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# IMPROVING INVESTMENT PERFORMANCE

# AND

# THE ROLE OF FIXED-INCOME SECURITIES

Richard G. Fischer

A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Business Administration

Graduate School of Business Administration
George F. Baker Foundation
Harvard University

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## Abstract

The objective of the study was to determine the normative role of fixed-income securities in contributing to improved investment performance in mixed-asset portfolios of non-taxable institutions. The Markowitz/Sharpe technique was applied uniformly to fixed-income and equity securities in constructing efficient portfolios based on total expected returns over a one-month forecasting horizon. The security sample included: twenty-two U.S. Treasury, industrial and utility bonds covering a wide range of maturities, coupons, and quality levels; and sixty-six common stocks that frequently appear in institutional portfolios.

Market related, diversifiable security risk was isolated by calculating the regression coefficients relating each security's returns to market indexes for five-year U.S. Treasury bonds, Aa-utility bonds, and the Standard and Poor's index of 425 common stocks for the period July 1962 through June 1970. Whereas the patterns of "market sensitivity" coefficients for bonds were consistent with general perceptions of bond behavior and were insensitive to stock market changes, the returns on many common stocks were significantly related to changes in the bond markets as well as the stock market. The stocks which exhibit strong bond-like behavior could not be readily identified by their utility or non-utility classification suggesting that the single-index models commonly found in the literature overlook the important affect of interest rate changes on common stock returns.

Using the market sensitivity coefficients, the risk and return characteristics of each security were calculated and used in forming efficient sets of portfolios for a wide range of market forecasts. For all market conditions, the proportion of total investments held in bonds diminished with increasing portfolio risk but was typically greater than 50 percent even at high risk levels. Most of the bonds in the efficient portfolios were of very short maturity and served the leveraging function of a riskless asset; to that extent they were not a part of the actively managed portfolio. Bonds, however, also played a substantial role in the manageable, risky asset portion of the portfolio. In comparison to the bullish stock market forecast which made equity securities the dominant investment, the corresponding, equally likely forecast for the bond markets produced efficient portfolios dominated by "risky" bonds, a consequence that was even more strong in the latter half of the sample period.

The principal conclusion of the study was that fixed-income and equity securities play essentially equal portfolio roles as risky assets when both are evaluated on a market value accounting system against the objective of maximizing total portfolio return.

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responsible for the final document, its errors and omissions. In-spite of its shortcomings, it is hoped that this study will lead to an improved understanding of fixed-income securities and their role in investment portfolios.

New York, New York
May 1973

Richard G. Fischer

## Chapter 1

## Introduction

> In recent years more and more institutions have begun placing major emphasis on equity portfolio price performance. This usually means that they have valued their stocks at market periodically, calculated a book profit or loss for a quarter or a year, added in net realized profit and dividend income, and rated their stock investment program on the size of the aggregate percentage gain.... since price fluctuations in stocks are usually much larger, up or down, than the dividend income, this accounting standard serves to concentrate the manager's attention on medium-term price changes.
>
> My question today is this: If this system of judging portfolio performance is sound for equities, why isn't it also sound for bonds? ... I suggest that performance accounting is sound for both stocks and bonds. [1]

Sidney Homer, one of the Street's most knowledgeable bond men, made that observation in 1968. Charles Ellis, the author of Institutional Investing and formerly a Vice-President of Donaldson, Lufkin, & Jenrette, Inc., offered a contrasting viewpoint in an interview for Forbes magazine three years later:[2]

---

1. Homer, Sidney, Institutional Bond Investment Policies in 1969. A talk before the annual meeting of the National Industrial Conference Board, "Business in 1969", at the Waldorf-Astoria Hotel in New York City on September 19, 1968.

2. "As I See It", Forbes, November 15, 1971, p. 69.

> A large, well-diversified, long-term portfolio should not own bonds on the merits. I have never seen a good case for holding bonds for any large institutions that is going to be around for virtually an indefinite period. .... (For) the endowment of Harvard College, for the General Motors pension fund, for the enormous long period that those funds are going to be invested where they can ride through the cycles and where they are not going to have a surprise terminal period, bonds don't carry the weight. They don't yield as much, they don't grow, they are less predictable and they lose capital value over the long-term because of inflation.

These statements, of course, were not the opening arguments in the debate on the relative merits of bonds and stocks; nor were they the closing summations. The controversy surfaced again in an exchange between Daniel Seligman and William C. Freund in Fortune magazine.[3] For the most part, this debate centered on determining an acceptable long range forecast for bond and stock prices. The details of the argument are interesting but unimportant in the present context. Essentially, it seemed that once again the issue was less joined than avoided.

The issue that is examined in this study is the normative, relative roles of bonds and stocks in contributing to total portfolio performance for a variety of market forecasts. The study is most specifically directed to the portfolio managers

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3. Seligman, Daniel, "A Bad New Era for Common Stocks", Fortune, October, 1971, p. 73; and Freund, William C. "What 'Bad New Era' for Stocks", Fortune, April 1972, p. 45

and the investment committee members responsible for institutional investments, especially those institutions which are non-taxable and where broad legal flexibility exists to shift portfolio composition between bonds and stocks. Managers of other institutions may also benefit from the analysis and conclusions of this study, but the lessons should be qualified properly to recognize any special constraints on portfolio management.

Although the methodology employed in analyzing the relative roles of bond and stocks rests on rather complex theoretical assumptions and models, the discussion focuses primarily on the application of these tools to the problem at hand, avoiding many of the technical arguments which have been examined thoroughly throughout the literature on capital market and portfolio theory. Mathematical details are relegated to an Appendix.

In judging the relative roles of bonds and stocks in the portfolio context, it is first necessary to determine whether there are any necessary constraints limiting the potential role of one or the other class of securities. The characteristics of the two security classes and the structures of the markets in which they are traded are examined in Chapter 2. Consideration is also given to the possible existence of constraints more arbitrary in nature, such as portfolio manager attitudes, or biases, and accounting systems.

In Chapter 3, the methodology for comparing bonds and stocks is discussed. Necessary constraints on the role of either security class, to the extent they exist, are incorporated but other constraints which are deemed to be more arbitrary are eliminated intentionally. The Sharpe model of the securities market and the Markowtiz model of the portfolio selection process are described as tools that should permit the most unbiased analysis of bonds and stocks. The choice of this modelling approach implies a normative rather than an empirical analysis of the relative roles of bonds and stocks.

The sample of bonds and stocks, the sample period, and the procedures for obtaining total return observations are reported in Chapter 4. The raw total return data are examined in Chapter 5 to determine whether the crude data suggest any distinctive roles for bonds and stocks.

The market model is used in Chapter 6 to extract from the crude total return characteristics of each security that portion which is most relevant to portfolio management, namely the market-related returns which are subject to managed diversification. The criterion for selecting the market model is discussed. The patterns among the calculated market sensitivity coefficients are analyzed for any further tentative conclusions that might be drawn regarding the portfolio roles of bonds and stocks.

Risk/return efficient portfolios, as defined by Markowitz, are calculated in Chapter 7 for a variety of market forecasts. The location and shape of the efficient portfolio sets and the composition of selected efficient portfolios are studied. The focus of the analysis is the indicated division of available portfolio funds between bonds and stocks. Then, an assessment of the magnitude of the normative, relative roles of bonds and stocks in contributing to portfolio performance is made. The trend in the relative roles of the two security classes is evaluated in Chapter 9 on the basis of the changes which occurred between the first and second halves of the sample period.

Chapter 8 is devoted to the question of whether in practice it is possible to separate the bond and stock portfolio management functions and still approximate the expected performance of the optimal efficient portfolios previously obtained in the integrated treatment of bonds and stocks. Procedures for obtaining the most efficient set possible, given the assignment of bonds and stocks to separate departments, are recommended.

The conclusions obtained during the various stages of the analysis and possible qualifications affecting the interpretation of the results are summarized in Chapter 10. Several suggestions for further investigation are also presented.

## Chapter 2

## Bond Portfolio Management Philosophy

The management of fixed-income securities portfolios is heavily influenced by several legal and accounting biases that inhibit realization of the investment opportunities available in this market. Perhaps the biases originated in the period before the development of reasonably efficient secondary markets when the foundations of present day legal and accounting procedures were established. In any event, there is much in today's practice of bond portfolio management that is inconsistent with the lessons of capital budgeting theory which are commonly applied in equity portfolio management.

With the aim of finding those areas in which bond portfolio management may be made more efficient, in this chapter the distinguishing characteristics of fixed-income securities, the markets in which they are traded, and common portfolio practices will be reviewed. The standard for comparison will usually be the comparable aspect of common stock portfolio management. The purpose of the review is to determine those changes in bond portfolio management attitudes and policies which would permit improved performance. The implementation of these modifications will be examined in detail in subsequent chapters.

## 2.1 Current Bond Portfolio Management Practice

In order to make the distinction between traditional practice and the approach to be developed in this paper, it is necessary only to observe that the predominant strategy for managing bond portfolios is to hold all securities purchased to maturity. It is recognized, of course, that for portfolios which have multiple objectives, such as the provision of liquidity along with return maximization, modifications of this strategy are common. For example, the bond portfolios of commercial banks typically serve both liquidity and investment functions. But even with respect to commercial banks the popular literature[1] recommends structuring portfolios according to varied forms of "maturity ladders." This approach which is not only consistent with but generally presumes the hold-to-maturity strategy, also assumes that bankers, whom one would believe to understand the financial markets, are either unwilling to make assessments about the future movements in interest rates or they lack sufficient confidence to act on their assessments. However, there are other possibly overriding reasons that more fully explain the continued reliance on the hold-to-maturity strategy.

---

1. See, for example, Roland I. Robinson, The Management of Bank Funds - McGraw-Hill Book Company, New York 1962

Common practice in fixed-income security management seems to have evolved from an era when secondary markets were characterized by so little depth that it was virtually impossible to get an acceptable bid for bonds. In other words, the spread between bid and ask prices in the market was so wide that the yield-to-maturity on bonds currently held generally constituted the true return maximizing rate. In such circumstances, the only relevant question regarding a particular bond was whether to buy it, for it was reasonably certain that if purchased the bond would be held to maturity. Furthermore, under these conditions the criterion for such a decision is exactly of the same form, only inverted, as the criterion used by an issuer in deciding whether to sell the bond. Thus, the investor seeks the maximum yield-to-maturity and the issuer desires the minimum yield, or cost, to maturity.

It seems that much of the literature on bonds has been written from the issuer's rather than the investor's viewpoint; and investors and bond portfolio managers seem to have accepted the existing literature as their starting point, even thought it assumes a viewpoint contrary to their own. This phenomenon may be due in part to the mystique and popular image of the investment banking industry which underwrites new bond issues. The debtor-orientation

of the literature, such as in prospectuses, would not only help to explain the investor's almost total reliance on yield-to-maturity as the proper return measure, but also the emphasis on credit risk to the virtual exclusion of market risk. The focus on the issuer's position would seem to reflect the greater confidence of the underwriter and the investor in the tools of credit analysis and a reluctance to make any comparable judgments about the market. The pre-eminence of concern about credit risk undoubtedly stems in part from the objective to maintain the safety of principal that is common in trust accounts and thus a part of fiduciary responsibility. It may be that only in terms of yield to maturity can the cost in sacrificed return of this objective be justified.

Until the recent development of more efficient secondary markets for fixed-income securities and the commensurate increase in the significance of market risk, continued reliance on debtor-oriented yields-to-maturity has meant that the bond portfolio manager has used an inadequate input, or criterion, in his investment, and especially, dis-investment, decisions. It is difficult to say just when the further development of a secondary market for fixed-income securities began to add new dimensions to bond portfolio management. But it may be supposed that most of the characteristics of the secondary markets as we know them

evolved in the postwar period. Unfortunately for holders of fixed-income securities, particularly those holding long-term bonds, the larger part of this period has been characterized by steadily mounting inflation, one of the primary forces underlying the long postwar bear market for bond prices. In such a market the counter-productive but common psychology underlying the reluctance to "realize" losses, which seems to be more prevalent in bonds than in equity portfolio management, also helps to explain the widespread use of hold-to-maturity strategies. Surely, given a decision to invest in long-term bonds, if bond yields steadily rise or if they remain stable, yield-to-maturity is probably a suitable criterion for a hold-to-maturity strategy. But this measure may not properly indicate whether long-term bonds should be held at all. Although there have been other similar periods in bond market history, the late sixties and early seventies was the first time in the postwar period when market yields moved sharply in both directions, not only because of the apparently increased elasticity of yields to the rapidly expanding supply and demand for fixed-income securities but also due to a major shift in Federal Reserve policy away from such great emphasis on stabilizing interest rates as evidenced in the early sixties.

But irrespective of why they occurred, the more volatile swings in interest rates presented a new opportunity to the fixed-

income security investor. Specifically, greater yield fluctuations signified the increasing importance of market risk, relative to credit risk, and a commensurate opportunity to improve portfolio return. It was unlikely, however, that the investor using the traditional yield-to-maturity criterion would be able to make the necessary comparative choices from among a wide variety of securities to capitalize on the new investment opportunity.

Long-standing accounting practices and the legal responsibilities of the financial fiduciary are institutional reasons supporting the hold-to-maturity strategy for fixed-income securities.

The use of cost, or book value, accounting has been consistent with the concern of fiduciaries for capital preservation. At a time when the secondary bond market was relatively thin compared to today and when the likelihood of trading a bond and realizing a change in capital value was quite small, book value accounting appropriately reflected the capital value of securities held. Since the secondary market has developed considerably in recent years, the book value of a bond may have little relation to its actual current value. If one of the fiduciary's objectives continues to be the preservation of capital, it must now be achieved by the careful evaluation of the prospective market values of bonds held, in addition to weighing the credit risk which was the primary task when book value accounting was more appropriate. Measurement of success in preserving capital would best be accomplished

by a market-value based accounting system.

As valuable as it is for protecting the interest of the unwary investor, the "prudent man" rule , which was established in Massachusetts law in the seventeenth century and remains as the foundation of fiduciary responsibility, severely restricts the imaginative investment manager. "Prudence" in fiduciary investment management is defined implicitly in terms of an industry norm. Even if a certain practice could be justified against some absolute investment standard, it would be legally imprudent if it differed much from common practice, which by the same standard might be less desirable. The legally embodied prudent man concept must introduce a material bias in the mind of the investment manager against making potentially return-maximizing decisions where legal risk is added to the existing, but perhaps acceptable, market and credit risks.

Of course, the strong postwar bull market in equity prices has also played a role in investor attitudes toward fixed-income securities. Led by the New York Stock Exchange, ownership in American business was successfully promoted to the point where today over 30 million people own common stocks. The rapid growth of the brokerage business in equity securities created an enormous demand for registered representatives and others knowledgeable in equity values. The burgeoning expansion of the mutual fund industry required portfolio managers with special skills

in selecting common stocks. But beyond even these most visible developments, the resources of the entire market shifted to the source of greatest perceived returns, namely equities. Consequently, present day portfolio managers gained most of their experience in the equity markets. Only residual portions of their portfolios were allocated to fixed-income securities, usually as reserves for subsequent investment in equities. As the market for bonds became more volatile, and the profit potential increased in the late sixties, however, portfolio managers were generally unaware of how to employ fixed-income securities efficiently in conjunction with equities to maximize returns on the total portfolio. The traditional dichotomy between the equity and bond markets, emphasizing the differences rather than the similarities, has persisted.

## 2.2 Fixed-Income and Equity Securities and Market Compared

Since the differences between fixed-income and equity securities seem to be well understood by the portfolio manager, the following comments emphasize the similarities which are often overlooked. The arguments will show that, rather than treating these two security classes as totally different in kind, they in fact have only limited differences in degree which do not in themselves justify distinct investment management policies. The differences in the structure and behavior of the markets for the two classes of securities, however, do suggest that different

resources may be required for successful performance in each sector. These differences are also discussed.

The two fundamental characteristics of bonds relative to common stocks are the current income provision and the term-to-maturity. Investment in bonds typically provides, on a contractual and periodic basis, a fixed rate of cash income subject only to the ability of the issuer to pay. Equities may or may not be a source of income through dividends; in any event, such income would generally be considered irregular and variable, although there are many exceptions. The distinguishing aspect between these two classes of securities on the income dimension is the fixed versus variable, or certain versus uncertain, character of the returns. It is clear that from the broad selection of securities available in each class, individual securities from either class could be located virtually anywhere on this continuous spectrum, not necessarily all at one end or the other.

Because of the tax deductibility of interest payments by corporations and because of the senior creditor but non-residual ownership position of debt holders, it is most common to find coupon yields in excess of stock dividend yields. Consequently, assuming that total returns on equities equal or exceed those for bonds, more of the total return for equities than for bonds must comprise changes in market value. But whether there is a 0% or

3% dividend yield on a common stock or a 6% coupon yield on a bond, the proportional importance of fixed and variable returns in the total return is only a difference in location on a continuous spectrum of return leverage.

The existence of a finite maturity is the other distinctive characteristic common to most bonds. The term-to-maturity may range from a matter of a few days to several decades and, in the case of so-called "perpetuities," to infinity. In terms of maturity the latter are equivalent to equities. But even for the more common long-term bonds, such as those with twenty or more years to maturity, the present value of the principle to be repaid at maturity is so insignificant at any reasonable discount rate that in fact the current market price is determined in the same way as that of an equity security, namely on the basis of an expected stream of income payments. As already noted, a higher degree of confidence that the elements of that stream of income will be received is usually associated with fixed-income securities than with equities. But in general it is again clear that the maturity characteristic is a parameter appropriate to both bonds and equities which may be located on a continuous spectrum from finite to infinite and which for long-term bonds has a virtually indistinguishable affect on current market price. In fact, as will become apparent later, the maturity per se of such bonds

becomes irrelevant when considering marketable securities that can be traded easily.

Although equities and bonds possess certain fundamental similarities which may be scaled on a continuous spectrum, possibly reflecting some overlap between the two types of securities, the two markets are organized and function quite differently. The equity market for the most part is centralized to a greater extent than the bond market. Most trading in common stocks is executed through specialists on one or more of the few organized stock exchanges, though competition from "third-market" firms which trade over the counter have recently put pressure on this system. The supply and demand for listed stocks typically is balanced by the price judgment of just one individual in most cases.

In contrast the bond market is highly decentralized and, in fact, is structurally much like that historically less significant portion of the equity market, the over-the-counter market, where trading is generally inactive in a nonetheless large number of securities. Instead of working through a centralized system of specialists, bonds are exchanged through a loose network of bond dealers, each one of whom may make a market in a particular bond, and wholesale brokers. For the institutional bond investor and trader, direct access to numerous dealers potentially willing to take a position, either long or short, signifies a greater

number of trading opportunities than would be the case in a specialist-centered market. The trading opportunities are particularly attractive since the transaction cost per dollar, or the bid/offer spread, is negotiable and is generally much lower than the fixed commissions which still prevail on the equity exchanges. The existence of such opportunities in bond trading underlines the generally greater importance of trading skills in this field.

The market behavior of fixed-income and equity security returns should also be compared. For the moment the more interesting aspect of this behavior is the correlation of total security returns within the two classes of instruments. In the results of calculations which are described more fully in a later chapter, it is found that the monthly total returns of bonds are much more highly intercorrelated than those for a representative set of equities. The modal correlation sufficient for the samples of stocks and bonds were 0.35 and 0.75 respectively. To most practitioners this will not be a novel observation, but it is not clear that its portfolio implications are fully appreciated.

The comparatively high intercorrelation of total returns on fixed-income securities means that the market forecast, rather than security analysis, is much more critical for investing in and trading these securities. For equities, the unique, non-market related (or residual) forces are relatively more important in

determining price movements and require extensive research efforts for their analysis. Typically, then, macroeconomic forecasts are most critical in bond portfolio management whereas common stock research must place greater emphasis on micro-economic assessments. The broader range of correlations which exists among equity instruments requires a greater degree of subjective assessment if efficient risk management is to be achieved. The assessment of so many complex interrelationships is unnecessary in the bond markets, however; risk management is accomplished by more technical means which depend primarily on the forecast of market yields. In essence the tighter co-movement of bond returns means that the task of managing fixed-income securities is more focussed and requires less analytical manpower, although it does require greater emphasis on technical or trading skill.

The markets for fixed-income and equity securities reflect certain distinctions which may mean that the same portfolio strategy, especially the one developed in this paper, may not be appropriate to all participants. The high unit value for bonds, the relatively wide bid/offer spreads on odd-lot transactions, and the lack of any organized promotional effort to a broad class of investors has kept the investment and trading of fixed-income securities primarily within the realm of the institutional investor.

Investment in common stocks, which are available in a variety of prices seldom as high as the cost of a bond, has been promoted actively by the stock exchanges, such that a still large but diminishing proportion of outstanding equities are held and traded by individuals. The equity markets also receive broad daily press coverage, facilitated by the more massive collection of trading and investment data, and serve as the most visible symbol of the free enterpise, capitalistic system.

Finally the markets for bonds and for equities may be distinguished by the forces acting on them to cause price changes. These forces are not well understood in any detail but market participants do seem to look to different sources of change in anticipating price movements in each of the markets. Much depends of course on the time horizon under consideration. In the very short-run, both markets are probably extremely sensitive to rumors and news developments of all varieties. Beyond moment to moment influences, the bond market reacts to inflationary expectations and to the anticipated demand for new funds from credit users in relation to the potential sources of the required funds. The equity market may be more sensitive to the general business outlook, especially for corporate profits. In the long-run, prices in both markets are probably most affected by real economic developments.

It is unnecessary to go beyond this level of generality to demonstrate that the portfolio manager in making his forecasts for each market may place different emphasis on a variety of forces. Reliance on different informational inputs, however, does not by itself suggest that distinct investment strategies for bonds and for stocks should be held as consistently as experience suggests.

It appears that the commonly cited distinctions between fixed-income and equity securities are nothing more than differences in degree and that, as remains to be explained, even these differences diminish when bond investment opportunities are viewed appropriately. Furthermore, with regard to non-taxable institutions, there are no significant differences in the markets themselves which would call for a set of investment attitudes specific to each market. Thus there appears to be no evidence to indicate that the portfolio manager should employ fundamentally different investment strategies for his trading decisions in fixed-income and equity securities.

## 2.3 The Character of the Investment Decision

At the conceptual level the similarities between the bond and equity investment decisions may be derived from the theory of capital budgeting. Essentially capital budgeting involves the allocation of resources to those uses which will yield the maximum return over time. Full recognition of the uncertainty of achieving any particular expected return must be incorporated. In portfolio

investment decisions, the focus is on the allocation of a given sum of funds to a variety of assets since in most institutions, the volume of liabilities is not subject to the portfolio manager's control.

As revealed in capital budgeting theory, the investment process corresponds to a series of overlapping, sequential choices where the principal criterion is the re-investment rate, a figure that is most likely unknown but subject to the decision-maker's assessment. The purest measure of return, consistent with maximizing the future value of assets held, is total return, which when applied to marketable securities, should reflect fully the likely change in the market value of each investment option plus any cash or non-cash distribution. The task, therefore, is to assess for all feasible investment options the uncertain rate at which funds can be re-invested at various times in the future. When the current price of each security is subtracted from the future price implied by the assessed re-investment rate and when the difference is added to an estimate of interim cash flows, the total return expected for the elapsed period may be calculated. After taking account of the uncertainty involved in each assessment and the effect of possible interdependencies among the returns on the several options, those purchases or sales may be implemented which will maximize the total return on the portfolio over the coming period.

The brevity of this description of the investment process, as derived from capital budgeting theory, is belied by the difficulties in making it operational. Various approaches such as the one underlying the methodology to be used in this study, have been used to incorporate somewhat sophisticated assessments of total returns and of interdependencies in portfolio management decisions, particularly for equity portfolios. In order to circumvent some of the theoretical complexities, hopefully at minimal cost, certain assumptions have become customary in the application of these procedures to equity selections but which would be inappropriate in choosing among bonds. Although the tendency in practice is to overlook dividend income and focus on price changes, the resulting errors in estimating equity total returns are not often great since dividends typically consitute only a small portion of total return. Secondly, the choice of a forecast horizon may not be made explicit. Equity securities possess no characteristic similar to the maturity of a bond which because of the yield-to-maturity convention traditionally has been used as the forecasting horizon. Nevertheless, some general notion of a period such as a quarter or a year, during which a forecast is expected to be realized is evident in return assessments for common stocks. Other important practices in the application of the more sophisticated

approaches to portfolio decision-making, which are more characteristic of the process itself rather than the securities to which it is applied, will be examined in the next chapter.

Similar assumptions with regard to the measurement of total return and the specification of the forecasting horizon lead to more serious errors in fixed-income security selections. The decision of which bonds to hold is most often based on a comparative analysis of yields-to-maturity. In the first place the yield-to-maturity criterion strictly emphasizes contractual cash inflows, including return of principal, and ignores interim changes in market value. Secondly, use of the maturity date as the reference point is arbitrary in that there is no relationship between the direction of market price movements and the maturity of any particular bond. Both of these errors mean that many opportunities for improving portfolio performance may be overlooked. The problem is that the comparative analysis is based on incorrect information. The seriousness of this error is that it is made in the data collection phase, the very first stage in the investment decision-making process, coming even before the more complex issues of forecasting uncertainty and interdependencies of returns are raised.

Clearly, more appropriate information on likely bond returns is required if efficient investment decisions are to be

made. The forecasting horizon, or tentative investment holding period, should be more explicitly defined. It need not be the same for all investment options but the exigencies of day-to-day decision-making will be facilitated if this is so. Such a choice will not compromise the quality of the information as long as the period is shorter than the typical price cycle on any security and is consistent with the investor's objective and strategy.

