bias and estimation error. Finding this optimal tradeoff is in fact what we seek to achieve through the shrinking process. We are shrinking the unbiased estimator full of estimation error towards a fixed target represented by the biased estimator.

The problem, as Ledoit posed it, is to come as close as we can to the true covariance matrix $\Sigma$ with the estimated covariance matrix $\hat{\Sigma}$ and therefore to minimize the mean square error:

$$\min E [\| \hat{\Sigma} - \Sigma \|^2]$$
The first step in the solution Ledoit gave as:
\[ \hat{\Sigma} = \gamma ml + (1-\gamma)S \]
where \( m = \frac{1}{N} \sum_{i=1}^{N} \sigma_{ii} \)

\( ml \) is the shrinkage target
\( \gamma \) is a shrinkage intensity between zero and one

The second step in the solution is:
\[ \gamma = \frac{r^2}{d^2} \]
\[ 1-\gamma = 1- \frac{r^2}{d^2} = \frac{r^2}{d^2} \]

to which he gave a geometric interpretation:

Turning to empirical testing, Ledoit described a sample consisting of monthly stock returns for NYSE and AMEX stocks for 1972 to 1994. Data from August of year \( t-10 \) to July of year \( t \) were used to estimate the covariance matrix of stock returns. Then on the first trading day in August of year \( t \), a portfolio is constructed with minimum variance. The portfolio is held until the last trading day in July of year \( t+1 \), at which time it is liquidated and the process is started over again. In this way the in-sample period goes from August of year \( t-10 \) to July of year \( t \) and the out-of-sample period goes from August of year \( t \) to July of year \( t+1 \). What is of interest is the out-of-sample standard deviation of this investment strategy over the twenty-three years from August 1972 to July 1995.

Two minimum variance portfolios were considered: the global minimum variance portfolio and the portfolio with minimum variance under the constraint that the expected return had to be 20%. In both cases short sales were allowed.

Ledoit presented a table showing results using a number of covariance matrix estimators to conclude that the shrinkage towards the market model, the estimator he had described, produced the lowest out of sample standard deviation for both the unconstrained and the constrained portfolios.

He did not claim that his method, applied to his sample, would necessarily produce better portfolios than some commercially available methods that incorporate refinements his model did not. But he did claim that his method was better than any nonproprietary method, and that his technique for shrinkage would improve on almost any proprietary method.

Ledoit went on to demonstrate that his covariance matrix estimator can be used to estimate factor returns more accurately. And he concluded by describing further research he plans.

**Retirement Fund Investing**

79. The Distribution Builder: A Tool for Determining Investor Preferences (Fall 2000)

William F. Sharpe, STANCO 25 Professor of Finance Emeritus at Stanford University, Nobel Laureate and Chairman, Financial Engines, Inc.,

The presentation focused on the introduction and description of a tool called the "Distribution Builder" that allows an individual to examine different probability distributions of future wealth and choose a preferred distribution from among all alternatives with equal cost. A primary objective here was to help people understand the tradeoff of opportunities for high returns against downside protection. Sharpe referred to a number of financial economics models and behavioral models designed to help better understand investor preferences, pointing out the limitations of these models and indicating why he had chosen his particular approach.

There are two major uses for the new tool. The first is normative in nature. Once an individual has used the tool to choose a distribution, one can determine an investment strategy that through time seems to offer the distribution. The purpose here is to help the individual achieve his or her goals. The second application is related to positive models of asset pricing and investor behavior. The individual's choices, using the tool, can be used to draw inferences concerning his or her utility function. Combining experimental data from a number of individuals should facilitate better selection of a set of parsimonious assumptions about investor preferences for building equilibrium capital market models.

We begin with the concept of the investment strategy. An investment strategy embraces a probability distribution of future outcomes. The goal of the investor is to choose the strategy that provides the most attractive distribution from those that are feasible, given his or her resources.

A strategy is considered inefficient if it is dominated by at least one other strategy. We are seeking the efficient strategy, comparable to a point on the efficient frontier in portfolio optimization, that matches the preferred distribution.

The Distribution Builder is designed to focus on a single important outcome: how satisfactory a standard of living can the individual achieve in retirement. Probability distributions are represented in a form that individuals are expected to understand. Here Sharpe has relied on what can be learned from cognitive psychology. The tradeoffs involved in forming distributions and making choices are similar to those available in capital markets. Thus, the choices made by the individual can be converted to portfolios. The tool determines the least-cost investment strategy for the individual's preferred distribution. This achieves the goal of efficiency.

Sharpe presented an illustrative example. The outcome for the user of the Distribution Builder tool is standard of living in retirement, expressed as a percentage of pre-retirement standard of living. The budget is the present value of past and future pre-retirement savings to be used to finance the retirement standard of living. It is assumed that the individual has no other resources for this purpose. The capital market that will finance the outcome is assumed to consist of stocks and fixed income securities. Stock returns are assumed to follow a binomial process (another process could be chosen) with independent and identically distributed returns. More specifically, for the example Sharpe had chosen a real return of 2% per year for bonds, a risk premium of 5% per year and a risk of 15% per year for stocks, with probability of 0.5 that the stock market will rise 22% and probability of 0.5 that it will decline 8%.
The binomial process is very convenient in that when it is carried out for six years, the number of paths to the horizon is sixty-four, so there are sixty-four states of the world at the horizon, each equally probable, and for any set of sixty-four payoffs we can determine a least cost strategy. Given the parameters we have established there are only seven different final states among the sixty-four, and Sharpe demonstrated the pricing of each of these states using Arrow-Debreu prices.

To determine the least cost of a chosen probability distribution, we set up the distribution as a vector of payoffs (in our case with sixty-four elements) in decreasing order of values. We match this vector to the vector of state prices, now arranged in increasing order of prices, and for each state we multiply the payoff by the price to get a cost, and we sum the sixty-four costs to get the total cost. We then compare the total cost to the budget to see whether the chosen distribution is feasible. (The tool performs this comparison very quickly.)

The tool itself, essentially a computer screen presented to the individual participant, must be seen to be fully understood. Essentially, the individual is looking at a matrix with rows labeled from 0% to 200% in intervals of 5%, representing the standard of living in retirement as a percent of the pre-retirement standard of living. There are sixty-four markers which can be placed in any of the rows. To the individual participant the markers are described as individuals, while we know that they correspond to the sixty-four payoffs. The individual is told that he or she is represented by one of these markers, but is not told which one. The markers are to be arranged across the rows to form a preferred distribution or pattern. After the user has chosen an arrangement, the markers begin to disappear from the board one by one until the only one left is the one representing the participant.

And this, of course, reveals the corresponding outcome in terms of standard of living in retirement. As the participant moves the markers around on the board, achieving different distributions, an indicator shows whether the particular pattern chosen fits within the budget which is represented as 100%. Part of the value of the exercise is to show the user how the budget is consumed by moving markers up the board towards higher retirement benefits and how the budget is freed up by moving them down to accept lower benefits, where the added cost of moving a marker up 5% is less than the cost reduction from moving a marker down 5%.

Sharpe continued, discussing ways of arriving at the bond-stock allocations appropriate to the chosen distributions. And he went on to deal with the process of inferring investor preferences. If we assume that the chosen distribution maximizes the investor’s expected utility, subject to the budget constraint, then the distribution provides points on the investor’s marginal utility curve. If the investor has constant relative risk aversion, then it turns out that there is a linear relationship between \( \ln(p) \) and \( \ln(w) \) with the slope of the line equal to the negative of the risk tolerance parameter in the utility function, where \( p \) is the Arrow-Debreu price corresponding to \( w \), the investor’s wealth. The R² of the regression line will indicate the degree of consistency with the assumption of constant relative risk aversion.

In summary, Sharpe described the Distribution Builder as an interactive tool that can help an investor choose an optimal strategy and elicit information about an investor’s preferences. It can be used for portfolio decision-making, and for surveys designed to obtain information about the range of investor preferences. Its potential benefits therefore are better decisions and better models of capital markets.

Shlomo Benartzi, Assistant Professor, Anderson School of Management, UCLA, distributed a paper written by himself entitled: “Why Do Employees Invest Their Retirement Savings in Company Stock?” and a paper by himself and Richard H. Thaler entitled: “Naive Diversification Strategies in Defined Contribution Saving Plans.”

One objective of the research reported by Benartzi is to understand how well or badly individuals manage their retirement money. A further objective is to gain some insight in how to design defined contribution plans so as to encourage desirable choices by participants. Further, when consideration is given to modifying Social Security so as to enable participants to choose the funding method for their ultimate benefits it may be well to consider how participants are likely to make those decisions.

The most obvious conclusion to be drawn from patterns of asset allocation by participants in defined contribution plans is the “1/n” heuristic. That is, offered a choice of n different funds in which they might invest, participants are likely to allocate their money approximately 1/n in each alternative. When TWA pilots were offered five stock funds and one fixed income fund, they invested 75% in stocks. When University of California employees were offered one stock fund and four fixed income funds, they invested 34% in stocks. When TIAA-CREF participants were offered a choice between a stock and a bond fund, the most popular allocation was 50% to each. The pattern described above is confirmed by data for plans over two time periods, the first characterized by a limited selection of funds and the second by a broader selection. When the choice during the first period was between a balanced fund and a bond fund allocations averaged 21% to equities. In the following year, when the choices were augmented by the addition of four more stock funds, the allocation of funds to equities jumped to 46%.

The appeal of the 1/n allocation is understandable. Faced with a number of alternative funds in which to invest, and without any knowledge as to the relative superiority of the funds, it is not unnatural to divide money equally among the funds. And Benartzi observed that such a mix does not necessarily result in an inefficient portfolio. But it may well result in a portfolio that is poorly suited to the needs of the particular participant.

He moved next to the question why employees invest retirement savings in the stock of the company that employs them. Some statistics are impressive. Roughly a third of the assets in plans including a company stock alternative are invested in company stock. Ninety percent of the Coca-Cola plan assets are in company stock. And Coca-Cola employees direct 76% of their discretionary contributions to company stock. Benartzi discussed a number of suggested explanations for heavy investment in company stock. One is that stock is offered at a discount from market price. But none of the plans used in his sample offers such a discount. Another explanation is that company stock is made a part of the employer contribution and employees cannot reallocate that part to other investments. While this may be true, it turns out that the contributions the employee is permitted to allocate still go heavily into
company stock. Still a further explanation is that employees have proprietary information on the future prospects of company stock and this is what motivates them to allocate contributions to that stock. If this is the motivation, it turns out that the information was not very valuable. What motivates the purchase of company stock may be excessive extrapolation of recent historical performance of the stock. In other words, people see trends in truly random sequences. Additional explanations that have been offered include optimism with respect to the employer, overconfidence, familiarity with the employer, loyalty to the employer, and peer pressure.

What is quite significant is the misunderstanding of employees with respect to the risk of investment in a single stock. Benartzi reported the results of a survey sent to Morningstar.com subscribers. Of a group of well paid and well educated subscribers, only 16.4% believed that company stock was riskier than the overall stock market. And only 6.5% of those without college education believed the company stock to be riskier. In summarizing, Benartzi’s point were:

- Employees buy company stock after it has already gone up.
- Employees are overconfident (and optimistic) about company stock.
- The costs of insufficient diversification can be substantial.
- Some employees are better off holding cash.

81. A Model for Investment Planning (Spring 2000)

Gerald C. Wagner, President, IBIS Capital, LLC, presented an extremely versatile computer model for retirement planning. In his introduction he said "unless they have invested only in fixed-income accounts and securities, most people planning their retirement have little idea of how much they can draw from their portfolios each year and not outlive their money. Few are aware of how long they may live and of the effects of inflation over long periods of time. Most invest conservatively and are insecure about making investment decisions."

His model, and his presentation, combine spending goals, inflation, investment expected return and risk, and longevity. The model is interactive, and responds very quickly (especially when many simulations are required) to the user's changes in parameters.

The model is designed to help retirement planning in cases where an individual, or a couple, have a certain amount of money to carry them for the rest of their lives, and must work out a plan for investing and spending that money such that they can sustain themselves until both are dead. (Alternatively, the couple may be wanting to know how much they will need at retirement to achieve the same spending objective.) The critical elements, beyond the starting amount, are life expectancy, mean rate of return and volatility of return, inflation, and the spending formula. There seem to be two major benefits to be gained from use of the model. One is to test the viability of recommendations the couple may have received from various advisors as to appropriate investments and spending formulas. It may turn out that following that advice is likely to result in satisfactory retirement spending only
under extraordinary conditions. A second use of the model may enable the couple to design a plan for use of their funds that is very unlikely to fail to take care of them throughout the remainder of their lives. However, given the uncertainties of investment experience, inflation, and dates of death, it is impossible to eliminate all risk of running out of money while one or both are still alive. This at least is true if the spending formula is to be set in advance and adhered to year after year. Two typical spending formulas suggested by Wagner (and of course always subject to the minimum distribution requirements of the Internal Revenue Code) are to spend a specified percent of the value of the account each year, or to spend a specified percent in the first year and then to increase the spending by a fixed percentage in each subsequent year.

A series of exercises using the model and presented by Wagner seemed to lead to two conclusions. One is the attractiveness of annuitizing the sum available for investment and turning the problem of investment and mortality risk over to an insurance company. At least if the retirement fund in question is to be the sole support of the individual, or couple, throughout their retirement, and does not have built into it a substantial cushion for reduced spending this option is a safe one. Wagner was not enthusiastic about this alternative, however. The second option is to modify the spending plan each year, depending on the amount remaining in the fund. That is, following a year of bad performance, the whole planning model is re-run, and the spending reduced.

The model is probably more useful to the researcher or consultant than to the individual seeking to plan his or her retirement. It is enormously versatile, capable of rapidly dealing with a variety of input changes, including income and capital gain taxes, allocations among asset classes, and simulated results.

