"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 4

1991-1995
SUMMARY OF PROCEEDINGS 1991-1995
VOLUME 4
SUMMARY OF PROCEEDINGS
PREFACE TO VOLUME 4

With the end of 1995, the Q-Group® completed its 30th year. Throughout this time period Q® mirrored both the growing use of quantitative methods and the changing shape of the financial community. By the time Q® was five years old, the brokerage community had begun a period of turmoil with a spate of mergers, cost cutting and bankruptcies that blew through the industry. Q® survived that period because the applications of quantitative techniques had also begun to prove themselves to be viable investment processes, and interest in those techniques escalated. This interest enabled Q® to begin new growth under the excellent direction of its Chairman, Jim Farrell, and the members of its Board of Directors and its Officers. By the early 1980s, the Institute’s membership had more than doubled and members were imbued with working quantitative portfolio management applications. At that time, Q® decided to stop adding new members in order to preserve the close knit nature of the organization. Thus, a waiting list for Q® membership was established. Many quantitatively oriented new firms that are now an integral part of the Institute’s membership did not even exist at the time of Q’s founding. Today, The Q-Group® membership numbers more than 100 firms with 40 more on the waiting list.

In total, the four volumes of our Proceedings cover the period from 1976 through 1995. This period coincides with our arrangement with Professor J. Peter Williamson of the Amos Tuck School of Business Administration at Dartmouth College, who began summarizing Q’s individual seminars at the start of that period. Upon seeing the excellent quality of Peter’s efforts, many of our attendees stated that his summaries helped them to bring the presentations into focus and to understand some very technical and difficult subjects. It soon became obvious that if the individual seminar summaries could be collated into a volume organized by subject matter, rather than merely by date, there would be a valuable new resource for the Institute’s sponsors – so, the first volume was born. Our continuing thanks to Peter Williamson for a job so well done for so many years. It is our sincerest hope that he will continue this effort on our behalf for many more years to come.

In Volume 4 of our Summary of Proceedings, we have included some heretofore unpublished information concerning the research and papers presented at Q® seminars in the period 1966 through the early 1970s. The list begins at page 146 and continues through 154 and contains many interesting early research papers in the field of quantitative financial analysis. Please note that these papers, as well as all other Q® papers, continue to reside in the archives of the Thomas J. Watson Business School Library at Columbia University Graduate School of Business. Sponsors of the Institute wishing to have access to the Q® papers should contact the library at Columbia for the correct procedure to follow.

Of course, we all realize that the success of these summaries is based upon the underlying excellence of the Institute’s programs. The Institute’s Program Committee, most ably directed by H. Gifford Fong of Gifford Fong Associates has consistently identified important new topics and speakers, thus retaining the interest and participation of the audience. In part, Q’s continued success relies upon Gifford and the other members of the Committee to correctly measure the pulse of the financial community. The Committee has accomplished this goal seminar-after-seminar, year-after-year. Our thanks to Gifford and all the Committee members who have helped to plan Q® programs over the years.

Dale Berman
Secretary-Treasurer
The Q Group®
New York, NY
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ACTIVE EQUITY MANAGEMENT

1. OVERVIEW: A NEW PERSPECTIVE ON ACTIVE MANAGEMENT
(Spring, 1995)

Robert E. Shultz introduced the topic of Active Management. In anticipating what some of the other speakers would discuss, and in referring back to some of his own experience, issues that had been discussed at previous Q Group seminars, and some of the ideas of Barr Rosenberg, he stressed some of the longstanding problems of multiple manager active portfolio management. Part of the problem has to do with optimizing portions of the portfolio management process without optimizing the performance of the total portfolio. Part of the problem has to do with whether the focus is on absolute or relative returns. Another part has to do with the "deadweight" issue, to be explored in some detail by other speakers. A number of proposals have been made to deal with these issues, and succeeding speakers would continue the search for answers.

John D. Freeman, Vice President, Martingale Asset Management, began by tracing the evolution of institutional investment management (borrowing in part from Peter Bernstein), characterizing the 1970s by emphasis on stock selection, the 1980s by index management, the 1990s by diversified active management, and forecasting the next decade as characterized by asset class management and long/short active management. His theme was finding more efficient ways to manage money. One path to greater efficiency is the separation of traditional active portfolio management into two components: indexing and long/short management. The traditional method of investment, by which the active manager is given a substantial asset pool and permitted to take only long positions, fails to make the best use of whatever skill the manager has in stock selection. The role of the active manager is essentially to employ skill in overweighting or underweighting stocks relative to some normal benchmark. The best that the manager can do will still lead to a portfolio that includes some holdings of stocks the manager finds unattractive and substantial holdings of stocks the manager favors but that would be included in the benchmark anyway. Freeman referred to the portion of the active portfolio that is actually earning only the index rate of return or less as the "deadweight" portion. This deadweight introduces a positive hurdle and a defensive drag. The positive hurdle comes from the fact that the benchmark portfolio already contains the stocks favored by the active manager, so that value added over an index return comes entirely from the manager's over weighting. The defensive drag comes from the fact that the portfolio includes some stocks dis favored by the manager. To make any significant impact on the return of the portfolio the manager must have extraordinary judgment. A particular example of wasted talent is shown in the case where the manager has particularly good information with respect to expected poor performance of a small stock and, with a prohibition on short positions, can add little to the overall performance of the portfolio. Freeman also pointed out that combining the individual deadweight percentages of the managers' portfolios gives an even larger deadweight percentage for the total portfolio.

In conclusion, he suggested that active managers should be permitted to sell short, that the benchmark should be a cash return plus some premium, that there should be no deadweight in the portfolio with futures and passive strategies used to gain asset class exposure.

The presentation was picked up by William E. Jacques, Chief Investment Officer, Martingale Asset Management. He reiterated the inefficiency of traditional active management, pointing out the waste of committing large amounts of capital to managers who are able to operate only at the margin. Harking back to some of the introductory comments of Bob Shultz, he pictured multiple managers focused on the appropriate characteristics of their portions of the total fund, without any clear vision of that total fund. He considered ways in which overlapping holdings of multiple managers might be reduced or eliminated and the value of making strictly long portfolios more aggressive, to conclude that the only satisfactory solution is "pure active portfolios" which means portfolios whose managers are permitted to go both long and short.
2. QUANTITATIVE ACTIVE MANAGEMENT (Spring, 1995)

Ronald N. Kahn, Director of Research, BARRA, distributed a set of material entitled "Seven Quantitative Insights Into Active Management." He described the process of Active Management as efficiently utilizing superior information. Research, the "art" of the process, produces superior information, while the "engineering" portion of the process carries that superior information into superior performance.

The object of Active Management is to add value through superior forecasting. If the active manager forecast is the same as the consensus forecast, then the portfolio should be the benchmark. The manager adds value in a mean/variance framework according to:

\[ VA = \alpha - \lambda w^2, \]

where \( \lambda \) measures individual investor preference.

The familiar information ratio is given by:

\[ IR = \alpha / w. \]

So

\[ VA = IRw - \lambda w^2, \]

and a differentiation gives us the maximum value added:

\[ VA^* = (IR)^2 / 4\lambda. \]

For any investor, at any level of risk aversion, the object is to find the highest IR. So the task now is to work out how to do this.

The fundamental Law of Active Management is that:

\[ IR = IC\sqrt{BR} \]

A more precise expression is:

\[ IR = \left( \frac{IC}{\sqrt{1-IC^2}} \right) / \sqrt{BR}, \]

but the previous equation will be satisfactory for normal values of IC. In these equations IC is the information coefficient, which is the correlation of forecast and realized residual returns (that is, the skill of the forecaster) and BR is the number of independent bets taken by the manager per year, which Kahn described as "breadth." The information ratio is then the product of the skill of the manager and the number of independent times that skill is exercised. The product is important because a modest skill level exercised many times can accomplish more than a super skill level exercised infrequently.

Kahn next decomposed the alpha into the product of IC, volatility, and score. In equation form:

\[ a = E(r,g) - E(r) = \text{Cov}(r,g) \text{Var}^{-1}(g)(g - E(g)). \]

Here \( E(r,g) \) is the expected return conditioned on a raw signal (a piece of information) \( g \), and \( E(r) \) is the expected return in the absence of this signal. A high covariance between \( r \) and \( g \) is obviously beneficial, while a high variance in \( g \) is not. And one wants the value of the signal \( g \) to be greater than the general expectation of \( g \). Kahn observed that we can think of the formula as a Bayesian adjustment to the expected return, as the result of the signal \( g \).

He went on to discuss the perils of datamining and the statistics of datamining. The t-statistic in a regression can be misleading if one forgets that the regression is but one of many seeking a true relationship.

Kahn turned next to the ways in which the implementation process subtracts value from the expected alpha. Transaction costs are obvious, but constraints imposed on the portfolio are another contributing factor. Reducing turnover can be helpful, but rather than simply reducing transactions it is better to schedule the most valuable trades first, take account of differing transactions costs among stocks, and improve the trading function.

Finally he discussed the matter of distinguishing skill from luck. Unfortunately, it takes a very long time to achieve a high level of confidence in the skill of a manager.
3. **ACTIVE MANAGEMENT AS AN ADVERSARY GAME (Spring, 1995)**

Jack L. Treynor, President of Treynor Capital Management, Inc., presented a paper entitled “Active Management As An Adversary Game.” His presentation concerned the trading by large institutional investors, acting essentially as adversaries and pitting their skills against one another. (The assumption here is that institutions do rather limited liquidity trading.) This adversary trading is then a zero sum game less transaction costs.

We can think of the consensus value of a stock as a function of a variety of states of information held by different investors and a variety of opinions of market timers. Corresponding to (but not equal to) this consensus will be a market price \( P' \) given by:

\[
P' = V(x_1, x_2, \ldots, u_1, u_2, \ldots) + e,
\]

where the \( x_i \) explain why different securities have different values at the same point in time, and the \( u_i \) explain why the same security has different values at different points in time, and \( e \) differentiates the market price from the consensus value. The differential in the market price \( P' \), related to changes that will be acted upon by an information motivated stock picker, by a timer, and by a value motivated stock picker are given by:

\[
dP' = \sum \frac{\partial V}{\partial x} dx + \sum \frac{\partial V}{\partial u} du + de.
\]

Both buyer and seller are motivated by expectations with respect to \( dx \), \( du \), and \( de \). Both anticipate a change in the market price from \( P' \) to \( P \). The relationship between the old and the new prices is given by:

\[
P = P' = M_1 + M_2,
\]

where \( M_1 \) and \( M_2 \) are the respective transactors' motives in trading.

We designate by \( p \) the equilibrium trade price, which is the price agreed upon by the two parties that satisfies both with respect to price and trade size. If \( P_1 \) and \( P_2 \) are the transactors' expectations for the new consensus price, then their expected returns are respectively \( P_1 - p \) and \( P_2 - p \). Relying next on the Treynor-Black propositions with respect to active holdings, we can represent the desired active positions of the two traders as \( h_1 \) and \( h_2 \), where

\[
h_1 = H_1 (P_1 - p) \quad \text{and} \quad h_2 = H_2 (P_2 - p),
\]

where \( H_1 \) and \( H_2 \) are factors reflecting risk aversion, portfolio size, etc. Since \( h_1 + h_2 \) must equal 0 we derive:

\[
p = \frac{(H_1 P_1 + H_2 P_2)}{(H_1 + H_2)}
\]

for the equilibrium price, and

\[
x = \frac{H_1 H_2}{H_1 + H_2} (P_1 - P_2)
\]

for the size of the trade. (The algebraic sign on \( x \) will be positive for the buyer and negative for the seller.)

So far we have considered the motivations of each party. Now we introduce the expectations each party holds of the motivation of the other. We let \( (E_1) \) and \( (E_2) \) be the expectations of the respective parties. Then we have

\[
P_1 = P' + M_1 + E_1 (M_2)
\]
\[
P_2 = P' + E_2 (M_1) + M_2.
\]

Substituting in previous equations, we are brought to the size of the trade represented by:

\[
x = \frac{H_1 H_2}{H_1 + H_2} \left[ (M_2 - E_2 (M_1)) - (M_2 - E_1 (M_2)) \right]
\]

and for the rate of return on the trade to the buyer (subscript 1) we obtain:

\[
p - p = \frac{H_2 (M_1 - E_2 (M_1)) + H_1 (M_2 - E_1 (M_2))}{H_1 + H_2}
\]

Treynor pointed out that a comparison of the last two expressions is instructive. Maximizing the rate of return to the buyer (subscript 1) involves maximizing the expression \( M_2 - E_1 (M_2) \), but maximizing this term minimizes the size of the transaction \( x \) is positive for the buyer). The objectives of high rate of return and large size of transaction are in conflict.
The equation for the return also demonstrates the danger of underestimating the motivation of the other party. Bearing in mind that $M_2$ (the motivation of the seller) is a negative number, note that if the expectation held by the buyer of the motivations of the seller is an underestimate, then the return will be disappointing. Treynor's observation was that subject to the weights, who wins and who loses depends on who makes the bigger estimation error. Underestimation of the other party's motivation causes losses. Hence there are four ways to lose the active game: One can have no motive in which case the other party cannot underestimate it. One can have a motive so visible and obvious that the other party cannot underestimate it. One can assume the other party has no motive, in which case one's underestimate is maximized. And one can make bigger bets on one's research than the other trader would. A concluding observation was that if the expected return on the trade is very high, then the motive of the other party has probably been seriously underestimated.

4. ACTIVE MISMANAGEMENT (Spring, 1995)

Albert S. Kyle, Associate Professor of Finance at the Fuqua School of Business, Duke University, described his presentation as an application of game theory. In particular, he compared the relationship of institutional investor and money manager to the relationship of principal and agent. The problem of the principal and agent relationship can be used to understand the problem of the investor and manager relationship. Two aspects of the problem are adverse selection and moral hazard. Of these two, the latter is the more significant, and is represented by hidden actions and hidden information. It turns out that the ideal game theory approach is not the same for the two.

Examples of actions of the investment manager that may be hidden from the institutional investor are excessive transactions costs, perhaps through inadvertence or perhaps with side payments to the manager, allocation of trades to favored parties, mispricing of illiquid assets purchased from associates, inappropriate risks in the portfolio (for example, from writing options to enhance performance), and manipulation of prices that may leave the client with a loss or modify the track record. Where it is not practical to monitor the actions of the money manager adequately, the investor may protect itself in a number of ways. The manager may be tied to an index, and given little freedom to take hidden actions. The index must be observable, tradable, and non-manipulable. The manager must be capable of backing a guarantee to provide credibility to a promise to equal the return on the index. The effectiveness of these precautions depends, however, on the manager not hiding information from the investor.

The most important hidden information is probably that having to do with risk in the portfolio. The best remedy here is generally a risk sharing device, but its effectiveness will depend on the absence of hidden actions. Generally, however, the investor must deal with the possibility of both hidden action and hidden information.

In this case there is no "first best" solution and we must go to a "second best." This will take the form of a combination of restrictions on manager behavior and monitoring. Restrictions may include limits to turnover, a prohibition against self-trading, an insistence that all customers be treated the same, and perhaps a requirement that only liquid assets are to be traded. The important thing about monitoring is that reliance on the track record is simply not satisfactory. Careful observations of style are necessary and global or statistical review is more appropriate than looking for a single transgression of the rules. Frequently marking to market and comparison to benchmarks is called for and here Kyle observed that computer technology is very helpful.

He focused on option writing as a particularly significant hidden action. Option writing can involve a very high probability of improving performance to a small extent coupled with a very small probability of disastrous loss. The consequences of such a strategy are what we may have seen in Orange County and Barings Bank. Options ironically offer some of the best opportunities for reducing risk and, at the same time via hidden actions, the greatest source of intolerable risk.

Kyle went on to consider the ways in which four classes of financial institutions deal with the principal/agent problem. The strength of banks lies in their ability to monitor
illiquid assets. The strength of securities firms lies in real-time monitoring of their own employees, good use of incentive contracts, and skills with market-valued assets. Hedge funds suffer from an extreme form of the principal/agent problem. Hidden information can be very important. Hence risk sharing is a very important protection for the investor. Institutional investors control very large pools of capital, have long-time horizons, and can bear relatively large losses.

5. PERFORMANCE FEE INCENTIVES - PERCEPTION VERSUS REALITY
(Spring, 1995)

Robert Ferguson, Associate Professor, Fordham University, distributed a paper by himself and Dean Leistikow entitled “One-Period and Long-Run Fee Incentives.” The incentives created for managers by one-period performance fees have been discussed in a number of articles. In general it turns out that managers maximize their fees by maximizing performance volatility which is not in the client’s best interest. Ferguson’s work added to the literature a methodology to be used to analyze long-run performance fee arrangements as well as single period arrangements. The most straightforward single-period performance fee rewards the manager on the basis of end-of-period performance. The performance that is rewarded, with respect to a benchmark, is defined as

\[ 1 + R_{pb} = \frac{V_p}{V_b} \]

where \( R_{pb} \) is the relative return, \( V_p \) is the portfolio’s actual value at the end of the period, and \( V_b \) is the portfolio value if it had been invested in the benchmark portfolio. The fee itself is given by:

\[ F_c = \text{Max} \left[ 0, f \left( R_{pb} - R_T \right) \right] \]

where \( R_T \) is a threshold level of performance, expressed as a relative return and \( f \) is the proportion of performance above the threshold level (the excess performance) paid as a performance fee. As the expression suggests, the performance fee is a fraction \( f \) of a call option where the “underlying performance asset” \( (1 + R_{pb}) \) is log-normally distributed and the strike is \( (1 + R_T) \). Not surprisingly, this fee structure can be termed a “call performance fee structure.”

The “bull-spread performance fee” structure puts a cap on the performance fee. With the bull-spread, the manager is long a performance call with a strike price of \( (1 + R_T) \) and short a performance call with a strike price of \( (1 + R_c) \), where \( R_c \) is the cap. Finally, the flat fee provides some incentive to perform because the base for the next period is increased by positive performance.

Turning to long-run performance fees, Ferguson’s assumption was that the client would renew the one-period management contract so long as the manager’s most recent one-period performance exceeded a pre-specified minimum level, \( R_m \). It turns out that the value to the manager of this long-run performance fee arrangement is a multiple of the value of the one-period arrangement. The multiple plays the role of a capitalization factor, and depends only on the riskless interest rate, the minimum performance required to renew the contract, and performance volatility.

The interesting question is what sort of incentives the various performance fees offer to managers, and the extent to which the incentives encourage behavior attractive or unattractive to clients. The most important consequence to the client is likely to be the extent to which the manager is encouraged to take on inappropriate volatility. It turns out that in most cases the value of the one-period performance fee depends on performance volatility and the obvious incentive to the manager is to strive for very high volatility. The incentives created by the multiple alone are more complicated. For “lenient” clients, those that set the minimum level \( R_m \) very low (generally \( \leq 0 \)), the incentive created by the multiple alone is to closet index and to maintain low volatility, generally unattractive consequences for investors who think they have hired an active manager. For demanding clients, those with relatively high values for \( R_m \), the incentive is for the manager to maintain a performance volatility of \( \sqrt{2 \ln(1+R_m)} \). The net incentive will be a combination of the incentive motivated by the one-period performance fee and that motivated by the multiple. In addition to \( R_m \), the
threshold level, $R_T$, is important in establishing the incentive.

Ferguson presented a number of graphs showing the interplay of the various parameters. For the long-run call performance fee, with a positive performance threshold, closet indexers earn nothing. With demanding clients the incentive is to maximize performance volatility. The same is true with lenient clients but with very lenient clients the incentive is to limit performance volatility.

For a negative performance threshold, closet indexers make money. Demanding clients again provide an incentive to maximize performance volatility. Lenient clients encourage closet indexing. Very lenient clients encourage limited performance volatility.

For the long-run bull-spread performance fee, where the performance threshold is positive, closet indexers earn nothing. Demanding clients encourage limited but typically excessive performance volatility, and lenient clients encourage limited performance volatility. Where the performance threshold is negative, closet indexers make money. Demanding clients encourage limited but typically excessive performance volatility, while lenient clients encourage closet indexing and very lenient clients encourage limited performance volatility.

With a long-run flat fee, closet indexers make money, demanding clients encourage limited but typically excessive performance volatility, neutral clients and lenient clients encourage closet indexing.

It appears that a one-period performance fee never motivates managers to provide reasonable performance volatility. Volatility is maximized by call performance fees, is typically too large with bull-spread performance fees, and is irrelevant for flat fees. Long-run performance fee incentives are very like those for one-period when the minimum performance required for contract renewal is non-negative. Performance volatility is maximized by call performance fees and is made too large by bull-spread performance fees. For flat fees there is an extremely weak long-run incentive to closet index when the minimum return is zero. It appears that managers can be motivated to take on reasonable performance volatility only when they are assured of not being fired for poor performance. The paper concluded that "For all practical purposes, the performance fee structures analyzed here fail to provide either reasonable incentives to managers or reasonable termination conditions to informed clients."

**ASSET ALLOCATION**

6. CONTROLLING MISFIT THROUGH THE USE OF DYNAMIC COMPLETENESS FUNDS (Spring, 1995)

David E. Tierney, Managing Partner, Richards & Tierney, Inc., distributed a paper entitled "Controlling Misfit Through the Use of Dynamic Completeness Funds." His presentation was closely related to previous discussions in the course of the Seminar concerning "deadweight," and the problem of reconciling the actions of active managers with the overall asset allocation strategy of the investor.

He began by defining the "misfit" problem. The investor can be thought of as first establishing an asset category target (ACAT). The ACAT represents the set of feasible investment opportunities the investor believes best achieves its investment policy. It can be thought of as the single portfolio which the investor would hold if it had to have all of its assets in that portfolio and passively managed. Plan sponsors typically choose broad market indices for an ACAT. For example, the S&P 500. Next, the investor hires a number of active managers, chosen for their perceived skill as well as to achieve some diversification in investment style. There are different ways of identifying style, but for purposes of his presentation Tierney arrayed managers in two dimensions, one ranging from large to small capitalization size, and the other representing a range between growth and value. A graph of over 200 domestic equity managers showed relatively few in the small value quadrant, more in the large value quadrant, still more in the small growth quadrant, and many in the large growth quadrant. A second graph showed clearly that style matters, that indeed there is significant negative correlation between the rolling three-month performances of value managers and those of growth managers.
Tierney’s approach was to specify a manager’s investment style by designing a custom asset-list benchmark portfolio to reflect that style. The benchmark, then, is a passive, investible representation of the manager’s permanent investment characteristics. It can be thought of as the ideal “manager universe.” The problem now is that the sum of the benchmarks of all of the managers will not generally equal the ACAT. Hence the contribution of active management, which is the difference between the performance that would have been achieved by the passive ACAT and the actual performance, is in part a function of the difference between the aggregate of the benchmarks and the ACAT, and in part a function of manager skill. Algebraically, the return on the investor’s overall portfolio is given by:

\[
\text{Portfolio Return} = \text{Passive ACAT Return} + \\
(\text{Passive Benchmark Return} - \text{ACAT Return}) + \\
\text{Active Return}.
\]

It is the passive benchmark return minus the ACAT return that is the misfit return or “style bias.” There is in fact a misfit portfolio. It is the difference between the holdings of the benchmark and the holdings of the ACAT. The misfit return is the return on this portfolio, and the variability of misfit return is the misfit risk. For the typical plan sponsor, Tierney reported, the misfit risk in aggregate is often greater than the active management risk. Misfit risk is unproductive and should be avoided. Tierney suggested a number of ways in which this might be accomplished.

Using the ACAT as the benchmark for all managers might seem to eliminate the problem but does not. Swapping the benchmark return for the ACAT return might seem to be another solution, but since the swap would almost certainly have to be arranged with a brokerage firm it would be prohibitively expensive. Another solution may appear to be allocating funds among the managers such that the aggregate benchmark is equivalent in its characteristics to the ACAT. This strategy may not only lead to allocations that are quite incommensurate with perceived manager skills, it may be impossible without the addition of further managers to widen the range of the benchmarks, even though the skills of those managers are not seen as justifying their retention. Another possibility to reduce misfit risk is the use of an index fund, or, even better, to use a passive fund specifically designed to bridge the gap between the ACAT and the aggregate of the active manager benchmarks. Tierney discussed the reasons why even this alternative may be less than satisfactory.

Finally, what he proposed was the creation of a dynamic completeness fund (DCF). Such a fund will have a return equal to the passive ACAT return minus the passive benchmark return, exactly offsetting the misfit return. The ideal DCF is a hedge portfolio, with long and short positions exactly offsetting. As a practical matter short positions may be unacceptable to the investor, and a positive-weight DCF is designed with only long positions to mimic so far as possible the performance of the long-short DCF.

Tierney presented the results of a case study. From June, 1983 through June, 1988 the plan sponsor experienced a misfit return of 1.69% and an active value-added return of 0.99%. Since the net of these two returns was negative, active management had actually impaired the overall performance. In 1988 the plan sponsor implemented a DCF. From June, 1988 through December, 1993, the misfit return was +0.44% and the value added by the managers was 1.15%. The positive misfit return was actually unintended; the object was to reduce misfit risk and this was in fact achieved, as one of Tierney’s graphs illustrated.

7. INVESTMENT STRATEGIES FOR A LOWER INTEREST RATE ENVIRONMENT (Fall, 1993)

Martin Leibowitz, Managing Director and Director of Research, Salomon Brothers Inc., spoke on the adaptation of a strategic asset allocation to a change in interest rates. He began with a proposition that a pension fund holds a conventional portfolio invested 60 percent in equities and 40 percent in bonds. Initial expectations were that the equity risk premium was 5 percent (with 5 year bonds yielding 7 percent), that the standard deviation for the bonds was 5 percent and for the equities 18 percent, and that the correlation between equity and bond returns was 0.35. The 60/40 portfolio then had an expected return of 10 percent with a standard deviation of 11.65 percent. It turns out that from these parameters we can conclude a 50 percent probability of
portfolio returns greater than 10 percent. To find other portfolios with a 50 percent probability of returns greater than 10 percent we have to increase the equity percentage beyond 60 percent.

It also turns out that our 60/30 portfolio offers a 67 percent probability of returns greater than 5 percent. When we look for other portfolios that also offer a 67 percent probability of returns greater than 5 percent, we find there are very few, and they are constituted of less than 60 percent equities.

The 60/40 portfolio also offers a 90 percent probability of returns greater than -5 percent. Other portfolios offering this same -5 percent shortfall constraint will consist of less than 60 percent equities.

Now we assume interest rates drop 200 basis points, and the 5-year bond now yields 5 percent instead of 7 percent. Leibowitz also assumed that this decline in interest rates was not accompanied by any change in volatilities and the risk premium. This of course may be a limiting assumption.

In order to achieve a 10 percent expected return in this new environment, we would have to move to 100 percent equities. It turns out that we simply cannot preserve a 67 percent probability of exceeding a return of 5 percent, at any asset allocation. We can, however, maintain the -5 percent shortfall protection by reducing the equity percentage to 46 percent. We now face three choices. We can retain our fixed 60/40 asset allocation as the appropriate allocation for all conditions. We can preserve our 10 percent return target by increasing the percentage of equities and increasing the risk of a shortfall. Or we can maintain our shortfall risk control by moving the percentage of equities down. In preserving our shortfall protection, however, we must be aware that our expected return is now lower than the expected return for the 60/40 portfolio, and therefore lower than the expected return for a 60/40 benchmark. If the most important criterion is maintaining shortfall protection, then the Interest Rate Sensitive Asset allocation (IRSA) indicates that when interest rates fall, the equity allocation should be reduced.

Leibowitz demonstrated that one can overlay tactical considerations on the IRSA strategy. For example, if the tactical prospects for equity turn worse than normal when interest rates decline, there is further encouragement for reducing the equity percentage to maintain the shortfall protection.

Up to this point Leibowitz had been discussing a portfolio consisting of equities and bonds. He turned next to an all-bond portfolio, to show that when interest rates decline the change that is analogous to the reduction of the equity percentage is the reduction of the duration of the bond portfolio.

To this point the discussion had been based on rather simple criteria of seeking high returns but also seeking to control shortfall risk. Leibowitz referred to a number of other considerations. These would include comparisons to a peer group and to market indexes, liability effects, the use of longer horizons than one year for risk assessment, and the use of multiple investment horizons. And he referred to a number of other risk control techniques beyond simply reducing the percentage of equities or the duration of the bond portfolio. He also considered surplus preservation as a possible objective, and showed how one might combine the objectives of achieving a shortfall limitation and preservation of surplus, in the face of a decline in interest rates. In concluding he said:

(1) Holding to return targets that have become unrealistic can lead to insidiously dangerous decisions.
(2) One should look at much more than the risk premium.
(3) It may be necessary to reassert a strategic risk policy even in the face of unattractive return prospects.
(4) We need to reexamine levels and balance of return/risk targets in the context of changing markets.
(5) We should question whether any fund ought to have fixed nominal return/risk targets.
(6) We should review goals and constraints to determine which are long, short, or something between long and short term.
(7) Rather than establishing an invariable strategic asset allocation, we should make the allocation a function of market observables.
8. MANAGING ASSET CLASSES
(Spring, 1993)

James H. Scott, Managing Director, Prudential Investment Corporation distributed a paper entitled "Managing Asset Classes."

He began his presentation with the question what asset classes are suitable for investment? To this he added the questions which asset classes, if they are to be used at all, must be actively managed, and which asset classes may be managed passively? Passive management may take the form of index funds or of static asset allocation. The use of index funds rests on the assumption that the asset market is efficient in an investment sense. Active management is justified when there are inefficiencies within the asset class. Static asset allocation is appropriate when the opportunity set and risk tolerance are constant. Active asset allocation assumes changing opportunity sets or inefficiencies across asset classes.

The difficult question is whether passive management is appropriate for a particular asset class. Scott distinguished between pure investment assets and pure commodity assets, suggesting that all asset classes lie on a continuum between these two extremes. A pure investment asset is bought and sold (at the margin) solely by those seeking monetary gain. A pure commodity, on the other hand, is bought (at the margin) solely to meet consumer needs or to provide enjoyment. Pure investment assets offer expected returns that are commensurate with their perceived risk. Pure commodity assets, on the other hand, are priced in accordance with supply and demand. Commodity assets are purchased to satisfy needs and preferences other than financial gain. For example, central banks hold gold for reasons other than profiting from the gold. A bakery may hold grain for reasons unrelated to inventory price speculation. The result is that expected financial returns for a passive investor in a commodity are not necessarily commensurate with the perceived risk in that commodity. The result is that for the passive investor the commodity may be overpriced but will never be underpriced. Furthermore, it is generally not possible to sell the commodity short.

Scott raised the question whether a number of asset classes should be considered investments or commodities. These include art, diamonds, race horses, real estate, professional sports teams, venture capital, gold, oil reserves, and copper. The seminar participants expressed widely-ranging opinions with respect to the investment and commodity characteristics of a number of these asset classes. Some also felt that certain of these classes might be considered investment assets at some points in time and commodities at other times. Scott showed that historic data on correlations, rates of return and standard deviations are not very helpful for commodity asset classes. What matters most is the expected rate of return and because of the "convenience yield" enjoyed by so many buyers of commodities, historic data are a poor guide to expected returns to pure investors.

However, commodity futures might provide appropriate passive investments. A combination of a long position in a commodity futures contract and a money market investment could constitute an appropriate passive investment. This will be the case if the futures market is efficient, where futures-inventory arbitrage is active, and where the market for the physical commodity is efficient in an investment sense.

Whether an asset class is appropriate for active management is a question more easily answered. If the market is inefficient, and if active management can be seen to add value, then active management is appropriate.

9. EVALUATING THE VENTURE CAPITAL ALLOCATION (Spring, 1993)

Robert E. Angelica, President, AT&T Investment Management Co. moderated a panel consisting of Jack R. Meyer, President, Harvard Management Company and Bart Holaday, Managing Partner Venture Capital, Brinson Partners.

Meyer described the role of private placements in the Harvard Endowment. These private placements include investments in commodities, real estate, and venture capital. The Harvard Management Company uses a mean-variance model to assist in asset allocation. Meyer presented a table of capital market assumptions, based somewhat on
historical data but modified to make sense as long-term forecasts. The 16 asset classes in the table included the three private placement classes. Real estate falls between stocks and bonds, in terms of return and risk, with fairly low correlations. Venture capital looks rather like a high-risk domestic stock. Commodities show a modest expected return but very low correlations.

In practice, Meyer said that fairly tight constraints had to be imposed on an optimization model to deliver asset allocations that were acceptable in view of a policy that favored allocations not too different from those of other major endowments. He showed a comparison of Harvard's allocation against an average of four leading university endowments, pointing out that the Harvard endowment included "tilts" indicated by the optimizing model.

He turned next to the benchmarks used in evaluating real estate, venture capital, and commodities investments. For real estate, Harvard uses the Russell-NCREIF Index, but leverages it 50 percent, since Harvard's real estate holdings are generally leveraged to this extent. For venture capital, the venture economics index is used, although it is based on appraised values and has a selection bias towards high returns. For commodities, the Harvard Management Company had intended to use the producer price index plus 4 percent, but came up with a home-made weighted average.

Meyer concluded with a discussion of the manner in which Harvard manages its private placements. Seventy percent of the management is internal, with 18 professionals. A major motivation here was reducing costs, which Meyer said might be 600 basis points for external management.

It is becoming possible to make more rapid reallocations in private placements. It is possible to swap the Russell-NCREIF Index to alter real estate exposure. It is not possible yet to swap venture capital (although one might use small stocks as a substitute), but commodity futures facilitate quick changes in commodity exposure.

Bart Holaday began his presentation by discussing the objectives of allocation. These are to expand the efficient frontier by adding to a portfolio the characteristics of private assets, consisting of venture capital, buyouts and buy-ins, mezzanine debt, restructuring and distressed debt, and corresponding investments from international markets.

He discussed some of the characteristics of these classes of private equity, indicating for most of them target rates of return, gross expected returns from a portfolio, and the net geometric expected rate of return after fees and expenses. At the high end, the target return for an early stage venture capital investment was 37 percent, with the net geometric expected return at 18 percent. At the low end, the net geometric average expected return for mezzanine financing was 13 percent.

He said at the present time of all of these private equity classes venture capital is the best understood. Time series of data from which one might derive expected return and risk statistics are not yet available for the various debt categories. So optimization must depend upon judgment rather than quantitative analysis.

10. HOW TO GET RICH QUICK USING GAAP (Spring, 1993)

Robert Ferguson, Associate Professor of Finance, Fordham University, Graduate School of Business, distributed a brief paper by himself and Neal Hitzig, Associate Professor of Accounting, Fordham University, Graduate School of Business, entitled "How to Get Rich Quick Using GAAP." The point of Ferguson's paper and presentation was the effect of cross-ownership of corporations, which inflates assets and equity capital as corporations acquire common stock in one another.

Having shown this "multiplier effect," which he described as similar to the multiplier effect as banks create deposits, Ferguson turned to some practical consequences. To the extent that corporations included in a capitalization weighted stock index hold shares in one another, the capitalization weights are distorted. And the results of asset allocation models may be distorted. As participants at the seminar began to think of the possible magnitude of the distortion, a question was raised about the effects of corporate pension funds holding equities.
There was some discussion of the impact of the cross-holdings on security analysis. Ferguson pointed out that per share figures are unaffected and therefore much of security analysis should be unaffected.

Jack Treynor presented a brief analysis of the risk effects of cross-holdings, showing that the sensitivity of the aggregate equity value to the aggregate asset value of a corporation is equal to \(1/(1-k_1k_2)\) where \(k_1\) is the fraction of the corporation's equity held by another company, and \(k_2\) is the fraction of the other company's equity held by the corporation. The risk factor clearly increases as the degree of cross-ownership increases.

The presentation left many participants seriously concerned about the usefulness of capitalization weighted indexes (in other countries as well as in the United States), and about the validity of asset allocation procedures based upon the performances of those indexes.

11. GLOBAL ASSET ALLOCATION  
(Spring, 1992)

Robert Litterman, Vice President, Goldman Sachs & Co. distributed a paper entitled "Global Asset Allocation and the Home Bias" by himself and Fischer Black of Goldman Sachs & Co. Litterman began his presentation with an explanation of the equilibrium model used by the authors and their reasons for preferring it to the mean variance optimizing model. The chief advantage of the equilibrium model is that it assures consistency. The demand for assets must equal the supply in all markets. The model also provides guidance for identifying normal rates of return – the rates of return necessary to bring about equal supply and demand.

The approach taken by the authors begins with the concept of a global CAPM equilibrium. This rests on assumptions of

- single period optimization
- efficient markets: no taxes or transaction costs
- no constraints on investors
- homogeneous investor risk tolerance
- assets include stocks and bonds in 7 countries
- investors optimize in terms of their home currency

The result of these assumptions is an equilibrium in which there is "universal hedging". All investors hedge a constant fraction of their currency risk and the formula is given by

\[
1 - \lambda = \frac{\mu_m - \sigma_m^2}{\mu_m - \frac{1}{2} \sigma_e^2}
\]

\(\lambda\) average risk tolerance
\(1 - \lambda\) fraction of foreign investments hedged
\(\mu_m\) average world market portfolio expected excess return
\(\sigma_m^2\) average world market portfolio return variance
\(\sigma_e^2\) average exchange rate return variance

The model to arrive at the equilibrium involves these operations:

- Investors in different countries maximize a quadratic utility function in terms of risk and return for their own currency

- For a given set of expected excess returns, aggregate the individual investor demands

- Search over sets of expected excess returns and minimize the sum of squared excess demand for stocks, bonds, and currencies using these empirical inputs:
• Monthly returns for stocks, bonds, and currencies for the period February 1975 to December 1991

• Market capitalizations for January 1, 1992

• Countries include US, Japan, UK, Germany, France, Canada, and Australia

Litterman next displayed the annualized equilibrium expected excess returns in U.S. dollars for the seven country markets, necessary to bring about the global equilibrium. The highest risk premium was shown for U.K. equities, and the next highest for Japanese equities. In fact, however, actual investor behavior differs significantly from the global CAPM equilibrium. Most investors concentrate on their own domestic securities, and the authors call this a "home bias". When the degree of home bias is measured by the difference between the proportion of a country's equity portfolio invested in domestic equities and that country's share of world equity market capitalization, the authors report that Japan's home bias is 43%, and the home bias for the U.S. and the U.K. are 62% and 68%. It appears impossible to explain the home bias in terms of taxes and other costs.

To explore the home bias, the authors divide investors in each country into two classes: restricted and unrestricted. The restricted investors are constrained to invest in market capitalization weights of domestic stocks and bonds. This means that the assets left over also have market capitalization weights for the world as a whole, the universal hedging equilibrium holds, and all unrestricted investors hold the world market portfolio with a constant fraction of currency holding.

Next, the authors investigate the incremental gains for a restricted investor if the restrictions are relaxed and the investor is allowed to sell domestic stocks and to buy hedged or unhedged foreign stocks, or to sell domestic bonds and buy hedged or unhedged foreign bonds. For a restricted U.S. investor, the gains are 441 basis points for stocks and 188 basis points for bonds. In general, the smaller the country and the more independent it is of the world market, the bigger the gains for its restricted investors. It also appears that the incremental gains diminish slowly as the restrictions are further relaxed. As the proportion in non-domestic assets increases, that component requires diversification and currency hedging. This could be seen in tables showing the optimal portfolios for a restricted U.S. investor as the restrictions are reduced further and further.

When the percentage of investors who are restricted is reduced, and those restricted investors are allowed to choose their own holdings of domestic stocks and bonds, we find the incremental gains from international diversification are still substantial.

We move on to a partial domestic equilibrium, in which restricted investors are now permitted to hold up to 20% of their portfolio in foreign assets. They are also allowed to lend in the domestic currency and borrow in a foreign currency to the extent of holdings of that country's securities. Solving for the mean excess returns on securities and currency contracts that imply zero excess demands for all holdings, indicates incremental gains from international diversification that are similar to, but are smaller than those in the universal hedging equilibrium. The optimal portfolios for unrestricted investors are very similar from country to country, but not exactly identical as they were when restricted investors were precluded from any investment outside their own country.

In conclusion, the home bias equilibrium seems more realistic than the universal hedging equilibrium. People clearly do have a home bias. Whether one starts with the universal or the home bias equilibrium, the procedure is the same, and the benefits of the equilibrium analysis are all present.

12. HARVARD MANAGEMENT COMPANY CASE STUDY  
(Spring, 1992)

Jay O. Light, Professor and Senior Associate Dean at the Harvard Business School, distributed the case study and led a discussion of it. The problem was essentially to identify an appropriate asset allocation policy for the Harvard endowment.

A number of participants offered comments directed at identifying the "liability" matched against the endowment asset, and the risks peculiar to Harvard's position. It was
suggested that the liability is essentially a "real annuity". Alternatively, it was pictured as an economic gap to be bridged by spending from the endowment, driven by corresponding economic gaps at competing universities. Minimizing risk might then be achieved by matching the asset allocations of those competing institutions. A "shadow asset," accompanying the endowment, was seen as the potential of donors to make major gifts to the university. One risk then was that these gifts might be foregone if the endowment performance were poor. On the other hand, the suggestion was made that the gift potential is in fact insurance. If the endowment does poorly, the university may be able to count on gifts to make up the shortfall.

Still another view was that the endowment might be seen itself as an insurance fund, something to take up the slack in years when expenses are high and sources of revenue from tuition and gifts turn down. In this case, one would want an endowment fund showing a low correlation with the economy. This might suggest recourse to foreign investments and perhaps to domestic fixed income assets.

At least two distinct starting points for the formation of an asset allocation policy were suggested. One was the world market portfolio. Another was a mean variance efficient portfolio computed by a familiar optimizing routine, with inputs as the expected returns, standard deviations of returns, and correlation coefficients of returns for the assets under consideration.

The discussion closed with a brief presentation by Jack Meyer, President of the Harvard Management Company since the fall of 1990. He described the process by which the asset allocation had been determined. There had been extensive discussions within the Harvard community to try to establish the tolerable risk level. Then a mean variance optimizer had been used to establish a starting point for asset allocation. Adjustments had been made from that asset allocation towards an "institutional norm", represented by what other major universities were doing with their endowment funds. The result was a little more emphasis on foreign securities than would be found at other universities, greater investment in commodity assets (oil, gas, etc.), and a -5% in cash (achieved via futures). The fact that the university has indebtedness of nearly $1 billion led to some downward adjustment of the acceptable risk in the endowment fund, but not to any change in asset allocation. To a suggestion that the endowment might be invested substantially in non-marketable assets for which no valuations would have to be disclosed, he pointed out that the endowment functions much as a mutual fund, with units being sold and redeemed monthly, so that unit values are important.

The policy finally established was 40% domestic common stocks, 18% foreign equities, 7% land, 12% venture capital, 6% commodities, 15% domestic bonds, 5% unhedged foreign bonds, 2% distressed securities, and a -5% in cash.

**AUCTION THEORY**

**13. AUCTION THEORY I (Fall, 1992)**

John McMillan, Professor, Graduate School of International Relations and Pacific Studies, University of California-San Diego, distributed chapters from his book *Games, Strategies and Managers*. He presented an introduction to auction theory, commenting that in the last 10 to 15 years game theory has been an active area in the field of economics, and that the analysis of auctions has been a prominent application of game theory. The essence of auctions is strategic decision-making under uncertainty. A bidder's decision on how to bid must reflect how he or she believes other bidders will behave. Similarly, the seller's choice among the various ways in which an auction can be conducted must reflect predictions of how bidders will respond.

McMillan described the function of the auction as an information revealing device. The seller does not know which buyer places the highest value on the item to be sold, nor what that value is. The buyer does not know how much he or she will have to pay for the item to be sold. There are two distinct cases of uncertainty. In the private values case, each bidder has a distinct private value for the item to be sold, knows exactly what that value is, but does not know the values attributed by other bidders to the item. In the common value case, all bidders have in mind a single value -- the true market value of the item to be sold. But none knows exactly what that value is. An
example of the former case is a corporate takeover where each bidder has in mind doing something different with the target, in terms of combining that target with itself in order to achieve a unique set of synergies. An example of the latter case is the corporate takeover, where all bidders have in mind acquiring a corporation, improving its management, and then realizing its full value.

Turning to bidding strategies, McMillan posed four situations. First is the open auction dominated by private values. The rule for the bidder in this case is quite simple: keep raising the bid until the bidder's private value is reached. The winning bid in this case will turn out to be just a little higher than the second highest private value, and the winner will secure the item at somewhat less than his or her own private value. The greater the variance in private valuations, the greater the profit to the winner. And the fewer the bidders, the greater the profit to the winner.

The second case is the open auction characterized by common value. The rule for the bidder is the same: keep bidding until the bidder's best estimate of the common value is reached. But in this case, the bidding behavior of other bidders may provide useful information as to what the true common value is. So the bidder may want to revise his or her estimate of the common value as the bidding proceeds.

The third case is the sealed bid auction with private values. In this case the private values of competitors cannot be learned through the bidding process. The rule a bidder should follow is to assume that he or she has the highest valuation, then to estimate the second highest valuation and to submit a bid at or just above that value.

The fourth case is the sealed bid with common value. Here is where the winner's curse problem arises. The winning bid is likely to represent the most optimistic estimate of the common value. It is quite likely that this most optimistic estimate will be higher than the true common value, and that therefore the winner will overpay. It is necessary to adjust one's sealed bid to allow for winner's curse.

Turning to the behavior of the seller, McMillan observed that the more bidders the better, since whether the auction is open or by sealed bid, the appropriate bidding strategy calls for higher bids as the number of bidders increases. It is also helpful for the seller to make use of a reserve (minimum) price. An interesting comparison, from the seller's point of view, is between the use of the open and sealed bid auctions. In the private value case it should not matter which form of auction is used. But in the common value case the open auction provides more information to bidders, reducing the risk of winner's curse and therefore permitting higher bids.

An interesting variation on the sealed bid auction is the second price auction. In this case, the highest bidder is the winner, but the price to be paid is the second highest price bid. This arrangement should lead to more aggressive bidding (in the private values case the bidder should bid actual value), but is not likely to do as well for the seller as an open auction.

The seller can obtain higher bids by releasing information, at least in the common value case, that reduces the risk of winner's curse. McMillan referred to the practice of auction galleries of estimating in advance of the auction what the prices are likely to be.

Preferential bidding, a form of discrimination among bidders, may benefit the seller. For example, one bidder may be identified and promised acceptance of his or her bid if it is within 10 percent of the highest bid. The result is likely to be increased bids generally since those who do not enjoy preferential treatment know that they must significantly outbid those who do. An example of this technique arises in the case of municipal procurement policies that call for bids from suppliers and promise acceptance of bids from minority bidders who are within a certain percentage of the non-minority best bid. McMillan suggested that the result for the municipality is generally lower cost bids from potential suppliers.

If the bid price is made up in part of royalties, or some sharing of the profits from the item to be sold, the seller is likely to do better. This is because the risk to the bidders, in particular the risk of winner's curse, is reduced.
The strategies developed for auctions also apply to informal negotiations. The choice between open and sealed-bid auctions, for example, becomes a decision whether or not to inform the people competing for one's business of each other's best offer.

14. AUCTION THEORY II
(Fall, 1992)

R. Preston McAfee, Professor, Department of Economics, University of Texas at Austin, distributed an article by himself and John McMillan, "Bidding Rings," from The American Economic Review, Vol. 82 No. 3, June 1992, as well as a paper by himself and Daniel Vincent, Michael A. Williams, and Melanie Williams Havens, entitled "Collusive Bidding in Hostile Takeovers". The topic of his presentation was collusion in bidding.

McAfee raised the question how those who are colluding keep their fellow colluders from cheating? There must be some credible punishment for cheating. The tit-for-tat strategy is one in which cheating by one colluder leads to retaliation as soon as the cheating is discovered. For example, if one colluder reduces prices the others follow suit. The advantage of this strategy is easy recovery if the price cutting was a mistake. One disadvantage is that the cheater's behavior must be visible, and the punishment is not a strong incentive to avoid cheating.

Another strategy is the "grim trigger strategy". In this case, if any colluder cheats, then the other colluders drop their prices permanently. This provides maximal deterrence to cheating, but there is no recovery from a price reduction that was a mistake.

It turns out that a good deal of cheating on the part of colluders results from simple mistakes. The best strategy to deal with these cases is a combination of the tit-for-tat and the grim trigger strategies. A participant in the collusion should set a critical value either for the market price or for that colluder's own sales quantity. If the price or the quantity falls below the critical value, then a price war is begun, with a reversion to the cartel behavior after a predetermined time interval. This was the strategy used by the deBeers diamond cartel to discipline Tanzania after that country's attempt to increase market share at low prices.

McAfee discussed some of the ways in which the victim of a cartel may fight back and even destroy the power of the cartel. Giving all one's business to one member of the cartel, picked at random, may help to break the price agreement, particularly if this selection induces suspicions that the favored party has betrayed the cartel. Other factors that will tend to weaken the strength of a cartel are easy access to the business, the existence of close substitute products, the existence of many producers, leading to large cartels, prices that are not quickly or easily observable, an absence of trade association, and poor information about the costs of the cartel members.

For a cartel that functions as an auction ring, the allocation of the cartel profits can pose a problem. McAfee described some of the allocation rules that have been used, as well as the ways in which cartels have allocated business among themselves after agreeing not to compete for that business.

His final topic was hostile takeovers, and he described five cases in the 1980s in which bidders competing for a corporate takeover target formed a cartel, stopped a bidding process, and acquired the target. In four cases, one bidder paid the other a dollar amount to quit bidding. In the fifth case, the cartel agreed on a split of the target between the two raiders. The cases yielded some surprising insights. First, three cases led to litigation and in all three the courts concluded that the evident collusion was not illegal under U.S. law. Second, it appeared that the collusion in all cases had very little effect on the ultimate price paid. Finally, it is not generally clear what the appropriate public policy should be toward raider cartels. An attempted hostile takeover will alert other potential raiders to the target and suggest that a bidding contest may ensue. However, a high preemptive bid will discourage competition. When the raider business is competitive, increasing the frequency of raider cartels increases the frequency of beneficial takeovers. Once the raiders have arrived, however, and started bidding, shareholders would like to prevent a cartel from forming.
15. AUCTIONS: THEORY AND LABORATORY APPROACH TO BEHAVIOR (Fall, 1992)

Charles R. Plott, The Edward S. Harkness Professor of Economics and Political Science at the California Institute of Technology described his primary interest as basic research, rather than applications, but observed that the basic research is continually revealing useful applications. He presented a number of game strategy puzzles to the seminar participants, illustrating the importance of understanding the reasoning of competitors and colleagues. A simple example is the following.

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>10</td>
<td>-5</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>-5</td>
</tr>
<tr>
<td>B</td>
<td>30</td>
<td>-1</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>-1</td>
</tr>
</tbody>
</table>

There are two players in this game, one designated **bold** and the other designated *italics*. Each has a choice between the A strategy and the B Strategy. The numbers in the table show the payoffs. For example, if both **bold** and *italics* select A, then each receive payments of 10. If both **bold** and *italics* select B, then each receives a negative payoff of 1. If *italics* chooses A and **bold** chooses B, then B receives 30 and *italics* pays 5. And if *italics* chooses B and **bold** chooses A, then *italics* receives 30 and **bold** pays 5. Now how should *italics* and **bold** choose between A and B?

*italics* might reason in this way: if **bold** chooses B, then my best choice will be B, since I will lose 1 instead of 5. If **bold** chooses A, my best choice will still be B, since I will gain 30 instead of 10. Therefore, I should choose B. **Bold's** reasoning might go as follows: having thought through *italics* position, I realize that *italics* will prefer B whether I select A or B, so I can count on *italics* choosing B. Since *italics* will choose B, I will be better off choosing B than A since I will lose 1 rather than 5. This reasoning leads to the conclusion that both *italics* and **bold** will choose B, and both will suffer a minor loss. And indeed, this is the most likely end result. Yet, clearly it would be better for both *italics* and **bold** if both were to choose A. For both to choose A, however, requires both *italics* and **bold** to credit the other with a fairly high degree of sophistication.

Plott moved on to deal with the sealed bid option, a topic the earlier speakers of the day had discussed. What was particularly interesting here was that in a game that involved sealed bid options, the pattern of bids by participants turned out to be remarkably close to the theoretical pattern after adjustment for risk aversion. Plott's point was that we are able to come up with theoretical models that are extremely good predictors of the behavior encountered in experimental research.

