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WILSHIRE

WILSHIRE ASSOCIATES INCORPORATED
100 WILSHIRE BOULEVARD
SANTA MONICA, CALIFORNIA 90401
PHONE (213) 451-8728

AN INTRODUCTION TO WILSHIRE ASSOCIATES INCORPORATED

BACKGROUND

Wilshire Associates is a financial consulting firm specializing in providing analytical assistance to retirement systems, endowments, and investment managers. The firm was formed in 1972 as O'Brien Associates. The activities of Wilshire Associates include investment management systems, investment policy consulting, performance evaluation services, and special consulting services. In order to preserve its reputation for objective analysis, the firm will not recommend the services of any investment manager and does not participate in underwritings of securities or conduct a general brokerage business.

Wilshire Associates has established securities brokerage facilities for the sole purpose of accommodating fee payments from clients on a directed commission basis. Therefore, in lieu of cash, clients may pay for consulting services by directing brokerage commissions through our trading desk. Brokerage orders placed with our firm are introduced to, executed, and cleared by either Becker Securities or Bear, Stearns & Co. on a fully disclosed basis. These correspondent relationships were established to provide access to all major stock exchanges and to ensure a top-quality execution capability for clients. The firm's clients have indicated a high degree of satisfaction with this arrangement.

PROFESSIONAL QUALIFICATIONS

Wilshire Associates offers the services of a highly experienced team of professional financial consultants. Professional staff members are located at the firm's head office in Santa Monica, California, and a regional office in Minneapolis. Staff members have published numerous articles and are frequently called upon to present papers at seminars held by the Center for Research in Securities Prices, the Institute for Quantitative Research in Finance, the New York Society of Security Analysts, and other financial organizations.

The professional consulting staff is supported by a staff of data analysts, a publications department, a securities trader, and an administrative group.

In addition to the regular staff, senior outside consultants to Wilshire Associates include Professor James Lorie, who directed the Pension Fund Performance Measurement Study for the Bank Administration Institute; Mr. Jack Treynor, editor of the Financial Analysts Journal; and Professor Fischer Black of the University of Chicago. All three have published a number of papers relating to the investment management process. Each of these gentlemen has an arrangement with the firm providing for his availability as a consultant. Wilshire Associates engages additional consultants when needed and appropriate for particular projects.

SERVICES OFFERED

Investment Systems Analysis

- Monitoring systems of portfolio risk-and-return characteristics
- Portfolio structuring and revision systems (PRISM)
- On-line and published financial data bases
- Capital markets' risk-and-return research and publications
- On-line investment policy simulation (PENSIM)
- Special system design projects and analytic studies in the investments area

Retirement Plan Analysis

- Long-range risk planning for pension assets
- Performance monitoring and evaluation
- Evaluation of characteristics of alternative forms of investment
- Special system design projects and analytic studies for retirement plans

Educational Endowment Analysis

- Establishment of total-return spending procedures
- Investment policy simulation
- Performance monitoring and evaluation

LOCATIONS

General offices of Wilshire Associates are located at 100 Wilshire Boulevard, Santa Monica, California 90401 (213) 451-8728. The regional office is located at Fox Meadows Office Park, 3140 Harbor Lane North, Minneapolis, Minnesota 55441 (612) 559-3033.

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PROFESSIONAL STAFF

DENNIS A. TITO, PRESIDENT

Mr. Tito received a Bachelor of Science Degree from the New York University College of Engineering and a Master of Science Degree in engineering science from Rensselaer Polytechnic Institute. While at Rensselaer, Mr. Tito was an analytical engineer at United Aircraft Corporation. After graduating, he was a systems analyst and senior engineer at Jet Propulsion Laboratory, later a member of the technical staff at TRW Systems, and a consultant to Synergetic Sciences, Inc. Prior to founding Wilshire Associates, he was manager of the Management Sciences Department at Jas. H. Oliphant & Co.

Mr. Tito also attended the University of California Graduate School of Management as a Ph.D. candidate in finance and has completed all course work required for the degree. While at UCLA, he co-authored an article entitled "Risk-Return Measures of Ex-Post Portfolio Performance," which was published in the December 1969 issue of the Journal of Financial & Quantitative Analysis.

LARRY CUNEO, VICE PRESIDENT

Mr. Cuneo received a Bachelor of Science Degree in mathematics from California State Polytechnic College. After graduation, he became a senior project leader in the Management Sciences Department at Wells Fargo Bank. Later he was a consultant to the Financial Analysis Department of Wells Fargo, developing computer-aided portfolio management tools and financial simulation models.

Mr. Cuneo co-authored a paper on the cost of trading stocks, which he delivered at the Center for Research in Security Prices in May 1972. Mr. Cuneo directs the development activities of Wilshire Associates.

S. RICHARD SILVERNESS, VICE PRESIDENT

Mr. Silverness received Bachelors Degrees in both law and business finance from the University of Minnesota. While in the military, he served with the U. S. Army Finance Corps. Prior to joining Wilshire Associates, Mr. Silverness was a vice president of the Capital Management Systems Division of Piper, Jaffray & Hopwood, Inc., where he served as an investment management consultant. Earlier he served as the manager of Pension Financial Administration in the Treasurer's Department of General Mills, Inc. Mr. Silverness operates the Minneapolis office of Wilshire Associates.

WAYNE H. WAGNER, VICE PRESIDENT

Mr. Wagner is a graduate in business administration from the University of Wisconsin and received a Masters Degree in management science from Stanford University. After graduation, he joined International Business Machines Corporation in San Francisco as a systems engineer. Later he was associated with Wells Fargo Bank, progressing to assistant vice president in the Management Sciences Division. Most recently, he was a private consultant in investment management procedures.

Mr. Wagner has published several papers on practical applications of capital market theory, including an article in the October-November 1971 issue of the Financial Analysts Journal entitled "The Effect of Diversification on Risk," which was awarded the Graham & Dodd Scrol by the Financial Analysts Federation. Mr. Wagner directs the investment systems consulting activities of Wilshire Associates.

SUZANNE TITO, VICE PRESIDENT AND SECRETARY-TREASURER

Ms. Tito is a graduate of the University of California, Riverside. After receiving her Bachelors Degree, she joined Broker Cashiering, Inc., where she supervised the Purchases & Sales Department. Later she served in the capacity of supervisor of Management Review and Performance Reporting for the Analytical Services Division of Jas. H. Oliphant & Co. Ms. Tito is a founder of Wilshire Associates.