Risk Management

82. The Practice of Risk Management: The Green Zone (Spring 2000)

Robert Litterman, Managing Director, Goldman Sachs & Co., distributed a paper entitled: "The Green Zone...Assessing the Quality of Returns." He began his talk with an overview of the risk management process. A great deal of progress has been made in recent years. What began in broker dealers and banks has now moved to asset managers. Software has become available and regulatory activity has been stepped up. Some significant problems remain, however. The example of Long Term Capital Management (to be discussed later in the seminar, see summary 63), poses a challenge to risk measurement and control.

Turning to the risk management function in an asset management firm, he observed that the basic objective is quality control. Active managers are expected to provide excess returns over the returns on a benchmark. Clients pay a fee for those excess returns and they also take risk. That risk, which is independent of the risk in the underlying benchmark, requires monitoring. Effective monitoring will channel correct and comprehensible information to the investment decision-makers.

Senior management commitment is critical to the process, and Litterman endorsed a risk committee as part of senior management. The function of the risk manager is to monitor risk, not to make investment decisions. The portfolio manager’s job is to add value by taking risk, and risk monitoring can provide important guidance to that manager. For example, it can help the manager to avoid unintended bets, such as the failure to size underweighting appropriately. A manager may
underweight a particular sector in the benchmark without realizing how much this underweighting contributes to tracking error.

Litterman turned next to tracking error and his "green zone." Tracking error is normally measured as the standard deviation in the differences between the manager's rates of return and the benchmark rates of return. There are four kinds of tracking error: the actual tracking error based on the actual difference between the manager's return and the benchmark return, the target tracking error, which is the level agreed by the manager and the client to be appropriate, the estimated tracking error which is the manager's forecast of what the error will be, and the true tracking error which is an unmeasureable quantity.

With respect to the target tracking error, Litterman suggested that the manager propose a target to the client, who can then decide how to allocate funds among managers. It is then up to the client or the client's consultant to monitor the actual tracking error. It will not be surprising that some managers' actual tracking errors are far from the target. The problem is to determine how far is too far. Some of the deviation may be due to changing volatilities and correlations of the underlying securities, something beyond the control of the manager. Some of the deviation is simply due to noise in the measurement process. Litterman has concluded that there is no single standard measure of the appropriate tracking error.

The paper on the green zone describes the development of a model for evaluating tracking error. The green zone identifies a range of tracking error around the benchmark rate of return that should be acceptable to manager and client. Beyond the green zone is a yellow zone, and beyond the yellow zone a red zone. The yellow zone was designed such that one might expect the realized tracking error to reach this zone a couple of times a year. The red zone was designed so that one might expect the tracking error a couple of times in five years. A more frequent actual tracking error in the yellow and red zones would then call for some consultation between client and manager to see why the error had been so large and what significance it might have for the client/manager relationship.

The tracking errors — standard deviations — were calculated in two ways: using the standard deviation of twenty successive days of excess returns and using the standard deviation of sixty days of returns. Litterman felt that the use of these high frequency measurements was critical to close current monitoring of risk. Finally, Litterman spoke of risk budgeting. The process begins by establishing how much total risk the client should take. The next question is how much of that should be indexed risk and how much active risk. Next comes the question of how to allocate the active risk among managers. All sources of active risk should offer the same marginal return to risk.

83. The Topography of Risk Management (Spring 2000)

Jacques Pezier, General Manager of Marketing, Credit-Agricole-Lazard Financial Products Bank, focused his remarks primarily on the industry standards established by the Basle Committee on Banking Supervision 1996 Amendments. He began by identifying three forces behind risk measurement and control (essentially in the banking industry). Internal forces are motivated by a desire for an optimal return on capital, and survival. Regulatory forces are motivated by protection of customers, maintenance of fair competition, and control of systemic risk. External forces are customers,
competition, new products and the whole risk management industry.

The financial regulators draw a clear distinction between the trading book and the banking book. Risk measurement and control focuses on the trading book, that is on positions or transactions that can be marked to market, easily valued, and disposed of rapidly. The banking book, on the other hand, represents positions or transactions that cannot easily be valued and are normally accounted for with provisions for uncertainty. Criticizing the risk measurement for the banking book, Pezier observed that conservatism is not good when it introduces distortions. There is no incentive to use risk mitigation techniques that do not lead to lower capital requirements. And there is incentive to take on risks that are not recognized. Turning back to the trading book risk measurements, he observed that marking-to-model is an acceptable extension of marking-to-market so long as all expected costs are accounted for but with no adjustment for model uncertainty.

Pezier next discussed the basic principles of the 1996 Amendments. The minimum solvency ratio, which is eligible capital/risk weighted assets must be greater than 8%. Concentration of risks is limited to 25% of the capital base for a single exposure and 600% of the capital base for the aggregate of exposures greater than 10%. Next he distinguished between credit risk requirements and market risk requirements. Some problems with the former include weaknesses in reflecting relative credit worthiness, no consideration of the maturity of exposure, limited use of credit support, no allowance for portfolio diversification, and arbitrary potential future exposures for derivative contracts.

Internal models for meeting market risk requirements are synonymous with value-at-risk (VAR). A number of methods are permitted for VAR calculation, but there must be satisfactory backtesting of whatever method is used. Pezier discussed the advantages and disadvantages of VAR. Important disadvantages include failure to distinguish among the varying liquidities of market positions, and the capture of only short-term normal risks, ignoring long-term volatility and repo costs. VAR also requires significant human and technological resources.

Summarizing current problems, he identified complex measurement in some areas, while other areas are ignored. Separate measurements are not properly integrated. Credit risks are crudely measured. Market risk focuses on a few small short-term risks. Operational costs and risks are ignored.

Pezier turned next to the Basle Committee Consultative Paper of 1999, which suggests a major role for credit agencies and sophisticated banks, and may result in major business shifts between better and worse credits. He observed that there is still major confusion between expected default loss and credit risk.

In concluding, he identified steps still to be taken. With respect to market risks, a reduction in distinctions between banking and trading book. Revised implementation of VAR to concentrate on major risks and adequate time scales. Employment of alternative risk measures. With respect to credit risks, he suggested development of forecasts of default probabilities and recovery rates, price default loss, and calculation of credit risks based on default probabilities and adequate time scales. Finally, we need practical methods for integration of market and credit risks.
84. Key Factors For Market Risks: Identifications and Applications  
(Spring 2000)

Carol Alexander, Professor and Chair in Risk Management, ISMA Centre, The Business School for Financial Markets, Reading University, UK, distributed a paper entitled: "Key Factors For Market Risks: Identification and Applications." She began with a reference to the Basle Committee on Banking Supervision 1996 Amendments, discussed by the previous speaker (see summary 83), and its recommendation of internal models to generate value-at-risk (VAR) and maximum loss. She observed that for an institution with a great many positions and transactions, there is a very large universe of all possible risk factors and hence an enormous covariance matrix is required to evaluate risk exposure. She proposed reduction of the set of all possible risk factors to a short list of key independent factors with the advantages of dimension reduction, noise control, risk measures that are robust, and clarity of the sources of risk.

Briefly, we summarize a set of data with \( T \) observations on \( k \) asset or risk factor returns in a \( T \times k \) matrix \( Y \). Principal component analysis will give up to \( k \) uncorrelated stationary variables, the principal components of \( Y \), each component being a simple linear combination of the original returns. The process also states exactly how much of the total variation in the original system of risk factors is explained by each principal component, and the components are ordered according to the amount of variation they explain.

She presented an example making use of NYMEX crude oil futures prices from February 1993 to February 1999, using 1, 2, 3, 6, 9 and 12-month maturity futures contracts. The factor weights showed that the interpretations of the first three principal components were trend, tilt and curvature. The first explained almost 96% of variation over the period, and the first and second together explained over 99%. The GARCH (1, 1) model shows that the first component has low market reaction but high persistence, and the opposite is true for the second component. It turns out that the GARCH model and a model making use of exponentially weighted moving average variances gave very similar volatilities. The GARCH correlations however, more accurately reflect the true nature of the data. Alexander discussed further advantages of GARCH models, going on to show orthogonal GARCH term structure volatility forecasts for one-month crude oil futures.

Her next example applied the orthogonal GARCH (1, 1) model to a more difficult term structure, using daily zero coupon yield data in the UK with eleven different maturities. Two principal components accounted for only 72% of total variation. Still, the volatilities obtained using the orthogonal GARCH model were very similar to those obtained by direct estimation of exponentially weighted moving averages.

A still more difficult example made use of four European equity indices and their associated sterling foreign exchange rates. Her choice of examples was designed to show that it is possible to estimate covariance matrices when direct methods are not possible, or require unrealistic restrictions. Provided the assets are first divided into reasonably highly correlated categories, principal component analysis provides a way to extract the important independent sources of information in each category. The covariance matrices for each category are generated from the variances of these key risk factors, and then a large covariance matrix that encompasses all categories is spliced together.
Alexander now turned to the second part of her presentation, dealing with scenario-based maximum loss calculations, especially important for derivatives. For equity options there is often a negative correlation between at-the-money (ATM) volatility and the underlying price. The effect is modest when the equity market is very stable and trending, greater when daily price movements were limited to a “normal” range, but much greater during a mini-crash period. This creates some problems for realistic scenarios for ATM volatility at different index prices. She went on to examine fixed-strike volatility compared with ATM volatility. Work by Derman suggested three volatility regimes: a range bounded market, a stable trending market, and a jumpy market. It turns out that in the bounded market regime, the fixed-strike volatility is independent of the index, while the ATM volatility is negatively correlated with the index. In the trending market regime, the fixed-strike volatility is correlated with the index while the ATM volatility is independent. And in the jumpy market, the fixed-strike volatility is negatively correlated with the index while the ATM volatility is doubly negatively correlated.

The analysis suggests methods for identification of the current market regime. And in fact she showed a signal in the summer of 1998 of a change in market regime before the mini-crash of August. Having identified the current volatility regime and found a signal of an impending change, the next question is how to use this information. It turns out that principal component analysis of the difference between the fixed-strike volatility and the ATM volatility can be useful in predicting movements in the volatility skew as the index moves under different market circumstances.

In summary: First, regression models that are based only on recent market data are used to indicate which volatility regime is likely to prevail in the near future, and the relevant sensitivity of ATM volatility to changes in the index level. Then, the key risk factors of a volatility skew are quantified by the trend, tilt and curvature components of the deviations of fixed-strike volatility from ATM volatility. The response of fixed-strike volatilities to changes in the index level depends on which of these key risk factors are important in the current market regime.


She reported an analysis and study based on Rigobon’s study of stock market contagion, in which he defined contagion as a situation in which a shock in one country propagates to another country although the economic fundamentals in that country are unchanged. The definition is consistent with the notion that contagious episodes appear at random and the phenomenon is empirically supported by the fact that some crises have not been explained by trade linkages or policy coordination. South Korea, for example had limited linkages with other Asian economies, yet it was considerably hurt by the Asian crisis. A somewhat expanded definition of contagion says that if the propagation of a shock from one country to another is dependent upon whether it occurs at a quiet time or a time of crisis then we have a case of contagion. The research undertaken by Rigobon was based upon movements in stock market prices. Vanroyen reported on analysis of data including both prices and quantities in
the form of daily portfolio flows in and out of 25 countries, from June 1996 to October 1999. The data came from the State Street Bank and Trust records and included over 3 million transactions by international investors.

The model estimated vector autoregression over the period studied. Current flows were regressed on past flows and macrovariables. The residuals therefore recorded the shocks, and the variance-covariance matrix was the key to identifying contagion. A binary index measures how often a country tested positive for contagion. The general index weighs the test results and the magnitude of flows.

The study was performed on 23 countries. Four were from Latin America, six were from Asia, four were from Europe (including the United Kingdom), five represented commodity-linked countries, and four (Eurozone, Japan, and Switzerland) were classified as “safe” countries. The general index is a measure of contagion weighted by the magnitude of portfolio flows. The general index peaked at the end of June 1997, just four days before Thailand announced the managed float Baht. The index fell sharply until mid-September and after a short period of increase it fell further in October, perhaps in response to the devaluation in Taiwan and the continued attacks on other Asian currencies. It then increased, perhaps because of a rally in Asian markets following the rescue packages and negotiations with the IMF. After reaching another high at the end of February 1998, the index decreased sharply and reached an all-time low at the end of August. This may have been associated with problems experienced in Russia throughout the summer of 1998. Since November 1998, the index has been fluctuating but the amplitude of the moves has not been comparable to the ones observed in the earlier periods of financial turbulence. The index became negative at the end of July 1999, which might reflect a progressive drying up of international funds and Y2K effects.

The binary index displayed little evidence of contagion. The maximum of 21 pairs of countries testing positive was reached in July 1998, but on average over the three year period only 7 contagious pairs of countries were detected. The index reached a first local maximum between the end of May and early June of 1997. It reached another high point in mid-August 1997, subsequently fluctuating but remaining at a relatively high level. The summer of 1998 saw an increase in contagion seeming to coincide with the Russian crisis. Following August, the index showed a marked decreasing trend except for a short-lived increase at the end of January 1999, at the end of the Brazilian crisis. There has been a sharp increase in the index since August 1999, perhaps due to the rally in commodity and oil prices.

The regional indices are probably of more interest. Asia is the region which generated the highest degree of contagion. Not surprisingly, the region with the least degree of contagion was the group of safe countries. The index for commodity-dominated countries was volatile until the end of 1997. In general, crises tended to be regional rather than global.

It appears that contagion does not propagate to a great extent from region to region. Contagion in Asia had no noticeable effects in other regions. The same is true for commodity-linked countries. Safe countries appear generally sheltered from contagion. Latin America, however, transmitted crises to Asia, emerging Europe, and commodity-linked countries.