In still another bidding game, however, we discovered that experimental subjects are almost always the victims of winner's curse. And in a further experiment patterned after one demonstrated at a Q Group Seminar a few years ago by Vernon Smith, participants in an experiment created a classic "bubble" pattern following decision rules that appeared to defy all rational thinking. Plott reported that a second experiment run with the same participants led to a repetition of the bubble development, although the bubble was much shorter lived. And a third run of the experiment led to no bubble at all.

Plott conducted an oral double auction with the seminar participants. Given a number of participants holding long positions at various costs (and therefore providing a supply of a security), and another set of participants given the opportunity to resell at a variety of prices (and therefore constituting a demand schedule), the resulting series of bids and asks in the form of the traditional "open outcry" tended to lead to the equilibrium pricing that would have been predicted from the intersection of supply and demand curves. Plott presented a graphic display of experiments he had conducted, replicating the real time sequence of bids and asks and transactions, demonstrating the equilibration process and the resulting equilibrium. He went further, to show what happens when the demand curve is deliberately shifted. The process moves gradually from the old equilibrium to a new equilibrium.
Combining an upward sloping demand function (created by causing resale prices to rise with volume) with the traditional upward sloping supply function, one can create various intersections of the demand and supply curve, some representing a stable equilibrium point and others an unstable equilibrium point. And by altering the shape of the supply curve, one can turn the stable into unstable and the unstable into stable equilibrium points. When this change is made in the course of trading, the convergence of transaction prices at an equilibrium point that is stable but changes to unstable disappears gradually over time and is replaced at an equilibrium point that has changed from unstable to stable. All of this is very reassuring in terms of confirmation that auction markets work as they should, and that perturbations produce the results economic theory would predict.

The experiments were successful enough that, as Plott explained, they provide some basis for developing new markets and testing their usefulness through experimental design. The markets we are accustomed to generally involve a single dimension: units of a particular commodity. But it now appears possible to design an auction market for packages representing more than one dimension. As an example, Plott proposed an auction of cubic measures of space. Bids would be submitted for a package identified by its length, width, and height. All bids would be accepted tentatively, until a bid arrived that caused the aggregate of tentatively accepted bids to exceed the dimensions of the total space to be auctioned. At this point, a linear programming algorithm would review all of the bids that had been tentatively accepted, including the new bid, to determine what mix of bids would fall within the constraints of the total space to be auctioned, and would yield the highest aggregate bid price. In the process, at least one of the formerly tentatively accepted bids, or the most recently proposed bid, would have to be rejected. And from that point on, each new bid would almost certainly require a re-evaluation of all bids that had been tentatively accepted. Ultimately, the highest value set of bids falling within the constraints of the total space to be auctioned would be determined, and these bids would be finally accepted. While this particular model, involving space, may not be of great practical interest, the point was that we are now in a position to apply the auction process to much more complex commodities. And we have gained enough experience with experimental design to be able to test such models with a fair degree of confidence. Plott referred to work with the Pacific Stock Exchange to develop a market for pollution permits, a new market that might permit the efficient exchange and use of a recently introduced device for efficient allocation of permissible industrial pollution.

16. DUTCH AUCTION STOCK REPURCHASES (Fall, 1992)

Laurie Simon Bagwell, Associate Professor, Kellogg Graduate School of Management, Northwestern University, distributed a reprint of her article "Dutch Auction Repurchases: An Analysis of Shareholder Heterogeneity," The Journal of Finance, Vol. 47 No. 1, March 1992. Bagwell introduced Dutch auctions as a significant financial market innovation, presenting us with auction theory in practice, and giving us some important insights into shareholders' valuation of their shares, and appropriate strategies for corporations engaging in share repurchases.

The fixed-price tender offer for shares is made by a corporation at a single price. Shareholders who accept the offer sell their shares to the corporation at that price, sometimes selling only a fraction of the shares tendered if the aggregate tendered exceeds the amount the corporation is prepared to buy. The Dutch auction offer specifies a price range from which shares will ultimately be purchased. Shareholders are invited to tender their stock at any price within the stated range. The corporation aggregates the responses of the shareholders, creating a supply curve for the stock. It pays all of the tendering shareholders the same price for their shares, the lowest price that allows it to buy the number of shares sought in the offer. Once again, a tendering shareholder may sell only a fraction of the tendered shares to the corporation if the aggregate of shares tendered is greater than the number of shares the corporation is willing to buy.

Bagwell's research for a sample of 32 Dutch auction repurchases indicated that on average the corporations sought to repurchase 18 percent of their outstanding stock, and
offered a price range between a 2 percent and a 16 percent premium above the closing price the day preceding the announcement of the offer. On average, the offer was open for 22 trading days. And on average, 13.7 percent of the outstanding shares were repurchased, at a premium of 13.1 percent.

The following table can be used to demonstrate how the Dutch auction works. Suppose the corporation wishes to repurchase 250 shares in a price range between $20 and $20.50. And suppose the following table represents the responses of the shareholders to its offer.

<table>
<thead>
<tr>
<th>Price ($)</th>
<th>Quantity Tendered at Price</th>
<th>Cumulative Quantity Tendered</th>
</tr>
</thead>
<tbody>
<tr>
<td>20.00</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>20.125</td>
<td>45</td>
<td>70</td>
</tr>
<tr>
<td>20.25</td>
<td>50</td>
<td>120</td>
</tr>
<tr>
<td>20.375</td>
<td>30</td>
<td>150</td>
</tr>
<tr>
<td>20.50</td>
<td>80</td>
<td>230</td>
</tr>
</tbody>
</table>

Since the total number of shares offered is 230, the corporation will accept all of them and for each will pay the highest price on the schedule, which is $20.50. Now suppose the corporation was seeking only 100 shares. The 70 shares tendered at $20 and $20.125 do not meet the corporation's requirements, so shares must be accepted from three groups of shareholders: those tendering at $20, those tendering at $20.125 and those tendering at $20.25. No shares will be accepted from those who tendered at prices above $20.25. But the aggregate shares tendered at $20.25 or less is 120 and only 100 are desired. So the firm repurchases 5/6 of a share for each share tendered by those who are willing to accept no more than $20.25. The price paid for all of these shares will be $20.25.

Bagwell presented a table showing the increasing use of corporate repurchases as an alternative to dividends in order to dispose of surplus cash to shareholders. Over the years from 1980 to 1987, dividend distributions increased from $56.6 billion to $80.4 billion, while repurchases increased from $6.6 billion to $52.6 billion (all numbers deflated to 1986 dollars). She also showed the substantial increase in the use of Dutch auction repurchases relative to fixed price tender offers. In 1984 only 2 of 23 self-tenders used Dutch auctions, while in 1989 24 of 37 self-tenders were by way of a Dutch auction.

She explained why shareholders whose tendering would be highly unlikely to affect the price ultimately paid for tendered shares would be motivated to submit tenders truthfully revealing their own valuations of the corporate shares. That is, we have every reason to believe that if a shareholder tenders at $20.25, that is the value the shareholder actually places on his or her shares. Further, it turns out that the shareholder values revealed through their tenders differ dramatically. From data on the tenders for a number of corporations, Bagwell was able to construct upward sloping supply curves. It turned out that to acquire an additional 10 percent of outstanding stock, the corporation had to offer an average additional premium of 14.6 percent of the pre-announcement market price. The average elasticity was 0.68.

Bagwell pointed out that a Dutch auction will produce different outcomes from a fixed price repurchase tender only if two conditions are met. The first is that shareholders differ in their valuations of the corporation's stock, and the second is that the management does not know these values. If only one condition is met, then the Dutch auction will lead to the same
number of shares purchased as the single price repurchase, although the price paid for the shares may not be the same.

Finally, she discussed why a corporation would prefer a Dutch auction repurchase to a single price repurchase offer. To begin with, the repurchase will almost certainly take place at a lower cost to the corporation. In addition, there may be a special takeover deterrence at work. The Dutch auction tends to remove the shareholders who place the lowest value on their shares, leaving those who place a higher value and might be considered more “loyal” in the event of a takeover attempt. Finally, there is probably a smaller wealth transfer from non-tenders to tenders when the Dutch auction is used.

BONDS

17. EQUILIBRIUM OF THE BOND MARKET (Fall, 1995)

Gifford Fong, President, Gifford Fong Associates introduced Oldrich Vasicek, Senior Vice President. Fong referred to Vasicek’s paper, “The Efficient Bond Market,” as a fundamental paper setting forth a framework from which we can establish efficient or benchmark prices for fixed income instruments, including derivatives. Once we have these benchmarks we are in a position to value instruments that otherwise can be valued only with great difficulty if at all, and we have a basis for judging whether instruments are over- or under-valued. A key feature of the framework established by Vasicek is that the determination of values is based entirely on observable data.

Vasicek began by setting up three questions to be answered as we move towards a way of pricing fixed income instruments: What is the mechanism of bond pricing in an efficient (that is, arbitrage-free) market? What is the general form of a multiple-factor term structure model? What is the explicit form of a term structure model in which the factors are constant maturity yields?

We start with the proposition that we are pricing zero-coupon bonds. The prices are assumed to follow a diffusion process, with an expectation that they will reach maturity value at maturity, with stochastic deviations from a steady path. Bond returns are characterized by an expected rate of return and covariance of returns. Both may be functions of prices and other economic variables.

The money market bond is a useful concept. Its yield is the “short rate,” and it can be thought of in practical terms as a treasury instrument with a one day maturity.

The expected return on a portfolio of bonds is a product of the risk in the portfolio and what Vasicek described as a finite bound and called “market risk incentive.” In expanding on the market risk incentive, Vasicek’s next proposition was that a necessary and sufficient condition for the efficiency of the bond market is that there exist a positive process with a finite variance called the “risk compensation process,” such that this process is a martingale and the price of a bond is the expectation of the face value measured not in dollars but in units of the risk compensation process, discounted at the short rate. The expected return is determined by the compensation process at the short rate plus the risk premium, which is the negative of the covariance of price with the compensation process. Finally, the risk incentive is the standard deviation of the compensation process.

To price bonds, or derivatives, we need a model that deals with a finite number of risk factors, and those factors must either be observable or determinable by other observable elements. The first factor will be the short rate, which is the negative of the first derivative of the log of price, at time equals maturity. A generalization is to choose the negatives of the first n derivatives of the log price as the factors to be used in a multiple factor case. A special case is the one factor model, where we use the short rate and the slope of the yield curve. In general the expected return is given by the short rate plus the sum of the risk exposures, each multiplied by a risk premium. The risk premia themselves are observable quantities, determined by the factors. In conclusion, Vasicek presented a general multiple factor model, based entirely on observable values.

18. SPREAD ANALYSIS (Fall, 1995)

Martin L. Leibowitz, Executive Vice President and Chairman, CREF Finance
Committee, TIAA-CREF, distributed two Salomon Brothers publications by himself, Stanley Kogelman and Laurence N. Bader, entitled "Spread Immunization," and "Yield Curve Positioning for Multi-sector Bond Portfolios." He began his presentation by describing the task of many bond managers as beating a benchmark without taking on significant risk. We assume the benchmark is a mix of treasury and corporate bonds. The standard popular approach to enhancing return is to replace some short term treasuries with short term corporates, gaining the yield spread between the corporates and the treasuries and taking on a little credit risk, minimized by the short maturity of the corporates purchased. Leibowitz offered a better way of improving return, and the prospect that the standard approach may in some circumstances be quite wrong.

We imagine two plots of expected return against duration, one for corporates and one for treasuries. As a practical matter, Leibowitz represented expected return by yield, so that we are really plotting two yield curves, one for corporates and a lower one for treasuries. We can identify the duration of our corporate portfolio and the duration of our treasury portfolio on the yield curves, and think of each portfolio as represented by a bullet maturity of that duration. So we have now identified a single point on the corporate yield curve representing our corporate portfolio, and a single point on the treasury yield curve representing our treasury portfolio. The expected return on the total investment is simply the weighted sum of the expected returns on the corporate and treasury portfolios.

We impose two constraints on our process for improving our rate of return. We want the total portfolio (corporates plus treasuries) duration to remain constant, so that the total portfolio will respond to parallel shifts in yields as the benchmark will respond. The total portfolio duration is simply the weighted average of the durations of the corporate and treasury portfolios. The sensitivity to spread changes (between corporate and treasury yields) is measured by the spread duration which is the product of the relative weight of the corporates and the duration of the corporate portfolio. Our second constraint is that the spread duration is to remain constant. Given these two constraints our problem is to maximize the return on our total portfolio, a return that is a function of the durations on the corporate and treasury portfolios, and the weights of the two portfolios. We can differentiate the return on the total portfolio with respect to the weight given to the corporate portfolio as follows:

\[
\frac{dR_P}{dW} = \left[ R_C - \frac{dR_C}{dC} \times D_C \right] - \left[ R_T - \frac{dR_T}{dT} \times D_T \right]
\]

Where \( R_P \) is the return on the total portfolio, \( W \) is the weight given to the corporate portfolio, \( R_C \) is the return on the corporate portfolio and \( R_T \) is the return on the treasury portfolio, \( D_C \) is the duration of the corporate portfolio and \( D_T \) is the duration of the treasury portfolio. Now so long as the derivative of portfolio return with respect to the weight of the corporate portfolio is positive, we keep shifting assets from the treasury to the corporate portfolio. It turns out that there is a graphical interpretation of the crucial derivative. If we go back to our graph of the yield curve for corporates and the yield curve for treasuries and we draw the tangent to each curve at the point corresponding to the durations of our corporate and treasury portfolios, and we note where those tangents intersect the vertical axis of our graph, the distance between those two points of intersection is our derivative. So long as the intersection of the tangent from the corporate curve is above the intersection of the tangent from the treasury curve, the derivative is positive and we should keep shifting assets from the treasury to the corporate portfolio. If the intersection of the tangent from the treasury curve is above the intersection of the tangent for the corporate curve, then of course we should do the reverse, and shift assets from the corporate to the treasury portfolio.

Next we have to determine the shifts we must make in the duration of the corporate portfolio and in the duration of the treasury portfolio. So long as we are shifting assets from the treasury to the corporate portfolio, we will shorten the corporate duration and lengthen the treasury duration. The changes are given by:

\[
\Delta D_C = -\left( \frac{\Delta W}{W + \Delta W} \right) D_C
\]
\[ \Delta D_T = \left( \frac{\Delta W}{1 - (W + \Delta W)} \right) D_T \]

It is now apparent that the standard adjustment, always shifting from short treasuries to short corporates, may in fact lead to worse results.

Leibowitz went on to discuss the consequences of relaxing the spread duration constraint, so that the desirability of a shift between the treasury and corporate portfolios depends entirely on the slopes of the treasury and corporate yield curves at the portfolio duration points on each curve. In answer to a question how one might incorporate a particular view on interest rate movement and spread changes, Leibowitz said that those views should be incorporated in the starting treasury and corporate portfolios, followed by an application of the process he had described for possible further improvement.

19. FIXED INCOME VOLATILITY MANAGEMENT (Fall, 1991)

Robert L. Whalen, Managing Director, CIGNA Corp. introduced the program for the fall Seminar. He said there were four criteria for the selection of appropriate presentations. These had to be innovative, providing fresh insights, they had to be of the highest quality, they had to be responsive to the stated needs and preferences of the sponsors, and at least some presentations should have immediate applicability. He reviewed the fixed income presentations scheduled for Monday, the first day of the Seminar, equity presentations for the second day, and real estate presentations for the morning of the third day.

H. Gifford Fong, President, and Oldrich Vasicek, Senior Vice President of Gifford Fong Associates, distributed a paper entitled "Fixed-Income Volatility Management: A New Approach to Return and Risk Analyses in Fixed-Income Management." Fong began the presentation by describing the results of a recent application of the technique he and Vasicek had developed. They constructed two portfolios of treasury bonds indexed to the Shearson/Lehman All Treasury Index. And they tracked the portfolios over the period from August 1990 through March 1991, a period designed to capture the interest rate volatility during the Gulf War. One portfolio followed the conventional method of matching duration and convexity to the index, and controlling sectors such as high and low coupons to match the index. The second indexed portfolio matched only two characteristics of the index: the duration and the volatility exposure. It turned out that for the conventional indexing strategy the monthly tracking error was 0.028, with a standard deviation of the tracking error of 0.065, while for the indexing based on duration and volatility exposure matching, the tracking error was only 0.019 and the standard deviation was only 0.025.

Fong turned next to some theory. There are two ways to describe the term structure of interest rates: by way of a yield curve that relates interest rates to maturity, and by way of behavior of interest rates over time -- a time series. The approach the authors had taken was the second, improving it by focusing on ways to control the risk associated with rate changes over time.

Fong identified the steps to be followed in setting up a term structure of interest rates. First the factors responsible for a change in interest rates must be identified. Second one must establish the market pricing of risk associated with each factor, third one must establish equilibrium conditions with no opportunity for a risk-free arbitrage, and fourth there must be a closed form solution if the model is to be of practical value.

He identified the simplest equilibrium model as

\[ P(t) = \exp(-rt + 1/6 s^2 t^3) \]

where

- \( P(t) \) = price of a bond with term \( t \),
- \( r \) = short rate, and
- \( s^2 \) = variance of the short rate.

The price of the bond depends on the level of interest rates, but it also depends on the volatility associated with those rates. And while the term structure models that have so far been developed all assume a constant volatility parameter, Fong demonstrated graphically that the volatility of long treasury rates is not constant, that there are
significant changes in both actual and implied rates (implied from the prices of options on futures contracts). And he showed that the volatility is a function of interest rate levels. Furthermore, recognition of changing volatility leads to the need for volatility management.

Vasicek continued the presentation, to provide a simple explanation for why bond prices should depend upon volatility of interest rates.

One possible alternative to a term bond is rolling over a short instrument over the same time span. The rate of return $R_{\text{roll}}$ on such a rollover strategy is given by

$$1 + R_{\text{roll}} = [(1+r_1)(1+r_2) \ldots (1+r_n)]^{1/n},$$

where $r_1, r_2, \ldots, r_n$ are the holding period rates of return on the short instrument. The rollover strategy rate of return is the geometric average of the rates of return realized on the short instrument. The geometric average is always equal to or less than the arithmetic average, and the greater the fluctuation in the short rates the lower the geometric average for any given arithmetic average. So the return on the rollover strategy is inversely related to the variability of the short rate. Since the return on the long bond must be in equilibrium with the return on the rollover strategy, the yield on the long bond will be low when the volatility of the short rate is high.

Vasicek proposed a stochastic volatility term structure (SVTS). The behavior of the short rate $r$ is described by a diffusion process:

$$dr = a(r - \bar{r}) \, dt + \sqrt{v} \, dx,$$

where 

- $dr =$ change in the short rate,
- $a =$ speed of reversion to the mean $\bar{r}$,
- $\bar{r} =$ long term mean of the short rate,
- $dt =$ change in time,
- $v =$ instantaneous variance (volatility),
- $dx =$ random element.

The equation describes an interest rate fluctuating around its long-term mean with a random element. The volatility of this random element is described by:

$$dv = c(v - \bar{v}) \, dt + k \sqrt{v} \, dy,$$

where

- $dv =$ change in volatility,
- $c =$ speed of reversion to mean $\bar{v}$,
- $\bar{v} =$ long-term average volatility,
- $dt =$ change in time,
- $k =$ strength of the volatility factor,
- $v =$ instantaneous variance, and
- $dy =$ random element.

Combining the random process for the rate change and the random process for the volatility change, and applying a condition of no riskless return through arbitrage, we arrive at:

$$P(t, r, v) = \exp(-rD(t) + vF(t) + G(t)),$$

where 

- $P(t, r, v) =$ price of a zero-coupon bond with term $t$, given the current values $r$ for the rate level and $v$ for the volatility level.

The quantities $D(t)$, $F(t)$, $G(t)$ in the bond pricing equation are functions of the term $t$ alone. They are obtained as the solutions of ordinary differential equations to which the partial differential equation reduces. $D(t)$ is simply duration, and $F(t)$ is the exposure to volatility, a quantity that like $G(t)$ must be derived from a complicated but closed form expression involving the confluent hypergeometric function. Just as the duration of a portfolio is a weighted sum of the durations of the cash flows for the portfolio, the volatility exposure is the weighted sum of the volatility exposures of the individual cash flows.

Vasicek closed by pointing out that one can use volatility exposure as part of a passive strategy, by matching the exposure of an index, and one can use it as a part of an active strategy by raising the exposure in anticipation of increased market volatility and lowering it in anticipation of reduced volatility.
20. VALUATION AND MANAGEMENT OF BONDS WITH SINKING FUND PROVISIONS (Fall, 1991)

Andrew Kalotay, President, Andrew Kalotay Associates and Professor at the Graduate School of Business Administration, Fordham University at Lincoln Center, distributed a paper by himself and George O. Williams entitled, "Valuation and Management of Bonds with Sinking Fund Provisions."

Kalotay's presentation dealt with strategies for both bond investors and bond issuers, facing the complexity of a variety of refunding possibilities.

The focal point of his paper was what he regarded as a fairly standard bond. The maturity of the bond is 30 years. A level 5% sinking fund begins in the eleventh year. The bond is first callable in the tenth year at a price of par plus 60% of the coupon. The call price declines in equal annual increments until the twenty fifth year and thereafter the bond is callable at par. The issuer is allowed to purchase bonds in the open market at any time. These pre-purchases remain undesignated, which means that the issuer has a delivery option. That is, the prepurchased bonds may be used to satisfy sinking fund requirements at any time or held back to be part of the balloon payment at final maturity. Acceleration is permissible, which means that the issuer may increase any sinking fund by a specified amount. Acceleration of 100% corresponds to "doubling up" on the sinking fund. Kalotay's observation was that most analyses of the refunding decision fail to recognize the value of all of the options available to the issuer, in particular the value of the delivery option. He cited a recent example in which an issuer was wondering whether to double up a $20 million sinking fund to $40 million, at par. The bonds were selling in the market at a small premium and it had appeared at first that it would have to be profitable to retire as many bonds as possible at par. The bond indenture, however, provided that bonds acquired from doubling up the sinking fund had to be applied to the balloon payment at final maturity. The result was that although an immediate saving could be achieved by redeeming bonds at less than market value, the sacrifice in the value of options that would be lost more than offset this saving.

To put into perspective the values of the various options connected with a bond, Kalotay first showed a graph indicating the coupon premium appropriate for each of four options. The coupon premium is the extra coupon the issuer should offer to the investor in exchange for the option retained by the issuer. In all cases, the coupon premiums rise with the volatility of interest rates. At a 10% volatility, the privilege of doubling up sinking funds is worth about 14 basis points. The privilege of tripling up is worth about 20 basis points. The standard call privilege is worth about 22 basis points, and the delivery privilege is worth about 19 basis points. These values apply to each option in isolation. Combinations of options lead to somewhat different results. The value of the call option plus the delivery option, with no acceleration privilege, is nearly equal to the sum of the value of the call option in isolation and the value of the delivery option in isolation. But the value of accelerating the sinking fund, while substantial in isolation, is trivial if the issuer also has the option to call the issue. It is also of interest that as the spread between long and short interest rates rises the call option declines in value while the delivery option rises. That is, the ability to refund in the market at a current interest rate becomes less valuable as the current rate rises, but the falling market price means that pre-purchasing with a delivery option becomes more valuable.

Kalotay turned next to the effects of investor accumulation of bonds versus issuer prepurchase of bonds. By accumulating bonds, in effect achieving a sort of "corner" on the market for the bonds, an investor can reduce the value of the delivery option to the issuer and force the issuer to pay par for sinking fund. Prepurchases of the bonds by the issuer, on the other hand, enables the issuer to optimally designate the use of prepurchased bonds depending upon what happens to interest rates. At the same time, prepurchases by the issuer may reduce the incentive of investors to accumulate to their own advantage. Kalotay showed a graph demonstrating the value of "hoarding" by investors as a function of the percent of the issue accumulated. The potential value for a discount bond is around 4% of par value, while that for a current coupon bond is
around 1 1/2% and that for a premium bond is well under 1%. The value of prepayments in the tenth year ranged from close to 4% for premium bonds, 2% for current coupon bonds, and 0.5% for discount bonds. The message here was that large investors should consider the accumulation of current coupon bonds, should be sensitive to issue prepayments, and should be quick to preempt the issuer taking value from the investors through prepaying. For issuers, Kalotay observed that management begins with the structuring and distribution of the issue. The importance of the specification of call privileges is well recognized, but other features, including deliverability, are important and not so well recognized. Distribution of the issue is important, if the issuer is to find the liquidity necessary to engage in prepaying when this is attractive. Kalotay recommended the monitoring of distribution and secondary market prices and careful consideration of prepayments. His observation was that issuers are far from taking full advantage of prepay opportunities.

In summary, the interrelated embedded options in a standard bond issue demand rigorous analysis. The value of the call option overwhelms the value of acceleration provisions, a fact that may escape issuers considering optional sinking fund payments. Call and delivery option values are virtually additive. The delivery option often dominates. Prepayments and accumulation can profoundly alter values. The investor accumulation will affect the value of the delivery option and issuer prepayments will affect the values of both call and delivery options.

21. EXAMINING AND MODELING CORPORATE BOND RATING DRIFT (Fall, 1991)

Edward I Altman, Max L. Heine Professor of Finance at New York University and Duen Li Kao, Director, Investment Research, General Motors Corp. distributed a paper entitled "Examining and Modeling Corporate Bond Rating Drift." Altman began the presentation by referring to a variety of studies that have been performed on rates of default for corporate bonds, and observed that the present study dealt with a much more subtle indicator in the form of "rating drift." It covers every bond rating change from one letter grade to another (e.g. from AA to A) over the period January 1970 through September 1989. The sample included 7,195 rated new issues with at least one year of experience, and 1,959 issues with ten years' experience. The largest sector represented was industrial corporations; next came electric utilities with nuclear facilities, financial institutions, financial subsidiaries of industrial firms, electric utilities without nuclear facilities, other utilities, and all other issues.

A table of rating drift for all issues over the ten years following issuance showed that about half of the AAA bonds had been downgraded, close to half of the AA bonds had been downgraded, about 40% of the A bonds had had their ratings changed, more down than up, close to 60% of the BBB bonds had had their ratings changed, primarily up, about 80% of the BB bonds ratings had changed, primarily down, and about half of the B bonds that had their ratings changed about evenly up and down. About 15% of the CCC bond ratings had been lowered, and none of the CC ratings had changed. A comparison of changes in the 1970s with those in the 1980s indicated that except for the AA bonds, ratings had been considerably more stable in the 1970s.

Kao took over the presentation to discuss three approaches to modeling the credit rating drift experience. These were a Markov stationary process, a Markov non-stationary process, and a mover-stayer model. The Markov chain process is a stochastic model that describes certain time series. It consists of an initial distribution of observations (the bond ratings) with a finite number of categories and the matrices of transition (rating change) probabilities. In the stationary Markov chain the transition probabilities are assumed to be constant over time, while in the non-stationary Markov chains they are assumed not to be constant. The mover-stayer model is a generalization of the Markov model. It assumes that the population actually consists of two sub-groups: the "stayers" that remain in the same state during the entire sample period, and the "movers" whose transition pattern follows a simple stationary Markov probability matrix. The transition probabilities were estimated from the initial sample distribution and the observed transition probabilities over the test period.
It turned out that both the stationary and non-stationary simple Markov chain models underestimated the observed percentages of "rating unchanged" issues in all time periods and all rating categories. The mover-stayer model, on the other hand, tended to overestimate the "rating unchanged" issue percentages. Kao presented chi-square tests of the three models and a naive model that simply extrapolated the experience of the prior ten years. The three models performed well in predicting the three-year transition horizon for most rating classes. The mover-stayer model provided significant chi-square results even for the five-year transition horizon. Of the two simple Markov chains, the non-stationary model outperformed the stationary model for every rating up to the seven year transition. The results in the 1970s were significantly better than those in the 1980s, as might have been predicted. For the tests reported so far both parameter estimations and compatibility tests used the same set of sample data. Kao also described a back test on the data outside the modeling sample. A performance benchmark was also constructed by applying a naive model using historical five year transition matrices observed during the past ten years. The two Markov models did significantly better than the historical naive model in almost all cases from 1982 to 1984 and for the two year transition horizons in 1985. The mover-stayer model also outperformed the naive model in most cases.

Altman returned to discuss practical applications of the credit rating drift model. First, the model can be used to assess the credit quality risks taken by corporate bond investors. And he showed forecasts for a sample bond portfolio of average rating shifts in future years. Second, the model may help to establish more precise loss reserves for bond portfolios. Third, the model may help to establish guidelines for structured finance obligations such as collateralized bond obligations. Fourth, it may help to establish tolerance levels for aggregate changes in a portfolio's rating composition before liquidation procedures are enforced. (The example he showed would be particularly useful in this application.) Finally, the model may lead to better estimates of expected rate of return for bond portfolios. And Altman showed an example of this application.

He closed with a series of correlation analyses, showing that downgrades tended to be followed by further downgrades while upgrades were equally likely to be followed by up or downgrades.

DERIVATIVE SECURITIES AND CONTINGENT CLAIMS

22. INTEGRATING EURODOLLAR INTEREST RATE DERIVATIVE PRODUCTS (Fall, 1995)

Robert Jarrow, Ronald P. & Susan E. Lynch
Professor of Investment Management at Cornell University, distributed a paper by himself and Stuart M. Turnbull entitled "An Integrated Approach to the Hedging and Pricing of Eurodollar derivatives." (The research behind this paper was supported by funding from the Q-Group.)

Jarrow commented that it has been common practice to use either the term structure of treasury yields or the term structure of Eurodollar rates as the basis for pricing and hedging over-the-counter derivative instruments. But there are significant advantages to using both together, and it is the use of the combination that is reported in the paper. The ideal pricing model should be (1) arbitrage free, (2) consistent with the positive spread between treasury and Eurodollar rates (the TED spread), (3) computable by way of analytic solutions or lattice structures, and (4) extendible to multiple factors. (The TED spread can be thought of as consisting of a credit risk spread and a convenience yield spread. The latter derives from the usefulness of treasury bonds as collateral.) The proposed model fits all four criteria.

The Eurodollar and the treasury yield curves are taken as exogenous. The yield on the Eurodollar deposit includes a default premium. The default premium will depend upon a payout rate in the event of bankruptcy, and the probability of bankruptcy. It turns out (ignoring the convenience yield for the present) that the TED spread between Eurodollar and treasury rates is completely determined by the parameters of the bankruptcy process - the payoff ratio and the probability of bankruptcy. Jarrow next showed how the model can be used to price derivatives. These included European-
call options on Eurodollar deposits, and options where the option writer can also default. Turning to the pricing of LIBOR futures, Jarrow traced the data and the equations that lead to forward rates and prices. He next introduced convenience yields, that had been left out of the analysis so far. The convenience yield is created by shortages of treasury securities which prevent short sales. This yield can then be thought of as the difference between yields on bonds that can be shorted and those that cannot. The TED spread is then defined as incorporating both credit risk and convenience yield, and the derivative prices and rates are deduced from this new TED spread.

As a practical matter, one cannot be sure of the extent to which credit risk and convenience yields are actually to be found in the TED spread. Jarrow reported different opinions from traders he had talked with and there appears to be no empirical basis for estimating either component.

23. THE DERIVATIVE PORTFOLIO MATRIX - COMBINING MARKET DIRECTION WITH MARKET VOLATILITY (Spring, 1995)

Eric H. Sorensen, Managing Director, Salomon Brothers Inc., had constructed most of his presentation around the phenomenon of the relationship between movement in rate of return and movement in return volatility of the stock market. The significance of derivatives lies in their use to exploit expectations with respect to changes in return and volatility. As far back as 1976, Fischer Black had observed an inverse relation between return and volatility. That is, as the volatility in return on an asset increased, the price of the asset tended to fall. And vice versa. No causal relationship seems to have been discovered, only the fact of simultaneous changes. Sorensen observed that the value of the relationship for practical purposes rests on volatility being easier to forecast than price movement.

Practical applications, making use of put and call options, as well as futures, could be expressed in a matrix with price forecasts on one axis and volatility forecasts on the other. For example, if the S&P 500 Index is expected to rise, then for a forecast of lower volatility in the Index one sells a put, for a forecast of no change in the volatility one buys futures, and for a forecast of rising Index volatility one buys a call. A graph of the S&P 500 futures price versus the volatility implied by option prices confirmed the negative correlation between movement in the price and movement in volatility. For the months from 1983 through 1995, those in the top quintile of volatility increase had a 50% probability of being in the bottom quintile of rate of return. Daily data for March, 1990 through November, 1994 indicated the odds were 2:1 that if one of price or volatility was rising, the other was falling. Sorensen presented a number of conditional market direction probabilities for the S&P 500 Index, given changes in volatility.

It turns out that the relationship is very similar for the stock markets in the United Kingdom and in Japan. It also turns out that the relationship exists for a number of industries.

Focusing on investment strategies, Sorensen discussed forecasting conditional returns, to make shifts in global asset allocation or to effect industry rotation. The strategies depend, of course, on a forecast of volatility and Sorensen reported on the results of using a GARCH model for this forecast. He presented a table of quantitative relationships between the expected return and the expected change in volatility.

He concluded with a discussion of Salomon Brothers Dynawrite model and illustrated its use for a DAX call option writing decision tree. Four factors are used: the last month DAX return, the last month DAX volatility change, the last week DAX volatility change, and the volatility change forecast derived from a GARCH index forecast tool.

24. INTRODUCTION TO DERIVATIVE PRODUCTS (Spring, 1994)

Murali Ramaswamy, Vice President, Salomon Brothers Inc. opened the series of presentations on derivative products. He began by recounting a series of recent mishaps involving derivative securities, mishaps that have made newspaper headlines and appear to have highlighted the extraordinary risks that go with the use of derivatives. Against this, he balanced some recent success stories. Apparently a great deal of money can be made or lost through the use of derivatives, and it seems important to understand the dimensions
of the derivative market and what the risks are.

A derivative can be defined as a contract or security whose value derives from an underlying asset, rate or index. Some derivatives constitute standardized contracts and are actively traded on organized exchanges. Others are not standardized and are privately negotiated between parties. Some derivatives take the form of contracts, as in forward exchange contracts, swaps, options, and futures and futures options. Others take the form of securities, as in treasury strips, and convertibles or warrants, with embedded options.

Turning to the magnitude of the derivatives markets, at the end of 1991 globally outstanding listed derivatives (notional value) amounted to about 11 percent of the global market, OTC derivatives another 14 percent, equities another 31 percent and bonds 44 percent. Of the four kinds of swaps (interest rate, currency, equity and commodity), interest rate swaps are by far the largest, with something like $4 trillion notional value outstanding in 1993. Similarly, of four kinds of options (interest rate, caps and collars, stock indices and currency) interest rate options are by far the largest, with swaptions becoming important in the last year or so.

It is useful to separate the risks in derivatives into systemic and non-systemic. It is systemic risk that mostly concerns the regulatory agencies. The Group of Thirty report defines this risk as "the risk that a disruption in a firm causes widespread difficulties at other firms, in other market segments or in the financial system as a whole." Ramaswamy listed a number of issues relevant to assessing systemic risk. Non-systemic risks consist of market risk, credit risk, legal risk and operational risk. Of these, the one of chief concern to regulators is credit risk, and Ramaswamy presented some statistics on derivatives exposure of the 50 largest U.S. banks.

In closing, he discussed who uses derivatives, the most used derivative strategies, and the regulatory structure for the derivatives market.

25. MEASURING MARKET RISK: VALUE AT RISK AND STRESS TESTING: MARKET RISK UNDER NORMAL AND ABNORMAL CONDITIONS (Spring, 1994)

Robert J. Mackay, Professor of Finance and Director of the Center for Study of Futures and Options Markets in the R. B. Pamplin College of Business at Virginia Tech, and Project Advisor to the Group of Thirty Global Derivatives Study Group, distributed a paper entitled: "Value at Risk and Stress Testing: Marketing Risk Under Normal and Abnormal Conditions." He also distributed Appendix III, Survey of Industry Practice, to the report published by the Group of Thirty, in March, 1994.

Mackay's presentation was largely devoted to a discussion of the principal recommendations of the Group of Thirty, with reference to the survey responses. He pointed out that the survey was completed sometime before the research that led to the recommendations, so that the survey questions were not directly related to the recommendations. Yet the survey was useful in verifying the extent to which the recommendations are already being followed.

Perhaps the most important of the recommendations was one that dealers should mark their derivatives positions to market on at least a daily basis for risk management purposes. The survey responses indicated that a great many firms are doing this already, and others expect to follow suit.

A second recommendation has to do with how the valuation should be performed. Mid-market valuations should be adjusted to allow for expected future costs such as unearned credit spread, close-out costs, investing and funding costs, and administrative costs. The survey results indicate there is no set industry standard, at least as of early 1993, with respect to the adjustments.

A third recommendation had to do with measuring market risk. Dealers should use a consistent measure to calculate daily the market risk of their derivatives' positions and compare it to market risk limits. The preferred
measure of market risk is "value at risk" based upon probability analysis using a common confidence interval and time horizon. Mackay suggested the use of a two standard deviation confidence interval and a one-day time horizon.

Another recommendation proposed that dealers should regularly perform "stress tests" through simulation techniques to determine how their portfolios might perform under abnormal or stress conditions. The survey results indicated that the major global dealers are already undertaking some of this activity, but a significant number of dealers do not or only rarely conduct stress tests.

Finally, Mackay discussed the recommendation with respect to independent market risk management. The Study Group of Thirty proposed that dealers should have a risk management function, with clear independence of trading or market making activity and authority to develop policies, to monitor, to design stress scenarios, and to review and approve pricing models and valuation systems. The survey indicated that a substantial number of dealers already had some sort of independent risk management function in place, and many more planned to establish one.

Mackay went on to discuss recent guidance published by the Federal Reserve Board and the Office of the Comptroller of the Currency, on "safe and sound" risk management practices. The guidelines are rather similar to the Study Group recommendations. They include marking to market, measuring market risk, stress testing, and independent market risk management.

Expanding on the concepts of value at risk, and stress testing, Mackay discussed the development of a "worst case" scenario for normal market conditions, and one for abnormal market conditions. This may be the most effective way of identifying the risk exposure of an institution, and of capital adequacy.

26. RISK CAPITAL ALLOCATION FOR TRADITIONAL LENDING USING THE TOOLS OF DERIVATIVES (Spring, 1994)

John H. Treanor, from the United States General Accounting Office, began his talk with some history of bank lending, the risk and return relationship in bank loans, and the pricing of those loans. Traditionally, bank loans have been priced in terms of a spread over treasuries, and a portion of that spread has related to the risk in the loans. Until the 1960s, much of the object of lending, at least in the United States, was to obtain and hold customer demand deposits. The 1960s saw the better customers shift their reliance from bank loans to commercial paper. Not only did the banks lose loans, they lost the safest loans. Competition drove the banks to lending overseas. First Western Europe, then Eastern Europe, Latin and South America, and Asia offered opportunities for expanding loans. The trouble with this overseas expansion of loan activity was that banks seriously underestimated the risk in the loans and did not charge sufficiently high interest rates to compensate for that risk. Competition, indeed, made it impossible to charge adequate interest rates and remain in those markets. The Basel Agreement corrected some of the competitive excesses by creating international uniform standards for bank capital.

Relatively few banks practiced active risk capital allocation for their lending. Treanor identified J. P. Morgan and Bankers Trust, later joined by Irving Trust, as banks that were willing to allocate capital according to perceived risk, and then to set interest rates corresponding to the risk. If it was not possible to make loans at interest rates necessary to compensate for risk, then these banks simply withdrew from lending. What the banks required for internal purposes, and what the regulatory agencies require for establishing bank capital standards, is some methodology for identifying risk in loans and determining the appropriate capital allocation. Here is where we can use methodologies devised for derivatives. Yet we find that some banks are far advanced in their use and understanding of derivatives, but have, made little progress with respect to capital allocation for lending. One reason is that those who manage loan portfolios are generally averse to marking those portfolios to market. And the same people are not always knowledgeable enough to understand the ideas that have come out of derivatives. Indeed, some of the lending practices of commercial banks are actually perverse, in that they actually increase risk although their intention was risk reduction.
In closing, Treanor reiterated his point that sensible lending must involve a commitment to charge interest rates that correspond to the risks in the lending, and a willingness to withdraw from or curtail a lending business that cannot achieve those rates.

27. PANEL DISCUSSION – DERIVATIVES (Spring, 1994)

Murali Ramaswamy, Vice President, Salomon Brothers Inc. introduced the panelists. The first to speak was Jeffrey Geller, Managing Director, Portfolio Management, BEA Associates, Inc. He discussed the use of derivatives, particularly options, managing money at BEA. He stressed the unwillingness of BEA to use any investment instruments in the absence of liquid markets facilitating hedging to lay off risk. Much of the BEA strategy in using options is a function of an expectation of mean reversion in volatility. There seems to be evidence that traders assume recent high or low levels of volatility will persist forever, when history suggests that reversion will be at work.

Geller described a number of arbitrage situations. The stages of the thought process in an arbitrage decision he gave as:
(1) Compare the current implied volatility to the historical implied volatility.
(2) Contrast the current implied volatility with the current actual volatility.
(3) Decide whether there has been a fundamental shift or a temporary aberration.
(4) Consider timing and liquidity.
(5) Isolate the volatility arbitrage from market risk.
(6) Establish an exit strategy, based on changes in (1) and (2).

He illustrated the strategy with two transactions. One involved the purchase of puts and calls on Deutschmarks on the basis of historically low implied volatility, and the sale of puts and calls on yen, on the basis of very high implied volatility.

Kris Mahabir, Director of Derivatives at Fidelity Management & Research, discussed the use of derivatives as part of the development of fixed income strategies at Fidelity. The strategy begins with a fundamental view on interest rates, and a perception of risk. The next step is the determination of the appropriate risk level for the particular fund making the investment. Derivatives can then be used to achieve that risk level and facilitate the transaction. He described as an example the use of a three-year inverse floater to in effect leverage a strategy based on the expectation last year that Japanese interest rates would decline with the largest move at the three-year maturity.

Robert Mark, who heads the Financial Risk Management Consulting practice at Coopers & Lybrand, discussed the recommendation of the Group of Thirty that derivatives should be marked to market. The Group of Thirty offered no suggestions as to the process by which market values, and adjustments to market value, might be determined. Mark went through in some detail just what is involved in implementing the recommendation. First, the lack of available market prices for a variety of derivatives calls for the use of valuation models. And this in turn calls for some Generally Accepted Risk Principles, analogous to Generally Accepted Accounting Principles. Once a model has been developed, there will have to be independent verification of the inputs to the model. These might include the shape of a swap rate curve, trends in swap spreads, and volatilities both implied and historical. The choice of the model itself is not trivial, and a number of different models now exist. Among the adjustments called for by the Group of Thirty recommendations are expected credit losses, administrative cost adjustments, close-out costs, investing and funding cost adjustments.

Market risks must be quantified, both systemic and non-systemic. This probably calls for the specification of distributions with confidence levels. It may be feasible to develop benchmarks, for example, the price change corresponding to a one basis point change in yield of a particular maturity, and then to estimate price changes for other maturities. Special difficulties arise if volatilities and correlations are not stable, and so the relation to a benchmark is not stable.

Mark set out the various steps in adjustment for credit risk, including identification of the worst case, with a given level of confidence, and the expected credit equivalent exposure path.
Following his review of the wide variety of adjustments, he concluded by outlining the organizational steps required:

- independent risk management function
- authorize only professionals with requisite skills to execute, report, control and audit derivatives activities
- establish risk management information systems to measure, manage and report derivatives risk
- adopt accounting and disclosure practices for greater transparency.

28. AN OVERVIEW OF THE FOUNDATIONS OF FINANCIAL ENGINEERING WITH AN APPLICATION TO SWAPS (Fall, 1992)

Chi-Fu Huang, J.C. Penney Professor of Finance at the Sloan School of Management at MIT, distributed an outline entitled "Foundations of Financial Engineering with an Application to the Valuation of Swaps". His task was to trace the development of financial engineering (which he described as a history of financial physics) to explain the framework in which we can analyze swaps.

The story began with Brownian motion, moved to Samuelson's use of Brownian motion to model stock price changes, went on to the Black-Scholes option pricing formula, thence to Merton's extension of the Black-Scholes analysis, on to the Cox and Ross observation that in the Black-Scholes model the option price is an expectation under an artificially constructed probability, to the Harrison and Kreps demonstration that the Cox-Ross observation goes beyond the Black-Scholes model and is much more general. The Harrison and Kreps conclusion can be expressed as:

- in an economy where one cannot create something out of nothing,
- for any security, $S_0$, chosen as numeraire, there exists a probability $Q$ so that for any other security $S_n$,
\[
\frac{S_n(t)}{S_0(t)} = EQ\left[\frac{S_n(T)}{S_0(T)} | I_t\right].
\]

- where $S(t)$ is the price of the security at time $t$; $S(T)$ is the price at a future time $T$; $I_t$ is all information available at time $t$; $EQ$ is the expectation under the probability distribution $Q$; and $Q$ is the probability distribution unique to the numeraire.

- that is, $S_n/S_0$ is a "martingale" under $Q$ and we call $Q$ a martingale probability for the numeraire $S_0$.

In particular, if
\[
S_0(t) = e^{\int_0^t r(s)ds}
\]

where $r$ is the continuously compounded riskless interest rate, so that $S_0(t)$ is just the value of one dollar compounded at the riskless interest rate from $t=0$ to $t=t$.

Then,
\[
S_n(t)e^{-\int_0^t r(s)ds} = EQ\left[\frac{S_n(T)e^{-\int_0^T r(s)ds}}{S_0(T)} | I_t\right];
\]

- equivalently,
\[
S_n(t) = EQ\left[\frac{S_n(T)e^{-\int_t^T r(s)ds}}{S_0(T)} | I_t\right];
\]

under this $Q$, all assets earn an expected rate of return equal to the riskless interest rate.

The probability distribution $Q$ that we choose in this case, would apply if all investors were risk neutral. Risk neutrality means that risk premiums would disappear and all assets could be expected to earn the riskless rate.

Huang turned next to the topic of complete markets.

If the number of linearly independent securities is equal to one plus the number of the independent sources of uncertainty, markets are "complete". It turns out that it will be convenient to use the risk-free security as the "n+1" security.
Any financial payoff $X$ at $T$ (no matter how complicated) that depends on (up to the complete history of) the prices of the traded securities can be duplicated by a unique dynamic trading strategy.

When markets are complete, there exists a unique martingale probability distribution for any numeraire chosen.

The "arbitrage value" of $X$ at $t$, denoted $f(t)$, has the martingale property too:

$$f(t) = E_Q \left[ X \exp \left\{ \int_0^T r(s)ds \right\} \right],$$

where the expression on the left of the equality is the current price of the payoff, and the expression on the right is the expected payoff at time $T$, discounted at the risk-free rate.

Equivalently,

$$f(t) = E_Q \left[ X \exp \left\{ \int_t^T r(s)ds \right\} \right].$$

Huang next discussed the Samuelson-Black-Scholes model. In this model there is one source of uncertainty and two linearly independent traded securities, implying completeness of market. One security is a common stock, and the other is a risk-free investment. The following differential equations apply to the two:

$$dS(t) = \mu S(t)dt + \sigma S(t)dw(t),$$

$$dB(t) = rB(t)dt.$$

Where $\mu$ is the expected return on the stock; $\sigma$ is the standard deviation for the stock returns, $w$ represents Brownian motion and is a variable with standard normal distribution; and $r$ is the risk-free rate.

We use $B$ as the numeraire, and under the martingale measure $Q$,

$$dS(t) = rS(t)dt + \sigma S(t)dw^*(t),$$

where $w^*$ is a Brownian motion under $Q$ with

$$w^*(t) = \frac{\mu - r}{\sigma} t + w(t).$$

The differential equation enables us to find the distribution $Q$. Once we have this distribution, we can calculate the price or value at the present time of any future payoff. Black and Scholes valued a European call option on $S$ with an exercise price $K$ and a maturity date $T$ as follows:

$$C(S(t), t) = E_Q \left[ \max[S(T) - K, 0]e^{-r(T-t)} I_t \right]$$

$$= S(t)N(d_1) - Ke^{-r(T-t)}N(d_1 - \sigma \sqrt{T-t}),$$

where

$$d_1 = \frac{\ln(S(t)/K) + r(T-t) + 1/2 \sigma^2(T-t)}{\sigma \sqrt{T-t}},$$

Next, one can determine the duplicating strategy, which is the strategy to equal the desired payoff at $T$. For the option this is:

- $C(S, t)$ is twice continuously differentiable in $S$ and once in $t$ for all $t < T$.

- Apply Itô's lemma to $C(S(t), t)/S_0(t) = C(S(t), t)e^{-rt}$ under $Q$ to get:

$$d(C(S(t), t)e^{rt}) = (Q - \text{Martingale})$$

$$= [1/2e^{-rt}CsS^2 \sigma^2 + re^{-rt}C_S - re^{-rt}C]dt$$

$$+ e^{-rt}C_t dt \quad \text{(time trend = 0)}$$

$$+ C_S(S(t), t)dw(S(t)e^{-rt})$$

(Q - Martingale)

- Thus

$$C(S(t), t)e^{-nt} = C(S(0), 0) + \int_0^t C_S(S(s), s)ds(S(s)e^{-nt}).$$

- The duplicating strategy is

$$\theta(t) = C_S(S(t), t).$$

In summary, here are the steps in what Huang referred to as financial engineering:

- Build models that imply complete markets.

- Estimate parameters of the model.
• Fix a numeraire and work out the martingale probability.

• Calculate the "arbitrage value" of any financial payoff.

• Take derivatives to get the duplicating strategy.

The duplicating strategy is $\theta(t)m$, where $\theta(t)$ is the number of shares one purchases as the alternative to the purchase of an option. A portion of the purchase of $\theta(t)$ shares is paid for in cash, and this is the price of the option in cash. The balance is borrowed at the risk-free rate.

29. FUTURE OF RISK MANAGEMENT: SWAPS AND CONTRACTUALS
(Fall, 1992)

Myron S. Scholes, Managing Director, Salomon Brothers Inc., distributed an outline entitled "Future of Risk Management: Swaps and Contractuals". He began by contrasting a functional approach to problem solving with an institutional approach. The functional approach focuses on risk and return and the achievement of objectives at the lowest possible cost. It tends to be "culture-free," and is therefore more flexible and less bound by tradition.

As an example, Scholes discussed three ways to reduce risk in an investment portfolio. In the 1960s and 1970s the most popular method was to shift out of risky assets into safe assets. This could involve high transactions costs and also loss of ability to profit from expertise in managing risky assets. In the 1970s and 1980s a second method -- diversification -- became popular. This still had the disadvantage of transactions costs and also precluded focusing on segments of the market where the manager's skill level appears highest. In the 1990s we turn to a third method -- insurance. Hedging with options, the use of swaps and futures contracts, enable the manager to remain active wherever the payoffs seem greatest, while hedging the risks.

Scholes took international investment as a useful example. Clearly, investing beyond the U.S. increases the opportunity set but at the same time can incur substantial costs in the form of transactions costs, withholding taxes, and in some cases a prohibition against U.S. persons from using futures in foreign markets. These costs can be expressed as an effective "front-end load" on foreign investing. Scholes had estimated the load can be as high as 7 percent for investment in Australia, 5.3 percent for the U.K., 5.1 percent for Germany, and 2.5 percent for Japan. It makes sense to construct a transaction (and such a transaction was described in the next session by Robert Litzenberger and Steven Sitver) to enable a U.S. investor to benefit from the foreign opportunities without incurring the costs of direct investment. As managers try to participate in the returns available in a number of instruments and markets, while hedging or avoiding risks and transactions costs and taxes, a variety of new products emerges to meet their needs. Examples are equity linked notes, world government bond index linked swaps, futures markets and options markets on indices.

Turning from investment management to corporations, Scholes suggested that in the 1990s derivatives will become part of general corporate finance strategies. The point here is to enable the corporation to leverage the returns on its core businesses, those for which its skills are greatest, while reducing the risks in the parts of the business that are beyond the control of the corporation or in which it lacks expertise. An example is that of an airline hedging the cost of fuel. Risk reduction of this sort should enable the corporation to operate with less equity capital. Scholes pointed out that equity is very expensive for a variety of reasons. There are significant benefits then to reducing the need for equity. Derivative instruments (as in the case of fuel futures contracts), and balance sheet instruments -- contingent interest bonds, for example -- will become easier and cheaper to use.