Three considerations are relevant to the choice of the forecasting horizon. The existence of transaction costs and the cost of preparing forecasts imply that the tentative holding period must be greater than zero; that is, enough time must be permitted, even aside from the uncertainties involved in forecasting, to permit prices to change sufficiently to cover transaction costs.

Secondly, there is no reason for the forecasting horizon to be any shorter than the period over which the investment manager would consider it most unlikely that he would reverse a decision. Ideally, of course, decisions are subject to a continuous review, but in practical circumstances, having just completed a thorough analysis of a particular security, there is usually some period during which the introduction of new information would unlikely affect the original commitment. The length of this

period is difficult to define, but it may be inferred in approximate terms from the overall investment approach of the manager. A go-go type mutual fund manager, who is likely to trade on rumors and technical opportunities, might consider this period to be on the order of a few days or a week. A portfolio strategist focussing on price changes more closely tied to general economic growth would be more likely to consider several months, at least a quarter, as his decision turn-around time. In either case it would be unnecessary to analyze information introduced with a frequency greater than that which is relevant to the strategy; such information is nothing more than "noise" and is meaningless.

The third consideration, already alluded to above, is that the forecasting horizon should be shorter than (or possibly equal to) the shortest likely cycle in total return (or price) movement for any security or group of securities which is relevant to the investment strategy. The specification of this upper limit on the forecasting horizon depends on the investment manager's (perceived) ability to make a priori distinctions in the period of price swings, a skill which presumably exists to some degree since it is implicit in investment strategies. Thus, it is likely that the portfolio manager could draw subjective distinctions among the likely frequencies of price fluctuation

for the common stocks of various industries and for various classes of bonds. For example, it would seem reasonable to expect short term U.S. Treasury bills to fluctuate in price more often and hence have a shorter price cycle than long term bonds. The reason for relating the forecasting period to the shortest cycle in total return is to avoid missing trading opportunities in that particular security or security class. Using the same forecasting horizon for all other securities will permit a periodic review of their return prospects and will assure that no opportunities are overlooked. In Chapter 4, where the collection of data for the present study is discussed, a forecasting horizon of one month is recommended as being consistent with these considerations for a typical non-taxable institutional investor.

The second required modification in the kind of input information used in the comparative analysis of securities, especially if the relative investment merits of bonds and equities are to be properly evaluated, is the uniform reference to the <u>total</u> return on investment. Not only the anticipated rate of all interim cash distributions, whether dividends or coupon income, but also the expected end-of-period price must be related to the present market value (not the acquisition cost). For bonds, this means that yield-to-maturity cannot be used as the selection

criterion. Yields-to-maturity at the end of the current tentative holding period may be used as the object of the forecast but the implied price should then be used to calculate the total expected return for the period in order to properly compare bond investment options with those of common stocks.[4]

Principally utilizing these two modifications in the information required to evaluate fixed-income securities -- namely, the choice of a tentative holding period other than term-to-maturity and the use of total holding-period-return rather than yield-to-maturity -- the present study will demonstrate the implications for the bond/equity composition of security portfolios.

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4. The experienced bond portfolio manager, of course, may make efficient selections from among bonds, particularly of the same maturity and type, without explicitly converting from yield-to-maturity to the holding-period return. The ability for anyone to do this, however, probably declines as the scope of options is broadened, and it probably disappears when a wide range of equities is introduced.

## Chapter 3

### Methodology

As stated previously, the objective of this study is to show that, by employing the same basic investment strategies for both fixed-income and equity securities, overall investment performance is likely to be improved by holding a larger proportion of total funds in bonds than is commonly the case. In order to arrive at a reliable conclusion, it is necessary to utilize a procedure which eliminates the biases found in portfolio management practice while introducing no new imbalances in the treatment of bonds and equities. Since this study essentially asks the question "what would happen if the investment approach to bonds and stocks were the same", it is difficult if not impossible to conduct an empirical examination of current practices to find an answer. Even if this were possible, however, any generalizations drawn would be tenuous since virtually every portfolio is managed under a unique set of conditions.

The approach taken in this study is to abstract from the unique circumstances of particular portfolios and to focus on the general parameters common to a broad class of security portfolios so that the results of the study will be as widely applicable as possible. Models of the portfolio selection process

and of the securities market, which are the embodiment of recent developments in portfolio theory, will be used. After discussing the background and application of each of these models, the affect that the use of such theoretical models is likely to have on the conclusions to the study and hence on the value of the conclusions for portfolio management practice will be examined.

3.1 The Markowitz Model of Portfolio Selection

Markowitz[1] introduced the portfolio selection model by assuming that investors make portfolio decisions strictly on the basis of two portfolio characteristics, expected return and risk, and that investors are risk averse. Risk is defined as the investor's uncertainty that his return expectations will be realized. (Although there is a technical difference in meaning, the terms risk and uncertainty will be used interchangeably in this paper) The assumption of risk aversion implies that an investor, given two portfolios with the same return, will choose the one with the least risk; and, conversely, given two portfolios characterized by the same level of risk, he will choose the one promising the higher return.

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1. Markowitz, Harry M. "Portfolio Selection", The Journal of Finance, Vol VII, No. 1, March 1952, pp. 77-91; and Portfolio Selection: Efficient Diversification of Investments. Cowles Foundation, Monograph 16. New York, John Wiley & Sons Inc., 1959

Markowitz then proceeded to make a few technical assumptions, chosen in part to approximate observed practice but also to facilitate computation. He first recognized that an investor's assessment of the rate of return on a security --- irrespective of how the assessment was formulated -- could be represented by a probability distribution; thus, there was some small probability that a very high or a very low return might be earned, but it was more likely that an intermediate return would be realized. The shape of the assessed probability distribution could be summarized approximately by two statistical parameters, the expected return and the standard deviation of return. The expected return represents the "best guess" of the possible return, and the standard deviation measures the spread of possible returns from the expected return and hence reflects the investor's uncertainty.

In addition to these steps toward the quantification of investor assessments, the Markowitz approach was further distinguished by the provision for interrelationships among security returns. The closeness of the relationship between the returns on two securities can be measured by the correlation coefficient. The index ranges from +1 for returns that always move in the same direction to -1 for returns that always move in the opposite direction. The value of the index is zero for security returns

that exhibit no interrelationship.

Markowitz then assumed that the general shape of the investor's assessed probability distribution could be approximated by the so-called normal, or bell-shaped, distribution. Not only did this assumption seem reasonable from the assessment viewpoint but it vastly simplified the calculation of the distribution of possible returns on a portfolio of securities. Under the assumption of normality, the expected portfolio return equals the sum of the individual security returns, each return being weighted by that security's proportionate role in the total portfolio. (See Appendix A to this Chapter for precise definitions.) The standard deviation of the portfolio return requires a slightly more complex calculation encompassing the standard deviations of the returns on the component securities, the correlation coefficients between all pairs of security returns, and the fraction of the total portfolio invested in each security. Rather than describe the calculation in detail, it is more important for the purpose of this discussion to recognize that the standard deviation of portfolio return not only incorporates the investor's uncertainty about each security's return, but it also explicitly accounts for the correlation of security returns. For a normal distribution, the standard deviation of portfolio returns has the same general interpretation as the

standard deviation of security returns; namely, the probability is about 67 percent that the actual return will fall within one standard deviation of the expected return and 95 percent that it will be within two standard deviations of the expected return.

Using this simple structure, Markowitz then proceeded to show that for each level of portfolio uncertainty, or standard deviation, there is a single combination of securities which maximizes expected portfolio return. He called such a combination an "efficient" portfolio. A different efficient portfolio corresponds to each level of portfolio risk and the entire set of such portfolios, covering the full range of portfolio risk, is called the efficient set. As a consequence of the particular assumptions Markowitz made, the efficient set relates expected portfolio return to portfolio risk in a manner such that for higher levels of expected return more than a proportionate increment in risk must be assumed; that is, a portfolio that is expected to earn twice as much as another will involve more that twice as much risk.

Although there is substantially more complexity to the theory of portfolio selection, such as the procedure for choosing a particular investor's optimal portfolio from the efficient set, the description given thus far should provide sufficient perspective for the methodology used in this study. Before discussing the manner in which this model of portfolio selection is to be used,

the problems of obtaining the assessments of expected returns and standard deviations for a variety of portfolios must be solved.

## 3.2 The Securities Market Model for Estimating Expected Portfolio Returns and Standard Deviations

The difficulty with the Markowitz portfolio model in the form described above is the impracticality of assessing so many uncertain variables. In addition to the expected returns and standard deviations for each security, the model requires the estimation of the correlation coefficients between every pair of securities. For only 50 securities, assessments of 1225 correlation coefficients, 50 expected returns, and 50 standard deviations would be required, clearly an impossible task, especially if the need for periodic re-assessment is taken into consideration.

The process of assessing parameters for uncertain variables exhibits a further complication which is implicit in the Markowitz model. Markowitz specified what to do with the various assessments once obtained, but he avoided discussing in any detail just how to formulate the assessments. Few if any individuals are sufficiently skilled to make purely subjective assessments that yield meaningful information about their uncertainty regarding expected events. Several developments in statistical decision theory, such as in Bayesian statistics, may be used to assist the forecaster, but such methods have not yet been streamlined sufficiently to make their use in repetitive and massive

problems practical. Consequently the less elegant but more feasible approach commonly adopted is to assume that the future behavior, especially over a forecasting horizon as short as one month, of each security will not differ significantly from its recent behavior. Since this assumption also underlies all technical and most fundamental security analysis, it is not unreasonable to employ it for the purposes of this study. Such a choice possesses the further advantage that, in relying strictly on historical behavior in developing assessments of security risk and return, bonds and equities will be treated in a similar, unbiased manner, an important stipulation if the study's results are to be meaningful.

By incorporating historical security performance, the securities market model provides a practical method of obtaining the large number of required risk and return assessments. The structure of this model was first outlined by Markowitz[2] and then further developed by Sharpe.[3] The model assumes that the effects of the correlations of the returns between one security and all other securities may be adequately approximated by measuring the sensitivity of that security's return to a change in the market as a whole. Thus, part of a security's return is viewed as being

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2. Ibid. pp. 96-101
3. Sharpe, William F. "A Simplified Model for Portfolio Analysis", Management Science, Vol. 9, (January, 1963), pp. 277-93.

dependent on the movement of the market and the remainder is considered the result of circumstances unique to that particular security.

Sharpe developed the mathematical structure, based on regression analysis, necessary for using the security/market relationship in order to generate the assessments required for the portfolio selection model. Primarily, he assumed that the interdependencies among all security returns, previously measured by Markowitz's correlation coefficient, could be explained entirely by each return's relationship to the market index(es) and that the non-index related or residual portion of each security's return was strictly independent of the residual returns on all other securities. This assumption is important in that it eliminates the task of assessing individual correlation coefficients (except for the few which would be required if more than one market index is used). Furthermore, using historical data, the regression technique generates all of the necessary estimates of expected security returns and standard deviations for the portfolio selection model.

One particular implication of the security market model for the structure of the security analysis process is noteworthy. The decomposition embodied in the model of a security return into "common" (in the sense of being related to the same market factors) and "unique" portions suggests a corresponding division

of the security analysis process in which subjective assessments and the results of regression analysis would be combined. The security analyst could concentrate on estimating the unique or residual portion of a security's return and the associated risk, while market experts could devote their time to forecasts of likely movements in the market indexes and their uncertainty about such movements. The products of these efforts would then be combined using the parameters found by regression analysis to obtain usable estimates of security return and standard deviation.

The imposed distribution between the common and unique portions of security returns further supports the assertion made in the previous chapter. Since the total returns on fixed-income securities tend to be much more highly intercorrelated than those for equities and therefore are related more closely to overall bond market behavior, more macroeconomic analysis is required for bonds than equities where individual security characteristics play a greater role in each security's behavior.

The specific parameters of the securities market model which are derived from the regression analysis also have meaning for the portfolio selection process. The regression analysis for each security yields a coefficient or weighting factor for each market index which measures the sensitivity of that security's

return to movements in each index. For example, if one of the market indexes is the Standard & Poor's 425, a change of one percent in this index might historically be associated with a change in total return on one security by two percentage points and on another by only one-half percentage point. The sensitivity coefficient on the former more responsive security would be 2 and, on the more sluggish security, only 0.5. Clearly, the sensitivity coefficient is related to the riskiness of a security.

The assumed independence of the risk corresponding to the residual portions of all security returns implies that this kind of risk cannot be eliminated from a portfolio by diversification. The set of sensitivity coefficients for each security, therefore, fully describe its diversifiable and hence relevant riskiness. As long as only historical data are used, as in this study, and given the expected return and standard deviation forecasts for the market index(es), these parameters completely determine the expected return and standard deviation measures required for each security in the portfolio selection model.

The mathematics supporting the portfolio selection model and the securities market model is not complex but it is unnecessary to present the details here. The relevant equations and assumptions are presented in Appendix A.

3.3 Methodological Implications for the Conclusions

The likely impact the use of such models may have on the conclusions to this study needs to be evaluated. To what extent do the recognized shortcomings of these models, evaluated against common practice, compromise the objectives of the study? Recalling that the essence of this study is a comparative analysis of the portfolio role of fixed-income and equity securities which requires the avoidance of any biases that might affect one class of securities more than the other, it is clear that the models need only be relatively, but not rigorously, valid. Thus, no pretense is made that the securities market model developed here actually "explains" in any thorough sense the behavior of either equities or bonds, but only that it represents their respective behaviors equally well.

A substantial amount of research has been done to show that security returns, specifically for equities, are not distributed normally, as assumed, but probably exhibit slightly broader distributions. The use in this study of such additional precision would be necessitated only if the distributions, of whatever type, were different for bonds and equity returns. The existing research on the distribution of security price changes suggests that the character of the distribution depends less, if at all, on the nature of the security rather than on the market process in which

prices are determined.[4] Although the equity and bond markets are organized differently, there appears to be no clear reason to suspect that the distributions of price changes would be different for bonds and common stocks. It thus seems unlikely that the assumption of normally distributed returns will influence the conclusions of the study.

The Markowitz portfolio selection model and the securities market model are both static whereas the investment process is dynamic. The Markowitz model assumes that all portfolio decisions are made at one point in time and apply until the next review; no provision is made for the evolutionary nature of the investment process. In addition, the securities market model typically implies that the sensitivity of each security's return to changes in the market index(es) is stable over time when, in fact, bond maturities and the circumstances of each equity security are constantly changing. The tests involved in this study, however, do not require models which stand up under dynamic conditions. The purpose of the analysis is to show that at a given point in time it would be possible to improve portfolio performance by applying the same investment strategy to both bonds and equities. Although the methodology employed here may suggest ways in which a balanced strategy might be developed

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4. Fama, Eugene F."Mandebrot and the Stable Paretian Hypothesis," Journal of Business, Vol. 36, No. 4 (October, 1963)pp. 420-29.

there is no intent to propose better ways of making sequential decisions. In fact it is hoped that the implications of this analysis for the bond/equity decisions will be sufficiently distinct from common practice as to be meaningful irrespective of what assessment methods and decision-making procedures are used.

The securities market model also is not put forth as a sophisticated forecasting model as it has been in some studies. Although the results of the study might be more interesting if they were derived from forecasted returns using only current assessments for the market index(es), the results will be equally valid and applicable by using historically determined mean returns and standard deviations of the market index(es). This model, however, does permit a limited evaluation of the impact of market dynamics on portfolio composition by varying the rates of change and the standard deviations of the market index(es).

Thus, although the divergence between the theoretical assumptions of the models and the reality of market behavior may limit the correspondence between ex ante actions and ex post results, it seems that the methodology employed here should permit a balanced treatment of bonds and equities and should in no significant way compromise the results of the study.

## 3.4 A Computer Program for Calculating Security Parameters and Efficient Portfolio Sets

Most of the complex computations involved in developing the specific models for this project were performed using a computer program developed by Professors White and Glauber at the Harvard Graduate School of Business Administration and sponsored by the Cambridge Project. The program readily performed the following functions relevant to this study, as well as several others, storing the results of each calculation that would be required for subsequent stages:

(1) Regression analysis of historical security returns against the market index(es);

(2) Computation of several statistical measures of the quality of the regression;

(3) Computation of the efficient portfolio composition at various levels of specified expected portfolio return, given a market forecast.

The flexibility of the program eliminated extra-system data handling and permitted the rapid solution of portfolio problems in very few discrete steps.

## 3.5 The Stages of Analysis and the Criteria Employed

The computer program was used to accomplish three types of tests. A series of general tests was performed to

to determine the statistical characteristics of the returns on selected securities, characteristics which under comparative analysis were expected to contrast significantly with general impressions, especially with respect to bonds. Secondly, the securities market model was constructed and the correspondence between the resulting model and the theoretical assumptions was tested. Lastly, efficient portfolios were selected under a variety of market conditions in order to determine the affects on portfolio composition of using monthly holding period returns for bonds and stocks together. The specific purposes, procedures, and criteria employed in each of these stages are described in more detail below. The results are analyzed and interpreted in Chapter 5 and in subsequent chapters.

One presumed justification for the use of a special investment strategy for bonds, especially one that relegates these securities to a second-class or reserve function status, is that bonds are not as risky as equities and hence there is less opportunity to achieve distinctive performance in bonds. The perceived lower profit potential explains the little effort and minimal resource allocation devoted to bond portfolio management. In order to clarify the return and risk characteristics of fixed-income relative to equity securities, the means and standard deviations of the total returns for a representative set of these

securities will be examined. The question is whether there is a significant overlap in the behavior of the raw returns (meaning before the application of the securities market model as below) of bonds and common stocks. Although it would be unreasonable to argue that the behaviors of the two security classes are in any sense comparable, a general impression of the relative riskiness of the two types of securities may be obtained by comparing the standard deviations of security returns. Although it is believed that the results of these comparisons will reveal that bonds and stocks behave more similarly than is generally perceived, the lack of a suitable measure of such perceptions prohibits a rigorous examination of the possible differences between investor impressions and security behavior. The bond/stock comparisons, however, may prove enlightening.

Security behavior is also reflected by the way security returns move with respect to one another, a relationship measured by the correlation coefficient. If bond returns tend to be highly correlated with one another and if equity returns seem to be correlated with one another at a generally lower level, but bond and equity returns are only slightly, or maybe negatively, correlated, then a clear distinction would exist in the markets for these two classes of securities. If on the other hand there were numerous examples of high correlations between the returns

of particular bonds and equities, it would be difficult to draw such a conclusion. The existence of a difference in the behavior of fixed-income securities and of equity securities, as measured by the correlations of their returns, may be evaluated by examining the degree of difference in the following three distributions of correlation coefficients: bonds versus bonds, equities versus equities, and bonds versus equities. A material difference in the latter from either or both of the former distributions would suggest a dichotomy in market behavior. This test of bond/stock similarities should prove more rigorous than the above comparison of standard deviations, since bond and equity returns would have to move in the same direction simultaneously and in an amount roughly proportional to their respective standard deviations if a conclusion of no inter-class distinction is to be supported. Such a conclusion seems unlikely since it isggenerally believed that bond returns and equity returns respond to different forces. In fact, some market participants have argued that the returns on bonds and stocks are inversely correlated. Even if this were true, however, justification for the use of different investment strategies would not necessarily be demonstrated.

The above test plus two supplementary tests can be used to indicate the degree of intra-class correlations of bond and equity returns. The comparison of the bond versus bond and equity versus equity correlation coefficient distributions

above serves as one measure. The distributions of correlation coefficients of bond returns with a bond market index and of equity returns with the Standard and Poor's 425 stock price index will present further evidence of intra-class relationships. The results of these tests will suggest the relative importance of market analysis in formulating investment strategies. If it is found that bond returns are very highly inter-correlated, it will signify that the selection of particular bonds is less important than the decision of how much should be allocated to bonds in general.

The second set of tests relate to the development of the securities market model. The issues include the choice of one or more indexes for the model, the criterion for choosing the best model, and the interpretation of the parameters of the final model.

The selection of indexes for the securities market model is subject to several criteria as well as constraints. Although the purpose here is not to build a forecasting model per se, the index(es) should be such that it could be the subject of a forecast if desired. The index(es) therefore should possess some independent meaning in the sense that the market analysis has sufficient perspective on the behavior of the index(es) to make meaningful judgments. Consequently, ad hoc indexes would be unsuitable

except for the possibility, as may be the case in the bond market, that all the returns in a particular sector are sufficiently correlated so that a simple average would give the analyst an adequate reference for his assessment. In contrast the indexes developed in factor analysis, although useful in building more efficient "explanatory" models for analytical purposes, would not be of value here since they possess little intrinsic meaning that would permit forecasting.

There are also reasons to keep the model relatively simple by limiting the number of indexes. Again with the task of forecasting in mind, assuming that if more than one index is chosen they will probably exhibit some interdependency, the inter-relationships would have to be evaluated by the market analyst in the form of correlation coefficient estimates. It is difficult to say how much can be expected of the analyst in this regard, since it would partly depend on the particular indexes involved, but the assessment of correlation coefficients between three or four indexes is probably near the limit.

Furthermore, for the specific purposes of this study, testing the affects of market changes on portfolio composition requires that the number of indexes be limited. From a theoretical viewpoint, it would be interesting to determine each

and every set of market conditions that implied a particular portfolio composition such as, for example, a portfolio with no allocation to bonds. Having such information, one could make a judgment whether the market conditions obtained might be reasonably expected to occur and hence whether the related portfolio composition would even be a reasonable investment strategy. The desired determination implies the specification of a particular portfolio composition first and then the calculation of the related market conditions. Unfortunately, because it is intended that the structure of the analysis in this study conform to investment practice, the direction of the computation is just the opposite of that which would lead to theoretically interesting results; thus, the investor begins with an expectation of market conditions and then calculates the appropriate portfolio compostion. However, using this computational structure it may be possible to draw some limited inferences about the sets of market conditions implying particular portfolio compositions. If the number of market indexes is kept small enough, portfolio composition behavior may be revealed by permuting the values of the market indexes. If the pattern is sufficiently clear, it may then be possible by extrapolation to infer some but probably not all of the market conditions that imply a particular portfolio compostion. The clarity of the portfolio composition patterns will depend on the number of portfolio compositions that can be calculated within

the budget available for computer expenses.

The utility of a particular securities market model is determined by its consistency with the theoretical assumptions on which it is based. The critical assumption is that the market indexes capture all the common or interdependent movements among security returns so that the residual portions of the returns are perfectly independent from one security to another. If portions of the returns on several securities vary independently of one another, the portfolio risk corresponding to such movements is non-diversifiable and, hence, unmanagable. Security returns that are interdependent vis-a-vis the market, however, can be managed, or diversified by selecting securities that are more or less sensitive to market movements in accordance with the market forecast. This assumption, to the extent that it is empirically valid, permits sole reliance on the sensitivity coefficients of the market indexes to describe the security risk which contributes to portfolio risk. Since it is most unlikely that the residual returns in a real model will, in fact, be independent of one another, the issue becomes one of measuring and evaluating the degree of interdependence. This may be done by comparing the distribution of correlation coefficients among residuals with the similar distribution implied by the ideal model which, because of the independence assumption, consists entirely of zero-valued correlation coefficients. The Chi-square

statistic is designed for such a comparison.

Some explanation of the special use made in this study of the Chi-square measure is necessary since it differs somewhat from the normal interpretation. In the usual application the Chi-square measure is intended to measure the significance of the difference in two distributions. The Chi-square statistic itself is described by a probability distribution such that it is possible to determine the probability that two distributions are significantly different. For the purposes of this study, however, the Chi-square statistic will not be used in this manner. The objective is to find the securities market model which most closely approximates the ideal model, in the sense of having independent residuals, even though the best model still may exhibit a significant amount of dependence among residuals. The Chi-square statistic therefore will be used simply as an ordinal measure to rank each of the trial models. The securities market model with the set of indexes exhibiting the lowest value of Chi-square will be chosen for subsequent purposes of the study.

A comment is necessary regarding the role in this study of the degree to which the securities market model "explains" individual security returns, a characteristic most often measured by the coefficient of determination or r-squared. It may be possible for example to choose such a combination of market indexes that

nearly every change in a security's return would be captured by movements in one or more of the indexes. The explanatory power of such a model thus would approach 100%. Although it may be desirable to achieve a high degree of explanatory power for some purposes, such as in forecasting, the same criterion too often is used mistakenly in assessing the efficiency of a model for portfolio selection purposes. The requirement of the model for the latter purpose is to separate diversifiable and non-diversifiable security risk. Even a model which yielded an extremely low value of, for example, 0.1 for r-square (on a scale ranging from 0 to 1.0) for a particular security might be very useful in portfolio selection if the indexes involved adequately captured the common, or diversifiable, elements of risk. It is for this reason that the Chi-square rather than the r-square statistic is used as the criterion for selecting the most efficient securities market model.

The parameters of the final securities market model must be examined for implications regarding the behavior of fixed-income and equity securities. As has already been explained the sensitivity coefficients of the market indexes are surrogate measures of security risk. The coefficients are, in fact, better measures of security risk than the standard deviations of security

returns which were previously discussed since these coefficients focus not on the total security risk but on the diversifiable risk which is surely the more important characteristic from the portfolio selection viewpoint. Therefore, a comparison of the distributions of sensitivity coefficients for bonds and equities, respectively, will allow an improved judgment of whether bonds and equities behave differently. The comparison becomes somewhat complicated, however, if more than one index, and hence more than one sensitivity coefficient, is involved. Because the procedure to be used will depend on the structure of the final model, the method of comparison will be described subsequently in conjunction with the analysis of the model.