The general contagion index possesses a degree of autocorrelation and hence predictability. The predictability doubles if we can identify three regimes,
for highly positive, moderate, and highly negative contagion. Vanroyen concluded that her results support traditional theories of shock transmission through real economy linkages. There is little evidence of contagion at an aggregate level. Regions appear relatively disconnected from one another, although there is some evidence that Latin America, but not Asia, is contagious.

86. A Taxonomy of Market Crisis (Spring 2000)

Richard Bookstaber, Director of Risk Management, Moore Capital Management, distributed a paper entitled: “A Taxonomy of Market Crisis.” He began by revisiting the presentation he had made to The Q-Group® at the Autumn seminar in 1996 on the pitfalls of risk management (see summary 93). He had observed then that diversification tends not to work in a market crisis and had raised the question why this happens. He had also raised the question whether one can predict a market crisis or understand it well enough to manage it. At the present session he was continuing the exploration he had begun four years earlier. And he began by commenting on the characteristics of market prices. He suggested that prices are driven more by liquidity than by information, despite the academic wisdom to the effect that prices essentially reflect information and price changes are due to new information.

The dynamics of feedback are important. An action by a single investor, if that investor is important enough, can trigger a market move. In essence, the market is not determined by economic effects. Economic principles tell us that when prices decline buyers step in, assuming no change in fundamentals. But we can observe price declines that simply lead to more selling and further declines. Correspondingly, we can observe that price increases lead to more and not less buying. These phenomena lie behind some of the value-at-risk problems. Scenario analysis is generally based on economics. It would do better to examine who owns the assets in questions, and the tactical relationships that will lead to price changes. How people will behave in a crisis can become a crucial question.

The wealth cycle is one of the simplest market cycles. Investors’ risk tolerance increases as their market winnings pile up. And the more people win the smarter they think they are. When an investor makes money on a particular view he adheres more strongly to that view and is willing to take increasing risk. If an investor loses money he drops out of the market. As the market continues to go the way of the winners, it becomes narrower with more and more capital focused on the investment set of the winners. Those who could pull the price down through their selling have sold. Those who bet against the market through short positions are stopped out. A bubble is well in the making and it will have nothing to do with new information coming into the market or with investors becoming more informed. It will only have to do with the effect of winning and losing. Prices will be driven up by speculative flows until they reach the point such that there is no more flow to go into the market. When the flow stops, the market will come back to earth and very quickly. The boom in internet stocks is a good example of the wealth cycle. The warning signs for the wealth cycle are large price changes coupled with large flows: high volume to float, a high percentage of short interest relative to float and high volatility.

The liquidity cycle takes us to the problems of Long-Term Capital Management (LTCM). The important characteristic of hedge funds is not what
they are in terms of leverage or risk of asset holdings, but what they have the capability of becoming. Hedge funds are potentially highly levered, potentially high value-at-risk institutions, and potentially illiquid. The risk cycle comes from the confluence of risk, leverage and illiquidity. The risk of loss coupled with leveraged positions leads to a need to liquidate into a market that cascades in price because of the rise in liquidation orders. The liquidity crisis for a hedge fund takes place in three stages. First is a loss that acts as the triggering event. Second is the need to liquidate positions to raise cash because of the loss, the source of the need to post margin with counterparties and deal with redemptions by investors. The third stage is a further drop in asset value as the market reacts to the institution’s attempts to sell in too great quantity or too quickly for the market liquidity to bear. Hence a further decline in the fund’s mark-to-market value and still further needs to liquidate.

In the absence of leverage, losses may be painful but not fatal. The risk from leverage is not the leverage itself, but the potential for leverage to invoke a forced liquidation of positions. When in liquidation mode, it is not just quantity but also time that is a constraint. The institution must sell and must sell quickly. Rapid sale requires substantial price reduction. But as noted earlier, price reduction may make it harder and not easier to sell because those who might have bought are frightened away. The market participants who were assumed to provide liquidity end up demanding liquidity.

When the effect of liquidation lowers the value of the remaining fund position more than the amount of cash raised from the liquidation, the fund is caught in an ever widening downward spiral.

To monitor the risk of a firm being caught up in a liquidity crisis we need to look at the “effective liquidity” of the portfolio. This is a combination of the liquidity of the assets themselves and the willingness of the manager to liquidate. Examination of the variability in the risk/capital ratio over time is useful. If this risk exposure, adjusted for changes in asset size, is constant, then the fund tends to be illiquid either because of the nature of the assets held or because of the risk management approach of the manager. If the exposure varies widely and rapidly over time, then the assets are apparently liquid and the manager is willing to take advantage of that liquidity. A key ratio then is: risk to capital ratio divided by standard deviation of the risk to capital ratio.

This crisis risk ratio can give an indication of whether a hedge fund is prone to a liquidity crisis. It can also be used to see what the likelihood is of being caught in an avalanche triggered by another hedge fund. If the manager of a hedge fund finds that other hedge funds with similar types of trading interests and tactics tend to have high crisis risk ratios, then there is a greater chance the markets he trades in will be in the center of a liquidity crisis and that his portfolio will face disaster. Bookstaber’s estimate was that LTCM had a high crisis risk ratio.

The credit risk cycle works this way: traders who extend out in credit risk outperform their counterparties. When all the economic opportunities are taken, other traders who want to keep up with their peers take non-economic and riskier trades. In time, only the less prudent traders will remain active and they will be paired off against the lower quality counterparties. Then a credit event causes losses and gets the attention of management. Everyone runs for cover, even those who are actually trading prudently. The losses and the management demands for liquidation are exacerbated by the unwillingness of others to take on the securities. It is the
lack of day-to-day losses revealing the risk of the positions, and the overconfidence of those making money selling volatility, and the extension of capital to these traders by management that does not appreciate the unresolved risks, that lead to the crisis.

Turning back to the issue of risk management, Bookstaber's conclusion was that ultimately what matters in firm-wide risk management is the ability to detect and steer around market crises. But he also concluded that risk management is not going in the right direction to deal with these potential crises. Its tendency is to deal in greater and greater detail with the day-to-day risks that are adequately managed but to ignore the market crises that can spell life or death to the firm. Consolidation of markets, of information, and of institutions, all have the same effect of putting stress on the financial habitat and raising the risk of market crises. There is a greater likelihood that everyone will be in the same markets at the same time and will share the same portfolios. More and more investors are taking advantage of ready access to information and markets, but with a convergence of views among investors — particularly the retail or individual investors — because the information sources are all the same. Consolidation of firms means fewer institutions willing to act as liquidity providers through a risk taking role. Salomon Smith Barney was just as quick to get out of the market as LTCM.

Active managers possess proprietary skills and information. The funding they need to implement their skills, both in quantity and cost, is at the discretion of their clients and other financial market participants. They find an opportunity to earn an "alpha." The yield spread between on-the-run and off-the-run U.S. Treasuries offers an opportunity to sell the more liquid issue and buy the less liquid issue, in effect selling liquidity for a price. Financing the purchase and short sale through a repo and reverse repo may eliminate most of the current profit, but the expected convergence of price offers the prospect for gain. Suppose that in the short run the spread widens rather than narrowing and the result is a loss. What to do now? The opportunity appears better than it was when the positions were first taken. Should more money be invested? Is funding available to take a large position? The prospect is of a high return if it is possible to hold the position long enough. For a constant risk tolerance level, one can calculate the appropriate leverage for changes in the yield spread, and the investors’ wealth.

This was the situation for LTCM in August 1998. A graphic presentation over the period following August showed a further rise and then a fall in the yield spread, a dramatic decline in wealth followed by a partial restoration and then a dramatic rise, with a significant rise and then fall in leverage. The ability to hold on long enough would have paid off handsomely, but the significant early decline in wealth raised the question whether the institution would have had the nerve and the resources to hold on.

87. Risk Management in Active Investment Management: A "Corporate Finance" Perspective (Spring 2000)

André F. Perold, Sylvan C. Coleman Professor of Financial Management, Harvard Business School, distributed a series of four cases on Long-Term Capital Management, prepared for use at the Harvard Business School. His presentation took the form of a sequence of decision points, tracing the history of LTCM. His position was that the active management of LTCM presented a problem that was essentially one of corporate finance.
Perold then turned more specifically to LTCM. Returns were very high from 1994 through 1997. Precautions had been taken to assure that LTCM was financed on a long-term basis. The three year equity lockup, the $230 million of unsecured three year term loans with unusual provisions to prevent early call, a $700 million unsecured revolving line of credit, and term repos with unusual six to twelve month duration, all seemed to give LTCM the ability to take long-term positions without fear of emergency liquidation. As of the end of 1997, capital had risen to $7.5 billion, assets to $129 billion, and notional off-balance sheet transactions amounted to over $1 trillion. The principals' investment had risen from $146 million to $1.9 billion.

At this point, the management concluded that the profit prospects were not nearly as attractive as past returns, and indeed did not justify the capital invested. The result was a distribution of $2.7 billion to the least favored investors, at year-end. A question raised by Perold was whether this was a sensible decision. In retrospect, one might argue that it would have been better to keep the capital since it would have served LTCM in good stead during the crisis of 1998. On the other hand, some seminar participants raised the question what LTCM would have done with respect to leverage if they had had the capital. One risk that was certainly taken in the forced redemption was the alienation of those whose participation in the fund was extinguished over their objections. Access to capital that might have proved the solution to the crisis of August 1998 was perhaps eliminated by that forced distribution.

Perold proceeded to trace the events of 1998 up through August of that year. Salomon Smith Barney closed down its U.S. Bond Arbitrage Group in July. This might have been taken as a signal that a formerly significant player in the marketplace, one that might have been thought of as a source of liquidity should LTCM need one, was now gone. It might also have been taken as an indication that attitudes towards the whole U.S. Bond arbitrage process were changing throughout the industry.

By August 21, LTCM was in a desperate situation. On that day alone the fund lost $550 million. During the day the U.S. Treasury swap spread widened significantly. The UK gilt swap spread also widened. And LTCM suffered a significant loss in a risk arbitrage position. In early September an effort to raise capital failed and losses continued. By September 25, losses for the year were 4.6 billion dollars. On September 23, a consortium of fourteen firms put up 3.6 billion dollars for 90% of the firm.

In concluding, Perold raised a number of issues arising from the LTCM story. One concerned the appropriate scale of operations. What was the LTCM business model? Who else is doing the same thing? Was LTCM the victim of liquidity shocks? Was LTCM a victim of transparency when opacity might have saved it? Had LTCM failed to provide for adequate funding sources? Was there a failure of diversification? While conceding that it is almost impossible to establish just what LTCM might have done to avoid catastrophe, Perold suggested that the firm had enjoyed an enormous franchise value up to early 1998, a value that it may not have been aware of and apparently made no effort to exploit.

88. Risk Management for Hedge Funds: An Introduction and Overview (Spring 2000)

Andrew W. Lo, Harris & Harris Group Professor, Sloan School of Management, Massachusetts Institute of Technology, began his presentation with the observation that risk management for
hedge funds is of interest from three different perspectives: those of the academic, the institutional investor and the hedge fund manager. He described the typical risk management protocol as consisting of five steps: identifying risk exposures, identifying value-at-risk (VAR), targeting the risks to be hedged, selecting the hedging vehicles and evaluating the post-hedge VAR. He commented on the shortcomings of VAR and noted the variation in risks among different hedge funds. And he compared the risk exposures of an equity hedge fund with those of a fixed-income hedge fund, to conclude that current risk management practices are inadequate for both.

Risk transparency for hedge funds is essential for both individual and institutional investors, and it requires a unique set of risk analytics. Lo stressed the difference between risk transparency and position transparency. Managers do not wish to reveal positions, and investors cannot readily interpret positions in terms of risk. Further, strategies cannot generally be reverse engineered from risk disclosure. So risk transparency is what investors need and should present no disclosure problems to the fund manager.

Lo discussed data issues and survivorship bias, with a careful demonstration of the importance of the bias, and the illusion of superior performance from managers who in fact demonstrate no skill.

Turning next to dynamic risk management, he discussed some of the characteristics of hedge funds and noted that static risk analytics are not appropriate for these funds. To illustrate his point he offered conventional performance measures for 96 months of history for a hypothetical fund. The measures included mean monthly returns and standard deviations, minimum and maximum monthly returns, the annual Sharpe ratio, and correlations with the market index, as well as corresponding measures for the index. The measures all demonstrated significantly superior or at least acceptable statistics for the fund, and dramatically superior performance over the index. Even an examination of the monthly returns on the funds and the index supported a conclusion that the fund had done extraordinarily well. The monthly standard deviation had indeed been higher than that for the index, but did not appear excessive and the Sharpe ratio was certainly encouraging. He then revealed the trading strategy for the fund. It was very simple. It was to replicate a short European put option on 10 million shares of a single stock, at a strike price of $25 and a time to maturity of two years. The standard performance measures would of course have given the investor no clue to the risk in this fund.

Turning next to correlation and risk adjustments, Lo noted that hedge funds are seen as diversifying, offering low correlation to market indices and often characterized as "market neutral." But how neutral is a hedge fund and where does the alpha come from? There must be some risk exposure that is not market risk. Hedge fund returns are nonlinear, and risk attribution must be able to cope with this. As an example, Lo described "phase-locking behavior." In this form of behavior, the manager sometimes (perhaps very rarely) is highly exposed to a factor with very high variability, and the rest of the time has no exposure to this factor. The result is that during the brief periods of exposure the correlation will be very high and in the extended period of non-exposure it will be very low. The historic unconditional correlation will appear to be very low, and the investor will be quite unaware of the brief periods of very high risk.
In conclusion, Lo listed some of the things we learned from the summer of 1998, referring to the LTCM experience that had been discussed the day before.

- Correlations Depend on Business Conditions
- Leverage Creates Multiplier/Accelerator Effect
- Nonlinearities Are Important
- Financial Markets Are Path-Dependent (Non-Markovian)
- Small Probability ≠ Zero Probability

His final conclusion was that managers need to provide more risk transparency and that investors need more training in understanding hedge fund risk.