In summary, Scholes closed with these thoughts: the 1990s will be exciting times for portfolio managers, with many new instruments coming along. Managers should go back to basics to examine what is an optimal investment program, one that reduces so far as possible constraints on the manager's activities and enables the manager to profit from what he or she does best.
30. RECENT INNOVATIONS IN THE SWAP MARKET (Fall, 1992)

Robert Littenberger, Edward Hopkinson, Jr. Professor of Investment Banking at the Wharton School and Chief Economist, AIG Financial Products Corp., and Steven Sitver, Vice President, AIG Financial Products Corp. distributed an outline entitled "Cross-Market Investment Opportunities Created Through Swaps". Littenberger began the presentation with a discussion of the motivation of counterparties. Asymmetric tax treatment and asymmetric access to markets provide a motivation for swaps, as do particular macroeconomic views, especially those having to do with the trend in interest rates. He explained that the presentation would deal with three examples: the Dax swap, the LIBOR differential swap, and the Tax Indexed swap.

Littenberger described the Dax swap. (The Dax is a German value weighted index of 30 stocks.) The problem for a U.S. investor wishing to purchase German stocks is that a corporate tax imputation credit equal to 56.25 percent of dividends is available to German individuals and German corporate stockholders, but not to U.S. investors. In addition, dividends paid by German companies to U.S. investors are subject to a 10 percent German withholding tax, for which no U.S. credit is available to tax exempt investors. Finally, the Commodity Futures Trading Commission prohibits U.S. funds from trading in Dax futures. A Dax swap allows a U.S. investor to lock in a 110 basis point pickup for a term of up to three years. The swap works in this way: the investor first purchases $10 million of two-year AA rated floating rate notes with semiannual coupons at LIBOR plus 15 basis points (alternatively, a synthetic FRN can be created). Next, the investor enters into a two-year, $10 million Dax/LIBOR swap. The investor receives semiannually the U.S. dollar total return of the Dax (including dividends) and pays semiannually the U.S. dollar LIBOR minus $100 basis points. The combination of the two transactions produces the U.S. dollar total return on the Dax plus $100 basis points. The total return on the Dax to a German investor is approximately the U.S. dollar total return plus 140 basis points, so the U.S. investor making use of the swap can come within 15 basis points of the total return available in Germany, and 125 basis points more than the total return available to a U.S. investor investing directly in the Dax. The aggregate benefit to the parties lies in the tax benefits of the swap.

Sitver continued the presentation, discussing LIBOR differential swaps. The object here is to obtain an exposure to foreign interest rates without taking a foreign currency risk, and to go further in exploiting interest rate differentials between foreign and domestic markets. The situation as of September 11, 1992 was this: the six-month Deutschmark LIBOR rate was 9.75 percent, while the six-month U.S. dollar LIBOR rate was only 3.25 percent, for a 6.50 percent differential. At the same time the five-year Deutschmark swap rate was 8.33 percent, and the five-year U.S. dollar swap rate was 5.62 percent. The six-month forward Deutschmark LIBOR rates declined from close to 10 percent six months out, to around 8 percent, five years out. At the same time, the six-month forward U.S. dollar LIBOR rates ranged from a little over 3 percent, half a year out, to approximately 8 percent five years out. The downward sloping Deutschmark curve and the upward sloping U.S. dollar curve suggested that Deutschmark interest rates would remain above U.S. dollar interest rates for some time, and that the two would converge in something like five years. The breakeven spread in U.S. dollars was in fact about 265 basis points.

For the investor wishing to take advantage of the differential between Deutschmark and U.S. dollar interest rates, without currency risk, a LIBOR differential note was created in this way: the investor puts up $10 million to purchase a five-year promise of the Deutschmark six-month LIBOR rate less 285 basis points. Initially, with the six-month Deutschmark LIBOR rate at 9.75 percent, the note coupon is 6.90 percent, or 3.65 percent above the six-month U.S. dollar LIBOR rate. Sitver reported the consequences to this transaction of the dramatic turbulence in interest rates and currency exchange rates in early September. As of September 16, five days after establishment of the transaction, the six-month forward Deutschmark LIBOR rates dropped somewhat and the apparent time to convergence with U.S. rates shortened. The breakeven spread dropped from 265 to 205 basis points, and the value of the swap dropped to 97.44 percent of the initial $10 million investment. The initial six-month interest rate advantage, of course,
was still there. By October 5, 1992, Deutsch-
mark rates had increased somewhat, and the
value of the swap was up to 98.36 percent of the
initial investment.

Finally, Silver discussed tax indexed
notes. Municipalities have for some time taken
advantage of the fact that the municipal yield
curve is somewhat steeper than the taxable
yield curve. Hence municipalities have issued
variable rate tax-exempt notes, and used swaps
to convert the variable rate obligation to a
fixed-rate obligation somewhat below the rate
the municipality would pay on a direct issue of
a long-term fixed rate instrument. The tax
indexed note enables a taxable investor to
hedge income tax rates and also to take a
position with respect to likely upward or
downward changes in the tax rate. The
transaction begins with an implied tax rate of
29 percent. This is the marginal tax rate that
would make an investor indifferent between
taxable and tax-exempt interest rates. The
investor purchases an instrument paying
LIBOR, from a AAA issuer. The investor then
enters into a tax-exempt swap with a dealer, so
that the net result is receipt of LIBOR + (the
actual implied tax rate – 29 percent) x .25. This
means that when the actual implied tax rate
goes above 29 percent, one quarter of this will be
added to the LIBOR rate received by the
investor. The transactions will prove
profitable if implied tax rates rise, and will in
any case provide a hedge against rising taxes.

31. THE ROLE OF REGULATION
(Fall, 1992)

Charles M. Lucas, Senior Vice President,
International Financial Markets Function,
Federal Reserve Bank of New York, discussed a
broad set of public policy issues arising from the
markets in derivative securities, and swaps in
particular.

He began by expressing his confidence that
derivative products have increased and will
continue to increase efficiency in financial
markets. He stressed the importance of this
conviction, because as regulators discuss their
concerns about risks in the derivative security
markets, it is easy to picture them as opposed to
the use of derivatives. He went on to say that
he thinks the cycle of inflation and deflation of
the 1970s, 1980s and early 1990s would have
presented much more serious problems in the
absence of financial innovation. The regulatory
intention is to insure that the benefits of
innovation continue, while anticipating serious
problems and preparing to deal with them.

Lucas sees the development of derivative
instruments as driven in the 1970s and 1980s by
macroeconomic events, and driven now by
technology. These developments have made
regulatory structures erected over some 60 years
largely obsolete, and we need now a new range
of public policy responses.

He described some of the consequences of
the failure of Drexel Burnham. The Drexel
swaps book was not very large, and for the most
part “plain vanilla” swaps. Drexel offered its
counterparties to reverse all transactions at 85
cents on the dollar. Dealing with the swaps
book presented few serious problems. It was the
government securities portfolio and especially
the mortgage-backed portfolio that were the
prime sources of concern in the closing of Drexel.
But Lucas said the next case could be much
worse. He presented to his listeners the
question how do you understand the credit
exposure of the counterparty you are dealing
with? It is not clear that information necessary
to understand risk is increasing as rapidly as
the risk itself.

As we look back some 25 years at the
banking industry, the information available
was not very good, but it was good enough for a
world of simple financial products and not very
aggressive market participants. Today
participants are much more aggressive and
more innovative. Efficiency is higher, and
participants are exploiting credit to the limit.

As an example of a transaction that is
puzzling in some respects to the Fed, Lucas
referred to the U.S. pension fund that buys a
portfolio of Japanese stocks, and contrasted it
with the same fund buying treasury bills and
swapping the Nikkei against a dollar
denominated floater. In the first case, there is
an international transfer from the U.S. to
Japan, one that will turn up in the international
funds flow known to the Fed. In the second case,
while the exposure of the pension fund is the
same, the flows are very different. Is there a
capital outflow from the United States to
Japan? The answer depends upon whether some
entity in Japan holds the actual securities or
whether a U.S. broker holds them. The Fed
will have great difficulty sorting out the funds flow consequences of the transaction. But Lucas also raised the question, does this matter?

Turning to the complexity of a number of hedged transactions, Lucas wondered whether participants fully understand the risks they are running. Have they thought through what will happen if a counterparty fails? He felt it was especially hard to anticipate the combined effects of a market break and the private difficulties of a firm. The example of portfolio insurance and its operation on October 19, 1987, suggested some of the difficulties that might arise.

**EQUITY MARKET STRUCTURE AND TRADING**

**32. THE WINNERS AND LOSERS OF THE ZERO-SUM GAME (Spring, 1993)**

Lawrence Harris, Professor, University of Southern California School of Business Administration, distributed a paper entitled "The Winners and Losers of the Zero-Sum Game: The Origins of Trading Profits, Market Efficiency and Liquidity." He introduced the topic with a number of questions. The most important included: Is trading a zero-sum game? If so, why does anyone trade? How and why do traders make prices efficient? How and why do traders offer liquidity? To answer these questions we have to identify styles of trading. While no one trader follows a single style, it is useful to decompose trading behavior into component styles, and to identify a number of characteristics for each style.

A brief digression demonstrated why it is extraordinarily difficult to draw from past performance inferences with respect to future performance. Distinguishing skill from luck requires so many years of data that the exercise is not practical.

Trading is often thought of as a zero-sum game. This is true if financial gains and losses tell the whole story. But if people participate in trading for more than the expectation for financial gain, then trading becomes a positive sum game. Among the external reasons for trading are moving money through time, hedging risk, converting asset types, obtaining entertainment, obtaining soft dollar services, and testing one’s ability to trade.

Harris described three basic styles of traders. Winners expect to profit from their trading. Utilitarian traders obtain external benefits from trading. And futile traders expect to profit but for a variety of reasons fail to do so. Winning traders make prices efficient and provide the most liquidity. Utilitarian and futile traders effectively underwrite the efforts of the winning traders.

Winners are characterized by: choosing better portfolios than losers; timing their trades better than losers; negotiating better terms than losers; performing better analyses than losers; paying more attention than losers; acting faster than losers; and organizing information more efficiently than do losers.

Harris included in his paper a table summarizing characteristics of stylized traders, their goals, their information resources, their effect on price efficiency and on liquidity, and the sources of their profits and losses. The important consequences concern the effects of winners on price efficiency and on liquidity. With respect to price efficiency, value-motivated traders set price levels. They also maintain cross-sectional fundamental relations among asset classes and individual securities. Informed traders update prices to reflect new information. Technical traders increase efficiency with counteracting predictable patterns. They decrease efficiency when exacerbating uninformed order flows. Arbitragers insure that common risks have common prices. With respect to liquidity, value-motivated traders are the ultimate source of depth and resiliency. Upstairs traders provide depth and organize liquidity for large traders. Market-makers provide immediacy by connecting liquidity demands through time. Arbitragers connect liquidity demands across space.

Harris returned to the importance of losers, those traders expecting to suffer financial loss in order to obtain external benefits. While these traders may contribute directly in a minor way to efficiency and liquidity, their chief contribution comes in providing the motivation for winners to trade, with the winners adding substantially to efficiency and liquidity.
In concluding, Harris described three scenarios for future changes in trading. First, if passive trading continues to grow, losers will lose less, so winners will win less, research expenditures will decline and prices will become less efficient. Second, a new transaction tax would take wealth out of the zero-sum game, losing traders would become discouraged, trading would decrease; liquidity would decrease; and prices would become less efficient. Third, as fundamental information dissemination and report systems improve, more traders will incorporate value-motivated investing styles into their trading. But it will become more difficult to profit as a value-motivated trader. Liquidity and price efficiency will both increase, and utilitarian trading will increase.

33. ASSESSING THE QUALITY OF A SECURITY MARKET (Spring, 1992)

Joel Hasbrouck, Associate Professor of Finance at the Stern School, New York University distributed a paper entitled "Assessing the Quality of a Security Market: A New Approach to Transactions Cost Measurement". The research was supported by the Q Group. He began his presentation with the common proposition that in addition to the explicit cost of executing a security transaction (such as a commission) the trader incurs an implicit cost. That implicit cost is the difference between the actual transaction price and some benchmark price that could be considered to be "fair" or "efficient". Transaction costs are important to traders, who want to consider the effect of those costs on their expected rates of return. But they are also important in a social sense, because we generally believe that markets with low transactions costs are superior to those with high transactions costs. Hasbrouck's work is aimed more at the identification of a cost measure that would permit comparing the qualities of markets, than it is to meeting the needs of individual traders.

The cost of transaction can be written as:

\[
\text{Transaction price} = \text{Benchmark Price} + \text{Pricing Error}
\]

The pricing error is taken as the implicit transaction cost, and Hasbrouck's position is that the dispersion of the pricing error measures how closely actual transaction prices track a random walk and is therefore a natural measure of market quality. In his model, the efficient price follows a random walk without drift, and the pricing error is a zero-mean covariance-stationary stochastic process.

The pricing error can be thought of as consisting of an information-correlated component and an information-uncorrelated component. The former arises from adverse selection effects and from lagged adjustment to information. The latter results from price discreteness, transient liquidity effects, inventory control effects, and "noise" trading. Models have been proposed in the past for dealing with the case where pricing error is entirely information correlated, with other models for cases where the pricing error is completely information uncorrelated. Between these two extremes, the dispersion of the pricing error differs considerably. Hasbrouck's model, however, permits both information-correlated and -uncorrelated effects.

The next step is to strengthen the analysis by including explanatory variables in addition to prices. Imagine that the market consists of a risk-neutral dealer, and informed and uninformed traders. At the close of period \(t-1\), the trading history and the efficient price \(m_{t-1}\) are common knowledge. At the beginning of period \(t\), public information \((u_t)\) arrives, making the expected security value \(m_{t-1}+u_t\).

About this value, the dealer posts bid and ask quotes: \(q_t^b = m_{t-1} + u_t - c\) and \(q_t^a = m_{t-1} + u_t + c\), where \(c\) is the half-spread. The arriving trader faces these quotes and may buy or sell one unit of the security \(x_t = \{-1, +1\}\). The transaction price is \(p_t=q_t^b\) if \(x_t=-1\) and \(p_t=q_t^a\) if \(x_t=+1\). From the relations \(p_t = m_{t-1} + u_t + cx_t\) and \(m_t = m_{t-1} + u_t + gx_t\), it is apparent that \(s_t = p_t - m_t = (c-g)x_t\). In this example, it is interesting to contrast the estimated pricing error variance with the bid-ask spread. The half-spread is, of course, \(c\). This overstates the pricing error, because a portion of this \((g)\) reflects the update to the efficient price conditional on the trade. The pricing error reflects only the remaining component, \((c-g)\).
The next step is to allow general serial correlations in the returns and other explanatory variables.

Working with data from the Institute for the Study of Security Markets (ISSM) tape for the first quarter of 1989, Hasbrouck estimated the average pricing error standard deviation at about 0.33% of the stock price. If the pricing error is assumed normally distributed, and it is always a positive cost incurred by traders, the corresponding average transaction cost for these traders is 0.26% of the stock price. For the largest capitalization stocks, the standard deviation of the average pricing error was about .15% and for the smallest capitalization stocks it was about .55%. It also turned out that the standard deviations were higher in the early morning and late afternoon hours than in mid-day.

34. LIQUIDITY, TRADING RULES AND ELECTRONIC EXCHANGES (Spring, 1991)

Wayne Wagner, of The Plexus Group, introduced the topic of liquidity and trading rules. He began with the question what facilities and innovations in market structure are in the best interest of managers and fiduciaries. He suggested that we do not really know how to determine the cost of transacting. Nor do we know exactly how stock prices adjust. And finally, we don't know just what market facilities are desirable, what they should cost, and who should pay for them.

Effecting transactions is fundamentally different from security selection and portfolio balancing. Successful investment management requires both good decision making in terms of what to do -- the exercise of portfolio management discipline -- and good decision making in terms of how to do it -- the exercising of transaction discipline.

Lawrence Harris, Associate Professor at the School of Business, University of Southern California, and Research Coordinator for the IQRF, distributed a paper entitled "Liquidity, Trading Rules, and Electronic Trading Systems". He began with an overview of the general topic of market microstructure, and then turned to the particular subject of liquidity. On the general level, he pointed out three economic principles or elements underlying market structure. First is asymmetric information. Second is externalities, such as the regulatory activity of the New York Stock Exchange. And third is the principal/agent problem, which concerns whether a broker is doing its best for a customer.

Three issues under trading strategies are sunshine trading, block trading, and manipulative trading. Sunshine trading, as it has been proposed, would separate the informed from the uninformed investor, and would help to deal with the adverse selection issue. Block trading may be one way to separate the informed from the uninformed investor although block trading may simply transfer the difficulties of an uninformed investor confronting a suspicious market to the block trader acting on behalf of the uninformed investor and confronting an equally suspicious market.

Still another issue concerns centralization versus competition in markets. A single central market is the best arrangement if all traders are identical and the structure of that market is the best possible. Under different conditions, competition may be superior to centralization.

Clearing and settlement risks were identified by Harris as important. Trading cost measurement, as Wagner had suggested, is still an important issue. And finally, Harris posed the question why do people trade? It appears that liquidity trading is declining and there are good reasons for this.

Tuning to the particular subject of liquidity in the marketplace, Harris identified the key question as: What market structure will best capture order flow? The three premises underlying his analysis were: (1) liquidity demanders seek liquid markets, therefore (2) markets must attract liquidity suppliers by trading rules offering adequate protection to these supplies and trading systems offering them low-cost transactions, and (3) liquidity suppliers include off-floor traders. In fact, probably the off-floor traders are the most important suppliers of liquidity.

It is important to recognize the value of liquidity, because there are two approaches to dealing with a shortage of liquidity. One is to curb the demand for liquidity (by limiting various kinds of trading, for example) and the
other is by increasing sources of liquidity. Harris contrasted the regulatory approach, which is to dampen demand, with the entrepreneurial approach, which is to increase supply. Buy-side institutions and individual traders are particularly important sources of liquidity, and it is important therefore to find ways to encourage their participation in a market.

The Exchange can attract off-floor liquidity suppliers by giving them good service at low cost. Harris suggested that the present fee structure generally subsidizes liquidity demanders and taxes public liquidity suppliers, a situation that really should be reversed.

The display of limit orders offers the market both liquidity and information about value and future liquidity. However, some traders who are willing to provide liquidity do not want to provide information and therefore do not want to display their orders. If they are forced to display, they may simply not offer the orders. This poses a dilemma to the Exchange. The answer may be an electronic limit order book that displays or hides orders as desired.

Harris discussed order precedence rules and suggested the use of conditional liquidity offerings, by way of an electronic limit order book that could automatically adjust orders according to variables such as cash indices, derivative prices, interest rates, and volumes. This procedure would have some clear cost advantages over the use of floor brokers in adjusting limit orders.

His conclusion was that liquidity can be supplied by buy-side institutions and public traders, that they can be encouraged by cost-lowering innovations and service-enhancing innovations, that it will be the innovative Exchanges that capture liquidity and order flow, and that an electronic environment will offer a substantial advantage to the innovator.

He began by describing a system in which there is an order book and the function of the specialist is simply to match orders in the book, including matching market orders with the appropriate limit orders. There are two ways in which the matching might be done. In the discriminatory price auction (DPA) a market order triggers a series of limit orders and the market order is filled at a series of prices, starting with the most attractive and ending with the least attractive necessary to complete the order. This is the practice on the New York Stock Exchange except for block trades, and also characterizes a U.S. treasury auction. In the uniform price auction (UPA) the market order is filled at a single price -- the least attractive price of the limit orders necessary to fill the market order. This is the rule for block trades on the New York Stock Exchange and for Dutch auction share repurchases by corporations.

Rock's presentation dealt with the different consequences of these two auction methods for large and small customers.

We begin by imagining an open book in which there is a high and a low bid and a high and a low offer, in each case for one share of stock. Market orders will arrive at time zero, and at time one the stock will pay off in a liquidating dividend. The limit investors are equally uninformed about the payoff, they are risk-neutral, and their expectation is a payoff of one-half. As market orders arrive, the market investors are either impatient, demanding quick execution, or they are informed investors. The possibilities for the market orders are set out in Table 1.

<table>
<thead>
<tr>
<th>Market Order</th>
<th>Probability</th>
<th>Limit Investors' Expectations of Payoff, given Market Order</th>
</tr>
</thead>
<tbody>
<tr>
<td>BB</td>
<td>2/3</td>
<td>7/8</td>
</tr>
<tr>
<td>B</td>
<td>1/3</td>
<td>5/8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1/2 (prior to any market orders)</td>
</tr>
<tr>
<td>S</td>
<td>1/3</td>
<td>3/8</td>
</tr>
<tr>
<td>SS</td>
<td>2/3</td>
<td>1/8</td>
</tr>
</tbody>
</table>

A single "B" refers to a market order to buy one share; a "BB" refers to a market order to buy two shares. Similarly, "S" and "SS" refer to

35. THE SPECIALIST'S ORDER BOOK
(Spring, 1991)

Kevin Rock, Co-Head, Mergers and Acquisitions, Financial Institutions, Citibank, presented an analysis of the impact of the specialist on transaction costs.
market orders to sell one and two shares respectively. Buy orders will tend to raise the limit investors' expectations of the payoff above 1/2, while sell orders will tend to depress the expectations.

Anticipating the possibility of the market orders set out in Table 1, the limit orders will be as shown in Table 2.

<table>
<thead>
<tr>
<th>TABLE 2</th>
<th>DPA</th>
<th>UPA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limit Bids</td>
<td></td>
<td></td>
</tr>
<tr>
<td>higher</td>
<td>5/24</td>
<td>3/8</td>
</tr>
<tr>
<td>lower</td>
<td>1/8</td>
<td>1/8</td>
</tr>
<tr>
<td>Limit Offers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>higher</td>
<td>7/8</td>
<td>7/8</td>
</tr>
<tr>
<td>lower</td>
<td>19/24</td>
<td>5/8</td>
</tr>
</tbody>
</table>

For the UPA rule, the higher bid of 3/8 reflects the fact that an "S" market order will trigger the bid at the expected payoff, while an "SS" order will trigger the same bid at only 1/8, the expected payoff. In the DPA case, however, while there is a 1/3 probability of an "S" market order triggering the bid, there is also a 2/3 probability of an "SS" market order triggering the same bid but producing an expected payoff of only 1/8. At this point, the market order customer with the small order -- a single "B" or "S" will prefer the UPA method, because it presents a higher bid and a lower offer. The larger market order customer, on the other hand, will prefer the DPA rule, which is the general rule for the New York Stock Exchange.

Now, one might think that the UPA rule should be the exchange rule because it favors the small customer. But Rock pointed out that a large order might be broken into many small orders, so that a large investor could take advantage of the UPA rule. In an effort then to benefit the small investor under the DPA rule, we bring in the specialist. Table 3 presents the specialists' bids and offers. The specialist is in a position to react differently to a "B" market order than to a "BB" market order. The additions and subtractions of 1/16 in Table 3 reflect the specialist's intent to make a profit on trades.

<table>
<thead>
<tr>
<th>TABLE 3</th>
<th>Specialist Bid &amp; Offer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market Order</td>
<td>&quot;Value&quot; Assuming No Inventory</td>
</tr>
<tr>
<td>&quot;Value&quot;</td>
<td>DPA</td>
</tr>
<tr>
<td>BB</td>
<td>7/8</td>
</tr>
<tr>
<td>B</td>
<td>5/8</td>
</tr>
<tr>
<td>S</td>
<td>3/8</td>
</tr>
<tr>
<td>SS</td>
<td>1/8</td>
</tr>
</tbody>
</table>

A comparison of Tables 2 and 3 show that the specialist will preempt the "B" and "S" trades, and will back away from the "BB" and "SS" trades, leaving those to the book. The result is that the small investor is indeed better off when the specialist activity is added to the book of limit orders. But the limit order placers are worse off and the result may be a reduction in the number of limit orders placed. What is going on is that the specialist is able to discriminate on the basis of order size and price, something the limit order placers cannot do.

Rock then replaced Table 3 with Tables showing the specialist bids and offers assuming the specialist starts with an inventory of one share and then an inventory of two shares. The greater the inventory, the lower the specialist bid and offer. Despite apparently free competition in this market, the fact that the specialist is able to set prices from a privileged position leads to both the bid and offer of the specialist being below the "correct" price. As the specialist brings both bid and offer down, the specialist becomes unable to make a market on the buy side. The limit bid for a "S" market order is better than the specialist bid. But the specialist will get the buy orders. The best offer available will be a limit order and the best bid available will be the specialist's bid.

The end result is a transaction cost schedule that shows the cost of a market sell order rising with order size, but also shifting with the magnitude of the specialist's inventory. The greater the specialist's inventory, the higher the transaction cost for a minimum order size but the more slowly the cost rises with order size. What we have found is that participation of the specialist begins by helping the small trader and hurting the large trader. But the heavier the inventory the specialist is carrying, the less the differential effect between small and large traders.
36. VOLATILITY & TRADING MECHANISMS: EVIDENCE FROM THE JAPANESE STOCK MARKET (Spring, 1991)

Haim Mendelson, Professor at the Graduate School of Business, Stanford University distributed a paper by himself and Yakov Amihud, Visiting Professor, Tel Aviv University, entitled "Volatility, Efficiency and Trading: Evidence from the Japanese Stock Market". He began by reviewing some of the important characteristics of market microstructure, and the measures of performance by which we might judge the efficacy of these characteristics. Two major mechanisms are represented by the continuous trading market and the periodic clearing market, or call market. Examples of continuous markets are the New York Stock Exchange which includes specialists, the NASDAQ market made up of dealers, and the stock markets of Toronto, Paris, and Milan based on limit order books. Examples of the clearing transaction or call market are the daily opening of the New York Stock Exchange, and the twice a day opening on the Tokyo Exchange. The performance measures Mendelson identified are first, liquidity (the cost of transacting), second, volatility (the frequency and magnitude of price changes), and third, efficiency (the extent to which prices reflect information about value).

Research on the markets of the New York Stock Exchange and the Milan Stock Exchange had led to some conclusions with respect to the call market versus the continuous market. For the New York Stock Exchange, the variance in rates of return from one opening to the successive opening had proved to be about 120% of the variance from one close to the succeeding close. The high variance would appear to be related either to the use of a call market at the opening, or to the fact that the opening succeeds a lengthy period of non-trading, while the close succeeds a period of trading. The returns from open-to-open also showed much stronger negative autocorrelation than the returns from close-to-close. Research based on trading on the Milan Stock Exchange suggested that the high variance and strong negative autocorrelation associated with the openings was due more to the beginning of the day's trading than to the call market structure.

Trading on the Tokyo Stock Exchange takes place in two daily sessions, one lasting from 9:00 a.m. to 11:00 a.m. and the second lasting from 1:00 p.m. to 3:00 p.m. The opening for both sessions is a clearing transaction; subsequent trading is continuous with no specialist. Mendelson reported performance results based upon the behavior of the 50 most active stocks on the Tokyo Stock Exchange measured over 24-hour periods, using four daily price series. The first series measured returns from first session opening to first session opening. The second measured returns from first session close to first session close. Similarly, the second session opening and closing prices established the third and fourth series. For the first session, the results were very similar to those that had been found for the New York Stock Exchange. The open-to-open variance was approximately 20% larger than the close-to-close variance, and there was strong negative autocorrelation in the open-to-open returns. The second session results, however, showed very little difference between the open-to-open series and the close-to-close series. It appears then that it is the long period without trading before the first session opening that accounts for the high variance and strong negative autocorrelation. Mendelson stressed that there are no information differences that might explain the variance and autocorrelation differences.

The analysis was repeated using residual returns, after controlling for the market index, rather than the actual total returns, with the same results.

Mendelson next reported performance measurements over the four time intervals within each day. For each day there were two trading periods and two non-trading periods. The variances during the two trading periods were four to five times greater than the variances of the non-trading periods. And the variance of the mid-day break was about twice as high as the variance during the overnight period. Mendelson's conclusion was that the returns over the four time intervals include a great deal of noise which dissipates through the trading day. This conclusion was strengthened by performance measures for the five stocks in the sample that are also traded in the U.S., and therefore experience longer trading hours each day.

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Finally, Mendelson reported evidence of intra-day price reversals. Correlations between the returns in each of the four daily time intervals and the returns in the immediately preceding intervals proved to be negative, with the strongest reversal taking place during the morning session and the weakest during the afternoon. The pattern was strong enough and consistent enough to suggest a profitable trading strategy.

Overall then, the research suggests that the clearing transaction mechanism is not inferior to the continuous market mechanism (and perhaps is superior) in terms of volatility and efficiency, when instituted during the trading day concurrently with continuous trading.

37. MAJOR WORLD EQUITY MARKETS: CURRENT STRUCTURE AND PROSPECTS FOR CHANGE (Spring, 1991)

Hans Stoll, Professor of Finance at the Owen Graduate School of Management at Vanderbilt University distributed a paper entitled "Principles of Trading Market Structure" and a paper by himself and Roger Huang entitled "Major World Equity Markets: Current Structure and Prospects for Change".

In describing alternative market structures, Stoll suggested a major distinction between auction markets and dealer markets, commenting that both can be either continuous or call markets. Examples of dealer markets are the NASDAQ stock market, the London Stock Exchange, and bond markets. Auction markets with a limit order book exist on the Exchanges in New York, Toronto, Paris, and Tokyo. Auction markets without limit order books can be found in the futures markets in the United States.

London, Toronto, and Paris have all experienced significant changes in the structure of the marketplace in recent years. The London market since the 1986 "big bang" has moved to an upstairs dealer system, similar to NASDAQ. In Toronto, the CATS system has automated the limit order book for inactive stocks, and a new modified floor system mixes floor trading with an electronic market for actively traded stocks. In Paris the CAC system, copied from the Toronto CATS system, has provided automated trading for all stocks, replacing the old call auction market and moving stock trading upstairs.

Stoll next reviewed a number of characteristics on the basis of which one might judge the usefulness of different market structures. The desirability of immediate trading argues for continuous rather than call markets. But Stoll commented that there is a growing interest in call markets. With respect to processing efficiency, it is hard to choose between dealer and auction markets. An auction market with a limit order book seems somewhat more efficient than a market with many dispersed dealers. Risk bearing is facilitated by the availability of limit orders, multiple dealers in each stock, and multiple stocks for each dealer, and free entry.

Free trading options always present a problem. Any limit order gives the rest of the market a free trading option that will be "in-the-money" if valuable information arrives while the limit order is outstanding. The value of the option will depend upon it not being canceled before it can be hit by a market order, and on the volatility of returns of the underlying stock. Automation can reduce the free trading option by speeding execution.

The effect of informational trading is important. The presence of informed traders complicates the design of trading systems. Those with information do not want to give it away and those without information do not want to lose to informed traders. Stoll commented that the reputation of a trader may become very important in the context of information trading, and it is difficult to build a reputation where markets are fully automated.

Comparing the costs of dealer and auction markets, Stoll commented that London appears to have higher spreads, with its dealer market, than New York and Paris with their auction markets. Commenting on fragmentation, he concluded that it is inevitable. One can deal with fragmentation by regulation, either restricting trading to a single market, as in Paris, or requiring that a number of markets arrange links to each other. His own preference was to leave it to brokers to provide the linkages, seeking the best price for their customers among the available markets.
The London market seems to be moving in this direction. In concluding, he suggested that dealer and auction markets are becoming more alike and auction markets are tending to move towards negotiated upstairs markets.

38. EXPERIMENTAL METHODS AND MARKET MICROSTRUCTURE
(Spring, 1991)

Vernon L. Smith, Regents' Professor of Economics at the University of Arizona, distributed a paper authored by Joseph Campbell, Shawn LaMaster, Mark Van Boening and himself entitled "Off-Floor Trading, Disintegration, and the Bid-Ask Spread in Experimental Markets".

Smith began by describing laboratory experiments in economics. He discussed the elements of a laboratory experiment, the purposes that can be served by such experiments, and went on to present a number of examples. A good many of the experiments had involved price discovery under different market rules. Common to the experiments was the use of a number of participants, serving as suppliers and demanders of a commodity. Each supplier was provided with a set of reservation prices, that is minimum prices at which the supplier would be willing to furnish the commodity. And each demander was furnished with a set of reservation prices constituting the maximum prices that individual would be willing to pay. In the absence of any further information, the demand side participants would proceed to make bids while the supply side participants would proceed to make offers. In this double auction, the simplest market structure required only that each bid be at a price lower than the preceding bid and that each offer be at a price higher than the preceding offer. The bids and offers would then converge over time. The experimenter would have complete knowledge of all of the reservation prices, and therefore knowledge of the price at which the demand and supply schedules intersected -- that is the market clearing price. A measure of the success of the rules under which the participants played the game was whether the bids and offers converged on the true market clearing price, and how quickly they did so. The double auction structure generally led to conversion at the correct price. The more experienced the participants, the more rapidly the convergence took place. Smith discussed the results of variations on the double auction structure. It turned out that a double dutch auction appeared to be the most effective in arriving at a correct market clearing price. In the double dutch auction, the bid price is steadily lowered while the offer price is steadily raised, and bidders and offerors are required to indicate when a satisfactory price has been reached. The process goes on until the market has cleared -- that is until all of the supply has been committed and spoken for. At this point the clearing price is determined and applies to all transactions. (This is a "uniform price auction" as distinguished from a "discriminatory price auction").

Smith also described some experiments in which the participants had been carefully instructed as to the intrinsic value of a commodity over time, had been allocated cash and shares of the commodity, and had been set free to offer their shares and bid for shares with one another. The trading patterns set up by the participants had shown extraordinary deviations from the predetermined intrinsic value path. It seemed clear that the trading pattern itself generated expectations with respect to price behavior that were wildly different from the intrinsic values known to all of the participants. As the experiment was re-run, and participants gained experience, the "bubbles" tended to decrease in size although they did not disappear. Even participants who were well aware of the apparently irrational behavior of inexperienced competitors were unable to bring about trading that eliminated the bubbles, except through the ability to engage in very substantial short selling.

The particular experiment described in the paper concerned the motivation and the effect of off-floor trading. The argument against permitting off-floor trading is that it diverts orders from the central market place and therefore reduces the quality of trading in that central marketplace. The argument in favor of permitting off-floor trading is essentially that it provides healthy competition to the central marketplace and is therefore likely to add to the quality of that marketplace.

The experimenting began with five "baseline" experiments. In three of these the double auction structure was used, and the supply and demand equilibrium was unchanged
over the 15 periods of trading. That is, the true clearing price remained unchanged over the 15 periods. For these baseline experiments no off-floor trading opportunities were provided — all trading was confined to the marketplace in which the double auction structure prevailed. Observations were made on the mean transaction prices, their deviation from the correct clearing prices, and the variances and spreads in these deviations. In two of the five baseline experiments, the supply and demand equilibrium was shifted randomly in each of the 15 periods of trading. That is, the true clearing price was changed randomly. As might have been expected, the deviations of the transactions prices from the correct prices were larger than when the correct price had been held constant, and the variances and spreads were larger.

The next experiment brought experienced participants into the experiment, and off-floor trading was permitted. Off-floor trades, however, were restricted to trades of a single unit of the commodity.

Next, a series of three experiments made use of randomly changing supply and demand equilibrium, participants with increasing experience, and the opportunity to make block or multiple unit off-floor transactions. The introduction of block trading increased the off-floor volume. Increased experience of the participants also increased the off-floor volume but reduced the quality of both the marketplace and off-floor trading, in terms of spreads and variance and error of price deviations. Close to 80% of the off-floor block trades were inside the bid-ask spread at the time of acceptance. This suggested that the primary motivation for these trades was to split the gains in the standing bid-ask spread. The increased use of off-floor trading that came with experience suggests that traders become more skilled in making use of both the central marketplace and off-floor trades. Finally, as off-floor trading increased, there was a steady decline in market efficiency as measured by price deviations, variance and spreads. The decline in quality, however, was not significant, and Smith’s conclusion was that the experimental results provided only weak support for the proposition that the central market quality will be degraded by off-floor trading. The paper’s final conclusion was that "off-floor trading may be less of a problem for the social objective of maximizing the gains from Exchange, than it is for the Exchange firm that loses volume to bilateral traders who free ride on the public price information generated by the Exchange".

39. MARKET STRUCTURE
(Spring, 1991)

Morton Rothstein, Professor in History, University of California at Davis, distributed a paper entitled "The Telegraph's Impact on Market Structure".

The subject of his talk, and of his paper, was the emergence of markets of various kinds in the western world since the early 1800s. Three major motivations appeared to underly almost all of the development: reducing costs, improving productivity, and reducing risk or uncertainty. The most dramatic developments probably came about in the United States in the 1840s and the two or three succeeding decades. The introduction of the McCormick Reaper had a dramatic impact on wheat production. With the increase in wheat production came the development of massive grain elevators and centralized warehousing of grain. The repeal of the British Corn Laws in 1846 opened up world markets for grain and other commodities. And of course the telegraph, which first connected Baltimore with Washington in 1844, had an enormous effect on the availability of information, particularly the availability in one market of information with respect to prices in other markets.

The Chicago Board of Trade is a particularly interesting marketplace since it felt the impact of most of these important changes. The trading of grain in the cash market, through negotiable warehouse certificates, was the natural result of the developments already described. Next came forward sales, apparently generally accepted as an appropriate way in which to pass on risk. Trading in futures began in the 1850s outside the Board of Trade. And it was not until 1865 that futures contracts were accepted by the Board of Trade as a legitimate trading vehicle. Hedging had in fact been fairly well established by 1860, but hedging was seen by farmers as a serious threat to their welfare. Agricultural prices declined from about 1873 to about 1897, reflecting the overexpansion of world agriculture. The decline, however, was
popularly attributed to the use of futures and hedging transactions. And legislation was proposed to tax these transactions.

Speaking specifically of the telegraph and the importance of rapid information transfer, Rothstein discussed the difficulties of merchants struggling to gain news of important economic developments that might affect prices, and successive dependence upon fast ships, couriers, the postal service, and finally the telegraph.

What he emphasized was the magnitude of the changes that came about within just a few decades of the last century, and the implications of the changes for anyone engaged in buying and selling. An understanding of how much had happened so quickly is essential, he suggested, to anticipating the future.

40. A BAYESIAN MODEL OF INTRADAY SPECIALIST PRICING
(Spring, 1991)

Ananth Madhavan, Assistant Professor of Finance, Wharton School, The University of Pennsylvania distributed a paper by himself and Seymour Smidt entitled “A Bayesian Model of Intraday Specialist Pricing”. The research was supported by the Q Group.

He described the purpose of the paper as exploring what it is that drives price changes during the trading day. Two likely sources of price change are first public information shocks, and second the trading process itself. Three elements of the trading process influence price changes. Transaction costs account for the “bid-ask bounce” in prices. Inventory control may lead a market maker to adjust the level of bid and ask prices in the course of the trading day. And the presence of asymmetric information will lead market makers facing large orders to react on the assumption that those orders represent informed trading.

The model proposed by the authors assumes a dealer market with sequential bilateral trading (although transactions may also take place without participation by the dealer), in which the market maker posts bid and ask prices before each trade; the quotes can be revised following each trade; and public information arrives between trades. In the model, price is linearly related to the market maker’s current share inventory:

$$p_t = \mu_t - \gamma (I_t - I_d) + \Psi D_t$$

In this equation, \( \mu_t \) is the expectation of \( \hat{v}_t \) (value) conditional upon the market maker’s information at time \( t \); \( I_d \) is the long-run desired inventory level (assumed constant); \( I_t \) is the market maker’s current share inventory; \( D_t \) is an indicator variable where \( D_t = +1 \) for a buy order and -1 for a sell order; and \( \Psi \geq 0 \) and \( \gamma \geq 0 \) are constants. At this point the model cannot be estimated because \( m_t \) is unknown. We therefore need a proxy for \( \mu_t \), which the authors set out as follows:

$$\mu_t = \pi y_t + (1 - \pi) \hat{w}(q_t)$$

where \( \pi \) is the weight placed by the market maker on prior beliefs with respect to the correct price, and of course \( 1 - \pi \) is the weight placed on what can be learned from the order flow with respect to the correct price. \( y_t \) is the prior mean value belief in the correct price, \( q_t \) is the order quantity in period \( t \), and \( \hat{w} \) represents a demand function.

Now we must determine \( y_t \) and \( \hat{w} \). For \( y_t \) the authors propose yet another proxy, using the lagged price, adjusted for inventory and tick effects. For \( \hat{w} \), a demand function is assumed, and the model is now:

$$\Delta p_t = \kappa + \lambda q_t - \left( \frac{\gamma}{\pi} \right) I_t + \gamma I_{t-1} + \left( \frac{\Psi}{\pi} \right) D_t - \psi D_{t-1} + n_t$$

The model represents a price change explained by the order size, the inventory change, and the tick effect.

The data used to estimate the model consisted of the inventory data and trading records for a New York Stock Exchange specialist covering 16 stocks and almost 75,000 transactions, plus ISSM data for all transactions in the 16 stocks over the same time period. Altogether, the estimation made use of 129,000 trading records for 199 trading days, including October, 1987.
The authors obtained a rather good fit. For eight stocks, the $R^2$ was greater than 0.50. This meant that public information effects apparently accounted for something like half of the price variability, and the trading process accounted for the other half. It turned out that information effects were very significant (this is the coefficient $l$). Inventory effects, on the other hand, were quite weak. The average value for $p$ was .76, and it was between 0 and 1 for all 16 stocks. The indication is that the specialist believed in asymmetrical information, and attached some importance to the pricing implications of the order flow. The coefficient $l$ was positive for all 16 stocks. Its value was 5.19 in October 1987, compared to 1.65 for the year 1987. This result suggested strong evidence of information effects, although it appeared that the estimated size of $l$ was low. Madhavan offered some suggestions as to why this might be so.

It turned out that there was an inverse relationship between the degree of specialist participation and the value of $p$. A high value for $p$ would imply less asymmetric information and this in turn would perhaps lead to less participation by the specialist because it would be easier to arrange trades that did not involve the specialist.

The overall conclusions drawn from the model estimation were:

Strong evidence of asymmetric information;

Trading activity explains a significant portion of price volatility;

Information asymmetry and spreads were abnormally high during the month of the market crash, perhaps because noise traders withdrew from the market at this time;

The information parameter helps to explain specialist activity;

The price impact was not linear in the size of the quantity traded.

41. TRADING IN EQUILIBRIUM  
(Spring, 1991)

Fischer Black, Partner in Goldman Sachs Asset Management, distributed a paper entitled "Trading in Equilibrium". Black began by explaining that his paper is the latest version of an attempt to design an equilibrium marketplace where specialists and dealers would not be needed. He saw two attractive results from a successful design: elimination of any monopoly profits, and more rapid adjustment of stock prices to information.

One of the difficulties with the present New York Stock Exchange system, discussed at other sessions of this Seminar, has to do with stale limit orders. Black's thesis was that a limit order is probably stale by the time it is entered in the book, because even during that short time interval the price of the stock will have changed. Furthermore, once entered in the book normal limit orders do not change with market conditions. Index arbitrage, to be discussed at a later session, exploits these stale limit orders.

A second deficiency of limit orders is that they are allowed only at certain prices — in intervals of 1/8. Priority of limit orders at a particular price depends upon time of arrival. But a queue based on time of arrival is a poor allocation device. It would be much better if priority could be based entirely on price.

Still a third difficulty with limit orders is that they are seen to grant a free option. Black identified at least three interpretations of this free option argument. One is that the stock can trade through the limit price, triggering a limit order at the price of that order, but the transaction that triggered the order may go on to trigger other orders at better prices. A second point, made by Larry Harris, has to do with the ability of a second trader to place a small limit order at a slightly better price than a large limit order and gain downside protection from that larger order. A third objection to the use of limit orders comes from the fact that a specialist can "stop" a market order using a limit order as insurance.

Black's answer to these problems with the present limit order is "unpriced" limit orders. An unpriced limit order would participate in all market orders on the other side of the market. The limit price would be created by the arrival of market orders and would be a function of the market order size.

Turning to market orders, Black suggested that one would expect that a person trading on
information would trade until the stock price had been moved to fully reflect the value of the information. But if a single trade brought about this full price adjustment, then the informed person would trade at the true value of the stock, and there would be no point to the trade. Such a trader therefore has an incentive to break the initial trade into small pieces, each one having some effect on price but each enabling the trader to achieve a portion of the profit inherent in the information. Breaking the trade into small pieces has the effect of picking off limit orders, but runs the risk that before the series of small trades can be executed the price will have fully adjusted. Black’s answer is to encourage the market order to be presented intact at its full size and immediately to impact the price. The trader would be rewarded by a credit of half the price change caused by the order. This is about what the trader might expect under present market structures if the order is broken into small pieces. In effect, the informed trader would be assured of a profit of half the price move. To finance this payment, the Exchange would impose fees on those who present limit orders. The fees would be a function of the degree of immediacy demanded by those who placed the limit orders. (As one participant pointed out, this suggestion is almost the exact opposite of proposals in other sessions that it is appropriate to induce more traders to bring limit orders as a means of providing liquidity for market orders.)

Black proceeded to deal with a number of the phenomena we observe or think we observe in the present market structures, and to explain why these should disappear in a true equilibrium market. There is no need to distinguish between liquidity traders and informed traders. Market depth should be constant across time. Inventory effects should vanish. And a variety of devices by which some traders are seen to take advantage of other traders should disappear.

In summarizing the paper, Holden explained that it does four things. First, it explains how arbitrage trading can exist in a financial market equilibrium. Second, it explains the role of arbitrageurs as cross-sectional market makers. The familiar market maker in a stock market is a time-series market maker, maintaining inventories and coping with imbalances of buy and sell orders through time. The arbitrageur takes care of imbalances between two markets at the same point in time. Third, the paper determines the effects of arbitrage trading in terms of market volatility, the hedging effectiveness of derivative securities (which has to do with correlations between the market for stocks and the market for derivative securities), and liquidity of the markets. Finally, the paper addresses the importance of segmentation of the market for stocks from the market for derivative securities.

The model is a single period model based on two markets: the market in stocks and the market in synthetics or derivatives. Each market has its own liquidity traders and its own market makers. The price in the stock market is $S_t$ and the price in the derivative market is $Z_t$. Investors in the stock and derivative markets receive a liquidity shock of $L$ and $I$ shares, respectively, and trade with market makers. The two assets are expected to pay liquidating dividends at timepoint 2 of $D_2$. The result is that $D_2 = S_2 = Z_2$. A negative exponential utility function is assumed for the liquidity traders and the market makers in each of the two markets. Arbitrageurs are assumed to be identical, with no specified utility function except that less risk is better than more risk. The arbitrageurs can take arbitrage positions or invest in a riskless asset.

The price difference as a consequence of both liquidity trading and arbitrage trading is an observable

$$\epsilon = Z_1 - S_1.$$ 

The unobservable price difference due to liquidity trading is

$$\dot{\epsilon} = b \left( \frac{L}{1+NS} - \frac{I}{1+NZ} \right)$$

42. A THEORY OF ARBITRAGE TRADING IN FINANCIAL MARKET EQUILIBRIUM (Spring, 1991)

Craig W. Holden, of the School of Business, Indiana University, distributed a paper entitled "A Theory of Arbitrage Trading in Financial Market Equilibrium".
where \( N^S \) is the number of market makers in stocks and \( N^Z \) is the number of market makers in synthetics. Next,

\[
\epsilon = \hat{\epsilon} - c \theta^A
\]

where \( \theta^A \) is the total quantity of arbitrage positions.

When the two markets are segmented:

\[
\epsilon = \frac{\hat{\epsilon}}{1 + N^A}, \quad \theta^A = \frac{\hat{\epsilon}}{(1 + N^A)c}, \quad \pi^A = \frac{(\hat{\epsilon})^2}{(1 + N^A)^2 c}.
\]

The first equation tells us that the price difference is reduced in proportion to \( 1 + \) the number of arbitrageurs. The second equation tells us the equilibrium arbitrage quantity of each arbitrageur. And the third equation gives us the equilibrium profit of each arbitrageur. It follows that as the differential liquidity shock \( \left( \frac{1}{1 + N^S} - \frac{1}{1 + N^Z} \right) \) increases, \( \hat{\epsilon} \) increases. At the same time \( \epsilon \) increases, the arbitrage positions increase, and the equilibrium profit increases. As the number of arbitrageurs increases, the price difference decreases, the equilibrium arbitrage quantity decreases, and the equilibrium arbitrage profit decreases.

Next, we assume that individuals can make alternative investments costing \( C^A \), \( C^S \), or \( C^Z \), to become an arbitrageur, a market maker in stocks, or a market maker in synthetics respectively. First, each individual must decide whether or not to become a market maker or an arbitrageur. Next the liquidity shocks are realized, and finally everyone trades. The assumption is now that the distributions of \( D_2, L, \) and I are multivariate normal with zero means, except that \( EB(D_2) \) is greater than zero. It now follows that

\[
N^S = N^Z = f(C^A, C^S) \quad \text{and} \quad N^A = g(C^A, C^S)
\]

\[
\frac{\partial N^S}{\partial C^A} > 0, \quad \frac{\partial N^A}{\partial C^A} < 0, \quad \frac{\partial N^S}{\partial C^S} < 0, \quad \frac{\partial N^A}{\partial C^S} > 0
\]

That is, the number of participants depends upon both the cost of becoming an arbitrageur and the cost of becoming a market maker in stocks. As the cost of becoming an arbitrageur declines, the number of arbitrageurs rises, the number of market makers in stocks declines, the price difference declines, the equilibrium arbitrage quantity of each arbitrageur declines, and the equilibrium profits decline. As the cost of becoming a stock market maker declines, the number of arbitrageurs declines, the number of stock market makers rises, the price difference declines, the equilibrium quantity of each arbitrageur declines, and the arbitrage profit declines.

Holden next discussed the effect of arbitrage trading on market volatility, on the hedging effectiveness of synthetic securities (as measured by the intermarket price correlation) and on market liquidity. A partial equilibrium analysis led to the conclusions that an exogenous increase in the number of arbitrageurs, while holding the number of market makers fixed, reduced the variance in prices on both the stock and derivative markets, increased the correlation between the prices in the two markets, and increased liquidity in both markets. A full equilibrium analysis, where the entry of individuals to become arbitrageurs and market makers is endogenous, was conducted by comparing two economies: one in which arbitrage is banned and the other in which arbitrage is permitted. Here, it turns out that the variances of both stock prices and derivative prices is the same in both economies. The correlation between stock prices and derivative prices is increased as arbitrage activity is permitted. And liquidity in both the stock and derivative markets is increased as arbitrage is permitted. The absence of change in variance inspired some questions to which Holden responded that the precise offsetting of an increase in the number of arbitrageurs and a decrease in the number of market makers in the stock market resulted from the particular utility functions chosen for the model.

43. NEW TRADING PRACTICES AND SHORT-RUN MARKET EFFICIENCY
(Spring, 1991)

Kenneth A. Froot, Associate Professor, Sloan School of Management at MIT, distributed a paper by himself and André F.
Perold entitled "New Trading Practices and Short-Run Market Efficiency". The research was supported by the Q Group.

Froot described the research he had undertaken as first documenting a large decrease in autocorrelation and an increase in the variance of recent short-run returns on several broad stock market indexes. Next, the short-run index autocorrelation was decomposed into three components: the bid-ask bounce, non-trading effects, and non-contemporaneous cross-stock correlations in specialists' quotes. Finally, the research attempted to establish the causes of these findings.

A graphical display showed clearly that the average daily first-order autocorrelation in 15-minute returns on the S&P 500 Index has declined dramatically from 1983 through 1989. Beginning at approximately .38, the autocorrelation dropped to zero in about 1987, and has been negative ever since. At the same time, although we have evidence from other studies that the volatility of the S&P 500 Index has declined in recent years, another graph showed that the ratio of annualized 15-minute to weekly volatility has risen quite substantially. Froot offered four possible explanations for these observed phenomena. More rapid incorporation of new information in stock prices might explain the drop in autocorrelation. (Perfect incorporation of new information might lead to a drop in the serial correlation of the index with no change in the autocorrelations for the individual stocks.) Second, prices might be showing more "overreaction" than in the past, which would lead to a decline in the serial correlation of individual stocks. Third, the bid-ask bounce may have increased, which would lead to a decline in the serial correlation of last-trade index. (The reported index is based on last-trade prices.) But last-trade index serial correlation might remain unchanged. Finally, trading staleness may have decreased over the years. In this case, the autocorrelation in the last-trade index should fall, but the current-quote index serial correlation might remain unchanged.