KENNETH CHEN, INVESTMENT SYSTEMS CONSULTANT

Mr. Chen received a Bachelor of Arts Degree in business from Waseda University, Tokyo, and a Masters Degree in business administration from UCLA. After graduation, he became an operation research analyst at United California Bank. Later he was a consultant to R. C. Brown & Co., developing portfolio management information systems.

REBECCA KELLER, PENSION FUND ANALYST

Rebecca Keller was graduated from UCLA with a Bachelors Degree in math-physical science. After working for the Naval Undersea Center as a mathematician-technical writer, she joined Wilshire Associates, first as a member of the performance measurement staff, then as a pension fund analyst.

MICHAEL LANCE, PENSION FUND ANALYST

Prior to joining Wilshire Associates, Mr. Lance was a structures engineer at Rockwell International, B-1 Division. While at Rockwell, he specialized in computer simulation modeling and was coordinator of the Academic Advancement Program. Mr. Lance received a Bachelor of Science Degree in aerospace engineering from the University of Texas at Arlington.

SHARON MILLER, DIRECTOR OF PERFORMANCE ANALYSIS

Ms. Miller received her Bachelor of Arts Degree from the University of California, Los Angeles. Prior to joining Wilshire Associates, Ms. Miller was employed with Jas. H. Oliphant & Co., first as a data analyst and finally as assistant supervisor of Client Services for the Management Sciences Division. Ms. Miller coordinates the Performance Measurement and PRISM services for Wilshire Associates.

JOAN RYDBECK, DIRECTOR OF PUBLICATIONS

Ms. Rydbeck directs the publication activities of Wilshire Associates. Her background includes experience as an editor, copywriter, and production coordinator in the aerospace industry, medicine, and educational research. Ms. Rydbeck is an alumnus of the University of California, Los Angeles.

MARY SCADUTO, PERFORMANCE MEASUREMENT ANALYST

Ms. Scaduto graduated from UCLA with a Bachelor of Science Degree in psychology. After graduation, she joined the Performance Analysis Department of Wilshire Associates.

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PARTIAL LIST OF CLIENTS

INSTITUTIONAL INVESTORS

Bank and Trust

Bank of America
Bank of California
Bank of New York
The Bankers Trust Company
Continental Illinois National Bank
First National Bank of Chicago
First National Bank of Minneapolis
Harris Trust & Savings Bank
Manufacturers Hanover Trust Company
Marine Midland Banks
Mellon National Bank & Trust Company
The Northern Trust Company
Pittsburgh National Bank
Security Pacific National Bank
State Street Bank and Trust Company
Texas Commerce Bank
Wells Fargo Bank
Wilmington Trust Company

Investment Counsel & Fund Management

Alliance Capital Management Corporation
Baker, Weeks & Company, Inc.
BEA Associates, Inc.
Canavest House Limited
Chase Investors Management Corporation
Compufund Management Company
Lionel D. Edie & Company, Inc.
Endowment Management & Research Incorporated
FMR Investment Management Service, Inc.
Funds, Inc.
IDS Advisory Corporation
Keystone Custodian Funds, Inc.
National Investment Services of America, Inc.
Newton & Company
Penmark Investments, Inc.
T. Rowe Price and Associates, Inc.
The Putnam Management Company, Inc.
Scudder, Stevens & Clark
Thorndike, Doran, Paine & Lewis

Insurance

John Hancock Mutual Life Insurance Company
The Prudential Insurance Company of America
The Travelers Insurance Company

RETIREMENT PLANS

Corporate

Allis-Chalmers Financial Corporation
American Motors Corporation
Cooper Industries, Inc.
De Laval Turbine, Inc.
Evans Products Company
The General Tire & Rubber Company
Illinois Bell Telephone Company
Minnesota Mining & Manufacturing Company
The Mead Corporation
New York Telephone Company
Owens-Corning Fiberglas Corporation
The Pillsbury Company
Public Service Company of Colorado
Saga Corporation
Samsonite Corporation
Shell Oil Company
Square D Company
Standard Oil Company (Indiana)
United Merchants & Manufacturers, Inc.
Wallace Business Forms, Inc.
Washington Gas Light Company
White Motor Corporation
Whittaker Corporation
Wisconsin Electric Power Company

Jointly Trusteed

Carpenters Pension Trust for Southern California
Motion Picture Industry Pension Plan
Southern California Meat Cutters and Food Employers Council
Southern California Retail Clarks and Food Employers Council

Public

Arizona State Retirement System
Denver Employees Retirement Plan
State of Oregon

ENDOWMENTS AND FOUNDATIONS

The Common Fund
The Ford Foundation
The Harvard Management Company
Stanford University

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Wilshire Associates, Inc., provides consulting services and investment management analyses for pension and endowment trusts and for managers of trust portfolios. The basic services offered are:

POLICY CONSULTING AND SIMULATION

This unique service allows pension system officers and their portfolio managers to examine the effect of alternative investment policy on average funding levels and extreme funding levels which may be associated with more aggressive investment policies. This service includes consideration of:

- The projected future liability and payout growth
- The calculation of the fund's assigned asset value
- The calculation of the annual funding requirement
- Special procedures which may have been adopted or are under consideration to moderate the effects of instability of the fund's assets when valued at market

PORTFOLIO MANAGEMENT ANALYSIS

This service permits the owners and managers of portfolios to assess portfolio structure against the investment policy, and assess the impact of successive portfolio changes on the portfolio return, market sensitivity and diversification.