The third and final series of tests relates to the use of the portfolio selection model and hence to the ultimate goal of the paper, an assessment of the relative role of fixed-income securities in portfolio mangement. The purpose is to determine the optimal portfolio compositions, especially with respect to the allocation of funds between bonds and equities, that are implied by a variety of market conditions. Given the parameters of the securities market model and the assessed characteristics of the market index distributions, the composition of the efficient portfolio is found using the methodology developed by Markowitz and described in general terms earlier. The

mathematical details of the optimization procedure are presented in Appendix A.

The role of fixed-income securities in an investment portfolio depends on several conditions: the level of acceptable portfolio risk; the market forecast, both with respect to the expected change in the market and the uncertainty about that change; and the structure of the securities market model, which may change over time. The affects of each of these conditions on the composition of the efficient portfolio will be examined.

It would be most useful to have a standard against which to compare the role of fixed-income securities implied by this study. Unfortunately, no adequate standard exists that would permit reliable comparisons. The actual composition of each institutional portfolio is the product of a wide variety of considerations including the important ones that are isolated in this study. If the results obtained here suggested a different role for bonds than was apparent in a particular institutional portfolio or sample of portfolios, it would be impossible to determine whether the difference was the result of variances in market outlook or acceptable risk level, or whether it may have resulted from a more fundamental bias in the investment decision-making process, possibly embedded in the structure of the organization. It is hoped that the approach taken in this study will provide the basis for some improvement in the latter regard.

It would be possible to develop a useful standard of comparison if a sufficiently large sample of portfolios of non-taxable institutions could be obtained in which the determining market forecast, the a priori portfolio risk taken, and any external constraints (e.g., statutory) were completely specified for each portfolio. Such a sample would permit a controlled comparison which isolated different attitudes toward the management of bonds and stocks. The creation of such a sample, however, is beyond the scope of this study.

The lack of a suitable standard means that the analysis of the efficient portfolios found here must be essentially normative. The composition of the efficient portfolio, especially the division between bond and equities, for varying market forecasts and risk levels will be presented so that the individual portfolio mangger may determine whether with the same forecast and risk attitude he would have adopted a different portfolio strategy. If so, he should examine whether the difference is the result of the procedure for measuring bond returns and risk, a failure to account properly for the interrelationship between bonds and stocks, or the methodology used here for creating efficient portfolios.

## Appendix A

## Mathematical Definitions and Equations for Securities Market Model and Portfolio Selection Model

### A. 1 Definitions

Expected security return $\bar{r}_i = \sum r_i p(r_i)$

Standard deviation of security return $\sigma_i = \sqrt{\sum p(r_i)(r_i - \bar{r})^2}$

Correlation coefficient $c_{ij} = \sum \frac{(r_i - \bar{r}_i)(r_j - \bar{r}_j)p(r_i, r_j)}{\sigma_i \sigma_j}$

When $r_i$ = a possible return on security

$p(r_i)$ = the probability that $r_i$ will occur.

Expected portfolio return $\bar{R} = \sum x_i \bar{r}_i$

Standard deviation of portfolio return $\sigma_R = \sqrt{V}$

$V = \sum \sum x_i x_j c_{ij} \sigma_i \sigma_j$

where $x_i$ = fraction of total funds invested in security i

$V$ = variance of portfolio return

Note: The estimates of the expected security return and standard deviations, $\bar{r}_i$ and $\sigma_i$, do not have to be obtained as indicated in the definitions by listing possible security returns and assessing the associated probabilities. For example, the estimates might be calculated from the distribution of historical returns or by using the securities market model.

A.2. The Securities Market (Multi-Index) Model[1]

Define the relationship between a security's actual return and the market indexes as $r_i = a_i + b_{i1} I_1 + b_{i_2} I_2 + \ldots + b_{i_m} I_m + e_i$ where

$r_i$ = the actual return for a given period on security i

$I_j$ = the change in market index j for the same period for indexes 1 through m,

$a_i, b_{ij}$ = estimates of sensitivity coefficients for security i obtained by regression analysis, and

$e_i$ = regression error, or residual, term. (Note that the regression technique implies that $\bar{e}_i = o.$)

Assume (1) that the residual terms between all securities are uncorrelated, $c_{e_i, e_j} = 0$ for $i \neq j$ and (2) that the changes in index values are uncorrelated with the residual terms, $c_{e_i, I_j} = 0$ for all i and j. Then $\bar{r}_i = a_i + b_{i2}\bar{I}_2 + \ldots + b_{im}\bar{I}_m$

$$\bar{R} = \sum x_i(a_i + b_{i1}I_1 + b_{i2}I_2 + \ldots + b_{im}\bar{I}_m) \text{ and}$$

$$V = \sum_i \sum_j (x_i b_{ij} \sigma_{I_j})^2 + \sum_i \sum_j (x_i b_{ij} \sigma_{\bar{I}_j})(x_i b_{ik} \sigma_{I_k}) C_{I_j I_k} + \sum_i (x_i \sigma_{ei})^2$$

where $\sigma_{I_j}$ = the standard deviation of index $I_j$

$C_{I_j I_k}$ = correlation coefficient for indexes $I_j$ and $I_k$

and $\sigma_{e_i}$ = standard deviation of the residual term.

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1. See Sharpe, William F. Portfolio Theory and Capital Markets McGraw-Hill Book Company, New York, 1970, pp. 117-190

In the procedure used for this study, the $a_i$, $b_{ij}$ and $\sigma_{e_i}$ are determined for each security by regression analysis. Except for the $x_i$, the assessment of $\bar{I}_j$, $\sigma_{I_j}$ and $C_{I_jI_k}$ for each of the indexes completely determines the necessary portfolio characteristics, $\bar{R}$ and V (or $\sigma_R$). For one, two, three, or four market indexes, the total number of investor assessments required is 2, 5, 9, and 14, respectively.

A. 3. The Portfolio Selection Model

The purpose of the portfolio selection model is to determine the proportional investment in each security (the set of $x_i$) that minimizes V for a specified $\bar{R}$. (This approach is computationally more easy than the alternative of maximizing $\bar{R}$ for a given V.) .The problem may be stated as follows:

Minimize V

subject to $\bar{R} = k$ (a constant)

and $\sum x_i = 1$.

The minimization procedure utilizes a technique called quadratic programming which is essentially a special application of differential calculus. A quadratic programming algorithm originally prepared by Professor John Bishop at the Harvard Business School was modified slightly to solve the present problem.

The efficient set of portfolios is generated by specifying different values of k, and hence $\bar{R}$, to obtain the corresponding value of V and the related portfolio compositions, $x_i$. The process may be repeated for different assessments of $\bar{I}_j$, $\sigma_{I_j}$ and $C_{I_jI_k}$ to determine the affect of various market conditions on portfolio risk and composition at each level of expected portfolio return.

## Chapter 4

## Selection and Preparation of Holding Period Returns

The purpose of this study, to repeat, is to examine the implications of evaluating bonds and stocks in an identical manner. In order to provide a sound basis for comparable evaluation, identical measures of return for bonds and stocks are used. The insistence on comparable data is the principal distinction between the approach used in this study and that widely followed in investment practice. In this Chapter, the selection of the security sample and the compilation and treatment of the raw data are discussed. Since there were several complications in obtaining holding period returns for bonds suitable to the purposes of this study, the steps followed are reported in some detail below.

### 4.1 Holding Period Returns

The concept of return used throughout this study is that of holding period return. The phrase "holding period return" is used to distinguish clearly from the yield-to-maturity concept often used as a measure of returns on bonds. The "holding period" refers to the span of time over which a security might be held rather than when it actually was held. The intent is to emphasize the ex ante problem of portfolio decision-making instead of the ex post issue of performance measurement. Although the purpose of this Chapter is to discuss the collection of

historical holding period returns, this is done as a means of estimating ex ante holding period returns.

Holding period return for both bonds and equities is defined as the difference between the security's price at the end of the period and the price at the beginning of the period plus any cash value distributed or accured as dividend or interest income during the period, the result divided by the security's price at the beginning of the period. This measure of return is also called total return.

The holding period was chosen to be one month. The criteria for choosing the holding period were discussed broadly in Chapter 2 and will be elaborated here. Ideally, a unique ex ante holding period would be implicit in every investment decision since each purchase or sale would be based on a comprehensive review that included a specific forecast of prospective returns for the coming period on all possible investments. The distribution of holding periods implicit in actual portfolio decisions would probably be broader for equities than bonds due to the lower intercorrelation of returns on equities which requires greater security-specific rather than market-specific forecasts. But at the present stage of capability in investment decision-making, it would seem virtually impossible to associate confidently a specific ex ante holding period with each decision.

In order to recognize the limitations imposed by practice, two general considerations suggest upper and lower bounds to the length of holding period. It is reasonable to assume that the horizon of an investment decision should approximate the optimal forecasting horizon; that is, the period over which the investor is sufficiently confident in his assessments to take action. Thus, in very general terms, it may be possible to make sufficiently distinctive forecasts to permit selection decisions that would be appropriate for a horizon of maybe six months or, at the outside, possibly a year. Beyond that horizon, forecasts are likely to become so general that selective action could not be taken.

On the other hand, information derived from daily or maybe weekly assessments of security or market behavior is likely to be either more in the character of rumor or so widely known and immediately discounted that again selective, profitable action would be foreclosed. Furthermore, the structure of the portfolio decision process at most institutions would suggest that there is some minimum period, possibly a month, within which no decision would be reversed since it is highly unlikely that any distinctive information would become available during the period which could not be anticipated at the beginning of the period. These considerations suggest that the selection of a one-month

holding period is a reaonable compromise. This choice is also convenient, although not necessary, from the viewpoint of data acquisition since data for a few of the bond series specified below are most readily available on a monthly basis.

4.2 The Sample Period

The period initially selected for analysis was December 31, 1959 to June 30, 1970 although this was later contracted to June 30, 1962 through June 30, 1970 due to the lack of readily available equity price data for the earlier segment. This period, even as contracted, included significant bull and bear markets for both equities and bonds. The existence of price volatility, and hence market risk, is an essential condition for making a meaningful evaluation of the relative portfolio roles of stocks and bonds. During approximately the first half of the sample period, bond yields and prices exhibited more stable behavior than was characteristic either immediately before or since. It is believed that the focus during that period of the Federal Reserve Board on interest rates in a policy often called Operation Twist contributed to bond yield stability. If in fact a fundamental change in the behavior of bond prices has taken place as a result, in part, of a change in monetary policy, it should be possible to examine the implications for portfolio strategy by studying the first and last halves of the period separately. The changes in the

behavior of the raw data are summarized in Chapter 5 and the portfolio implications are presented in Chapter 9.

Several of the difficulties encountered in obtaining stock price and bond yield data are explained in the following sections. The adjustments required to obtain comparability of bond and stock holding period returns as well as the assumptions underlying the adjustments are also discussed.

## 4.3 Technical and Conceptual Problems in Obtaining Bond Price (Yield) Data

The prices of fixed-income securities are affected materially by the characteristics of the bond itself. The most important characteristics of a bond which determine its relative value are the sector classification (e.g., industrial, utility, or government), credit rating, maturity and coupon. In order to obtain a representative sample of bond price behavior, bonds characteristic of each of these four dimensions must be chosen. Before discussing the selection of the particular bond yield series, some of the general problems of obtaining bond price data will be reviewed.

Relative to the voluminous research into the behavior of stock prices done over the last decade, studies of bond price movements have been insignificant. Consequently there has been little demand for extensive bond price series comparable to those

available for stocks. Furthermore, the lack of a centralized market and the less frequent turnover for bonds means that one is less likely to find uniform bond price series comparable to the stock price records obtained, for example, from the New York Stock Exchange ticker tape. As a result, historical records of bond prices tend to be relatively primitive being confined to dealer quote sheets, trade tickets, newspapers, or various sources which have extracted data from these three.

Trade tickets showing the actual prices at which specific transactions were executed are ultimately the best source of price data but constructing complete records for many different bonds, or even classes of bonds, would be prohibitively expensive. The bid and offer quotations available from dealer quote sheets, and reported selectively in the daily press, are more easily obtained but suffer from several analytical shortcomings. Primarily, quoted prices are not actual prices. In addition to variation in quoted bid prices among dealers, especially for less actively traded bonds, actual bid prices may differ significantly from the quoted price depending on the size of the transaction, the relationship between the dealer and the customer (If the customer is an institution generating frequent and large trades, he may receive "inside" prices, i.e., at narrower spreads than the "board" quote), or the willingness of the dealer to go long or short in a particular bond.

The insignificant, or in most cases, nonexistent role of the "specialist" in the bond market suggests that the universe of historical bond prices might contain a relatively wide range of prices for each bond at any given moment, much more like what might be found in the over-the-counter stock market than in listed equities. Although some of these same types of data noise undoubtedly exist in available records of stock prices, it is unavoidable that some comparability in historical prices is lost due to the different trading processes in the bond and equity markets.

Beyond these limitations inherent in the trading process itself, the character of the analysis undertaken in this study imposes further compromises. Essentially, the purpose of the study requires the determination of the particular bonds and equities that should be held in a portfolio at a specific point in time. In this study, the portfolio decision is based on security risk and return characteristics produced by the securities market model which in turn is derived from the behavior of security prices over time. In contrast to stocks which have infinite maturities, bonds have maturities which continuously shorten, meaning that in effect a given bond behaviorally becomes a different security from one time to another. Thus, in order to understand the likely behavior of a given bond at a specific point in time, price movements of bonds of a similar type and with the same maturity must be

analyzed through time rather than the prices of the particular bond.

4.4 Bond Yield Indexes as the Basis for Bond Returns

Because of the difficulties of collecting adequate records of prices (or yields) on individual bonds and because the changing maturity of a bond is analytically unsatisfactory, published yield indexes were used as the basis for bond holding period returns. For most of the yield indexes described below, the characteristics are relatively stable since the publishers remove issues as they become unrepresentative and substitute others that satisfy the definition of the index. The impact of substitutions among the component bonds on the holding period return for the index will be reviewed shortly.

A consequence of using yield indexes to get bond holding period returns is that returns on the component bonds are implicitly assumed to be perfectly correlated. To the extent that the returns on individual bonds are less than perfectly correlated, the standard deviations of the index-generated returns will underestimate the total risk of the underlying securities. The effect of this approach is that bonds may appear less risky than in fact they are. The potential impact of this assumption on the composition of efficient portfolios will be considered after discussing the particular bond yield indexes that were chosen.

The bond yield indexes used in this study are listed in Table 4.1. All of the corporate (utility and industrial) bond holding period returns were obtained from yield averages calculated by Moody's and Salomon Brothers. The eight series of Moody's yields include the top four credit categories (Aaa, Aa, A and Baa) of both industrial and utility bonds. Each series of yields is an average of the yields on ten individual bonds (with few exceptions). As the maturity of a bond shortens, or if for any other reason a bond becomes non-representative of a particular class, another bond, usually with a longer maturity, is substituted. As a result, the average maturity of the series may fluctuate over a narrow range but it does not continuously shorten so that, at a minimum, it is fair to say that the underlying behavior of the Moody's yield average for a given bond type and credit rating is consistent with that of a long maturity bond.

Bonds characterized by different coupon levels, which determine the extent to which they behave more like discount or premium bonds, are represented by Salomon Brothers indexes of Aa utility yields for selected coupon ranges. The typical range of coupon values in each index is about $\frac{1}{4}$ percent. In calculating bond prices, the midpoint of the range was used as the coupon value for the index and is reported in Table 4.1. Since no substitutions were

Table 4.1
Characteristics of
Identification and/Bond Series Used in Study

| Symbol | Type | Maturity (yrs.) | Quality | Coupon | Source |
|---|---|---|---|---|---|
| TREA01 | Treasury | 1 | | | Salomon Bros. |
| TREA02 | Treasury | 2 | | | Salomon Bros. |
| TREA03 | Treasury | 3 | | | Salomon Bros. |
| TREA04 | Treasury | 4 | | | Salomon Bros. |
| TREA05 | Treasury | 5 | | | Salomon Bros. |
| TREA10 | Treasury | 10 | | | Salomon Bros. |
| TREA20 | Treasury | 20 | | | Salomon Bros. |
| TREA30 | Treasury | 30 | | | Salomon Bros. |
| AA2.81 | Utility | | Aa | 2.81 | Salomon Bros. |
| AA3.25 | Utility | | Aa | 3.25 | Salomon Bros. |
| AA3.75 | Utility | | Aa | 3.75 | Salomon Bros. |
| AA4.25 | Utility | | Aa | 4.25 | Salomon Bros. |
| AA4.69 | Utility | | Aa | 4.69 | Salomon Bros. |
| AA5.06 | Utility | | Aa | 5.06 | Salomon Bros. |
| AAAUTL | Utility | | Aaa | | Moody's |
| AAOUTL | Utility | | Aa | | Moody's |
| AOOUTL | Utility | | A | | Moody's |
| BAAUTL | Utility | | Baa | | Moody's |
| AAAIND | Industrial | | Aaa | | Moody's |
| AAOIND | Industrial | | Aa | | Moody's |
| AOOIND | Industrial | | A | | Moody's |
| BAAIND | Industrial | | Baa | | Moody's |

made overtime that materially affected the average maturity of the bonds in each index, the average maturity declined steadily throughout the period, typically from about 28 years to 20 years.[1] The yield and price behavior of each index should not be very sensitive to the change in maturity since at any point during the period a bond corresponding to each index would qualify essentially as a long maturity bond.

For both utility and industrial bonds, it is also assumed that distinctive features such as sinking funds and callability have the same impact on the yield averages over time. Even though some of the bonds in the averages are callable, this feature was unlikely to be an important influence on yield behavior since, for most of the period under study, these bonds were selling usually at substantial discounts. Indexes of high coupon bonds, with coupons of 5½% and above, which might sell at a premium and thus be subject to call, had to be excluded from the study since such bonds did not exist for most of the sample period.

Bond maturity is probably the most important factor affecting the relative price behavior of bonds. On a monthly basis, Salomon Brothers calculates a yield curve for U.S. Treasury bonds and reports the yield levels at several yearly intervals ranging

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1. Richard Johanneson of Salomon Brothers kindly supplied the maturity data for each index that permitted the calculation of the corresponding prices.

from short to long maturities. To capture the term structure (i.e. maturity) effect in bond price behavior, eight maturities ranging from 1 to 30 years were selected for the study. The advantage of obtaining yield data from yield curves is that it is possible to follow yield movements over time for a specific maturity without worrying about specific securities.

But there are several shortcomings as well. The drawing of a yield curve is something of an art requiring frequent subjective judgments about the extent to which a particular bond should be permitted to influence the position of the curve. But the breadth and continuity of the government securities market and the number of outstanding issues, particularly in the short-and intermediate-term areas, means that the yield curve tends to be fairly determinable. Use of yields from a yield curve assumes that, in fact, a bond of the particular maturity under examination exists. This may not be true in many instances but a bond exhibiting approximately the same behavior can be found at a nearby maturity.

A more important assumption required by the yield curve techique regards the coupon on the hypothetical security at each maturity. Since the yield curve is drawn more or less irrespective of security characteristics other than maturity, and

since for any given maturity these characteristics, including the coupon, would change over time, it is necessary to assume a coupon equal to the beginning of month yield when calculating holding period returns. Although this means that in a period of generally rising yields the procedure assumes the existence of essentially current coupon bonds rather than the discount bonds that actually exist, it turns out that the monthly holding period yield is quite insensitive to the coupon assumption. The sensitivity of holding period returns to the coupon assumption is illustrated in Table 4.2. Even for an extremely large hypothetical change in the market yield for a one-month period, the maximum error in holding period return is only 5 percent. Results of the same order of magnitude are obtained for different coupon levels and for different relationships between the coupon level and yield levels. Consequently, assuming a coupon level equal to the beginning of month market yield should have no noticeable impact on subsequent results.

## 4.5 Evaluating the Consequences of Using Bond Yield Indexes

Exhibit 4.1 illustrates the impact on the average coupon and average maturity of the Aaa utility yield index resulting from security substitutions in the bonds comprising the index. An examination of the same characteristics of several other yield indexes indicates that this sample is representative.

Table 4.2

Illustrative Calculation of Error in Holding Period Return Resulting from Assuming a Coupon Different than Actual Coupon

Actual coupon: 5 percent

Assumed coupon: 4 percent

Beginning of month market yield: 4.00 percent

End of month market yield: 5.00 percent

| | Maturity (years) | | |
|---|---|---|---|
| | 1 | 5 | 20 |
| Holding period return using actual coupon (%) | -.55 | -3.90 | -11.67 |
| Holding period return using assumed coupon (%) | -.55 | -3.98 | -12.27 |
| **Percent error** | **0.0** | **2.1** | **5.1** |

Exhibit 4.1

Affects on Average Maturity and Coupon of Changes in Underlying Composition of Aa Utility Index

K&E 1 YEAR BY WEEKS X 180 DIVISIONS KEUFFEL & ESSER CO. 46 3010 MADE IN U.S.A.

In order to minimize the effect of a bond substitution on the holding period return, for the month in which the substitution occurred, the beginning of month price was calculated using the post substitution coupon and maturity values with the pre-substitution market yield, namely the yield at the end of the prior month. This procedure avoids the major errors that would occur as the result of a coupon and/or a maturity change. The only error not eliminated is that the pre-substitution market yield may be slightly different than would have been the case if the yield on the new bond had been available for inclusion in the average.

The sensitivity to a 10 basis point change in market yield of the holding period return as a result of the bond substitutions in the Aa utility index is exhibited in Table 4.3. Since the largest percentage difference in the holding period returns before and after each substitution is only 3.2 percent, it seems safe to assume that the unavoidable bond substitutions will not be a major source of error.

For the several reasons mentioned earlier, it was deemed more practical yet suitable to the purposes of this study to use available series of yield averages for several sets of bonds rather than attempting to collect raw data for individual bonds. It was noted at that time that this procedure implied an assumption that the

Table 4.3

Effect of Bond Substitutions in Aa Utility Index on Holidng Period Returns

| Month of Substitution | Holding Period Return Assuming 10 b.p. Increase in Pre-Substitution Market Yield | | Percentage Difference |
|---|---|---|---|
| | Pre-Substitution Coupon/Maturity | Post-Substitution Coupon/Maturity | |
| 11/62 | -1.506 | -1.524 | 1.2 |
| 5/63 | -1.510 | -1.492 | -1.2 |
| 5/64 | -1.444 | -1.490 | 3.2 |
| 10/65 | -1.432 | -1.468 | 2.5 |
| 8/66 | -1.366 | -1.367 | 0.1 |
| 2/67 | -1.386 | -1.421 | 2.5 |
| 8/67 | -1.351 | -1.376 | 1.9 |
| 11/67 | -1.323 | -1.321 | -0.2 |
| 2/69 | -1.253 | -1.249 | -0.3 |
| 12/69 | -1.116 | -1.100 | -1.4 |

prices (or returns ) of all bonds of one classification and credit rating and with approximately the same maturity and coupon are perfectly correlated. If not, the risk characteristics of individual bonds would be underestimated by using the standard deviation of the index returns. Although sufficient data necessary for calculating correlation coefficients between the returns on individual bonds is unavailable, the general pattern of correlation coefficients among bond index returns reported later in Chapter 5 suggests that a value of 0.75 may not be an unreasonable estimate of the typical inter-bond correlation coefficient. A rough estimate of the amount of error in risk estimation resulting from the lack of perfect correlation may be obtained by recognizing that each index is comprised of ten bonds and by assuming the standard deviations of the returns on the individual bonds are approximately equal and that all the correlation coefficients equal approximately 0.75. Under these assumptions the estimated standard deviation of bond returns (based on the index) is about 88 percent of the assumed true standard deviations. Of course the errors for individual bonds will vary widely from this estimate, but the order of magnitude is not too disturbing. It suggests that some bonds, especially those based on the eight Moody's indexes, may appear more favorably than they should in the portfolio selection process. The affect of this bias on the interpretation of the role of bonds in a portfolio will depend

on whether the bonds most subject to the bias seem to compete more with other bonds or with stocks. The efficient sets found in Chapter 7 will be interpreted in the light of this shortcoming.

Since the bond indexes discussed throughout this Chapter are used as surrogates for individual bonds, the distinction will be dropped; in the remainder of the study they are referred to simply as bonds rather than as sets of bonds.

4.6 Calculating Holding Period Returns on Bonds

Market yields as of the close of business on the last business day of each month are used. There are 97 observations in the sample period for each of the twenty-two bonds.

For the eight bonds derived from Moody's indexes, the coupon and the term to maturity were set equal to the averages of the coupons and maturities of the component issues as they existed on each observation date.

For the bonds of various coupon levels, the midpoint of the coupon range covered by the Salomon Brothers' index was used as the coupon for the related bond. The maturity of the bond representing each coupon level was defined as the average of the maturities for the component issues which were supplied by Richard Johanneson of Salomon Brothers. Since there were no substitutions of component bonds during the sample period, the term to maturity for each bond declines continuously throughout the period.

The maturity of each of the U.S. Treasury bonds was obtained as a consequence of the definition of the bond. As already mentioned, the coupon on each U.S. Treasury bond was set equal to the market yield at the beginning of each month which in turn equals the yield at the end of the previous month.

For each observation, the market yield was converted into a price using the standard bond yield/price formula appropriate to government (actual days/year) and corporate (360 days/year) bonds. The accrued interest as of each observation date was calculated and added to the market price to obtain the total market value of the bond for that date. The monthly holding period returns on a bond were computed by dividing its change in market value in each month by the market value at the beginning of that month. Thus, for each of the twenty-two bonds, there are 96 sequential monthly holding period returns.