Froot was able to show from changes in the pattern of first order and higher order serial correlation that the decline toward zero in first order autocorrelations seems to occur in higher order autocorrelations as well, and these results are inconsistent with the view that new trading practices have led to short-term overreactions.

Next he reported the results of decomposing the serial correlation. This was done working with three indexes -- the last-trade index, the last-trade mid-quote index, and the current mid-quote index. The difference between the last-trade mid-quote index and the current mid-quote index is a measure of staleness. And the difference between the last-trade index and the last trade mid-quote index is a measure of the bid-ask bounce. It was possible then to decompose the index returns to identify staleness and bid-ask bounce. It was also possible to assess how much of the change in autocovariance was attributable to own-stock effects and how much to cross-stock effects. It appears that bid-ask bounce explains very little of the decline in total autocorrelation.

Further decomposition revealed something about non-trading effects. It turns out that the autocorrelation is higher for the current mid-quote index than for the last-trade mid-quote index, which is contrary to what one would expect. But since non-trading would explain lower autocorrelation, the result could be the result of a reduction in non-trading. The result is that we cannot find an explanation for the reduction in autocorrelation through non-trading effects.

A graph showing autocorrelation of daily returns on three stock indexes -- the Dow Jones Industrials, the S&P 500, and the NYSE Value Weighted Index -- from 1926 through 1990 suggested that non-trading appears not to have any significance. All three indices have behaved very similarly over that full time period, and especially over the last 25 years. Froot's conclusion was that trading practices account for the changes in these index autocorrelations.

Froot's final conclusion was that the research had rejected the hypothesis that prices now "overreact" more than in the past, that the bid-ask bounce has increased, and that trading staleness has decreased, but is consistent with the hypothesis that information is processed more rapidly now than it was some years ago.
FOREIGN EXCHANGE

44. INTRODUCTION TO EXCHANGE RATES (Spring, 1994)

Jack L. Treynor, President, Treynor Capital Management, introduced both Rudi Dornbusch, Professor, Department of Economics, Massachusetts Institute of Technology, and the subject of exchange rates. He referred back to the presentation made at the Q Group Seminar in the Fall of 1993 by Ken Froot, who had discussed the example of investment in a home in London, England by a resident of the United States, as investment in an asset the value of which is determined entirely by the local London market, and is independent of economies outside London. Treynor contrasted the market price for this sort of local asset with the price of tradeable assets. Tradeable assets are those that are bought and sold in many countries at prices that are not independent of one another.

For tradeable products, the value of the U.S. dollar in foreign currencies will affect U.S. output, employment, and corporate profits. Most textbooks on economics, Treynor noted, treat the U.S. economy as essentially closed, hence ignoring the economics of tradeable products. He suggested a number of reasons for this limited view of the U.S. economy. One is that many currently tradeable products were formerly strictly home goods. Automobiles are a good example. In addition, before 1971 the era of fixed exchange rates effectively masked the economic effects of changes in those rates. Today, there is an increasing emphasis on global investing and a much greater sensitivity to the economics of tradeable products. At the same time, central banks are currently practicing currency policy, so that to some extent foreign exchange rates are becoming a policy variable. In Treynor's view, however, central banks would prefer that their actions not be regarded as based on policy, but simply as reactions to the marketplace. This may in part be because the real purpose of devaluation is to lower the value of wages, and this is not a subject anyone wants to discuss.

Finally, Treynor presented Rudi Dornbusch as the co-author of an economics textbook that does recognize open economies and the economics of tradeable goods and presented him as one of the outstanding scholars on the subject of foreign exchange.

Dornbusch began with a comment on the importance of currency exchange rates and their increasingly pervasive effects. Recent large losses of hedge funds resulted from mistaken expectations with respect to movements in the yen, behavior of the Bundesbank and jumps in other currencies. Even the backing up of long bond yields in the U.S. resulted from U.S. exchange rate policy toward Japan.

He organized his presentation around three topics. The first asks whether there is a simple model for exchange rates, one that is basically correct. His second topic was to ask what we know about equilibrium exchange rates and the effects of exchange rate changes. His third topic asked where is research going and what is coming out of it. Finally, his fourth topic was to discuss some specific currencies.

On the first topic, he said that the purchasing power parity model is the international version of the quantity theory of money. And it is just as wrong as the quantity theory of money. Both theories work half the time and don't work half the time. If a country's price level in dollars is rising very rapidly, that rise cannot last forever, so the exchange rate will adapt and the price level in dollars will ultimately align itself more or less with price levels of other countries. The more or less is the half truth, because deviations can be large and very persistent. He displayed a graph showing for 18 countries over the period 1973 through 1993 the inflation differential from inflation in Germany and the appreciation against the local currency. The graph generally supported purchasing power parity. It showed that there was roughly a linear relation between the inflation differential and the Deutsch mark appreciation. Dornbusch commented that this is the usual picture that is presented to support purchasing power parity. He noted that it is very helpful to have in the upper right-hand corner of the graph a country (in this case Portugal) that has shown extremely high relative inflation and an extremely large devaluation. This is the extreme case in which purchasing power parity tends to hold, and it is important in completing the picture that supports purchasing power parity. Hidden in the graph, however, are non-trivial deviations from purchasing power parity that over a 20-year period cumulate to offer significant deviations from the model.
Without purchasing power parity, we have to explain why the real exchange rate is not a constant. The two determinants of real exchange rate are economic activity differentials and supply and demand. It is economic activity that is the most important guide to the long-run behavior of real exchange rates. If a country has rapid growth in manufacturing, with rising productivity that lowers unit labor costs, this rising activity raises demand for labor, raises wages, and raises prices in the "home goods" sector. In a country that has only moderate growth in productivity, prices in the home goods sector are not rising. Comparing Japan, with very rapid productivity growth, and the United States, with only moderate growth, one would predict that Japan will have more inflation than the United States. With a fixed exchange rate, Japan would simply have more inflation. With a flexible exchange rate their price level in dollars would still be rising, but that could happen as the result of domestic inflation or as the result of yen appreciation. Dornbusch demonstrated with a chart that the price level in Japan compared to the price level in the United States, in U.S. dollars, has risen some 300 percent over the last 100 years. The same aggregate comparison between two countries can be made by matching the countries by industry.

Productivity growth differentials determine real prices over time. Irving Kravis and his associates at the University of Pennsylvania have built a world system of national accounts from which Dornbusch presented some comparative price levels. For low income countries, characterized by a GDP index of 41 (relative to a U.S. index of 100), prices of home goods, measured in U.S. dollars, were 25 percent of the prices of those same goods in the United States. While for high income countries, characterized by a GDP index of 108, the price index for home goods was 97. The table also showed significant differences in the prices of tradable goods. For the low income countries the index was only 60, while in the high income countries it was 118. One might wonder why the prices of tradables, measured in U.S. dollars, should vary so much. In a world with perfect competition, one might expect that prices of tradables would differ only by transportation costs. The answer lies in a number of factors. Industrial organization, meaning the segmentation of markets by firms to the extent that they can restrict transshipments, as well as tariffs and quotas can explain large differentials.

Detailed price comparisons done on a large cross-section of countries over 40 years provides support for this productivity-based view of real prices that in the end dominates trends in exchange rates. These trends have an important bearing on the equilibrium real exchange rate.

Turning to this second topic, Dornbusch pointed out the occasional major jumps in the equilibrium real exchange rate. For sterling, for example, a major real depreciation against the U.S. dollar took place at the end of World War II. Britain had actually been declining for 80 years, in comparison with the United States, but the change was not ratified in the exchange market until the mid-1940s. Dornbusch's comment was "the exchange market doesn't know exactly where to put a break in a time series. It is reluctant to reflect the cumulative effect of economic activity differentials, and the adjustment comes all of a sudden." Fixed exchange rates tend to accentuate this effect.

Dornbusch raised the question whether there is such a thing as an equilibrium real exchange rate from day to day. Models of the exchange rate began with a monetarist view, and looked at exchange rate determination essentially in terms of the nominal money supplies of two countries. These models did not work. Later models brought in a number of macroeconomic variables, but with little success. So researchers moved to time series models and discovered that random walk models beat structural models. This was very disillusioning for those who believed in the systematic behavior of exchange rates. Structural models have made some comeback to defeat random walk models, but only when they use a lot of news variables. That is, news defined as realized values on variables relative to the predictions that were made for those variables one or two months before. Even at that, these models do not do very well.

There are models that attempt to determine the real exchange rate for current account equilibrium. These models show that sterling is always undervalued, that the U.S. dollar is always undervalued, and that the yen is always overvalued. As a result, the models don't seem very useful. In summary, asking
what is the equilibrium exchange rate is a little like asking what is the equilibrium value of the stock market.

From the frustration of attempting to find equilibrium exchange rates, Dornbusch turned to safer ground, to explore the effects of real exchange rates as they are being predicted from macroeconomic models of the world economy. He presented a table showing simulations of the impacts of different monetary and fiscal policies in the U.S. and Japan. What was interesting about the simulations was how small the spillover effects were in Japan and Germany from changes in U.S. monetary and fiscal policy. Similarly, a Japanese fiscal expansion would have very little effect on GDP in the U.S. And the effect on the exchange rate would also be very small.

Dornbusch then raised the question how much rationality is there in the foreign exchange market. One might think that the forward exchange premium predicts actual depreciation of a currency. However, forward premiums and realized depreciation rates are basically uncorrelated. If a foreign exchange market is rational, then it is rational in a way we cannot really understand. A study done in the Japanese foreign exchange market based on surveys of exchange rate expectations of 400 participants -- exporters, importers, financial people -- shows that expectations always extrapolate the recent trend for short time horizons and always predict a reversal for longer horizons. These expectations consistently reject rationality at high levels of confidence. So these people are systematically wrong. A comparison to stock market expectations may be apt.

One aspect then of ongoing research is an attempt to establish rationality and to better explain what people are thinking in the exchange market. Another important research topic is how economies adapt to exchange rate regimes. Interestingly, while there is general agreement that the pattern of real exchange rates depends on what regime we are in -- fixed or floating rates -- no one can find a difference in the volatility of macroeconomic aggregates across exchange rate regimes.

Tuning to some examples, Dornbusch commented on the Canadian dollar, which has recently depreciated significantly against the U.S. dollar. His explanation is a fear of what is going on in Quebec. The Bank of Canada has slowed the decline with high interest rates at the cost of a recession and high unemployment. Central bankers share a fear that without their intervention there would be no exchange rate equilibrium. If the concern about Quebec increases, we can expect to see simultaneously higher interest rates in Canada and a lower Canadian dollar, but never enough of either to avoid the conflict between interest rates to encourage support for the Canadian dollar and an exchange rate that, if low enough, would solve the problem.

Turning to the Mexican peso, Dornbusch presented a picture of relative price levels, in U.S. dollars, for Mexico and the U.S. from 1970 through 1993. The pattern supports the view that peso devaluations follow elections in Mexico. The devaluations have been successful in bringing down inflation, but not enough to prevent the real exchange rate from appreciating. Today Mexico has zero growth, a current account deficit of 6.5 percent of GNP, interest rates that are rising to defend the exchange rate, and increasing political uncertainties. A reasonable expectation is that there will be a substantial devaluation sometime in the next two months.

In summary, Dornbusch said that the correct view of an exchange rate is that it is an asset market price, that movements in real exchange rates over the long term are well explained by productivity differentials, although one or two year patterns are extremely hard to explain in any systematic fashion. Exchange rates can become grossly misaligned, either from expectations that feed off the wrong story, or from central bank policies. When they become grossly misaligned, there will be a correction, but that correction may take several years. The important research directions are in trying to understand better what is the rationality in the foreign exchange market, and what are the real economic consequences of an exchange rate regime.

45. A PRACTITIONER’S GUIDE TO CURRENCY HEDGING (Fall, 1993)

Hedging." He organized his presentation around four major topics:

(1) The pricing of currency forward contracts
(2) The forward rate as a predictor of the future spot rate
(3) The minimum risk currency hedging policy
(4) The optimal currency hedging policy

He explained the pricing of currency forward contracts on the basis of the covered interest rate parity theorem. To explain the forward rate as a predictor of the future spot rate, he discussed the uncovered interest rate parity theorem, which states that the forward rate is an unbiased estimate of the future spot rate. So long as the current forward rate equals the mean value of the distribution of future spot rates, if we do not hedge the currency risk, we may gain or lose from a difference between the forward rate and the future spot rate, but the probabilities of gain or loss cancel. On the other hand, if it is the current spot rate that is the unbiased predictor of the future spot rate, then the likelihood of gain from an incorrect forecast is not the same as the likelihood of loss. The value of hedging then depends upon whether the forward rate is at a discount or a premium from the current spot rate.

It turns out that over the period July 1973 through December 1992 the forward rate for pounds, marks, French francs and yen has systematically overestimated changes in the spot rate. These results then do not support uncovered interest rate parity. Furthermore, over this period we would have suffered a loss if we had sold a forward contract at a discount from the current spot price but gained if we had sold at a premium.

Turning to the third topic, the minimum risk currency hedging policy, Kritzman took the derivative of the total risk with respect to the weighting of a currency forward contract, set it equal to zero to determine the weighting for minimum risk, and arrived at the conclusion that the weighting equals the negative of the portfolio beta with respect to the currency forward contract. That is, if we know the standard deviation of the underlying portfolio, the standard deviation for the currency forward contract, and the correlation of the currency forward contract with the underlying portfolio, then we can deduce the correct fraction of the portfolio to hedge with the currency forward contract in order to minimize currency risk. Kritzman extended the example to deal with a portfolio of multiple foreign assets, and was able to draw the following generalizations:

(1) If the correlation between the domestic assets and the currency forward contract is positive, the minimum risk hedge ratio decreases as foreign asset exposure increases.

(2) If the correlation between the domestic assets and the currency forward contract is negative, the minimum risk hedge ratio increases as foreign asset exposure increases.

(3) If the domestic assets and the currency forward contract are uncorrelated, the minimum risk hedge ratio is invariant to foreign asset exposure.

It turns out that over the period July 1973 through December 1992 there was a positive correlation between U.S. stocks and bonds and forward contracts in marks, French francs, pounds and yen. This means that minimizing risk even for a purely domestic portfolio involved forward currency contracts. Kritzman pointed out that in effect, a short position in a currency forward contract is equivalent in this case to holding a negative beta asset.

Turning to his fourth topic, optimal currency hedging policy, Kritzman set up the utility function as expected return – risk aversion x risk. It becomes necessary to determine the investor’s risk aversion, to identify constraints in the form of asset weights of the underlying portfolio and exposure limits to currency forward contracts, and to estimate the currency forward contract return and covariance, in order to determine the exposure to currency forward contracts that maximizes expected utility. He explained a method for determining risk aversion for an investor from data on the investor’s portfolio. For a two-asset portfolio, the expected utility can be expressed in terms of the weights, expected returns, and variances of the two assets, as well as the risk aversion and the correlation between the two assets. From the expression for expected utility, one can derive the marginal utility of exposure to each of the assets, and at the optimum these two marginal utilities can be set equal. From this equality one can calculate the risk aversion. With a little more
calculus and algebra one can arrive at the optimal hedge ratio.

Kritzman described the results of alternative currency hedging policies for a portfolio consisting of 35 percent S&P 500, 30 percent U.S. treasury bonds, 5 percent French equities, 5 percent German equities, 15 percent Japanese equities and 10 percent U.K. equities. Simulations were carried out from July 1974 through December 1992. Four alternative policies were no hedge, a full hedge, optimal hedging on the assumption that the forward rate is an unbiased estimate of the future spot rate, and optimal hedging on the assumption that the current spot rate is an unbiased estimate of the future spot rate. It turned out for this period of time that the full hedge produced the worst results, and the fourth strategy produced the best.

Finally, Kritzman summarized his presentation as follows:

Currency forward contracts are priced so that investors cannot earn riskless profits from interest rate differentials. This relation is called covered interest rate parity.

The forward rate historically has overestimated changes in the spot rate. This result violates the notion of uncovered interest rate parity, which holds that the forward rate is an unbiased estimate of the future spot rate.

The minimum risk exposure to a currency forward contract, expressed as a fraction of the portfolio's value, equals minus one times the portfolio's beta with respect to the currency forward contract.

Based on the historical correlation of the major currencies with U.S. stocks and bonds, the minimum risk hedge ratio increases as foreign asset exposure decreases. Moreover, the risk of a purely domestic portfolio can be lowered with a short position in currency forward contracts.

The optimal currency hedging policy balances risk reduction with the cost of hedging.

A rational investor's willingness to incur costs in order to lower portfolio risk can be inferred from her chosen portfolio.

Historically, a hedging policy in which the expected return of the currency forward contract was set equal to the forward discount or premium increased the portfolio's return and lowered its risk.

46. CURRENCY HEDGING OVER LONG HORIZONS (Fall, 1993)

Kenneth Froot, Professor, Graduate School of Business Administration, Harvard University, described hedging policy as essentially an asset allocation decision, and pointed out that his topic concerned currency hedging over long, as opposed to short, horizons.

It is easy to justify currency hedging of international portfolios for short horizons. The short horizon foreign exchange exposure of international portfolios is large, while that of domestic portfolios is small. A one percent depreciation in the domestic currency will be associated with essentially no change in the value of a domestic stock and bond portfolio, but with approximately a one percent decline in the domestic currency value of a foreign stock and bond portfolio. Furthermore, expected excess returns for bearing the risk of foreign exchange exposure are small. In other words, it appears that in the absence of hedging costs, hedging reduces portfolio volatility with little or no effect on expected returns.

But when we turn to longer horizons, the situation changes. It is useful to distinguish nominal exchange rates from real exchange rates. Froot presented some graphs that showed real exchange rates as appearing to move randomly, with mean reversion, while nominal exchange rates did not appear to change randomly nor to demonstrate mean reversion. It is also useful to distinguish two components of foreign exchange returns: changes in real exchange rates and inflation surprise. The first of these dominates exchange returns in the short run, while the latter dominates in the long run. The currency exposure of different asset classes depends upon exposures to each of the two components.

To take an example, Froot considered an unhedged investment in real estate in the U.K. This investment is probably highly exposed to real exchange rate fluctuations but not very exposed to inflation surprise. High inflation in
the U.K. would be likely to send the pound down against the dollar, but at the same time the value of the U.K. real estate would probably rise in pounds, so that the two effects might be expected to offset. As a result, in the short run when real exchange rate changes dominate, real returns will be highly correlated with a currency hedge. But in the long run, when inflation surprise dominates, correlation will not be high. One might say that the U.K. real estate is “naturally hedged” in the long run. As a result, if one were to fully hedge the investment in U.K. real estate, the result would be to add to rather than reduce volatility.

We know something about exposures of real returns on asset classes to currency fluctuation in the short run. The betas are about 1.0 for foreign stocks, 1.2 for foreign bonds, 0.1 for domestic stocks, and 0.2 for domestic bonds. We can conjecture for long horizons betas of essentially 0 for foreign and domestic stocks. For foreign bonds, if the inflation shock is in the foreign country, then the beta will be close to 1, while if the inflation shock takes place in the U.S., the beta will be close to 0. For domestic bonds, we would conjecture just the reverse. Using 200 years of data, Kritzman had tested the conjectural exposures from a U.K. perspective of investing in U.S. real assets, stocks, bonds and bills. It turned out that the foreign stock exposure began at about 1 for a one-year horizon and fell to about .4 at three years, remaining at this level until about eight years. The benefits of hedging to reduce volatility at short horizons mostly disappears by an eight year horizon.

Returning to the decomposition of hedge returns into real exchange rate changes and inflation surprise, Froot asked whether we can hedge the two separately. For example, for the U.K. real estate investment, if we want to hedge foreign exchange risk over the long period, we will want to hedge the real exchange rate risk. This is not easily done, and in fact hedging with standard instruments becomes less and less effective as the horizon lengthens.

In summarizing, Froot observed that pre-existing exposures for many asset classes to foreign exchange risks are much lower over long horizons than over short horizons. The free lunch intuition for hedging is too strong: for long horizons a fully hedged position may involve higher volatility than an absence of hedging. A constrained optimum hedge depends upon risk tolerance, the time horizon, and specific asset exposures.

47. UNDERSTANDING FOREIGN EXCHANGE RISK (Fall, 1993)

Robert Hodrick, Tokai Bank Professor of International Finance, Kellogg Graduate School of Management, Northwestern University, distributed a paper entitled “Understanding Foreign Exchange Risk.” He began his presentation with a simple comparison between a hedged and an unhedged international investment. If the return on the investment is certain, then in the hedged case there is no overall uncertainty, while in the unhedged case the overall outcome depends upon the future spot rate. Where the return on the investment is uncertain, the overall outcome in the unhedged case depends both upon the actual return on the investment and the future spot rate. We define the forward premium as

\[ F^\text{f}_t = (F_t - S_t)/S_t \]

where \( F_t \) is the forward rate, and \( S_t \) is the spot rate at time \( t \). Interest rate parity tells us that

\[ F^\text{f}_t = (r^*_t - i^*_t)/(1 + i^*_t) \]

where \( i^*_t \) is the risk-free U.S. interest rate and \( i^*_t \) is the risk-free foreign interest rate. The unbiasedness hypothesis says that

\[ F^\text{f}_t = E_t(\%DS_{t+1}) \]

where \( E_t \) is the expectation at time \( t \), and the quantity in the parentheses is the percent change in the spot rate from time \( t \) to time \( t+1 \). That is, the forward premium is an unbiased predictor of the depreciation in the spot rate. In this case, the mean of the hedged return equals the mean of the unhedged return.
We go on to test the unbiasedness hypothesis, assuming rational expectations. That is, we assume that the actual depreciation in a currency is equal to the expected depreciation plus an error term whose mean is 0. It follows then that the mean depreciation is equal to the mean expected depreciation, and if the unbiasedness hypothesis is true, the mean of the actual depreciation will equal the mean of the forward premium. An analysis of monthly rates of depreciation, forward premiums, and ex-post risk premiums for 1975 to 1989 showed mean values for which we cannot reject the unbiasedness hypothesis. At least for the relation between the pound and the U.S. dollar and the yen and the U.S. dollar. In these two cases the actual depreciation was 3.59 and -4.99, while the mean difference between the forward rate and the original spot rate was 2.16 and -3.74. Although the mean depreciation was not the same as the mean difference between the forward and the initial spot rate, the differences were not statistically significant.

The next test was performed through regressions. The form of the regression was as follows:

\[ S_{t+1} - S_t = a + b(f_t - S_t) + \epsilon_{t+1} \]

where the dependent variable is the currency depreciation and the independent variable is the difference between the forward premium and the initial spot rate. We would expect to find a beta of 1, but what we find is closer to 2. The standard errors are small and hence we now reject the null hypothesis that beta is 1. From the discovery that the regression betas are not only not 1 but negative, one might draw the incorrect conclusion that a high interest rate in a country is a predictor that the currency of that country will not depreciate but will appreciate. What the results really mean is that the foreign currency has depreciated less rapidly than the unbiased theory would predict. The constant terms in the regression results, that is the values of alpha, are substantial.

These regression tests began around 1979, when enough data had accumulated since the freeing of exchange rates, and a number of criticisms were raised over the years with respect to the quality of the analysis. Hodrick had concluded that the criticisms were generally not well founded. It turned out that certain imprecisions in the data simply did not make a difference to the results.

In an attempt to explain the failure of the unbiasedness hypothesis, Eugene Fama proposed a risk premium. If we think of forward currency contracts as part of a broader set of investments, the matter of covariance between the forward contracts and other features of the set of investments becomes important.

Hodrick and Bekaert followed up on the risk premium proposition. Given some evidence that dividend yields predict equity market returns and forward premiums predict money market returns, the two researchers found that dividend yields also predict money market returns and forward premiums predict equity market returns. The work has been extended by other researchers, and Hodrick ended his presentation with these conclusions: the empirical results are puzzling. Some argue that they can be used to make money in the foreign exchange market, but the reliability of this claim is not at all clear. Acceptance of the regression results requires the assumption of rational expectations. This comes down to the assumption that investors understand the distributions of all asset returns and implies no learning experience. A second assumption is the validity of the asymptotic distribution theory. And a third assumption rests on the ergodicity of the data. When we assume that a time series is ergodic, we assume that a reasonably long sample is representative of the true distribution that investors face when they made contracts to set the forward rate. But if during the time period investors anticipated important events that did not happen, the historical means, variances and correlations in the data may tell us very little about the means, variances and correlations of returns in the future.

INFLATION

48. INTRODUCTION: THE IMPORTANCE OF INFLATION
(Spring, 1995)

Lawrence Harris, Professor at the School of Business Administration, University of Southern California, and Research Coordinator
for the Q Group, introduced the Inflation topic. He suggested that the three most important factors in investment analysis are inflation, the equity risk premium, and political risk, but that they rarely receive the attention they deserve. The purpose of the Monday presentations was, in part, to make up for this deficiency.

He presented the familiar equation \( PQ = VM \), which in words expresses the equality between the price level times the quantity of economic activity and the velocity of money times the money supply. A brief graphical presentation for the period 1972-1993 used the Consumer Price Index for \( P \), the Index of Industrial Production for \( Q \), and \( M2 \) for \( M \). The velocity \( V \) was calculated from these three variables, and although there was substantial year-to-year variability, over the two decades \( V \) was almost always between 3 and 3.5, and there appeared to be no trend. Harris added a graph of short-term interest rates and showed that the velocity traced short-term rates very closely until about the last three years. As another example, he used the same parameters for Greece that he had used for the United States, and once again the velocity had been very stable.

In commenting on the experience of recent years he pointed out that transaction technology, which has changed significantly, will have a large effect on the velocity of money. In addition, it is increasingly difficult to know just what “money” consists of.

While monetary policy is intended to create stable prices, it is difficult to target prices themselves because price movements generally lag monetary policy. At the same time, targeting interest rates has not worked and it is extremely difficult to control the money supply. In trying to find an indicator on which to focus, Harris suggested there is probably a tendency to look at the capacity of the economy.

49. THE POLITICAL ECONOMY OF INFLATION (Spring, 1995)

Kenneth Rogoff, Professor at Princeton University, offered some perspectives on political determinants of inflation. There has been some research on the political/business cycle. The theory here is that politicians in power attempt to build up the economy, particularly to build up employment, on the eve of an election. The buildup may indeed increase inflation, but the inflation effects will lag the economic surge, and not be felt until after the election. The evidence to support this theory is rather weak, although Rogoff pointed out that President Nixon’s 1972 campaign stood out as an extreme example supporting the theory. However, there is stronger evidence to support the theory of a political/budget cycle. The governmental activity here is likely to have to do with taxes and budgets.

Another theory has to do with a partisan business/political cycle. Here, one expects that following the election a Republican administration will deliver lower inflation than a Democratic administration. The evidence appears to be that economic activity following an election does differ between Republican and Democratic victories, but the effect is very short-lived. The Gross Domestic Product growth in the second quarter following the election of a number of Democratic presidents was at a 6.2% rate, while following the election of a number of Republican presidents it was -.3%. But the differential disappeared in subsequent quarters.

Turning to the role of the Central Bank in controlling inflation, Rogoff set out in algebraic form the objectives of the private sector with respect to inflation, and the objectives of a central bank. The private sector wants to minimize the error in predicting inflation. Businesses establishing wage contracts want those contracts to incorporate as accurate an inflation estimate as possible. And those buying long-term bonds want, of course, to properly incorporate inflation in the yields they accept. The Central Bank objective is a little different. The monetary authority wants to add to the inflation expectation a “wedge” and in addition to add (or subtract) inflation to counteract shocks to the economy. There are various purposes to the wedge, including the reduction of the real value of the public debt. The problem the monetary authority has is that rational expectations will tend over time to frustrate its objectives. The private sector comes in time to anticipate the “wedge” as well as the response to economic shocks.
The ideal Central Bank policy should be to eliminate systematic inflation, using its authority only to respond to the shocks. How might this ideal be achieved? A truly independent Central Bank with conservative management is one answer. The Bundesbank may be the closest approximation, but the Bundesbank will not even respond to economic shocks. Rogoff presented a graph plotting for a number of countries the average inflation from 1960-1988 against the degree of independence of the Central Bank. It appeared that low inflation did indeed accompany a high level of independence.

Pursuing the topic of the credibility of the Central Bank in dealing with inflation, Rogoff presented a number of graphs showing real exchange rates. The real value of the peso per U.S. dollar, the real value of the peseta per deutschmark, and the real value of the lira per deutschmark, all showed evidence of a serious lack of faith that inflation would be controlled and fixed exchange rates would hold. And in all three cases the end result was significant devaluation.

Turning to yields on long-term bonds today in the United States, Rogoff concluded that the steepening of the yield curve reflects a lack of credibility of Central Bank efforts to control inflation. He also suggested that the decline in the United States dollar reflects fear of U.S. inflation.

In conclusion, although the rate of inflation in the United States is very low today and has been low in recent years, it would be dangerous to ignore the possibility of an increase. We can see in the collapse of the dollar and high yields on long-term bonds evidence of uncertainty. A desire to further reduce unemployment and a wish to eliminate deficits without tax increases are also forces suggesting increased inflation.

50. INFLATION AND WORLD EQUITY SELECTION (Spring, 1995)

Campbell R. Harvey, Associate Professor of Finance at The Fuqua School of Business, Duke University, distributed a paper by himself and Claude B. Erb and Tadas E. Viskanta entitled “Inflation and World Equity Selection.” He began his presentation by noting that many managers engaged in asset allocation have moved away from unconditional allocations in which they make use of long-term average performance characteristics, to the use of characteristics consistent with the most recent state of the economy. It is particularly important to get the expected returns on the different assets classes correct, but Harvey also observed that we should not ignore getting the variability measures right.

As a specific application of the importance of conditional forecasts, Harvey considered the use of foreign stock and bond markets in hedging the risk in U.S. equity investments. The value of the hedging depends greatly on the correlation of returns in foreign countries with returns on U.S. equities. And these correlations change over time. We want to know why.

Harvey described the data on which his conclusions would be based. For each of the countries in two groups — developed countries and emerging economies — these data included rates of return, volatility in those rates, covariances with U.S. equity returns, and correlations with U.S. equity returns. He began by splitting the data between months in which U.S. stocks showed positive returns and months in which they showed negative returns. It is in those latter months that we would like to take advantage of the diversification benefits of foreign investment. But what Harvey found was that almost all countries showed on average negative returns when the U.S. returns were negative. He also found that when U.S. returns were negative the variability of returns in foreign countries was relatively high. The end result is that just when we would hope for benefits from foreign diversification those benefits are small.

Next Harvey split the data by the state of the economy: months of economic expansion and months of economic recession in the United States. Returns in foreign countries tended to be low in periods of U.S. recession and high in periods of U.S. expansion. Volatilities in foreign returns were somewhat lower in U.S. recessions; covariances were very much higher; and correlations were higher. We can conclude here that the state of the business cycle is important to the diversification benefits of foreign investment. And Harvey’s contention
was that we are better able to forecast the state of the economy than we are able to forecast equity returns.

Finally, Harvey examined the significance of inflation as a state variable. For the foreign countries, as with the United States, equity returns were generally higher in low inflation periods. This was true of returns measured in local currency. But historically there has been a positive relationship between a country's average inflation experience and the total U.S. dollar return of its equity market. Volatility in U.S. dollar returns was also positively correlated with inflation in the foreign country. It is future inflation, of course, that really matters and while realized inflation provides useful information about the inflation of the next period, Harvey's research used forward-looking country credit risk measures to proxy inflation expectations. In general, the lower a country's perceived sovereign credit rating the higher the country's rate of inflation and the higher the rate of return on the country's stock and bond markets.

In conclusion, Harvey had demonstrated how expected returns, variability, covariance and correlation for returns in foreign countries used to hedge U.S. equity returns are impacted by bull and bear markets in the United States, the U.S. business cycle, and inflation. Asset allocation involving the use of foreign markets should take these impacts carefully into consideration.

51. COMMODITY PRICES AND INFLATION (Spring, 1995)

Robert F. Whitelaw, Assistant Professor of Finance, Stern School of Business, New York University distributed an outline by Jacob Boudoukh, Matthew Richardson, Paul Richardson, and himself entitled "Stocks, Commodities, Interest Rates and Inflation." He began his presentation by observing on the great importance that the investment community and the financial press seem to attach to the prospects for inflation. Every economic event that might suggest rising inflation and hence rising interest rates is reported as negative news for the stock market. There is indeed empirical evidence that contemporaneous stock returns and inflation are negatively correlated. Whitelaw described his task as discussing the measurement of inflation, the modeling of expected inflation, explaining the relationship between stock returns and inflation and between commodity prices and inflation, and discussing commodity prices and interest rates. He began with five measures of inflation. First was the Consumer Price Index. Then came three producer price indexes — one for finished goods, one for intermediate materials, and one for crude materials. Finally, there was the Goldman Sachs Commodities Index. The monthly mean values and standard deviations differed substantially among the five. He chose the CPI and the PPI (Crude) as the two indexes to use for the balance of his presentation. The standard deviation of the PPI (C) was some six times the standard deviation for the CPI, but in general the two series appeared to move together. All five measures were reasonably highly correlated, except for the CPI and the PPI (C).

The next step was to divide inflation into its expected and unexpected components. The reason is that returns on any asset presumably compensate investors for expected inflation but cannot compensate for unexpected inflation, leaving a need to hedge unexpected inflation.

In developing a good model for expected inflation, candidate explanatory variables are lagged inflation, interest rates, commodity prices, and gold prices. It turns out that CPI inflation is explained primarily by lagged CPI inflation and the three-month treasury bill yield. Lagged PPI (C) inflation is statistically significant but probably not economically significant. Gold is not significant at all. For PPI (C) inflation, lagged CPI inflation is a useful predictor, the Goldman Sachs Commodity Index is the best predictor, and gold is statistically, but probably not economically, significant. Whitelaw’s conclusions with respect to modeling expected inflation were that CPI inflation is much more predictable than PPI (C) inflation, Goldman Sachs Commodity Index has some predictive power for CPI inflation, and excellent predictive power for PPI (C) inflation, and gold is not as helpful as a predictor as many seem to believe.

Whitelaw next turned to the relationship between stock returns and inflation. The Fisher model says that returns on real assets (including stocks) should be unaffected by changes in nominal prices, but we know empirically that
stock returns are negatively related to both expected and realized inflation. The two conclusions can be reconciled if inflation is actually correlated with future real output. A correlation analysis of industrial production for individual industries with aggregate industrial production identified cyclical and noncyclical industries. The cyclical industries show high correlation while the noncyclical industries show low correlation. The noncyclical industries tend to show reasonably high correlation with expected inflation, but only mining provided a good hedge against unexpected inflation. The research also found that as the time horizon is extended to one year, the regression coefficient on expected inflation moves towards 1, and at a five-year horizon the coefficient is above 1 and the coefficient on realized inflation becomes significant. That is, at a five-year horizon stocks do provide an inflation hedge.

Whitelaw next turned to the use of commodities to hedge inflation. He first showed that individual commodity sectors have extremely variable prices and there is low correlation between sectors. All of the various commodity prices appeared to lead the PPI (C). Regression results showed that precious metals, energy and the Equally-weighted Commodity Index all show a potential to hedge inflation.

Finally, Whitelaw had investigated whether the Federal Reserve appears to be using commodity prices in order to determine monetary policy, and hence whether commodity prices may predict the federal funds target and short term interest rates. It turns out that lagged interest rates explain most of current rates, but the Goldman Sachs Commodity Index does have some marginal predictive power with respect to the three-month treasury bill yield.

In conclusion, Whitelaw observed that commodity prices help improve inflation forecasts, that commodities (especially precious metals and energy) show the potential to hedge inflation and stock returns, and that commodity prices help to predict interest rate movements.

52. GROWTH AND INFLATION: A CROSS-COUNTRY STUDY
(Spring, 1995)

Brian Motley, Research Officer at the Federal Reserve Bank of San Francisco, presented a paper entitled “Growth and Inflation: A Cross-Country Study.” He offered the widely accepted proposition that inflation has bad economic effects. One of these is a reduction in the level and growth rate of GDP. Motley had undertaken to examine the effects of inflation on economic growth, drawing on data from a number of countries, and then to compare the economic costs and benefits, in present value terms, of a Central Bank policy that curbs inflation. He based his research on Robert Solow’s neoclassical growth model as extended by Mankiw, Romer and Weil. The model sets the log of real income per worker in the steady state as a function of the level of technology, the growth rate of technology, the growth rate of the labor force, the depreciation rate for tangible and human capital, investment in tangible capital as a share of GDP, and investment in human capital as a share of GDP. (Motley discussed some of the problems in the data, including how investment in human capital is to be measured.) Cross-sectional regressions were run for five large samples of countries over a 30-year period from 1960-1990. Because the results might be seriously affected by supply shocks and it is difficult to identify all of the supply shocks in all of the countries over the 30-year period, the regressions were also run for each of the three decades in this period.

The first set of results was for the full 30-year period. For the OECD countries, it turned out that in long-run steady state, a 10% inflation rate will reduce annual per capita growth by about 1.4%. A further interesting result was that the marginal effect of inflation is relatively high for inflation rates between 5-15%, and much lower for inflation rates below 5% and above 15%. For the very high inflation rates it seems likely that institutions and activities develop to enable economic agents to reduce the consequences of inflation. In addition, there may be a measurement bias in the output data because activities intended only to counter the high inflation may boost the measured GDP of high-inflation countries.
Motley concluded with a cost/benefit analysis of inflation reduction. It appears that lowering inflation by 5 percentage points would add at least 0.1 percent to steady state growth and perhaps as much as 0.5 percent. With a 40-year working life, a 3% real discount rate, and a reduction in inflation that would yield a 0.1 percent boost to steady state growth, the discounted lifetime income of a typical worker would increase by about 15% of one year's income, while a 0.5 percent boost to steady state growth would be worth almost 140% of one year's income. These estimates of the benefits of lower inflation appear to exceed the costs of bringing inflation down, which have been estimated as amounting to at most 12-15% of one year's GDP for a 5 percentage point reduction in inflation.

53. THE PROSPECTIVE REAL YIELD AND ITS RELEVANCE TO ACTIVE GLOBAL BOND MANAGEMENT (Fall, 1992)

Robert Bernstein, Senior Vice President and Director of Fixed Income, Delaware Investment Advisers, and Ian Sims, Managing Director, Fixed Income, Delaware International Advisers, Ltd. distributed a paper by Ian Sims entitled "The Prospective Real Yield and Its Relevance to Active Global Bond Management". Bernstein introduced the presentation with the statement that a mainstream approach to global bond management involves forecasting interest rates and currencies, and adjusting country allocations accordingly. The methodology used by Delaware bases the allocation on the prospective real yield of a country's bond market. The prospective real yield is the yield to maturity on a benchmark bond adjusted for future inflation. The expectation is that countries with higher prospective real yields will exhibit consistently stronger relative performance.

An economic rationale for the prospective real yield approach lies in the theory of purchasing power parity, which holds that currencies should track inflation differentials. We know the theory does not work very well in the short run; the proposition here is that it works well enough in the long run to facilitate superior investment results. The success of the model depends of course on ability to forecast inflation.

Ian Sims continued the presentation with a discussion of the tests that had been applied to use of the proposed methodology. The first took the form of a regression of relative real returns (for example, the difference between the return on German bonds and the return on U.S. bonds, all converted to U.S. dollars), on the prospective real yield differential (for example, between German and U.S. bonds). Regressions were run monthly for 1974 through 1989, for the countries included in the Salomon World Bond Index. (These are the U.S., Germany, the U.K., France, Japan, the Netherlands, Canada, Switzerland, and Australia.) There were three definitions of inflation. In the "perfect foresight" case, the actual realized inflation rate over a two-year horizon was used. While such a test would not show what management could have achieved over the time period, it would at least show whether the whole approach made sense and would provide some sort of upper bound to the success of the strategy. The second definition of inflation was the "M2 model". The M2 model made use of regressions of inflation on the money supply for the nine countries. Finally, the third inflation definition was the "OECD forecast", being simply the inflation forecast published by the OECD for each country. For all three definitions of inflation, the regression results showed very low values for R^2 but the coefficients on the prospective real yield differential were significant. Sims' conclusion was that the "perfect foresight" model indicated a stable mechanism, and that the more practical models predicted superior performance. A non-parametric test, the Henrikson-Merton test, confirmed the results from the regressions.

The next step was exploration of simulations, where assets were allocated across the nine countries on the basis of the prospective real yield differentials. Two allocation strategies were used, one a mean/variance and the other a simple ranking rule, by which the top five countries were chosen, with the first given a weight of 40, the second a weight of 30, the third a weight of 20, and the fourth a weight of 10. A graph of the results of using the unhedged mean/variance country allocation, for the three definitions of inflation, over the years 1974 through 1989 indicated that all three inflation measures provided substantial benefits above the Salomon World Index. As one might expect, the
perfect inflation forecasting provided the best results, and as Sims pointed out, led to rather steadily improving performance over almost all of the time period. The performance of the M2 inflation forecasting worked best until about 1980, delivering no further improvement until about 1986, and then working well through 1989. Use of the OECD inflation forecasts led to the greatest variability in improvement over the World Index. It turned out that despite the superiority of the M2 methodology to the OECD methodology in beating the World Index, the OECD methodology actually turned out to be somewhat more accurate. Sims' explanation was that it was very difficult to distinguish statistically between the two.

LONG/SHORT STRATEGY

54. AN OVERVIEW OF LONG/SHORT STRATEGIES IN EQUITIES (Fall, 1995)

Robert E. Shultz introduced the subject. He discussed the attractiveness of market-neutral investing and went on to the question whether active management can add value. If it does, then the market-neutral approach may offer the best way to exploit active management, particularly with a multiple manager structure.

Implementation, however, of a market-neutral approach is not so simple. One might hope that it would lead to a number of benefits, including better identification of manager skills and improved performance attribution.

Shultz introduced the first presentation on the subject: Understanding, Evaluating and Comparing Long/Short Strategies. Richard O. Michaud, Senior Vice President, Acadian Asset Management, distributed an article entitled: "Are Long/Short Equity Strategies Superior?" He began with some basic terminology. We are discussing active management as the maintenance of a long portfolio and a short portfolio, dollar neutral in the sense that each represents the same dollar value. The portfolios are also market neutral in the sense that the systematic risks of the two portfolios cancel. The long/short strategy may be equitized, through the use, for example, of an index fund that in conjunction with the long and short portfolios leads to an overall rate of return that is approximately the market or index rate of return plus the return achieved by the active manager on the combination of the long and short portfolios.

There are various perceptions of the long/short strategy, including a number of fallacies that Michaud listed. The most important of these, according to Michaud, is a failure to appreciate the risk that may be incurred in a long/short strategy. Another fallacy is a belief that the long/short strategy always dominates long-only strategies. He observed that a number of academic studies backtesting a long/short approach, report amazing rates of return that managers seem unable to achieve in practice. There is apparently more to the strategy than the academic research suggests. A number of errors are possible when comparing the long/short with the long-only strategy. A major source of confusion has to do with risk measurement. Michaud offered an analysis of the return and risk in the long/short strategy.

So far as the returns are concerned, the excess returns on the long and the short portfolios can be added, and the alphas for the two portfolios can be added. If we assume a market-neutral position, the beta coefficients cancel and there is no market risk. The risk of a combination of the long and short portfolios depends upon the correlation between the two. The gamma ratio is the ratio of alpha to residual risk in the combination of the long and short portfolios. What is of interest is the ratio of the gamma for the long/short strategy to the gamma for the corresponding long-only strategy. Michaud presented this ratio as \( \sqrt{\frac{2}{1+\rho}} \) where \( \rho \) is the correlation between the returns on the long and short portfolios and we assume that the alphas and the residual risks in the long and short portfolios are equal. So long as the correlation is less than one, the gamma for the long/short strategy will be greater than the gamma for the long-only strategy. The success of the long/short strategy then depends heavily on low correlation. Michaud suggested that empirical correlations may be in the range 0.8 to 0.9.

Comparison of the long/short strategy with a long-only strategy can be made by means
of a graph of alpha against residual risk. The efficient frontier for the long/short strategy starts at the lower left where the index itself has an alpha of zero and a residual risk of zero, and rises in a curve with decreasing slope. The efficient frontier for the long-only strategy starts at the same point but rises less than the long/short frontier and therefore lies below it. So far it would appear that the long/short strategy will always deliver a higher alpha at the same residual risk than the long-only strategy. Michaud pointed out, however, that the gamma ratio is highest for low levels of risk and decreases as one goes to higher levels of risk. (The slope of the frontier decreases with higher levels of risk.) And he suggested that most long/short strategies will involve relatively low levels of residual risk. At these levels the gamma ratio for the long/short strategy may not be much greater than the ratio for the long-only strategy.

He went somewhat further, showing that if we allow for greater transactions costs with the long/short strategy, its efficient frontier drops and at low residual risk levels the efficient frontier for the long-only strategy is actually superior to that for the long/short strategy. It appears then that only at fairly high levels of residual risk will the long/short strategy prove superior to the long-only strategy.

Michaud went on to comment that as a practical matter long/short strategies offer much greater risk than long-only strategies, apparently because of a failure to achieve market neutrality.

In conclusion, he saw the benefits of the long/short strategy as enhancing the opportunity set and enabling investors with highly reliable forecasts to leverage the value of those forecasts. He saw limitations as including increased risk and increased costs, and the need to achieve a fairly high residual risk for the strategy to pay off well. He raised questions about whether investor expectations for long/short strategies are realistic, whether there are alternatives to the long/short strategies that may be superior, and whether the long/short strategy is something to be used on a continuous basis or something that is better used only when special opportunities arise.

55. THE LONG AND SHORT OF LONG/SHORT (Fall, 1995)

Bruce I. Jacobs, Principal, Jacobs Levy Equity Management distributed a package of publications of Jacobs Levy as well as a detailed outline of his presentation.

He took issue with a number of conclusions that had been reached by Michaud. In particular, he said that the long/short strategy is not necessarily riskier than a long-only strategy, and he objected to treating the strategy as consisting of two distinct portfolios. He believes the strategy should be looked at as a single portfolio taking long and short positions. In response to Michaud's analysis that made use of an alpha and a residual risk for each of the long and short portfolios, Jacobs position was that no meaningful alpha or residual risk can be calculated for the two portfolios, nor can a meaningful correlation coefficient be calculated. One can only look at the alpha and the residual risk for the combination of long and short portfolios.

He presented examples of the performance of both market-neutral and equitized long/short strategies. For the market-neutral strategy, as might be expected, the overall return is independent of the performance of the underlying benchmark. Jacobs' examples included the returns on the long and short positions, the holding of a cash liquidity buffer invested at a modest rate of interest, and a rebate of interest on the cash collateral posted in connection with the short position. He provided a number of reasons why securities may be overpriced and why there may be greater benefits to be had from short positions than from long positions. He also pointed out a number of restrictions that may get in the way of fully exploiting short sale opportunities.

Jacobs argued that Michaud appeared to assume that the long position in a long/short strategy would be the same as the long position in a long-only strategy, and presented a number of reasons why they could be quite different. He said the long-only portfolio is index-constrained and that the assumptions made by Michaud in his analysis assumed that both the long and short portfolios were index-constrained. In his view both were free of index constraints, and it was from this that the benefits of the long/short strategy arose. He
went on to discuss the transportability of the long/short spread. One can combine a long/short strategy with any index or benchmark equitizing.

Exploring some of the details of the long/short strategy, Jacobs discussed margin requirements, cash management, bookkeeping requirements and short sale regulations.

Like Michaud, Jacobs discussed a number of perceived characteristics of the long/short strategy that he believes are false. These include perceptions of problems with ERISA and under the Internal Revenue Code.

Finally, he concluded with a cost/benefit analysis saying that whether the enhanced returns from the long/short strategy will compensate for the costs of that strategy will depend (as with the long-only strategy) on the quality of the manager's valuation insights.

56. DECISION VALUE AND IMPLEMENTATION COSTS
(Fall, 1995)

Wayne H. Wagner, President, and Vinod Pakianathan, Analyst, Plexus Group, distributed a short paper entitled "Spotlight: Decision Timeliness and Duration" and another handout entitled "Decision Value and Implementation Costs." They were reporting on an analysis of the accuracy and effectiveness of analysts' decisions, based on their own large set of transaction data. Wagner identified three areas they had explored: where managers add value and where value slips away, how far into the future analysts and managers can project, and how long/short management changes the scene. The first area led to a conclusion that managers have good stock picking ability, but that implementation costs, which are often ignored or severely underestimated, can seriously undermine the usefulness of a good idea. Judged over six weeks after the original decision to buy or sell, eight out of ten buy decisions (without adjustment for costs) outperformed the market, but only seven out of ten buy realizations outperformed the market. Sell decisions were worse, with only four out of ten outperforming the market and only two sell realizations outperforming the market. For decisions to sell one stock and buy another, only four out of ten resulted in a net gain.

It turned out that on average a buy decision was worth 167 basis points before costs and only 67 basis points after costs. The average sell decision on the other hand, was worth -5 basis points before costs and -108 basis points after costs. A substantial part of the transaction costs have to do with the opportunity loss because it may take several days to fill institutional orders and many never are filled. Timing costs are the costs of seeking liquidity, with the price changing before the transactions can be executed. Impact costs are the costs of buying liquidity, with the change in price between placing an order and its execution. And finally there are commission costs. Wagner was able to show graphically the significant difference between the value of a decision before transactions costs, and the value of the realized transaction.

Pakianathan picked up the presentation to report on the results of some 80,000 transaction decisions made in 1993 and tracked for a full year. It turns out that for momentum and value managers, the buy decisions (adjusted for the market and the market risk) added value, while the sell decisions did not. For the momentum managers the cumulative alpha for buys reached about 600 basis points by the end of 250 days, while the cumulative alpha for sells reached -400 basis points over the same time period. It also appeared that for the most part momentum managers bought from and sold to value managers.

Pakianathan concluded that most of the value from decisions occurs fairly quickly. It appears that forecasters predicted one or two quarterly earnings announcements. And managers must act promptly to capture the value of their information. For the most part the value to be achieved in buy decisions has been realized within 30 days after the transaction.

Wagner then took over the presentation to discuss an analysis of buys and sells for long/short portfolios. The data base here was about 50,000 transactions for about 5 managers. The results were rather different from those than had been discussed so far. It turned out that the most successful transactions were short sells, with the next most successful being long sells. In both cases the alphas were positive, but the positive results showed up only after some 60 or so days after the transaction. And
the benefits continued for up to 250 days. The long buys and the covering buys, on the other hand, showed positive alphas very soon after the transaction, but negative alphas after about 90 days. The alphas continued negative for up to 250 days.

His final conclusion was that value is added by the selling side of the long/short strategy and that the strategy is worthwhile, but the short positions must be maintained for several months.

57. MARKET NEUTRAL LONG/SHORT STRATEGIES: THE PERCEPTION VS. THE REALITY (Fall, 1995)

Naozer Dadachanji, Consultant, Towers Perrin, distributed a paper entitled “Market-Neutral Long-Short Equity Strategies” and a handout entitled “Market-Neutral Long-Short Equity Portfolios.” He began by emphasizing that the issue is not simply whether institutional investors should permit short sales, but whether a particular stylized strategy should be used, one that invests equal dollar amounts long and short and matches the risk characteristics of the long and short portfolios. Systematic risk may or may not be introduced synthetically (generally by what we call equitizing). He pointed out that every long-only portfolio is a long/short portfolio in the sense that underweighting relative to the benchmark is essentially going short versus the benchmark. He also commented that “market-neutral” does not mean quite the same thing for all managers. The neutrality of managers’ long/short portfolios is typically closely related to benchmark-relative neutrality of their long-only portfolios, and systematic style biases can be expected to persist in the long/short portfolios.

He next explored a number of claims that he has found are frequently made for long/short strategies. One is that the long/short strategy exploits both anticipated winners and losers and that long-only portfolios do not. His response was that the claim is somewhat overstated, since long-only portfolios also exploit losers, but are constrained in the extent to which they can do so. A second claim is that a market-neutral long/short portfolio will produce positive returns year after year, in both up and down markets. His comment was that the issue is whether returns are above cash returns, not simply positive. And the expectation of above-cash returns year after year is almost sure to be mistaken. Such a result is equivalent to producing above benchmark returns with a long-only portfolio. A further claim is that long/short portfolios allow investors to uncouple asset allocation and stock selection. While the claim is true, derivatives can also be used to uncouple asset allocation and stock selection. Dadachanji raised a question why investors would want to combine a market-neutral long/short strategy with synthetic exposure to a different asset class.