Structure and Design

- Market sensitivity
- Diversification
- Projected portfolio returns given assumed future market levels and assumed levels of security
- Undervaluation
- Impact of non-market factors on expected portfolio returns

Market Timing and Security Selection

- Incremental return due to shifts in portfolio volatility posture
- Incremental return due to specific securities selected
- Analysis of sales list and purchases list

PERFORMANCE MEASUREMENT AND COMPARISON

- Internal and time-weighted rate of return
- Volatility history
- Comparison with other professionally managed funds

SECURITIES RESEARCH EVALUATION

- Risk-adjusted analysis of securities research
- Comparison of internally and externally generated securities analysis

FINANCIAL DATA BASES

- Historical returns on securities on a weekly, monthly, quarterly and annual basis
- History of security beta coefficients and associated statistics
- History of risk-adjusted security returns (historical "alphas")
- History of mutual fund total returns, beta levels and alphas
- History of adjusted (Bayesian variance weighted) beta coefficients

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INVESTMENT SYSTEMS CONSULTING
"PUTTING YOUR IDEAS INTO ACTION"

Wilshire Associates provides investment systems consulting services to investment management organizations, corporate pension funds, and educational endowments. Recent systems consulting clients include The Northern Trust Bank, Shell Oil, The Common Fund, Continental Illinois Bank, and Harris Trust.

The Wilshire systems consultants work closely with the client to develop the application in accordance with his needs and desires. The experience of Wilshire consultants results in an effective, easy-to-use application that is relevant to the client and his particular situation.

The participation of Wilshire consultants varies with the nature of the specific project being undertaken. Activities performed in previous projects include:

- Decision assistance and recommendations
- System design and specification
- Programming and implementation
- Preparation of executive guides and operator manuals
- Preparation of client materials

Wilshire consultants often coordinate with in-house systems staff or third-party system developers.

Whenever possible, projects are bid on the basis of a written proposal, to be completed within a specific time frame at a fixed price. Where project goals are not well formulated and a fixed bid cannot be given, we recommend a preliminary analysis to define the problem and delineate potential solutions.

Some of the recent projects undertaken are:

- A system design and preparation of user and client materials for a trust investment performance measurement system for the Manufacturers Hanover Trust Company.
- The design and development of a performance measurement system for General Tire & Rubber Company.
- An evaluation of portfolio accounting requirements for National Investment Services, Milwaukee.
- The development and installation of a trust investment account profile system for the Pittsburgh National Bank.

PENSION WORLD

Models of Behavior?

Using Simulation To Chart the Way

By Frank C. McLaughlin

A clear and detailed written statement of investment objectives appears to be a *sine qua non* given the fiduciary relationship between a pension fund sponsor and its investment manager. Investment experience in 1973-74 brought into sharp focus this vital function mostly, to enable the plan administrator or trustees to ascertain what happened and where they were going. The lessons learned in expanding communications between pension fiduciaries on subjects such as risk and diversification were valuable standing alone but should also be considered good practice for what appears to be a fundamental requirement of the Pension Reform Act.

Does this experience suggest, in the sense of "practice makes perfect," that the process of setting investment objectives is clear, uniform and easy to accomplish? You know better. The simulation of liabilities with the aid of computers, as well as the simulation of the impact of alternative investment policies on plan assets, is one area of developing methodology in objective setting which is a good example of the thoroughness that this process requires if the probable requirements of a prudent fiduciary are to be met — both by the trustees of a pension plan and the portfolio manager.

The design and implementation of suitable investment objectives and the choice of the actuarial basis are crucial to a pension plan's financial health. Too often actuarial decisions are made without concern for the pension fund's investment program and its implications; the reverse error also occurs. Making a better selection among today's alternatives in either area requires an understanding of the possible future consequences of those decisions.

To assist our clients in this difficult but vital area, we have explored the use of pension fund financial planning models to determine which alternative investment policies will be most responsive to the characteristics of their plans; as well as those of their workforce, their labor costs, and their entire business — that is, their investment needs. These models simulate the future impact of investment performance on a pension fund. They permit a plan sponsor to test alternative investment assumptions on paper before deciding what their investment objectives should be and how assets should be deployed to meet plan requirements.

Planning models also examine the relationships between a proposed

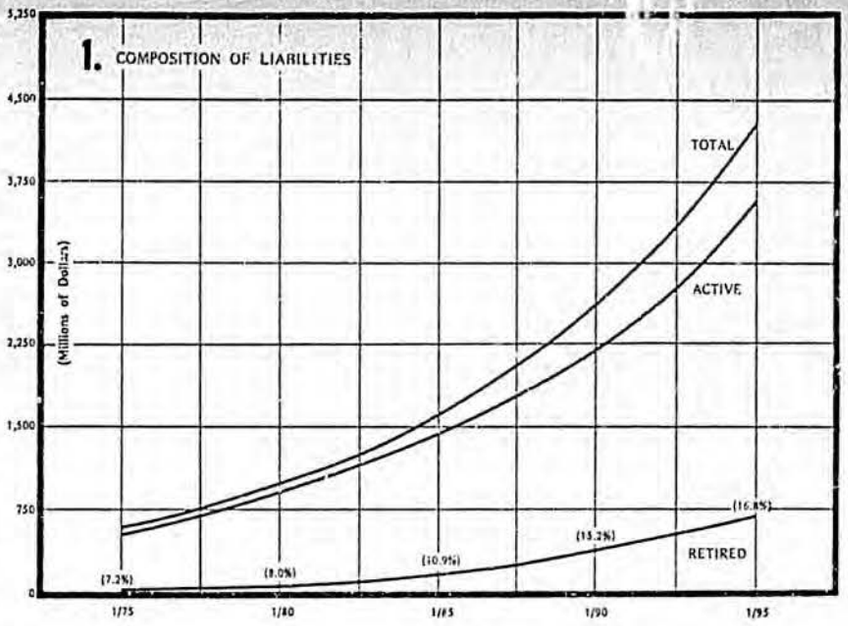
Frank McLaughlin, CFA, is a vice president of Thorndike, Doran, Paine & Lewis, an investment counseling firm in Boston. His article is adapted from the speech he delivered at PJW's New York Conference on Employee Benefits.

investment policy and several important ingredients of the plan's actuarial basis, such as the investment return assumption and the asset valuation method. The models simulate a dynamic capital market environment — the real world in which capital values go up and down in response to interest rates, inflation trends, investor psychology, and other business and economic forces.