89. Aggregating Risk Across Multiple Asset Classes (Spring 2000)

Andrew Rudd, Chairman and Aamir Sheikh, Senior Vice President, of BARRA, Inc., distributed a paper entitled: “Aggregating Risk Across Multiple Asset Classes.” Rudd began the presentation with the importance of an enterprise-wide perspective on risk. He described the investment management business as experiencing radical change in the last few years from individualistic entrepreneurial activity to the business of a major corporate industry, almost comparable to industrial corporations in some respects. Organizations are quite complicated, spanning global and cultural investment practices, a variety of assets, and diversities within the compensation structure. At the same time, the business is people intensive and individuals are the driving force. Finally, regulatory oversight has become much more significant. In summary:

- As portfolio management evolves into an "industry," so risk management must become an enterprise-wide function.
- Business management requires a common risk measurement platform throughout the organization.
- Analytical complexity is now at a level beyond that for a single portfolio.
- Risk measurement should properly include all important aspects of risk, including market, credit, liquidity, and operational dimensions.

He turned to some examples of the failure of adequate risk management, generally the result of a simple failure to understand the risks of the entire firm. Not managing aggregate risk leads to:

- Incomplete knowledge of the aggregate risks
- Careless exposures to uncompensated risk sources
- Over diversification
- Less than optimal risk/return tradeoff

In integrating risk management across the firm, we want to achieve an optimal risk/return tradeoff across multiple dimensions, including securities, factors, asset classes, industries, sectors and countries. We face two problems: one is preserving the accuracy of risk models for single asset classes, and a second is dealing with different lengths of historical data series for different classes.

At this point the presentation was taken up by Aamir Sheikh. He began by describing a series of statistical tests on the U.S. equity market. We decompose equity returns and risks into market and residual components. We take as data U.S. equity excess returns from January
1973 to April 1997, and we divide the sample into periods in which the market excess return was positive and periods in which it was negative. Then we examine changes in volatilities, correlations and betas of excess returns in the following period.

We find that for nine industries and the market average, volatility falls after an up market and rises after a down market. Similarly, we discover that the average correlation of pairs of industries falls after an up market and rises after a down market. Sheikh noted that these results are consistent for the U.S. equity market and also for the Japanese equity market over a long period of time (but for the Canadian and Australian markets the volatility and correlation shifts are not consistent over long periods).

To try to get at the causation of the volatility and correlation changes we carry the examination further. It turns out that for the nine industries, there is no significant difference between betas following up markets and those following down markets. Nor is there any significant difference in the standard deviations of the residual returns, nor in the correlations in residual returns. It appears then that shifts in market volatility are the driving force behind the changes in total volatility and correlation that we have seen following different market conditions. This information can be incorporated into forecasts of U.S. equity covariances. For example, BARRA's U.S. equity factor covariance matrix is scaled to match the predicted variance of the S&P 500. Covariance for the S&P 500 is predicted using an extended GARCH model that includes lagged S&P 500 excess returns as a predictive variable.

The next problem described by Sheikh is integrating what we have learned across asset classes. We must put together unconditional covariance matrices with the conditional (up and down market) market variances. And we must take this across all of the asset classes that concern us. In doing this, we want an end result that will give us the same measures for each asset class that the model specific to that class would give. It is this integration process that lies at the heart of the work reported on by the two speakers and Sheikh outlined the process step by step.

He next extended the analysis to deal with credit risk. We need measurements of exposure and measurements of counterparty quality. The latter involves likelihood of rating changes and expected default frequency. We bring together losses and likelihoods, modeling default and rating change probabilities, using historical transition matrices for given ratings. From a distribution of equity returns and rating change likelihood we infer the return associated with each rating change. And from joint equity return distributions we compute the likelihoods of joint rating changes.

Finally, we integrate credit and market risk. This involves a joint distribution of:

- Market risk factors
- Equity values, fixed income factors (term structure and spreads) and currencies
- Equity values related to joint distribution of credit rating changes

90. Measuring the Risk of International Investments (Fall 1998)

Campbell R. Harvey, J. Paul Sticht Professor of International Business, Fuqua School of Business, Duke University presented a paper by himself and Dana Achour, Greg Hopkins and Clive Lang of Merrill Lynch Global Asset Management, Ltd., entitled: “Stock
Selection in Emerging Markets: Portfolio Strategies for Malaysia, Mexico and South Africa”.

Harvey began by observing that three years earlier in a presentation at the Spring 1995 seminar of the Q-Group® (see Volume 4, Summary 50) he had talked about country choice in making international investments, and most research on international investing has focused on country choice rather than stock selection. Research on stock selection in undeveloped countries is made difficult by the scarcity of data, information asymmetry between local and global investors, and extremely high transaction costs. In this paper, however, he had undertaken a model for stock selection. He commented that emerging markets may be “cheap” at the present time, and stock selection may be especially relevant. It is also important that as of the middle of 1998 we have historical data for emerging markets covering both good and bad times. This makes the data much more useful than they were some time back, when history appeared to include only good times.

In principle, we might prefer a global bottom-up model to deal with all emerging markets. However, Harvey’s observation was that emerging markets are so different that we really have to proceed country by country.

He described three distinct methodologies: cross-sectional regressions, sorting, and a hybrid of the two. His presentation described a hybrid that involved a sort procedure followed by the use of regressions to optimize. Regressions alone suffer from very unstable coefficients, at least as applied to emerging markets. Sorting also introduces stability problems, and he described some ways of dealing with this. Sorting is at least a good simple starting procedure. Sorting by attributes leads to portfolios organized from most to least attractive and regression analysis can be used to weight the portfolios. The end result is a flexible and highly non-linear methodology for identifying superior and inferior securities.

The research embraced three emerging markets: Malaysia, representative of Asia, Mexico, representative of Latin America, and South Africa, a simply unique market.

At the start of each holding period, firms are sorted on 19 observable characteristics and assigned in equal numbers to a predefined number of portfolios on the basis of sorting rank. The number of portfolios varied from three to five. The most interesting are the top and bottom portfolios. The sorts are primarily univariate although some bivariate sorts were performed but not reported. The 19 characteristics included a number of fundamentals, like market capitalization, debt to equity ratio, dividend yield, 1 and 3 year historical earnings growth. Expectational factors included a number of statistics published by I/B/E/S, including change in consensus fiscal year one estimate, and consensus forecast earnings estimate revision ratios. Momentum variables included 1 month and 1 year price momentum. For the screening process the “in-sample” period ends in December 1995. The “out-of-sample” period extends from 1996 through May 1998.

Following the sorts on observable characteristics, weights are assigned to the characteristics and final portfolios are selected. Harvey described a number of diagnostic criteria to assist the evaluation of each screening factor. There are 28 of these, and all are related to performance. Annualized average return, cumulative return, systematic risk, maximum number of consecutive negative periods, relative performance, and cumulative annual returns over the last 2 and 5 years are examples. In addition, Harvey emphasized the importance of
consistency. Quantitative measures such as the longest strings of negative and positive absolute and relative returns, performances in up and down markets, and the historical probabilities of losing money add further dimensions to traditional statistical risk and expected return measures. The final portfolio selection was based on a combination of screening, diagnostics, correlation analysis, success ratios, quadratic optimization, quantitative adjustments for high transactions costs, and a final "knock-out" list. This last criterion is intended to eliminate firms that are too small for meaningful portfolio investment and also firms that have unreasonable leverage. The success ratio measures the percentage of stocks in the top portfolio that outperform the benchmark portfolio and the percentage in the bottom portfolio that underperform. The average of these rates through time will reveal a depth of portfolio performance and a proportion of firms driving performance. This measure is examined for each of the screening factors.

An important innovation in the work presented lies in the scope of the data sources. Most research on emerging markets has made use of International Finance Corporation data. The present research included data from Worldscope and I/B/E/S as well as Morgan Stanley Capital International. A great deal of effort went into data cleaning.

Results were presented in a variety of tables. For each of the three emerging markets, for each screening item, statistics were presented for the ranked portfolios. Next, a table compared the top and bottom portfolios for each screening variable. Another table presented success rates, with standard deviations and consistency of success rates. Finally, tables of performance showed the impact of rebalancing monthly, quarterly and semiannually. Since the analysis ignored transactions cost, there is a reason to compare the rebalancing frequency. Harvey presented a graphical illustration of the differences among the top and bottom portfolios and the benchmarks for the emerging markets, through the in-sample and the out-of-sample periods. The out-of-sample results were generally quite good for all three markets, in terms of sorting the best from the worst securities.

In closing, Harvey outlined plans for future research, observing that the most pressing problem is the merging of the country selection and stock selection exercises.

91. Risk Containment Strategies For Investors With Multivariate Utility Functions (Spring 1997)

Don Rich, Joseph Reisman Research Professor at Northeastern University, presented a paper by himself and Mark Kritzman, Managing Partner, Windham Capital Management-Boston, entitled: "Risk Containment For Investors With Multivariate Utility Functions."

He began his presentation with a multiple contingency matrix, a very simple picture of how the performance of a money manager might be characterized. In the first quadrant the manager outperforms an absolute target and also outperforms a benchmark relative target and the performance can be characterized as "great." In the fourth quadrant, the manager underperforms both targets and the results can be characterized for the manager as "disaster." In the second and third quadrants, where one target is outperformed and the other is underperformed, one can characterize the performance as "tolerable." One can generalize this matrix to a number of agency situations, but Rich's research was focused on money management.
Rich proposed protection of the portfolio (and the manager's reputation and perhaps compensation) through options. The first option would exchange the performance of the benchmark for the managed portfolio performance when the managed portfolio absolute return fell below a specified threshold. Another option would pay off (in the case of investment in foreign securities) only when the underlying portfolio's local return fell below a specified threshold. The most interesting option would pay off only in the fourth quadrant (disaster) case, when the portfolio underperforms both its absolute target and its relative benchmark target. The paper set out the mathematics for pricing these options. In his presentation, Rich showed the costs of insuring quadrant two, three and four results, and the much lower cost of insuring quadrant four – the "disaster"-quadrant alone.

The next step was to finance the cost of insuring quadrant four by giving up a portion of the benefits of quadrant one – the "great" quadrant. In effect, the purchase of a collar would achieve this result. A put option would insure against the disaster result, while writing a call option giving the buyer the excess of the portfolio return over the benchmark return would complete the collar. The objective was a collar that could be put in place at zero cost. The call option would be conditioned on the portfolio achieving a specified hurdle rate. The call option could be exercised only if the portfolio outperformed that hurdle. The question then was what hurdle rate would make the value of the call option exactly equal to the value of the put option and hence put a zero price on the collar.

The empirical work concerned the construction of a hybrid collar for a U.S. portfolio invested in the Japanese NK 225 Index. The protection sought then involved both the foreign exchange exposure and the stock index exposure. It turned out that for a reasonably wide range of assumptions, the cushion on favorable absolute performance that must be exceeded before the investor is required to relinquish relative gains is close to 15% as long as the riskless return is 6% and the holding period is one year. That is, the call option would be exercised only if the portfolio performance exceeded 15% over the index benchmark, in which case all of the excess over the benchmark would be subject to call.

A variety of hybrid collars might be devised. The point of the reported research was to demonstrate the general usefulness of a hybrid collar providing protection from joint negative events in exchange for relinquishing relative gains that occur above an absolute threshold.

An interesting aspect of the research concerned moral hazard. The usual concern is that a manager may increase the risk of a portfolio in the expectation of achieving or exceeding performance targets. Rich believed that the consequences of increasing volatility in the context of the put option would be so uncertain that there was little chance of that behavior on the part of the manager.

A new moral hazard is created, however, by the put option. If the performance of the portfolio places it in quadrants two or three, where there is no protection, the manager may find it attractive to sacrifice performance, move to quadrant four, and collect the insurance. The zero cost collar appears to remove this incentive. There may be, however, conditions under which it will be better to end up in quadrants two or three than in quadrant one, given the collar. At the same time, the interests of the manager and of the client portfolio would appear to be aligned, so that the manager's incentives would be to act in the best interest of the portfolio client.
92. The Nature of Risk — A Panel Discussion (Fall 1996)

James L. Farrell, Jr., Chairman of the Institute, moderated a panel to conclude the Monday discussion of the nature of risk.

William F. Sharpe, Nobel Laureate and Professor of Finance, Graduate School of Business, Stanford University, described his analysis of the Morningstar mutual fund rating system. Morningstar divides the mutual funds it reviews into four rating categories: equity, hybrid, taxable bond, and municipal bond. Within the equity category there is a further subdivision into a variety of equity mutual funds. Those funds that are rated are given 1, 2, 3, 4 or 5 stars. Five stars represents the highest rating.

Morningstar does not provide explicit explanations for the derivation of its ratings. However, Sharpe reported his use of monthly rates of return for the rated funds to construct, or closely approximate, the Morningstar ratings. A number of interesting conclusions came out of this construction.

The ratings turned out to be very highly correlated with the Sharpe Ratio of efficiency: the mean excess monthly return over returns on U.S. Treasury Bills, divided by the standard deviation of returns or excess returns. That is, the Morningstar ratings are a fairly accurate differentiation of historic efficiency in terms of a Sharpe Ratio.

However, the efficiency that is rated is not a measure of management skill. It is a measure of historical success, which combines management skill with the success of a particular style of investing.

So long as the ratings are used to select a single best fund for an investor, they are as useful as historically derived Sharpe Ratios. However, for an investor interested in an attractive combination of mutual funds the ratings offer little advantage.