Another claim is that the long/short strategy is benchmark-free. More specifically, the long/short strategy permits managers to avoid bets on sectors or industries about which they have no insight, and evaluating manager performance is simple because the benchmark is always cash. Dadachanji’s response was that in the long-only strategy managers are not required to bet on sectors or industries about which they have no insight. And evaluating manager performance is no easier than for a long-only portfolio. It is difficult to deal with systematic style biases, and we generally have insufficient data to separate the signal from the noise.

The potential for leverage is often put forward as an advantage of the long/short strategy. It is possible to lever systematic or residual risk/return. Investors may simply want more risk, and Dadachanji thought this would apply in particular to wealthy individuals. Most institutional investors apparently do not feel that the level of residual risk/return that is obtainable with traditional long-only strategies is insufficient.

Some institutional investors think they pay a lot in active management fees for a small amount of active management. This is likely because of a large number of managers with overlapping responsibilities, and can continue even if the investor uses exclusively long/short strategies. Currently it appears that most long/short managers deliver roughly twice the active management for roughly twice the fee level.
It does appear that the potential for increased efficiency in the use of information ratios might be achieved from a long/short strategy because of the ability to underweight a stock by more than its index weight. But the potential benefits must be considered in the context of increased investment management fees, the cost of borrowing securities, and increased trading costs. The drag on performance can be expressed by $r_c - r_s$, where $r_c$ is the cost of carry for a futures overlay, and $r_s$ is the short sale rebate. The magnitude of this differential, which is generally around 25 to 30 basis points, is driven by risk differences and the cost of borrowing securities.

Dadachanji discussed the argument that there is low correlation between long and short residual returns. His judgment was that the correlation is probably not low, but that the real question is whether the correlation between those components in the long/short portfolio is any lower that the correlation in the long-only portfolio.

Market-neutral long/short equity portfolios are sometime described as "enhanced" cash. But most such portfolios are considerably more risky than the typical investments referred to as enhanced cash. Although there may be little or no systematic risk, there may be considerable residual risk in the long/short portfolios, and hence a significant probability of negative returns.

In summary, reviewing nine perceptions of the long/short strategy, Dadachanji concluded that three were correct: the potential for leverage, the potential for more efficient use of information ratios, and the ability to uncouple asset allocation and stock selection. Six perceptions he labeled as false: assurance of positive returns year after year, significant reduction in management fees, significantly better use of capital, a benchmark-free construct, creation of an asset class, and characterization as enhanced cash. His own additional conclusions were that performance evaluation should consider residual return and residual risk, and that the importance of risk control is heightened in the case of long/short portfolios because of the potential for leverage.

**NON-PARAMETRIC METHODS**

58. OVERVIEW OF NONPARAMETRIC TECHNIQUES IN FINANCIAL ANALYSIS (Fall, 1994)

The presentation was made by Andrew W. Lo, Harris & Harris Group Professor of Finance at the Sloan School of Management, MIT. He began by showing a scatter plot for two variables, and raising the question how we might go about determining what relation exists between them. It is clear that we must apply some structure to the data in order to understand them and a possible relationship. One such structure is a parametric model. We may be able to improve our analysis by bringing information we have gained beyond the data set, and we may be able to satisfy ourselves that we have obtained the best estimate of the true relationship. At the same time, the parametric model requires a number of assumptions. It is important to understand just what those assumptions are and to appreciate their limitations. In tuning to nonparametric methods we generally seek to avoid some of the troublesome assumptions of parametric methods. One of these assumptions generally has to do with the form of the distribution of the variables represented by the data.

But what we gain by relaxing or eliminating troublesome assumptions we pay for in other ways. Among these are increased computational requirements, increased data requirements, a need for more intuition in imposing a structure on the data, greater difficulty in interpreting results, and risks of over-fitting the data and data-mining. We must also remember that while some assumptions may be eliminated or relaxed as we turn to nonparametric methods, other assumptions remain.

Lo reviewed a number of nonparametric techniques, some classical or traditional, others more recent in their origin. A significant characteristic of many of these techniques is the elimination of assumptions with respect to the distribution of the variables. In addition, nonparametric methods offer far more flexibility in approximating a functional relationship than do parametric methods.
He discussed kernel regression as an example of a modern technique. Starting with a scatter plot, one suggesting a nonlinear relationship between two variables, we imagine dividing the scatter into vertical slices. For each of the slices we calculate a weighted average of the plotted values of the \( y \) variable. The width of the slice is known as the bandwidth and a weighting scheme, which may differ for each slice, is known as the kernel. Both the kernel selection and the bandwidth selection involve some judgment, as we strive to achieve the best description of the relationship. Lo went through an exercise demonstrating the effect of varying the bandwidth.

Neural networks are another important modern nonparametric technique. Lo passed over them fairly quickly, since the subject was to be dealt with in more detail later in the day. He turned next to what nonparametric methods cannot do. One example was the estimation of supply and demand curves, something that can be done by a parametric method: two stage least squares regression. This is because the parametric method brings an economic structure to the problem. In stressing the importance of the economic structure, he described a nonlinear stock selection model that yielded superb results in back testing, but demonstrated a fatal flaw in the economics of the underlying assumptions.

In concluding, he suggested these questions are important in moving from parametric to nonparametric techniques:

1) Are parametric assumptions plausible?  
2) Are nonlinearities important?  
3) How much data/structure is needed?

And in turning to nonparametric techniques we must consider these tradeoffs:

1) Less restrictive parametric assumptions  
2) Less restrictive linearity assumptions  
3) More restrictive requirements for:  
   a) Stationarity  
   b) Dependence  
   c) Sample Size  
   d) Structure  
   e) Computation  
4) Complex interpretation.

59. NONLINEAR DYNAMICS IN FINANCIAL MARKETS: EVIDENCE AND IMPLICATIONS (Fall, 1994)

David Hsieh, Professor of Finance and Economics at the Fuqua School of Business, Duke University, distributed a paper entitled "Nonlinear Dynamics in Financial Markets: Evidence and Implications." His presentation dealt with models of daily asset price changes. Two key properties of such price changes are a lack of autocorrelation in the price changes themselves, but strong autocorrelation in the absolute values of price changes. He presented tables of autocorrelations for daily price changes in interest rate futures, foreign currencies, stock indices, and spot prices of gold, silver and crude oil. The statistics clearly illustrated the two characteristics that are best explained by nonlinear models. The possibilities are additive and multiplicative models. It turns out that the multiplicative is the better model in explaining the two key properties.

Those two key properties are evidence against the price changes being independently and identically distributed. There are two explanations for the non-iid condition. One is based on the likelihood of exogenous regime changes. For example, from 1979 to 1981 the Federal Reserve pursued control of the money supply rather than direct control of interest rates, and the result was a relatively high volatility in interest rates. We would expect exogenous regime changes to account for the non-iid situation over long histories, but not over short histories and the daily price change data demonstrate non-iid characteristics over short histories.

A second explanation of the non-iid condition is nonlinearity. Nonlinearity may be characterized by a changing conditional mean. In this case the direction of change is predictable. Or it may be characterized by a changing conditional variance. In this case, the direction of change is not predictable.

Hsieh described the additive nonlinearity/conditional mean model first. Deterministic chaos is a special case of these models. Threshold autoregressive models are another example. Hsieh’s assessment of these models was that they did not satisfactorily explain the high degree of autocorrelation in
the absolute values of daily price changes. He turned therefore to the multiplicative nonlinear/conditional variance models. Examples of these models are the autoregressive conditional heteroskedasticity (ARCH) model and the generalized version (GARCH) models. His assessment here was that conditional volatility provided a good fit to the daily price change data.

In discussing the dynamics of volatility, Hsieh commented that the GARCH models put a high persistence in volatility, to the degree that volatility is nearly a random walk. But the data he had presented did not show this volatility persistence. Furthermore, random walks in volatility mean that volatility can be arbitrarily large, which was not reasonable in the case of the daily price changes. And volatility implied by options indicated that volatility is heavily mean reverting.

Finally, he discussed the autoregressive volatility/stochastic volatility model:

\[ X_t = \log \left( \frac{P_t}{P_{t-1}} \right) = s_t e_t \]

\[ \log s_t = a + S b_1 \log s_{t-1} + \sqrt{t} \]

\[ e_t \text{ iid, mean } 0, \text{ variance } s_u \]

\[ \sqrt{t} \text{ iid, mean } 0, \text{ variance } s_j \]

\[ e_t \text{ and } \sqrt{t} \text{ have correlation } r. \]

This model was superior to the GARCH model in reflecting the low persistence in the data.

In discussing applications of the model, he referred to determination of the market risk of asset/liability positions, determination of margin requirements for a futures contract, and gave two examples of the correction of portfolio market risk estimation by taking account of changing prospective volatility.

60. ANALYSIS OF INTERACTIVE MACHINE LEARNING IN A SIMULATED MARKET (Fall, 1994)

Blake LeBaron, Associate Professor of Economics, Department of Economics, University of Wisconsin distributed a paper by W. Brian Arthur, John H. Holland, Richard Palmer, Paul Taylor and himself entitled “An Artificial Stock Market.” The reason for creating, via computer, an artificial stock market was to understand the behavior of agents using artificial intelligence to forecast the future behavior of a traded asset paying a random dividend, and the phenomena possible from the interactions of learning algorithms brought together in a simple stock market trading environment. The model made use of several (generally about 50) traders buying and selling two assets: a stock paying a risky dividend and a risk free bond paying risk free interest. All transactions went through a specialist playing only a mechanical function in matching orders.

The agents were given a set of rules for forecasting, rules making use exclusively of historical trading data. In the course of the trading, the agents kept track of the success or failure of the various rules. Through time, they relied more on the rules that had been more successful; they abandoned bad rules; and they constructed new rules. LeBaron described the processes by which new rules were constructed by agents. In some cases, noise was added to old rules; in other cases two old rules were combined into one new one.

LeBaron concluded by describing some experiments that had been conducted on the model. Three different dividend dynamics were tested. First, the dividend was assumed to follow an iid process, with no predictability. The market quickly converged to a point close to the rational expectations price. Trading volume indicated that the agents continued to trade as they explored new rules, but the volume did appear to settle to a stable level over time.

The second dividend process studied was the AR (1) case, with an autoregressive property, and hence a forecastable dividend. The agents were informed of the process, and given the autoregression formula. In this case, trading volume was about 1/10th the level in the preceding case. The cross sectional variability of shareholdings for the different agents over time appeared very stable and small.

The third process was again the AR (1) process with the process not revealed to the agents. Volume showed an initial large spike and then settled down. Holding variability was much larger than in the case where the agents were given the autoregressive relationship.
61. NEURAL NETWORKS AND WAVELET MODELS FOR FINANCIAL MARKET APPLICATIONS (Fall, 1994)

Halbert White, Professor of Economics, Department of Economics, University of California, San Diego began by describing what artificial neural networks (ANNs) are. They are essentially input-output models designed originally by cognitive science researchers attempting to model the processes of the human brain. In its simplest form, an "input layer" is connected to an "output layer" by gamma weights, in a manner very similar to regression analysis. The input layer contains the independent variables, the output layer the dependent variables, and the weights are the regression coefficients.

The next level of complication inserts a "hidden layer" between the input and output layers, and applies beta weights between the hidden layer and the output layer. In effect, what happens is that data inputs are conveyed from the input layer to the hidden layer, weighted by the gamma weights. The hidden layer picks up these weighted inputs and transmits them newly weighted to the output layer. The introduction of a nonlinear transfer function at the hidden layer makes this model especially useful.

White demonstrated the use of more than one hidden layer, and also the combination of a direct transfer from the input layer to the output layer with a transfer by way of a hidden layer. This particular model makes it possible for the network to determine for itself whether a linear or a nonlinear structure is the more appropriate. He went on to demonstrate recurrent hidden layer networks, where there is feedback from the output layer back to a hidden layer or from a hidden layer back to itself. Finally, he explained the learning process that takes place in the neural network. "By exposing the neural network to a sample of examples representing the mapping to be learned, optimal values of the free network parameters (weights) can be learned."

In effect, what we have is a nonlinear regression model.

White turned next to wavelets. These constitute a new method for time-frequency analysis and a new basis for representing functions. While the ANN can be seen primarily as a forecasting device, wavelets serve to provide a description of what has gone on in the past, a description that can be revealing in distinguishing white noise, stationary and transient phenomena. White showed a number of graphs of frequency against time for various functions, including the performance of the S & P 500 index. It was possible to identify the extent of noise, the importance of short lived phenomena, and the importance of long lived phenomena. He also demonstrated the comparative effectiveness of a variety of structural models in duplicating the actual history.

White next discussed implied volatility forecasting. For options on S & P 500 futures, he used the Black-Scholes implied volatility. The estimation sample consisted of 759 observations from 11/30/89 thru 11/30/92. And for the evaluation sample he used 279 observations from 12/01/92 thru 01/06/94. Three models were applied to the data: a linear model, a neural net, and a multivariate adaptive regression spline (MARS) model. The periodicity and mean reversion were clear in the implied volatilities. Comparing the results of the three models was complicated by the fact that in some respects one might be superior whereas in other respects another proved superior. The overall R squared was one measure for comparison, but deterioration of the forecasting ability of the model as the forecast extended into the future was another measure.

In summary, White observed that:

1) Wavelets can be used to represent time series and to investigate their structure.

2) ANNs can be used as flexible regression models to approximate complex multivariate relationships.

3) Judicious application of these new tools appears to have the potential for both intellectual and financial payoffs.

62. PANEL DISCUSSION:
INVESTMENT APPLICATIONS OF NONPARAMETRIC METHODS (Fall, 1994)

Sandip Bhagat, Managing Director, Travelers Investment Management Company,
introduced the panel. He reviewed investment applications of nonparametric methods, beginning with the observation that the high level of noise in financial systems requires a robust model. Noise, unexplained variance, and mispricing may be created by liquidity considerations, trading frictions, or investor psychology. While nonlinear models attempt to capture complex underlying relationships, the estimated functional form can be influenced by noise. The result may be relationships that are spurious, not predictive, and/or nonstationary and unstable.

Recognizing the importance of nonlinear models, we move from parametric methods to nonparametric methods. Bhagat listed a number of nonparametric alternatives, introduced the kernel function, and moved to an example based on data for the stock returns and book/price ratios for 1000 stocks.

H. Russell Fogler, partner in Aronson and Fogler, discussed artificial intelligence, in terms of genetic algorithms, classification trees, and information theory. The importance of the last of these is that events that have very low probability (surprises) have a high information content. Rather than emphasizing orderly relationships, information theory suggests that the information payoff lies in the residuals.

Fogler distributed a paper entitled “Quantitative Research and Artificial Intelligence,” and a paper by Gary Koehler and himself entitled “Data Classification Algorithms.”

He provided a brief introduction to genetic algorithms, and went on to discuss their weaknesses and strengths. They are most attractive for large combinatorial optimization where very small improvement is worthwhile.

Similarly, he provided a brief introduction to classification trees and discussed their strengths and weaknesses. Summarizing, he observed that linear models are simply not good enough. We must turn to nonlinear models but in the process we must give up on statistical significance, we must be careful of data mining, and a blend of traditional and computer analysis will be helpful.

Dean Barr, Chief Investment Officer at LBS Capital Management, described his firm’s use of neural networks. Each week they apply neural network analysis to 4000 stocks. They believe the return distributions are unique to each stock, and therefore have a different algorithm for each. The neural net is retrained every week, starting from scratch.

For each stock a raw alpha is produced, and combined with a stock specific variance measure to produce a scaled alpha. The BARRA optimizer then produces a portfolio. He displayed graphs for three stocks, showing distinct differences in the distribution of alpha measures. It turns out that the neural networks are much more reliable in identifying outliers in the form of very high or very low alphas, than they are at distinguishing alphas close to zero. The safest bets then are on the very high and very low forecast alphas. At the same time, the quality of the forecasts has varied over different time periods. In concluding, Barr observed that alphas must be quality controlled, but the neural networks’ ability to examine a large universe of stocks with nonlinear adaptable learning carries a significant advantage.

Steven Armentrout, Principal and Research Scientist, Neural Analytics, distributed a paper by Lowell D. Pratt Jr., James J. Gannon and himself entitled “Out of the Lab and Into the Market.” The work he described began with the failure of a proprietary analytical system based on persistence theory of market trends. In the recent past, the frequency of shifts in market preference outpaced the ability of this system to adapt. This prompted a turn to neural networks in the hope that rapid adaptation to changing market conditions could be achieved. The model used at Neural Analytics begins with 50-75 statistically significant factors, and reduces these to a manageable number of aggregates. One thousand stocks are evaluated weekly on a neural net that is retrained monthly. During the first quarter of 1994, the model performed extremely well. The market correction of March/April confronted the users of the model with a choice between using the model trained on precorrection data and using it based on post-correction data. The answer was to time weight the two periods, initially placing the greater weight on the pre-correction data and as time went on shifting the
weight more to the post-correction data. It
turned out that it would have been better to
move immediately to the post-correction data.
However, the shift in weighting was rapid
enough that although the market decline
lasted for two months, clients of the model
suffered for only one month.

OPTIMIZING

63. OPTIMIZERS AS A PRACTICAL
TOOL OF INVESTMENT
MANAGEMENT (Fall, 1994)

Richard O. Michaud, Senior Vice
President, Acadian Asset Management,
introduced the subject of portfolio selection.
The focus of five presentations on this subject
was to be the statistical character of mean-
variance optimized portfolios. His own focus
was to be on the instability of optimized
portfolios. He referred to the gulf he saw
between practice and academic research on this
subject, and the longstanding challenge to make
mean-variance optimization a practical
investment tool.

A first graph showed the classical mean-
variance efficient frontier for assets comprised
of stock indexes from six countries plus U.S. and
European bonds. Data were monthly from
January 1978 through June 1994. The efficient
frontier took the usual form, from the lowest
return and lowest standard deviation,
represented by bonds to the highest return,
highest standard deviation which happened
to be represented by Japanese stocks. It turned
out that a portfolio distributed equally across
all of the asset classes was very close to the
efficient frontier. Another graph showed the
efficient frontier for return premiums (returns
above a risk-free rate) and in this case the
stock indexes for the various countries plotted
somewhat further from the efficient frontier,
although a portfolio equally distributed across
the asset classes was still close to that frontier.

Michaud turned next to traditional
criticism of the mean-variance allocation
model. One complaint is that the semi-
variance, recording downside risk, would be
more appropriate than the variance.
Michaud's comment was that for equities the
variance is almost symmetrical so it does not
matter whether variance or semi-variance is
used. And for other asset classes he did not
think the difference would be significant. The
mean-variance criterion has the significant
advantage that quadratic programming
algorithms are available.

To the objection that the mean-variance
model is a single period model and not entirely
satisfactory for long term horizons, Michaud
commented that methodologies exist for
identifying the portfolios that are optimal in
the short term but not in the long term and
discarding these solutions.

Monte Carlo models have been proposed as
alternatives to mean-variance, but Michaud
argued that while they may be attractive for
financial planning purposes they are inferior
for portfolio optimization.

The fundamental limitation of the mean-
variance efficient modeling lies in the
instability of the optimized portfolios. This
limitation has some important consequences. It
leads to portfolios that practitioners
immediately reject as inappropriate. It tends
to maximize statistical error. And in fact the
optimizing algorithm is simply too powerful
for the level of information that has
customarily been supplied.

To illustrate these statistical
ccharacteristics of mean-variance optimization,
Michaud turned to simulation. Taking the same
asset classes and the same statistical data that
had produced the efficient frontiers
demonstrated previously, he simulated 198
monthly return premiums from the distribution
based on the original data. From these return
premiums he simulated 100 efficient frontiers,
and showed these in graphical form. The result
could be taken as a sort of informal confidence
range for the efficient frontier, derived from
the original data. What was interesting was
that the individual asset classes -- the stock
indexes for various countries -- still fell far
from the range of efficient frontiers, what
Michaud referred to as the "statistical
equivalence region."

He turned next to the topic of admissible
estimators and empirical Bayes-Stein
estimation. An empirical Bayes-Stein
procedure proposed by Frost and Savarino
shrinks both the vector of means and the
covariance matrix. A graph based on this
estimator produced a narrower range for the
efficient frontier and the statistical equivalent region was a little more compact. Michaud commented that assets and portfolios are more likely to lie within the statistical equivalence region, reducing the need for portfolio turnover and trading.

The next topic was benchmark optimization and priors. These are among the most powerful methods for reducing the instability of mean-variance optimization and enhancing the investment value of solutions. The first of three benchmark methods discussed by Michaud is the implied return procedure, which assumes that a given portfolio or index is efficient and then solves for the returns implied by the efficiency of the index and the sample covariance matrix. The procedure requires the identification of an efficient portfolio and one can begin by assuming that a manager’s benchmark index is efficient. Michaud showed graphically the efficient frontier generated by this procedure and again added his statistical equivalence region. The latter was more compact than the ones we had previously seen, but the individual assets were now much closer to the region. Michaud commented that the procedure appears to have little power to reject mean-variance inefficiency.

A second benchmark procedure is mixing forecast views from active managers with historical data. Michaud’s comment was that the procedure was not particularly robust. Small changes in assumptions can lead to significantly different optimal solutions.

Index-relative optimization is another benchmark method. The index or benchmark is defined as the portfolio with no active management risk. A graph of the optimization based on this method showed significant differences from the graphs from the Unconstrained optimization. When the statistical equivalence region was added to the graph, the individual asset classes fell well outside the region. Michaud commented that the index-relative efficient frontier equivalence region may have more power to reject inefficiency than the implied return or return premium efficient frontiers.

Finally, Michaud discussed a final benchmark optimization process based on economic liabilities. For a pension fund the benchmark is defined in terms of a model of the economic (nonactuarial) risk and return characteristics of the fund liabilities. The objective here is not to beat an index but to fund a liability. Michaud referred to two kinds of economic liabilities for a pension fund: the fixed liability that would result from planned termination and the variable liability resulting from unvested benefits. A simple example might assume sixty percent plan termination liabilities and 40 percent variable liabilities modeled with a portfolio of 60 percent government and corporate bonds and 40 percent stocks. A graph of the efficient frontier and the statistical equivalence region showed US stocks and bonds well within the region. Michaud suggested that it might be appropriate to combine mixed estimation with the economic liability approach.

Noting that mean-variance optimization is equivalent to a suitably defined constrained linear regression, Michaud suggested that many linear regression statistics can be computed and may be useful for statistical inference related to the mean-variance model. He showed the t-statistics for some of the efficient portfolios on his original return premium efficient frontier. These statistics are useful as portfolio construction heuristics, guiding the analyst to the asset weights with the most impact on mean-variance efficiency.

In summarizing, Michaud pointed out that the most serious limitation of mean-variance optimization as a practical tool is probably the statistical instability of the process. Statistical noise can be reduced by better statistical estimation procedures, particularly by the inclusion of priors. And the statistical equivalence region is useful in describing the variability inherent in mean-variance optimization. It can serve as a statistical test of the efficiency of candidate portfolios, and in many practical cases this is all that is required.

64. ESTIMATING THE MEAN-VARIANCE EFFICIENT FRONTIER: THE MARKOWITZ CRITERION IS NOT ENOUGH (Fall, 1994)

J.D. (Dave) Jobson, Alexander Hamilton Professor of Business, Faculty of Business, University of Alberta, distributed a paper
entitled “Estimating the Mean-Variance Efficient Frontier: The Markowitz Criterion is Not Enough.” He began with a quick review of the mean-variance optimizing procedure. And he provided an example based upon twenty assets. To estimate the Markowitz efficient frontier we need twenty asset return means, twenty asset return variances, and 190 asset return correlations. The assumptions are serial independence and normality, and constant distribution of parameters over the observation period. In practice, it is difficult to rank asset mean returns reliably. The variation in the mean return of a single asset from period to period is greater than the variation between different asset means. In addition, the results of the Markowitz Criterion are very sensitive to the rank order of the sample means. The result is that estimation risk makes the promised return an unlikely event. The objective pursued by Jobson was to reduce estimation risk by constraining parameters. To do this he studied how the parameters affect the values associated with the Markowitz Portfolio and he also studied the properties of the sample estimators of the parameters. He posed four questions: whether asset mean returns are equal, whether correlations among assets are equal, whether the asset Sharpe ratios are equal, and whether variances and covariances are equal. His approach to answering these questions was to determine the number of observations necessary to reject the hypothesis of equality. If that number turned out to be large (and it was 960 months in the case of the equality of mean returns) one needs very large samples in order to detect significant differences among the assets. The analysis led Jobson to conclude that it would be reasonable to assume equal correlations, equal Sharpe ratios, and equal covariances. He concluded however, that variances should not be assumed equal. The sampling behavior of the mean, variance, Sharpe ratio, and correlation coefficient confirmed these conclusions.

The assumption of a constant Sharpe ratio across assets implies that the asset mean returns should have a linear relationship with the asset standard deviations, hence the use of the asset variances coupled with the mean Sharpe ratio determined the expected returns. In fact, the Sharpe ratios all fell within a fairly narrow range, and a regression of mean returns on standard deviations supported the assumption of a constant Sharpe ratio across assets. Similarly, a correlation histogram supported the choice of the average correlation for all asset pairs.

Jobson turned next to the possible influence of a single extreme observation on the sample mean, the sample variance, and the sample Sharpe ratio. It turns out that the sample mean is quite vulnerable to extremes, although the sample variance is not. The sample Sharpe ratio was quite sensitive, consistent with the sensitivity of the sample mean. Jobson suggested that return data should be scanned for extremes and some form of robust estimation should be considered.

Jobson next compared three models: the unrestricted mean-variance optimization model, the constant correlation model, and the constant correlation with constant Sharpe ratio model. The last of these he referred to as the baseline model. The comparisons included the number of parameters, which were 230, 41, and 22 for the three models, as well as the conditions for positive weights and the actual efficient frontiers derived from the models. The constant correlation model produced an efficient frontier very close to that from the unrestricted model. The baseline model, however, did produce a somewhat different frontier. An interesting observation had to do with estimates of beta coefficients. Betas were calculated as the ratio of the mean return premium to the mean market return, assuming the “market” consists of the twenty assets. Jobson suggested that the betas derived from the constant Sharpe ratio assumption may be more useful than the betas derived from other sources.

Finally, Jobson reported the results of a simulation study in which he drew a sample of 60 observations from his population, and computed efficient set parameter estimates and from them portfolios. A comparison of mean square errors indicated the superiority of the baseline model over the unrestricted model. In conclusion, Jobson stated that his baseline model is a useful starting point for asset allocation. It yields low estimation risk. The practitioner may choose deviations from this baseline, but this should be done with caution. Estimation risks will rise with departures from the baseline.
65. INTERTEMPORAL INVESTMENT OPPORTUNITY SETS AND PORTFOLIO FORMATION: IMPLICATIONS OF THE ASSETS AND THE ESTIMATION (Fall, 1994)

Bob Korkie, AF Collins Professor of Finance, Faculty of Business, University of Alberta, distributed a paper entitled "Intertemporal Investment Opportunity Sets and Portfolio Formation: Implications of the Assets and the Estimation." For Korkie's purposes, the investment opportunity set (IOS) is the set of efficient portfolios resulting from an optimization process. His objective was to construct a limited IOS that makes sense. He showed the familiar hyperbola that represents the IOS resulting from unconstrained mean-variance optimization. He then showed how the addition of very low risk assets shifts the hyperbola towards the vertical (expected return) access, and in the extreme case, where the zero risk asset is included, the hyperbola becomes a triangle with its vertex at the point represented by the risk free asset. The IOS then consists of two straight lines. This extreme case is of some interest, because since the risk free return is known only the slope of the IOS is unknown and subject to estimation error. The inputs to the optimizing process (termed "conditional moments" by Korkie) are the familiar forecasts of returns, variances, and covariances.

Korkie represented the actual (unknown) return on an asset as the sum of the expected return and the unknown forecast error and the covariance as the sum of the estimate and the error in that estimate. Rational expectations imply that the errors in the mean and covariance estimates are unrelated to the available information set instruments. This implies unbiased forecasts of the conditional mean and covariance moments and that forecast errors in the returns will not be related to past values of the conditional means, covariances, or their past errors. These rationality restrictions are important, and the question is how one can implement the restrictions while obtaining the coefficients of the conditional moment equations.

Korkie suggested that a conditional mean might be represented by a first order autoregression combined with economic variables and private information. The conditional covariances might be obtained by a similar model based on the GARCH (Generalized Autoregressive Conditional Heteroskedasticity) model. Korkie referred to a GMM (Generalized Method of Moments) procedure.

Korkie demonstrated the procedure drawing on monthly return observations from January 1963 through December 1990, for five financial asset portfolios and a set of information instruments. The assets were US Treasury bills with 1, 2, and 5 months to maturity, a long term government bond portfolio, and a value weighted stock index. The information instruments were: a constant, the first lag of the one month treasury bill return, two lags of an asset's return, two lags of both the stock index and the bond portfolio monthly returns, a January indicator and variable, two lags of own squared errors and own absolute errors. Using GMM, the coefficients of the mean and the covariance equations were computed. The conditional moments for each asset class were then computed and were used to compute the parameters of the IOS for the month. The process was repeated monthly, thereby generating a sequence of investment opportunity sets through time.

Graphical representations of the results showed two things: the addition of information instruments resulted in a different and perhaps more precise estimate of the conditional IOS, and there was considerable variation in the IOS from month to month, with the changes being predictable. Korkie concluded that more information leads to more precise forecasts and hence a more precise IOS. An interesting question is how precise the forecasts have to be to produce a valuable IOS. We do not yet have an answer to this question.

66. DEALING WITH ESTIMATION RISK IN PORTFOLIO SELECTION (Fall, 1994)

Philippe Jorian, Associate Professor, Graduate School of Management, University of California Irvine, distributed a paper entitled "Estimation Risk in Portfolio Selection." He began by picking up the statements of Dick Michaud to the effect that optimized portfolios are rarely used by practitioners because these portfolios lack "investment
value” and provide unstable optimal solutions. Three explanations are that (1) the investment weights are extremely sensitive to changes in inputs, (2) the expected return inputs contain error which leads to estimation risk, and (3) the optimizer tends to load on assets that show large estimation error and thus acts as an “error maximizer.” Two solutions to the problem appear to be the imposition of restrictions, such as a prohibition against short-selling, to make optimized portfolios more “reasonable,” and on the other hand to take a Bayesian approach.

In discussing estimation risk in portfolio selection, Jorion proposed a measure of the impact of estimation risk as the loss of utility due to making incorrect decisions based on estimated parameters. And he set out this loss in the form of an equation.

Jorion found constrained estimation to be unsatisfactory. The constrained rates are not real, but are imposed to produce an appearance of reasonable portfolios. If they are motivated by a desire to reduce transaction costs, then the objective function should be modified to account for these costs, instead of using artificial constraints that imply infinite costs. In any case, the constraints lead to suboptimal portfolios.

The Bayesian approach is to add information in the form of a prior distribution. This distribution is combined with sample evidence. The empirical Bayes approach is related to “shrinkage” estimation methods, leading to estimators of the mean return that are obtained by shrinking the usual sample mean toward a common value. Shrinkage begins with the weak prior that all assets have the same mean return.

An alternative is the use of equilibrium Bayesian estimators. An equilibrium model, such as the Capital Asset Pricing Model, is used to establish equilibrium returns. From the covariance matrix and the optimal portfolio, one can derive the implied rates of return.

Jorion next turned to simulation evidence on the usefulness of the different approaches. He worked with ten assets that were the ten size portfolios comprised of NYSE stocks sorted on the basis of market values at the beginning of each year and weighted equally. The size effect insured a reasonable dispersion of returns.

Summary statistics for the period 1931 through 1993 showed, as might be expected, mean returns ranging from high returns for the small size decile through low returns for the large decile, with standard deviations high for the small size decile and low for the large size decile. Jorion also presented statistics for the optimal portfolios over the sixty-three years.

He presented a graph of the loss due to estimation error for five estimators: the classical (Unconstrained) estimator, the Bayes-Diffuse estimator (which increases the variance/covariance matrix), the Bayes-CAPM estimator, the Bayes-Stein estimator, and the minimum variance estimator (which simply minimizes risk and ignores returns). For a sample size as short as five years, the loss due to estimation error in the Unconstrained model makes the model quite unusable. For the Bayes-Diffuse model, the loss is still substantial. For the Bayes-CAPM model, the loss is much smaller, but still significant. For the Bayes-Stein model, the loss is small, and for the minimum variance model it is quite small. As the sample size is increased from 5 to 10 and then to 20 years, the loss due to estimation error drops very significantly for all of the models, and ends up within a very narrow range for all five models. In effect, as the sample size rises the loss due to estimation error is reduced, ultimately to essentially zero. Jorion commented that the same result can be achieved by access to good information, which is equivalent to increasing the sample size in terms of reducing estimation error.

He repeated the depiction of loss due to estimation error, in a case where no short sales are allowed. In this case, for all of the estimators, the loss due to estimation error was quite small even with a sample size of only five years. At the same time, the benefits from increasing the sample size were smaller, and in the limit the estimation error drops to 2 percent rather than to zero. The lesson was that if one has good information then it is best not to impose the short-sale restriction. But for small sample size and little information imposing a ban on short sales may be quite useful.

Jorion then moved to the question whether the covariance matrix can be reliably forecasted from historical information. This is important because the Bayes-CAPM and the minimum variance approaches rely heavily on
the covariance matrix for portfolio selection. To assess the forecastability of the covariance matrix, Jorion reported an out-of-sample experiment. Using the size deciles, portfolios were constructed each month from 1931 to 1993 to have minimum risk, using only prior information from a moving window of 2 or 5 years. Three models were considered: one with correlations equal to their historical values, another with correlations equal to the mean correlation, and a third with correlations derived from a single factor model, using the index as the factor. The lowest risk was obtained by the full historical model using five years of data. Imposing a no short sale restriction significantly degraded performance. Jorion commented that these results demonstrate that imposing artificial restrictions such as positive weights, or a simplified correlation matrix, is not always warranted.

In concluding, he said that estimation risk is indeed a major impediment to the use of mean-variance optimizing models. One can attempt to solve the problem by imposing restrictions, but a better avenue is a Bayesian method, and a choice of Bayesian methods is available.

67. MEAN-VARIANCE PORTFOLIO ANALYSIS: SOME PRACTICAL PROBLEMS AND THEIR SOLUTION (Fall, 1994)

Andrew L. Turner, Director of Research, Frank Russell Company, presented what he described as a practitioner approach to mean-variance optimization. He noted at the outset that there are two paths of research on the subject at the Frank Russell Company. One consists of efforts to adjust forecasts or constraints to obtain reasonable results from the mean-variance analysis, while the other differs somewhat from mean-variance analysis and depends upon operations research and management science methodologies. He intended to restrict his presentation to the former.

He reiterated the shortcomings perceived by investors in the mean-variance technique that had been mentioned by other speakers. These included oversensitivity to forecast errors in the inputs and the fact that portfolios similar to the optimal portfolio in risk and return can be very different in composition. He added the observation that investors do not always equate risk with total variability of portfolio returns. He noted that a difference is perceived between long and short term forecasts, and the mean-variance optimization is a single period methodology. Finally, transaction costs and trading activity seem excessive when the mean-variance model is used. The optimization process itself presents difficulty in dealing with derivatives and other assets with highly skewed distributions.

Turner described a first experiment to compare the loss measured in percentage cash equivalent terms due to errors in means, variances, and covariances. It turned out that the percent cash equivalent loss could be very significant due to errors in means, but fairly small due to errors in variances and especially in covariances. A second experiment measured the effect on portfolio composition of errors in the same three measures. Once again, errors in the mean returns could produce substantial turnover, errors in variances could produce not insignificant turnover, and errors in covariances could produce low levels of turnover.

An examination of near-optimal portfolios showed that portfolios very close to the optimal in return and risk characteristics could have substantially different compositions. The implications were that moving to or staying at a near-optimal portfolio may be preferable to incurring the transaction costs of moving to the optimal portfolio. And high-turnover strategies are justified only by dramatically different forecasts.

Minimizing the impact of forecast errors and improving portfolio performance could be achieved in three ways: (1) Using appropriate minimum and maximum constraints on asset weights, (2) treating similar assets in a similar manner, and (3) using transaction costs in the optimization for a more accurate representation of reality. A third experiment tested the improvement in performance from the judicious use of constraints. A comparison was made between the performance of an unconstrained portfolio and a constrained portfolio with a band of plus or minus 10 percent around the benchmark which was a portfolio consisting of 60 percent stocks, and 40 percent bonds. In
addition, the impact of 20 percent and 30 percent constraints was examined. All three constraints produced better results than the unconstrained optimization. Yet all four optimizations produced results worse than simply holding the 60/40 benchmark.

An alternative to imposing constraints is modifying the inputs. A fourth experiment examined improvements in performance from using adjustments to inputs. Three levels of "shrinkage" were used. First, the expected return for each stock was set equal to the average of returns across stocks. The same was done for bonds. Second, in addition to the first shrinkage all stock-stock and bond-bond correlations were set equal to the within-group averages. Third, expected returns, correlations and variances were set equal within an asset class. That is, all stocks were treated as identical, all bonds as identical, and all cash as identical, independent of country. The results showed that portfolios with adjusted inputs dominated the portfolio based on simple historical inputs. And once again even the 60/40 benchmark dominated portfolios with unadjusted inputs. Turnier closed with a brief discussion of alternative stochastic models. He suggested alternative definitions of risk (for example penalized shortfalls) and a multiperiod model for multiple time horizon problems.

During the question period, Harry Markowitz presented his view of the state of mean-variance models. He observed that mean-variance models have been developed to deal with a number of utility functions, and some can deal with derivative assets. Liquidity, he said, is the real problem. It may simply be extremely difficult or expensive to dispose of positions in many securities. Turnover constraints may be helpful in dealing with this problem. He also suggested that limitations on holdings of individual assets are fairly common, and he seemed to feel they were appropriate. He commented on work that has already been done to deal with the problem of long-term optimization and agreed with Turnier that multi stage optimization is worth exploring.

**PERFORMANCE MEASUREMENT**

68. **FIXED INCOME PERFORMANCE ATTRIBUTION** (Spring, 1994)

H. Gifford Fong, President, Gifford Fong Associations and Oldrich Vasicek, Senior Vice President, Gifford Fong Associates, distributed an outline of their presentation, and Gifford Fong began with an overview. He pointed out that it is important to separate the performance of a fixed income portfolio into the portion due simply to market movement and the portion due to management activity, and to specific management skills. This separation is useful in determining compensation for managers within a management firm, and useful to clients in selecting and monitoring managers.

To begin with, what we want is the time weighted rate of return for a period of time which Fong took to be generally one month because of data availability. We need the values of the assets at the beginning and end of the month, and we need to know the cash flows in and out of the portfolio and in and out of individual securities, during the month. Fong went on to describe three levels of decomposition of the total return on the portfolio. The first separates the contribution of the market and the contribution of management. The contribution of the market can be further subdivided into expected and unexpected market performance. The former is the return that would have been achieved had there been no change in forward rates. The second level of decomposition continues with the determination of any duration policy effect. In the absence of a duration policy imposed on the manager, deviations from the duration of the market index will be attributed to management decisions. The second level decomposition goes on to subdivide the return attributable to management into the results of interest rate management, sector/quality management, security selection, foreign exchange, and transaction timing. The third level of decomposition subdivides interest rate management into returns due to duration choices, convexity, and yield curve shape change anticipation. It also subdivides the foreign exchange contribution into local market performance, currency performance, and the effect of hedges. Fong showed a sample analysis for a portfolio with the component
returns shown for all of the management attributes. He also discussed the time series analysis of return residuals. This would help to determine the significance of the contributions that had been attributed to various management skills. He also discussed the data required for the analysis, including the rather routine descriptions of securities held, but going on to risk exposures for each asset or commitment brought about by duration, partial durations, convexities, volatility exposure, and foreign exchange exposure.

Vasicek then took up the presentation, beginning with measures of exposure for each security to a variety of risk factors. For duration, for example, several key maturities are viewed as driving yield curve changes. The partial duration for a security is the sensitivity of the price of that security to a change in the yield at that key maturity. Vasicek explained that this sensitivity is computed by valuing the security at the actual yield for the maturity and at a slightly different yield, using a valuation model. The partial durations, for the various key maturities, are then added up to determine the total duration. The exposure to market volatility is the sensitivity of the security price to changes in volatility. (The importance of volatility in interest rates, as opposed to simple changes in the level, had been discussed in an earlier presentation to the Q Group.) Exchange rate exposure is measured by the sensitivity of the price of the security to exchange rate changes. The price change for each security due to its exposure to these risk factors is simply the sum of the risk factor changes multiplied by the risk exposures.

The duration component of return is given by the shift in the yield curve multiplied by the difference between the security duration and the market duration. The convexity component combines a measure of the yield curve shift and the yield curve twist with the difference between the convexity for the security and the market convexity. And the effect of the yield curve shape change is calculated as the sum of the differences between the security partial durations and the market partial durations multiplied by the changes in the factor rates, less the duration and convexity components.

For each security the total return is calculated essentially from accounting data including beginning and ending prices and accrued interest, coupon income and principal repayment. And this total return for the security is in turn represented by the sum of market return, duration effect, convexity effect, yield curve shape change, sector effect, and security specific return.

Vasicek next turned to the contribution of derivatives. Derivatives that are themselves securities (for example, options) present no special difficulty. They can be treated simply as securities. Derivatives that take the form of contracts, however (such as futures contracts), must be treated differently. Their effect on portfolio duration and return must be empirically determined.

The contribution of foreign securities is straightforward, with separation into local currency return and the effect of exchange rate change.

In answer to a question, Fong said that client accounting data with respect to prices were used as input to the model, and these data might of course be subject to error. In answer to another question, Vasicek said that embedded options in fixed income securities were accounted for when the risk exposures were calculated. This is a very complex process, since the security, with its embedded option, must be valued twice in order to determine price sensitivity to changes in a risk factor.

69. ON-LINE PERFORMANCE MEASUREMENT (Spring, 1994)

David M. Stein, Director of Quantitative Portfolio Management & Research, IBM Retirement Fund and Thomas K. Phillips, Director of Advanced Research, Rogers, Casey & Associates, distributed a paper by themselves and by Emmanuel Yashchin, IBM T. G. Watson Research Center, entitled "On-Line Performance Measurement for Actively Managed Portfolios." David Stein began the presentation, stating that what was wanted to monitor the performances of retirement fund managers was a standardized approach that could be presented in both graphical and statistical terms. The focus was to be on a rate of return relative to a benchmark, consistency of returns or excess returns achieved by a manager,
and the use of risk-adjusted returns, with the emphasis on establishing confidence in the manager's ability. All of this was to be achieved on an on-line basis, so that deficiencies in performance could be identified as soon as possible.

The starting point was measuring monthly excess rates of return relative to a benchmark. Simply plotting these excess returns, and adding a 12-month moving average, provided a useful picture of the performance of a manager through time. Three useful statistics were the excess return, the tracking error, and the information ratio which is simply the excess return divided by the tracking error. Stein took time to explain why the tracking error is of particular interest. It can be estimated from monthly data far more precisely than total volatility can be estimated. And when combined with the excess return to produce the information ratio, the result establishes the probability that a manager will outperform the index in the future. The more traditional portfolio alpha, derived from the linear model, is important and Stein discussed the alpha measurement and a measure of confidence that the alpha is greater than zero.

Phillips took over the presentation to move from measurement of performance to monitoring of performance. The key to their methodology is statistical quality control. The technique was developed at the Bell Labs in the 1930s to monitor a manufacturing process and determine whether the process was in or out of control. In our case the question is whether the investment management process is in or out of control. Put another way, the purpose of monitoring is to raise an alarm as soon as there is sufficient statistical evidence to indicate that a manager is underperforming his or her benchmark.

The statistical process for quality control in the case of monitoring investing management differs somewhat from the process developed for monitoring a manufacturing process. The CUSUM (Cumulative SUM) procedure was developed by E. S. Page in 1954. The key measure is the cumulative sums of deviations from the benchmark (excess or negative excess returns). One plots a graph of the cumulative excess returns through time and observes the slope of the plot over any period of time. A positive slope indicates the continued achievement of excess returns, and a consequent rise in the cumulative excess return. A negative slope indicates negative excess returns and a decline in the cumulative excess return. The point of this procedure is that changes in slope are relatively easy to detect. To monitor a money manager, we look for evidence that the current slope of the CUSUM plot has turned negative.

It is important that the CUSUM procedure is more than just a visual tool. Page developed the theory of the CUSUM which is a Likelihood Ratio Test. It is robust to distributional assumptions, and demonstrably optimal for detecting changes in a process. The CUSUM procedure begins with the formation of a sequence of likelihood ratios going back in time. We stop at the maximum likelihood ratio, and discard all data preceding the time period from which this maximum likelihood ratio was determined. We next compare this likelihood ratio to a preestablished threshold. If the ratio exceeds the threshold, we have a warning that the manager's ability appears to be deteriorating.

Summarizing the technique, Phillips set out the following steps:

1. Decide on a measure of performance, and the recommended measure is the information ratio.
2. Define realistic good and bad levels of performance. The suggested levels are 0.5 or better as a good level and 0 or worse as a bad level.
3. Fix an acceptable level of false alarms. The methodology can be expected to produce a number of alarms that are not reliable indicators of unsatisfactory performance. The recommendation is that one anticipate and allow for one false alarm in seven years or longer.
4. Plan the action that will be taken if an alarm is raised. It would be foolish to treat the alarm as the basis for dismissing a manager. The action called for is investigation, and a careful review of possible causes of an apparent deterioration in management skill.

Phillips' conclusions were:

1. CUSUM is a powerful technique for monitoring performance.
(2) The technique is simple to use and requires minimal data collection.

(3) It must be used with caution, recognizing that false alarms can and will occur.

70. THE PERFORMANCE MEASUREMENT AND VOLATILITY OF UNQUOTED PENSION FUND INVESTMENTS (Spring, 1993)

Peter W. Stanyer, Investment Director, British Rail Pension Trustee Company, Ltd., distributed a paper by himself and Kathryn Long entitled "The Performance Measurement and Volatility of Unquoted Pension Fund Investments."

As of the end of 1992, some 9.3 percent of the assets of the British Rail Pension Fund was invested in unquoted asset classes: 1.3 percent in venture capital, 7.3 percent in real estate, and 0.7 percent in works of art. Stanyer explained why the fund had invested in works of art. The investment objective of the Fund was to maintain purchasing power against the inflation rate in the U.K. In 1974, real returns had for some years been extremely negative for equities, bonds, and real estate. In searching for some way to keep up at least with inflation, the trustees decided to invest in works of art. Approximately 2,024 items purchased in October 1974 had been sold by January 1992. The purchase and sale prices of these items had been used to compute some statistics on the performance of art investments.

Statistics on the performance of real estate investments were based on realized internal rates of return from purchase to sale for 1,730 individual properties, obtained from Jones Lang Wootton's property performance assessment system. Venture capital data were obtained from purchases and sales of 85 direct investments in individual unquoted companies by the British Rail Pension Fund since 1976. Stanyer felt that the data were representative for U.K. real estate and works of art, but had some doubts about how representative they were of U.K. venture capital.

Art market auctions provide an unusual opportunity for testing the reliability of experts' valuations. At these auctions expert valuation ranges are published -- the range within which the expert believes the item will be sold. It turned out that for the 1,700 auctions of art items, "hammer prices" failed to reach the experts' low estimate 28 percent of the time and exceeded the high estimate 47 percent of the time. The high and low estimates themselves were on average 18 percent above and below the mid-point of the range. For the actual price to have fallen within the guide range in two-thirds of the sales, the range would have to have been widened to the central estimate plus or minus 50 percent. This gives an indication of the degree of uncertainty of value in expert appraisals.

The performance measures used for all three markets were internal rates of return, which of course combine investment manager performance with the timing of the purchases and sales. It turned out that the internal rate of return, after inflation, was 5.6 percent for the pension fund works of art, and for the same time period was 3.3 percent in U.K. treasury bills and 12.1 percent in U.K. equities. The authors had added some statistics for a U.S. investor and a Japanese investor. Had a U.S. investor had the same experience in works of art as the British Rail Pension Fund, the return, after U.S. inflation, would have been 6.9 percent on the works of art, compared to 2.7 percent in U.S. treasury bills and 8.3 percent in U.S. equities. A Japanese investor, again with the same investments in the works of art, but adjusting for Japanese inflation, Japanese treasury bills, and Japanese equities, would have experienced a return of 4.3 percent on the works of art, 3.5 percent on treasury bills and 15.5 percent on equities. Stanyer pointed out that the relative attractiveness of works of art, which he felt constitute part of a worldwide art market, vary substantially for investors from country to country.

The volatilities of the returns in the three unquoted asset classes were estimated largely by trial and error. It was assumed that the logarithms of realized returns were normally distributed, and standard deviations were tried out to see what distribution best approximated the actual distribution of realized returns. For art objects and for real estate, the normality assumption seemed justified, but for venture capital the distribution appeared hardly normal. The implied standard deviation of the logarithms of annual returns were 0.225 for works of art and 0.215 for U.K. real estate. The best estimate for venture capital was 1.00, but this estimate is somewhat less reliable than
the other two. Staney commented that these figures should be taken as minimum estimates of specific risk for individual unquoted investments, because the observations cannot be regarded as independent. The holding periods for the individual investments generally overlapped, so that if there is any market effect it will tend to have biased the measures downward. There is probably a market effect for all three classes, although it was not possible to identify it specifically. Some work with non-overlapping returns for real estate suggested that the bias due to lack of independence of observations is probably small.

The 21.5 percent standard deviation for real estate could be compared with the 15.5 percent standard deviation obtained from a valuation series based on surveys rather than actual transactions. These figures suggested a smoothing factor of 1.4 results from the use of valuations rather than transaction prices.

It turns out that real estate appears to indicate a lower risk for individual properties than one finds for blue chip company stocks in the U.K. Staney explained this in part on the fact that it is customary in the U.K. (or was until very recently) to employ exclusively 25-year leases. This made investment in real property very similar to investment in a bond.

71. A CONTINGENT CLAIM APPROACH TO PERFORMANCE EVALUATION (Spring, 1994)

Lawrence R. Glosten, Professor, Columbia University, distributed a paper by himself and Ravi Jagannathan of the Federal Reserve Bank of Minneapolis and the University of Minnesota entitled "A Contingent Claim Approach to Performance Evaluation." The research was supported by the Q Group.

Glosten summarized the paper as showing that valuing performance is equivalent to valuing a particular contingent claim on an index portfolio. The contingent claim is approximated by a series of options. The trick is to construct this series of options.

The performance measured here is the value added by the portfolio manager. It does not attempt to address the question what are the sources of the value added. Glosten discussed the familiar use of linear beta pricing models like the capital asset pricing model and the shortcomings of these models when applied to portfolio using derivatives. The linear model assumes a straight line relationship between the return, or excess return on a portfolio and a risk measure. The assumption is that the error term is unsystematic, but where the portfolio makes use of derivatives the error term is systematic and the linear evaluation model will give incorrect results. In general, the CAPM model would find an erroneous negative alpha for a portfolio of call options even though management neither adds nor subtracts value, and would find a positive alpha for a strategy of writing covered call options, again when the management neither adds nor subtracts value. The approach of the authors was to characterize the nature of portfolio returns in terms of contingent securities defined on factor risks, and to value the relation between the factor risks and the portfolio returns. This amounts to valuing the contingent securities.

As we saw, the linear relationship that prices returns off risk factors, as in the capital asset pricing model, cannot be relied on when the portfolio makes use of derivatives. We need something other than a linear relationship. Glosten discussed the possibility of using a polynomial. The coefficients in the polynomial might be obtained from a regression. The polynomial approach, however, has two weaknesses. First, the estimated coefficients can be very sensitive to outliers, and second, it is hard to think of powers of the index as contingent claims. The methodology chosen by Glosten makes use of linear splines. In essence, we imagine a curved line tracing the expected relationship between the portfolio returns and the returns on an index. We approximate this curved line by a series of straight lines. The points at which the straight line segments intersect the true curved line are known as "knots." In order to apply the methodology one must specify in advance the number of knots and the location of the knots. The method the authors used to make these decisions was to run simulations for an investment strategy that involved buying 3-month call options, holding them for a month, and then selling them. The strategy that involves no value added buys the call options at the Black-Scholes price. The simulations were run for exercise prices ranging from .95 to 1.2 of the value of the index. We know the true
value of the excess return is 0, since the options were all purchased at the Black-Scholes value. It turned out that 3 knots gave a close approximation to a 0 excess return. Having concluded that a choice of 3 knots would be satisfactory, the authors next addressed the question how good their model is at identifying true excess return. So they now simulated an informed strategy, and the results, for a 3 knot spline and even for a 1 knot spline, indicated that the process is unbiased and reasonably good at identifying true superior performance.