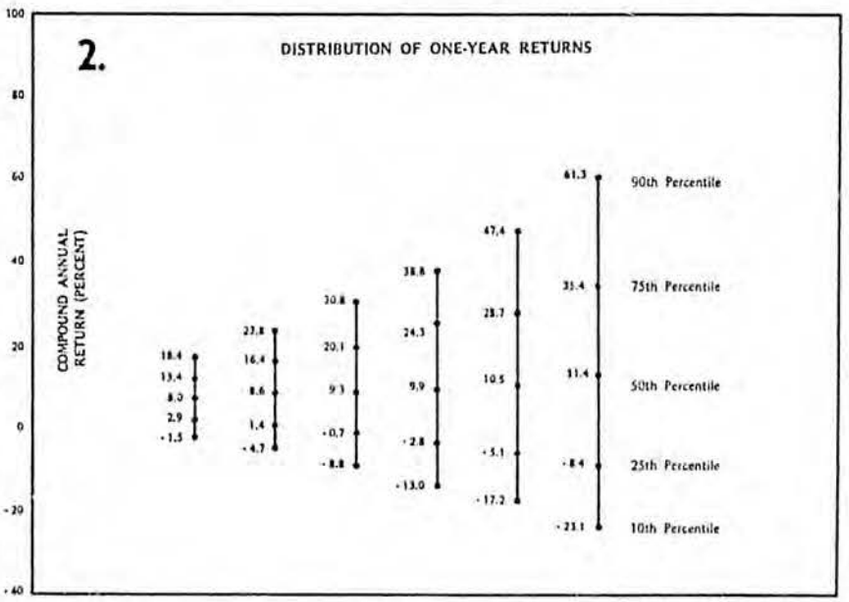
The presence of this new dimension distinguishes these models from usual actuarial projections of pension funds, which typically assume a uniform annual growth of a plan's assets. While these models will undoubtedly undergo continued refinements, they fulfill a critical need in the pension planning process.

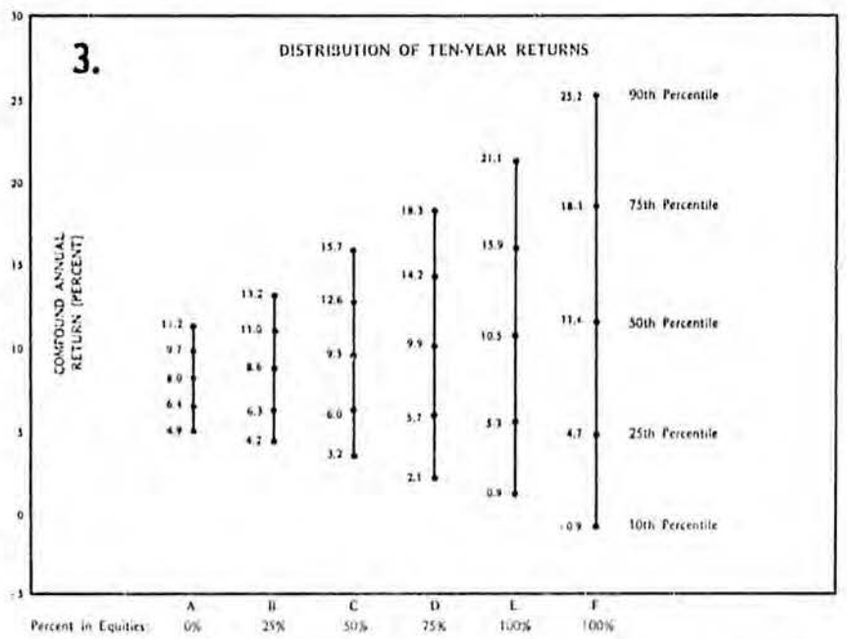
What do these models show and what is necessary in the way of input to perform the simulations? A determination of plan liabilities is critical to the planning model. Without a realistic projection of the needs, it is obviously impossible to choose an investment policy which may best meet them. Either the census data provided by the plan sponsor to his actuary or a model best approximating the present and anticipated company profile can be used to start the projection process. The data from the latest actuarial report is necessary to construct a model. While the latter method is not precise by definition, it has the advantage of much lower cost and will probably be used more frequently, at least initially, as this type of study becomes more widely accepted.

The determinants of liability must be assumed. These include factors such as the expected growth rate of active and retired participants and raise a series of questions such as: What is the anticipated male to female hiring ratio? What growth in the wage base is anticipated to cover expected inflation? What real wage increases are expected? What are the assumptions for mortality, separation, and retirement? Lastly, what is the actuarially assumed rate of interest? The assumptions for salaries to be paid to newly entering participants and the proportion of persons to be



Dynamic dimension: Start with the 'real world' . . .





Fabian Bachrach

. . . says this Prudent Man

hired at various age groups can be derived from the census data or from a model.

By computer simulation this data can be progressed through time periods up to 20 years or more to ascertain the anticipated growth patterns for plan participants, both active and retired, by number and age. Wage and benefit trends can likewise be simulated. These factors are then combined to provide a composite of liability trends as shown by Chart 1, developed in an actual case study.

Capital market assumptions must also be made. These include a distribution of annual equity and fixed income market returns over various time preiods. The anticipated average return from cash equivalents must be ascertained to determine future returns from reserves. The impact of anticipated inflation rates on returns is also important. It is vital that the same inflation rate assumption is applied to both liabilities and returns. It has been our experience that, in many cases, this requirement has not been adhered to. Combining these projections of liabilities and expected investment returns allows the plan sponsor to simulate his annual funding costs. These distributions are shown by percentile ranges to ascertain the most likely case.

Once this information is fitted into the model, alternative investment policies can be simulated to determine median and extreme rates of return over various time periods — one, five, ten, and 20 years. While the mix of investment policies to be used has to be selected on a judgmental basis in each case, the objective categories listed in Table I show the characteristics of one set which can be used for this purpose.