Robert Kopprasch, Managing Director of Fixed Income, Smith Barney Capital Management, offered a critique of VAR (value at risk) analytics. VAR had been discussed at a previous (Spring, 1996) Q-Group® seminar as one method for estimating and presenting the risk exposure of a financial institution. Kopprasch entitled his presentation “VAR Arbitrage,” which he defined as the deliberate creation of risky trades which appear to be low risk in a VAR framework. The incentive system for traders suggests that there is a motivation to hide risky trades.

He reviewed methods for calculating VAR including the historical method (using a vector of observed changes in market factors), the analytic method (specifying distributions for risk factors), and a simulation or Monte Carlo method (defining parameters for distributions of market factors). All three have significant weaknesses. And all lend themselves to exploitation of the weaknesses. For example, the historical method makes use of moving averages of historical volatility. A trader can take advantage of a temporary collapse of volatility to calculate a deceptively low VAR. Or the trader may be able to vary the length of time over which the volatility is calculated, for the same purpose.

It is particularly difficult to verify the accuracy of VAR calculations. The ordinary small day-to-day fluctuations may indeed reflect the calculated VAR, but fail to warn of the rare catastrophe which is what the VAR is supposed to reveal.

Arnold S. Wood, President, Martingale Asset Management titled his presentation: “Caveat Emptor or Carpe Diem,” which he translated as “why smart people make dumb decisions.”
The problem begins with over-confidence: we think we can add skill to a game of chance. Hard work, concentration, involvement, focused research, and strategy development would all seem to be the basis of superior investment management. The difficulty comes in identifying appropriate opportunities for the application of this effort. We have trouble separating the opportunities where skill can make a difference from those where we are dealing with pure chance. He closed with the thought that it might be useful to have one's decision making process independently appraised for behavioral flaws.

93. Global Risk Management: The Limits of Analytics (Fall 1996)

James L. Farrell, Jr., Chairman of the Institute, introduced the first speaker of the day: Richard Bookstaber, Managing Director and Global Risk Manager, Salomon Brothers, Inc. His responsibility at Salomon Brothers is global risk management, which entails the overall risk exposure of the firm, encompassing all of its activities. He distributed a brief paper entitled: "Global Risk Management: Limits to Analytical Risk Management." The theme of his presentation was the existence of serious blind spots in the customary analysis of global risk exposure, and serious limits to what the standard analytic methodology reveals with respect to risk exposure.

Risk management systems typically build up a value at risk number that is based upon the exposure of various desks to various risk factors. Most desks also look at inventory in assessing risk. Inventory risk is particularly important, yet the hedging risk of inventory remains unmeasured by most firms. Inventory risks occur as discrete – and usually large – events. They do not show up as fluctuations in daily price moves, a usually convenient source of risk measures.

For financial markets, distributions are not "normal." They have fat tails and the major risks lie in those fat tails. The drop in the S&P 500 on October 19, 1987, was approximately a 20 daily standard deviation event. The December 1994, move in the Mexican Peso was an 18 standard deviation event. In general, every financial market experiences one or more daily price moves of 4 standard deviations or more each year. And in any one year, there is usually at least one market that has a daily move that is greater than 10 standard deviations.

Value at risk measures depend very much on correlation assumptions. The correlations are generally measured on the basis of typical day-to-day movements under a normal market environment. The result is that the correlations are good representations of the inter-market structure except during major market events. The correlations can shift from being small to very large, and can even change sign. It may be best to assume that in the event of a market catastrophe, correlations will go to either plus 1 or minus 1, so that hedges either provide perfect protection or double the risk. The weakness in using day-to-day history suggests that scenario analysis may be more valuable. The unpredictable nature of correlations during major market events, compounded with the tendency of large market moves to spread from one market to another, means that diversification does not work when it is most needed.

Negative gamma is a particularly important source of market risk. This is the phenomenon of non-linear exposure, where exposures that are small at the current level of the risk factor grow more than proportionally with changes in that risk factor. Negative gamma leads to cascading losses in adverse markets, and
the potential for loss is not shown in day-to-day price movements of the position.

The truly catastrophic risks are generally quite simple. Losses occur because no one in the organization asked the right question or because senior management did not follow through when questions were raised. In other words, the risk of greatest loss is an organizational risk. Bookstaber identified four characteristics of an organization that should be examined. The first is incentives. Is there an incentive structure in place that leads traders to look beyond their own books, and staff to consider thoughtfully the positions of the desks? The second is information. Are revenue and position information, and strategies, open for discussion and peer review? The third is interaction. Is there true freedom of interaction, where traders and staff can ask questions and compare notes across desks and business lines, and do junior traders and staff have a genuinely open line to senior officers of the firm? The fourth is initiative. Does senior management have the initiative and the knowledge to seize issues directly, or do they simply refer issues back to the trading floor?

The real problem is that the most serious risks are the most difficult to explore. We have highly specialized analytic models that purport to identify risks. It is much easier to refine these models and do a more thorough job on minor risks than it is to attack the major risks. Bookstaber’s concern is that most firms are pushing ahead with the models, because we understand the models and their uses, when the time and energy should be going into the much more difficult preparation for unknown catastrophes.

Catastrophic losses come not from failing to dig deep enough, but from not digging in the right spot. What we need are not finer tools for more precise evaluations of minor risks, but the development of better ways to examine organizational risks and what Bookstaber called “extended uncertainty.”

94. Uses of Market Exposure in Trading and Risk Management (Spring 1996)

Robert Litterman, Partner, Goldman Sachs & Company, distributed a paper entitled: “Managing Market Exposure.” The “market” here can be thought of as any linear combination of asset weights, and the market is defined to suit the portfolio for which risk exposure is being measured. The exposure itself is essentially a beta that is the coefficient in a regression of the return of the portfolio on the return of the market – the covariance of the portfolio and market returns divided by the variance of the market return.

Litterman was dealing primarily (although not exclusively) with fixed income portfolios and he contrasted the use of the market exposure beta to the use of duration, a concept with which fixed income managers are particularly familiar and comfortable. Market exposure is a much more comprehensive measure of risk than is duration. Bond traders, however, do not think in terms of beta at least at Goldman Sachs; they tend to think in terms of 10-year equivalents. That is, their unit of risk is the risk in 10-year U.S. government notes. What this amounts to is measuring the marginal impact on a portfolio of a small change in interest rates, such as a one basis point move, and then expressing that impact in terms of the quantity of the current 10-year note that would have the same sensitivity to rate moves.

Litterman showed for a portfolio consisting of a variety of maturities as well as some swaps, the difference
between using duration as the risk measure and using market exposure in determining the amount of 10-year equivalents that represent the risk in the portfolio. This amount of 10-year equivalents would in effect determine what it would take to fully hedge the portfolio against interest rate risk. The differences were quite dramatic, with the duration based calculation calling for three times the hedge portfolio indicated by the market exposure measure of risk.

Litterman continued, showing the calculation of the 10-year equivalent for a portfolio of European fixed income securities, including bonds and futures of three countries. Once again, the differences between using duration and market exposure as the risk measure were dramatic.

Relative value trades are particularly important. These are trades in which the motivation is to capture the relative value of one security versus another without exposure to the general risk affecting all related securities. Such market neutral positions should have zero market exposure. The hardest part of achieving neutral positions is to identify the “market” toward which the trade is to be neutral. Litterman said that Goldman Sachs has found simple definitions to work best. For example, where the trader believes that German bonds will outperform French bonds the appropriate “market” is an equally weighted combination of French and German 10-year bonds. We then need the co-variances of the French and German bond returns, respectively, with the returns on this defined market. That will give us the appropriate weight for French and German bonds in a portfolio that is market neutral but will exploit the perceived difference between the prospects for the French and German bonds.

Traders often have access to asset return volatilities, but not to co-variances with each other or the market portfolio. In this case we might define the market portfolio, for a two asset portfolio, to be a weighted combination of the two assets with the weights inversely proportional to the return volatilities. In this special case each asset contributes equally to the market portfolio volatility. The market neutral spread portfolio has the same weights with one long and the other short.

Litterman continued to consider a butterfly trade example. We are now dealing with bonds of three maturities. We assume the market portfolio has equal weights in each bond, and we assume a long position of one unit in one of the bonds. Now we must find the market neutral weights for the other two bonds. The co-variances will give us a sum of weights but we need a constraint to complete the calculation. Assuming that the two weights sum to one, we can solve for each of them. We can go further, and impose a constraint that brings about neutrality to a “steepening” of the yield curve.

In closing, Litterman stressed the importance of the determination of market neutral weights as an appropriate consideration for all relative value trades. The “market” and the “portfolio” can be any linear combination of asset weights. From the variance of the market return and the co-variances of the returns of the assets we can control the market exposure of the portfolio.


Robert Cialdini, Regents' Professor, Department of Psychology, Arizona State University, delivered the opening presentation at the Spring 1997 seminar. He began by describing some empirical research he had undertaken in an effort to determine which psychological factors, in everyday human interaction,
most powerfully push an individual to act simply because someone else has requested the action. The academic literature had reported a great many essentially laboratory tests of human behavior, tests offering some insight with respect to those psychological factors, but Cialdini was determined to pursue his research beyond the laboratory. He enrolled, incognito, in the training programs of various sales organizations and learned how to sell encyclopedias door to door, portrait photography by phone, used cars from a lot, and appliances from a showroom floor. He worked for a time in a public relations firm, in a pair of advertising agencies, and in the fundraising departments of two charity organizations. He took a job in a restaurant, he interviewed political lobbyists, labor negotiators, and religious cult members to learn how influence occurred in those domains.

Throughout this research he looked for common principles, used across all of these situations in which one person was attempting to influence others. In the end, he found six principles to be consistently effective in use over the wide range of activities surveyed. The principles proved to be remarkably effective, yet Cialdini was surprised at how rarely they were being used optimally by those who could have benefited from them.

The first principal was reciprocity. In all human societies, the recipient of a favor, even one that has not been requested, will feel indebted and can be expected to return the favor. A person can significantly increase the chance that another will comply with a request for a favor by providing a small favor first. Cialdini provided a number of examples of the principle and distinguished three applications. The successful use of this principle involves the conferring of a genuine favor in expectation of the return of a favor. The "smuggler", on the other hand, confers a worthless favor that may in the short run result in a return of favors but in the long run is unlikely to be successful. The "bungler" confers a legitimate favor, but fails to take advantage of the opportunity to extract a reciprocal favor or, perhaps more important, extract a commitment for such a favor in the future.

The second principle was consistence. People share a strong drive to be consistent in their attitudes, words, and deeds. So if a person can be persuaded to make a commitment that person is likely to act consistently with the commitment. The principle is important because the initial commitment may cost very little, but may lead to a much more costly follow-up. An example was the willingness of people to wear a lapel pin endorsing cancer research, a commitment that later greatly increased their willingness to contribute money for cancer research.

The third principle was social validation. An effective strategy for an influence agent, therefore, is to provide information to the influence target indicating that a lot of people just like the target have taken a desired action.

The fourth principle was liking. People prefer to say "yes" to the requests of those they know and like. Praising the person to whom the request is to be made, and stressing the similarities between that person and the one making the request, will increase the probability of a "yes."

The fifth principle is authority. Authority bespeaks superior information and power, and people tend to comply with the recommendations of properly constituted authorities. If the influence agent can call on authority, as in the case of quoting the endorsements of physicians for a medical product, a positive response is likely.
Finally, the sixth principle was scarcity. Cialdini cited a number of examples for the principle that we like most what we cannot have, or at least what will soon be in short supply. People can be influenced to purchase a commodity by showing them that its availability is in peril.

Cialdini closed by observing that most of his audience were probably already aware of the principles he discussed. They had probably experienced most of them as part of the process of influencing others or as part of the process of being influenced by others. But his experience had taught him that while people may be aware of these principles they greatly under-utilize them. Sometimes their behavioral instincts get in the way of using them, and sometimes they simply do not think of them at the appropriate time. His closing advice, therefore, was to strive to remember and implement what they knew.

96. A Heterogeneous Expectations Model of Speculation and Speculative Bubbles (Spring 1997)

Speculative Bubbles and the Equity Risk Premium Introduction: Are the Bears in Hiding? (Spring 1997)

James L. Farrell, Jr., Chairman of the Institute, Chairman, Farrell-Wako Global Investment Management, introduced the topic of speculative bubbles and the two speakers: Lynn Stout and Jack Treynor. He began with a number of questions to be explored during the next four sessions. What is a bubble? How does one define speculation? Can it be measured? Are bubbles the result of irrational or rational behavior? What are the implications for market efficiency? What is the appropriate risk premium?

He reviewed some statistics on market cycles over the 70 years 1926 - 1996, and identified some of the major changes in stock prices. Some of the evidence suggested the existence of speculative bubbles and their bursting, while some of the evidence did not. In short, the subject presented a puzzle.

Lynn A. Stout, Professor of Law, Georgetown Law Center, and Guest Scholar, The Brookings Institution, distributed a paper entitled: “A Heterogeneous Expectations Model of Speculation and Speculative Bubbles.”

Academics have offered a number of explanations, ranging from a denial that bubbles actually exist, to irrational behavior, and rational behavior. Stout’s object was to revive the heterogeneous expectations, or HE model. And she began with a simple example. We imagine a case in which the current price of gold is $500 an ounce, and the market consists of five participants, of which one is an actual user of gold and in fact owns all of the gold. None of the five market participants have any reason to think that the price of gold will change. Now news arrives, news that persuades one of the participants that the price will go very quickly to $510, and convinces another of the participants that the price will drop very quickly to $490. The other participants, including the user holding the gold, have no reason to think there will be any change in the price. The immediate result is that the bullish participant acquires all of the gold from the current holder and establishes a new price of $510. Next, events unfold such that it becomes clear that both the bullish and bearish participant were wrong and the correct price of the gold is actually $500 an ounce. The bullish participant no longer has any reason to hold on to the gold, and sells it back to the user. The price drops back to $500. What we have imagined is the formation of and the bursting of a bubble.