The next question concerned the choice of an appropriate index. One obvious choice, in evaluating common stock portfolios, is the equally weighted index portfolio of stocks on the New York Stock Exchange. Another choice might be the value weighted index. The authors chose to apply their methodology to evaluate the performance of mutual funds, and then to examine the sensitivity of their results to the choice of index.

The performances of 130 mutual funds over the period 1968 to 1982 were evaluated. A number of conclusions could be drawn. There were substantial differences in the estimates of value added between the use of the two indices. However, the value estimates were highly correlated and the rank correlation was also very high. Some funds were classified as adding value independent of whether the equally weighted or the value weighted index was used. The 1-knot and 3-knot spline specifications produced very similar results, suggesting that the use of a 1-knot spline approximation is good enough for this particular application. Use of the equally weighted index produced generally lower values for the excess return.

The top performer was found to be the Templeton Growth Fund. It was interesting that the shape of the fit tended to be concave with a positive intercept. The shape corresponded to a fund that uses written covered calls in its portfolios, and obtains a better than fair value for those written calls.

72. MEASURING MARKET TIMING STRATEGIES (Spring, 1992)

Gilbert L. Beebower, Executive Vice President and Michael Kantor, Vice President of SEI Corporation distributed a reprint from the Financial Analysts Journal, November-December, 1991 entitled "Measuring Market Timing Strategies" by Beebower and A. P. Varikooty. Beebower commented on the popularity of asset allocation strategies, suggesting methodologies for measuring market timing ability and empirical tests for such ability.

The study being presented examined one parametric and five non-parametric methods for measuring market timing performance and evaluated the relative usefulness of these methods. The first method was the Henriksson-Merton parametric test; the second was their non-parametric test, the third made use of the standard t-statistic test for superior performance relative to a benchmark; the fourth measure was the percentage of times the market timer underperformed the benchmark; the fifth measure was a non-parametric chi-square test where the null hypothesis was that the timers' proportion of investment in an asset class was independent of whether a bull or bear market prevailed; and the sixth test applied the Probit model, focusing on the timers' propensity to invest in a particular asset class, given the differences between the returns of various asset classes.

The measures were tested using a simulation. The two assets available to the simulated manager were the S&P 500 Index and Treasury Bills, over the 64 years 1926 through 1989. The first step in the simulation was identification of bull and bear market phases. This was done assuming a 10% change rule as the sign of transition between phases. Following the 10% rule, Beebower had identified 63 turning points, where a bull phase changed to a bear phase or vice versa. On average then there was a switching opportunity about once a year. A 5% cut-off (rather than the 10%) was also used, to produce 127 turning points or about two switch opportunities a year.

A number of hypothetical managers were assigned forecasting probability distributions, identifying each manager's probability of calling the turning point as much as 10 months early or as much as 12 months late. That is, to each of 23 months from 10 months before the turning point to 12 months after, a probability was attached that the manager would recognize in that month that a turning point
was about to take place or had taken place. This distribution characterized the manager through the entire 64-year period. The probability distributions were designed to simulate the performances of managers with different forecasting characteristics, including managers who are systematically late in detecting bull or bear markets as well as some who are systematically early.

The manager having recognized a bull phase is assumed to become 100% invested in the S&P Composite Index, while recognition of a bear phase was taken to result in a switch to 100% investment in treasury bills. For each manager, 200 simulations were run. Both average return and standard deviation were calculated on a monthly rolling basis for every one, three, and five-year period over the entire 64 years. The simulations were also performed for the 44-year period 1946-89.

Beebower presented the results for nine different simulated managers (with nine different probability distributions), given the 5% cutoff rule to identify bull and bear phases over the 64-year period. The average monthly excess returns above or below the S&P 500 ranged from -0.015% to 1.033%. The monthly standard deviations of excess return varied in a narrow range around 4% per month. What was particularly interesting were the accompanying percent probabilities of under-performing in any given year. A manager who added no value through timing could be expected to underperform the S&P 500 in any given year with a probability of approximately 42%. But a manager who added 1.5 to 2% to the S&P 500 return might be expected to underperform about 35% of the time. Beebower believes that these probability of underperformance statistics are important to clients of market timing managers. They emphasize the perhaps surprisingly large probability of underperforming years for managers that do add significant value over a long period of time.

Michael Kantor continued the presentation, discussing the testing methodologies that had been evaluated. It turned out that the t-test was the most satisfactory. In this case the t was measured as:

$$t = \frac{\bar{R} - \mu}{\sigma / \sqrt{n}}$$

Beebower summarized the research as exploring useful ways of presenting to clients of market timing managers appropriate expectations. T-values based upon past performance appear to be the most useful, in discriminating between good and bad management. The Probit criterion was next most useful, probably erring on the side of caution. None of the other methods seemed useful. Even the t-statistic test is not as useful as a practical matter as the simulations might have suggested. The t-statistics derived in the research resulted from running 200 simulations for the entire 64-year period. It turns out that one needs a great many years of observation -- far more than we ever have in a real situation -- to establish timing ability at a 95% confidence level. Even for the best of the simulated managers, four years of data would be required and for the second best 96 years of data would be required. In short, even if real timing skill exists, it is extraordinarily difficult to distinguish it from pure luck.

PRIVATE PLACEMENTS

73. THE STRUCTURE AND PRICING OF PRIVATE PLACEMENT CORPORATE LOANS (Spring, 1994)

Willard T. Carleton, Karl Eller Professor of Finance, University of Arizona and Simon Kwan, Assistant Professor of Finance, University of Arizona, distributed a paper entitled "The Structure and Pricing of Private Placement Corporate Loans." Carleton opened the presentation with a description of the peculiar characteristics of private placement loans. First, the secondary market for privately placed debt is extremely limited. Lenders expect to be compensated for the lack of liquidity, either by a premium in the interest rate or by contract provisions reducing their risk. A sample of contract provisions was contained in an appendix to the paper, drawn from what Carleton considered to be a representative private placement made in May, 1991 from a privately held, highly leveraged company. The loan was priced relative to the yield on the treasury security whose maturity most closely matched the
loan’s average life. The spread of course constituted only the “explicit” price, while “implicit” prices were embedded in other contract provisions. The first of these had to do with security, provided by the senior status of the loan, specific asset security, and by key man insurance and guarantees. Redemption was dealt with by provisions for scheduled principal redemption from years 3 to 10 and, after 4 years, optional redemption. Of considerable importance was that the call price involved a “makewhole” provision, that had the effect of sharing the refunding gains from a decline in interest rates between lender and borrower. Covenants were considerably more complex than what one would expect to find in a public debt issue. Provision for event risk consisted of a put option for the lender in the event of a change in control of the firm. This particular put option stems from the likely consequence of a leveraged buyout in increasing the risk to existing lenders, as happened in the case of the RJR Nabisco buyout and the more recent announced Marriott restructuring plan. Lenders have become more sensitive to the consequences of substantial increase in leverage on the part of a borrower, but protection in the form of a put option seems so far to be largely restricted to the terms of private placements and not incorporated in the terms of public offerings.

Important aspects of the private placement are monitoring and contract renegotiation. In the public debt market, loan monitoring is generally delegated to a third party, such as a trustee and/or a bond rating agency. In the private placement market, loan monitoring is performed directly and primarily by the private lender or lender group. In the public debt market, contract renegotiation, other than in the event of financial distress, is virtually impossible because of the Trust Indenture Act of 1939, which requires unanimous debt-holder consent before the loan contract can be altered. For privately placed loans the number of lenders is generally small, and debt restructuring is relatively easy and quite common.

Carleton introduced the quantitative empirical analysis of the paper by describing the data used. Terms and conditions of 585 privately placed loan contracts, approved between January 1985 and December 1992, were obtained from Teachers Insurance and Annuity Association. Some summary statistics on the private placements were compared with corresponding statistics for a sample of public market bonds issued by publicly held companies between 1985 and 1992, obtained from the Merrill Lynch Corporate Bond File. Firms borrowing in the public market tended to be bigger in terms of total assets and sales revenues. The public market bonds on average were larger in size and longer in maturity. They were also less likely to have call option, put option, and sinking fund provisions than private placement loans. None of the public issues had a “makewhole” provision.

For the public market bonds, the mean yield spread over treasuries was 1.06 percent for Moody’s ratings of Aaa to A, and 1.85 percent for bonds rated Baa. These spreads were clearly lower than the spreads for private placement loans of corresponding credit risk (using the NAIC ratings).

Kwan took over the presentation to discuss the statistical analysis. He began with a comparison of the incidence of six contract provisions of the sample private placements, sorted by credit risk ratings and by time periods. The incidence of makewhole provisions declined uniformly with credit risk. The incidence of a put option also appeared to be more likely for loans with high credit rating, although the direction of causality was not clear. A high percentage of the private placement loans were callable, regardless of credit risk. Private placements with high credit risk tended to be more likely to have sinking fund provisions. Subordinated or junior claims were associated with higher credit risk. The relation between security and credit risk is less clear because on the one hand security lowers the risk of a loan contract but on the other hand the riskier loans are more likely to be secured. The incidence of makewhole provisions, put options and call options all showed a very noticeable time trend, and might be considered to be innovations in the private placement market.

Statistics on the incidence of contract modifications in the private placement market suggested that private placement contracts are signed with knowledge by both borrower and lender that future renegotiation is possible. An overwhelming majority of modified loans were renegotiated “in good standing,” supporting the
idea that renegotiation in this market is a strategic contracting element, rather than simply a mechanism to deal with financial distress.

In the single equation pricing model, the yield spreads of privately placed loans were regressed on thirteen variables. The first three were risk structure variables: the borrowing firms' capital to asset ratio, a binary variable equal to 1 for an LBO loan (considered to be relatively high risk) and 0 otherwise, and the term to maturity of the loan contract. Five more explanatory variables were related to contract attributes. All were binary variables, equal to 1, if the loan was secured, if the loan was subordinated, if the lender had a put option, if the loan was callable before maturity, and if the loan had sinking fund provision, and otherwise 0. Similarly, two informational explanatory variables were set equal to 1 if the borrowing firm was privately held and if the borrowing firm had rated public debt. Finally, three transaction costs variables were the natural log of the loan proceeds, the natural log of the total assets of the borrowing firm, and a binary variable equaling 1 for a syndicated loan and otherwise 0.

The adjusted $R^2$ for the regression was 0.48, and the F-statistic was 41.48, significant at the 1% level. With few exceptions the coefficients were significant at the 1% level and had the expected signs. The call variable had the expected positive sign but was statistically insignificant. The security and sinking fund variables were both significant and, contrary to expectation, positive. It seems likely that although both characteristics tend to lower risk, they are also associated with loans to high-risk companies. Loan size was found to be unrelated to the yield spread.

It seemed likely that some of the contract attributes were in fact endogenously determined. So the security and sinking fund variables were allowed to be determined endogenously, to form a three equation simultaneous model. Next, the put variable was also endogenized and a four equation simultaneous model was estimated. Overall, these simultaneous contracting models provided qualitatively similar results to the single equation model, and corrected for the surprising signs on the security and sinking fund variables.

In conclusion, the authors found that contract features and borrowing firm characteristics in the private placement market differ markedly from their public market counterparts. The yield spreads in private placement loans were found to fit the risk structure of interest rates quite well. And in addition, yield spreads were found to be related to information production cost, monitoring cost, transaction cost, as well as contract attributes.

**PRIVATIZATION**

74. PRIVITIZATION IN RUSSIA:
EVIDENCE FROM THE RUSSIAN SHOPS (Fall, 1995)

Andrei Shleifer, Professor of Economics, Harvard University, distributed a paper by Nicholas Barberis, Maxim Boycko, Natalia Tsukanova and himself entitled "How Does Privatization Work? Evidence from the Russian Shops." He began his presentation by describing the purpose for the reported research. There have been two kinds of privatization in Eastern Europe in recent years. One is small scale privatization, usually involving retail shops. The second has concerned large industrial enterprises. This research was based on the former. There are two major views as to the reasons why privatization might be considered a good thing. One theory is the human capital theory, which says that managers selected by politicians, under a system of government ownership, are generally good bureaucrats, loyal to the politicians. Their skills are not likely to be the best for running an enterprise, so that a change in the skill set of managers that may be expected to result from privatization should be for the better. A second theory – the incentive theory – says that it is manager motivation that drives efficient operations, and privatization will put the incentive of ownership in the hands of managers who can be expected to perform better than their predecessors under public ownership. A primary motivation for the research was an attempt to identify the relative importance of these two theories in explaining what had gone on in the privatization of Russian shops.

The researchers gathered data on 452 shops in six Russian cities. Of the 452, eighty percent sold food, eleven percent sold other
retail products and nine percent sold services. On average the shops had twenty-five employees. Of the 452, 413 were privatized and the others remained owned by various governments. The privatizations took place from April, 1992 through about the middle of 1993. The sample was chosen randomly from lists obtained in each of six cities.

The research itself took the form of interviews with managers of the shops. These were generally rather brief interviews and took place within a few months of privatization. The managers were not asked about any financial details, such as revenue or profits. The questions dealt entirely with restructuring. And restructuring was defined to include four changes: renovation of premises, a change in the supplier to the shop, extension of hours when the shop was open, and employee layoffs.

Privatization was accomplished in three different ways. In about twenty-five percent of the cases there was simply an auction, and the high price determined the buyer. In about forty percent of the cases, there was a “competition”, and the successful buyer was chosen on the basis of several criteria of which price was only one. In about thirty-five percent of the cases the shop was turned over to employees and managers, probably at a very low price and possibly without any payment. In almost all cases, some restrictions were imposed for one to five years. The most common restriction had to do with a commitment to continue selling the same product. Some restrictions applied to employee layoffs, and some restrictions applied to prices. By and large the restrictions had little effect. It turned out that it was very easy for the new owners and managers to evade them.

The ownership structure after privatization was important, and the shops were characterized as under “new ownership” if none of the old management and employees were among the new owners. Shops were regarded as being under new management if the old management was completely replaced. The degree of management ownership of privatized shops was considered important, and a distinction was drawn between the cases where the management owned more than the twenty-two percent median management ownership, or less.

Shleifer presented a table summarizing the relation between each of the four restructuring characteristics and a set of ownership characteristics. The latter set included whether or not there had been a complete ownership change, whether or not there had been management layoffs, whether or not the management ownership was above or below the median, whether there was outside investor ownership, whether or not the shop owned its own premises, and whether or not the sale had been via the competitive method. It turned out that a complete ownership change made a very large difference in the extent to which restructuring took place. Management layoffs were also very important. The other characteristics of the newly privatized shops were less important. It was difficult to determine from this first table whether the human capital theory or the incentive theory was primarily responsible for restructuring. Succeeding tables were designed to get at this question. What they showed was that while the human capital theory seemed to have a very high explanatory power, it was far less clear that incentives had been effective. The general conclusion by Shleifer was that restructuring depended very heavily on complete replacement of the old management.

75. DETERMINANTS OF PRIVATIZATION PRICES
(ANALYSIS OF THE MEXICAN EXPERIENCE) (Fall, 1995)

Florencio López-de-Silanes, Professor of Economics and Public Policy at the J.F. Kennedy School of Government, Harvard University, distributed a paper entitled “Determinants of Privatization Prices.” The paper addresses how to sell a state-owned enterprise. The data source was quite extraordinary. In March, 1992 the Ministry of Finance and Public Credit of Mexico allowed the author to review all privatization files in their archives. Other Mexican government agencies, bidding companies, and some privatized companies were also helpful. The data collected were for 346 companies privatized between November 1983 and June 1992, and covered over ninety-eight percent of privatized companies in Mexico up to that time.

The determinants of the price achieved in the auction process could be explained by three sets of variables. The first were related to
characteristics of the company privatized and its industry. The second set was related to the auction process itself. And the third set was related to restructuring policies of the government prior to auctioning the company. The important results of the analysis were these: The costs and characteristics of the labor force have a significant impact on the price at which the company can be sold. The speed of the privatization process was important, with delays in putting the company on the block leading to significant deterioration in price. Reductions in the labor force before selling the company, and particularly the firing of the CEO lead to significantly higher prices. Repayment of debt, investment, and performance improvement programs do not increase the price realized, while divestment measures prove beneficial.

The price obtained by the government for each privatization was calculated by the author as the present value of the nominal sale price less the cost of restructuring measures undertaken by the government prior to the sale, less the costs of commitments made by the government, adjusted by special reimbursements on both sides. From the net price the author calculated Tobin's Q as the value of the total equity of the company, based on the net price realized, plus the total liabilities at the time of privatization, all divided by the total assets of the company just before privatization. What Q measured then is the fraction of the value of the assets realized in the net sale price. For the entire set of privatizations, Q was fifty-four percent. The value of Q for the gross price received was eighty percent, so the cost of selling amounted to about twenty-five percent. For a few industries, however, Q was above 100 percent, while for a few it was actually negative.

López-de-Silanes presented a number of tables analyzing the specific effects of variables within the three sets already referred to. The labor history of the company had a significant effect on the price realized. The price was significantly higher if the buyer gained control of the company. Two time periods were considered. The first was the number of days between the first memo hinting at privatization until the day of the first public announcement. The second period was from the day of first public announcement to the day of the auction. The length of the latter period had no significant effect on the price realized, while the length of the former period had a significant negative effect. It appears that the longer people are aware that a company will be put up for sale the more the company itself deteriorates. And indeed the financial statistics over the three years preceding sale clearly indicated deterioration in performance.

A concise statement of advice for obtaining the best prices for assets sold appears to be: Fire the CEO, cut labor costs, don't attempt to restructure the company, don't allow it to make any investments, and sell it quickly.

REAL ESTATE

76. REAL ESTATE AND VENTURE CAPITAL: HISTORICAL VALUE INDICES OF COMMERCIAL REAL ESTATE (Spring, 1993)

Jeffrey D. Fisher, Professor, Indiana University, began the presentation with introductory comments on problems in compiling a useful historical series of commercial real estate values and rates of return. A serious problem has to do with the illiquidity of real estate. Real estate may have seemed a liquid asset during a part of the 1980s, simply because prices were rising and there were plenty of buyers active. At the present time, however, investors appear to be demanding a high premium for lack of liquidity. One commonly accepted measure of the premium is the difference between the capitalization rate being used to value real estate and the yield on stocks of REITs, a spread on the order of 150 basis points at present.

One might try to avoid the liquidity premium problem in constructing a series of historical rates of return by using stocks of REITs which do provide liquidity. But these stocks behave rather like stocks of small capitalization companies, and seem to lose many of the characteristics of the underlying real estate.

David Geltner, of the University of Cincinnati discussed procedures for processing existing series of real estate values to produce risk and return characteristics comparable to those available for stocks and bonds. The ultimate objective is a set of data that makes it
feasible to apply mean variance asset allocation models to real estate stocks, and bonds. There is no single best way to construct this desired series of historical values and rates of return. Different methods suffer from different weaknesses, but the weaknesses at least differ, and from a number of approaches we can make some progress.

He described in general terms a mechanical "unsMOOTHING" of the Russell-NCREIF Index of commercial property values (the details of the methodology are contained in a forthcoming paper). There are three sources of smoothing in the Russell-NCREIF Index. First, appraisals rather than actual transaction prices, tend to smooth valuations. Second, there is temporal aggregation in that quarterly numbers are arrived at from the appraisals taking place during the quarter and not necessarily at the quarter end. Third, appraisals tend to be concentrated in the fourth quarter, so there is a seasonality element and a smoothing element introduced.

The mechanical unsMOOTHING of the Russell-NCREIF Index can be represented (in greatly simplified form) by the following:

\[ V_t^* = \alpha V_t + (1 - \alpha) V_{t-1}^* \]

where \( V_t^* \) is the smoothed value, \( V_t \) is the actual value, and \( \alpha \) lies between zero and one. The smoothing formula can be inverted to:

\[ V_t = (V_t^* - (1-\alpha)V_{t-1}^*)/\alpha \]

In order to apply the equation above, one must have a value for \( \alpha \). Geltner's methodology estimated \( \alpha \) empirically using time series statistics, assuming the true rates of return were uncorrelated through time. He presented a graph of the Russell-NCREIF series and the unsMOOTHed series. There was clearly considerably more volatility in the unsMOOTHed series. It also appeared that while the Russell-NCREIF series was still declining at the end of 1992, the unsMOOTHed series seemed to have leveled off, having reached bottom by the end of 1991.

The next question was how to interpret the unsMOOTHed series. Geltner's preference was to treat these values as the prices that would have been observed directly if the properties had been securitized. One could still not be sure, however, that these values and corresponding rates of return were truly comparable to values and rates of return observed in the stock and bond markets.

Brian Webb, Of the School of Business at Indiana University, continued the presentation, describing two further unsMOOTHing methodologies. Webb reviewed briefly a paper he had presented at the Q Group Fall 1991 Seminar, subsequently published in the AREUEA Journal, Summer 1992. That paper had made use of actual transaction prices for real estate, rather than appraised values. From the observed property prices, nine characteristics of properties had in turn been priced from the sample of properties actually sold, and these prices of characteristics had then been applied to the characteristics of unsold properties, to construct a series of returns for both sold and unsold properties. This methodology had suffered from certain disadvantages. First, it relied heavily on cross-section regressions, and not differences in value through time, although it is the difference in value through time that we really want in constructing a rate of return series. Webb had also found the earlier methodology did not lead to any market factor for real estate. Finally, the method required the assumption that characteristics of properties have stationary prices through time.

The first of the new models he described was his Hedonic model. This model made use of cross-sectional regressions to price characteristics of properties, but it also used dummy variables to establish value changes through time. The Hedonic model still assumes stationary prices of characteristics of properties, could provide only annual data points, and is limited in its usefulness by the number of sales of properties that can be incorporated in the database. The method, however, does not require a capital market factor and it does not impose on unsold properties the prices of characteristics of sold properties. Webb's conclusion from the 1982-92 Hedonic model series was that investors seemed to sacrifice liquidity for reduced volatility, and that in applying asset allocation models, one somehow has to factor in the cost of illiquidity. Otherwise, the models lead to quite excessive allocations to real estate.
Fisher concluded the presentation with a review of the time series of property valuations. The Russell-NCREIF Index is a useful benchmark, but since it is based upon appraisals it tends to show a very low variance, and therefore superior performance relative to stocks and bonds. An asset allocation model working with the Russell-NCREIF Index tends to put a very large proportion of an investment into real estate. By comparison, the unlevered NAREIT Index is based on actual stock sales, shows many of the characteristics of common stocks, and much more variance than is found in the Russell-NCREIF Index. The transaction driven index discussed by Webb is based on actual prices from property sales, shows more variance than the Russell-NCREIF Index, but uses proprietary data which limits further research. Finally, the unsmoothed Russell-NCREIF Index makes use of public information, corrects for appraisal smoothing, and produces a variance comparable to that for common stocks.

He reported work currently underway that makes use of lease transactions to get actual changes in the price of space. It appears that the index based on rental figures leads the Russell NCREIF Index and shows more volatility than that index.

In response to a question, Geltner observed that the annual volatility of real estate returns appears to be around 8 percent a year, or roughly half that of the Standard & Poor's 500 Index. The correlation of annual real estate returns with returns on stocks and bonds seems to be close to zero. As yet, a liquidity premium for real estate remains to be identified.

77. MEASURING COMMERCIAL MORTGAGE PERFORMANCE: AN INDEX APPROACH (Spring, 1993)

Michael Giliberto, Director of Real Estate Research, Salomon Brothers Inc., described the development of a new commercial mortgage performance index. Although one rarely hears much about commercial mortgages except when they are in trouble, they represent more than $1 trillion of investment assets, and holdings are significant for life insurance companies, commercial banks, and thrifts. Unlike residential mortgages, no more than 5 percent of commercial mortgages have been securitized.

The basic design of the index involved constructing a model portfolio to replicate representative holdings, tracking interest and principal payments, adding new loans to maintain the representative character of the portfolio, marking to market periodically, and generating and applying credit losses. This last element was the most controversial and the most difficult.

The index is based on data from the American Council of Life Insurance for loan commitments. Only fixed rate and fixed term loans are used; all loans are assumed to amortize over 25 years, and have a term equal to the shorter of the stated maturity and 15 years. The 15-year cutoff is the only provision for early repayment. Data were collected for the third quarter of 1965 and subsequent quarters, but the portfolio was considered to be usable for an index only as of the fourth quarter of 1971. Giliberto explained that data are not available loan by loan, nor is it possible to classify loans by the type of property borrowed against.

As of the fourth quarter of 1971, the index contained $18.1 billion out of a total of LIC holdings of $45 billion. The weighted average coupon was 7.9 percent; the average remaining loan term was 11 years, and the effective duration was 6.7 years. As of the fourth quarter of 1992, the index contained $140 billion out of total LIC holdings of $240 billion; the average coupon was 10.4 percent; the average remaining loan term was 5.6 years; and the duration was 3.0 years.

The credit loss function was the most critical element in developing the index. The incidence of delinquencies and completed foreclosure data come from an ACLI survey. But no data are available on the severity of losses. So some assumptions had to be made: that completed foreclosures entail an immediate loss of 30 percent of book value and that delinquencies incur a loss of 50 basis points per month as a reduction of principal balance, as well as lost interest. Giliberto discussed the rationale for the assumptions, and some sensitivity testing on their importance. In allocating credit losses to individual loans, each loan is assigned to one of three risk categories. Each loan has an initial collateral value based on its initial loan-to-value ratio. The collateral value is updated each period
using a real estate value index. The scheduled future cash flows from the loan are valued using current treasury rates and mortgage spreads. A market-based loan-to-value ratio is then determined and on the basis of this ratio the loan is assigned to a risk category. Dollar amounts of 'credit event' loans are allocated across the risk categories, with the highest category receiving the greatest share.

Over the 44 quarters from 1972 through 1992, the mean return (annualized) of the index before credit losses was 10.4 percent, with a volatility of 5.2 percent. Credit losses reduced the mean to 9.8 percent, with a volatility of 5.3 percent. Giliberto also presented statistics comparing the index with Salomon Brothers broad investment-grade bond index, and discussed the reasons for performance differences. He closed his presentation with a sensitivity analysis on the amortization assumption, the prepayment assumption, and the loss assumptions.

78. ON THE NATURE OF SYSTEMATIC RISK IN COMMERCIAL REAL ESTATE  
(Fall, 1991)

Brian Webb, Assistant Professor, School of Business, Indiana University distributed a paper by himself, Mike E. Miles and David Guilkey entitled "On the Nature of Systematic Risk in Commercial Real Estate." He began with a brief review of various methodologies for arriving at indices of real estate value and rate of return series for investment in real estate. Appraisal derived indices have tended to be the industry benchmark. An example is the set of indices from The Frank Russell Company and the National Council of Real Estate Investment Fiduciaries (NCREIF). These indices tend to give high risk adjusted rates of return on real estate, indicate low correlations with other asset classes, and show positive correlation with inflation and expected inflation.

A second set of indices are transaction driven. Again The Frank Russell Company and NCREIF have developed such indices and the Miles, Webb and Guilkey work is directed toward these indices. Evaluation Associates and James Hoag have also developed such indices. (Hoag spoke at the Fall 1981 Q Group Seminar.) In fact, Webb said, much of his own work was an update of Hoag with extension of the data to cover more regions and more types of real estate.

A third set of indices are driven by "de-smoothed" appraisals. This involves attempting to remove the smoothing that goes with annual or even quarterly appraisals. A fourth method of establishing indices is based on percentage changes in cash flows. This can be done by removing appraisals from the appraisal rate of return. Finally, lease indices, based on the percentage change in effective rents, is perhaps the most promising long-term methodology for arriving at indices of real estate value.

Webb set out a proposed methodology for a transactions-driven series of real estate values. One begins by modeling the value of commercial real estate. This involves devising a multiple regression that links real estate value to a number of factors. One then supplies the value variable in the form of prices from a sample of transactions, and values an unsold sample of properties on a quarterly basis, constructs property specific returns from these values, and then constructs weighted indices from the property specific returns. The data used in the research reported by Webb included a sample of 592 properties valued at $5.2 billion. The properties were located in 40 of the 48 continental states, represented 22 different investment managers, and were distributed among 151 office properties, 120 retail properties, and 321 industrial properties.

The variables used in the regressions fell into four categories. Fixed property specific variables had to do with quality of location, functionality and the like. Property specific variables valued quarterly had to do with income, quarterly appraisals, improvements and cash flows. Variables specific to the primary metropolitan statistical area (PMSA) were evaluated quarterly, and quarterly capital market data, including risk premium and yield curve data, were included. The reduced form value equation was as follows:

\[ V_{i,t} = f(PersInc_{i,t}, CPop_{i,t}, NISFi_{i,t}, \]

\[ NIPotnli_{i,t}, Locate_{i}, Funct_{i}, RP_{i}, CMFi_{t} ) \]

where:
PersInc
\textsuperscript{i,t} = Personal income per capita in the PMSA of property i at time t
CPop
\textsuperscript{i,t} = Change in population in the PMSA of property i at time t
NISF
\textsuperscript{i,t} = Net income per square foot for property i at time t
NIPotnntl
\textsuperscript{i,t} = Highest potential net income for property i as demonstrated by its rent history
Locate
\textsuperscript{i} = Quality of location within the PMSA for property i
Funct
\textsuperscript{i} = Functionality as a measure of quality of construction and amenities
RP
\textsuperscript{i} = Dummy variable that captures the cross-sectional differences in risk premiums
CMF
\textsuperscript{t} = Capital market factor that captures the time-series differences in risk premiums.

Webb discussed the significance of the variables. It turned out that the risk premium variable was important. The net income per square foot variable was also important. The capital market factor, on the other hand, was not. The analysis revealed no systematic risk, even when 20 different proxies for a capital market factor were tried out in the model. (Finally, the capital market factor was omitted.) The net income per square foot variable explained approximately 1/2 the value of office and industrial properties and 75% of the value of retail properties.

Webb presented a comparison of mean rates of return and standard deviations of rates of return for the analysis based upon transactions data and the same analysis based upon appraisal data. As one might have expected, the standard deviations were considerably lower when the analysis was based upon appraisals rather than transactions. The mean returns also tended to be lower. Webb then turned to a similar comparison but this time the results were based upon appraisal and transaction driven indices rather than appraisal and transaction driven individual property returns. Now the standard deviations and the mean returns were much more similar for the appraisal and transaction driven analyses. Webb's conclusion was that the diversification effect present in the indices brought down the standard deviations and he suggested that for diversified portfolios of real estate, return series based on appraisals may not understate variability as much as some have thought.

Webb closed with three conclusions. His first was that appraisal-driven returns understate the true variance of real estate returns for individual properties (but not necessarily for diversified portfolios of properties). Second, most individual property risk is diversifiable within the real estate asset class. And third, the correlation between real estate returns and stock and bond returns is low.


Randall Zisler, President, Russell-Zisler, Inc. distributed a paper by himself entitled "The Quantification of Real Estate: End of the Romantic Age or the Beginning of the Modern Era?," as well as a paper by himself and Stephen A. Ross entitled "Risk and Return in Real Estate," published in the Journal of Real Estate Finance and Economics in 1991. Zisler's presentation reviewed a number of aspects of real estate investment which he brought under the general topic of quantification. His theme was that analysis of value and rates of return in real estate has not fully come to grips with the complex bundle of contractual arrangements that determine investment results from real estate ownership. A powerful motivation for a better understanding of what is involved in real estate investment is driven by the very poor performance of real estate in the last decade or so. What seemed remarkable to Zisler is that statistics on construction starts and vacancy rates in the mid-1980s failed to discourage a construction boom continuing through 1989 and leading to a collapse in 1990 and 1991.

Outlining a research agenda, he began with performance measurement. The difficulty here is in identifying risk in real estate investment and hence determining risk adjusted returns. The smoothing effect of appraisal-based return data is well known. Transaction-based series are an improvement, but it is still not clear that we fully understand real estate
risk and how it should be incorporated into return measurements and asset allocation models. Correlations between real estate and other asset classes are particularly important and Zisler commented that the raw Frank Russell Company Index shows negative correlations of .15 to the S&P 500 Index and .29 to a government bond index, and a positive 0.5 correlation with inflation, while the adjusted FRC Index shows positive (but close to zero) correlation with the S&P 500 and with a government bond index, and much lower correlation with inflation. Even after adjustment, however, real estate does seem to offer significant opportunities for improving the risk and return characteristics of a multi-asset class portfolio.

Zisler has seen disequilibrium in the asset and rental markets. These two markets sometimes seem to move differently, and it is hard to understand why. Development of a good rental index would be helpful.

Transactions costs should also be researched. They vary over time, and Zisler believes that spreads are at a historic high at the present time. Perhaps transactions costs should be incorporated in valuations.

Market efficiency is another worthwhile topic of research. Those in the real estate market claim it is still inefficient and that managers have abilities to exploit the inefficiencies. But real estate markets may be more efficient than is commonly supposed.

We particularly need to know more about how information is transmitted in the real estate market. Manager quality is another important topic. Managers tend to be measured more on effort than on talent. Real estate money management suggests opportunities for increasing our understanding. The reluctance to sell properties is an interesting phenomenon.

Zisler also discussed normal portfolios and benchmarks. More research is needed on the characteristics of real estate that are priced in the market, with a view to constructing better normal portfolios or benchmarks. Incentive fees constitute another interesting topic. Very little real estate research has focused on alternative fee structures. Zisler displayed two examples where managers were apparently doing extraordinarily well, leaving investors far behind.

Securitization is something Zisler expects to see increasing. Pension funds in particular favor securitized forms of real estate investment. An increase in securitization may make a wider variety of investment technologies available to real estate. Securitization may also introduce a broader array of hedging strategies that will be practical for real estate.

Finally, Zisler raised the possibility of the discovery of synthetic real estate investment. He left the seminar with the question whether one could simulate real estate investment with tradable instruments.

RESTRUCTURINGS

80. TROUBLED DEBT RESTRUCTURINGS (Fall, 1991)

Kose John, Charles William Gerstenberg Professor of Finance at the Stern School of Business, New York University, distributed a paper by himself, Stuart C. Gilson, and Larry H. P. Lang, entitled "Troubled Debt Restructurings: An Empirical Study of Private Reorganization of Firms in Default." His study was concerned with firms that were financially distressed, and focused on the distinction between those that found relief through successful restructuring outside of Chapter 11, and those that ended up in Chapter 11 bankruptcy. The analysis was based upon information for 169 firms that encountered financial distress in the period 1979-1987. Of the 169, 80 firms privately restructured their debt, and 89 firms filed for Chapter 11, although approximately 90% of the 169 firms attempted a private restructuring.

The authors were looking for characteristics that go with successful restructuring and avoidance of Chapter 11. John commented that the motivation for the study had to do with implications for investment strategy, the valuation of debt securities, and the efficiency of the bankruptcy process. In connection with this last point he observed that there had been serious academic criticisms
of violations of the rule of strict priority in bankruptcy cases.

Among factors that led to private restructuring, John and his co-authors had identified cost savings associated with this route and the likelihood that creditors and stockholders would agree to a private settlement. The next step was to find empirical proxies for both factors. With respect to cost savings, it was very difficult to obtain estimates of direct costs. One measure lay in the fact that private workouts generally involve about 15 months, while bankruptcy proceedings involve about 20 months. Indirect costs were probably more important than direct costs and of the indirect costs the destruction of going concern value in the course of a bankruptcy appeared significant. The proxy that was chosen for this was the ratio of market value to replacement value of assets.

The probability of reaching agreement for a private restructuring was seen to depend upon the number of creditors of a firm in distress, the heterogeneity of those creditors, the type of debt to be restructured (bank debt being easier to restructure than publicly held debt), and the existence of asymmetric information (with creditors not having access to the inside information possessed by management and shareholders). Proxies for the probability of settling were seen to be the number of creditors, the fraction of debt that was privately held, and the ratio of market value to replacement cost of assets.

The research had begun with identification of the firms listed on the New York and American stock exchanges for which the three-year unadjusted common stock returns fell within the bottom 5%. For each of these firms a search through the Wall Street Journal index was made to find a default, bankruptcy or debt restructuring in one of the surrounding five years. The two-step procedure was repeated for each of the years 1979-1985. The final sample analyzed consisted of 169 companies of which 80 firms privately restructured their debt and 89 firms filed for Chapter 11. The characteristics of firms that were successful in achieving restructuring outside bankruptcy, and the characteristics of those firms that were unsuccessful generally fitted the expectations of the study. The ratio of market value to replacement cost was significantly higher for the successful restructurings than for those that were unsuccessful. The same was true of the predominance of bank debt as a percentage of total liabilities. The number of debt contracts outstanding (per dollar of debt) also showed a significant difference between the successful and unsuccessful cases. The length of a private debt restructuring in months was significantly shorter than the length of bankruptcy proceedings, although the time period during which a private debt restructuring was attempted but failed was rather short. If the attempt at restructuring is to be unsuccessful, failure generally comes quickly.

A regression analysis indicated that the market value to replacement cost ratio, the bank debt to other debt ratio, and the number of debt contracts outstanding were all three significant variables.

John also reported data on common stock returns both in terms of a reward for a successful private restructuring and as a signal anticipating successful restructuring. Two-day average excess returns had been determined associated with the initial announcement of a private debt restructuring, and with the first announcement of the resolution of the restructuring. For successful debt restructurings, the excess return had been -1.6% at the initiation of the restructuring, and +0.7% at the resolution. For unsuccessful debt restructurings, the excess return had been -6.3% at the initiation and -16.7% when the private restructuring failed and recourse was made to Chapter 11.

Cumulative excess returns for successful and unsuccessful debt restructurings were 41.4% for the successful and -39.9% for the unsuccessful.

John was able to report as final conclusions: private renegotiation is favored by a preponderance of intangible assets (represented by the market to replacement cost ratio), by a preponderance of bank debt, and by a small number of distinct classes of debt. Evidence from rates of return on common stocks indicated that the market identifies in advance the attempted private renegotiations that will be successful, and the market rewards successful private settlements. He went on to discuss some of the remaining research on his agenda. This includes work on distressed exchange offers,
voluntary corporate restructurings, optimal procedures under Chapter 11, and improvements to the theoretical model.

RETIREMENT FUNDS

81. THE FUNDING RATIO RETURN
(Fall, 1994)

Martin L. Leibowitz, Managing Director and Director of Research and Stanley Kogelman, Director, Salomon Brothers Inc. distributed a pamphlet entitled “Funding Ratio Return: A More ‘Universal’ Measure for Asset/Liability Management.”

Leibowitz began the presentation by observing that he and his colleagues came up with the funding ratio return (FFR) as a useful performance measure related to the funding ratio of a pension fund. Stan Kogelman continued the presentation, describing pension fund experience in 1993. The total returns of the Salomon Brothers BIG index at 9.9%, and the total return of the Standard and Poor's 500 index at 10.1%, meant that most combinations of stocks and bonds returned about 10%. This would seem a reasonable proxy for the 1993 return on pension fund assets. At the same time, the Salomon Brothers Pension Liability Index indicated that a typical Projected Benefit Obligation (PBO) rose about 22.8% in 1993. The result was a decline in the funding ratio. The reason for the substantial difference between the increase in the PBO liability and the return on bonds is the wide duration gap between the 4.8 years for the BIG index and the 14 years for the Liability Index. Kogelman commented that rising interest rates in 1994 should mean that the liability index will be falling faster than asset values, and the funding ratio should be rising.

The surplus is the excess of pension fund assets over liabilities. The surplus return for a year is a matter of some interest to pension plan sponsors and can take two forms: the change in the surplus over the year divided by the initial asset value, or the change in the surplus over the year divided by initial liability value. One of the benefits of working with the funding ratio rate of return (FFR) is that it does not depend upon the level of the funding ratio. The funding ratio itself is the ratio of initial assets to initial liabilities. And the FFR is equal to (the asset return minus the liability return)/(1 + the liability return.) This means that for given asset and liability returns, all funds will have the same FRR no matter what their initial funding ratios.

Kogelman next turned to a discussion of the FRR distribution. The distribution will remain constant for any given asset allocation. The assumption was made that stock-bond and liability returns are lognormally distributed. If the asset mix is maintained by continual rebalancing to a 60/40 allocation, the FRR distribution is lognormal.

The next set of assumptions had to do with returns and volatilities. Bonds with a duration of five years were assumed to have an expected return of 8 percent with a volatility of 5 percent. Stocks, with a duration of 5.6 years, were given an expected return of 13% and a volatility of 16%, as well as a 0.35 correlation with bond returns. The liabilities were given a duration of 12 years with an expected return of 8% and a volatility of 12%. In effect, the liabilities were treated as equivalent to a bond with a duration of 12 years and an expected return of 8 percent.

All of these assumptions gave rise to a distribution from which a number of conclusions could be drawn. There is a 62% probability of a positive FRR, meaning that the final funding ratio is likely to be greater than the starting ratio. It is also possible to identify probabilities for various negative FRRs. For example, there is a 10% probability that the FRR will fall below -9.75%.

Equipped with the distribution parameters, we can examine how different equity allocations and bond durations affect the FRR. To begin with, if the pension fund is invested 100% in bonds with a 12 year duration, exactly matched to the duration of the liabilities, the asset and liability returns move together and the expected FRR and the FRR volatility are both zero. The result is immunization.

A graph of expected FRR against volatility in the FRR (opposite) is very similar to the usual graph of expected return and volatility for an asset portfolio. But in this case the riskless investment is 100% in bonds of a duration matching the duration of the liabilities. Leibowitz explained curves
showing the expected FRR and volatility for mixes of equities and 12 year duration bonds, as well as equities with 5 year and 19 year duration bonds. An interesting point is that the mismatches between the bond duration and the liability duration lead to a positive 0.7% expected FRR for the 100% 5-year bond portfolio, and a -0.7% expected FRR for the 100% 19-year bond portfolio.

Leibowitz next turned to the subject of shortfall risk. Shortfall is a negative FRR. We have already seen that under our assumptions there is no more than a 10% chance that the FRR will fall below -9.75%. If this particular probability of loss is acceptable to the sponsor, 9.75% becomes the “shortfall threshold,” and the requirement of exceeding that threshold is the “shortfall constraint.” The shortfall constraint can be superimposed on the graph of expected FRR and volatility in FRR. The constraint takes the form of an almost straight line intersecting the vertical axis at -9.75% and extending upward and to the right. The area of the graph lying above the shortfall line is an area of acceptable portfolios, while the area lying below the line is an area of unacceptable portfolios. One can then see, from the curves for different asset combinations, which combinations are acceptable and which are not. In the particular case Leibowitz demonstrated, combinations of 40% or more 5 year bonds and 60% or less equity were acceptable. Similarly, combinations of 40% or more 19 year bonds and 60% or less equities were acceptable. No combinations of stocks and cash were acceptable.

A different shortfall constraint leads to a shortfall line above or below the one already indicated, but parallel to it. For example, a -7% funding ratio shortfall constraint shifts the area of acceptable portfolios to exclude all combinations of equities and five year bonds, but to include combinations of equities and 19 year bonds over a limited range of proportions. As the shortfall constraint is tightened, the acceptable portfolios are more constrained, until at a 0% shortfall constraint the only acceptable investment is bonds with a duration matching the duration of the liabilities (immunization).

In conclusion, the FRR can be used to make funding ratio preservation part of the traditional asset allocation process. For a given set of market parameter assumptions, a specific asset allocation is associated with a single well-defined FRR distribution. Risk tolerances expressed in terms of the FRR can be translated into asset allocation boundaries, making it easy to see which allocations can, and which cannot, meet the shortfall constraint.
82. THE ECONOMICS OF PENSION FUND MANAGEMENT (Fall, 1994)

Keith Ambachtsheer, President of KPA Advisory Services Inc., distributed a paper entitled “The Economics of Pension Fund Management.” He began with a statement of the problem facing the pension fund management industry. It is essentially an image problem. A good deal of publicity has been given to the apparent lack of accountability for those who govern and manage pension funds. The motivations of managers have been questioned, and it is not clear that value added has justified costs incurred.

Ambachtsheer stressed the need for accountability which in turn calls for a disciplined and uniform system of accounting to measure results in a context people can relate to. His paper represented a report on a three year project to collect, classify and process data on pension fund performance, in an effort to answer the questions of critics and disclose the true state of pension fund performance. To date, the database (established by the firm Cost Effectiveness Measurement, Inc.), consists of 111 US funds and 73 Canadian funds with an aggregate value of 815 billion dollars. Most of the funds in the database are corporate pension funds (116 in 1993), but the public sector funds have the largest aggregate value (470 billion dollars in 1993).

Ambachtsheer set out his view of a pension fund production function. The business of pension fund management is to set an investment policy and to implement it. For any given policy there are two implementation paths: one is the lowest risk/cost path consistent with due diligence and prudence: the other is to take on additional risks and/or costs in the expectation of additional fund return. Management will then create one of the two following relationships over time:

Policy Return=\text{F(Policy Risk/Cost)}

or

Policy Return + Additional Return=\text{F (Policy Risk/Cost; Additional Risk/Cost)}

What this choice amounts to is either seeking to do no more than implement policy in the most sensible low cost way, or adding the intention also to be a profit center. The purpose of the analysis described by Ambachtsheer is essentially to report how well the profit center operation has been run. The paper sets out a seven point acceptable set of accounting principles for measuring pension fund management operations.

1. Total fund returns must be decomposed into policy-and implementation-related components. Policy returns relate to the asset allocation policy stated for a pension fund. These returns are actually calculated through the use of benchmarks, and policy-related return components across different funds contain no information about management skill.

2. Implementation-related fund returns tell us about management skill. It is useful to further decompose these returns into within-asset class and across-asset class (i.e. mix) segments. In practice, the within-asset class return is subtracted from the total implementation-related return, and the residual is identified as the mix return. Ideally, return decomposition continues down to the level of individual portfolio management mandates within the fund.

3. When peer comparisons of fund returns are made, only implementation-related fund return components calculated with identical decomposition procedures are comparable.

4. Total fund operating costs must be decomposed into minimum-required, and incremental components before any comparative analyses are performed. Minimum-required operating costs across different funds will differ, but will contain no information about management skill.

5. To understand the sources of incremental operating costs, it is useful to further decompose these costs into direct investment management-related and governance and administrative segments. Ideally, direct investment management-related cost of decomposition continues down to the level of individual portfolio management mandates within the fund.

6. When peer comparisons of fund operating costs are made, only incremental
operating cost components calculated with identical decomposition procedures are comparable.

7. When peer comparisons of fund return-operating cost combinations are made, only implementation-related fund return-incremental operating cost combinations calculated with identical decomposition procedures are comparable.

Ambachtsheer described the structure of the database. At its heart is an 11 x 4 matrix which captures annual actual and benchmark returns for 11 standard asset classes managed in one of 4 modes: internal passive or active, and external passive or active. For each of the asset classes data are collected for pre-expense returns, direct investment management costs, policy weights, and benchmark returns.

Apart from accountability measurements for individual funds and managers, the database may offer answers to a number of questions important to the whole pension fund management community. Ambachtsheer suggested some of these are:

Do differences in investment policy help to explain differences in fund returns?

How have pension funds performed in relation to their policy returns, and what factors have affected the production of implementation-related fund returns?

How do differences in fund size, asset mix, and nationality impact fund operating costs?

Is there any relationship for the funds in the database between implementation-related fund returns and incremental operating costs?

Is there any systemic imprint in the pension fund database related to longer term “winners” and “losers”?

Statistics for 1990-1993 provide some answers to these questions. Regressions on actual fund returns against policy returns (the benchmark returns corresponding to the stated allocation policies) over 1990-1993, indicated that differences in investment policy explain considerable proportions of the variance in fund returns in most time periods.

Fund implementation returns regressed on fund characteristics answered further questions. The characteristics chosen were fund size, proportion internally managed, proportion actively managed, proportion in stocks, whether the fund is corporate or “other” and whether it is US or Canadian. The results indicated that the only factor that has been significantly significant and year-to-year consistent is nationality. US Pension funds in the database had consistently higher implementation returns in 1990-1993 than their Canadian counterparts.

A further analysis decomposed total fund implementation returns into “in asset class” and “mix” components. The results indicated that the “mix” components are on average small and random.

Tuning to the analysis of fund operating costs, a regression of operating costs on fund characteristics indicated that the costs are systematically and consistently related to size, the proportion in stocks, the proportion in real estate and non traditional investments, and whether the fund is US or Canadian. The negative coefficient on fund size indicates that unit operating costs do decline as fund size increases. Costs rise with the proportion in stocks and they rise fairly steeply with the proportion in real estate and non traditional investments. Finally, unit operating costs are systematically lower in Canada than in the United States.

An important question is whether there is a payback on incremental costs. A regression of implementation-related fund return components against incremental operating costs provided some answers. The indication is that there was a negative payback in 1990, a zero payback in 1991 and 1992, and a positive payback in 1993. The average for 1991 through 1993 indicated that an incremental 10 basis points of operating costs was associated with an incremental 30 basis points of implementation return. The trend, and the average, are encouraging.

In summarizing, Ambachtsheer pointed out that the policy decision clearly does affect rates of return. Cost data indicate significant differences among pension funds, and considerable evidence that high costs may be well justified by high returns. And perhaps most important for the project, it is indeed
possible to articulate and implement sensible standardized accounting procedures to measure elements of pension fund performance.

83. THE RETIREMENT SAVINGS CRISIS: ARE AMERICANS GETTING THE MESSAGE (Fall, 1993)

Shari L. Powell, Marketing Researcher, Merrill Lynch Market Planning, reported the results of the 1993 Annual Survey on Retirement Planning and distributed a Merrill Lynch brochure entitled "How Employers Influence Retirement Savings in America." Merrill Lynch questioned 800 respondents, including pre-retirees, baby boomers, and benefits managers at companies. The survey was designed to be nationally representative of Americans between the ages of 25 and 64, all employed (none self-employed). The primary conclusion to be drawn from the responses is that a crisis of retirement expectations may be coming. Those responding have fairly modest expectations with respect to their economic situation at retirement, yet seem to be making provisions that fall far short of funding even these modest expectations. Respondents showed apprehension with respect to the adequacy of their funds to deal with retirement, yet for various reasons could not seem to bring themselves to set aside reasonable amounts towards retirement. One reason appears to be the very heavy debt service these respondents are carrying, leaving little for retirement planning.

Many respondents do not seem to understand fully the choices available in terms of investment vehicles, and there appears to be an extraordinarily high reliance on money market investments and an unwillingness to take risk in order to achieve higher returns. There appears to be a significant need for better education on the general subject of retirement planning. Companies are providing information to their employees, but Powell's impression is that these efforts do not go much beyond distribution of literature when what employees really need is help in the form of seminars and personal counseling.

Merrill Lynch has concluded that there are signs of a failure of individuals to take responsibility for their future financial security which will make it increasingly difficult for Americans to retire when and as completely as they may prefer. Many of the respondents anticipate continuing some sort of employment beyond their official retirement. The Merrill Lynch view is that the realities of a growing retiree population, increased longevity, rising health care costs, and a shrinking workforce contributing to Social Security could have severe financial consequences for individuals and the nation.

RISK MANAGEMENT

84. UNDERSTANDING LOSS REDUCTION STRATEGIES (Spring, 1994)

Sanford J. Grossman, Steinberg Trustee Professor of Finance, The Wharton School, University of Pennsylvania distributed a paper entitled, "Optimal Investment Strategies for Controlling Drawdowns," and one entitled "Equilibrium Analysis of Portfolio Insurance," by himself and Zhongguan Zhou. The first was motivated in part by his experience in managing a hedge fund. A drawdown is a decline in value in a portfolio from the maximum value the portfolio has achieved up to that time. The drawdown constraint reflects the unwillingness of the investor to lose more than a fixed percentage of that maximum value. The constraint is represented by

$$W_t \geq \alpha M_t$$

where $W_t$ is the wealth at time $t$, $M_t$ is the maximum value achieved up to time $t$, and $\alpha$ is an exogenous number between 0 and 1 (Grossman suggested it is probably about 10 percent). It turns out that for constant relative risk aversion utility functions, the optimal policy involves an investment in risky assets at time $t$ in proportion to $W_t - \alpha M_t$. The stochastic character of the floor studied here, $\alpha M_t$, has interesting effects on the investment policy in states of nature when wealth is at an all-time high; i.e., when $W_t = M_t$. At that point, $\alpha M_t$ is expected to grow at a faster rate than $W_t$, and therefore the investment in the risky asset can be expected to fall. It also turns out that the investment in the risky asset can be expected to rise when $W_t$ is close to $\alpha M_t$. The authors did not construct an equilibrium model, but conjectured that in such a model the stochastic character of the floor creates "resistance"
levels as the market approaches an all-time high (because of the reluctance of the investor to take more risk when $W_t = M_t$).