Table I: Investment Characteristics Of Alternative Investment Policies

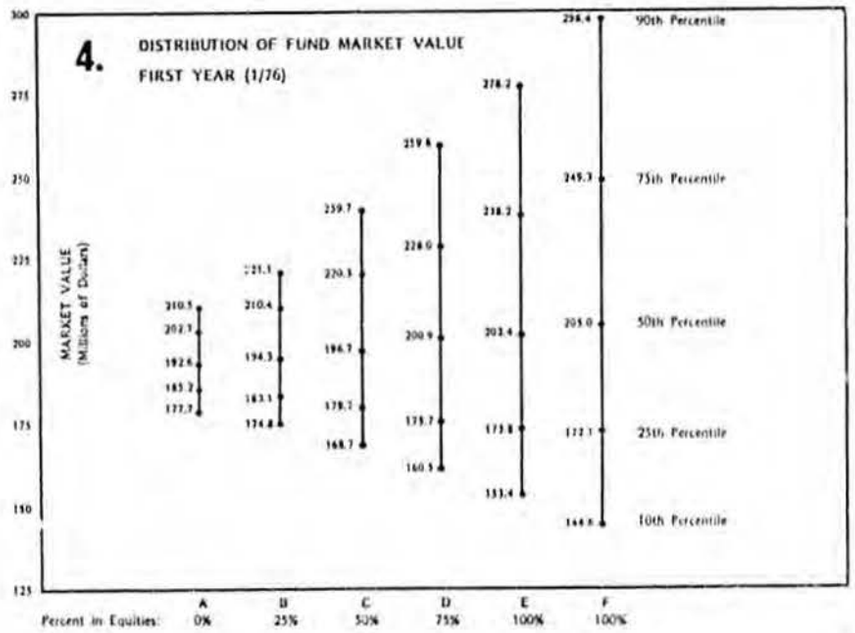
	Balance (%)		Portfolio				
Objective	Stocks	Bonds Or Cash	Volatility	Diversification (%)	Expected Total Return	Risk (Std. Dev.) (%)	Current Yield (%)
Fixed Income	—	100	.3	—	4.0	7.4	4.4
Income	50	50	.5	60	6.7	10.8	4.5
Conservative	75	25	.7	90	8.1	15.1	4.6
Growth & Income	90	10	.95	96	8.9	20.0	4.8
Growth	90	10	1.10	96	10.3	25.3	5.5
Aggressive Growth	95	5	1.25	80	12.2	33.5	3.0

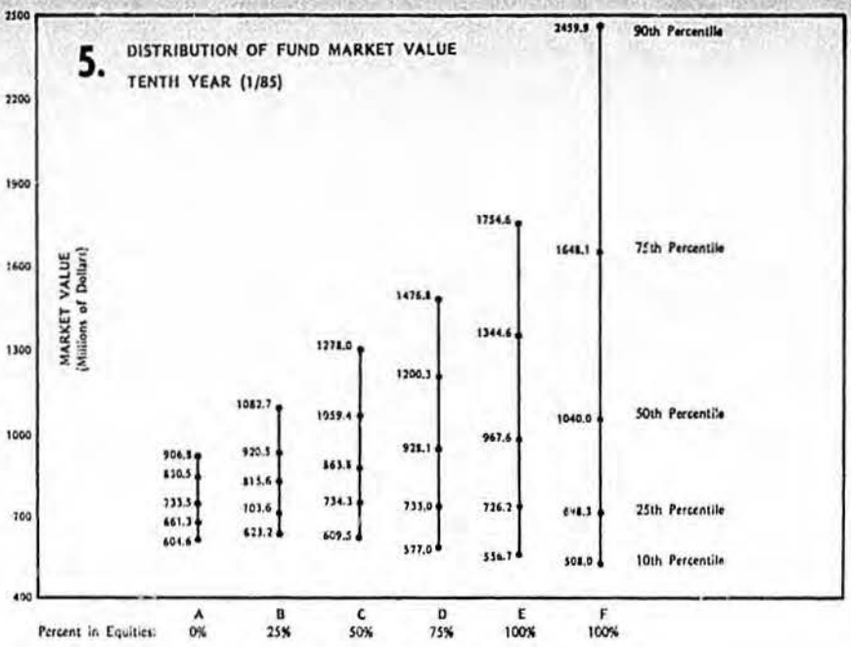
A distribution of investment returns is derived by applying the investment policies used to a capital market analysis. Results are grouped by percentile to reduce the simulation output to information upon which decisions can be made. That is, what is the most likely expected return and the extreme ranges from the bottom 10th percentile to the top 10th percentile? A sample is depicted in Charts 2 and 3. The value of these projections, of course, depends on the validity of the capital market assumptions utilized.

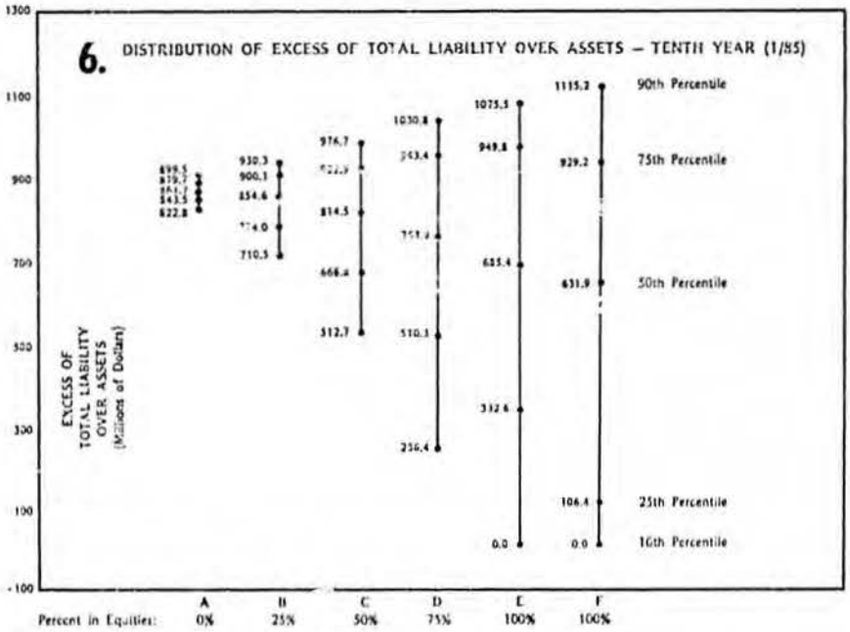
A distribution of pension plan total market values, based on the foregoing return input, is then simulated to determine if extreme expected ranges fall within the projected total liability and plan termination liability at given points in the future. Charts 4 and 5 are used with these liability projections to determine potential future compliance with ERISA's requirements.