The model required some greatly simplifying assumptions. Stout explained two important features to her model. First, she had ruled out short sales and therefore described an
incomplete market. The absence of short sales made it impossible for the bearish participant to exploit an expectation that the price would fall. The second feature was statistical uncertainty, that led to the bullish and bearish participants drawing quite different conclusions from the same item of news and producing the wide variance of expectations from a price of $490 to a price of $510. These were in fact the heterogeneous expectations.

The model offers an explanation for the tulip mania in Holland in 1636-1637. The feature of an incomplete market was important then, and Stout suggested that it may have been the introduction of futures trading that led to the collapse of the tulip bubble. A demand for tulip flowers and bulbs in France had led to increased prices for tulips in Holland in 1636. A trading market ensued, including what amounted essentially to the introduction of a futures market in tulip bulbs in November of 1636. The following January the price of tulip bulbs rose something like twenty fold. And in February within four days the prices fell back to their November level.

Increasing the disparity in expectations will increase the magnitude of the bubble. It is likely that increasing the size of the market, by bringing in more participants, may increase the disparity in expectations and therefore increase the likelihood and magnitude of the bubble. A member of the audience suggested that if an increase in participation in the stock market takes the form of investors making heavier use of mutual funds, there may actually be a decrease in the active participants in buying and selling stocks. However, the same activity will give those market participants a lot more money to invest. With more money, implementation of their investment strategies can have a larger impact on market prices.

The implication of her rather simple example was that when short sales are restricted, a price bubble can be produced simply by increasing and then decreasing the dispersion of market participant expectations for future prices. The bubble does not require any shift in the expectations of the average market participant. Put another way, the HE model implies that bubbles can be a predictable consequence of increased uncertainty that invites a self-selected group of optimistic speculators into an asset market where short selling is restricted.

The HE approach also suggested that a reduction in the costs associated with taking a speculative position in an asset could help to precipitate a bubble. On the other hand, introducing futures trading and therefore opportunities for speculators to take short positions may decrease the likelihood of price bubbles. However, to the extent that futures markets reduce the cost of speculating they may increase the incidence of price bubbles to the extent that asymmetry persists between the costs of going long and of taking a short position.

97. Bulls, Bears & Market Bubbles (Spring 1997)

Jack Treynor, President Treynor Capital Management, Inc., distributed a paper entitled: “Bulls, Bears and Market Bubbles.”

He offered a very simple model to determine the likelihood of a market bubble. We imagine a stock market in which there are three kinds of participants: active bulls and bears, and a group of passive investors who have no opinion about the future level of the market. If there are just enough of the passive investors to own the market exactly once, then the positions of the bulls and bears will have to be offsetting. The long position of the bulls will exactly
equal the short position of the bears. And when the market level changes, what one active group gains the other loses.

For both the bulls and the bears, market bets will depend upon four distinct considerations: the potential reward and risk perceived by the investor, the investor's aggregate wealth, and how aggressively he or she bets it. Optimal dollar holdings are proportional to expected excess return, and inversely proportional to the variance surrounding that expectation. If bulls and bears are drawn randomly from the same population with respect to forecast error and aggressiveness then, if the two groups are sufficiently populous, their average values of these parameters will be about the same.

Let $K$ equal the ratio of aggressiveness to forecast error variance for the population. Let the bulls and bears hold respective positions $h_1$ and $h_2$ proportional to both the difference between the current market level $p$ and their respective expectations $P_1$ and $P_2$ and their respective wealth $W_1$ and $W_2$.

We have

\[
\begin{align*}
    h_1 &= W_1(P_1 - p)K \\
    h_2 &= W_2(P_2 - p)K, \\
    h_1 + h_2 &= 0.
\end{align*}
\]

Solving for the equilibrium market level $p$ we have

\[
p = \frac{W_1P_1 + W_2P_2}{W_1 + W_2},
\]

Solving for position $h_1$ we have

\[
h_1 = -\frac{W_1W_2}{W_1 + W_2}(P_1 - P_2)K = -h_2.
\]

Now we examine the impact of new information. Instantly propagated new information alters both bull and bear price expectation by an amount $\Delta$. Absent a wealth transfer, the new equilibrium price $p'$ would be

\[
p' = \frac{W_1(P_1 + \Delta) + W_2(P_2 + \Delta)}{W_1 + W_2} = p + \Delta
\]

The change in the equilibrium price will transfer wealth from the bears to the bulls (or vice versa) so that the bulls' new wealth is

\[
W'_1 = W_1 + h_1\Delta
\]

and the bears' is

\[
W'_2 = W_2 + h_2\Delta = W_2 - h_1\Delta
\]

The wealth shift changes the desired holdings

\[
h_1' = \frac{(W_1 + h_1\Delta)(W_2 - h_1\Delta)}{W_1 + W_2}(P_1 - P_2)K,
\]

\[
= -h_2
\]

\[
= h_1 + \left(\frac{W_2 - W_1}{W_2 + W_1}\right)h_1\Delta(P_1 - P_2)K.
\]

\[
\frac{h_1' - h_1}{h_1} = \left(\frac{P_1 - P_2}{W_2 + W_1}\right)(W_2 - W_1)\Delta K.
\]

Thus instantly propagated new information leads to trading, even though buyer and seller get their information at exactly the same time. Turnover will be minimized when $W_1 = W_2$.

The wealth shift also leads to further price changes and the price changes to a further wealth adjustment. Finally, we arrive at

\[
\frac{p' - p}{\Delta} = W_1(W - W_1)\left(\frac{P_1 - P_2}{W}\right)^2 K.
\]

where $W = \text{total active wealth } W_1 + W_2$. The left side of the equation is the change
in the equilibrium market price divided by the change in expectations brought about by the new information. When this ratio is less than 1 the market is stable in the weak sense that, unless expectations change, the price will ultimately return to its original equilibrium. But when the ratio exceeds 1 we have a self-reinforcing process that results in a bubble. At the maximum value of the ratio

\[ \frac{P^1 - P}{\Delta} = \left(\frac{W}{2}\right)\left(\frac{P^1 - P_2}{W}\right)^2 K = \left(\frac{P^1 - P_2}{4}\right)^2 K. \]

For this ratio to exceed 1:

\[ \frac{P_1 - P}{\Delta} = \left(\frac{P_1 - P_2}{4}\right)K > 1, \]

\[ (P_1 - P_2)^2 > \frac{4}{K}. \]

Clearly, the potential of a bubble is highly sensitive to the degree of disagreement between bulls and bears.

98. Risk Aversion or Myopia? The Fallacy of Small Numbers and Its Implications for Retirement Savings (Fall 1996)

Shlomo Benartzi, Assistant Professor, Anderson School of Management, UCLA, distributed a paper by himself and Professor Richard H. Thaler entitled: "Risk Aversion or Myopia? The Fallacy of Small Numbers and Its Implications for Retirement Savings." He opened his presentation with a summary of the paper by Benartzi and Thaler that had been presented by Richard Thaler at the Q-Group meeting in the Fall of 1993 (See Volume 4, Summary 85). The authors of that earlier paper had tried to explain why, despite the historic superiority of stocks over bonds as investments, long-term investors continue to hold substantial quantities of bonds. They had found two explanations: mental accounting and loss aversion. Mental accounting has to do with the frequency with which investors evaluate their portfolios. Loss aversion (which is very different from risk aversion) refers to an asymmetry between the utility of gains and losses. The loss averse investor attaches much greater importance to a loss than to a gain of the same magnitude.

Turning to the current paper, Benartzi described Paul Samuelson's discussion of a bet he had offered to a colleague. The colleague was offered the opportunity to risk a one hundred dollar loss against a two hundred dollar win on the toss of a coin. He was also offered 100 coin tosses under the same conditions. The colleague declined the single coin toss but was willing to accept the 100 coin toss opportunity. His explanation for rejecting the single toss was that he would feel the one hundred dollar loss more than he would feel the two hundred dollar gain. Samuelson showed that the colleague's response was irrational. He should either have accepted both opportunities or rejected both. Benartzi offered an explanation for the colleague's preferences. If the colleague's loss aversion could be represented by a utility function that called for a 50% chance of losing one hundred dollars combined with a 50% chance of winning two hundred fifty dollars, the expected utility of a single bet would be negative while the expected utility of two or more bets would be positive.

The new paper consisted of three studies. The first investigated the attractiveness of repeated gambles. A group of subjects was offered a gamble on these terms: on each play there was a 10% probability of losing fifty cents and a 90% probability of winning ten cents. The play was to be repeated 150 times. Of the participants, only 49% would take the gamble rather than a three dollar certain amount. Yet the expected value of the gamble was six dollars. It seemed
likely that risk aversion was at work here and that the subjects were applying the probability of loss for a single bet to the longer sequence of 150 plays. When they were presented with a distribution of outcomes, a distribution actually made less attractive than the true distribution, the acceptance rate jumped to 97%. Presenting the distribution of final outcomes appeared to be a very important element in helping the subjects to understand the attractiveness of the game. Benartzi commented that Samuelson’s example had concerned a sophisticated colleague who understood the distribution implications of the repeated game, and while unwilling to engage in a single play was willing to undertake the series of 100 plays. The relatively unsophisticated subjects used in their research by Benartzi and Thaler were willing to engage in the multiple play game only when presented with details of the distribution of outcomes that enabled them to understand the benefits of the game.

The third study had to do with the implications of the first two for the defined contribution pension plan of USC. University staff eligible for this pension plan who had joined the university within the last year were asked how they would divide their funds between an equity fund and an intermediate term government bond fund. They were provided with historic information in three different ways. The first consisted of a graph showing one year returns for the stocks and for the bonds, from 1926 to 1993. On the basis of this presentation, the median proportion the participants would invest in stocks was 40%. The second presentation showed annual rates of return for periods of 30 years. The graph shown to the participants was based on simulations of thirty year sequences, using the actual annual rates of return drawn at random. On the basis of this presentation, the median proportion the participants would invest in stocks rose to 90%. Finally, a third presentation showed retirement income as a percentage of pre-retirement earned income, assuming retirement at age 70 for a 40 year old with salary growing a 1% per year. Once again, the median proportion invested in stocks would have been 90%. It was clear that the manner in which the historical performance of stocks and bonds was presented to the participants had a major affect on their allocation decision. Benartzi concluded that more information is not necessarily helpful to those making asset allocation decisions for their pension funds. What is critical is the manner in which information is presented.


Gifford Fong, President, Gifford Fong Associates, explained that although the title referred to “fixed income”, the presentation would be generalized to deal with a portfolio of many asset types. The issue was how one might measure and control risk. In describing the need for measurement and control he referred to the catastrophes at the Piper Jaffray Institutional Government Fund, the Orange County bankruptcy, the problems presented by dealer derivative product inventory, and a long list of sources of risk in a portfolio. The focus would be on those risk dimensions that are quantifiable, with the quantification focusing on three characteristics of risk: sensitivity analysis, value at risk (VAR), and stress testing.

He began with a discussion of sensitivity analysis. In the simple case the value of the investment changes by the sum of the product of the exposure to each risk factor and the change in that risk factor. In the complex case, a quadratic exposure is added to the linear
exposure. The expression is:

\[ \Delta P = A - \sum_{i=1}^{n} d_i X_i + \frac{1}{2} \sum_{i=1}^{n} c_i X_i^2 + Y \]

where \( X_i = \Delta F_i \) = changes in the value of each risk factor \( i \)

\( d_i = PD_i = -\frac{\partial P}{\partial F_i} \) = linear exposure

\( c_i = \frac{\partial^2 P}{\partial F_i^2} \) = quadratic exposure

\( Y \) = special effects

VAR is a popular concept. It was discussed in the “Group of Thirty” report, and the “Derivatives Policy Group”. It might be best described as the decline in the portfolio market value that can be expected within a given time interval (frequently described as 2 weeks) with a probability not exceeding a given number (such as a 1 percent chance).

Stress testing is the evaluation of changes in portfolio value under extreme and unfavorable market conditions occurring over a specific time interval. An example might be the price response curve of a mortgage backed security portfolio subject to extreme interest rate shifts.

At this point Richard Klotz, Partner, Coopers & Lybrand, continued the presentation with a focus on implementation of the three risk measures. He referred to the various regulatory bodies active in the securities and banking fields, as well as the Derivatives Policy Group for the investment banking community, and recommendations for the measurement of control and risk. Elements of all 3 risk measures had appeared in the proposals of these various bodies, although Klotz cautioned that the regulatory positions were still evolving.

Variance and co-variances are obviously important. They might be determined from historical data or they might be implied estimates, derived from such things as traded option and swap prices. So far it appears that regulators prefer the use of historical data. Klotz pointed out the problems in using historical data to estimate risk over a 2 week horizon. As an example of price volatility analysis he showed a case beginning with interest rate risk and adding cumulatively other market risks, derivative risks, specific risks, and foreign exchange risk. This might be performed for each security in a portfolio, to arrive at the total risk, expressed in dollars, for the portfolio.

As already noted, VAR is very popular, despite a number of weaknesses in this measure. It allows the measurement of market risk across multiple asset classes and currencies to be aggregated into a single number. It captures correlation effects; it provides a methodology to set limits; it permits the comparison of risks across different market sectors and asset classes; and it is useful in measuring risk-adjusted returns. However, it assumes risk factors are normally distributed; it assumes historical variances and correlations are good predictors of future variances and correlations; it does not identify the source of risk; and it does not quantify how large a loss could occur in an extreme market move.

The weaknesses in VAR lead to stress testing. Examples would be the gain or loss to a portfolio under extreme interest rate conditions. Or, in the case of an option portfolio, extreme changes in interest rates and volatility. The virtues of stress testing include consideration of extreme market move outcomes, isolation of specific risk exposures, better precision, and some intuitive appeal.