The optimal investment strategy at time $t$ is given by:

$$X_t = k(W_t - \alpha M_t), \text{ where}$$

$$K = \frac{\mu}{\sigma^2} \frac{1}{(1 - \alpha)A + \alpha}$$

$m$ = the expected risk premium over a risk free rate,

$\sigma^2$ = the variance in $\mu +$ the risk free rate

$A$ is a parameter in the investor's constant relative risk aversion utility function

$$U(W) = W(1-A)/(1-A)$$

Grossman showed graphically the sharp expected decline in holdings of the risky asset as $W$ approaches $M$.

In the absence of an equilibrium analysis for the drawdown constraint case, Grossman turned to the paper on portfolio insurance and the traditional portfolio insurance constraint. This constraint is expressed as follows:

$$W_t \geq \alpha W_0$$

In this case, the initial wealth, $W_0$ replaces the maximum wealth in the drawdown constraint. It turns out that:

1. The equilibrium price in the presence of insurers is lower than that in the absence of insurers in states where the insurers suffer losses.
2. The Sharpe ratio in the presence of insurers is higher than that in the absence of insurers in states where insurers suffer losses. Good news will lower the Sharpe ratio while bad news will raise it.
3. Price volatility in the presence of insurers is higher than that in the absence of insurers, and when good news comes, volatility falls, while bad news serves to raise it.
4. The serial correlation of asset returns is negative.
5. When the price goes up, insurers buy the risky asset, while a fall in price will prompt the insurers to sell it.

The change in the price level, Sharpe ratio and volatility is most dramatic around the point at which the wealth of the insurers is expected to equal the floor.

Grossman showed graphically the rise in the Sharpe ratio (that is, the improvement in expected excess return per unit of risk) as prices fall and insurers sell assets to non-insurers. Further graphs illustrated the changes set out above.

**RISK - PSYCHOLOGY**

85. MYOPIC LOSS AVERSION AND THE EQUITY PREMIUM PUZZLE (Fall, 1993)

Richard H. Thaler, H.J. Lewis Professor of Economics, Johnson School of Management, Cornell University, distributed a paper by himself and Shlomo Benartzi entitled "Myopic Loss Aversion and the Equity Premium Puzzle." He explained the equity premium puzzle as the fact that stocks have outperformed bonds over a long period of history by too great a margin to be explained by risk differences. The authors of this study offer an explanation based upon the "prospect theory" of Kahneman and Tversky. Investors are assumed to be "loss averse," meaning that they are distinctly more sensitive to losses than they are to gains. And investors are also assumed to evaluate their portfolios frequently even if they have long-term investment goals. The combination is termed by the authors "myopic loss aversion."

As an example of investor thinking, Thaler displayed a graph showing over time the way in which college and university faculty have allocated their contributions to the bond and stock portfolios of TIAA-CREF. By far the largest group allocates half of contributions to bonds and half to stocks. The second largest group, and one that is growing, allocates 100 percent of contributions to bonds. The third largest group allocates 75 percent to bonds and only 25 percent to stocks. The smallest group by far allocates 100 percent to stocks. It seems clear that these allocations are much too conservative for investors with truly long-term horizons, the kind of horizon one would think appropriate for an individual setting aside money for retirement. Thaler presented some statistics on the advantage of investing in stocks over the period 1876 to 1990,
and for working lifetimes as short as 25 years a portfolio invested entirely in bonds proved superior to one invested in stocks except for those retiring in a couple of years during the mid-1930s and the early 1940s. Those invested in all stock portfolios did better for other retirement years and often by very large amounts. For working lifetimes of 40 years there was not a single case in which the all-bond portfolio proved better than the all-stock portfolio. And for those retiring in the late 1950s and early 1960s the stock portfolios would have produced pensions more than seven times those from the bond portfolios.

Risk aversion alone does not explain the popularity of bond investing. Mehran and Prescott found that people would have to have a coefficient of relative risk aversion over 30 to explain the historic premium of stocks over bonds. In order to judge the likelihood of this risk aversion, one can turn to the following choice offered to an individual: play a game with a 50 percent chance of winning 100 and a 50 percent chance of winning 50. Alternatively, play a game providing a certain result. For a relative risk aversion of 30 the certain result would have to be 51. It seems very unlikely that anyone’s relative risk aversion could be as high as 30. If relative risk aversion cannot explain the very high historical equity premium, then what can? Thaler reviewed briefly a number of explanations that have been offered but do not seem satisfactory. The explanation Thaler followed up was one offered by Kahneman and Tversky which they called prospect theory in which utility is defined over gains and losses rather than levels of wealth. The utility function takes the following form:

\[ U(X) = \begin{cases} \alpha X & \text{if } X \geq 0 \\ -\lambda (-X)^\beta & \text{if } X < 0 \end{cases} \]

where \( \lambda \) is the coefficient of loss aversion. Kahneman and Tversky estimated \( \alpha = 0.88 \) and \( \beta = 2.25 \). What this utility function implies is that the pain in losing for example 10 percent is much greater than the pleasure of gaining 10 percent.

In addition to specifying the utility function, we have to establish how frequently investors evaluate returns. This is important, because if an investor has a long-term investment horizon, say 30 years in the case of an individual setting aside retirement funds, but examines the performance of the investment portfolio at quarterly intervals, then the investor is likely to behave as if the planning horizon were only three months. Hence the investor chooses a portfolio that maximizes utility one year hence, not 30 years hence. The authors use the utility function set out above in order to answer the question how frequently would investors have to evaluate their portfolios to make them indifferent between stocks and bonds. The question was answered by way of simulations using historic monthly returns from 1926 through 1990 on stocks, bonds and treasury bills. The prospective utility of holding each class for evaluation periods varying from 1 to 18 months was computed, using the utility function and the parameters set out above. It turned out that the horizon at which the prospective utility for stocks equaled the utility for bonds or treasury bills was always between 9 and 12 months, or roughly one year. The implication is that those who select a 50:50 allocation of their contributions between stocks and bonds for retirement purposes are actually thinking in terms of a one-year time horizon rather than a time horizon more appropriate for retirement investments. The evaluation period then, rather than the horizon, becomes the key measure in explaining risk premiums.

The next step reported by Thaler was to explore the relationship between the expected equity premium and the evaluation period. A graph of the implied real equity premium against the length of the evaluation period indicated a decline from about 6.5 percent for a one-year evaluation period to only 3 percent for a five-year evaluation period, and to 1 1/2 percent for a 20-year evaluation period.

Recognizing that the model developed so far may be characterized as one of individual decision-making, the authors next dealt with whether organizations sponsoring defined benefit pension funds can be said to follow the same thinking in terms of a utility function and evaluation frequency. A common pension fund asset allocation is about 60 percent stocks and 40 percent bonds and treasury bills, an allocation that does not seem to fit even with loss aversion if the time horizon used for evaluation is one of many years. The explanation seems to be that the same myopic loss aversion applies to the
corporation, and this is because although the corporation may have a very long expected life, the tenure of those who make the investment decisions is much shorter, and they are likely to be held accountable for results over quite short periods.

Thaler extended his discussion to see whether the theory he had developed could explain some other phenomena. One of these is the size effect, and the fact that small capitalization stocks have generally outperformed large capitalization stocks over a long period of time. The excess returns have been substantial, and prospect theory may offer a risk explanation. The researchers assumed that the evaluation period for small stocks was about 12 months, the period that had been found for stocks in general. And they assumed that small stocks are held primarily by individual investors. Their hypothesis was that investors tend to think about small stocks one at a time, while they may think about large stocks as aggregated in portfolios. They took the monthly returns from all stocks in the smallest and largest deciles on the CRSP tape from 1926 through 1990. For every stock they computed a 12-month nominal return, and then formed portfolios consisting of 1-10 stocks. The prospective utility for each size portfolio was computed as it was in the tests reported above, and found that the prospective utility of one small stock is almost identical to the prospective utility of a portfolio of many large stocks.

86. PSYCHOLOGICAL ASPECTS OF INVESTOR BEHAVIOR (Fall, 1993)

Zur Shapira, Professor, Department of Management and Organizational Behavior, Leonard N. Stern School of Business, New York University, distributed a paper entitled "Psychological Aspects of Investor Behavior." He described his presentation as a summary of research on managerial risk taking. He began with a definition of risk. In classical decision theory, risk is generally defined as variation in the distribution of possible outcomes, and we use variance or beta as the risk measure. But empirical observations do not fit these definitions very well. For one thing, the behavioral findings are generally to the effect that downward variance is perceived as risk while upward variance is not. The ways in which human decision makers define risk may in fact differ significantly from theoretical definitions and different individuals may see the same risk situation in quite different ways.

Tuning to attitudes toward risk, economists have assumed that individuals are risk averse and that expected returns must correlate with expected risk. However, behavioral research has indicated that decision makers do not always believe risk and expected return are positively correlated. Shapira's observations were based on interviews and questionnaires in which about 700 managers had been consulted on their perceptions of risk. His first conclusion was that managers see risk as associated with negative surprises not with positive surprises. Second, he discovered that the dollar amount that could be lost is more important than the probability of loss. Managers will accept high probabilities of loss with small dollar amounts, but not with large dollar amounts. Third, risk taking is not associated with gambling, and this has much to do with the sense of control over situations that some might regard as risky. And fourth, managers had a very hard time attempting to quantify risks.

A belief that risk can be minimized or eliminated by control seems common to all types of managers. Shapira referred to the "illusion of control" in situations where clearly the manager cannot control risk yet seems to believe that control is possible.

Risk attitudes are very much affected by the context. Executives were asked to rate the degree of risk they would take following great success, success, marginal success, marginal failure, failure, and considerable failure. It turns out that the propensity for risk taking tends to be high following great success and frequently also high following considerable failure, with the willingness to take risk somewhat less when past results have been neither very successful nor failures. Further investigation revealed that the managers interviewed fell into three groups: those who would take minimal risk under considerable failure, those who would take maximum risk under this scenario, and the remainder of the managers. The first group, the "cautious" executives are likely to take higher risks the more successful they are. The second group, the "fearful driven" executives display a tendency to take the highest risk under conditions of
considerable failure. Further investigation suggested that for executives there are two significant conditions. One is the survival point, where the organization has suffered badly, and things cannot get much worse, a point at which the cautious executives will take no risk, but the failure driven executives will take a high risk. The second significant condition is what Shapira called the aspiration level, or target at which the management had been aiming. Achieving this target can be considered success, and many managers seem to feel that risk taking is more warranted when faced with failure to reach this aspiration level than when the aspiration level is secure.

Shapira combined what he had learned from questioning the executives to propose the model shown in the accompanying figure. The diagram actually portrays two models. For managers who are focused on survival, risk taking is 0 when the total cumulated resources of the enterprise are at the survival level, and risk taking increases as the resources improve. For those managers focused on the aspiration level, risk taking is 0 right at that aspiration level, but rises as the resources fall below the aspiration level and there is a need to bring them up. The lower the cumulated resources below the aspiration level, the greater the risk taken. Once the aspiration level has been exceeded, however, as resources rise so does risk taking. For both models, risk taking rises beyond the aspiration point. But between the survival and aspiration points, risk taking will depend upon whether the focus is on survival or on aspiration level. In addition, the aspiration level may change over time. So in establishing the propensity to take risk, one needs to know the level of cumulated resources, the survival level, the aspiration level, and whether the focus is on survival or on aspiration.

Shapira is at present engaged in analyzing data on 20 government bond traders in a New York firm, over an 80-day period in 1990. The bond traders are required to update the value of their positions at least once a day, but are able to update as frequently as they wish. Because of the mandatory updating at the end of each day, the data include the profit and loss for each trader for each day. The first hypothesis was that the P&L on day t is considered as a target or reference point, and the P&L on day t+1 is considered either as a gain or a loss with respect to the target. According to the model set out in the figure above, if the trader focuses
on the P&L of day t as a target, then the larger the P&L on day t+1, the more risk the trader would be willing to take on day t+2. And the larger the negative P&L on day t+1, the larger the risk the trader would be willing to take on day t+2. Although Shapira's analysis of his data was not complete, he was able to provide some statistics for three traders and the hypothesis seemed to be supported.

STOCK PRICE AND RETURN DISTRIBUTIONS

87. IMPLIED BINOMIAL TREES
(Fall, 1995)

Mark Rubinstein, Professor of Finance at the University of California at Berkeley observed that a better title for his presentation is "Recovering Probability Distributions From Contemporaneous Security Prices," and he distributed a paper with this title by himself and Jens Carsten Jackwerth. His objective was to estimate risk neutral probability distributions of stock market returns. A common practice has been to use a historic time series to measure risk. Generally returns are assumed to follow a log normal distribution and the standard deviation, or the variance, is taken as the measure of risk. More recently, more complicated approaches have been taken to the analysis of historic rate of return series. Methods have been introduced for weighting historical data, generally giving more weight to more recent returns. The ARCH models are an example. Another approach is not based on historical series but deduces volatilities from the prices of related securities. An example is the use of the Black-Scholes option pricing model to determine the implied volatility of a stock or of an index. Still other approaches are nonparametric, making no assumptions with respect to probability distributions.

Rubinstein began with a discussion of the approaches that assume log normal distributions. The hypothesis that stock returns are log normal and that the annualized volatility is about twenty percent would suggest that the market decline of twenty-nine percent on October 19, 1987, at minus twenty-seven standard deviations, was simply impossible. The hypothesis would also suggest that the six percent decline in the market on October 13, 1989, at minus five standard deviations, was certainly quite extraordinary. The implication was that the assumption of log normal returns leads to an estimated volatility that is much too low. Rubinstein also presented data indicating that analysis of different sample periods from history gives very different estimates of volatility. Going beyond variance, to examine kurtosis and sample size, historical data indicate that kurtosis rises with sample size, which would be consistent with random changes in market volatility. It is also interesting that the volatilities implied by the Black-Scholes model are generally higher than historic volatilities calculated over prior sampling periods. In conclusion then, the combination of the log normal assumption and the analysis of historic data series appears to be an unsatisfactory method for estimating market volatility.

Rubinstein went on to discuss a number of other methods that have been tried. These included his own optimizing method, described in another paper. He concluded that "All these methods require an assumed prior distribution and occasionally lead to posterior distributions that have sufficiently little smoothness to be implausible. This suggests that an interesting approach might be to select the implied distribution with the maximum smoothness." It was this maximum smoothness model that Rubinstein proposed in his presentation.

The object is to find the smoothest distribution of prices in the sense of minimizing the second derivative of price with respect to the underlying asset level. This minimizes the curvature exhibited in the implied probability distribution. We determine implied volatilities across a range of striking prices based on bid-ask asset prices and optimized values. The smoothness criterion minimizes the second derivative of price with respect to striking price, summed over all possible striking prices. It turns out that this is equivalent to minimizing the fourth derivative of the call option price with respect to the striking price, summed over all possible striking prices. Since the striking price is sampled only at discrete intervals, the minimization is expressed in terms of finite difference approximations. A constraint is imposed to force the option values equal to their market prices whenever their striking prices coincide with actual available options.
In discussing empirical result, Rubinstein pointed out that there was a distinct change in shape between the probability distributions before October 19, 1987 and those following the market crash on that day. While the pre-crash distributions resembled the log normal distribution, the post-crash distributions showed leptokurtosis and left-skewness. It seems quite clear that the shape of the distributions was significantly altered by the market crash. The distributions the authors had arrived at indicated a much higher probability of extreme events - like the crash - than had been suggested by the log normal distribution. Rubinstein concluded that “maximizing the smoothness of the resulting probability distribution seems to be a well-suited objective for nonparametric methods of recovering risk-neutral probabilities from option prices.” Implied levels of skewness and kurtosis exhibit a discontinuity at the time of the 1987 market crash, but appear remarkably stable on either side of the crash. And the probability of another significant crash, as implied by the resulting distribution, is far greater now than prior to the crash.

Applying the ordered probit model, we consider a series of transaction prices \( P(t_0), P(t_1), P(t_2), \ldots, P(t_n) \) observed at times \( t_0, t_1, t_2, \ldots, t_n \), and denote by \( Z_1, Z_2, \ldots, Z_n \) the corresponding price changes, where \( Z_k = P(t_k) - P(t_{k-1}) \) is assumed to be an integer multiple of some divisor called a "tick" [such as an eighth of a dollar]. Let \( Z^*_k \) denote an unobservable continuous random variable such that:

\[
Z^*_k = X^*_k \beta + \varepsilon_k,
\]

\[
E[\varepsilon_k | X_k] = 0
\]

\( \varepsilon_k \) i.n.i.d. \( \text{N}(0, \sigma^2_k) \)

where "i.n.i.d." indicates that the \( \varepsilon_k \)'s are independently but not identically distributed, and \( X_k \) is a \( q \times 1 \) vector of predetermined variables that governs the conditional means of \( Z^*_k \). Note that subscriptions are used to denote "transaction" time, whereas time arguments \( t_k \) denote calendar or "clock" time. The observed price changes \( Z_k \) are related to the continuous variable \( Z^*_k \) in the following manner:

\[
Z_k = \begin{cases} 
-4 & \text{if } Z^*_k \in (-\infty, \alpha_1) \\
-3 & \text{if } Z^*_k \in [\alpha_1, \alpha_2) \\
\vdots & \vdots \\
+3 & \text{if } Z^*_k \in [\alpha_7, \alpha_8) \\
+4 & \text{if } Z^*_k \in [\alpha_8, \infty) 
\end{cases}
\]

What this means is that if \( Z^*_k \) falls between \(-\infty\) and \( \alpha_1 \), then \( Z_k \) is -4 ticks. And if \( Z^*_k \) falls within the interval \( \alpha_1 \) to \( \alpha_2 \), then \( Z_k \) is -3 ticks. The probit model applied to the data will find the values of \( \alpha \) for us, and will map \( Z^* \) into the a intervals. The parameters to be estimated then are the values of \( \alpha \), the \( \beta \)'s, and \( \sigma^2_k \). Probit can fit any arbitrary multinomial distribution. Other advantages of the model are that it includes other models of discreteness as special cases; normality is not necessary; and ordered probit can capture the price effects of economic variables in a way that models of the unconditional distribution of price changes cannot.

The authors made use of the Institute for the Study of Securities Markets (ISSM) transaction data base from the New York and American Stock Exchanges and the
Consolidated Regional Exchanges for 1988. This database consists of time-stamped trades, trade size, and bid/ask quotes. Working with a sample of five large capitalization stocks, the authors performed standard specification searches to set up the specification they then used without further revision on the primary sample of six stocks: IBM, Quantum Chemical Corporation, Foster Wheeler Corporation, Handy & Harman Company, Navistar, and AT&T. By using the specification derived from the test sample, the authors were attempting to reduce the impact of any "data snooping" biases that might be generated by specification searches.

Lo showed histograms demonstrating that the most common price change was a zero, with very few price changes larger than $\pm 3$ ticks.

The regression model took the following form:

$$X'_{tk} \beta = \beta_1 \Delta t_k + \beta_2 Z_{k-1} + \beta_3 Z_{k-2} + \beta_4 Z_{k-3} + \beta_5 S_{P500k-1} + \beta_6 S_{P500k-2} + \beta_7 S_{P500k-3} + \beta_8 IBS_{k-1} + \beta_9 IBS_{k-2} + \beta_{10} IBS_{k-3} + \beta_{11} (T| V_{k-1}) \cdot IBS_{k-1} + \beta_{12} (T| V_{k-2}) \cdot IBS_{k-2} + \beta_{13} (T| V_{k-3}) \cdot IBS_{k-3}.$$ 

$\Delta t_k$ is the time elapsed between transactions $k-1$ and $k$, in seconds. $Z_{k-1}$ is the price change lagged one transaction. $S_{P500k-1}$ is the five-minute continuously compounded return of the Standard & Poors 500 Index futures price, for the contract maturing in the closest month beyond the month in which transaction $k-1$ occurred. $IBS_{k-1}$ is an indicator variable lagged one transaction that takes the value one if the $k-1$ transaction price is greater than the average of the quoted bid and ask prices at time $t_{k-1}$, the value minus one if the $k-1$ transaction price is less than the average of the bid and ask prices at time $t_{k-1}$, and otherwise zero. $T|V_{k-1}$ measures the price impact of a trade per unit volume. $IBS_{k-1}$ is 1 for a buyer initiated trade, -1 for a seller initiated trade, and 0 for indeterminate origin.

Results of the regressions demonstrated first that the alphas were estimated with high precision for all stocks. The parameters for $\sigma^2_k$ were also statistically significant. Clock time turned out to be important for the conditional variances, but not for the conditional measures of $Z^*_k$. The lagged price change coefficients were negative for all stocks, implying a tendency toward price reversals. The lagged S&P 500 returns were significant. The coefficients here are a measure of how quickly market-wide information is impounded into prices. The tabular results of the regressions are difficult to analyze, and Lo presented graphical results that are more revealing. The percentage price impact of trades of different sizes computed from ordered probit probabilities, indicated, as one might have expected, that the impact is greater for smaller and less frequently traded stocks.

In summary, the sequence of trades does affect the conditional distribution of price changes, and the effect is greater for larger capitalization and more actively traded securities. Larger trades create more price pressure, but in a non-linear fashion. The price impact of a trade depends critically on the sequence of past price changes and order flows. The authors believe that they have demonstrated the superiority of the ordered probit analysis in dealing with the distribution of stock price changes.

**STOCK VALUATION - MODELS**

**89. CONTRARIAN INVESTMENT, EXTRAPOLATION AND RISK** (Fall, 1993)

Josef Lakonishok, Karnes Professor of Finance, Department of Finance, University of Illinois at Urbana-Champaign, Illinois, distributed a paper entitled "Contrarian Investment, Extrapolation and Risk" by himself and Professors Robert W. Vishny of the University of Chicago and Andrei Schleifer of Harvard University.

The ideas in the Lakonishok paper go back some sixty years to Graham and Dodd. There was a period following Graham and Dodd during which academic thinking was dominated by the efficient market theory, and papers not in accordance with that theory were
difficult to publish. In recent years, however, there have been a number of published papers on the predictability of stock returns, and Lakonishok presented a short bibliography on this subject. The controversy today is not over whether stock returns are predictable, but over the meaning of their predictability. Lakonishok's paper demonstrated clearly that over a very long period of time, working with a very large data base of stocks, a contrarian strategy, favoring value or out-of-favor stocks over glamour stocks had paid off handsomely. The question, then, was why? Those who believe in market efficiency, argue that value stocks are more risky, or that there is something wrong with the research that has demonstrated the return superiority of value stocks. Another set of explanations is that the market is not truly efficient, and that mistakes are systematically made by naive investors, or because of institutional constraints, leaving profitable opportunities for sophisticated investors that need not involve high risk.

The research Lakonishok reported made use of all New York Stock Exchange and American Stock Exchange companies, from April 1963 to April 1990. The analysis began in April 1968, with all of the stocks divided into deciles, first by the ratio of book to market value. Each decile became an equally weighted portfolio held for five years, with annual rebalancing but no change in the stocks in the portfolio. In April 1969 a fresh set of portfolios were chosen and held in the same way for five years. The process was repeated through April 1989. So twenty two sets of portfolios were followed for five years each. The Lakonishok group as had Fama and French, found that the high book-to-market ratio portfolios substantially outperformed the low book-to-market ratio portfolios. Limiting the choice of stocks to the top fifty percent on the two Exchanges, by market value, did not change the results significantly, nor did limiting the stocks to the top twenty percent by market value.

Dividing the stocks into deciles by the ratio of cash flow to price worked about as well as using the book-to-market ratio, in distinguishing the high return value stocks from the lower return glamour stocks. Sorting on the earnings-to-price ratio did not produce as strong results, but a high earnings-to-price ratio was still a predictor of higher returns.

The characteristics tested so far were ratios at a particular point in time (the previous year end). Lakonishok turned next to the use of a historic growth rate, taking as an example growth in sales over the previous five years. The decile with the lowest historic growth in sales outperformed the decile with the highest historic growth, although the difference was not as great as it had been when the sorting was on the ratio of book-to-market or cash flow to price.

Lakonishok's next step was to provide a more precise definition of value stocks and glamour stocks. The value stocks are those with low historic growth rates in some characteristic such as sales, and low expected growth in the form of low multiples such as book-to-market. Glamour stocks were those with very high past growth rates and high expected growth as shown by high multiples such as price to cash flow. He showed that separating stocks by a historic growth variable as well as an expected growth variable was far more powerful in separating low returns from high returns than the use of a single expected growth variable or a single past growth variable. The rate of return differentials were on the order of seven to eight percent a year, and the methodology appeared to rest on a sensible intuitive or theoretical basis. Investors who observed high historic growth rates and extrapolated these into high expected growth rates were generally disappointed when the expectations were not fulfilled, while investors who extrapolated low historic growth rates into low expected growth rates tended to be pleasantly surprised. Indeed, a comparison of historic growth rates with actual future growth rates indicated that for the glamour stocks the actual future growth rates were below the historic growth rates and the converse was true for the value stocks.

The seven to eight percent annual differential between growth stock and value stock returns seemed very high to be explained by risk differentials, but Lakonishok and his co-authors had explored a number of risk possibilities. They looked to see whether in down markets the value strategy continued to outperform the glamour strategy, and found that it did. Using every sorting methodology, the value portfolio outperformed the glamour portfolio in the market's worst twenty five months over the period tested. A comparison of
beta coefficients indicated that the value portfolios had slightly higher beta coefficients but these were not nearly high enough to explain the higher returns. Similarly, the value portfolios showed higher standard deviations in rate of return than did the glamour portfolios, but the differences were not nearly enough to explain the differences in rate of return.

In concluding, Lakonishok indicated that patient (waiting a matter of five years or so) strategies based on investment in value stocks substantially outperformed strategies based on glamour stocks. Identification of value and glamour stocks made use of both past growth rates and multiples. The reason for the success of the value stocks over the glamour stocks is excessive extrapolation of expectations from past performance. There seems to be no evidence that the value stocks are riskier than the glamour stocks. On the contrary, a diversified portfolio of value stocks is probably less risky than one of glamour stocks.

90. A BEHAVIORAL FRAMEWORK FOR EXPECTED STOCK RETURNS (Fall, 1993)

Meir Statman, Professor of Finance, Santa Clara University, distributed a reprint of an article by himself and Michael E. Solt of Santa Clara University entitled “Good Companies, Bad Stocks,” from The Journal of Portfolio Management, Summer 1989. He also distributed an article by himself and Hersh M. Shefrin entitled “How Not to Make Money in the Stock Market,” from Psychology Today, February 1986. He began his presentation by discussing an annual survey Fortune undertakes soliciting ratings on eight characteristics of U.S. corporations, including quality of management, and value as a long-term investment. Those surveyed are asked to rate companies in an industry from 0 to 10. In February 1993 the five most admired companies were Merck, Rubbermaid, Wal-Mart, 3M, and Coca-Cola. The five least admired were Wang Laboratories, Continental Airlines, Glenfed, LTV, and The Dime Savings Bank of New York. When Statman asked his students which stocks they would buy, they invariably chose the five most admired. Statman attributed their error to the general class of cognitive errors and he described a number of experiments identifying cognitive errors and suggesting that the human brain is not a general purpose computing machine, but is highly specialized for doing tasks that reflect the long history of human development.

Returning to the Fortune survey, he reported a number of regressions he had run between the respondents’ identification of a company as a long-term investment and various other qualities they had identified. The very qualities that had been suggested as indicating poor investments in some of the contrarian presentations correlated fairly highly with these respondents’ identification of investment value. In looking for explanations of what appeared to be poor investment judgment, Statman reviewed a number of characteristics of human behavior. He commented on the element of regret, as part of a realization expect that choices other than those actually made would have been better. He also discussed defenses against the taking of responsibility, and the tendency to blame other people or simply bad luck for unfortunate consequences. He discussed as well our tendency to think in terms of individual investments rather than portfolios. The significant point made by Markowitz is that what matters in terms of risk is covariance, and one must look at the portfolio as a whole. We have in many cases great difficulty doing this, and Statman considered that the prudent man rule, which originally focused on one investment at a time, might have something to do with this difficulty.

91. BEHAVIORAL JUSTIFICATION FOR THE PERMANENCE OF THE P/E PHENOMENON (Fall, 1993)

Arnold S. Wood, Partner and CEO and William E. Jacques, Partner and Executive Vice President, Martinagle Asset Management, distributed a paper entitled “The P/E Anomaly Revealed.” Jacques began the presentation, tying his talk to earlier discussions during the seminar on contrarian investing. He referred to the presentation of Josef Lakonishok the day before, commenting on errors in forecasting that had led to the superior investment performance of value stocks over glamour stocks. It was clear from research based on data from 1972 through 1992 that there had been substantial returns to the low P/E factor, a factor identified by BARRA, net of other factors. In other words,
when other factors were controlled, betting on low P/E stocks had paid off handsomely.

The next question was why low P/E investing works so well. An answer could be found in the statistics for top and bottom quartile P/E companies. The first sort had been performed in December 1979, when the high P/E stocks were earning 47 cents for every dollar earned by the low P/E stocks. Over a five-year period, the 47 cents grew to only 68 cents. So at the end of five years the high P/E stocks were still delivering only 68 percent of what the low P/E stocks were delivering. Roughly the same relationship held true for the high P/E stocks as of each December for the next seven years. And this explains why the high P/E stocks have significantly underperformed low P/E stocks by an average of 9.8 percent per year over the last 12 1/2 years. One might think that given this record, investors would have responded by arbitraging away the P/E effect. But the spread between high P/E stocks and low P/E stocks recently is at least as large as the historic average. The opportunities still exist.

Capturing the spread seems to have benefited by adjusting for industry effects. That is, ranking stocks within an industry and comparing the high and low P/E quartiles reveals a greater spread than simply ranking stocks across industries.

Jacques commented briefly on the question of what earnings figure is best used in computing the P/E ratio for purposes of identifying the best investment values, and indicated that the IBES 12-month earnings forecast was the best.

Arnold Wood took over the presentation to focus on behavior of investors. He identified three elements of the P/E phenomena. The first was anchoring, the tendency of investors to believe and trust the most recent numbers, rather than reviewing a more complete history. Second was convergence, the tendency of individuals to make more and more similar judgments -- in effect the replacement of individual judgment by crowd behavior. And third was agents' dilemma. When the plan sponsor simply does not want disreputable company names in a portfolio, the portfolio manager, who knows better, is hard put to exercise best judgment.

In closing, Wood suggested six reasons for the growth phenomenon -- for the insistence by so many investors on growth stocks:

1. Growth stocks will always bail you out.
2. Growth companies let you order off the menu (a message to investment managers).
3. Growth managers get to describe their stocks as sexy.
4. The Street will never let IBM drop to 100.
5. Clients actually believe it when managers tell them they will get first call.
6. Traders get to make Arsenio hooting noises when executing trades at all-time highs.

92. FAMA AND FRENCH: THE DATA WIN (Fall, 1993)

Robert Ferguson, Associate Professor, Fordam University, distributed a paper by himself and Christopher R. Blake and Sris Chatterjee, Assistant Professors at Fordam University, entitled "Testing the CAPM in an Imperfect World." The paper grew out of the work of Eugene Fama and Ken French, presented at the Spring 1992 Q Group Seminar. In testing strategies involving the sorting of stocks by the ratio of book-to-market value and by size as well as by beta coefficient, Fama and French had concluded that average rates of return were rather well explained by the book value-to-market price ratio and by the size, but not by the beta coefficient. The implication was that the capital asset pricing model was not supported by their results. Ferguson's paper examined the power of the Fama-French tests, to conclude that those tests could not reject the hypothesis that beta coefficients were in fact related to average rates of return.

Fama and French had performed 330 monthly cross-sectional regressions of stock returns against (1) fundamental quantities, (2) beta coefficients, and (3) both the fundamental quantities and beta coefficients. They tested the null hypothesis that the coefficients of the independent variables were zero. To do this they averaged the coefficient estimates over the 330 regressions, they computed the estimated standard deviation of the averages, and they computed the t-ratios and tested the null hypothesis that the coefficients were zero. They rejected the null hypothesis for the coefficients of the fundamental quantities but they accepted the null hypothesis for the coefficient of beta.
Ferguson discussed the probability of rejecting the null hypothesis. This probability depends upon the true value of the parameter being tested. Ideally, we would like a test that rejects the null hypothesis whenever that hypothesis is false, that is whenever the true coefficient differs even slightly from zero. But in practice, the likelihood of rejecting the null hypothesis is quite small if the true coefficient is close to but not quite at zero. The question then is whether the true coefficient of beta in the Fama-French research is so close to zero that the test is likely to fail to reject the null hypothesis. In addition to difficulties applying the test when the true coefficient is close to but not at zero, Ferguson pointed out a variety of reasons that might invalidate the t-test.

To illustrate the problem, Ferguson described a simulation of 330 monthly returns on 50 securities, using a four-factor returns generating process, a process for which the CAPM holds. This model was deemed to be a true state of a hypothetical world. A parallel noisy state of the world was created, to introduce the estimating error that would be experienced by an investor attempting to measure the true world. A number of cross-sectional regressions could then be run, incorporating known items of data, noisy known items of data, and in particular regression beta coefficients and noisy regression beta coefficients. Graphical presentations of the probability of accepting the null hypothesis demonstrated the very high probability of accepting the null hypothesis in a case where we know it to be false. His conclusion was that the Fama-French test has low power and does not appear to justify rejecting the CAPM.

93. THE CROSS SECTION OF EXPECTED STOCK RETURNS
(Spring, 1992)

Kenneth R. French, Leo Melamed Professor of Finance at the Graduate School of Business, University of Chicago, distributed a paper by himself and Eugene F. Fama entitled "The Cross-Section of Expected Stock Returns". He introduced his topic as a second look at variables that have been examined by a number of researchers over the past dozen years and found to provide some explanation for cross-sectional stock returns.

The specific variables examined in this research are the beta coefficient, firm size, leverage, earnings to price ratio, and book to market value ratio. The first results he discussed had to do with the relation between return and size and return and beta. The data base was all New York Stock Exchange stocks over the 50-year period 1941 through 1990. The first step was to sort the firms by size (market value) in June of each year and then to form 10 deciles, from largest to smallest. The rates of return for each of the deciles were then tracked month by month through June of the following year. Another sort then took place; deciles were formed; and rates of return were calculated each month for another year. The result was 600 monthly rates of return for each decile. In addition, each June the beta coefficient for each decile was computed. A graphical presentation of average monthly returns and betas for each of the deciles showed an almost linear relation, with the largest capitalization decile showing the lowest beta and the lowest average monthly return, and the smallest capitalization decile showing the highest beta and the highest average monthly return. Capitalization size and beta were then almost perfectly correlated with each other and therefore with rate of return.

The next stage was to split each of the size deciles into 10 deciles by beta coefficient. A graphical presentation now indicated essentially no relationship between average monthly return and beta. The 10 beta deciles within the largest size decile indeed showed as a group a low average monthly return, while the 10 beta deciles within the small capitalization decile showed as a group a high rate of return, but within each size decile, the beta deciles showed a small tendency towards negative correlation with average monthly return.

Anticipating an objection that the beta coefficients might have been incorrectly determined, French discussed the "prior betas" computed each June from data over the preceding 3-5 years, and the "post-ranking betas", computed from the returns on the 100 portfolios after their formation by establishing size deciles and then beta deciles.
Next, for portfolios formed on the prior beta, the average return plotted against the post-ranking beta showed essentially a flat line. That is, the average monthly return was about the same over a range of betas from approximately .8 to approximately 1.7. The result may seem odd, since the research had already found a very high correlation between size and beta and between size and rate of return. Why then should there be essentially no correlation between beta and rate of return? French’s answer was that the effect of other variables, to be discussed later, swamped any effect the beta might have.

The analysis was continued, with the other variables already identified. The time period was shifted to July 1963, through December 1990, to accommodate the data availability from the Compustat tapes. As before, portfolios were selected in June of each year and the performances tracked in subsequent months. In each month a cross-sectional regression was run, providing 330 slope coefficients for each variable tested against rate of return. For the beta coefficients alone, the average slope was only 0.15 per month, corresponding to less than 2% a year, and the low t-statistic indicated no significance. For market size, the average slope was a negative 0.15% per month but the t-statistic indicated significance. For the ratio of book-to-market equity, the average slope was 0.50, highly significant. For leverage, measured both as the ratio of assets to market equity and the ratio of assets to book equity, the coefficients were 0.50 and -0.57, respectively, both significant. But French pointed out that the two leverage ratios could be collapsed into the ratio of book-to-market equity, a variable already tested. The earnings-to-price ratio showed a slope of 4.72, quite significant, for cases where earnings were positive. Where earnings were negative, a dummy variable of 1.0 was used to represent the earnings-to-price ratio, and the slope coefficient was 0.57, again significant. However, when the two earnings-to-price ratio variables were combined with the market value variable and the book-to-market ratio variable, their significance largely disappeared. The final conclusion then was that the earnings-to-price variable was subsumed as were the leverage variables by size and book-to-market ratio, leaving only the beta coefficient, the size variable and the book-to-market ratio variable as the ones of interest. The final conclusion was that the beta coefficient contains little information about average stock returns; there appears to be a reliable negative relation between size and average stock returns, and there appears to be a strong positive relation between book-to-market equity ratio and average stock returns.

French closed by discussing briefly plans to search for an explanation of the relationships that had been found, perhaps by discovering risk measures related to size and to the book-to-market value ratio. To the suggestion that liquidity differences might explain some of his results, he expressed some skepticism. There appeared to be ample liquidity in the categories of stocks that had displayed high returns.

94. FRANCHISE FACTORS IN EQUITY VALUATION (Fall, 1991)

Martin L. Leibowitz, Managing Director and Stanley Kogelman, Vice President, Salomon Brothers, Inc. distributed a Salomon Brothers publication they had authored entitled “The Franchise Factor for Leveraged Firms, Inside the P/E Ratio (Part III).” Leibowitz began a presentation that built on previous work that had explained the price to earnings ratio of a corporation in terms of two components. We think of the market value of a corporation as consisting of the sum of the tangible value and the franchise value. The tangible value is made up of the book value of assets and the premium over book value the firm is able to generate by achieving above market returns on those book assets.

For example, consider a tax-free firm that has a book value of assets of $100 million and a 15% return on book value when the market capitalization rate for the firm is 12%. Since the firm is able to earn 3% above the market capitalization rate, or $3 million, those $3 million capitalized at the 12% rate produce a $25 million additional premium over book value, and make the total market value of the firm $125 million. The P/E supported by the tangible value alone (referred to by Leibowitz as the base P/E) is then 125/15 or 8.33. The number can also be derived as the reciprocal of the 12% market capitalization rate. Leibowitz pointed out that the stock we had been
considering is directly analogous to a perpetual bond.

Franchise value will exist if the firm is able to invest in new assets that will return more than the market capitalization rate (12% in our example). Some simple arithmetic will produce the market value expression:

\[
\text{Market Value} = \frac{E}{k} + \frac{(R-k)xB}{k} = \frac{E}{k} + \frac{(R-k)xB}{rk} = \frac{E}{k} + \frac{(R-k)xB}{rk} \cdot G \cdot x \cdot E
\]

So \( P/E = \frac{1}{k} + \frac{R-k}{rk} \cdot G \)

\( G \) is the fraction of existing book value of assets that is represented by the present value of the new opportunities. This means that \( G \times B \), where \( B \) is the book value of current assets, gives the present value of the available investments. This present value is multiplied by the differential \( (R-k) \) between the return the firm can earn on these new assets and the market capitalization rate. This excess earnings is discounted to perpetuity at the market capitalization rate \( k \). The FF term is the Franchise Factor and the G term is the Growth Equivalent. Leibowitz commented that in order to move the P/E ratio up significantly above its base value, at plausible franchise factor levels, it turns out that it is necessary for \( G \) to be substantial -- on the order of twice or more the book value of existing assets. In other words, to achieve a significantly better P/E than the base P/E, the firm must find very substantial assets upon which it can earn an above market rate of return.

Kogelman then proceeded to add the leverage element. It is assumed that the total value of the firm is unaffected by the substitution of debt for equity in the absence of taxes. (This is in accord with the famous Proposition 2 of Modigliani and Miller.) The cost of debt is assumed to be constant at different levels of leverage, so that the market value of the debt is always equal to its face value. The market capitalization rate of the firm's equity will automatically adjust to keep the total value of the firm (debt plus equity) constant. An interesting question was whether under these assumptions the introduction of leverage would raise or lower the P/E ratio, or leave it unchanged. As Kogelman pointed out, all three results are possible.

Consider our original case, with $50 borrowed at an interest rate of 8%. The after-tax earnings drop from $15 to $11, after subtraction of the $4 interest. Fifty dollars of borrowing replaces $50 of the $125 firm market value, leaving $75 for the shareholders. The base P/E then drops to 75/11 or 6.82. The franchise factor, after leveraging, is given by the following expression:

\[
FF = \frac{R-k}{(R-i)k}
\]

where \( i \) = interest rate on debt

\( h = \) leverage as a percentage of book value.

At 50% leveraging at a 4% interest rate (that is, borrowing 1/2 of the 100 book value) and at an R of 18%, the franchise factor comes to:

\[
\frac{0.18 - 0.12}{(0.15 - 0.08 \times 0.50) \times 0.12} = 4.55
\]

Now if \( G \) is 125% of the initial book value, the product of FF and G will be 5.68, which when added to the base P/E of 6.82 gives a total P/E of 12.50. What happens when we add leverage is that the base P/E declines but the franchise element of the P/E rises. Whether the decline or the rise will dominate depends upon G, the amount of franchise investments the firm can make. The greater G, the higher the P/E will rise. There is a value for G for which the P/E will remain unchanged across all leverage ratios. For a given franchise factor then there is a "threshold" P/E ratio. If the firm's P/E is lower than this threshold, then leverage will bring it down further and if it is above this threshold then leverage will raise it. Kogelman demonstrated that for P/E ratios close to the threshold, leveraging up as far as about 40% will have rather little effect on the P/E.
He next commented on the result of introducing income taxes. The equations change only in that h, the fraction of the book value that is borrowed, is replaced by \((1 - t)h\), where t is the tax rate.

Leibowitz returned to discuss the character of the franchise. Assuming a substantial part of earnings are reinvested, what the franchise does is to boost earnings and therefore reinvestment of earnings, and to bring about a rise in the book value of the firm. If a franchise has a limited life then its boost to earnings will ultimately disappear, but it will have left behind a permanent boost in book value. As a franchise is used up the P/E ratio will decline until it reaches its original level, that is the base level. In closing he observed that it may be useful when confronted by a very high P/E ratio to attempt to construct a set of franchise factors and values of G that will explain the ratio.

95. TRADING LOCATION AND SMALL STOCK PERFORMANCE (Fall, 1991)

Andrew L. Turner, Senior Vice President and Director of Research, the Frank Russell Company began his presentation with the observation that small stock portfolios are likely to contain NYSE as well as OTC stocks, and there are widely held perceptions that small stocks in the OTC behave differently from small stocks on the NYSE. For example, a Russell study using the sixth through tenth size deciles of the CRSP index found that the mean return for small OTC stocks was less than the mean return for small NYSE stocks, and that the standard deviation was larger for the OTC small stocks. In addition, the study found differences in stock characteristics, but did not attempt to relate these differences to differences in rate of return. The characteristics showing a difference were the price to book ratio, the price to sales ratio, the dividend yield, the sales growth rate, and the debt to capital ratio.

Turning to the present study, Turner raised the question what explains the return differences between portfolios selected from NYSE small stocks and portfolios selected from OTC small stocks. The research had made use of time series to look for relations between the returns on portfolios of small stocks and macroeconomic variables, differences in equity characteristics, and measures of investor confidence. Cross-sectional analysis had been used to explore the relationship between trading location and individual security returns net of fundamental factors.

Data for two sets of small stocks had been used. The two were the sixth through tenth deciles of the CRSP index and the stocks in the Russell 2000. Both sets included NYSE and OTC stocks. Monthly returns on the portfolios and stocks were used, together with quarterly equity fundamentals from the Russell data base and monthly macroeconomic variables from a variety of data bases. The data covered the period from the first quarter of 1979 through the second quarter of 1991. An unexpected finding was that the sixth through tenth deciles of the CRSP index gave a mean return on small OTC stocks less than the mean return on the NYSE small stocks, but the Russell 2000 sample showed just the opposite. Turner suggested possible reasons for these apparently contradictory results, but had no conclusive explanation. Some participants at the seminar suggested weighting differences and sector differences.

The macroeconomic variables whose influence on return spreads between NYSE and OTC stocks was tested included the equity risk premium (the S&P 500 returns less treasury bill returns), the bond default premium, the Business Week industrial production index, and the treasury bill rate. Macroeconomic variables accounted for about half of the spreads in returns.

Differences in equity fundamentals explained a much smaller portion of the spreads. These differences were in average capitalization size, beta coefficient, book to price ratio, dividend yield, earnings to price ratio, and return on equity. Once the influence of the macroeconomic variables had been allowed for, size differences contributed very little to the explanation for the spreads. The same was true of the book value to price ratio. (These had been the two most significant equity fundamental variables.)

Three measures of investor confidence were incorporated in the time series regressions. One was the 12-month percentage change in consumer confidence in current business conditions. A second was the 12-month
percentage change in consumer confidence in expected business conditions. And the third was the average over the most recent quarter of the ratio of equity mutual fund sales to redemptions. The first of these appeared to be the most significant, but once again after the macroeconomic variables had been allowed for it contributed very little to the explanation for the return spreads between NYSE and OTC small stocks. The same was true of the mutual fund sales to redemptions ratio.

Cross-sectional regressions were run for each of 50 quarters, making use of the equity factors, economic sectors, and trading location (NYSE or OTC). Returns on individual stocks in the Russell 2000 index were used in these regressions. It turned out that the economic sectors were unimportant. The equity factors provided most of the explanation for the return spreads, and trading location did not add significant explanation to what was provided by those equity factors.

In conclusion, it was clear that small stocks on the NYSE do behave differently from small stocks in the OTC. The differences appear to be due to underlying economic factors, and not to the trading location as such. And portfolio construction methods that ignore fundamental or economic factors may miss the true sources of return.

96. FORECASTING THE RETURN TO SIZE: A PRELIMINARY INVESTIGATION (Fall, 1991)

Russell J. Fuller, CFA, Vice President, Concord Capital Management, distributed a paper by himself and John L. Kling of Washington State University entitled "Forecasting the Return to Size: A Preliminary Investigation." Fuller began his presentation with the question whether return to size is important to institutional investors. His answer was that indeed it is to his firm, Concord Capital Management. Concord manages a substantial amount of U.S. equities, and while it does not consider itself a small cap manager, it does tend to equally weight stocks in portfolios and the median market cap of stocks in its portfolios is generally below the median for the S&P 500 stocks. To a second question, whether the differential return of small cap stocks minus large cap stocks (DRET) can be explained or accounted for, his answer was a qualified yes. And to the question whether the DRET can be predicted, he said he did not yet know how. The importance of the DRET was shown by graphs showing over the years the annual difference between the small cap return series reported by Ibbotson Associates and the S&P 500 and the difference between Concord's normal versus the S&P 500. In the first case the mean absolute difference over 35 years was 14.1%, and in the second case the mean absolute annual differential was 4.4%.

Fuller proposed a simple liquidity premium asset pricing model to explain the return to size. The model is written as:

\[ R_{it} - R_{ft} = C_i L P_t + \beta_i (R_{mt} - R_{ft}) \]

The equation is the familiar capital asset pricing model with the addition of a liquidity term. The liquidity coefficient of the stock \( C_i \) is multiplied by a time-varying, economy-wide liquidity premium \( L P_t \). If we assume all stocks have a beta of 1, the relationship reduces to:

\[ R_{it} - R_{mt} = C_i L P_t \]

\[ DRET_{it} = C_i L P_t \]

Thus, DRET can be thought of as equal to the security or portfolio liquidity premium. The justification for ignoring differences in beta is supported by evidence that suggests that betas explain very little, if any, of the cross-sectional variation in security returns if one controls for size.

Return data were taken from CRSP New York Stock Exchange monthly returns, with the stocks ranked annually into deciles by size. For the DRET Fuller used the difference between the total return for decile 9 (small stocks) and decile 2 (large stocks). For the period 1926-1988, the DRET was 2.4% for all months, 5.4% for January only, and -3.1% for the months February-December. It seemed clear that the analysis would have to separate January from the rest of the year.

Fuller turned next to the search for explanatory variables for the return to size. Over 20 variables were used, including such economic variables as unanticipated industrial production, unanticipated inflation, change in
anticipated inflation, default premium, the ex ante real rate of interest, and the prime rate of interest. One stock market variable used was the standard deviation of the NYSE value weighted return index. The returns to size were the January DRET and the non-January DRET. It turned out that the standard deviation of the NYSE value weighted return index had the greatest explanatory power, and that once it was included the economic variables were of very little significance. For the non-January DRET, the default premium turned out to have significant explanatory power as did the January DRET for the current year and for the preceding year. There was a positive correlation between the non-January DRET and last year's January DRET, but a negative correlation with the current year's January DRET. Fuller attributed the negative correlation to the result of prices adjusting to an overreaction in January.

With respect to the economic value of the best models, Fuller distinguished between the January DRET and the non-January DRET. The January model forecasted a positive DRET for every January during the 43-year post World War II period, so that model is not very interesting. The best non-January model correctly forecasted the sign of the non-January DRET in 27 out of 43 years (63% of the time). But of the 14 years for which this model forecasted a positive non-January DRET, the forecast was correct only 7 times (50%). Fuller concluded that the research indicates a plausible liquidity premium asset pricing model can be developed. But explaining the variation in the return to size is very difficult, and more work needs to be done before we have reliable models to predict the time varying return to size.

STOCK VALUATION - QUANTITATIVE TECHNIQUES

97. THE EQUITY MANAGER'S POSITION (Spring, 1993)

William L. Fouse, Chairman, Mellon Capital Management, introduced the topic. He and Martin Liebowitz had been discussing present day security analysis, and the question whether quantitative techniques developed over the past decade or so had made any major impact on security analysis. The result was a portion of the program devoted to the presentation of two points of view: traditional security analysis relying rather little on quantitative techniques, and quantitative analysis making use of substantial data banks and new technology.

J. Parker Hall III, President, Lincoln Capital Management Company, described the important elements of traditional active equity management. Referring first to the professionals in the firm, he stressed the importance of continuity and stability. His firm has been characterized by very low turnover. Participation is an important element. Research people, together with all of the other professionals, have a vote on portfolio decisions. This helps in attracting the best researchers. All professionals in the firm own stock in the firm. The earnings of every individual vary with the earnings of the company.

From people, Hall moved to investment philosophy, which is seasoned growth. This philosophy has been consistent over many years, and it is important that this is the philosophy clients understand and want.

Hall described Lincoln as the first management company to initiate the use of benchmarks. Apart from their value in measuring performance, these form a useful focus and the firm is equipped to make a detailed attribution of rates of return.

Finally, the investment process is one of bottoms up, micro-oriented, leading to concentrated portfolios. Valuation discipline is important, with tight price limits and considerable patience in transactions. Apart from constraints imposed by clients, client portfolios are very similar leading to very similar rates of return.

Hall added that the firm does its best to keep costs low. He believes their fees are rather low, and commissions are carefully controlled although patience in transacting is more important than the commission itself.

Scott D. Stewart, Senior Vice President, Fidelity Management Trust Company, presented the results of an analysis of the work of the approximately 90 equity analysts at Fidelity. These analysts generally follow a
traditional approach, with a heavy emphasis on company visits. Each analyst is responsible for a list of stocks, grouped by industry (rather than by a value or growth characterization). Analysts actually manage money as well, something Stewart suggested may be unique to Fidelity.

The research he reported was undertaken to measure the value added by analysts. Three separate analyses were actually performed. The first began with actual historical buy, sell, and hold recommendations, and examined the subsequent returns to the corresponding stocks. The second examined the returns on stocks actually purchased by analysts for their own industry portfolios, compared to indexes developed for each industry assignment. The third analysis required the creation of broadly diversified portfolios based upon analyst recommendations and the comparison of rates of return from these portfolios with market indexes.