## 4.7 Holding Period Returns for Equities

The objective of this study is the examine whether a more active and possibly more extensive investment in fixed-income securities, which in some cases may behave very much like some common stocks, could improve portfolio performance. In order to permit a comparison between bonds and the class called "some common stocks" that will have a sufficiently broad application, it is necessary to avoid a too narrow selection for the latter category. On the other hand, there is no value in taking a completely

random sample of equity securities since it is not argued that bonds generally behave in a manner similar to all equities. With these considerations in mind, the only restrictions placed on the class of equities examined was that it contain generally high quality securities. This was essentially accomplished by choosing sixty-six common stocks that were actively followed as of June 1970 by Brown Bros. Harriman & Co. All of the sample equities were listed on the New York Stock Exchange between July 1962 and June 1970. The computer costs of calculating the composition of optimal portfolios necessitated a limitation on the total size of the security sample. The use of sixty-six stocks along with the twenty-two bonds already specified provided a total sample of eighty-eight securities.

The source of data for the holding period returns was the computer tape of monthly investment relatives prepared by the Chicago Center for Research in Security Prices. These investment relatives have been adjusted to include accrued dividend income and therefore permit the calculation of holding period returns that are directly comparable to those obtained for the fixed-income securities.

Subject to the availability of a complete data record for the sample period on the Chicago tape, the stocks were chosen to be broadly representative of three criteria: the diversification

category as defined by Brown Bros. Harriman & Co., the current yield, and the price/earnings ratio. There are six diversification categories: Consistent High Growth, Consistent Moderate Growth, Emerging Growth, Opportunity, Major Industrial, and Utilities and Banks. A stock is assigned to a particular category according to its market responsiveness as determined by a variety of tests. Since the intent of this study is to examine the behavior of bonds and common stocks under different market conditions, several stocks were chosen from each of the diversification categories in order to protect against using a sample that might have a too narrow range of market sensitivity. As the categories are defined, the choice of several stocks from each category assured the presence of several utility and bank stocks which are believed widely to behave similarly to bonds.

The current yields and price/earnings ratio were calculated as of June 1970. An attempt was made to include some stocks having a high current yield and possibly a low price/earnings ratio as well as others with possibly no dividend payout and a high price/earnings ratio. No effort was made to trace the behavior of these two characteristics during the sample period.

The sample stocks and their characteristics are listed in Table 4.4. The distribution of the sample stocks by diversification category range from six in the Consistent Moderate

Table 4.4

The Sample Equity Securities and Selected Characteristics

| Security | Symbol | Diversification Category[1, 2] | Current Yield[2] | P/E[2] |
|---|---|---|---|---|
| Anaconda | A | V | 7.6 | 5.7 |
| American Cyanamid | ACY | V | 4.6 | 12.9 |
| American Airlines | AMR | IV | 3.2 | 10.9 |
| Ampex Corp. | APX | III | - | 14.7 |
| Allegheny Power | AYP | VI | 6.9 | 9.5 |
| Boeing | BA | V | 2.0 | 13.3 |
| Bristol-Myers | BMY | I | 2.4 | 20.4 |
| Capital Cities Broadcasting | CCB | III | - | 16.0 |
| Control Data | CDA | III | - | 21.0 |
| Central Illinois Pub. Service | CIP | VI | 7.0 | 9.1 |
| CIT Financial | CIT | IV | 5.1 | 10.3 |
| Continental Oil | CLL | V | 6.8 | 7.6 |
| Central & Southwest | CSR | VI | 5.1 | 13.2 |
| Commonwealth Edison | CWE | VI | 6.9 | 10.3 |
| Delta Air Lines | DAL | III | 1.5 | 9.8 |
| Deltona | DLT | III | - | 11.3 |
| Emery Air Freight | EAF | I | 1.8 | 32.7 |
| Eastern Air Lines | EAL | IV | - | 20.0 |
| Eastman Kodak | EK | I | 1.9 | 24.7 |
| First Charter Financial | FCF | IV | - | 12.0 |
| Gen. Telephone & Electronic | GEN | II | 6.3 | 10.9 |
| General Mills | GIS | II | 3.4 | 12.1 |
| Gulf Oil | GO | V | 6.5 | 8.1 |
| Georgia-Pacific | GP | I | 1.9 | 21.5 |
| Gulf States Utilities | GTU | VI | 4.8 | 13.3 |

| Security | Symbol | Diversification Category[1, 2] | Current Yield[2] | P/E[2] |
|---|---|---|---|---|
| Houston Lighting & Power | HOU | VI | 3.2 | 15.1 |
| Int'l Business Machines | IBM | I | 1.8 | 28.8 |
| INA Corp. | INA | IV | 5.2 | 11.3 |
| Int'l Telephone & Telegraph | ITT | I | 2.5 | 13.1 |
| Johnson & Johnson | JNJ | I | 0.7 | 32.4 |
| Kellogg | K | II | 4.5 | 13.8 |
| Kresge | KG | I | 1.1 | 21.0 |
| Kennecott Copper | KN | V | 5.4 | 7.4 |
| Lone Star Gas | LSG | VI | 5.6 | 11.1 |
| McGraw-Hill | MHP | IV | 4.4 | 15.2 |
| Minn. Mining & Mfg. | MMM | I | 1.9 | 25.7 |
| Motorola | MOT | III | 1.1 | 19.3 |
| Merck & Co. | MRK | I | 2.4 | 29.4 |
| Middle South Utilities | MSU | VI | 4.4 | 13.8 |
| Int'l Nickel | N | V | 3.1 | 15.6 |
| Northern Natural Gas | NNG | VI | 6.2 | 10.1 |
| Northern States Power | NSP | VI | 7.0 | 10.0 |
| Pepsi Co. | PEP | II | 2.4 | 16.2 |
| Procter & Gamble | PG | II | 3.0 | 15.9 |
| Perkin-Elmer | PKN | I | - | 21.6 |
| Polaroid | PRD | I | 0.4 | 33.0 |
| Royal Dutch | RD | V | 4.9 | 7.3 |
| Standard Brands | SB | II | 3.8 | 14.5 |
| So. Carolina El. & Gas | SCG | VI | 5.7 | 10.5 |
| Standard Oil of California | SD | V | 6.8 | 7.8 |
| Supermarkets General | SGL | IV | 2.0 | 9.8 |
| Southern Co. | SO | VI | 5.5 | 11.0 |
| Southern Railway | SR | IV | 6.5 | 7.4 |
| Amer. Telephone & Telegraph | T | V | 5.5 | 10.9 |

| Security | Symbol | Diversification Category[1,2] | Current Yield[2] | P/E[2] |
|---|---|---|---|---|
| Taft Broadcasting | TFB | III | 3.3 | 8.2 |
| Trans World Airlines | TWA | IV | - | - |
| Texaco | TX | V | 6.2 | 9.0 |
| Texas Instruments | TXN | I | 0.8 | 27.4 |
| United Aircraft | UA | V | 5.0 | 7.2 |
| UAL, Inc. | UAL | IV | 5.3 | 10.9 |
| Union Oil of California | UCL | V | 5.9 | 8.3 |
| Union Pacific | UP | IV | 5.7 | 9.0 |
| U.S. Gypsum | USG | V | 6.2 | 16.8 |
| Western Bancorp. | WBC | VI | 3.5 | 12.5 |
| Winn-Dixie Stores | WIN | IV | 5.8 | 12.4 |
| Xerox | XRX | I | 0.7 | 33.8 |



1. Diversification categories as defined by Brown Bros. Harriman & Co.:
   - I. Consistent High Growth
   - II. Consistent Moderate Growth
   - III. Emerging Growth
   - IV. Opportunity
   - V. Major Industrials
   - VI. Utilities & Banks

2. Classification, current yield, and P/E are all as of June 1970. The P/E is based on 1970 estimated earnings.

Growth group to fourteen in the Consistent High Growth group. The current yields range from zero to 7.6 percent and the price/earnings ratios range from zero (for a firm with an expected loss for 1970) to 33.8.

It is believed that the sample of 66 stocks includes many of those held by the typical institutional investor. There appears to be no reason to believe that the composition of the stock sample would affect materially the general conclusions obtained in the analysis of optimal portfolios in Chapter 7.

## Chapter 5

## Comparative Analysis of the Monthly Holding Period Returns on Fixed-Income and Equity Securities

Before proceeding to the modeling stage, the monthly holding period returns for the security sample will be examined in this Chapter in order to evaluate the apparent risk/return character of the various types of securities. Presumably perceptions of these characteristics of the individual securities form part of the basis for traditional portfolio decisions. The shortcoming of the traditional approach in its simplest form, however, is that it fails to evaluate rigorously each security in a portfolio context, thus overlooking the interactions among securities that are specifically accounted for in this study. In particular, the averages and standard deviations of returns of the various securities and the amount of overlap in behavior between bonds and stocks will be examined. The extent of overlap in investment characteristics between the two major classes of securities found at this stage of the analysis may establish some basis for forming tentative conclusions regarding the role of bonds in mixed portfolios.

### 5.1 Comparative Behavior of the Bond and Stock Markets

The relative behavior of the broad market sectors may be represented by the returns on indexes appropriate to each sector. In Chapter 6, various market indexes are examined for possible use as independent variables in the regression equations

of the securities market model. Three indexes are selected in that Chapter for subsequent use: the Standard and Poor's Stock Price Index of 425 industrial stocks adjusted to include dividend income (SP1), the total return on Aa utility bonds (AAOUTL), and the total return on five-year U.S. Treasury bonds (TREA05). The criterion by which these particular indexes are selected will be described in full detail in the following chapter. Each of the three major groups of securities comprising the sample -- common stocks, long-term bonds and short to intermediate term U.S. Treasury bonds--is covered by one of these indexes. (Note that the indexes for the corporate and U.S. Treasury bond markets are the return on the Aa utility and five-year U.S. Treasury bonds which also form a part of the security sample.)

During the period July 1962 to July 1970, the monthly total return on the S&P stock index averaged 0.35 percent. The U.S. Treasury index of monthly total returns averaged 0.24 percent and that for corporate bonds averaged - 0.14 percent. The data are reported in Table 5.1. The mean returns reflect the generally bullish character of the stock market during the period as well as the relatively superior total return performance of the short term compared to the long term bond market.

It is generally recognized that equity investments are more risky than bonds. The standard deviations of the total returns for the common stock, corporate bond, and U.S. Treasury bond

Table 5.1

Means and Standard Deviations of Total Returns for Market Indexes

| | | Full period 7/62 - 6/70 | First half 7/62 - 6/66 | Second half 7/66 - 6/70 |
|---|---|---|---|---|
| **Stock market (SP1)** | Mean | 0.35 | 0.88 | -0.17 |
| | Std. Dev. | 3.63 | 2.88 | 4.19 |
| **Corporate bond market (AAOUTL)** | Mean | -0.14 | 0.13 | -.41 |
| | Std. Dev. | 1.75 | 0.67 | 2.35 |
| **U.S. Treasury bond market (TREA05)** | Mean | 0.24 | 0.21 | .27 |
| | Std. Dev. | 1.06 | 0.40 | 1.44 |

sectors were 3.63, 1.75, and 1.06 percent, respectively. Stock returns, therefore, generally span a range about twice as broad as the returns for corporate bonds and more than three times the range for intermediate term U. S. Treasury bonds. The greater volatility of the corporate bond market relative to the U.S. Treasury bond market principally demonstrates the increased riskiness of longer maturity issues. It is interesting to note here that in return for more than three times as much volatility or risk, stock market performance was only about 50 percent greater than that in the intermediate term U.S. Treasury bond market.

These statistical measures of total return behavior covering the entire eight-year period, however, obscure the significant changes in market patterns which occurred during the period. The first half of the decade of the 60's was characterized by full employment and very low rates of inflation. A primary object of monetary policy was to maintain stable capital markets through actions focussed on interest rates. Rapid growth in economic output was accompanied by a bullish stock market but by little change in interest rates. Under such conditions, the total return on bonds would not be much different than the yield-to-maturity.

Circumstances changed in the latter half of the decade. The buildup for the war in Vietnam was accompanied by rising inflation. In an effort to maintain efficient control of economic growth, the scope of monetary policy was broadened to include

more attention to monetary aggregates, such as bank reserves and the money supply, implying relatively less control over interest rate movements. In such an atmosphere, as might be expected, bond yields tended to rise to compensate for inflation and to fluctuate over a wider range around the trend. Rising bond yields, of course, implied lower and even negative total returns.

The effects of these changing forces on the security markets are apparent in a comparison of statistical measures, reported in Table 5.1, for the first half with those for the second half of the sample period. The stock market shifted in performance from a period of substantial average total returns to one of slightly negative returns. Long term corporate bonds produced modest average returns in the first half of the period but, during the following four years of accelerating inflation and declining bond prices, significantly negative total returns resulted. Shorter term U.S. Treasury bonds fared much better; in fact, total returns were slightly higher during the latter half of the period.

The latter half of the sample period was a more risky period for investment in each of the market sectors than the first half. The standard deviation of returns in the stock market increased modestly. In contrast, the standard deviations of returns for both the corporate and U.S. Treasury bond markets in the second half of

the period increased about four-fold from the quite stable behavior of the first half. It has been generally recognized that the volatility of prices in the stock market is the source of investment opportunity, particularly for carefully selected securities. The significant increase in the volatility of bond returns relative to that of stock returns thus would imply that the opportunity for improved total return performance through careful portfolio management was relatively greater in recent years and that more attention to the bond holdings of a portfolio was called for. To the extent that the bond markets exhibit greater return volatility, bonds presumably gain importance in their potential contribution to overall portfolio performance.

5.2 Average Returns and Standard Deviations for Bonds

The average total returns and the standard deviations for the individual securities in the sample are presented in Table 5.2. The data confirm several generally perceived behavior characteristics of bonds. In a period of generally declining prices, shorter maturity obligations tend to produce higher total returns. For the period as a whole and for each of the sub-periods, the total returns on U.S. Treasury bonds decline uniformly with increasing maturity. The highest yielding fixed-income security over the eight-year period was the shortest maturity (one-year) U.S. Treasury bond. (A three month U.S. Treasury bill presumably would have had an even

TABLE 5.2

Means and Standard Deviations of Total Returns for Sample Securities

| Security Symbol | | Full Period 7/62 - 6/70 | First Half 7/62 - 6/66 | Second Half 7/66 - 6/70 |
|---|---|---|---|---|
| U.S. Treasury Bonds | | | | |
| TREA01 | Mean | 0.36 | 0.28 | 0.45 |
| | Std. Dev. | 0.27 | 0.12 | 0.35 |
| TREA02 | Mean | 0.33 | 0.26 | 0.40 |
| | Std. Dev. | 0.53 | 0.23 | 0.71 |
| TREA03 | Mean | 0.31 | 0.24 | 0.38 |
| | Std. Dev. | 0.77 | 0.29 | 1.05 |
| TREA04 | Mean | 0.27 | 0.22 | 0.31 |
| | Std. Dev. | 0.92 | 0.35 | 1.25 |
| TREA05 | Mean | 0.24 | 0.21 | 0.25 |
| | Std. Dev. | 1.06 | 0.40 | 1.44 |
| TREA10 | Mean | 0.14 | 0.19 | 0.08 |
| | Std. Dev. | 1.42 | 0.61 | 1.92 |
| TREA20 | Mean | 0.03 | 0.15 | -0.09 |
| | Std. Dev. | 1.81 | 0.71 | 2.46 |
| TREA30 | Mean | -0.03 | 0.13 | -0.18 |
| | Std. Dev. | 1.97 | 0.84 | 2.66 |
| Corporate Bonds | | | | |
| AAAIND | Mean | -0.05 | 0.17 | -0.26 |
| | Std. Dev. | 1.32 | 0.47 | 1.78 |
| AAOIND | Mean | -0.07 | 0.17 | -0.30 |
| | Std. Dev. | 1.23 | 0.49 | 1.64 |

(continued)

| | | Full Period 7/62 - 6/70 | First Half 7/62 - 6/66 | Second Half 7/66 - 6/70 |
|---|---|---|---|---|
| AOOIND | Mean | -0.07 | 0.17 | -0.31 |
| | Std. Dev. | 1.25 | 0.52 | 1.65 |
| BAAIND | Mean | 0.04 | 0.27 | -0.19 |
| | Std. Dev. | 1.35 | 0.57 | 1.80 |
| AAAUTL | Mean | -0.16 | 0.11 | -0.42 |
| | Std. Dev. | 1.75 | 0.67 | 2.35 |
| AAOUTL | Mean | -0.14 | 0.13 | -0.14 |
| | Std. Dev. | 1.75 | 0.67 | 2.35 |
| AOOUTL | Mean | -0.14 | 0.11 | -0.39 |
| | Std. Dev. | 1.87 | 0.83 | 2.49 |
| BAAUTL | Mean | -0.10 | 0.18 | -0.38 |
| | Std. Dev. | 1.57 | 0.69 | 2.08 |
| AA2.81 | Mean | -0.04 | 0.15 | -0.23 |
| | Std. Dev. | 1.79 | 0.76 | 2.40 |
| AA3.25 | Mean | -0.08 | 0.12 | -0.27 |
| | Std. Dev. | 2.16 | 0.82 | 2.93 |
| AA3.75 | Mean | -0.06 | 0.14 | -0.25 |
| | Std. Dev. | 1.88 | 0.74 | 2.54 |
| AA4.25 | Mean | -0.10 | 0.12 | -0.31 |
| | Std. Dev. | 1.92 | 0.71 | 2.61 |
| AA4.69 | Mean | -0.05 | 0.17 | -0.25 |
| | Std. Dev. | 1.86 | 0.57 | 2.55 |
| AA5.06 | Mean | 0.01 | 0.24 | -0.21 |
| | Std. Dev. | 1.60 | 0.42 | 2.21 |
| **Common Stocks** | | | | |
| A | Mean | 1.00 | 2.30 | -0.28 |
| | Std. Dev. | 8.27 | 7.65 | 8.73 |

(continued)

| | | Full Period 7/62 - 6/70 | First Half 7/62 - 6/66 | Second Half 7/66 - 6/70 |
|---|---|---|---|---|
| ACY | Mean | 0.82 | 1.65 | -0.01 |
| | Std. Dev. | 6.49 | 5.64 | 7.19 |
| AMR | Mean | 1.55 | 3.86 | -0.71 |
| | Std. Dev. | 10.94 | 8.12 | 12.81 |
| APX | Mean | 0.73 | 1.23 | 0.24 |
| | Std. Dev. | 10.80 | 10.27 | 11.39 |
| AYP | Mean | 0.23 | 0.52 | -0.06 |
| | Std. Dev. | 4.81 | 4.03 | 5.50 |
| BA | Mean | 0.26 | 3.40 | -2.82 |
| | Std. Dev. | 10.54 | 9.24 | 10.92 |
| BMY | Mean | 1.32 | 2.17 | 0.48 |
| | Std. Dev. | 6.29 | 5.14 | 7.20 |
| CCB | Mean | 2.28 | 3.39 | 1.20 |
| | Std. Dev. | 9.25 | 6.83 | 11.10 |
| CDA | Mean | -0.25 | -0.34 | -0.17 |
| | Std. Dev. | 8.76 | 3.90 | 11.77 |
| CIP | Mean | 0.20 | 0.43 | -0.03 |
| | Std. Dev. | 5.17 | 4.31 | 5.93 |
| CIT | Mean | 0.88 | -0.20 | 1.93 |
| | Std. Dev. | 6.78 | 3.67 | 8.74 |
| CLL | Mean | 0.29 | 0.86 | -0.26 |
| | Std. Dev. | 5.34 | 4.76 | 5.85 |
| CSR | Mean | 0.45 | 0.64 | 0.27 |
| | Std. Dev. | 5.61 | 3.93 | 6.91 |
| CWE | Mean | 0.06 | 0.65 | -0.51 |
| | Std. Dev. | 4.80 | 3.53 | 5.76 |
| DAL | Mean | 2.77 | 5.82 | -0.21 |
| | Std. Dev. | 9.83 | 8.90 | 9.86 |

(continued)

| | | Full Period 7/62 - 6/70 | First Half 7/62 - 6/66 | Second Half 7/66 - 6/70 |
|---|---|---|---|---|
| DLT | Mean | 1.76 | -0.32 | 3.80 |
| | Std. Dev. | 14.12 | 7.74 | 18.20 |
| EAF | Mean | 2.35 | 4.09 | 0.64 |
| | Std. Dev. | 9.15 | 8.18 | 9.79 |
| EAL | Mean | 1.34 | 4.61 | -1.87 |
| | Std. Dev. | 13.41 | 12.21 | 13.88 |
| EK | Mean | 1.36 | 2.48 | 0.25 |
| | Std. Dev. | 5.27 | 4.79 | 5.53 |
| FCF | Mean | 1.41 | -1.14 | 3.90 |
| | Std. Dev. | 14.17 | 10.34 | 16.85 |
| GEN | Mean | 0.53 | 1.94 | -0.86 |
| | Std. Dev. | 6.02 | 4.66 | 6.88 |
| GIS | Mean | 1.18 | 2.33 | 0.04 |
| | Std. Dev. | 5.37 | 4.56 | 5.89 |
| GO | Mean | 0.73 | 1.14 | 0.33 |
| | Std. Dev. | 5.33 | 4.78 | 5.85 |
| GP | Mean | 2.15 | 1.64 | 2.64 |
| | Std. Dev. | 7.56 | 6.28 | 8.67 |
| GTU | Mean | 0.52 | 1.12 | -0.07 |
| | Std. Dev. | 6.35 | 4.48 | 7.76 |
| HOU | Mean | 0.45 | 1.03 | -0.11 |
| | Std. Dev. | 5.38 | 4.37 | 6.21 |
| IBM | Mean | 1.20 | 1.35 | 1.04 |
| | Std. Dev. | 5.58 | 5.23 | 5.95 |
| INA | Mean | 0.01 | 0.08 | -0.07 |
| | Std. Dev. | 7.58 | 4.68 | 9.67 |
| ITT | Mean | 0.93 | 1.61 | 0.27 |
| | Std. Dev. | 6.87 | 6.18 | 7.49 |

(continued)

| | | Full Period 7/62 - 6/70 | First Half 7/62 - 6/66 | Second Half 7/66 - 6/70 |
|---|---|---|---|---|
| JNJ | Mean | 2.12 | 2.24 | 2.00 |
| | Std. Dev. | 6.52 | 5.85 | 7.18 |
| K | Mean | 0.79 | 1.02 | 0.56 |
| | Std. Dev. | 5.74 | 6.22 | 5.29 |
| KG | Mean | 2.72 | 2.98 | 2.47 |
| | Std. Dev. | 7.54 | 7.48 | 7.66 |
| KN | Mean | 1.34 | 1.51 | 1.17 |
| | Std. Dev. | 7.15 | 5.48 | 8.52 |
| LSG | Mean | 0.35 | 0.36 | 0.34 |
| | Std. Dev. | 5.82 | 3.27 | 7.57 |
| MHP | Mean | 0.54 | 2.63 | -1.51 |
| | Std. Dev. | 7.82 | 5.31 | 9.28 |
| MMM | Mean | 0.61 | 1.09 | 0.13 |
| | Std. Dev. | 6.01 | 5.80 | 6.23 |
| MOT | Mean | 1.18 | 3.56 | -1.15 |
| | Std. Dev. | 10.48 | 8.38 | 11.82 |
| MRK | Mean | 1.68 | 2.81 | 0.57 |
| | Std. Dev. | 5.81 | 5.93 | 5.52 |
| MSU | Mean | 0.74 | 1.27 | 0.22 |
| | Std. Dev. | 6.38 | 4.11 | 8.02 |
| N | Mean | 0.86 | 1.13 | 0.59 |
| | Std. Dev. | 5.70 | 5.52 | 5.92 |
| NNG | Mean | 0.60 | 0.80 | 0.41 |
| | Std. Dev. | 5.48 | 5.22 | 5.76 |
| NSP | Mean | 0.09 | 0.33 | -0.15 |
| | Std. Dev. | 3.79 | 2.95 | 4.47 |
| PEP | Mean | 1.24 | 1.19 | 1.29 |
| | Std. Dev. | 6.33 | 6.69 | 6.02 |

(continued)

| | | Full Period 7/62 - 6/70 | First Half 7/62 - 6/66 | Second Half 7/66 - 6/70 |
|---|---|---|---|---|
| PG | Mean | 0.63 | 0.09 | 1.16 |
| | Std. Dev. | 4.68 | 3.93 | 5.31 |
| PKN | Mean | 1.41 | 2.14 | 0.69 |
| | Std. Dev. | 8.85 | 7.70 | 9.87 |
| PRD | Mean | 2.00 | 4.13 | -0.08 |
| | Std. Dev. | 9.85 | 9.28 | 10.04 |
| RD | Mean | 0.94 | 0.88 | 1.00 |
| | Std. Dev. | 5.50 | 4.60 | 6.31 |
| SB | Mean | 0.82 | 0.51 | 1.13 |
| | Std. Dev. | 5.44 | 4.21 | 6.46 |
| SCG | Mean | 0.32 | 0.86 | -0.21 |
| | Std. Dev. | 5.64 | 4.39 | 6.64 |
| SD | Mean | 0.27 | 0.80 | -0.24 |
| | Std. Dev. | 4.82 | 4.20 | 5.36 |
| SGL | Mean | 1.66 | 2.96 | 0.38 |
| | Std. Dev. | 11.15 | 10.69 | 11.55 |
| SO | Mean | 0.21 | 0.83 | -0.40 |
| | Std. Dev. | 5.68 | 3.96 | 6.96 |
| SR | Mean | 0.43 | 0.48 | 0.38 |
| | Std. Dev. | 6.07 | 5.05 | 6.98 |
| T | Mean | 0.07 | 0.27 | -0.13 |
| | Std. Dev. | 3.77 | 3.00 | 4.41 |
| TFB | Mean | 1.40 | 3.13 | -0.29 |
| | Std. Dev. | 10.13 | 9.06 | 10.91 |
| TWA | Mean | 1.24 | 5.94 | -3.36 |
| | Std. Dev. | 12.93 | 12.07 | 12.17 |
| TX | Mean | 0.44 | 1.05 | -0.15 |
| | Std. Dev. | 5.04 | 4.15 | 5.75 |

(continued)

| | | Full Period 7/62 - 6/70 | First Half 7/62 - 6/66 | Second Half 7/66 - 6/70 |
|---|---|---|---|---|
| TXN | Mean | 1.58 | 3.71 | -0.50 |
| | Std. Dev. | 9.00 | 9.31 | 8.26 |
| UA | Mean | 0.52 | 2.86 | -1.78 |
| | Std. Dev. | 9.04 | 7.47 | 9.90 |
| UAL | Mean | 0.95 | 4.24 | -2.28 |
| | Std. Dev. | 10.93 | 8.51 | 12.10 |
| UCL | Mean | 0.94 | 2.93 | -1.01 |
| | Std. Dev. | 6.95 | 5.16 | 7.93 |
| UP | Mean | 0.50 | 0.90 | 0.10 |
| | Std. Dev. | 5.75 | 4.79 | 6.59 |
| USG | Mean | 0.11 | -0.20 | 0.41 |
| | Std. Dev. | 6.73 | 4.35 | 8.48 |
| WBC | Mean | 0.67 | 0.59 | 0.74 |
| | Std. Dev. | 6.54 | 5.42 | 7.53 |
| WIN | Mean | 0.44 | 0.71 | 0.17 |
| | Std. Dev. | 4.47 | 4.72 | 4.25 |
| XRX | Mean | 2.62 | 5.16 | 0.14 |
| | Std. Dev. | 9.34 | 9.73 | 8.32 |

greater average total return had it been included in the sample.) In fact, the one-year U.S. Treasury bond produced a greater average total return than an investment in the S&P stock index. The short term U.S. Treasury security thus would appear to be a quite attractive investment alternative, especially when the much lower investment risk is considered.