In conclusion, Klotz observed that measuring risk is multi-dimensional. Sensitivity analysis quantifies the impact of risk exposure; VAR summarizes the
risk exposure; and stress testing evaluates extreme outcomes of the risk exposures.

**Stock Prices and Return Distributions**

100. A Century of Investment Returns: Expectations for Future Equity Market Performance (Fall 2000)

Elroy Dimson, Professor, London Business School, distributed a paper by himself, Paul Marsh and Mike Staunton entitled: “Risk and Return in the 20th and 21st Centuries.”

He began by describing the development of annual rates of return on stocks, bonds, bills and inflation for twelve major securities markets for the 100 years of the 20th century. The twelve represent today 90% of the world capital market. He characterized the study, published as *The Millennium Book*, as unique in using total returns, avoiding look-back and easy-data bias, minimizing country survivor bias, and making use of authoritative academic studies. In comparing the results of the study with those of other studies for the twelve countries (generally covering somewhat shorter time periods) he focused on the most significant difference: the lower equity rates of return revealed by his study and the lower equity premiums.

Over the century, equities were the best performing asset class in all twelve countries, and equities had the highest risk measured as standard deviation. Bonds proved a disappointing investment but the statistics for the full century indicated that average equity returns were lower than previous studies have suggested. A graphical presentation of returns on UK asset classes showed distinctly poor performance of equities in the early years of the century, years that had generally not been included in prior studies. Of particular interest was the UK “small-cap reversal,” with small-caps performing better than large-caps over the 1955-88 period, but under-performing over the entire century.

Inflation was a major force in the 20th century with wide variation across countries. The German hyperinflation in 1922-23 and the very high inflation around the end of WWII in Italy, Japan and France were vastly different from inflation in the other eight countries.

What was of chief interest to Dimson was evidence with respect to the equity risk premium in his new study and the extent to which it indicated a significantly lower premium than those suggested by other studies, notably that begun in the University of Chicago and continued by Ibbotson Associates for the United States. The 100-year U.S. equity risk premium relative to bills he had found to be 5.8%, very close to the average for all twelve countries. Relative to bonds, the risk premium was 5.3%. These risk premia were computed as geometric means. Dimson pointed out that when decisions are being taken on a forward-looking basis, the arithmetic mean is the appropriate measure. For the U.S. this average was 7.7% for the risk premium over bills. He commented that the historical arithmetic means were clearly influenced by the period of extreme volatility during the 20th century. If we are to assume the persistence of the risk premium as a geometric average under conditions of lower volatility in the future, we could anticipate lower arithmetic average equity risk premium. Assuming a standard deviation of 15%, his tables indicated a U.S. arithmetic average equity risk premium of 6.8% over bills. The same adjustment for the average
over all twelve countries brings an 8.1% premium down to 6.7%.

Dimson continued with further reasons for reducing the expected equity risk premium in future years to less than its historical average. These included a likelihood that financial economists, given access to The Millennium Book, may wish to revise downward their own forecasts of the premium. Finally, he concluded that companies basing investment decisions on cost of capital determined using equity risk premia may be exaggerating the premia and under investing.

101. A Century of Global Stock Markets
(Spring 1997)

William N. Goetzmann, Professor of Finance at the Yale School of Management, distributed a paper by himself and Philippe Jorion of the University of California at Irvine, entitled: "A Century of Global Stock Markets." The paper described two undertakings. First was the development of a database of capital appreciation indexes for thirty-nine stock markets with histories going back as far as the 1920s. The second was use of this database to compare rates of appreciation in the United States with rates of appreciation in other countries.

Goetzmann described the painstaking effort to assemble his database. A starting point was two established sets of data from Morgan Stanley (MSCIP), and the International Finance Corporation. The former includes equity indices starting in January 1970 for a sample of 19 markets from developed countries. The latter started a database in December 1980 with nine markets, back filled to December 1975 and expanded to twenty-six markets. For the United States monthly stock market indices are available back to the 1870s. Goetzmann and his co-author had turned to publications of the International Monetary Fund, the League of Nations, and the International Abstract of Economic Statistics. The result was a reconstruction of histories for a number of stock markets going back to the early 1920s. The database is not free from selection bias, because the back filling of an index uses only stocks that are in existence at the end of the sample. A more serious type of bias involves gaps. For a number of countries, not of course including the United States, there are simply gaps sometimes of several years duration, for which no data are available. Three different approaches were taken to dealing with the problem. The "survived" index is constructed using all markets since the last interruption. The "continuous" index includes all markets for which there are missing observations, linking series across temporary gaps but omitting markets which suffered permanent interruption. Finally, the "reconstructed" index attempts to fill-in series which experience a major interruption. The authors arbitrarily imputed a charge of 50% of the value of equities to a permanent series interruption. That is, when a series experienced a permanent break they assumed that the value of the market fell by 50% the following month. The reconstructed index was felt to be the most useful of the three.

The most striking result indicated by the data series was that appreciation returns in the U.S. have been significantly higher than mean and median returns for other markets. For the period 1921 through 1995, the arithmetic average real appreciation return of the U.S. market was 5.98%. For the "survived" global index the number was 5.37%; for the "continuous" index it was 4.86%; and for the "reconstructed" it was 4.74%. Goetzmann suggested that the differences would suggest a survival bias of 60 to 120 basis points per year.
The absence of dividend information meant that all of the statistics represent only appreciation. This in turn raised some doubts about the validity of a comparison between the United States and other countries. For the period over which dividends are available, there appears to be no significant difference between the global average contribution of dividends and the contribution of dividends in the U.S. to total returns. Goetzmann concluded that there was no indication that the high returns obtained by the U.S. markets over the last sixty-five years were due to a dividend bias.

The high returns obtained in the U.S. did not seem to be compensation for higher risk as measured by volatility, since the measured volatility of the U.S. market was not particularly high compared to volatilities in other stock markets. Goetzmann also considered that real returns could be a reasonable proxy for the equity premium. It was not possible to compute equity premiums in the usual way (that is, as a difference between stock returns and returns on some risk free asset) because the risk free asset return could not be identified in a number of the markets studied. But it seemed reasonable to hypothesize a risk free asset that generated at least the rate of inflation. The conclusion from inflation analysis indicated that the equity premium was significantly higher in the U.S. than in other countries.

The survival hypothesis suggested that what has happened in the U.S. is simply that the market has escaped a more or less disastrous crash, while markets in other countries have not. Hence ex-post observed equity returns are higher than ex-ante expectations for the U.S., while they may not be for the other markets. And the “survival bias” referred to may then be simply a measure of the difference between the ex-post and ex-ante equity premiums.

Stock Valuation — Models

102. Franchise Valuation Under Q-Type Competition (Fall 1998)

Martin L. Leibowitz, Vice Chairman and Chief Investment Officer, TIAA-CREF, distributed a paper entitled: “Tobin’s Q and the Franchise Ride Abstract”.

Leibowitz referred to earlier work on a sales-driven franchise approach to corporate valuation. The valuation process is likely to place heavy emphasis on a period of relatively high sales growth (and earnings growth) followed by stabilizing of sales and a period where the firm’s earnings may still continue to change as the pricing margin moves towards some competitive equilibrium. It is this second period – frequently a period of earnings decline – that is the focus of his new paper. Motivated by a belief that we can gain important insights by a more careful analysis of the second or even subsequent stages, and also by a recognition that Tobin’s q measure may be an important contributor to the behavior of earnings beyond the initial high growth stage.

We take as an example a firm with a book value (B) of 100, current earnings (E) of 15, consequent return on book (r) of 15%, and a cost of capital (k) of 12%. This is a firm able to exploit its franchise, achieving an 3 percentage points above its cost of capital. Leibowitz defined the franchise margin factor to be the excess earnings on each sales dollar above and beyond that required to cover the cost of capital. In previous work, he had described the effect of competition, or the threat of competition, driving the franchise margin down essentially to zero. That earlier work however had not taken account of the Tobin q effect. Adapting the Tobin notation to his own purposes, Leibowitz defined competitive
equilibrium as a situation in which one or more competitors could replace the original firm's production and distribution capability through the capital expenditure of less than $B$, the book value of our original firm, through a capital expenditure of only $QB$, where $Q \leq 1$. Returning to our original example, we assume that the $Q$ for a competitor is 0.75. The competitor will be inclined to act if its level of earnings, $kQB$, will cover its capital costs, and hence in a fully competitive environment the original firm's earnings would also have to descend to $kQB$. In our example, that means that earnings $E$ are reduced from 15 to 9. The decline might take place suddenly, or might be spread over several years. Hence we introduce the earnings decay rate ($d$) which in our example is assumed to 5% per year. That is $E$ declines from 15 to 9 at the rate of 5% a year. It might be noted that even if $Q$ for the competitor is 1.0, rather than 0.75, the earnings of the original company will decline to 12. It is not difficult to calculate the time it takes at a decay rate of 5% per year to bring earning down from 15 to 9, and Leibowitz showed the equation.

It is convenient to calculate a present value equivalent return rate ($r^*$). This is the constant level rate of return that would yield the same present value as the series of rates declining from $r$ to $kQ$. In our example, with a decay rate in earnings of 5% per year, $r^*$ is about 11%.

Leibowitz went on to show what happens to the price/earnings ratio under the competitive conditions he had introduced. An initial price earnings ratio of $1/k$, about 8.3, is reduced to $(1/k)(r^*/r)$, or approximately 6.

Next, Leibowitz modified his model to consist of two phases: the first characterized by $H$ years of earnings growth at an annual rate $g$, and the second phase consisting of the full payout of the earnings level reached at the end of the first phase. For 22% annual growth over a ten year period, earnings are carried from 15 up to approximately 110, book value reaches approximately 530, and $r$ reaches 20.7%. (All earnings are assumed to be reinvested.) He then characterized the second phase as one of zero growth, and the emergence of the same competitor we saw previously. At a $Q$ of 0.75, $QB$ is approximately 400, and $kQB$ is approximately 48. It should be noted that the consequence of high growth in the first stage leads to a much deeper slide in earnings and rate of return.

In summarizing the lessons to be derived from the examples, Leibowitz observed first that the post-growth phase cannot be neglected. Understanding this phase is crucial to understanding the potential effects of competition on earnings and value. Second, while high growth rates generally lead to elevated rates of return, elevated rates of return increase vulnerability to competition which can lead to a very deep slide in profitability and value. All of this emphasizes the importance of assessing the durability of franchise margins and rates of return.

103. Valuing Growth Stocks
(Fall 1998)

Jonathan B. Berk, Haas School of Business, University of California at Berkeley, distributed a paper by himself, Richard C. Green, Graduate School of Industrial Administration, Carnegie Mellon University and Vasant Naik, Faculty of Commerce University of British Columbia and Lehman Brothers entitled: “Valuation and Return Dynamics of New Ventures”. He began his talk with a brief commentary on the value of purely theoretical models, and the qualifications of a good model. The paper itself describes a theoretical model and some simulated results, but without any empirical work.
The questions motivating the paper were these: What is the value of a project with no current cash flows? How do systematic and unsystematic risks interact in the determination of the value of R&D ventures? How long should one continue development and when should one quit? And, what are the return dynamics of such ventures? The objective of the three authors was to construct a model for the valuation of an asset where the value is derived solely from the potential to generate a future cash flow stream. The model had to incorporate technical uncertainty, during the product development period, future cash flow uncertainty following development and completion of the product, risk of obsolescence and "learning by doing." The last of these was specifically related to the development of a measure of skill, reflecting likelihood of success as the R&D proceeded.

Technical uncertainty presents idiosyncratic risk. In this particular model, N stages of development must be completed in order to produce a finished product. At each stage the firm has three options: to make a further investment and proceed one more stage, to do nothing (mothball the project), and to abandon the project. There is a probability that the next stage will be successful, and the probability may be dictated by the firm itself or left to develop as success or failure is realized during the stages of development.

Uncertainty about potential future cash flows is systematic, calculated as the covariance of the cash flows with a pricing kernel. The cash flows are those to be realized on completion of the R&D. The cash flow for each period is modeled as the cash flow for the preceding period modified by random noise.

The risk of obsolescence is an idiosyncratic one. This is essentially the risk that an external event may extinguish the cash flow or the potential cash flow.

The risk presented by "learning by doing" is an idiosyncratic one. If the probability of success is assumed to be unknown, then it is initialized and updated stage by stage according to Bayes' rule, using the success rate to date for the adjustment.

The value of the completed project is computed as the present value of the perpetuity beginning with the first expected cash flow and discounted by a function of the growth rate in cash flows, the risk premium, and the risk free rate.

The R&D phase requires a decision at the end of each stage as to whether to proceed with the next stage, one that will involve a fixed cost and a variable cost proportional to the expected cash flows. The decision is made by comparing the value if the next stage is undertaken to the value if the project is mothballed or abandoned. Mothballing simply means setting the project aside for possible revival. Abandonment means ending the project forever. At any stage in the R&D phase there is a threshold number of failed stages such that the project is abandoned. The intuition here is that the threshold number of failures signifies the firm's inability to complete the project. The threshold number is revised as the R&D progresses stage by stage. In addition, there is a unique minimum expected cash flow such that the project is mothballed but not abandoned whenever the expected cash flow is below the minimum. The intuition is that should the expected cash flows be too low for the project to achieve a satisfactory profit, there is no point continuing it. At the same time, the expected cash flows may turn out later to offer the prospect of profit and the project can be revived.

The model cannot be solved analytically, but only through
simulations. Berk presented a table of numerical parameters, upon which a million simulations were based. The simulations led to both tables and graphs, from which a number of interesting conclusion could be drawn. The case where the probability of success is known to the firm provides a useful benchmark. In this case all uncertainty is attributable to two sources: the characteristics of the cash flow and the pure uncertainty of overcoming technical hurdles. With strictly variable costs, the option to mothball is never exercised and so the incomplete project has the same risk premium as the completed project. When there is a fixed component in the R&D cost, the option to mothball has value and commands a risk premium. The voluntary nature of the investment decision, which is made conditioning on current values of the expected cash flow, imparts systematic risk to the project. In addition, the firm's fixed investment expenditures can be viewed as a liability that offsets the value of its asset, the cash flow stream. Since the fixed liability has lower risk than the stochastic asset, the firm has operating leverage that will also alter the risk premium.