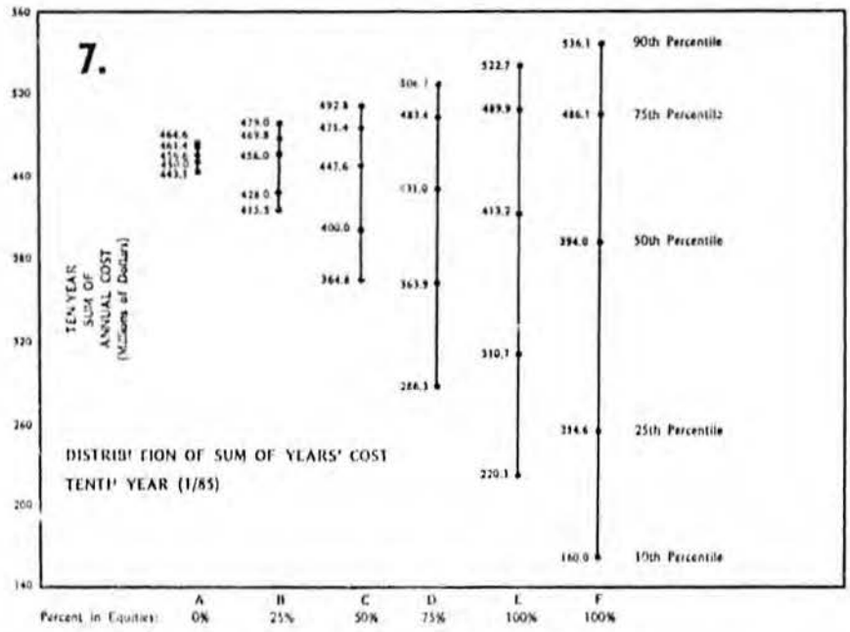
The distribution of excess of total liability over assets at given future dates, which can in due course approach zero, are also determined. This is projected in Chart 6 for ten years in the example used.

Assets and liabilities are then compared for each of the investment policies simulated to determine where the median asset values and liabilities will fall. Taking another step, expected actuarial earnings as a percent of annual total









cost are simulated for each investment policy to arrive at projected annual pension expense. This is displayed in Chart 7 for a ten year period.

The need for and use of this data may be difficult to envision without referring to an entire actual case study. Its importance can be highlighted by considering some of the questions which the process is designed to help answer. These are:

1. What mix of assets represents the optimal combination in terms of an adequate total investment return and acceptable volatility?

2. What spread between anticipated bond and stock returns is required to justify equity or fixed income media selection?

3. Can a pension plan afford to reject the historically high rate of return currently available on bond investments?

4. What is the funding goal? How rapidly should he sponsor reach it?

5. What is the relationship between investment rate of return, level of benefits, and contributions?

6. What is the actuarial policy? Is it consistent with their other accounting and financial practices?

7. What are realistic expectations for investment returns on bonds and stocks over the next ten (or 20) years?

8. What investment return goals are appropriate for a pension plan? For each of the investment managers? For fixed income? For equity?

9. Is it practical to expect investment counselors to make major shifts in portfolio structure in anticipation of stock market cycles and interest rate trends?

10. What monitoring procedures are most effective for assuring that investment objectives are being prudently pursued?

We believe that the use of pension planning models makes the process of selecting an investment policy more rational. It's basic purpose is to help ensure that the policy chosen is suitable to the future needs of the plan and it enhances the monitoring process to ascertain if they are being pursued. It may also be a requirement of prudence. ■

Diversification: old and new

A little diversification goes a long way, but not nearly far enough. The differences can swamp you.

James H. Lorie

Before the development of the modern theory of investment, investors relied on either of two homilies for guidance in diversifying their portfolios. The first homily is, "Don't put all of your eggs in one basket." The second is, "Put all of your eggs in one basket and watch it carefully." The homilies suffer from obvious deficiencies, including but not limited to the facts that they are contradictory and have no precise operational meaning. This article briefly discusses these and other shortcomings as well as, at greater length, the advantages of the guidance to be derived from the modern theory of investment.

THE HOMILIES

The first homily implies the wisdom of diversification, a policy which is probably the most important practical implication of the modern theory of investment. The shortcoming of the homily is not that it implies a foolish policy, but that it provides no sensible guide to its implementation.

The most common rule of thumb prescribes maximum percentage commitments in the securities of individual firms and industries but tells us nothing about the definition of an industry. Perhaps the most common maxima are 10% for an industry and 5% for the securities of any price. A narrow definition of an industry would permit great concentration (less diversification) than a broader definition. For example, if firms which manufacture men's apparel, women's apparel, and children's apparel were considered part of a single industry, only 10% of a portfolio could be invested in their stocks. If the firms were considered to be three different industries, 30% could be invested. There is no theoretical or empirical justification for the particular maxima selected. No one has ever been able to determine that limits of 5% in a firm and 10% in an industry are superior to higher or lower limits.

A more fundamental complaint is that diversification by conventional industrial categories may not be an efficient way to achieve the reduction in risk which is the purpose of diversification. For the purpose of reducing risk, the important thing is the financial characteristics of the securities -- particularly their volatility and the strength of their tendencies to move in step with the market — rather than the characteristics of the goods or services which the firms sell. There are dramatic differences in the financial characteristics of securities of firms in the same industry. In sum, the homily expresses a sensible view but offers little help in achieving efficient diversification.

The second homily is even less helpful. Implicit is the idea that serious study of individual assets is financially rewarding. Focusing on fewer assets makes serious study possible. The second homily, like the first, appears to make sense. If by study or any other means an investor acquires special knowledge about a security or group of securities, concentrating of investment in securities should normally follow. The second homily, like the first, provides no precise guide to action and has not even generated plausible rules of thumb. Another difficulty is that the homilies suggest the wisdom of contrary policies.

"DISCOVERY" OF RISK-AVERSION

Although dating the beginning of an important intellectual development in any field is somewhat arbitrary, most students of investment would probably agree that the flowering of the modern theory began with the publication of Harry Markowitz' work on portfolio selection in 1952. The theory is unusually satisfying, both because it has been extensively tested

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Our special thanks to Institutional Investor Systems, Inc., for reprint permission.

and confirmed with the abundant hard data from the real world of security prices and returns, and because it provides precise guides for investing.

Many fruitful insights stem from pondering the meaning of the obvious and overlooked. Newton had his apple, and Markowitz had the almost universal practice of diversification by investors. Markowitz concluded that diversification meant that investors do not try to maximize returns. If they did, they would put all of their money in the one security which had the greatest promise. Diversification implied a concern about risk as well as expected returns. From that simple and virtually indisputable fact, Markowitz developed a theory and a technique for identifying the portfolio of risky assets which maximized expected return at each level of risk. His work led to further effort on the measurement of risk and the relationship between risk and rates of return. More will be said on these subjects later.