The price and, hence, the total return volatility of bonds generally increases with maturity. For the period as a whole, the standard deviation of total returns increased uniformly from .27 percent on one-year U.S. Treasury bonds to 1.97 percent on thirty-year U.S. Treasury bonds. The pattern was the same for each of the sub-periods with standard deviations in the latter half being generally three to four times as large as those in the first half for each maturity.

Industrial bonds were more attractive for investment purposes than comparable quality utility bonds. In each quality category from Aaa to Baa, the average total return on industrial bonds for the entire period was greater (in most cases, less negative) than for utility bonds and the standard deviation of returns was less. The relative attractiveness of industrial bonds with respect to both average total return and standard deviation increased in the second half of the period compared to the first half.

The patterns of behavior among quality categories is less uniform. Exhibits 5.1 and 5.2 may be of assistance in deciphering the patterns. For utility bonds, the average total return increases with decreasing quality level. The standard deviation of returns also increases as the quality level declines with the noteworthy exception of the Baa bond which has a standard deviation comparable to the Aaa bond. In contrast, the average total return on industrial bonds tends to decline with lower quality levels. Again the exception is the Baa bond which had the highest average total return of the four quality categories. Furthermore, the standard deviation of returns on industrial bonds was higher for both the Aaa and Baa categories than for either of the intermediate grades.

A portion of the exceptional behavior for utility and industrial bonds of the average total returns and standard deviations with respect to quality level may be due to the condition of generally declining bond prices during the sample period. It seems more unlikely, however, that the observed behavior is a reflection of the limitations on the applicability of the quality level distinctions. Moody's bond ratings are primarily intended to rank credit worthiness, essentially a fundamental, or issuer-related, factor. The statistical measures of average total return and standard deviation more appropriately relate to market, or technical conditions. Thus, even though market participants commonly think of Moody's ratings

Exhibit 5.1

Average and Standard Deviation of
Raw Total Returns on Utility Bonds

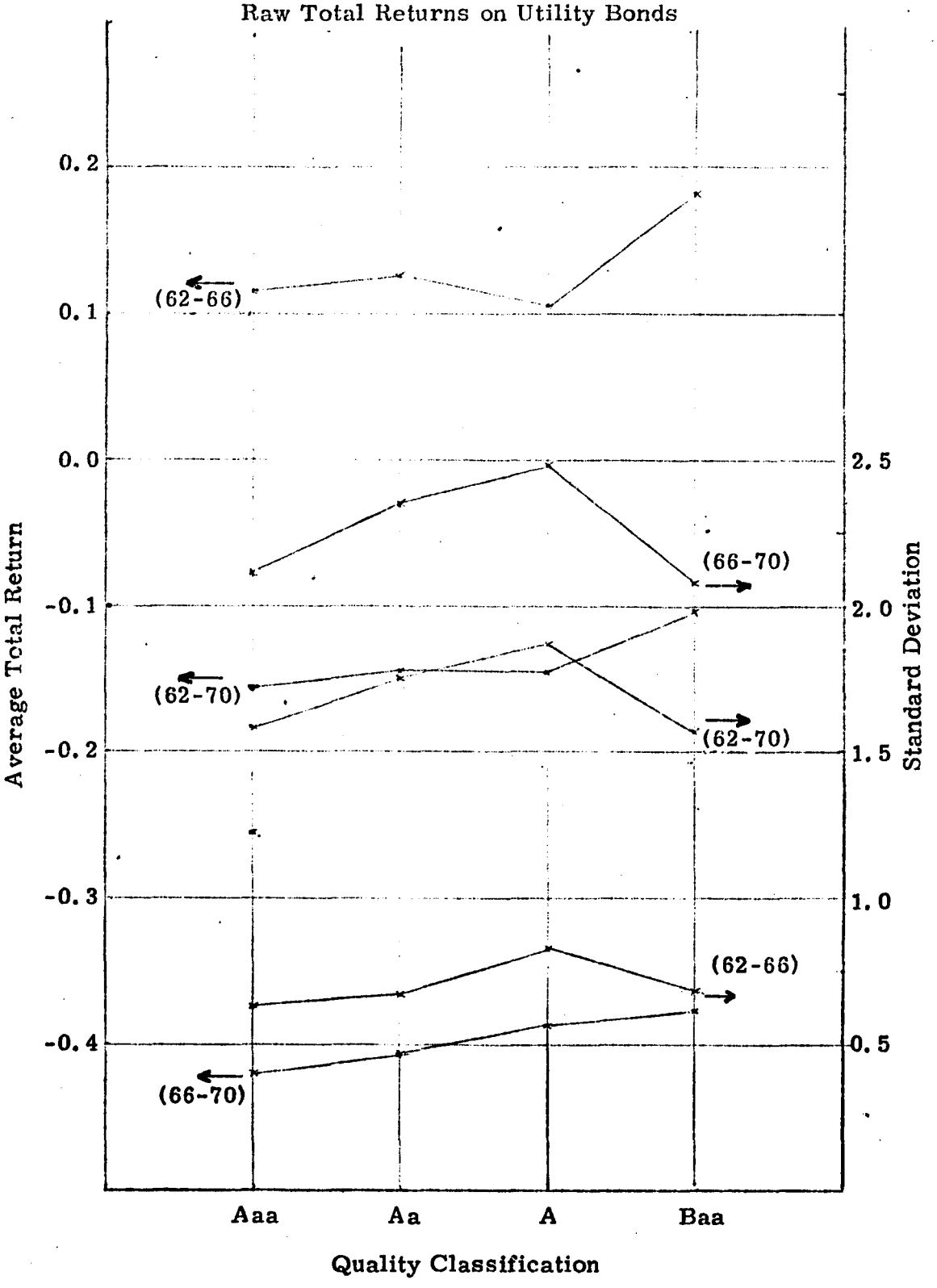
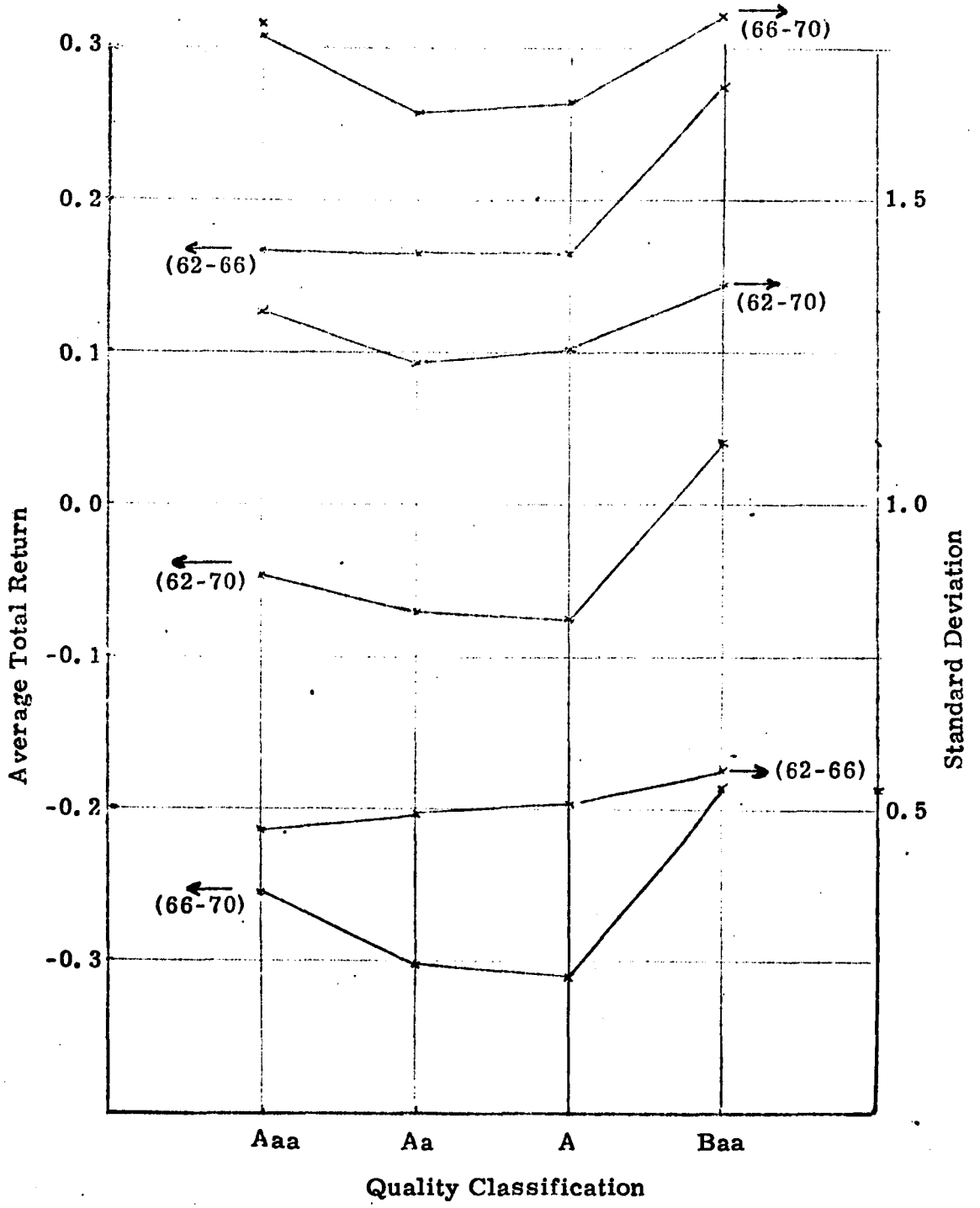


Exhibit 5.2

Average and Standard Deviation of
Raw Total Returns on Industrial Bonds



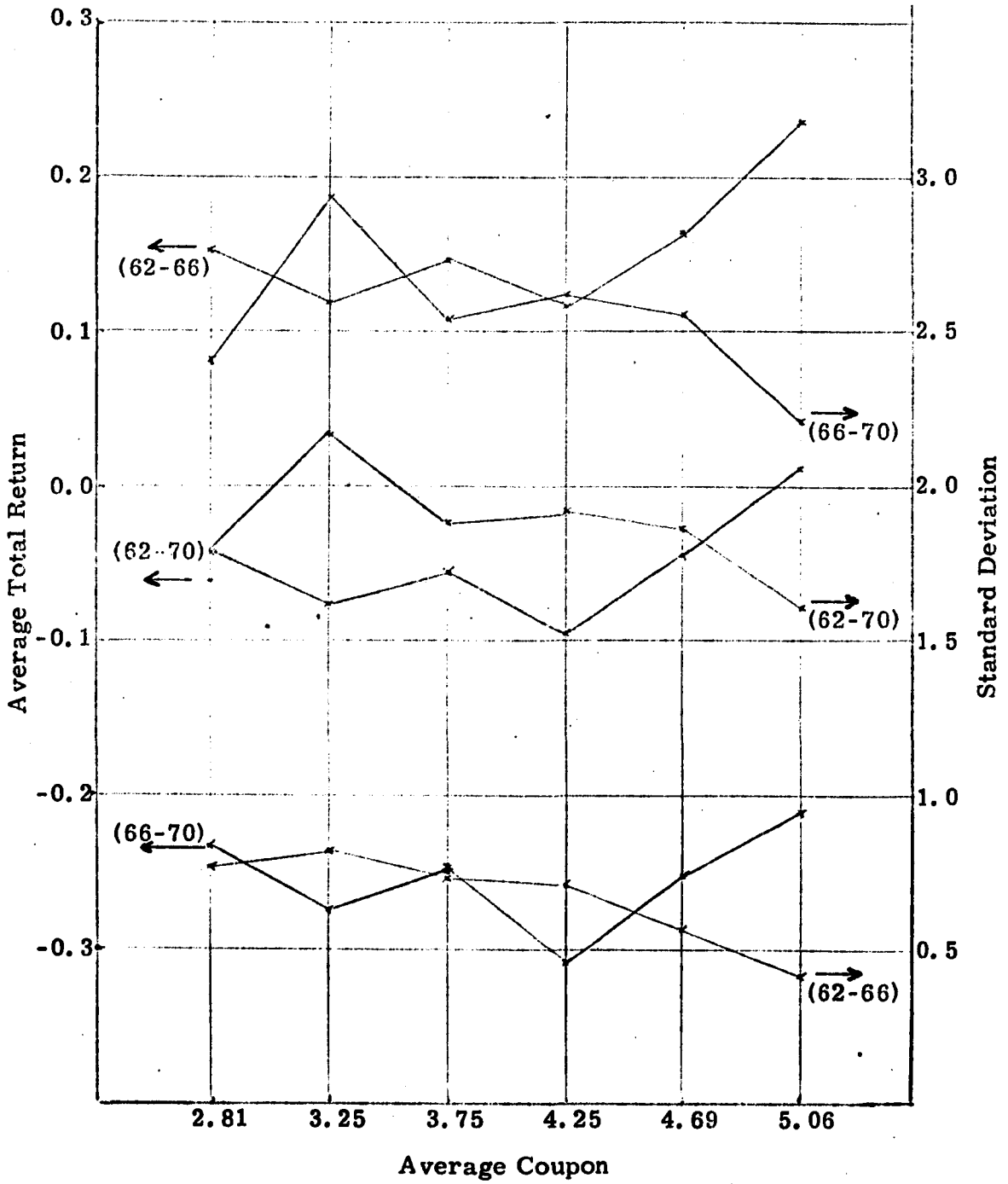
as having some market behavior implications in addition to the credit meaning, a consistent relationship should not be expected. The divergence between market related statistics and credit measures suggests that a more thorough analysis than simple reference to relative credit ratings is necessary for actively managed portfolios containing fixed-income securities.

The mathematical relationship between a bond's yield and its price implies that for a given change in yield the price change will be greater for bonds with lower coupons and greatest for the so-called discount bonds which are priced substantially below par. Bonds representing six different average coupon levels ranging from 2.81 percent to 5.06 percent were examined in this study. During the early part of the sample period, only those bonds at the lower end of this range would have been likely to behave like discount bonds with little likelihood that any call privilege would have been exercised. Toward the end of the sample period, after interest rates had risen significantly, the bonds for all of the selected coupon levels should behave like discount bonds, although to varying degrees.

The statistical behavior of the returns on discount bonds is summarized in Exhibit 5.3. For the most part it is difficult to distinguish the return and coupon patterns between the two sub-periods. High coupon bonds generate the highest average total returns

Exhibit 5.3

Average and Standard Deviation of
Raw Total Returns on Discount Bonds



but the deep discount bonds had only slightly lower average total returns. The intermediate range coupon bonds fared the worst. As might be expected, the standard deviations tend to decrease for higher coupon bonds. The significant exception is the unusually low standard deviation for the 2.81 percent average coupon bond.

The high average total return and low standard deviation for the lowest coupon bond may have resulted from the increasingly poor market for such bonds. As prices declined further and further on the deep discount bonds, institutional holders were burdened with greater book losses which tended to discourage trading these bonds. The bonds thus became "locked away". As a consequence, the available yield data on deep discount bonds do not reflect a very broad market. The implication is that for a portfolio which is traded actively and requires marketability the intermediate discount bonds may be the most effective vehicle for obtaining the characteristics, specifically the volatility, normally attributed to the deep discount bonds.

### 5.3 Average Returns and Standard Deviations for Equities

It is not the purpose of this study to analyze the market behavior of individual equity securities. Many other studies have been devoted to the subject. A few observations about the general behavior of the sample stocks, however, may add perspective to

the interpretation of bond behavior. Only one stock (CDA) had a negative average total return for the eight-year period and only fourteen had average total returns as low as the highest returning bond (TREA01). The mean of the average total returns for the 66 sample equity securities was 0.96 percent per month, substantially in excess of the broader S&P index which was 0.35 percent per month. The average of the standard deviations for the 66 stocks was 7.35 percent. (This figure should not be compared with the standard deviation of the return on the S&P index which is the standard deviation of an average rather than an average of standard deviations.)

For purposes of subsequent analysis, it will be helpful to draw some broad distinctions among the types of stocks. Since this study focuses on the bond-like characteristics of securities and since it is commonly believed that utility stocks exhibit bond-like behavior, the sample of stocks may be divided into three categories: utility stocks, utility-type stocks, and non-utility stocks. Although no objective criterion has been used for the assignment of each stock to a particular category, the distinction in most cases was clear. Utilities are defined to include firms in the power supply and communications industries. The utility-type stock category is comprised of all industries subject to a significant amount of government regulation: viz., airlines, broadcasting, commercial banking, finance companies, insurance,

oil, freight, and railroads. The remaining stocks have been assigned to the non-utility category. The resulting allocation of the sample stocks is shown in Table 5.3.

The means of the average total returns decrease from the non-utility stock category to the utility stock category. The means of the average total returns are as follows: non-utility stocks, 1.17 percent; utility-type stocks, 1.03 percent; and utility stocks, 0.35 percent. Although the mean of the average total returns for utility stocks falls within the region of typical bond returns, the average of the standard deviations on these stocks at 5.31 percent is substantially higher than the standard deviation for any of the bonds. The averages of the standard deviations for the utility-type and non-utility stocks were 8.20 percent and 7.60 percent, respectively. The lack of a material difference between the mean returns and average standard deviations for the utility-type and non-utility stocks groups suggests that this distinction may not be very important. The distinction nonetheless will be maintained to see if it is substantiated by subsequent analysis.

## 5.4 Interrelationships Among Bond and Stock Returns

An examination of the return correlation coefficients for the sample securities reveals the degree of interaction between

Table 5.3

Assignment of Equity Securities by Utility Category

| | Non-Utility (32) | Utility-type (20) | Utility (14) |
|---|---|---|---|
| | A | AMR | AYP |
| | ACY | CCB | CIP |
| | APX | CIT | CSR |
| | BA | CLL | CWE |
| | BMY | DAL | GEN |
| | CDA | EAF | GTU |
| | DLT | EAL | HOU |
| | EK | FCF | LSG |
| | GIS | GO | MSU |
| | GP | INA | NNG |
| | IBM | RD | NSP |
| | ITT | SD | SCG |
| | JNJ | SR | SO |
| | K | TFB | T |
| | KG | TWA | |
| | KN | TX | |
| | MHP | UAL | |
| | MMM | UCL | |
| | MOT | UP | |
| | MRK | WBC | |
| | N | | |
| | PEP | | |
| | PG | | |
| | PKN | | |
| | PRO | | |
| | SB | | |
| | SGL | | |
| | TXN | | |
| | UA | | |
| | USG | | |
| | WIN | | |
| | XRX | | |
| Average total return (%) | 1.17 | 1.03 | 0.35 |
| Average of Standard Deviations (%) | 7.60 | 8.20 | 5.31 |

securities in different sectors of the market and, in general, between the sectors themselves. In Table 5.4 the distributions of correlation coefficients among bonds, among stocks, and between bonds and stocks for the entire sample period and for each half of the period are shown.

Nearly all the sample stocks are positively correlated with one another. The modal correlation coefficient range for the stocks is 0.30-.35 and a few coefficients are as high as 0.75. It is apparent that the aggregate interactions of equity securities changed little in terms of modal behavior between the first and second halves of the sample period except that the breadth of the correlation coefficient distribution narrowed noticeably. The narrower range of correlation coefficients among stocks suggests that in the later years of the sample period it would have been more difficult to efficiently diversify an all-stock portfolio against market risk since there was a greater tendency for stock returns to rise or fall together in about the same fashion.

Bond returns for the entire sample period are much more highly intercorrelated than stock returns. The modal correlation coefficient range is 0.70-0.75 with some bonds being nearly perfectly correlated. Correlation coefficients in excess of 0.60 are primarily those between various U.S. Treasury bonds and between various corporate bonds. A less significant, secondary

TABLE 5.4

Interaction of Security Classes as Shown by Distribution of Security Correlation Coefficients

| Correlation Coefficient Range | | Bonds with Bonds 7/62-6/66 | 7/66-6/70 | 7/62-6/70 |
|---|---|---|---|---|
| -.35 | -.30 | 0.4% | 0.0% | 0.0% |
| -.30 | -.25 | 0.4 | 0.0 | 0.0 |
| -.25 | -.20 | 0.4 | 0.0 | 0.0 |
| -.20 | -.15 | 0.0 | 0.0 | 0.0 |
| -.15 | -.10 | 0.9 | 0.0 | 0.0 |
| -.10 | -.05 | 0.9 | 0.0 | 0.0 |
| -.05 | .00 | 1.3 | 0.0 | 0.0 |
| .00 | .05 | 2.2 | 0.0 | 0.0 |
| .05 | .10 | 3.9 | 0.9 | 0.9 |
| .10 | .15 | 2.6 | 0.9 | 0.9 |
| .15 | .20 | 2.2 | 1.3 | 1.7 |
| .20 | .25 | 3.9 | 1.3 | 0.4 |
| .25 | .30 | 4.8 | 2.6 | 3.9 |
| .30 | .35 | 3.9 | 2.2 | 2.6 |
| .35 | .40 | 5.6 | 3.9 | 4.8 |
| .40 | .45 | 7.8 | 6.5 | 6.1 |
| .45 | .50 | 10.4 | 5.2 | 8.2 |
| .50 | .55 | 7.4 | 7.4 | 3.9 |
| .55 | .60 | 5.2 | 5.6 | 5.6 |
| .60 | .65 | 3.5 | 6.1 | 6.5 |
| .65 | .70 | 7.4 | 6.5 | 8.7 |
| .70 | .75 | 6.5 | 10.4 | 11.3 |
| .75 | .80 | 3.9 | 12.6 | 10.8 |
| .80 | .85 | 6.1 | 10.0 | 8.2 |
| .85 | .90 | 3.0 | 6.9 | 6.9 |
| .90 | .95 | 3.5 | 6.1 | 5.2 |
| .95 | 1.00 | 2.2 | 3.9 | 3.5 |
| | | 100.0% | 100.0% | 100.0% |

TABLE 5.4 (continued)

| Correlation Coefficient Range | | Bonds with Stocks 7/62-6/66 | 7/66-6/70 | 7/62-6/70 |
|---|---|---|---|---|
| -.35 | -.30 | 0.0% | 0.0% | 0.0% |
| -.30 | -.25 | 0.1 | 0.0 | 0.0 |
| -.25 | -.20 | 0.3 | 0.0 | 0.0 |
| -.20 | -.15 | 1.2 | 0.3 | 0.0 |
| -.15 | -.10 | 2.3 | 0.6 | 0.2 |
| -.10 | -.05 | 3.3 | 2.2 | 1.1 |
| -.05 | .00 | 5.4 | 3.1 | 3.0 |
| .00 | .05 | 7.9 | 7.2 | 7.3 |
| .05 | .10 | 12.8 | 11.6 | 12.3 |
| .10 | .15 | 14.6 | 10.0 | 13.9 |
| .15 | .20 | 14.0 | 11.6 | 16.2 |
| .20 | .25 | 12.4 | 12.7 | 13.8 |
| .25 | .30 | 10.7 | 10.7 | 11.1 |
| .30 | .35 | 7.9 | 9.8 | 7.8 |
| .35 | .40 | 4.5 | 5.5 | 6.5 |
| .40 | .45 | 1.8 | 7.0 | 4.7 |
| .45 | .50 | 0.5 | 4.3 | 1.3 |
| .50 | .55 | 0.0 | 1.9 | 0.6 |
| .55 | .60 | 0.0 | 1.2 | 0.1 |
| .60 | .65 | 0.0 | 0.3 | 0.0 |
| .65 | .70 | 0.0 | 0.1 | 0.0 |
| .70 | .75 | 0.0 | 0.0 | 0.0 |
| .75 | .80 | 0.0 | 0.0 | 0.0 |
| .80 | .85 | 0.0 | 0.0 | 0.0 |
| .85 | .90 | 0.0 | 0.0 | 0.0 |
| .90 | .95 | 0.0 | 0.0 | 0.0 |
| .95 | 1.00 | 0.0 | 0.0 | 0.0 |
| | | 100.0% | 100.0% | 100.0% |