Stewart showed a chart of excess returns for the buys versus the sells (ignoring the holds), for U.S., U.K., Japanese, and Southeast Asian stocks, for years for which machine readable data were available. The differential (annual returns on buys minus annual returns on sells) ranged from 9.3 percent per year for the U.K. stocks to 22.1 percent for the Southeast Asian stocks. Next he showed for the analyst portfolios of U.S. industries, the excess returns over industry indexes (before adjusting for the cost of the analytic work). The excess returns averaged 4 or 5 percent a year, and ranged from -2.5 percent to +17.5 percent. Similar charts for the U.K. and Japan showed analyst portfolio returns exceeded industry index returns. A fourth chart compared the results of structured portfolios using analyst recommendations, with market index returns, in this case after allowing for the cost of the security analysis. The extra return for the structured portfolios ranged from 0.7 percent to 4.6 percent annually.

Stewart's conclusion was that even after allowing for the costs of security analysis, active management based upon the recommendations of security analysts had led to increased rates of return. He added that the value added was greater in the case of small cap stocks than in the case of the large cap stocks. He also added that it turned out the sell recommendations underperformed the market more than the buy recommendations outperformed it. This may have had something to do with the manner in which the research was carried out, in which recommendations were attributed in all cases to the end of a month when in fact they would be distributed through the days of the month.

Charles Pohl, Vice President, Dodge & Cox, Inc. discussed some differences between traditional security analysis, as practiced in his firm, and reliance on quantitative techniques. He said that most of what Parker Hall had said about Lincoln Capital Management would also apply to Dodge & Cox. The firm is seeking long-term economic value in its investments, and depends upon in-depth analyses of companies to be purchased. Pohl stressed that changes in world economic and competitive conditions call for continuous changes in analytic approaches. As an example of the importance of change, he took the significance of book value. The ratio of stock price to book value has become widely used in quantitative analysis, but the notion of book value has changed in recent years and it is not clear that the quantitative analysis always reflects this change.

Among the accounting changes that have dramatically affected book value per share are FASB 87/88 dealing with pensions, FASB 109 dealing with deferred taxes, and FASB 106/112 dealing with post-retirement benefits. Recent years have also seen very substantial write-offs and establishments of reserves for losses at a number of corporations, significantly affecting book value. Share repurchases have become very substantial in recent years, in many cases reducing book value and automatically raising price to book ratios. Historical cost accounting has always led to book values that in many cases are a poor representation of current economic value, particularly for buildings, natural resources, and financial assets. And a number of important items, such as environmental liabilities, patents, and brand names, are not shown on balance sheets at all.

As an example, Pohl selected General Motors and presented some interesting statistics. As of the end of 1991, the book common equity was $27 billion. But GM was estimating its obligations under FASB 106 (post-retirement health benefits) at between
$16 billion and $24 billion. Ultimately, GM identified $20.8 billion as the appropriate number and elected to take the full charge in one year rather than amortizing it. The impact on book value and hence on a price to book ratio, was enormous.

Pohl showed a graph of the historical price to book ratio for the Standard & Poor's industrials, a graph showing a significant rise in the ratio in the last year or so. The implication might be that a significant overvaluation has taken place. But a similar graph showing the price to sales ratio conveyed a very different message, with the implication that prices are by no means too high. He attributed the difference to significant reductions in book values in recent years, reductions unrelated to declines in economic value.

98. THE QUANTITATIVE ANALYST'S VIEW (Spring, 1993)

George M. Douglas, Director, First Boston Investment Management, traced the emergence of heavy usage of quantitative techniques in investment management. The 1970s saw increasing complaints about the performance of traditional quantitative security analysis. This analysis appeared to be lacking in discipline. It led to inconsistent performances. It relied heavily on Wall Street research. It led to too much risk taking, and then too little risk taking. Quantitative analysis was encouraged by the development of risk and pricing models. It offered easy back testing of these models and ways to combine valuation models. It offered portfolio optimization, computer based rankings, and simple ways to indexation and passive investment.

Douglas suggested that some recent disappointment with quantitative approaches point to serious flaws. Extensive back testing became excessive back testing. There was a search for permanent and structural mispricing patterns that could be exploited for long periods of time. And he questioned whether it is reasonable to expect any such patterns. There has been an obsession with avoiding the traditional use of judgment in the expectation that somehow pure quantitative analysis will lead to cleaner and more trustworthy results. There has been a lack of respect for the dynamic and competitive nature of capital markets.

At the same time, new investment technology has permanently changed the nature of investment management. Managers must be able to monitor and evaluate thousands of securities, something that cannot be done without computers and quantitative techniques. Benchmarks are here to stay. Traditional equity traders are competing with work stations that are programmed to trade against them. Derivative securities are here to stay. Synthetic equity strategies offer a serious competitive threat to the traditional active manager.

Perhaps the most important consequence of the quantitative techniques is the ability of the manager to achieve systematic returns in an efficient market using these techniques, with active positions in an inefficient market where the manager can use his or her skills. This point had been discussed at Q Group 1992 Autumn Seminar, when Myron Scholes pointed out that if a manager has true skill in any inefficient market, that skill can be combined with indexation in an efficient market to produce a return that is superior to that of an index of the efficient market. Douglas offered the example of enhancing the return on long-term treasury bonds by holding treasury bond futures and a market neutral portfolio of lower-rated corporate bonds, by a manager able to achieve superior returns through skill in this latter market.

His forecast for the future was that the use of benchmarks will increase; some excess performance above the benchmarks will be demanded of active managers; traditional traders will have a harder time competing; and hedge funds and investment banks working with proprietary capital will offer greater competition for manager talent.

David Umstead, Managing Director, Boston International Advisors, Inc. distributed a series of graphs and tables entitled "Style Life Cycles in International Equity Investing: What Works Long Term." The styles he was comparing were value and growth, and he began with the conclusions of Fama and French in their article in the Journal of Finance, February 1992, (presented by Ken French at the 1992 Spring Seminar of the Q Group) in which
they suggested that the ratio of book value to price, and capitalization size, are better risk measures than beta coefficients, providing better explanations of rate of return. These conclusions suggested that sorting stocks by the ratio of book value to price might be a useful path to superior performance.

Umstead presented some of the results reached by Capaul, Rowley and Sharpe in their article in the Financial Analysts Journal of January/February 1993, in which they compared the performance record of low price/book ratio (value) stocks with those of high price/book ratio (growth) stocks. Over the eleven and a half years from January 1981 through June 1992, the record for six national markets plus Europe and the Morgan Stanley global market, showed annualized average superior performances for the value stocks ranging from 1.35 percent (in the U.S.) to 6.41 percent (in France). Lest one associate the superior performance with a higher beta, Umstead showed that for all but Switzerland and France, the beta coefficients for the value portfolios were actually lower than those for the growth portfolios. The Sharpe ratios (reward to variability) were always greater for the value portfolios than for the growth portfolios.

Umstead added to the results of the Capaul, Rowley and Sharpe paper a similar analysis performed by Boston International Advisors Inc., covering the 18 years 1975 through 1992. In this case, all securities in the Morgan Stanley universe (rather than only the securities in the Morgan Stanley indexes) were used. As in the case of the earlier study, the value portfolios had outperformed the growth portfolios, with an average annual return differential ranging from 1.39 percent in Switzerland to 4.91 percent in Japan. A graph of the cumulative value minus growth spread showed that at the end of the 18 years the EAFE value index was 1.70 times the EAFE growth index.

Umstead discussed possible reasons for the superiority of a strategy of purchasing value rather than growth stocks. No strong theory had emerged, giving rise to some doubts as to whether the value of the strategy might persist. It did appear that there were tax disadvantages to the value stocks (because they generally paid higher dividends) but this disadvantage fell short of explaining the full before-tax superiority.

99. EQUITY STOCK SELECTION
(Spring, 1993)

William L. Fouse, Chairman of the Board, Mellon Capital Management Corp., moderated a panel made up of John Nagorniak, Chairman and CEO, Franklin Portfolio Associates; William Jahnke, Founder, Vestek Systems; and H. Russell Fogler, Partner, Aronson & Fogler. Fouse began by commenting that the previous day’s panels on stock selection had made few references to expected returns on individual stocks, and said he thought explicit forecasts of rates of return and the use of the discounted cash flow model provides useful insights.

John Nagorniak discussed three critical elements in stock selection. The first is information. While information covers a wide variety of sources and data, it is critical to be consistent in the way in which information is generated. There should be consistency from analyst to analyst and through time. Second, some structural assumptions must be made in the use of the information. A behavioral assumption might be that certain kinds of news can be acted upon because they have probably not yet been impounded in stock prices. Finally, there must be a procedure for discriminating among securities, perhaps simply by classifying them as buy, sell, or hold, or by ranking, or by expected return. The three elements apply to each of four disciplines followed by his firm.

The fundamental momentum discipline assumes information is received early enough that it is not yet impounded in stock prices. The relative value discipline looks back to develop "normal" prices, assuming that the past is a good indication of the future and that there will be a reversion to "normal" prices. The dividend model discipline assumes one can forecast future dividends and can build a structure around the forecasts. A final discipline draws on miscellaneous sources, including insider trading.

Bill Jahnke discussed the use of expected rates of return for individual securities as well as for classes of securities. Expectation estimates are generally based on historical performance, and he pressed the question whether it makes sense to place so much
reliance on history. Some 20 years ago Wells Fargo began to use a discounted cash flow model to arrive at expected returns for individual stocks. Once an expected return for each stock had been estimated, regressions were run to see how that expected return was related to beta, to dividend yield, and to cap size. He distributed a table produced by Vestek, showing by month from June 1991 through February 1993 the regression coefficients. What was of particular interest was the negative coefficient representing a negative return to yield. The statistics for February 1993, indicated that one must expect to give up 10 basis points of return for every one percentage point of yield. This statistic appears to contradict the proposition that value investing would prove more profitable than growth investing. Over the last 20 years, however, the historical high return to yield was 0.66. At that point in time, one might have anticipated obtaining 4 percentage points of extra return for investing for an average dividend yield of 5 percent, compared to investing in growth stocks with no dividends. The premium therefore was a respectable one. In 1978, the price of yield was about 0.4, so that a 1.5 percent yield tilt offered an extra 60 basis points of return. All of this might suggest that there have indeed been times when value investing made good sense, but that the time may have passed.

Jahnke went on to suggest that there are two elements to the return to value. One is an expected return to value, based on inherent differences between value and growth stocks. The second is what he called "cognitive bias" in forecasts of growth. Analysts think they are better at forecasting growth than they really are. When growth stocks produce less growth than was anticipated they make value stocks look relatively attractive. His conclusion was that while expected return to value may indeed have disappeared in recent months, cognitive bias is still at work.

Russell Fogler took the seminar participants back to Benjamin Graham, pointing out that much that we may feel we have discovered in recent years was already familiar to Graham, including a belief in efficient markets. Graham's ratios have become today's factors, and we continue to experiment with linear relationships seeking superior selection, as in the relationships that had been discussed in previous sessions indicating the superiority of value over growth stocks. Fogler's point was that to achieve superior stock selection today we must turn to nonlinear relationships and recognition of idiosyncratic characteristics.

He commented that trading has changed a great deal in recent years; it has become more institutional, computerized, enhanced by synthetic securities, and in general much faster. But, he said, security analysis remains much the same. Benjamin Graham's factors have been taken out, reducing alphas to approximately half what they were in the 1970s and 1980s.

The panel was asked to what extent the benefits of quantitative analysis may have disappeared and Fogler responded that only linear relationships can be arbitrated away, and that to a large extent this had happened. But he said the large cap market made up of something like 200 stocks differs significantly from the smaller cap market. There are much more serious limits on opportunities for superior performance in the large cap market.

100. RHETORIC OF ECONOMICS
(Spring, 1992)

H. Gifford Fong, President, Gifford Fong Associates and Chairman of the Program Committee, introduced the Spring 1992 Seminar with a brief discussion of the planning process, and an introduction to the primary theme of the Seminar which was "Experimental Design and Ways of Improving Design". Five presentations would be devoted to this theme. Jack L. Treynor, President, Treynor Capital Management Inc. then introduced Donald N. McCloskey, the John Murray Professor of Economics and Professor of History at the University of Iowa.

McCloskey distributed a paper entitled, "The Art of Forecasting, From Ancient to Modern Times". Referring to the title of his presentation, he observed that the rhetoric of forecasting goes far beyond its mathematics, to deal with the various ways in which forecasts are made persuasive. His theme might be taken as the societal function of forecasting.

He drew a number of parallels between forecasting as it was practiced over 2,000 years ago and forecasting today. In 45 B.C., Cicero
identified two techniques for divination (forecasting): artificial, and natural. Artificial forecasting was based upon the study of data (at that time primarily the entrails of birds or animals), while natural forecasting reflected intuitive powers thought to be divinely inspired. In modern terms, the artificial technique becomes the manipulation of quantitative information by way of econometric models. What distinguishes this technique from the natural technique is that any intelligent person trained in econometric methodologies is quite capable of practicing it. The natural technique still has about it the aura of magic, as it did 2,000 years ago.

Cicero was contemptuous of those who practiced the artificial technique for the same reason that econometricians are criticized today: practitioners faced with apparently identical data sets reach differing conclusions. And at both periods of history we find the practitioners of the artificial technique attributing apparent failures of their forecasts to technical defects in the ritual of analysis (statistical procedures, in modern times) and to erroneous interpretations of results provided by the forecaster.

Having drawn the historic parallel, McCloskey concluded that it illuminates the problems in forecasting. A particular problem he identified lies in the fact that those who propose models for forecasting that appear to offer opportunities for substantial profit are found not to invest in those models themselves. Indeed, he maintained that it is difficult to find an economist who has put forward such models and has achieved the wealth one would have anticipated had the models proved successful. Hence widespread skepticism. It is true, McCloskey noted, that some economic forecasters have become wealthy, but only from selling their advice rather than following it.

That forecasts should be eagerly purchased despite the case against the value of economic forecasting calls for some explanation. The comfort factor, the ability to shift responsibility for a decision to a professional forecaster, is one reason. Sometimes the comfort factor is not just psychological but has a legal basis, as when a standard of prudence in the management of money appears to require recourse to professional advice.

Turning to the rhetoric of forecasting, McCloskey concluded that a forecast that is sought after and believed must have a strong element of the natural or magical about it. It must be expensive. It must require the services of people with special powers, not simply those with a Ph.D. in Economics. Providing such forecasts is not the business of economists. Economics is anti-magical and economists should remember this when they are tempted by the pleading of those who really want magical forecasts. What economists can do is to observe history, to explain that history, and to make such forecasts as do not depend upon magic and do not offer the possibilities of great profit. As a practical matter, this generally means avoiding all unconditional forecasts.

101. DATA MINING – GOOD OR BAD? (Spring, 1992)

Edward E. Leamer, the Chauncey D. Medberry Professor of Management at the University of California at Los Angeles, distributed a paper entitled "Data Mining: Good or Bad?". Referring to "specification searches" as a more respectable term than "data mining", he identified two quite different approaches to the use of data in econometrics. The first, referred to as "Holmesian" after the famous detective of fiction, turns first to data, and derives theory from the data. The second, more respectable to most present day economists, calls for theory to come first, setting up a model the parameters of which may then be established by the use of data. As a practical matter the statistician is unable to make much progress with the Holmesian approach. Without a starting model it is impossible to arrive at a set of statistical criteria which can be applied to the data that are examined. In the end, one is inclined to combine the two approaches, starting with theory, turning to data, and then if necessary modifying the theory.

Leamer proposed a schematic to explain how data analysis may be carried out. The first stage is planning. Here we devise a model, and go further to plan how the model may be modified in response to hypothetical data (hypothetical, because we have not yet examined real data). There are four different kinds of planned responses, depending on whether the response is precise or imprecise and on whether the response takes the form of a
judgment or an action. Mainstream statistical theory deals with precise judgments and actions. From a Bayesian perspective, the quantification of precise judgments is the conceptually straightforward activity of forming a posterior distribution given a precisely defined prior distribution and a precisely defined sampling distribution.

Where there can be a substantial commitment to the original planned responses to the data, the data analysis can be thought as confirmatory and this analysis may be carried out entirely by a computer. Exploratory, rather than confirmatory, data analysis is characterized by a weak commitment to the original planned responses, and Leamer suggested that this is likely to be the case with economics and finance, as opposed to the hard sciences.

This leaves us then with determining the role of criticism and revision once we have exhausted our planned responses to the data analysis. Leamer's advice at this point was to devote sufficient care to the planning process that criticism and revision are unlikely to play a major role in the data analysis. This means choosing a set of models that is large enough and eliciting a prior distribution that is accurate enough that the data are unlikely to make us regret the initial choices.

Leamer focused the balance of his presentation on a particular form of data mining: interpretive searching, which is intended to deal with the problem of overparameterization. We have too many explanatory variables in a regression model, for example. A common approach is step-wise regression, in which a computer is allowed to identify the explanatory variables that are the most important. Leamer's alternative is a Bayesian approach. One establishes a set of plausible parameters (the "prior distribution") and asks if the real data require major revisions to initial parameter values. Beyond overparameterization there may be a second problem: vagueness. It may be particularly difficult to arrive at the required prior distribution. Leamer's advice was at least initially to ignore the vagueness problem and proceed with the best available prior distribution. Then do a sensitivity analysis to see whether the inferences change a lot with changes in the priors. If there is great sensitivity, then there may be little profit in working with the data.

Leamer proceeded to attempt a prediction of changes in the Standard & Poor's Composite (500) Index. He began with seven explanatory variables drawn from the literature on stock market prediction. He added an eighth variable, based on a finding that out of 25 Super Bowls, 17 NFC victories correctly predicted a market rise and 5 AFC victories correctly predicted a market decline. He demonstrated the application of step-wise regression to the problem, in which the computer concluded the football results were the most important explanatory variable. The Bayesian analysis required the establishment of a set of prior parameters, which Leamer performed in a rather naive way, assuming none of the variables could be expected to predict the stock market.

Ignoring the problem of vagueness, the Bayesian approach found one or two of the explanatory variables to be useful. Introducing the sensitivity analysis to deal with the problem of vagueness was accomplished by allowing the prior to have a covariance matrix twice as large or half as large and identifying the explanatory variables for which within that range it is impossible to tell even the sign of the coefficient. This analysis indicated a low degree of vagueness, that is, the prior distribution is not too bad, and the real problem is overparameterization.

Leamer's conclusion, based of course upon his prior distribution, was that the index is essentially unpredictable. But his principal point was that with the Bayesian approach (and emphatically not with the step-wise regression approach) one can discuss and modify the prior distribution to achieve something that seems to make intuitive sense, and then rerun the analysis.

102. IS ALL GOOD RESEARCH DUE TO BAD EMPIRICAL DESIGN? (Spring, 1992)

Stephen J. Brown, Research Professor in Finance at The Stern School in New York University, distributed a paper entitled "Survivorship Bias in Performance Studies". He began his presentation with the general proposition that in research for empirical
regulators in asset returns (such as returns resulting from superior management) we necessarily focus on interesting or unusual events (such as superior returns from management). But by neglecting times when interesting events do not occur (such as those when performance is inferior) we may draw some incorrect inferences.

Turning specifically to the question of superior performance, he commented that there is only weak evidence that managers in general achieve a positive alpha after commissions and fees. But there remains the possibility that some managers have superior skills and that their performances may be consistently superior in absolute or relative terms. A number of studies have led to mixed results, some finding evidence that funds which outperform other funds in one period will tend to outperform them in a second, and some finding no persistence. The analysis normally involves a contingency table in the form of four boxes. One box tabulates the number of managers whose performance was superior in each of two periods, a second tabulates the number whose performance was inferior in both periods, a third tabulates the number whose performances were superior in the first period, and inferior in the second period, and a fourth tabulates the number whose performances were inferior in the first and superior in the second. When the number of winner-winners or the number of loser-losers is greater than the number of winner-losers or loser-winners, we have some evidence of persistence in good or bad performance. Brown commented on the use of chi-square tests for significance and the alternative cross-product ratio tests. The chi-square test is appropriate when the numbers in the four boxes are independent, which in many of these persistence tests is not the case. The cross-product ratio is the ratio of the number of winner-winners multiplied by the number of loser-losers to the product of the number of winner-losers times the number of loser-winners. If there is no persistence in superior or inferior management, the cross-product ratio will be approximately one.

On the basis of these significance tests, some studies have claimed evidence of the persistence of superior management. It was the thesis of Brown that while there may indeed be superior management and it may indeed persist, the evidence that has so far been found can be explained by survivorship bias. His conclusions were based upon an experiment in which he simulated annual returns for 600 managers from

\[ R_{it} = r_f + \beta_i (R_{mt} - r_f) + \varepsilon_{it} \]

where the annual Treasury bill rate \( r_f \) is taken to be .07 and the annual equity risk premium is assumed to be Normal with mean .086 and standard deviation .208 corresponding to the Ibbotson and Sinquefield (1990) numbers. The idiosyncratic term \( \varepsilon_{it} \) is assumed to be distributed as Normal with mean zero and standard deviation \( \sigma_i \).

The managers are defined by their risk measures \( \beta_i \) and \( \sigma_i \). It is assumed that \( \beta_i \) is distributed in the cross-section of managers as Normal with mean .95 and standard deviation .25, corresponding to the cross-sectional distribution of beta observed in the Goetzmann and Ibbotson sample of money managers (one of the studies that found strong evidence that performance persists).

The distribution of nonsystematic risk across managers is functionally dependent on beta. Closet index funds with betas close to one typically have very low values of nonsystematic risk, whereas managers whose betas deviate from the market tend to be less well diversified. This suggests a relationship between nonsystematic risk and beta approximated by

\[ \sigma_i^2 = k(1 - \beta_i)^2 \]

The value of \( k \) chosen in the simulation experiment is .05349, which is the value which ensures that the average \( R^2 \) across managers is .90, given the distribution of beta and the assumed variance of the equity risk premium.

What we have, then, is an experiment in which managers are distinguished by their beta and by their non-systematic risk. It turns out that it is the dispersion of non-systematic risk that gives rise to an appearance of persistence in superior and inferior performance. In the experiment, Brown evaluated the risk adjusted performance for each manager using Jensen's measure, and cumulated risk-adjusted returns for the first two
years and the second two years. He ran the experiment assuming all 600 managers survive the entire four-year period, then assuming that in each of the first three years the bottom 5% of the managers go out of business, and finally assuming that the bottom 10% go out of business each year.

For the first run there is no apparent persistence of performance. But when managers are dropped from the sample for poor performance, there is evidence of apparent persistence in performance. And the more managers that are dropped for poor performance along the way, the greater the evidence of persistence of superior or inferior performance. An intuitive explanation for what is going on is that during the first period managers with high non-systematic risk will tend to deliver extremes of performance. The positive extremes will show up as superior performance, while the negative extremes are likely to result in the managers being dropped from the sample (assuming we are applying the 5% or 10% cut-off rule). As we move from period to period, some of the managers with the highest unsystematic risk will continue, purely by chance, to deliver among the best performances, while others will deliver bad performances and be dropped from the sample. The end result, then, is that a number of these managers with high unsystematic risk will create the impression that superior performance persists.

Brown commented that if one were to evaluate performance using the Treynor appraisal ratio rather than the Jensen adjustment, which has the effect of adjusting by unsystematic risk, much of the evidence of persistence in his experiments would disappear. This suggests the possibility of correcting empirical evaluations by way of this adjustment.

103. DATA MINING CORRECTIONS

(Spring, 1992)

Harry M. Markowitz, Professor, Department of Economics and Finance, Baruch College and Gan Lin Xu, Research Mathematician, Daiwa Securities Trust Company, distributed their paper entitled "Data Mining Corrections". Markowitz began by describing the problem they faced. A frequent way of identifying a "best" strategy is to compute how well different investment strategies would have worked in the past. Picking the historically best performing strategy can be referred to as "data mining". The problem comes in attempting to estimate the future performance of this strategy. It turns out that the past performance itself is not a good estimate of future performance, and the purpose of the corrections reported in the paper was to adjust this past performance to make it into a best estimate.

In the course of searching for a best portfolio selection method, Markowitz and his associates had tested at least 1,000 selection methods. Had only one method been tested, then the best unbiased estimate of the expected performance of that method would be given by the past mean performance:

$$g_b = \log_e (1+GM_b)$$

$$= \sum_{t=1}^{T} \frac{\log_e (1 + R_t)}{T}$$

But where the best method is identified is the one that delivered the best past performance of 1,000 methods we must somehow distinguish between the superiority that was truly inherent in the method and the superiority that was due to pure chance. In Markowitz' words, we should "discount" the performance of the observed best. The size of the discount should depend on the standard deviation of the distribution of "true returns" and the standard distribution of the observed returns given the true returns. But all we are able to observe is the standard deviation of the observed returns. Markowitz proposed three models for adjusting the observed returns. The three models are:

I. $r_{it} = \mu_i + \epsilon_{it}$

where $E(\epsilon_{it}) = 0$, $\text{cov}(\mu_i, \epsilon_{it}) = 0$,

$\text{cov}(\epsilon_{is}, \epsilon_{jt}) = 0 \quad \forall i \neq j, \text{ or } s \neq t.$

(e.g. where $r_{it} = y_{it} - z_t$ of model II when $z_t$ is observable.)
$y_{it} = \mu_i + z_t + \varepsilon_{it}$

$E\varepsilon_{it} = 0.$

$\text{cov}(\mu_j, z_t) = \text{cov}(\mu_j, \varepsilon_{it}) = \text{cov}(\varepsilon_{it}, z_t) = 0$

$\text{cov}(\varepsilon_{is}, \varepsilon_{jt}) = 0 \quad \forall i \neq j, \text{ or } s \neq t.$

$\text{III. } r_{it} = \mu_i + \varepsilon_{it}$

where $E\varepsilon_{it} = 0, \quad \text{cov}(\mu_i, \varepsilon_{it}) = 0$

$\text{cov}(\varepsilon_{it}, \varepsilon_{is}) = 0, \quad \forall s \neq t.$

Model II is perhaps the most useful. The observed return $y_{it}$ can be thought of as consisting of a premium $\mu_i$ plus some benchmark rate of return $z_t$ plus an error term. If $z_t$ is itself observable, then we have Model I. Model III differs from Model I in that $\varepsilon_{it}$ and $\varepsilon_{it}$ may be correlated. In other words, in any given time period there may be a correlation among the error terms for different portfolio selection methods, although there is no correlation from one time period to another.

In Model I, if we think of $\mu_i$ (the "true" return) as well as $\varepsilon_{it}$, as a random variable, and if we knew the joint distribution of $\mu$ and $\varepsilon$ [but not which method had which $\mu$] then the best linear estimate $\hat{\mu}_i$ of $\mu_i$ given $y_{1i} \ldots y_{iT}$ (i.e., $\hat{\mu}_i$ minimizing $E(\hat{\mu}_i - \mu_i)^2$ among those of form $x_0 + \sum_{i} x_i r_{it}$) would be

$$\mu_i = E\mu + \frac{\text{Cov}(\bar{r}_i, \mu_i)}{\text{Var}(\bar{r}_i)} (r_i - E\mu)$$

$$= E\mu + \beta (r_i - E\mu)$$

$$\beta = \beta_{r,\mu}$$

$$= \frac{\text{Cov}(\bar{r}_i, \mu_i)}{\text{Var}(\bar{r}_i)}$$

$$= \frac{\text{Var}(\mu)}{\text{Var}(\mu) + \text{Var}(\varepsilon) / T}$$

$$< 1$$

The key then to evaluating the true or expected return $\mu_i$ is the estimation of the beta, and most of the mathematics in the presentation was aimed at this evaluation. Two methodologies were used. The maximum likelihood estimate is probably the more respectable, but it turns out that it will work only for Model I, and closed form solutions cannot be found for Models II and III. Hence, a second methodology was applied, the RUE or ratio of unbiased estimates of numerator and denominator (referring to the numerator and denominator in the expression for beta). Since it turns out that the results of the maximum likelihood estimate and the RUE methods are very close for Model I, it seemed reasonable to use the RUE methodology for Models II and III.

For Model II, the formula for the beta is somewhat more complex than it was for Model I. From a discussion of this beta, Markowitz went on to consider tests of significance against the hypothesis that all differences in the performances among the one thousand methods tested were due entirely to chance. He also commented that the RUE method comes very close to a Bayesian approach.

For Models II and III, using monthly data from December 1972 to December 1990 on Japanese stocks, the beta turned out to be 0.5185, or approximately one-half. This meant that the expectation for the superiority of any selection methodology might be expected to be approximately one-half of its past superiority. Four different portfolio selection methods were illustrated in a concluding table. The methods were ordinary least square, latent root regression, weighted latent root regression, and robust regression. The WLRR procedure had historically provided 9 basis points above the average of the four methods, whereas the ROB method provided 9 fewer basis points per month than the average. The 18 basis point difference is reduced to approximately 9 basis points after applying the beta "discount". For Model III, the beta ratios vary from one selection method to another, and were .6195 for the WLRR method and .5490 for the ROB method. The indicated difference in expectations between the two portfolio selection methods is now about 10 basis points, very close to what was indicated by Model II.
STOCK VALUATION – TORPEDO EFFECT

104. THE SUBTLE RISK OF HIGH EXPECTED GROWTH – THE TORPEDO EFFECT (Fall, 1991)

Robert L. Hagin, Partner in Miller, Anderson & Sherrerd, distributed a paper entitled "The Torpedo Effect: The Subtle Risk of High Expected Growth." He had appeared at the Fall 1984 Q Group Seminar to explain the torpedo effect, and he opened his presentation at this seminar by referring to complaints at that time that he did not have enough data to fully support his thesis. His recent research was based upon earnings forecasts, actual earnings growth, and actual rates of return for between 500 and 800 of the largest capitalization stocks in the IBES universe over the 14-year period ended March 31, 1991.

First he demonstrated that had one had perfect foresight with respect to calendar year percent changes in earnings, one could have achieved extraordinarily high rates of return for all of the years from April 1977 through March 1991, simply by investing in the quintile of highest earnings changes. So ability to accurately forecast earnings changes would have paid off. Next came the torpedo hypothesis. We find that extreme ex ante earnings change forecasts can lead to good and bad surprises. The conjunction of least favorable forecasts with most favorable results leads to very pleasant surprises, while the conjunction of most favorable forecasts and least favorable results leads to great disappointments. It turns out that betting on the least favorable forecasts would have given better than average results, but betting on the most favorable forecasts would have led to very poor results.

Hagin turned to the significance of ex ante price/earnings ratios, and his table showed that over the 14 years using the price/earnings ratio as an investment guide would have led to very mixed results. Similarly, ex ante P/E ratios would not have been very helpful in forecasting actual earnings changes. However, for those who do have forecasting ability, the rewards were greater in low P/E stocks rather than the high P/E stocks.

Tuning to size as a characteristics of stocks, Hagin showed that as one might expect small stocks are risky, sometimes producing very favorable and sometimes very unfavorable year-to-year changes in earnings.

In brief, the research showed that earnings forecasts sufficiently accurate to place into quintiles the forthcoming percent changes in earnings would have led to above average investment returns. The best performing stocks are likely to be those for which analysts forecast the least favorable year to year earnings changes and the worst performing are likely to be those forecasted to have the most favorable earnings changes.

TRADING COSTS

105. THE COST OF INTERNATIONAL EQUITY TRADING (Spring, 1994)

Professors Andre F. Perold and Eric Sirri, of the Harvard Business School, distributed a paper entitled "The Cost of International Equity Trading." Sirri began the presentation by describing the origin of the research, which came out of discussions at State Street Global Advisors of how international equity trading is done, and the resulting costs. While the data gathered for empirical research came entirely from a single firm, the authors concluded that the disadvantages of a single data source were more than outweighed by the advantages of understanding clearly the process by which orders were formulated and executed. In particular, information was available on orders placed but never executed, so that it was possible to assess the cost of unexecuted trades.

For a single order, the activity path went like this: The portfolio manager would make a decision to trade. Almost immediately, an order would be placed. Frequently, the foreign market in which the trade would be executed would be closed for the day, so that execution could not begin until the following day. Portions of the order would be filled successively. The entire order might be filled, or it might not. For the most part, it was left to the brokers' discretion how far to pursue price changes in attempting to fill the entire order. The prices at which portions of the order were filled, and the amounts of each fill, are known.
The price five days following the order is also known. Sirri discussed a number of methodologies one might use to determine the transaction cost. One might simply compare, in the case of a buy order, the aggregate cost of the fills with the aggregate value of the shares at the five-day (or any other succeeding) time point. This is the "closing price benchmark" method. Alternatively, one might aggregate, in the case of a buy order, the difference between the actual cost of each fill less what the fill would have cost at the opening price on the day the fill was executed. This methodology makes use of the "opening price benchmark." The authors preferred an "implementation shortfall" method. The implementation shortfall includes both an execution cost and an opportunity cost, where the execution cost includes market impact, commissions, and taxes, and the opportunity loss is the loss (or gain) from not acquiring all of the shares ordered. Determining the implementation shortfall is fairly straightforward: One calculates the "paper return" as the value of the entire order at the five-day point, less the value of the entire order priced at the point at which the decision to trade was made. This is what the profit would have been had there been no cost of trading with the order executed at precisely the price at the time the decision was made. From this paper return one subtracts the real return, which is the value of the shares actually acquired, at the five-day point, less the cost of their acquisition. The result is the implementation shortfall.

State Street Global Advisors provided data on about 120,000 orders (representing about $12 billion), of which about 70,000 orders were used in the research, covering a time span from February 1987 to December 1991. The orders were placed through 35 brokers in 31 countries, and covered over 4,000 different equity securities. Close to two-thirds of the trades were passive, and the other third active. Close to three-quarters of the transactions were buys, and one-quarter sells. All transactions were done on an agency basis, with State Street soliciting commission bids from brokers and generally going with the lowest bid.

Sirri presented a number of statistics showing costs by country, time sequences for fills, and distributions of trading and costs. For all orders, the cost of commissions and taxes was 31 basis points; the market impact was 98 basis points; the completion rate was 0.96 and the opportunity cost was 207 basis points, for a total average implementation shortfall of 127 basis points. (The numbers do not appear to quite add up due to rounding. In principle, one multiplies the .04 incompletion rate by 207 basis points, and adds this amount to .96 completion rate times (31 basis points + 98 basis points).) The breakdown of the implementation shortfall for each of 18 countries showed that completion rates were rather small in Australia and Finland; the market impact was perhaps surprisingly high in the U.K. and Germany, and much lower in Japan. The entire implementation shortfall was highest in Belgium, at 200 basis points, and lowest in the Netherlands, at 78 basis points. The U.K. was above average; Germany was close to average; Japan was close to the lowest. For passive trading, the average implementation shortfall was 102 basis points, while for active trading the average was 176 basis points. In general, Sirri observed that the higher cost of international equity trading, compared to the cost of U.S. domestic equity trading, explains the usefulness of derivatives in international investing.

Andre Perold continued the presentation, comparing the implementation shortfall methodology with the use of the opening price and closing price benchmark. In the case of a buy transaction, if the order has a temporary upward impact on the stock price, which subsequently falls back, all three methodologies will capture the cost of this temporary impact. If the buy order has a permanent impact (where it is based on superior information), then the closing price benchmark method will not capture this impact as a cost. In the case of adverse selection, where the purchase is effected at the opening price but the price subsequently falls, then the opening price benchmark methodology will not capture the cost. In all three cases, only the implementation shortfall strategy captures the full cost. And because this methodology includes the opportunity cost of a purchase order not completely filled, a broker is not able to "game" the method as he or she might game the other two.
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March 25 - LIQUIDITY AND TRADING RULES
Liquidity, Trading Rules and Electronic Exchanges
Speakers: Wayne Wagner, The Plexus Group
          Lawrence Harris, Associate Professor, School of Business,
          University of Southern California, Research Coordinator, IQRF

The Specialist's Order Book
Speaker: Kevin Rock, Co-Head, Mergers and Acquisitions, Financial
         Institutions, Citibank

March 25 - INTERNATIONAL EVIDENCE
Volatility & Trading Mechanisms: Evidence from the Japanese Stock Market
Speaker: Haim Mendelson, Professor, Graduate School of Business,
         Stanford University

Major World Equity Markets: Current Structure and Prospects for Change
Speaker: Hans Stoll, Professor of Finance, Owen Graduate School of
         Management, Vanderbilt University

March 26 - ORTHOGONAL PERSPECTIVES
Experimental Methods and Market Microstructure
Speaker: Vernon L. Smith, Professor of Economics, University of Arizona

Market Structure
Speaker: Morton Rothstein, Professor in History, University of
         California at Davis

March 26 - INFORMATION DYNAMICS
A Bayesian Model of Intraday Specialist Pricing
Speaker: Ananth Madhavan, Assistant Professor of Finance, Wharton
         School, The University of Pennsylvania

Trading in Equilibrium
Speaker: Fischer Black, Partner in Goldman Sachs Asset Management

A Theory of Arbitrage Trading in Financial Market Equilibrium
Speaker: Craig W. Holden, of the School of Business, Indiana University

New Trading Practices and Short-Run Market Efficiency
Speaker: Kenneth A. Froot, Associate Professor, Sloan School of
         Management, MIT
October 13 -16, 1991
NEW RESEARCH PERSPECTIVES ON THE MAJOR ASSET CLASSES

October 14 - FIXED INCOME
Fixed Income Volatility Management
Speakers: R. L. Whalen, Managing Director, CIGNA Corp.
         H. Gifford Fong, President, Gifford Fong Associates
         Oldrich Vasicek, Senior Vice President, Gifford Fong Associates

Valuation and Management of Bonds With Sinking Fund Provisions
Speaker: Andrew Kalotay, President, Andrew Kalotay Associates, Professor,
         Graduate School of Business Administration, Fordham University

Troubled Debt Restructurings
Speaker: Kose John, Professor of Finance, Stern School of Business,
         New York University

Examining and Modeling Corporate Bond Rating Drift
Speakers: Edward I Altman, Professor of Finance, New York University
         Duen Li Kao, Director, Investment Research, General Motors Corp.

October 15 - EQUITES
Franchise Factors in Equity Valuation
Speakers: Martin L. Leibowitz, Managing Director, Salomon Brothers, Inc.
         Stanley Kogelman, Vice President, Salomon Brothers, Inc.

The Subtle Risk of High Expected Growth - The Torpedo Effect
Speaker: Robert L. Hagin, Partner in Miller, Anderson & Sherrerd

Trading Location and Small Stock Performance
Speaker: Andrew L. Turner, Senior Vice President and Director of
         Research, the Frank Russell Company

Forecasting the Return to Size: A Preliminary Investigation
Speaker: Russell J. Fuller, CFA, Vice President, Concord Capital Management

October 16 - REAL ESTATE
On the Nature of Systematic Risk in Commercial Real Estate
Speaker: Brian Webb, Asst. Professor, School of Business, Indiana University

The Quantification of Real Estate
Speaker: Randall Zisler, President, Russell-Zisler, Inc.

March 29 - April 1, 1992
ANALYZING MARKET BEHAVIOR: TECHNIQUES AND PITFALLS

Rhetoric of Economics
Speaker: Donald McCloskey, Professor of Economics and of History,
         University of Iowa

Data Mining -- Good or Bad?
Speaker: Edward E. Leamer, Professor of Management, University
         of California at Los Angeles
Is All Good Research Due to Bad Empirical Design?
Speaker: Stephen J. Brown, Research Professor in Finance, Stern School, New York University

Measuring Market Timing Strategies
Speakers: Gilbert L. Beebower, Executive Vice President, SEI Corporation
Michael Kantor, Vice President SEI Corporation

Data Mining Corrections
Speakers: Harry M. Markowitz, Professor, Department of Economics and Finance, Baruch College
Gan Lin Xu, Research Mathematician, Daiwa Securities Trust Co.

Global Asset Allocation
Speaker: Robert Litterman, Vice President, Goldman Sachs & Co.

The Cross Section of Expected Stock Returns
Speaker: Kenneth R. French, Professor of Finance, Graduate School of Business, University of Chicago

Harvard Management Company Case Study
Speakers: Jay O. Light, Professor and Senior Associate Dean, Harvard Business School
Jack Meyer, President, Harvard Management Company

An Ordered Probit Analysis of Transaction Stock Prices
Speaker: Andrew Lo, Associate Professor of Finance, Sloan School of Management, MIT

Assessing the Quality of a Security Market
Speaker: Joel Hasbrouck, Associate Professor of Finance, Stern School, New York University

October 11 - 14, 1992
MARKET EXECUTION: STRATEGIES AND TECHNIQUES

October 12 - SWAPS
An Overview of the Foundations of Financial Engineering with an Application to Swaps
Speaker: Chi-Fu Huang, Professor of Finance, Sloan School of Management, MIT

Future of Risk Management: Swaps and Contractuals
Speaker: Myron S. Scholes, Managing Director, Salomon Brothers Inc.

Recent Innovations in the Swap Market
Speakers: Robert Litzenberger, Professor of Investment Banking, Wharton School; and Chief Economist, AIG Financial Products Corp.
Steven Sitzer, Vice President, AIG Financial Products Corp.

The Role of Regulation
October 13 - AUCTION THEORY

Auction Theory I
Speaker: John McMillan, Professor, Graduate School of International Relations & Pacific Studies, University of California-San Diego

Auction Theory II
Speaker: R. Preston McAfee, Professor, Department of Economics, University of Texas at Austin

Auctions: Theory and Laboratory Approach to Behavior
Speaker: Charles R. Plott, Professor of Economics and Political Science, California Institute of Technology

October 14
Dutch Auction Stock Repurchases
Speaker: Laurie Simon Bagwell, Associate Professor, Kellogg Graduate School of Management, Northwestern University

The Prospective Real Yield and Its Relevance to Active Global Bond Management
Speakers: Robert Bernstein, Senior Vice President and Director of Fixed Income, Delaware Investment Advisers
Ian Sims, Managing Director, Fixed Income, Delaware International Advisers, Ltd.

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ASSESSING, COMPARING TRADED AND ILLIQUID ASSET CLASSES

March 29 - THE MANAGEMENT OF EQUITIES
The Equity Manager's Position
Speakers: William L. Fouse, Chairman, Mellon Capital Management
J. Parker Hall III, President, Lincoln Capital Management Co.
Scott D. Stewart, Senior Vice President, Fidelity Management Trust Company
Charles Pohl, Vice President, Dodge & Cox, Inc.

The Quantitative Analyst's View
Speakers: George M. Douglas, Director, First Boston Investment Management
David Umstead, Managing Director, Boston International Advisors, Inc.

The Winners and Losers of the Zero-Sum Game
Speaker: Lawrence Harris, Professor, University of Southern California School of Business Administration

Managing Asset Classes
Speaker: James H. Scott, Managing Director, Prudential Investment Corp.

March 30 - REAL ESTATE AND VENTURE CAPITAL
Real Estate and Venture Capital: Historical Value Indices of Commercial Real Estate
Speakers: Jeffrey D. Fisher, Professor, Indiana University
David Geltner, University of Cincinnati
Brian Webb, School of Business at Indiana University
Equity Stock Selection
Panelists: William L. Fouse, Chairman of the Board, Mellon Capital Management Corp.
John Nagorniak, Chairman and CEO, Franklin Portfolio Associates
William Jahnke, Founder, Vestek Systems
H. Russell Fogler, Partner, Aronson & Fogler

Measuring Commercial Mortgage Performance: An Index Approach
Speaker: Michael Giliberto, Director of Real Estate Research, Salomon Brothers Inc.

Evaluating the Venture Capital Allocation
Panelists: Robert E. Angelica, President, AT&T Investment Management Co.
Jack R. Meyer, President, Harvard Management Company
Bart Holaday, Managing Partner Venture Capital, Brinson Partners

March 31
The Performance Measurement and Volatility of Unquoted Pension Fund Investments
Speaker: Peter W. Stanyer, Investment Director, British Rail Pension Trustee Company, Ltd.

How to Get Rich Quick Using GAAP
Speakers: Robert Ferguson, Associate Professor of Finance, Fordham University, Graduate School of Business
Jack Treynor

October 17 - 20, 1993
INVESTOR BEHAVIOR: THE EQUITY RISK PREMIUM AND THE CURRENCY FACTOR

October 18
Contrarian Investment, Extrapolation and Risk
Speaker: Josef Lakonishok, Professor of Finance, Department of Finance, University of Illinois at Urbana-Champaign, Illinois

Fama and French: The Data Win
Speaker: Robert Ferguson, Associate Professor, Fordham University

October 18 - CURRENCY
A Practitioner's Guide to Currency Hedging
Speaker: Mark Kritzman, Partner, Windham Capital Management,

Currency Hedging Over Long Horizons
Speaker: Kenneth Froot, Professor, Graduate School of Business Administration, Harvard University,

October 19 - CURRENCY
Understanding Foreign Exchange Risk
Speaker: Robert Hodrick, Professor of International Finance, Kellogg Graduate School of Management, Northwestern University

Investment Strategies for a Lower Interest Rate Environment
Speaker: Martin Leibowitz, Managing Director and Director of Research, Salomon Brothers Inc.,
October 19 - RISK AVERSION
A Behavioral Framework for Expected Stock Returns
Speaker: Meir Statman, Professor of Finance, Santa Clara University

The Retirement Savings Crisis: Are Americans Getting the Message
Speaker: Shari L. Powell, Marketing Researcher, Merrill Lynch Market Planning

Behavioral Justification for the Permanence of the P/E Phenomenon
Speakers: Arnold S. Wood, Partner and CEO, Martingale Asset Management
William E. Jacques, Partner and Executive Vice President, Martingale Asset Management

October 20
Myopic Loss Aversion and the Equity Premium Puzzle
Speaker: Richard H. Thaler, Professor of Economics, Johnson School of Management, Cornell University

Psychological Aspects of Investor Behavior
Speaker: Zur Shapira, Professor, Department of Management & Organizational Behavior, Stern School of Business, New York University

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Introduction to Derivative Products
Speaker: Murali Ramaswami, Vice President, Salomon Brothers Inc.

Measuring Market Risk: Value at Risk and Stress Testing: Market Risk Under Normal and Abnormal Conditions
Speaker: Robert J. Mackay, Professor of Finance, Director of the Center for Study of Futures and Options Markets, R. B. Pamplin College of Business, Virginia Tech

Risk Capital Allocation for Traditional Lending Using the Tools of Derivatives
Speaker: John H. Treanor, United States General Accounting Office

Understanding Loss Reduction Strategies
Speaker: Sanford J. Grossman, Steinberg Trustee Professor of Finance, The Wharton School, University of Pennsylvania

Panel Discussion – Derivatives
Panelists: Murali Ramaswami, Vice President, Salomon Brothers Inc.
Jeffrey Geller, Managing Director, Portfolio Management, BEA Associates, Inc.
Kris Mahabir, Director of Derivatives, Fidelity Management & Research
Robert Mark, Financial Risk Management Consulting, Coopers & Lybrand

Introduction to Exchange Rates
Speakers: Jack L. Treynor, President, Treynor Capital Management,
Rudi Dornbusch, Professor, Department of Economics, MIT

Fixed Income Performance Attribution
Speakers: H. Gifford Fong, President, Gifford Fong Associates
Oldrich Vasicek, Senior Vice President, Gifford Fong Associates
On-Line Performance Measurement
Speakers: David M. Stein, Director of Quantitative Portfolio Management & Research, IBM Retirement Fund
Thomas K. Phillips, Director of Advanced Research, Rogers, Casey & Associates

The Structure and Pricing of Private Placement Corporate Loans
Speakers: Willard T. Carleton, Professor of Finance, University of Arizona
Simon Kwan, Assistant Professor of Finance, University of Arizona

The Cost of International Equity Trading
Speakers: Professor Andre F. Perold, Harvard Business School
Professor Eric Sirri, Harvard Business School

A Contingent Claim Approach to Performance Evaluation
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PORTFOLIO MANAGEMENT: NEWLY DEVELOPED STATISTICAL APPLICATIONS

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Overview of Nonparametric Techniques in Financial Analysis
Speaker: Andrew W. Lo, Harris & Harris Group Professor of Finance, Sloan School of Management, MIT

Nonlinear Dynamics in Financial Markets: Evidence and Implications
Speaker: David Hsieh, Professor of Finance and Economics, Fuqua School of Business, Duke University

Analysis of Interactive Machine Learning in a Simulated Market
Speaker: Blake LeBaron, Associate Professor of Economics, Department of Economics, University of Wisconsin

Neural Networks and Wavelet Models for Financial Market Applications
Speaker: Halbert White, Professor of Economics, Department of Economics, University of California, San Diego

Panel Discussion: Investment Applications of Nonparametric Methods
Panelists: Sandip Bhagat, Managing Director, Travelers Investment Management Company
H. Russell Fogler, Partner, Aronson and Fogler
Dean Barr, Chief Investment Officer at LBS Capital Management
Steven Armentrout, Principal & Research Scientist, Neural Analytics

October 4 - PORTFOLIO CONSTRUCTION
Optimizers as a Practical Tool of Investment Management
Speaker: Richard O. Michaud, Senior Vice President, Acadian Asset Management

Estimating the Mean-Variance Efficient Frontier: The Markowitz Criterion is Not Enough
Speaker: J. D. (Dave) Jobson, Professor of Business, Faculty of Business, University of Alberta
Intertemporal Investment Opportunity Sets and Portfolio Formation: Implications of the Assets and the Estimation
Speaker: Bob Korkie, AF Collins Professor of Finance, Faculty of Business, University of Alberta

Dealing with Estimation Risk in Portfolio Selection
Speaker: Philippe Jorian, Associate Professor, Graduate School of Management, University of California Irvine

Mean-Variance Portfolio Analysis: Some Practical Problems and Their Solution
Speakers: Andrew L. Turner, Director of Research, Frank Russell Company
         Harry Markowitz

October 5 - ASSET LIABILITY ISSUES
The Funding Ratio Return
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         Stanley Kogelman, Director, Salomon Brothers Inc.

The Economics of Pension Fund Management
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Speaker: Lawrence Harris, Professor, School of Business Administration, University of Southern California

The Political Economy of Inflation
Speaker: Kenneth Rogoff, Professor, Princeton University

Inflation and World Equity Selection
Speaker: Campbell R. Harvey, Associate Professor of Finance, Fuqua School of Business, Duke University

Commodity Prices and Inflation
Speaker: Robert F. Whitelaw, Assistant Professor of Finance, Stern School of Business, New York University

Growth and Inflation: A Cross-Country Study
Speaker: Brian Motley, Research Officer, Federal Reserve Bank of San Francisco

March 28 - ACTIVE MANAGEMENT
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         John D. Freeman, Vice President, Martingale Asset Management
         William E. Jacques, Chief Investment Officer, Martingale Asset Management

Quantitative Active Management
Speaker: Ronald N. Kahn, Director of Research, BARRA
Active Management As An Adversary Game  
Speaker: Jack L. Treynor, President, Treynor Capital management, Inc.

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Speaker: Albert S. Kyle, Associate Professor of Finance, The Fuqua School of Business, Duke University

Performance Fee Incentives — Perception Versus Reality  
Speaker: Robert Ferguson, Associate Professor, School of Business Fordham University

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Speaker: David E. Tierney, Managing Partner, Richards & Tierney, Inc.

The Derivative Portfolio Matrix — Combining Market Direction With Market Volatility  
Speaker: Eric H. Sorenson, Managing Director, Salomon Brothers Inc.

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Spread Analysis  
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Stanley Kogelman, Director and Manager of Asset Allocation, Salomon Brothers Inc.

Implied Binomial Trees  
Speaker: Mark Rubinstein, Professor of Finance University of California at Berkeley

Integrating Eurodollar Interest Rate Derivative Products  
Speaker: Robert Jarrow, Ronald P. & Susan E. Lynch Professor of Investment Management, Cornell University

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Richard O. Michaud, Senior Vice President, Acadian Asset Management

The Long and Short of Long/Short  
Speaker: Bruce I. Jacobs, Principal, Jacobs Levy Equity Management

Decision Value and Implementation Costs  
Speakers: Wayne H. Wagner, President, Plexus Group
Vinod Pakianathan, Analyst, Plexus Group
Market Neutral Long/Short Strategies: The Perception Vs. the Reality
Speaker: Naozer Dadachanji, Consultant, Towers Perrin

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Speaker: Andrei Shleifer, Professor of Economics
         Harvard University

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Speaker: Florencio López-de-Silanes, Professor of Economics
         and Public Policy, J.F. Kennedy School
         of Government, Harvard University
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