THE RANDOM WALK: A COMPLEMENT

Paralleling the work on risk and return was varied and ingenious study of the process by which security prices adjust to new information and changed perceptions of value. This originally led to the provocative conclusion that prices of common stocks follow a "random walk." The meaning of this work, which was generally misunderstood, was less provocative and upsetting than the phrase by which it was identified. The popular misconception was that the work indicated that stock prices were determined by, or at least that changes in stock prices were determined by, a senseless, random process. In fact, it indicated merely that study of the historical sequence of stock prices did not hold the secret of great wealth — or more modestly that such study does not produce abnormally high returns.

Subsequent work on changes in stock prices produced further understanding and a change in the descriptive phrase used to designate the work. The "random walk" theory evolved into the "efficient market" theory. The change in name reflects a change in understanding. Whereas the earlier name indicated merely a statistical fact, namely, the independence of successive changes in prices of common stocks, and an important conclusion about the value of most (perhaps all) technical analysis, the latter name indicated that prices react very rapidly and in an unbiased way to new information. This adjustment is precipitated by the ardent and presumably competent efforts of security analysts and asset managers to keep informed about current developments in corporations and in their economic environment. The result is to cause prices at all times to be "appropriate" or near their intrinsic or equilibrium values. Thus, investors who pick stocks without study can expect to do as well, taking risk into account, as those who pick stocks after much study. Ironically, it is the "much study" which causes prices to be appropriate and relieves many individuals of the need to investigate before they invest. At least, study of individual securities should not be expected to produce abnormal returns.

RISKY ASSETS AND RISKY ASSETS

About ten years after Markowitz' original work, William Sharpe developed the theory further. He thought of risk as having two sources. The first was uncertainty about the future value of all risky assets, designated collectively as the "market." Even if an investor owned all risky assets, risk would remain since the value of the entire collection or portfolio would change in ways which could not be precisely foreseen. This market risk could not be eliminated by diversification. Market risk is equivalent to and sometimes called "systematic risk."

No actual portfolio contains all risky assets. Actual portfolios, therefore, contain another kind of risk, usually called "non-systematic" or independent risk. Such portfolios are risky not only because future values of the market cannot be predicted, but also because changes in actual portfolios will differ from changes in the market in ways which cannot be precisely predicted. Diversification can diminish unsystematic risk by causing actual portfolios to resemble more and more closely the entire market.

Sharpe's theory, leaning essentially on the hypothesis that capital markets for risky assets are extremely efficient, indicates that investors can expect to be paid, that is, receive risk premia in the form of higher returns, for assuming systematic or market risk but not for assuming unsystematic or independent risk.

This theory, which is supported by much competent empirical work, leads to some interesting conclusions not always in accord with intuition. The first is that investors should hold portfolios of risky assets that replicate as closely as possible movements in the entire market of risky assets. That is the modern meaning of diversification. Diversification is measured not in terms of maximum commitments to individual industries or securities but in terms of the elimination of unsystematic or independent risk. The statistic which measures diversification in the modern sense is the correlation coefficient between the portfolio and the market as a whole. A correlation of 1.0 means that diversification is perfect, no unsystematic risk remains, and the investor assumes only risk for which he can expect a risk premium.

The argument presented so far might seem to suggest that all investors should hold identical portfolios except for differences in scale. That misconception could exist because the idea of a riskless asset has not yet been introduced. Riskless assets do exist, at least in terms of dollars. Treasury bills are the standard example of riskless assets; their returns in dollars can be precisely predicted. According to modern theory, adjustments in the riskiness of portfolios to suit the circumstances and tastes of individual investors, be they persons, endowed institutions, or pension funds, should be in the proportions of the portfolio allocated to risky and to riskless assets and not in the mix of risky assets.

According to this theory, all efficient portfolios — in the Markowitzian sense of maximizing expected returns per unit of risk — are perfectly correlated with the market. All such portfolios vary solely because of movements in the market. The sensitivity of a portfolio to market movements is measured by its beta coefficient (β). A beta of one for an efficient portfolio will cause it to rise and fall in perfect step with and just as fast as the market. A beta of one-half, achieved by putting half the investable funds in the riskless asset and half in the market, will move in perfect step with and half as fast as the market.

In sum, modern theory states that additional return should be expected solely from assuming systematic risk. Thus, all unsystematic risk should be eliminated by diversification. Perfect diversification produces a correlation of 1.0 between the portfolio and the market. Variations in risk are achieved by varying the proportions of investable funds allocated to the perfectly diversified portfolio of risky assets and to the riskless asset. The beta coefficient, indicating the sensitivity of the portfolio or market movements, measures risk, all of which is systematic, for efficient portfolios.

THE PRACTICE OF PROFESSIONAL PORTFOLIO MANAGEMENT

The modern theory of investments suggests that it is extraordinarily difficult consistently to identify undervalued or overvalued securities and thereby achieve abnormally high returns. And the record of professionally managed portfolios, including investment companies, bank-administered funds, and others, indicates that the theory has great validity. Nevertheless, with very few exceptions, professional portfolio managers reject the theory in its pure or extreme form. They use security analysis to attempt to identify investments which will produce abnormally high returns, thereby departing from perfect diversification and incurring unsystematic risk.

USING THEORY IN PRACTICE

Though professional portfolio managers reject the pure form of the modern theory, they are beginning to use it for setting investment policy, controlling its implementation, and evaluating results. Accumulating evidence on the difficulty of consistently picking winners implies that the selection of an investment policy is of great — perhaps dominant — importance. If the prescription of policy is to have clear operational meaning, modern theory can be helpful. Policy can be and increasingly is being set by specifying a level of systematic risk (β) and a required degree of diversification (correlation between the portfolio and the market). Control is exercised by monitoring actual beta and correlation coefficients.

Evaluation of results for portfolios controlled in this way is simple. Evaluation of decisions on market timing can be made by seeing the effect on returns of temporary departures in a beta from the prescribed level. The effect of departures from perfect diversification, i.e., the effort to pick winners, can be evaluated by comparing actual returns with returns from perfectly diversified portfolios with the same systematic risk (β) and the same total risk (measured by some statistic indicating total variation, perhaps the mean absolute deviation). The total effect of active portfolio management can thus be broken down into its traditional components, timing and selection.