A table of the values of the R&D project for different levels of expected cash flow, at different stages of development, was especially revealing. The differences between the value of the venture with the option to mothball, and the values assuming investment is non-voluntary, represent the value of the option to mothball, a value most important in the early stages of development and lower values of expected cash flow. The table also makes it possible to separately evaluate the contribution of operating leverage and the option to the risk premium. For high values of expected cash flow and when the project is close to completion, these values are close together even though the risk premium exceeds that earned on the completed project. The risk premium in these cases is attributable to the operating leverage associated with the fixed R&D expenses, rather than the voluntary nature of those expenses. Where the firm is close to exercising the option to mothball, on the other hand, the risk premium on the project is lower than that on the analogous venture with deterministic expenditure. The option to suspend investment truncates the downside of the distribution, lowering both systematic and unsystematic risk. Thus the "leverage" and the "optionality" embedded in the R&D venture operate in opposite directions.

From three dimensional graphs (risk premium, expected cash flow, and stage of development) Berk was able to show what happens to the risk premium under a variety of conditions. And he described the results of a similar analysis when the likelihood of success was unknown.

A further display of results covered the number of failures that trigger abandonment, expected returns, and the distribution of realized returns.

Idiosyncratic risk does not contribute to a risk premium, which is based entirely on systematic risk. Yet in this model the resolution of idiosyncratic uncertainty does play a part in determining the risk premium. The reason is that as technical (idiosyncratic) uncertainty is resolved, the probability of successful and timely completion changes. This changes the properties of the option to mothball the project, and hence the risk premium.

The authors' conclusion is that much of the value of the investment is associated with future cash flows that are contingent on intermediate decisions. The uncertainty these projects involve is of two distinct types. There is purely idiosyncratic risk associated with the resolution of technical uncertainty. There is also risk associated with cash flows after development is complete that
will have important systematic components.

The analysis highlights the importance of the nature of the information decision makers condition on, when they make the intermediate investment decisions to continue, expand, contract or abandon the project. Whenever that information includes variables, such as forecasts of post-development cash flows, that have a systematic component, this will impart considerable systematic risk to the project, even when the development process itself involves only technical risk. The systematic risk and the required risk premium of the venture are highest early in its life and decrease as it approaches completion, despite the idiosyncratic nature of the technical risk.

104. The Investment Value of Brand Franchise (Fall 1998)

Jack L. Treynor, President, Treynor Capital Management, Inc. and Fellow of the Institute, distributed a paper entitled: “The Investment Value of Brand Franchise”.

He began his talk with the observation that the brand name phenomenon arises from consumer uncertainty and disappears when uncertainty disappears. The superiority of branded merchandise exists in the minds of consumers, rather than in objective quality. The minds of consumers can be irrational, and economists may fail to incorporate brand franchise in models of industry competition. But investors cannot afford to ignore it.

He displayed a table of price spreads for a number of popular products, between the price of branded and the price of unbranded merchandise. This leads to the choice a manufacturer makes to offer branded or generic merchandise. The competitor (the owner of a brand franchise) charges the higher price but also restricts output to the franchise. The producer (as distinct from the competitor) charges the lower price and produces to capacity.

Developing and maintaining a brand franchise costs money. Marketing a brand is designed to take brand franchise from competitors, not to raise prices or increase total demand. As consumer uncertainty disappears, as it probably already has for milk and gasoline, then the price differential disappears and there is nothing that can be done to preserve a brand franchise.

Franchise shares may seem fairly stable over time, although there will be a continuous flow of customers among brands. A sustained marketing effort draws customers to a competitor from other brands, but those other competitors are constantly drawing customers away.

The gross cash flowback $z$ to a competitor is franchise share times brand premium. Where the total marketing effort involves a cash outflow $u$, including a fixed marketing cost $F$ (all measured as annual rates), then the variable cost portion of a firm’s marketing effort is $u-F$.

The change in cash flowback is $\Delta z = a(u-F) - \beta z$, where $a$ is a measure of efficiency of marketing effort and $\beta z$ represents loss of customers to competitors.

At any point in time $\Sigma \Delta z = 0$. That is, the movement of customers from brand to brand nets out at 0. So $\Sigma au - \Sigma F - \Sigma \beta z = 0$. Now if $\beta$ is the same for all competitors, then $\beta = (\Sigma au - \Sigma F)/\Sigma z$. $\beta$ can of course vary over time.

We assume that $a$ is different for
different competitors.  \( \sum au = \hat{a} \sum u \), where \( \hat{a} \) is the average \( a \) for all competitors.

So \( \Delta z = au - \left( \frac{\hat{a} \sum u - \sum F}{\sum z} \right) \cdot z \).

Now \( a \) and \( \hat{a} \) are unobservable. But

\[
\frac{\Delta z}{z} = a \left( \frac{u}{z} \right) - \hat{a} \left( \frac{\sum u}{\sum z} \right) + \frac{\sum F}{\sum z}
\]

and we might regress \( \Delta z / z \) on \( (\sum u / \sum z) \). From the coefficients we may then get \( a \) for our particular competitor.

We now define \( u^* \) as the marketing effort required to just offset the drain of customers to competitors. Hence:

\[
a(u^* - F) - \beta z = 0.
\]

It turns out that for an established competitor, the rate of return is

\[
\frac{\partial (z - u^*)}{\partial u} = \frac{\partial (z - u^*)}{\partial z} \cdot \frac{\partial z}{\partial u},
\]

\[
= \left[ 1 - \frac{\sum u - nF}{\sum z} \right] < a,
\]

assuming \( F \) is the same for all \( n \) competitors.

The rate of return goes up with the gross flowback from the industry's franchise, down with the level of rivalry, and up with the number of competitors.

But when firms enter into the battle for brand franchise, they incur the maintenance level of marketing effort. So we use maintenance cost

\[
u^* = z \left[ \frac{\sum u - nF}{\sum z} \right] + F
\]

as our measure of ease of entry. We can rewrite this expression as

\[
u^* = F \left( 1 - n \frac{z}{\sum z} \right) + \frac{z}{\sum z} \sum u.
\]

Differentiating with respect to \( n \), we have

\[
\frac{\partial u^*}{\partial n} = -\frac{Fz}{\sum z}.
\]

Since \( F, z \), and \( \sum z \) are all positive, entry always lowers maintenance cost for existing competitors.

Differentiating our maintenance cost expression with respect to \( z \) we have

\[
\frac{\partial u^*}{\partial z} = \frac{-F n}{\sum z} + \frac{u}{\sum z}.
\]

We see that maintenance cost will fall with rising franchise size \( z \) when we have

\[
\sum u < Fn, \text{ or } n > \frac{\sum u}{F}.
\]

So it pays large competitors to 1) encourage entry, 2) hold the level of rivalry down, and 3) increase the fixed costs of entry – for example, by increasing the frequency of new product introduction.

By differentiating our expression with respect to \( F \), we have

\[
\frac{\partial u^*}{\partial F} = 1 - n \frac{z}{\sum z}.
\]

A competitor's maintenance level of \( u \) can either rise or fall with increasing \( F \), the answer depending on whether his franchise satisfies

\[
z > \frac{\sum z}{n} = \text{average } z.
\]

It evidently pays to acquire competing firms – if they are big enough. (Consider the extreme case of acquiring a firm of negligible size: your \( z \) doesn't increase, but \( n \) falls by one.)

By calculating \( \frac{\partial}{\partial n} \left( \frac{\sum z}{n} \right) = -\frac{\sum z}{n^2} \), we see that, when a firm is acquired, (i.e., when \( n \) falls by one) the industry average increases by \( \frac{\sum z}{n^2} \).
From the conclusions above, Treynor offered some comments on antitrust policy and attitudes towards dominant size. If marketing expenditures necessary to maintain a franchise entail large fixed costs, then it does not pay to have a franchise unless it's big. It also takes low cost capacity to defend a franchise, and a lot of low cost capacity to defend a big franchise. Competitors have no incentive to withhold production. If a competitor produces less than its own franchise demands, it benefits competition while hurting only itself. Entry into the battle for franchise is daunting, but for a producer (a non-competitor) entry requires only some plant with a high unit variable cost of production, hence a low second hand value. In an industry with high fixed marketing costs, producers tend to be small compared to competitors.

In summary, when high fixed costs in an industry are associated with marketing rather than production, they put pressure on competitors to become as large as possible, discouraging entry into the battle for franchise and producing industries in which the low cost firms are large and the high cost firms are small. This is an industry then in which the firms who own the marginal capacity have little incentive not to use it. This is not the picture of high fixed costs discouraging entry in competitive pricing in commodity industries that lead to the establishment of antitrust policy.

105. Recent Innovations In Accounting-Based Valuation of Foreign and Domestic Assets (Spring 1997)

Richard M. Frankel, Assistant Professor of Accounting, School of Business Administration, University of Michigan, distributed two papers by himself and Charles M. C. Lee of Cornell University, entitled: "Accounting Diversity and International Valuation," and "Accounting Valuation, Market Expectation, and the Book-to-Market Effect." The Q-GROUP® provided financial support for both papers. He began his presentation by discussing the lack of uniformity in international accounting, and hence the difficulty in using earnings-to-price ratios and book-to-price ratios to establish values of companies in an international arena. It is true that efforts are being made to achieve more homogeneity in worldwide accounting, but he expressed doubt that standards would become sufficiently uniform that these ratios could be applied in all countries to reach sensible valuations. His objective, therefore, was to develop valuation models that were independent of differences in accounting standards. The ideal valuation is equivalent to a measure of the present value of future dividends yet is immune to accounting differences.

Frankel's model was based on the Edwards-Bell-Ohlson (EBO) valuation model. This model bases value on discounted residual income, and residual income is, for any accounting period, net earnings less the cost of equity. The value of the firm is then the capital at book value plus the present value of future residual income.

The EBO model can be expressed as:

$$V_t = B_t + \sum_{i=1}^{\infty} \frac{1 + r_e}{(1 + r_e)^i} E_t [NI_{t+1} - r_e B_{t+s-1}]$$

or

$$V_t = B_t + \sum_{i=1}^{\infty} \frac{1 + r_e}{(1 + r_e)^i} E_t [(ROE_{t+1} - r_e)B_{t+s-1}]$$

Where

- $B_t$ = Book Value at time $t$
- $NI_t$ = Net income in period $t$
- $r_e$ = Cost of equity capital
- $ROE_t$ = Return on book equity in period $t$. 

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The first equation requires forecasts of net income while the second requires forecasts of return on equity. The equations are to be consistent with "clean surplus" accounting, which assumes that the change in book value from period to period is equal to earnings for the period minus net dividends. While in principle the summation goes to infinity, we assume that the ROE will decline to $r_e$ in time, and then the series extends only until that event.

Frankel described an empirical test of the model. The original sample of firms consisted of all domestic non-financial companies on the NYSE, AMEX and NASDAQ return files from the Center for Research and Security Prices, with corresponding COMPUSTAT data.

$V_t$ was estimated in two ways. A historic value ($V_h$) was estimated assuming that the current year ROE was a satisfactory proxy for all future year of ROEs. To estimate a forecast $V_f$ ($V_f$) the future ROEs and book values were derived from IBES consensus forecasts.

The empirical results he reported indicated that $V_f$ explained about two-thirds of cross-sectional variations in prices, $V_h$ explained around 49% of the cross sectional variation and book value itself explained only around 36%. Statistics of buy and hold returns showed that both a $Vh/P$ based strategy and a $Vf/P$ based strategy out-performed a $B/P$ based strategy.

He next discussed problems in an international implementation of the model. The clean surplus relation is clearly violated in the United States, but he concluded that this problem was not a serious one. Availability of reliable forecasts is important, and reliability varies a good deal by country. Finally, it is important that firm value be captured quickly meaning that a reasonable value of $V$ must be obtained with only a few forecasting periods.

He turned next to an international data set. It appeared that for Australia, Germany, France, the U.K., Canada and the U.S.A., $V$ explained prices much better than book value and earnings. For Japan there was still an advantage in the use of $V$ but it was small. And it turned out that the $V/P$ produced consistently positive returns over the eight holding periods 1987-1994, in both up and down global markets. In conclusion, Frankel observed that $V$ is conceptually superior to the use of book value or earnings and provides a better explanation of prices worldwide. Country level $V/P$ ratios show promise as an aid in global asset allocation decisions.
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March 26 - TACTICAL ASSET ALLOCATION
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Charles J. Jacklin, Director, Asset Allocation Strategies,
Mellon Capital Management
Robert D. Arnott, President & CEO, First Quadrant Corporation

Computational Techniques for Calculating “VAR” for Complex Fixed Income Portfolios
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Walter A. Hass School of Business, University of California, Berkeley

The Specialist's Discretion: Stopped Orders and Price Improvement
Speaker: Mark J. Ready, Assistant Professor of Finance,
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Global Risk Management: The Limits of Analytics
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          Global Risk Manager, Salomon Brothers, Inc.

Asset/Liability and Pension Plans
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Risk Aversion or Myopia? The Fallacy of Small Numbers and Its Implications for
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Speaker: Shlomo Benartzi, Assistant Professor, Anderson School of
         Management, UCLA

The Nature of Risk - A Panel Discussion
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Speakers: William F. Sharpe, Professor of Finance, Graduate School of
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          Arnold S. Wood, President, Martingale Asset Management

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Size and Book/ Price Anomalies
Speaker: Jonathan Berk, School of Business Administration, University of Washington

Review of Empirical Research and New Methodologies
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