TABLE 5.4 (continued)

| Correlation Coefficient Range | | Stocks with Stocks 7/62-6/66 | 7/66-6/70 | 7/62-6/70 |
|---|---|---|---|---|
| -.35 | -.30 | 0.0% | 0.0% | 0.0% |
| -.30 | -.25 | 0.2 | 0.0 | 0.0 |
| -.25 | -.20 | 0.4 | 0.0 | 0.0 |
| -.20 | -.15 | 0.5 | 0.0 | 0.0 |
| -.15 | -.10 | 0.7 | 0.0 | 0.0 |
| -.10 | -.05 | 0.9 | 0.2 | 0.0 |
| -.05 | .00 | 1.7 | 0.4 | 0.1 |
| .00 | .05 | 2.8 | 1.1 | 0.8 |
| .05 | .10 | 4.2 | 2.0 | 2.1 |
| .10 | .15 | 6.1 | 4.1 | 3.7 |
| .15 | .20 | 7.9 | 6.3 | 7.0 |
| .20 | .25 | 10.3 | 9.6 | 11.7 |
| .25 | .30 | 11.5 | 13.3 | 14.7 |
| .30 | .35 | 11.6 | 14.8 | 16.3 |
| .35 | .40 | 11.0 | 14.2 | 15.0 |
| .40 | .45 | 11.4 | 10.4 | 11.4 |
| .45 | .50 | 8.2 | 9.6 | 9.6 |
| .50 | .55 | 5.0 | 5.2 | 3.5 |
| .55 | .60 | 3.5 | 4.3 | 2.2 |
| .60 | .65 | 1.1 | 2.0 | 0.8 |
| .65 | .70 | 0.6 | 1.0 | 0.5 |
| .70 | .75 | 0.1 | 0.8 | 0.3 |
| .75 | .80 | 0.1 | 0.5 | 0.0 |
| .80 | .85 | 0.0 | 0.1 | 0.0 |
| .85 | .90 | 0.0 | 0.0 | 0.0 |
| .90 | .95 | 0.0 | 0.0 | 0.0 |
| .95 | 1.00 | 0.0 | 0.0 | 0.0 |
| | | 100.0% | 100.0% | 100.0% |

TABLE 5.4 (continued)

| Correlation Coefficient Range | | Bonds and Stocks 7/62-6/66 | 7/66-6/70 | 7/62-6/70 |
|---|---|---|---|---|
| -.35 | -.30 | 0.1% | 0.0% | 0.0% |
| -.30 | -.25 | 0.2 | 0.0 | 0.0 |
| -.25 | -.20 | 0.3 | 0.0 | 0.0 |
| -.20 | -.15 | 0.7 | 0.1 | 0.0 |
| -.15 | -.10 | 1.3 | 0.2 | 0.1 |
| -.10 | -.05 | 1.8 | 0.9 | 0.4 |
| -.05 | .00 | 3.1 | 1.4 | 1.2 |
| .00 | .05 | 4.7 | 3.3 | 3.3 |
| .05 | .10 | 7.4 | 5.5 | 5.9 |
| .10 | .15 | 9.1 | 6.1 | 7.4 |
| .15 | .20 | 9.9 | 8.0 | 10.2 |
| .20 | .25 | 10.7 | 10.3 | 11.8 |
| .25 | .30 | 10.9 | 11.7 | 12.7 |
| .30 | .35 | 9.7 | 12.2 | 12.2 |
| .35 | .40 | 8.2 | 10.3 | 11.1 |
| .40 | .45 | 7.6 | 8.9 | 8.5 |
| .45 | .50 | 5.4 | 7.3 | 6.4 |
| .50 | .55 | 3.3 | 4.1 | 2.4 |
| .55 | .60 | 2.3 | 3.2 | 1.6 |
| .60 | .65 | 0.8 | 1.6 | 0.9 |
| .65 | .70 | 0.8 | 1.0 | 0.8 |
| .70 | .75 | 0.4 | 1.1 | 0.8 |
| .75 | .80 | 0.3 | 1.0 | 0.7 |
| .80 | .85 | 0.4 | 0.7 | 0.5 |
| .85 | .90 | 0.2 | 0.4 | 0.4 |
| .90 | .95 | 0.2 | 0.4 | 0.3 |
| .95 | 1.00 | 0.1 | 0.2 | 0.2 |
| | | 100.0% | 100.0% | 100.0% |

modal range appears at 0.45-0.50 which includes many of the interactions between the U.S. Treasury and corporate bonds. During the first half of the sample period, this secondary mode was in fact the primary concentration of correlation coefficients, although there was a lesser concentration in the 0.65-0.70 region. This orientation of dominant and secondary modes was reversed in the second half of the period. Except for the disappearance of a few negative correlation coefficients (mainly long term U.S. Treasury bonds with low grade utility bonds) after the first half of the period, the overall range of correlation coefficients did not narrow significantly.

The interactions of bonds with stocks show that the returns of the two security classes tend to move together. The modal correlation coefficient range is a positive 0.15-0.20, only slightly less than that for stocks. The modal range was slightly lower for the first half of the period than for the latter half. The decline in the proportion of negative correlation coefficients over the period suggests that fewer opportunities for "automatic" hedges were available at the end of the period.

For all of the securities taken together, the modal correlation coefficient range is 0.25-0.30. For the sample as a whole, it is clear that the inclusion of bonds along with stocks broadens the scope for portfolio diversification, especially at the high end of the correlation coefficient range but also in the

region where security returns are nearly independent.

On the basis of the analysis performed thus far, it is difficult to draw specific conclusions about the relative role of bonds in a portfolio of mixed securities. Since the likelihood of having a successful portfolio management program is enhanced by adding more securities that behave differently than presently eligible investments, the evidence present in this chapter clearly supports the conclusion that there is a role for bonds. Until the manageable portions of the returns on all the securities are determined in the next chapter, however, it will be impossible to estimate the magnitude of the role played by fixed-income securities.

## Chapter 6

## The Securities Market Model

As discussed in Chapter 3, the criterion for the choice of the securities market model was the minimization of the interdependence among the residual, or error, terms in the regression equations for the returns on each security. This can be accomplished by the proper choice of independent regression variables, or market indexes, and measured by the Chi-square statistic. The only constraint applied in obtaining the optimal securities market model is that the market indexes be held to a number which makes market forecasting operationally practical. It is believed that three or four indexes is about as many as can be used and still obtain reasonable forecasts. A review of the selection process and an analysis of the resulting securities market model will be presented in this Chapter.

### 6.1 Choosing the Market Indexes for the Securities Market Model

Two fundamentally different approaches were considered in identifying possible independent variables for the securities market model. In the more complex approach, the attempt was to identify the basic causes of changes in security price movements. Existing research on the causes of changes in long term interest rates is concisely summarized in an article by Martin Feldstein and

Otto Eckstein.[1] They describe and test several models which incorporate measures of liquidity, the supply and demand for funds, and inflation; such measures include variables for the money supply, personal savings rate, the net demand for funds by corporations and the Federal government, and changes in the consumer price index. In order to capture the effects of anticipations, lagged values of some of these variables were also tested. Using r-square as the primary criterion, the authors conclude that the following model provided the best explanation of quarterly movements in long term corporate bond rates:

$$RC_t = -14.08 - 8.02 \log RMBPC_t + 7.90 \log RPYPC_t + 1.47 \log RDEBTPC + 0.201\, \pi_t + \sum_{j=1}^{28} \alpha_j\, \pi_{t-j} + 0.58\,(RC_{t-1} - RC_{t-2})$$

$$\sum_{j=1}^{28} \alpha_j = 3.74\,, \text{ mean lag} = 8.33 \text{ quarters}$$

$$R^2 = 0.992$$

where

RC = yield to maturity on seasoned Moody's Aaa industrial bonds,

RMBPC = real per capita monetary base,

RPYPC = real per capita private gross national product,

RDEBTPC = real per capita privately owned Federal government debt,

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1. Feldstein, Martin and Eckstein, Otto. The Fundamental Determinants of the Interest Rate. Unpublished paper.

$\pi$ = quarterly rate of inflation using the price deflator for the consumer expenditure component of GNP, and

$\alpha_j$ = weighting factor used to capture distributed lag effects.

Similar attempts have been made to identify the causes of stock price movements. For example, Michael W. Keran[2] has analyzed the effects of expected corporate after-tax earnings, expected interest rates, and expected inflation rates on the general level of stock prices. These variables were used in an expanded version of the St. Louis monetary model in order to examine the relation between the actions of monetary policy and stock price movements. His analysis led to the following equation:

$$SP_t = -30.68 + \sum_{i=0}^{2} 1.31\, M^*_{t-i} - \sum_{i=0}^{7} 5.37 X_{t-1}$$

$$- \sum_{i=0}^{16} 11.96 P_{t-1} + \sum_{i=0}^{19} 4.80\, E^*_{t-1}$$

$$R^2 = 0.98$$

where SP = Standard and Poor's 500 Stock Price Index,

M* = rate of change in the real money stock,

X = rate of change in real Gross National Product,

P = rate of change in prices, and

E* = real corporate earnings.

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2. Keran, Michael W., Monthly Review, Federal Reserve Bank of St. Louis, Vol. 53, No. 1, January, 1971 pp. 16-31.

The inclusion of lagged values for each independent variable was used to capture expectational effects.

As becomes quickly apparent from a cursory examination of both of the above equations, the model structures have become by necessity quite complex in the effort to achieve maximum explanatory power, in the sense of high r-square values. Furthermore, the models are intended to be self-contained in that the values of the independent variables are all known at the time of the prediction of the dependent variable. The models assume that the dynamics of the market structure are fully captured in the regression parameters and that subjective assessments are therefore unnecessary. The predictive capability of such models has not been tested sufficiently under different economic conditions to permit confidence in decision-making applications. Lingering doubts regarding the reliability of these models may lead the market forecaster to prefer a less closed-form model so that he can supply assessments of certain key inputs.

In an attempt to arrive at a model which the practitioner may find more understandable and useful, a less complex structure was sought by stepping back from the causal process and looking at the aggregates with which he is familiar. The assumption is that the forecaster, at least in his own mind, is capable of relating all the broad economic variables, such as those in the above equations either through a purely judgmental process or by an independent

economic model, to arrive at a forecast of a few indexes of price movements in the capital markets. These indexes would then be used in a model of the returns on individual securities.

Given the emphasis in this study on both equity and fixed-income securities, indexes appropriate to each of these markets presumably would be included in the model. For example, the Standard and Poor's Index of 425 stocks and Moody's Index of Aa utility yields are common standards. Combinations of these indexes and selected others were used in an essentially trial and error process to find the set of indexes which minimized the Chi-square statistic.

Before reporting the conclusions of this analysis, the manner in which the Chi-square statistic is interpreted must be reviewed. Normally, the Chi-square statistic is used as the basis for accepting or rejecting a hypothesis of the form that the correlations among the population variates are zero. For the present purpose of choosing an optimal index model, however, no hypothesis is involved. In fact, it would be quite surprising if it were found that the correlations among such a large number of regression residuals were, or even approximated, zero. The objective is to find that set of indexes and hence that regression model which minimizes the correlation among the error terms. For this purpose it is adequate to use the Chi-square statistic merely as an ordinal

measure to rank each trial model. That model which yields the lowest value of Chi-square will be the one which most closely fulfills the market model assumption that the error terms are independent.

The Chi-square values for several trial models are presented in Table 6.1. The model with the Aa utility index (AAOUTL), Standard and Poor's Stock Price Index (SP1), and an index of yields on five-year U.S. Treasury issues (TREA05) produced the minimum Chi-square of 5442. This model will be used throughout the remainder of this study and will be called "the securities market model." (If the Chi-square value of 5442 were interpreted in its normal sense, its equivalent of approximately 90 standard deviations in a normal distribution with unit variance clearly would lead to a rejection of the independence hypothesis). Although the addition of a fourth index provided a further reduction in the value of Chi-square, it was believed that the compounded complexity inherent in working with the extra index was unwarranted by this limited improvement.

## 6.2 Interpreting the Equations of the Securities Market Model

The regression equations for each of the eighty-eight securities using the AAOUTL, SP1, and TREA05 indexes are reported in Table 6.2 along with the r-square values and the standard errors of estimate. It should be noted that of the eighty-eight equations only eighty-six are independent and hence useful since two of the securities are used as indexes. For the eighty-six independent results, the

TABLE 6.1

Selection of Indexes for Securities Market Model
Using the Chi-Square Statistic*

| Index combinations | Chi-square value |
|---|---|
| AAOUTL, SP1, TREA05, TREA20 | 5166 |
| AAOUTL, SP1, TREA01, TREA05 | 5320 |
| **SP1, AAOUTL, TREA05 | 5442 |
| SP1, AAOUTL, TREA05, no constant term | 5609 |
| AAOUTL, SP1, TREA03 | 5672 |
| SP1, AAOUTL, TREA01 | 6483 |
| SP1, BINDX | 7774 |
| SP1, BINDX, IPD | 7783 |
| SP1, AAOUTL | 7827 |
| SP1, BINDX, BILLS | 7852 |
| SP1, BINDX, no constant term | 7931 |
| SP1, AAOUTL, BILLS | 7948 |
| SP1, TREA01, TREA10 | 7983 |
| SP1, TREA05 | 8245 |
| SP1 | 12817 |
| BINDX | 20155 |
| LEADR | 27938 |
| M1R | 28479 |
| SFF | 28560 |
| M2R | 28665 |
| PROF | 28755 |
| MBASE | 28857 |

*Some of the index symbols are for fixed-income securities and have already been defined in Table 4.1. The other symbols are defined as follows:

| | |
|---|---|
| BILLS | discount rate on new issues of 91-day Treasury bills |
| BINDX | the sum of all 22 bond returns |
| IPD | implicit price deflator, Gross National Product |
| LEADR | composite index of 12 leading indicators, reverse trend adjusted |

(continued)

| | |
|---|---|
| MBASE | monetary base, seasonally adjusted |
| M1R | percent change in total U.S. money supply (demand deposits plus currency) |
| M2R | percent change in total U.S. money supply (demand deposits plus currency) and commercial bank time deposits |
| PROF | corporate profits after taxes annual rate |
| SFF | composite index of sensitive financial flows |

** This index model was used in all subsequent work.

## TABLE 6.2

### Securities Market Model Equations for 1962 - 70

| Security | Constant Term | Index | | | $R^2$ | Std. Error |
|---|---|---|---|---|---|---|
| | | AAOUTL | SPI | TREA05 | | |
| **U.S. Treasury bonds:** | | | | | | |
| TREA01 | .32* | .00 | -.01 | .21* | .65 | .16 |
| TREA02 | .22* | .01 | -.00 | .46* | .86 | .20 |
| TREA03 | .14* | .00 | .01* | .69* | .92 | .22 |
| TREA04 | .06* | .01 | .00 | .85* | .98 | .12 |
| TREA05 | -.00* | -.00* | -.00* | 1.00* | 1.00 | .00 |
| TREA10 | -.13* | .06* | .01 | 1.15* | .80 | .64 |
| TREA20 | -.22* | .19* | .01 | 1.13* | .59 | 1.18 |
| TREA30 | -.30* | .24* | .00 | 1.28* | .65 | 1.19 |
| **Corporate Bonds:** | | | | | | |
| AAAIND | .01 | .61* | .02 | .09 | .75 | .67 |
| AAOIND | -.00 | .59* | .01 | .62 | .77 | .60 |
| AOOIND | .02 | .62* | -.00 | -.01 | .73 | .66 |
| BAAIND | .06 | .50* | .01 | .21* | .58 | .89 |
| AAAUTL | -.08* | .81* | .01 | .14* | .90 | .50 |
| AAOUTL | .00* | 1.00* | -.00* | .00 | 1.00 | .00 |
| AOOUTL | -.00 | 1.00* | .00 | -.00 | .87 | .67 |
| BAAUTL | .06 | .83* | -.02 | -.16* | .74 | .82 |

*Indicates coefficient is significantly different from zero at 90 percent level of confidence.

| Security | Constant Term | Index | | | $R^2$ | Std. Error |
|---|---|---|---|---|---|---|
| | | AAOUTL | SPI | TREA05 | | |
| AA2.81 | -.04 | .73* | -.03 | .48* | .74 | .93 |
| AA3.25 | -.14 | .73* | .05 | .77* | .66 | 1.27 |
| AA3.75 | -.12 | .66* | .01 | .64* | .73 | 1.00 |
| AA4.25 | -.16* | .70* | -.02 | .69* | .76 | .96 |
| AA4.69 | -.08 | .72* | .00 | .57* | .79 | .87 |
| AA5.06 | .00 | .62* | -.02 | .43* | .69 | .90 |
| Common Stocks: | | | | | | |
| A | .40 | -.27 | 1.43* | .21 | .38 | 6.62 |
| ACY | .69 | .61* | 1.04* | -.65 | .40 | 5.13 |
| AMR | .70 | -.43 | 1.95* | .39 | .40 | 8.58 |
| APX | .08 | -.72 | 1.92* | -.55 | .37 | 8.72 |
| AYP | -.04 | .41* | .48* | .64* | .26 | 4.21 |
| BA | -.10 | .03 | 1.52* | -.71 | .26 | 9.20 |
| BMY | 1.06* | -.23 | 1.21* | -.82* | .44 | 4.81 |
| CCB | 1.47* | .22 | 1.52* | 1.30* | .45 | 7.00 |
| CDA | -.63 | -.12 | 1.49* | -.69 | .36 | 7.15 |
| CIP | -.29 | .11 | .54* | 1.28* | .28 | 4.45 |
| CIT | .50 | .95* | .44* | 1.48* | .29 | 5.81 |
| CLL | -.26 | -.35 | .77* | .97* | .31 | 4.51 |
| CSR | -.46 | -.45* | .53* | 2.75* | .39 | 4.43 |
| CWE | -.52* | .13 | .59* | 1.64* | .44 | 3.64 |
| DAL | 1.88* | -.48 | 1.60* | 1.07 | .36 | 7.99 |
| DLT | 1.62 | .53 | 1.46* | -1.21 | .15 | 13.25 |
| EAF | 1.55* | -1.08* | 1.24* | .85 | .23 | 8.15 |
| EAL | .24 | .48 | 2.01* | 1.64* | .35 | 11.00 |

| Security | Constant Term | Index | | | $R^2$ | Std. Error |
|---|---|---|---|---|---|---|
| | | AAOUTL | SPI | TREA05 | | |
| EK | 1.14* | .06 | .97* | -.49 | .43 | 4.04 |
| FCF | .25 | 1.22* | 1.63* | 3.14* | .38 | 11.37 |
| GEN | -.04 | .36 | 1.06* | 1.00* | .56 | 4.04 |
| GIS | .99* | .40* | .81* | -.17 | .35 | 4.38 |
| GO | .09 | -.64* | .98* | .87* | .44 | 4.05 |
| GP | 1.61* | .84* | 1.04* | 1.21* | .46 | 5.67 |
| GTU | -.24 | -.21 | .66* | 2.04* | .29 | 5.43 |
| HOU | -.10 | .39* | .57* | 1.71* | .41 | 4.18 |
| IBM | .85* | -.42* | 1.23* | -.60* | .56 | 3.75 |
| INA | -.38 | .16 | .74* | .62 | .16 | 7.06 |
| ITT | .65 | -.19 | 1.48* | -1.09* | .56 | 4.66 |
| JNJ | 1.92* | -.32 | 1.07* | -.91* | .32 | 5.47 |
| K | .60 | .43 | .62* | .12 | .21 | 5.18 |
| KG | 2.34* | -.25 | .94* | .06 | .19 | 6.89 |
| KN | .82 | -.36 | 1.09* | .34 | .29 | 6.12 |
| LSG | -.05 | .26 | .62* | .89* | .24 | 5.15 |
| MHP | .01 | -.14 | 1.24* | .32 | .33 | 6.50 |
| MMM | .12 | -.34 | 1.16* | .11 | .46 | 4.50 |
| MOT | 1.30* | .68 | 1.64* | -2.47 | .34 | 8.63 |
| MRK | 1.26* | -.52* | 1.03* | -.07 | .37 | 4.68 |
| MSU | -.11 | -.31 | .78* | 2.22* | .37 | 5.15 |
| N | .14 | -.99* | 1.10* | .81* | .47 | 4.24 |
| NNG | .26 | .42 | .61* | .76* | .29 | 4.70 |
| NSP | -.21 | .32* | .20* | 1.15* | .25 | 3.33 |

| Security | Constant Term | Index | | | $R^2$ | Std. Error |
|---|---|---|---|---|---|---|
| | | AAOUTL | SPI | TREA05 | | |
| PEP | .96* | -.15 | .95* | -.30 | .27 | 5.48 |
| PG | .29 | -.11 | .69* | .35 | .30 | 3.99 |
| PKN | .88 | -.65 | 1.52* | -.41 | .34 | 7.29 |
| PRD | 1.90* | -.17 | 1.41* | -1.71* | .25 | 8.68 |
| RD | .50 | -.05 | .88* | .51 | .37 | 4.44 |
| SB | .67* | .47* | .70* | -.12 | .28 | 4.70 |
| SCG | -.14 | -.11 | .62* | .92* | .21 | 5.10 |
| SD | -.26 | .38* | .79* | .81* | .38 | 3.86 |
| SGL | 1.25 | .37 | 1.55* | -.34 | .27 | 9.70 |
| SO | -.41 | .07 | .82* | 1.41* | .43 | 4.38 |
| SR | .24 | .39 | .96* | -.38 | .36 | 4.92 |
| T | -.07 | .68* | .47* | .30 | .45 | 2.84 |
| TFB | .93 | .22 | 1.64* | -.29 | .35 | 8.28 |
| TWA | .63 | .49 | 2.26* | -.47 | .42 | 10.01 |
| TX | -.12 | -.22 | .80* | 1.04* | .40 | 3.96 |
| TXN | 1.31* | -.22 | 1.49* | -1.16* | .33 | 7.50 |
| UA | -.11 | -.31 | .94* | 1.05 | .16 | 8.42 |
| UAL | -.17 | -.38 | 1.84* | 1.70* | .42 | 8.46 |
| UCL | .40 | -.49 | 1.21* | .20 | .36 | 5.63 |
| UP | .43 | .63* | .81* | -.52 | .33 | 4.78 |
| USG | .06 | 1.23* | .98* | -.49 | .46 | 5.05 |
| WBC | .31 | .56* | .64* | .89* | .25 | 5.76 |
| WIN | .29 | .07 | .53* | -.11 | .18 | 4.11 |
| XRX | 2.46* | .05 | 1.26* | -1.12 | .23 | 8.36 |

equations are of the form

$$Y = \text{Constant} + B_1(\text{AAOUTL}) + B_2(\text{SP1}) + B_3(\text{TREA05})$$

where for each security

Y = estimated total return

$B_1$, $B_2$, $B_3$ = estimated coefficients of market sensitivity for the markets represented by AAOUTL, SP1, and TREA05, respectively.

For example, the total return behavior of Georgia Pacific during the period July 1962 to July 1970 is characterized by the equation

$$Y_{GP} = 1.61 + .84\ (\text{AAOUTL}) + 1.04\ (\text{SP1}) + 1.21\ (\text{TREA05}).$$

Similarly, the total return on Baa utility bonds (BAAUTL) is expressed in the equation

$$Y_{BAAUTL} = 0.06 + .83\ (\text{AAOUTL}) - .02(\text{SP1}) - .16(\text{TREA05}).$$

In order to gain a better understanding of the securities market model, these two total return equations will be examined more closely.

The constant term in the total return equation is an estimate of the total return on the security when there is no change in any of the market indexes. Thus, under these conditions, one reasonably might expect a total return in the neighborhood of 1.6 percent per month on Georgia Pacific and 0.1 percent per month on Baa utility bonds. The coefficients of each market index estimate the impact of changes in each market on a security's total return. A 1 percent per month increase in the Aa utility index (AAOUTL) improves the total return on Georgia Pacific and Baa utility bonds by about the same amount,

0.8 percent per month. Georgia Pacific is much more affected by a change in the stock market (SP1) than Baa utility bonds since the sensitivity coefficient is larger; 1.04 versus -0.02. Changes in the market for U.S. Treasury issues, as exemplified by the five-year U.S. Treasury bond index (TREA05), likewise have a greater impact on the total return of Georgia Pacific than on that of Baa utility bonds. If a change in each index of a positive 1 percent per month occurred, the indicated total return for Georgia Pacific would be 4.7 percent per month and for Baa utility bonds, 0.7 percent per month.

6.3 The Quality of the Equations in the Securities Market Model

The standard error of estimate for each security is reported in Table 6.2. For a given security, the standard error of estimate measures the deviation between calculated and actual returns for the period of sample observations and suggests the possible errors which may arise in estimating future returns assuming accurate values of the independent variables, the market indexes, are used. The standard error has the same interpretation as the standard deviation; for example, the probability that the actual return will fall within a range of one standard error either side of the estimated return is approximately 67 percent.