Other refinements based on modern theory are beginning to be used. Portfolios are being broken down into three components: the riskless asset, a market portfolio of risky assets, and a portfolio of risky assets selected because they are judged to be undervalued. Theoretical work has been done to guide the rational allocation of funds between the market component and the specially selected component of the portfolio of risky assets. The essence of the theory is that the proportion which should be allocated to the specially selected component, be it a single stock or a group of stocks, increases with the magnitude of the predicted abnormal return and with the confidence in the prediction. Computer programs exist for allocating funds among this third element of the total portfolio so as to maximize the effectiveness of the diversification.

For example, a portfolio of the 50 stocks with the largest market values and with allocation of funds among stocks in proportion to market values had, during a recent period, 96.5% of its returns determined by movements in the market. The use of a computerized optimization program shifted funds among stocks so as to increase the percentage of returns explained by the market to 98.2%, leaving the beta unchanged. This apparently trivial improvement diminished indepen-

dent risk by about one-third, substantially increasing the predictability of the portfolio's reaction to the market. In other words, techniques exist for minimizing unsystematic risk, given any group of stocks that the portfolio manager wants to hold.

A LITTLE MEANS A LOT

At last, portfolio managers are beginning to understand the practical importance of scientific techniques for maximizing diversification. For too long there has been too little appreciation of how much uncertainty or risk is created by even apparently small departures from perfect diversification. Part of this failure was caused by work showing that about 90% of the possible reduction in the total variation in returns is generally achieved by holding only about 32 stocks. A reduction of about 95% is achieved with portfolios of only 64 stocks. Only recently has adequate attention been given to the importance of the remaining 5% to 10%.

The following exhibits dramatize the importance of scientific techniques of diversifying. Exhibit 1 shows the relationship of the number of securities in

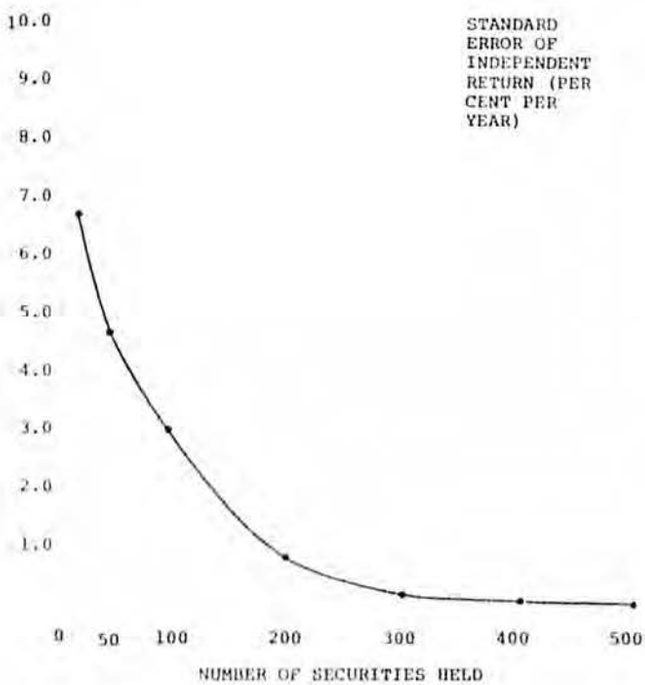

Exhibit 1 – Independent risk and portfolio size

Source: O'Brien Associates, Inc.

the portfolio to the standard error of annual independent returns. For example, a portfolio of the 50 stocks from the S&P 500 with the largest market values (and with allocation of funds among included stocks proportional to market value) produces returns that could

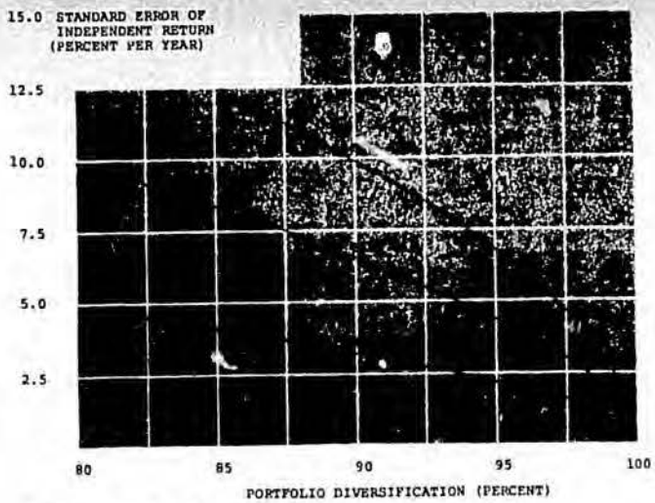

Exhibit 2 – The effect of beta and diversification on the level of unexplained return from a portfolio

Source: O'Brien Associates, Inc.

easily differ from returns for the entire 500 stocks by as much as 4.5 percentage points per year. Portfolios of 100 stocks could easily differ by as much as 3.0 percentage points. Investors who rely heavily on beta coefficients to predict returns and who do not understand the importance of scientific diversification are frequently surprised and not always pleasantly.

Exhibit 2 makes the same point somewhat differently. It shows for each level of diversification (measured by the coefficient of determination and expressed as a percent of possible diversification) and for three different betas the standard error of independent annual returns. For example, a portfolio with a beta of 1.0 and diversified 95% (coefficient of determination of 0.95) would fairly often have returns as much as 4.5 percentage points different from the market as a whole.

THEORY APPLIED TO HOMILY

The modern theory of investment, based on the theory of efficient markets and the pricing of risky assets, implies the wisdom of extreme diversification. The old homilies or rules of thumb provide some guidance, but their deficiencies are of great practical importance. Techniques derived from the modern theory can easily be used to make diversification more complete, thereby reducing independent risk for which payment in the form of higher returns cannot confidently be expected. The techniques help in setting policy, in controlling its implementation, and in evaluating the impact on performance of the judgement exercised by the portfolio manager in changing the systematic risk of the portfolio and in departing from perfect diversification in an attempt to identify undervalued securities.