To illustrate, the standard error of the returns on Anaconda is 6.62 percent per month. If the estimated return on Anaconda for a particular month were 1.0 percent, the probability

would be 67 percent that the return would fall between a negative 5.62 percent per month and positive 7.62 percent per month. Clearly this range of uncertainty, or possible error, in the estimated return is quite broad, but it is narrower than the standard deviation of the actual returns of 8.27 percent per month (See Table 5.2). Thus, use of the regression equation to estimate return permits a partial explanation of the actual returns.

The lower volatility and greater correlation of bond relative to equity returns suggest that the standard errors for bond returns may be smaller. The standard error for the estimated returns on Aaa industrial bonds, for example, is 0.67 percent per month compared to the standard deviation of the actual returns of 1.32 percent per month. For an estimated return of 1.0 percent in a particular month, the chances would be 2 out of 3 that the actual return would fall in the range from 0.33 to 1.67 percent per month.

A broader perspective on the relative potential errors that may result from using the regression models for the stocks and bonds may be gained by noting that the average standard error for all stocks in the sample is 6.05 percent per month and that for bonds is 0.72 percent per month. The average standard error for all securities is 4.81 percent per month.

The coefficient of determination, commonly referred to as the r-square statistic, for each equation is also shown in Table 6.2. The r-square statistic is the quotient of the standard error of

estimate and the standard deviation of actual returns. The resulting statistic, which may range in value from 0.0 to 1.0, is a measure of the explanatory power of the regression equation. R-square is often used as the criterion for choosing the optimal set of regression equations in portfolio analysis. For reasons already discussed, the Chi-square statistic was more appropriate for the purposes of this study.

Although maximization of the r-squares was not the criterion used here, the resulting r-square values nevertheless are within the range of those found in other studies. For the eighty-six independent securities, movements in the three indexes account for an average of 44 percent of the individual security returns. For the sixty-six stocks, the average explanatory power of the three indexes was 34 percent and for the twenty independent bonds, 76 percent. The r-squares ranged from 15 percent (Deltona) to 56 percent (IBM) on the stocks and from 58 percent (Baa industrial bonds) to 98 percent (4-year Treasury issues) on bonds. Clearly, an understanding of the relationship between market movements and security returns is an important element in explaining the behavior of security returns.

The possibility of improving the explanatory power of the model, in the r-square sense, against some sacrifice of error term independence as measured by the Chi-square statistic has not been examined in this study. Such an analysis might be warranted since

the Chi-square values in Table 6.1 suggest that there are several models which are not greatly differentiated.

## 6.4 The Statistical Significance of the Market Sensitivity Coefficients

The coefficients of market sensitivity reported in Table 6.2 are estimates, derived from the regression analysis, of the true coefficient values. The probability that the true coefficient value is significantly different from zero and that the estimated relationship is therefore a meaningful statement of the underlying process has been calculated. The coefficients in Table 6.2 which have a probability of 90 percent of being significantly different from zero are designated with an asterisk.

The relationship between the type of index and the type of security in terms of the significantly non-zero coefficients is summarized in Table 6.3. Although only 28 of the 86 constant terms are significantly different from zero at the 90 percent level of probability, the constant term was kept in the security model structure since its presence improved the Chi-square test of error term independence. The more interesting observations relate to the market index coefficients. If there is any overlap in the behavior of stocks and bonds as suspected, some of the securities should have significant coefficients for the stock market index and at least one of the bond market indexes.

As expected, of the 66 stocks, all 66 have stock market

TABLE 6.3

Number of Securities with Index Coefficients Significant at 90% Level

| | Total Securities | Constant | AAOUTL | SP1 | TREA05 |
|---|---|---|---|---|---|
| Stocks | 66 | 19 | 24 | 66 | 32 |
| Bonds | | | | | |
| Industrial | 4 | 0 | 4 | 0 | 1 |
| Utility | 3 | 1 | 3 | 0 | 2 |
| Discounts | 6 | 1 | 6 | 0 | 6 |
| Treasury | 7 | 7 | 3 | 1 | 7 |
| Total Bonds | 20 | 9 | 16 | 1 | 16 |
| Total | 86 | 28 | 40 | 67 | 49 |

index coefficients which are statistically significant. The returns on 42 of the stocks are also dependent on changes in the bond markets; 32 or about one-half, have significant U.S. Treasury bond market coefficients and 24, more than one-third, are materially influenced by movements in the corporate bond market.

The particular stocks which have significant coefficients for either of the bond market indexes are listed on Table 6.4. A large proportion, 27 out of 42, of the stocks influenced by movements in the bond markets are utility or utility-type (e.g. gas pipeline, transpor-

tation, oil, broadcasting, and financial) stocks. The following summary breakdown of utility and utility-type and non-utility stocks

| | Total | AAOUTL | TREA05 | Both Indexes |
|---|---|---|---|---|
| Utility-type* | 27 | 15 | 23 | 11 |
| Non-Utility | 15 | 9 | 9 | 3 |

*There are 34 utility and utility-type stocks out of 66.

with significant bond market coefficients provides further insights. Of the 34 utility and utility-type stocks, 27 are related closely to the bond market, principally the government market but in many cases the corporate market as well. Fifteen out of the total of 32 non-utility stocks are affected by one or the other -- and in only three cases by both -- of the bond markets. There is a greater tendency for utility and utility-type stocks to be influenced by both indexes than is the case for non-utility stocks.

The finding that utility and utility-type stocks behave in part like bonds is, of course, consistent with general knowledge. The analysis, however, further reveals that during the period under study several other stocks also correspond to bonds in their market behavior and that some utility and utility-type stocks apparently are unrelated to movements in either bond market. The implication is that the traditional method of associating the market behavior of a stock with its industry affiliation is unsatisfactory since the behavior characteristics

Table 6.4

Stocks with Significant Bond Market Index Coefficients

| Stock Symbol | AAOUTL | TREA05 | Stock Symbol | AAOUTL | TREA05 |
|---|---|---|---|---|---|
| ACY | | | LSG | | X |
| AYP* | X | X | MOT | | X |
| BMY | | X | MRK | X | |
| CCB* | | X | MSU* | | X |
| CIP* | | X | N | X | X |
| CIT* | X | X | NNG* | X | X |
| CLL* | | X | NSP* | X | X |
| CSR* | X | X | PKN | X | |
| CWE* | | X | PRD | | X |
| EAF* | X | | SB | X | |
| EAL* | | X | SCG* | | X |
| FCF* | X | X | SD* | X | X |
| GEN* | X | X | SO* | | X |
| GIS | X | | T* | X | |
| GO* | X | X | TX* | | X |
| GP | X | X | TXN | | X |
| GTU* | | X | UAL* | | X |
| HOU* | X | X | UCL* | X | |
| IBM | X | X | UP* | X | |
| ITT | | X | USG | X | |
| JNJ | | X | WBC* | X | X |
| | | | 42 | 24 | 32 |

* Stocks classified by industry as either utility or utility-type, as per Table 5.3.

appear to be more complex than revealed in such a system.

In contrast to the cross-over relationship evident in the returns on stocks, bond returns generally are unrelated to stock market movements. For the twenty independent bond securities none of the coefficients on the Standard & Poor's stock market index are significantly different from zero at the 90 percent probability level except that the three-year U.S. Treasury issue has a statistically significant coefficient which is quite small (.009) relative to other index coefficients. Thus there appear to be no bonds which display stock-like behavior.

6.5 The Market Sensitivity Coefficients

The market sensitivity coefficients for each security completely characterize the return and risk behavior of that security for the purposes of this study. Given an assessment of the market indexes, the coefficients determine the role of each securitiy in the efficient portfolio. In contrast to the average returns and standard deviations for each security that were examined in Chapter 5, the market sensitivity coefficients incorporate only the "manageable" portion of total security risk; meaning that securities with offsetting risk characteristics may be combined to reduce the total risk exposure. The remaining risk is independent among securities and thus "unmanageable" since the risk characteristics for individual securities are strictly additive. An examination of the coefficients therefore should provide a more clear understanding of the security characteristics

pertinent to portfolio analysis.

As observed above, none of the bonds are affected materially by movements in the stock market. Bonds, however, display a variety of patterns in their relationships to the corporate and U.S. Treasury bond markets. The following observations are based on the market sensitivity coefficients presented in Table 6.2.

As expected, for longer maturities, U.S. Treasury bonds become more sensitive to changes in the government bond market index. The U.S. Treasury bond coefficients increase steadily from 0.21 on the one-year issue of 1.28 on the thirty-year obligation. The marginal increase in the coefficient from one year to the next is much greater for those less than five years than for longer maturities, a relationship which conforms to the diminishing impact on current market price of the present value of redemption proceeds for longer maturities. A certain amount of additional impact on the longer maturity issues arises from movements in the corporate market. The portfolio implications of the increase in the sensitivity coefficients by maturity depend on the relationship between the forecasted risk and return for the government and corporate market indexes. For a given amount of assessed market risk, a low or negative expected market return would imply a preference for the short term issues and, conversely, a higher expected market return would tend to favor longer term bonds.

The constant terms in the equations for the U.S. Treasury bonds decline steadily with maturity. This pattern reflects the generally bearish market for bonds in the sample period during which the returns were lower on long term than on short term bonds.

Industrial and utility bonds of various quality levels respond primarily to movements in the corporate market. The irregular patterns among quality levels previously observed in the examination of the raw returns (see Exhibits 5.1 and 5.2) are also apparent in the behavior of the corporate bond sensitivity coefficients. In the present analysis, however, it is possible to make a more useful comparison since the returns on all the corporate bonds have been normalized in their relationship to the same corporate bond market index as a result of the regression analysis.

In the first place, industrial bonds of all quality levels are less responsive than utility bonds to movement in the corporate bond market. Secondly, Baa industrial and utility bonds have smaller corporate bond market sensitivity coefficients than all other quality levels in the respective class. However, the Baa industrial bond picks up some positive influence from movements in the government bond market while the Baa utility bond is affected negatively. If expected movements in the corporate and government bond markets are about the same, it appears that Aaa, Aa, and A rated bonds would

nearly be interchangeable for both industrial and utility bonds, the Baa industrial bond would be more sensitive to the market changes than other industrials, and the Baa utility bond would be considerably less sensitive to market changes than other utilities.

The market sensitivity coefficients for the industrial and utility bonds apparently capture all the effects of market changes since all the constant terms are nearly zero.

The Aa utility bonds of various coupon levels are about equally responsive to movements in the corporate and government bond markets. Although the pattern is irregular, the lower coupon bonds, which sell at the greatest discount, tend to be slightly more sensitive to changes in either or both of the bond markets. This pattern, including the exceptions, is consistent with that observed in Exhibit 5.3. The constant terms in these equations are negative but also small.

The important dimensions of a bond in managing a bond portfolio are the type of bond and its maturity, quality level, and coupon. The relative magnitudes of the market sensitivity coefficients permit an assessment of the dimension which is likely to be the most critical. Clearly, the maturity of a bond provides the greatest latitude in structuring a portfolio. Utility bonds appear to be roughly comparable to intermediate and long term government bonds in their response to market movements, but a shift to industrial bonds adds

appreciable flexibility. Swaps among coupon levels and quality levels offer only limited opportunities.

In order to understand the broad effects of changes in the market indexes on bonds and stocks, it may be helpful to categorize the positive and negative index coefficients as in Table 6.5. For this purpose more clear distinctions are made by examining only those coefficients which are significantly different from zero, even though all coefficients are used in the portfolio selection model.

None of the securities is related inversely to the market index with which it primarily is identified. Seven stocks have negative corporate bond market index coefficients and seven stocks have returns which move counter to the U.S. Treasury bond market. Only one stock, IBM, moves inversely to both bond markets. The only bond with a negative index coefficient is the Baa utility bond which has returns that move against the U.S. Treasury bond market. The constant terms for the following securities are negative: Commonwealth Edison, Aaa utility bonds, discount utility bonds with an average coupon of 4.25 percent, and all three of the longer term Treasury bonds. The existence of stocks which are countercyclical with bonds may have important implications for the structure of an efficient bond portfolio. Thus, a stock which would normally move upward with the stock market might be even more attractive in a bearish bond market, a combination of circumstances which has obtained during several periods in the past.

Table 6.5

Number of Significant Coefficients with Negative Signs

| | Constant | AAOUTL | SP1 | TREA05 |
|---|---|---|---|---|
| Stocks | 1[c] | 7[a] | 0 | 7[b] |
| Bonds | | | | |
| Industrial | 0 | 0 | 0 | 0 |
| Utility | 1[e] | 0 | 0 | 1[d] |
| Discounts | 1[f] | 0 | 0 | 0 |
| Treasury | 3[g] | 0 | 0 | 0 |
| Total Bonds | 5 | 0 | 0 | 1 |
| Total | 6 | 7 | 0 | 8 |

a - CSR, EAF, GO, IBM. MRK, N, SD

b - BMY, IBM, ITT, JNJ, MOT, PRD, TXN

c - CWE

d - BAAUTL

e - AAAUTL

f - AA4.25

g - TREA10, TREA20, TREA30

In addition to the statistical significance and the sign of each of the market index coefficients, the relative magnitudes of the coefficients determine the ultimate behavior of a security's returns, especially as to whether that behavior is more like that of a stock or a bond. For the single-index security models commonly found in the literature, if the index is an adequate representative of market movements, the average of the index coefficients for a large number of securities from that market should approximate unity since the aggregate of these securities will nearly equal the market itself. The average of the constant terms in this case would approximate zero since the virtual identity between the aggregate movements of the individual securities and the market exclude the need for any other explanatory term.

In this study, the use of three indexes representing different sectors of the securities market prohibits an a priori estimate of the averages of the coefficients for each index. Such an estimate would depend on the relative influence of each market on each security's return. However, using the coefficients and the average behavior of each market, an ex post evaluation of the character of each security may be undertaken.

The broad questions are whether the overall structure of the model is consistent with general observation and then whether there are any exceptions which may have implications for portfolio

management. Specifically, the tendency of each security to behave like its generic class will be examined. Within the sample of securities used in this study there are three broad classes of securities which are easily defined and presumably behave differently: common stocks, corporate bonds and U.S. Treasury bonds. It is assumed that the stocks are more different from either class of bonds than the bonds are from one another. The character of each security class is defined by the unweighted average of the coefficients for each index of the securities in that class. These averages are shown in Table 6.6.

The procedure is to examine the coefficients of each security and to determine the security class to which it most closely corresponds. The degree of correspondence, as represented by $d^2$, is measured by the sum of the weighted squared differences between each of the three index coefficients for the security and the respective average coefficients for the security class. The weighting of each squared difference was chosen to approximate the degree of correlation among the three sets of coefficients. Specifically, it was assumed that stocks are entirely different from bonds deserving the full weight of 1.0, but that the two classes of bonds are sufficiently similar to weight each by 0.5.

A security is associated most closely with that class for which the sum is the smallest. The values of $d^2$ for each of the securities are reported in Table 6.6 where the securities are grouped

TABLE 6.6

"Bondness/Stockness" Analysis:
Securities Grouped According to Minimum $d^2$ Value*

Corporate-like Securities

| | Stock | Treasury | Corporate |
|---|---|---|---|
| AAAUTL | .92 | .54 | .02 |
| AAOUTL | 1.11 | .80 | .03 |
| AOOUTL | 1.11 | .80 | .04 |
| BAAUTL | 1.07 | .81 | .04 |
| AAAIND | .86 | .44 | .01 |
| AAOIND | .88 | .45 | .01 |
| AAOIND | .91 | .53 | .01 |
| BAAIND | .84 | .30 | .06 |
| AA2.81 | .92 | .29 | .21 |
| AA5.06 | .87 | .24 | .17 |
| CLL | 1.32 | .69 | 1.78 |
| EAF | 3.06 | 2.19 | 3.09 |
| GO | 1.83 | .96 | 2.13 |
| N | 2.75 | 1.76 | 2.71 |
| PG | .78 | .62 | .70 |
| RD | 1.47 | 1.01 | 1.42 |
| SD | 1.28 | .72 | 1.55 |
| T | .47 | .56 | .18 |
| TX | 1.14 | .70 | 1.81 |
| UA | 1.26 | .97 | 2.04 |
| UP | .69 | 1.76 | .62 |
| USG | 1.09 | 2.54 | .86 |
| WIN | .54 | .93 | .16 |

Treasury-like Securities

| | Stock | Treasury | Corporate |
|---|---|---|---|
| TREA01 | 1.16 | .20 | .31 |
| TREA02 | 1.14 | .08 | .46 |
| TREA03 | 1.19 | .01 | .71 |
| TREA04 | 1.26 | .00 | .95 |
| TREA05 | 1.21 | .01 | 1.22 |
| TREA10 | 1.39 | .05 | 1.50 |
| TREA20 | 1.27 | .05 | 1.37 |

TABLE 6.6 (con't)

| | Stock | Treasury | Corporate |
|---|---|---|---|
| TREA30 | 1.37 | .10 | 1.37 |
| AA3.25 | 1.02 | .23 | .56 |
| AA3.75 | .89 | .20 | .38 |
| AA4.25 | .94 | .22 | .44 |
| AA4.69 | .90 | .26 | .30 |
| AYP | .42 | .40 | .73 |
| CIP | 1.04 | .39 | 1.91 |
| CIT | 1.27 | .79 | 2.23 |
| CSR | 4.30 | 2.22 | 8.27 |
| CWE | 1.39 | .66 | 2.96 |
| GTU | 2.36 | 1.18 | 4.72 |
| HOU | 1.35 | .75 | 3.06 |
| K | .41 | .72 | .24 |
| KG | .96 | 1.24 | .93 |
| LSG | .60 | .41 | 1.05 |
| MRK | 1.50 | 1.65 | 1.32 |
| MSU | 1.80 | 1.62 | 5.67 |
| NNG | .48 | .44 | .77 |
| NSP | 1.02 | .12 | 1.37 |
| PEP | .96 | 1.59 | .94 |
| SB | .46 | 1.05 | .29 |
| SCG | .97 | .40 | 1.35 |
| SO | 1.09 | .83 | 2.47 |

Stock-like Securities

| | Stock | Treasury | Corporate |
|---|---|---|---|
| A | 1.02 | 2.30 | 1.55 |
| ACY | .77 | 2.35 | 1.98 |
| AMR | 1.62 | 4.03 | 2.70 |
| APX | 2.65 | 4.97 | 3.22 |
| BA | 1.20 | 3.53 | 1.93 |
| BMY | 1.57 | 2.90 | 1.90 |
| CCB | .93 | 2.42 | 2.90 |
| CDA | 1.35 | 3.42 | 1.98 |
| DAL | 1.73 | 2.73 | 3.10 |
| DLT | 1.57 | 4.37 | 2.60 |
| EAL | 1.82 | 4.35 | 4.85 |
| EK | .87 | 1.84 | .96 |

TABLE 6.6 (con't)

| | Stock | Treasury | Corporate |
|---|---|---|---|
| FCF | 4.77 | 5.95 | 11.13 |
| GEN | .52 | 1.18 | 1.58 |
| GIS | .38 | 1.23 | .42 |
| GP | .73 | 1.45 | 1.94 |
| IBM | 1.68 | 2.68 | 1.81 |
| INA | .51 | .58 | .79 |
| ITT | 1.94 | 4.11 | 2.77 |
| JNJ | 1.82 | 2.77 | 2.00 |
| KN | 1.10 | 1.40 | 1.29 |
| MHP | .76 | 1.70 | 1.23 |
| MMM | 1.09 | 1.70 | 1.25 |
| MOT | 4.43 | 8.39 | 7.56 |
| PKN | 2.10 | 3.36 | 2.29 |
| PRD | 2.97 | 5.29 | 4.40 |
| SGL | .66 | 3.16 | 1.39 |
| SR | ..57 | 1.73 | .68 |
| TFB | .75 | 3.35 | 1.57 |
| TWA | 1.32 | 6.07 | 2.81 |
| TXN | 2.09 | 4.28 | 2.96 |
| UAL | 2.34 | 3.84 | 5.11 |
| UCL | 1.39 | 1.83 | 1.52 |
| WBC | .51 | .54 | .96 |
| XRX | 1.62 | 3.53 | 2.33 |

* The average values of the index coefficients for each class of securities by index are as follows.

| | AAOUTL | SP1 | TREA05 |
|---|---|---|---|
| Stocks | 0.03 | 1.07 | 0.35 |
| Treasury bonds | 0.06 | 0.00 | 0.85 |
| Corporate bonds | 0.74 | 0.01 | 0.04 |

according to minimum $d^2$.

The use of $d^2$ values confirms certain expectations and permits the identification of a few exceptions. With one exception, corporate and U.S. Treasury bonds separately appear to be elements of reasonably homogeneous classes. The minimum $d^2$ - values for industrial and utility bonds of different quality levels are small and fall within a narrow range. Discount bonds, with higher and more widely dispersed $d^2$ values, are somewhat less like other corporate bonds; indeed those with intermediate coupons behave more like U.S. Treasury obligations. All three sub-groups of corporate bonds are only distantly related to stock-like behavior, with discounts and industrials being more stock-like than utilities.

The behavior of stocks, however, is quite mixed. Eighteen stocks behave more like U.S. Treasury bonds and thirteen behave more like corporate bonds than stocks as a class. In all but two or three cases, the distinguishing differences are material. The equities which fall into the U.S. Treasury and corporate bond classes appear to capture the special characteristics of these two classes, respectively, since aside from the primary association they tend to be related more closely to stocks than to the other class of bonds. Of the thirty-one stocks which exhibit predominant bond-like behave, twenty-two fall within the category designated as utility or utility-type stocks in Table 5.3. On the other hand, there are several

utility and utility-type stocks which show no strong bond-like behavior. The conclusion once again is that for investment purposes the industrial category of a security is an inadequate distinguishing criterion.

## Chapter 7

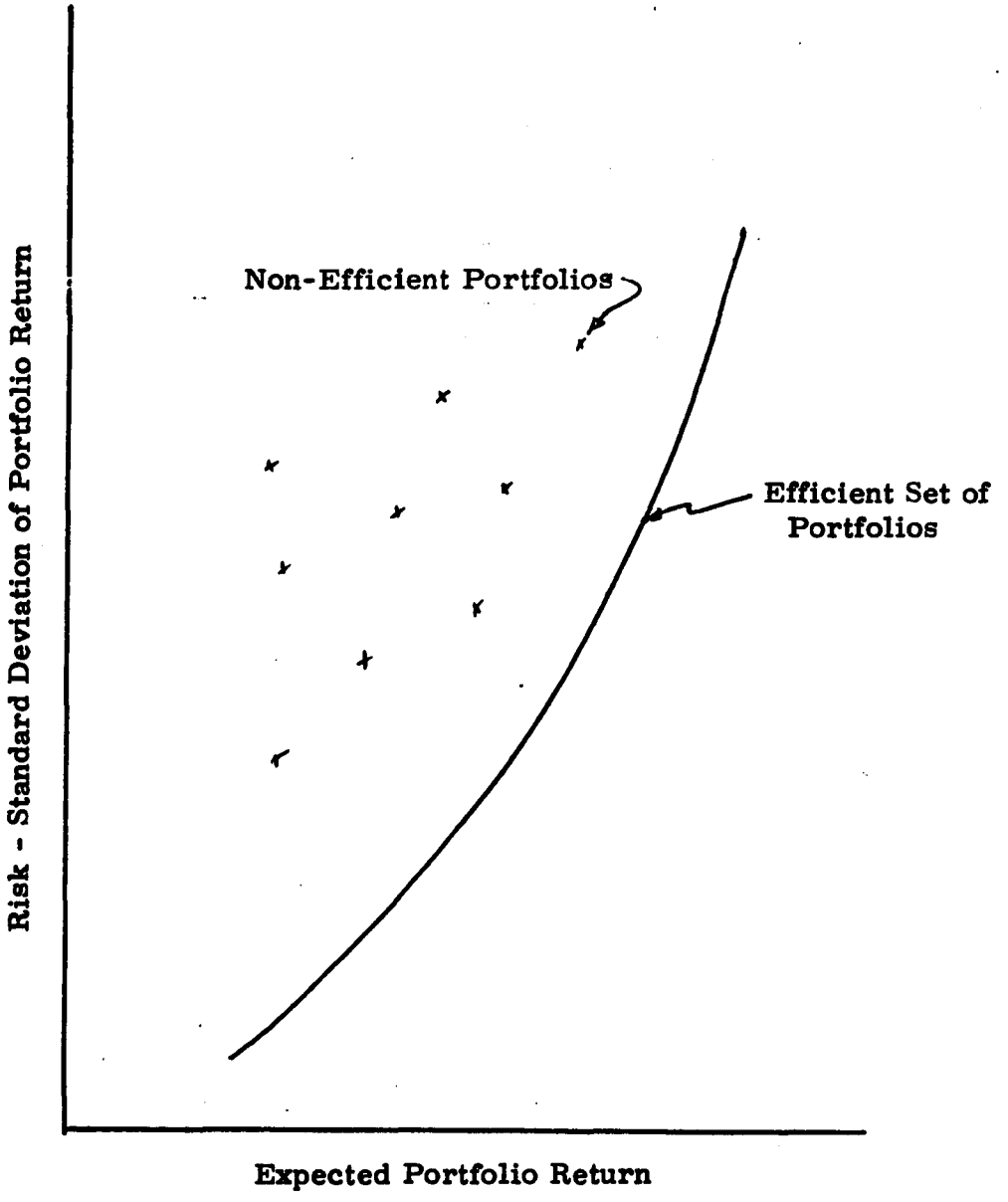
## The Efficient Set of Portfolios

In Chapter 6, a model of the securities market was developed and analyzed. With the aid of that model and forecasts of the expected index returns, the degree of uncertainty attached to each index return, and the possible interrelationships among the indexes, the expected return and associated uncertainty or risk for each security in the sample can be calculated. The object here is to analyze the risk/return relationships and interrelationships within the set of securities to find those combinations which are "efficient" in the sense of offering the maximum return for a given amount of risk or, conversely, the minimum risk for a specified return. The Markowitz procedure for computing the composition of efficient portfolios was described generally in Chapter 3. A summary of the mathematical details was presented in the Appendix to that Chapter. The location and shape of efficient portfolio sets for a variety of market forecasts and the composition of selected efficient portfolios are examined in this Chapter.

The graph of expected portfolio return versus associated standard deviation of return shown in Exhibit 7.1 is typical of efficient sets. The efficient set is the boundary of optimal opportunities available to the investor. There are many other security combinations

Exhibit 7.1

A Typical Set of Efficient Portfolios



which lie in the region to the upper left of the efficient set line but these are suboptimal since for each of these portfolios there is always another which either has a higher expected return or lower risk. Therefore, the only portfolios which need to be considered are those lying on the efficient set.

The selection of the particular efficient portfolio which is most suitable to an investor depends on the nature of the trade-off between risk and return which he is willing to accept. The efficient set becomes more steep for larger returns meaning that for each unit increase in expected return, the cost in terms of assumed risk becomes larger and larger. Thus it is unlikely that the typical investor will chose simply that portfolio with the greatest return.

Institutional investors generally specify a limit to the proportion of available funds they will invest in any one security in order to ensure an adequate degree of credit-risk, as opposed to market-risk, diversification. The computer program used for calculating efficient portfolios included a provision for specifying such a limit. When efficient portfolios were calculated using various limits on security participation, it was found that the proportional investments in equity securities were seldom affected by limits of about 10 percent or larger but that bond investments were frequently affected. Recognizing that each bond, as the term is used in this study, is actually a class of bonds from which many particular bonds could be

selected to provide adequate diversification against credit and business risks, it was decided not to use the security participation limit option. This procedure has the further advantage that the composition of the efficient portfolios therefore is determined solely by the risk/return characteristics of the participating securities and is in no way compromised by other constraints.

## 7.1 The Standard Market Forecast

In order to establish a basis for comparing efficient portfolios resulting from a variety of market forecasts, a "standard" market forecast applicable at the end of the sample period, July 1970, will be defined as the average market conditions existing over the entire eight-year sample period. Of course, virtually any other reference would be equally suitable in illustrating the effects of changed market conditions, as shown below. Use of long-term averages for the market indexes, as is done here, would correspond to the forecast of an investor who essentially makes no forecast, at least of short-term movements. The standard market forecast is presented in Table 7.1. As is apparent from the Table, nine assessments (excluding those for the constant term) are all that are required to calculate the efficient portfolios. The related efficient set of portfolios is plotted in Exhibit 7.2.

Before examining the efficient set derived from the standard market forecast, it may be worth emphasizing once again that the investment horizon and hence the forecasting horizon used in this

Table 7.1

The Expected Values and Covariances of the Market Indexes for the Standard Market Forecast for July 1970*

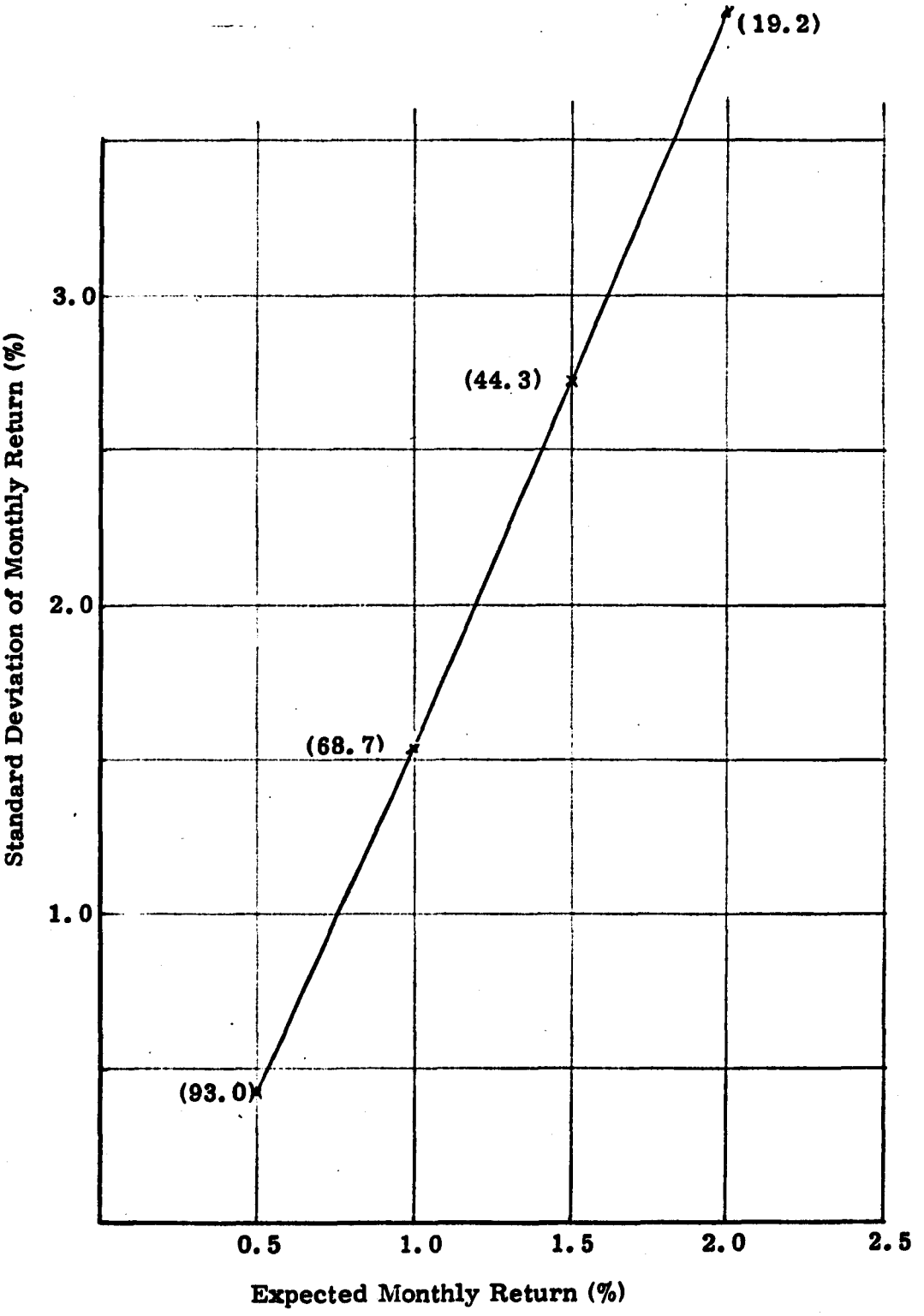
| | Constant term | AAOUTL | SP1 | TREA05 |
|---|---|---|---|---|
| Expected value | 1.00 | -0.14 | 0.35 | 0.24 |
| Covariance | | | | |
| Constant term | 0.0 | | | |
| AAOUTL | 0.0 | 3.07 | | |
| SP1 | 0.0 | 2.08 | 13.12 | |
| TREA05 | 0.0 | 0.81 | 1.01 | 1.12 |

*Based on average behavior for the sample period July 1962 to July 1970.

7.2

Exhibit 7.2

Set of Efficient Portfolios Based
on Standard Market Forecast*




*Numbers in parenthesis on percentage investment in bonds for indicated portfolio.

study is one month and that all security and portfolio returns as well as the standard deviations of returns are calculated on a monthly basis. In order to avoid the rather minor issue of the proper method for annualizing monthly rates and to emphasize the investment objective of maximizing portfolio return in each successive investment period, rather than over a succession of several periods, all returns and standard deviations are left on a monthly basis. However, since the more common method of reporting returns is on an annualized basis, a conversion table (Table 7.2) was prepared which may help set the results of this study in the more common perspective. The conversion is based simply on a non-compounded, linear extrapolation of the monthly rates.

The properties of the efficient set derived from the standard market forecast provide a basis for analyzing the changes which occur as a result of varying the forecast. The selection of portfolios ranges in expected return from 0.5 to 2.5 percent per month (the extreme upper point is off the graph). The corresponding range in the standard deviation of expected return is from 0.42 to 5.13 percent per month. This span of performance opportunities would seem to cover the range of reasonable interest to institutional investors. For example, if an investor chose the portfolio with the highest expected return shown, namely 2.5 percent per month, the probability of actually realizing a loss in any given

Table 7.2

Conversion Table for Monthly and Annual Expected Returns and Standard Deviations

| | Monthly | Annual* |
|---|---|---|
| Expected Return | | |
| | 0.5 | 6.0 |
| | 1.0 | 12.0 |
| | 1.5 | 18.0 |
| | 2.0 | 24.0 |
| | 2.5 | 30.0 |
| | 3.0 | 36.0 |
| Standard Deviation | | |
| | 0.5 | 1.73 |
| | 1.0 | 3.46 |
| | 1.5 | 5.19 |
| | 2.0 | 6.92 |
| | 2.5 | 8.65 |
| | 3.0 | 10.38 |
| | 3.5 | 12.11 |
| | 4.0 | 13.84 |
| | 4.5 | 15.57 |
| | 5.0 | 17.30 |

*Based on non-compounded, linear extrapolation of monthly rate.

month would be about 30 percent, a degree of risk which probably exceeds that acceptable to most institutional investors.

The proportion of funds invested in bonds, which for selected portfolios is shown in parentheses in Exhibit 7.2, declines as higher return is sought. In this particular case, the bonds in all the portfolios are one-year U.S. Treasury bonds. Long term corporate and U.S. Treasury bonds do not appear since the market forecast implies negative total returns for these securities (a result which is consistent with the accelerating inflation and rising interest rate environment prevalent in the 1960's). The interesting, if not surprising result is that short term U.S. Treasury bonds play such a large role over a wide range of portfolio risk in spite of the relatively bullish forecast for the stock market. An expected portfolio return of 0.5 percent per month could be achieved with an investment of 93 percent of available funds in the one-year U.S. Treasury bond. An investor seeking as much as a 2 percent per month return would still hold nearly 20 percent of his portfolio in the short term U.S. Treasury bond. Only for expected returns of about 2.5 percent per month and higher do bonds totally disappear from the portfolio. The apparent reason for the unusually large participation of U.S. Treasury bonds is that the risk/return is so favorable to these securities that they are needed to moderate the

higher return but proportionally much more risky equity securities that make up the remainder of the portfolio. The reason for the large proportional investment in bonds in this efficient set and those examined below will be investigated more thoroughly in Chapter 8.

The segment of the efficient set shown for the standard market forecast appears to be nearly a straight line, although in fact it does curve gradually upward. The significance of the shape of the efficient set curve and the reason for its apparent straightness in this one case, will also be discussed in Chapter 8.

## 7.2 Effects of Various Market Forecasts on the Efficient Set

### 7.2.1 Forecasting Assumptions

The relative impact of changing market forecasts may be ascertained by comparing the portfolio consequences of such changes with the characteristics of the efficient portfolio derived from the standard market forecast. The consequences of interest are the changing shape and location of the efficient sets and the changing composition of the efficient portfolios. In order to judge the relative effects of different market forecasts, the changes in the market indexes must be comparable. Rather than using the magnitude of the change as the criterion for comparability, it seems more important to adopt units of change which are equally likely to occur. Since the stock market is generally more volatile than either of the bond markets, the notion of a bullish (or bearish) stock market forecast probably represents a greater percentage change in the stock

market index than similar feelings about the bond markets imply for the bond market indexes.

In order to obtain forecast changes which are equally likely for each of the indexes, the standard deviation of the historical percentage changes of each index may be used as the unit of change. The following comparisons are based on changes in each of the market indexes of plus or minus one or two standard deviations of the historical changes. A change in the expected total return in any given market of one standard deviation would represent a change of 34 percent of the full range of the historical changes from the average rate of change used in the standard forecast above. In most situations such a large change would probably represent unusually strong feelings about the market, but for the purpose of testing the sensitivity of the model the standard deviation is a convenient unit. In the discussion which follows, a positive change of one standard deviation from the mean of any market index is termed a "bullish" forecast and a similar but negative change is called a "bearish" forecast. A "very bullish" or "very bearish" forecast is represented by a change of two standard deviations from the mean, a change which would correspond to 48 percent of the historical range in variations. The alternative forecasts of expected index changes are shown in Table 7.3.

In addition to his feelings about the expected change in the market indexes, the forecaster may also have a sense of his uncertainty about any expected change which differs from the

TABLE 7.3

The Expected Values and Covariances of the Market Indexes for Bullish and Bearish Market Forecasts

| | Constant Term | AAOUTL | SP1 | TREA05 |
|---|---|---|---|---|
| **Expected value** | | | | |
| Very bullish | 1.00 | 3.36 | 7.59 | 2.36 |
| Bullish | 1.00 | 1.61 | 3.97 | 1.30 |
| Standard | 1.00 | -0.14 | 0.75 | 0.24 |
| Bearish | 1.00 | -1.89 | -3.27 | -0.82 |
| Very Bearish | 1.00 | -3.64 | -6.89 | -1.88 |
| **Covariances (bullish & bearish)** | | | | |
| Constant term | 0.0 | | | |
| AAOUTL | 0.0 | 1.72 | | |
| SP1 | 0.0 | 1.17 | 7.40 | |
| TREA05 | 0.0 | 0.46 | 0.56 | 0.64 |

historically determined standard deviation or, its square, the variance which is the measure actually used in the model. It seems reasonable to assume that if the forecaster has assessed a change in a market index (in either direction) which differs from the average historical rate of change, he is probably less uncertain about his forecast than if he had made no forecast at all. To capture this increase in confidence, the standard deviation of expected index changes will be reduced arbitrarily but uniformly by 25 percent from the standard deviation of the historical values whenever the forecasted expected change differs by any amount from the historical average rate of change.

The expected interaction between any two markets may be measured by the covariance which is the product of the coefficient of correlation between the two markets and the standard deviations of each of the market indexes. It is assumed here that the market index correlation coefficients are a part of the market structure and are unlikely to change over short periods of time. In that case the extent of the interaction between two markets is affected only by the assessed standard deviation of each market index which was discussed just above. The alternative covariance matrices are shown in Table 7.3.

It is worthwhile emphasizing that the forecasting framework defined above is intended only to provide a basis for

evaluating the effects of varying forecasts on portfolio structure. Although it is believed that the assumptions specified above are reasonable, no attempt has been made to build a precise model of the forecasting process.

The results of varying the market forecast are shown in the following exhibits and tables which are organized to facilitate observation of the changing shape and location of the efficient sets and the changing composition of the efficient portfolios, especially in regard to the division between bonds and stocks. A substantial amount of data is provided in the tables so that the reader may focus on specific details if he chooses. The following discussion, however, is devoted to generalizations which are germane to the objectives of this study.

### 7.2.2 Effects of Market Forecast on Location and Shape of Efficient Set

The relative sensitivity of efficient portfolio characteristics to changes in expected index values and to changes in the uncertainty assessments (covariance matrix) may be evaluated using Exhibits 7.3-7.7.[1]

---

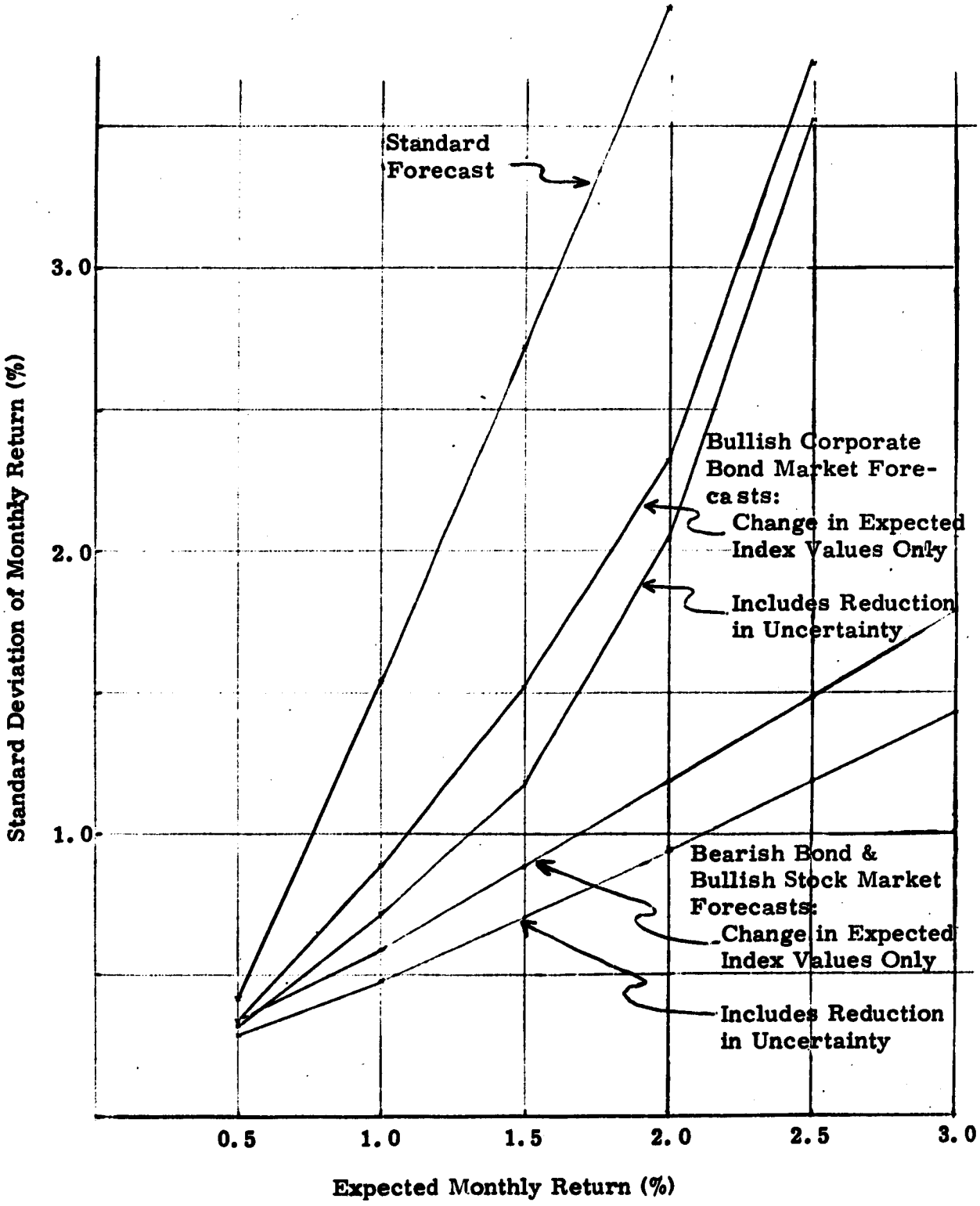
1. In the literature on efficient portfolio analysis, several efficient sets may be shown on the same graph in order to illustrate, for example, the relative efficiency of alternative portfolio strategies for a given market forecast. In this Chapter and in Chapter 9 efficient sets corresponding to different forecasts, rather than different portfolio strategies, are shown on the same graph in order to assess the sensitivity of the model to market changes. In this context the issue of relative efficiency has no meaning since an investor presumably would not hold more than one forecast simultaneously. This issue, the tendency of one portfolio strategy to dominate another, will be examined in Chapter 8. The related text and the labelling of each exhibit should make its purpose clear.

Exhibit 7.3 shows efficient sets for two selected pairs of market forecasts, viz., a pair resulting from a bullish corporate bond market forecast and one produced by a bullish stock market forecast combined with bearish forecasts for both the corporate and government bond markets. Within each pair the change in the expected values of the indexes, relative to the standard forecast, is one standard deviation. The upper efficient set of each pair includes no change in the covariance matrix while the lower member results from a reduction in the assessed uncertainty according to the assumptions previously specified. Relative to the standard forecast it is clear that the principle cause of the altered location of the efficient sets is the change in expected index values. Only a small portion of the shift in location may be attributed to the altered risk assessments contained in the covariance matrix. Although it seems that the observed relative importance of these effects would be maintained under a broader set of assumptions, acceptance of this generalization hinges directly upon acceptance of the reasonableness of the particular assumptions built into the forecasting framework.

Exhibits 7.4 - 7.7 illustrate the affects on the efficient set of a wider range of changes in the expected values of the indexes. In all of these Exhibits, the assessments of uncertainty are specified according to the assumption adopted above. It is apparent that for changes in the individual markets, the efficient set is more affected

Exhibit 7. 3

Sensitivity of Efficient Set Location to
Changes in Expected Index Values and Assessed Uncertainty

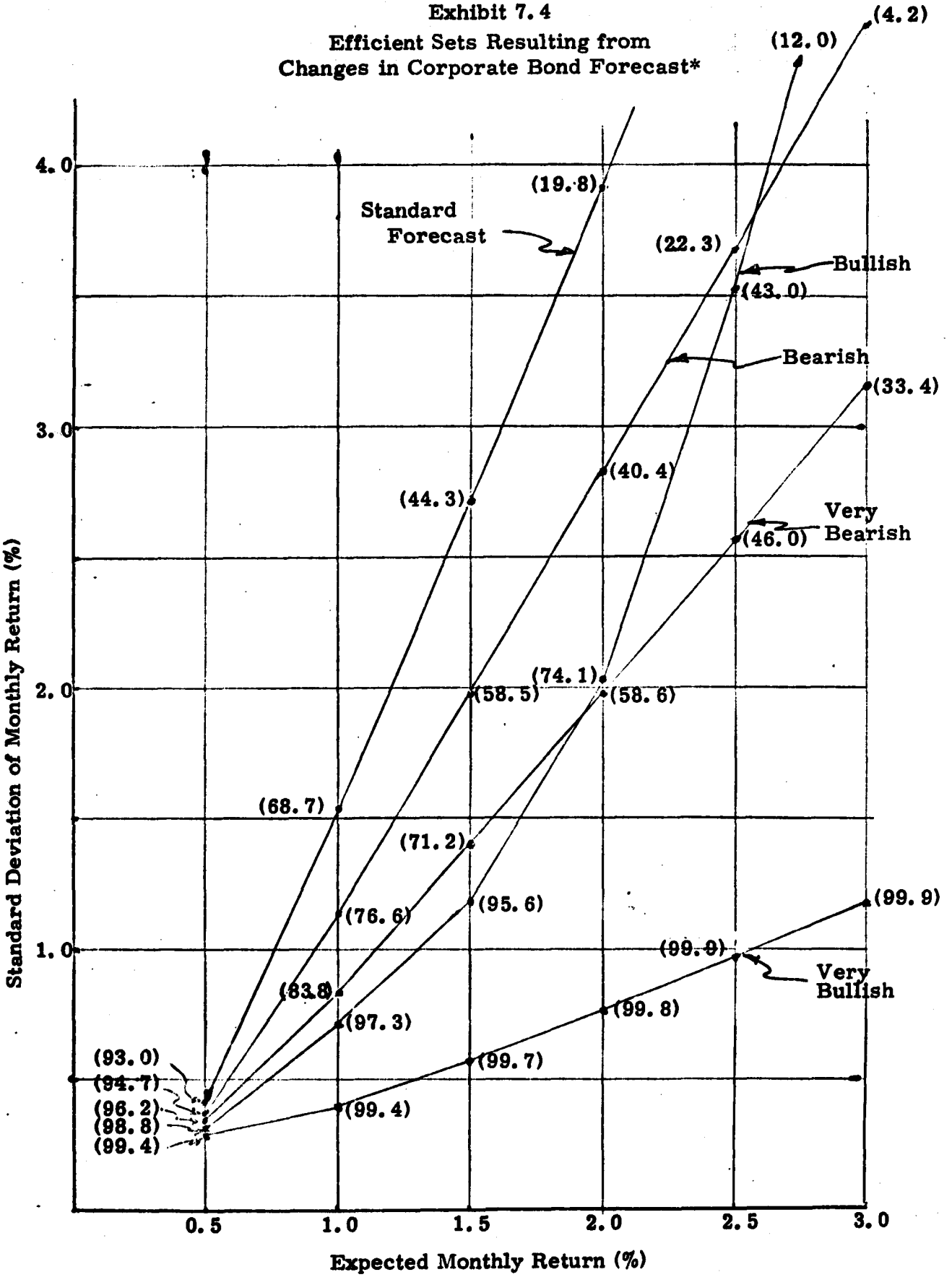


by a bullish stock market forecast than by bullish corporate or government bond market forecasts in the sense that at any given risk level the expected total return is higher. On the other hand, in a bearish stock market the returns on stocks are so low that the efficient set is practically reduced to a single portfolio of short-term U.S. Treasury bonds (see Exhibit 7.6). In addition to offering a wider range of risk/return opportunities as compared to the case in a bearish stock market, bearish forecasts for both the corporate and the government bond markets shift the efficient set to the right of its location for the standard forecast (see Exhibits 7.4 - 7.5). These observations suggest either that the cost of erring in the stock market forecast substantially exceeds that for similar errors in bond market forecasts or that, contrary to assumption, it is unreasonable to think of forecasting changes in the market indexes on the basis of the same probability of differing from the historical averages.

As would be expected, the efficient set shifts to a greater expected return position as the forecast becomes more bullish in each of the markets. It is not immediately clear, however, why more bearish forecasts in the corporate and government bond markets also produce greater expected returns. The answer may be found in an examination of the shifting composition of the portfolios comprising the efficient set. What happens is that in addition to a declining allocation to corporate and U.S. Treasury securities for

Exhibit 7.4

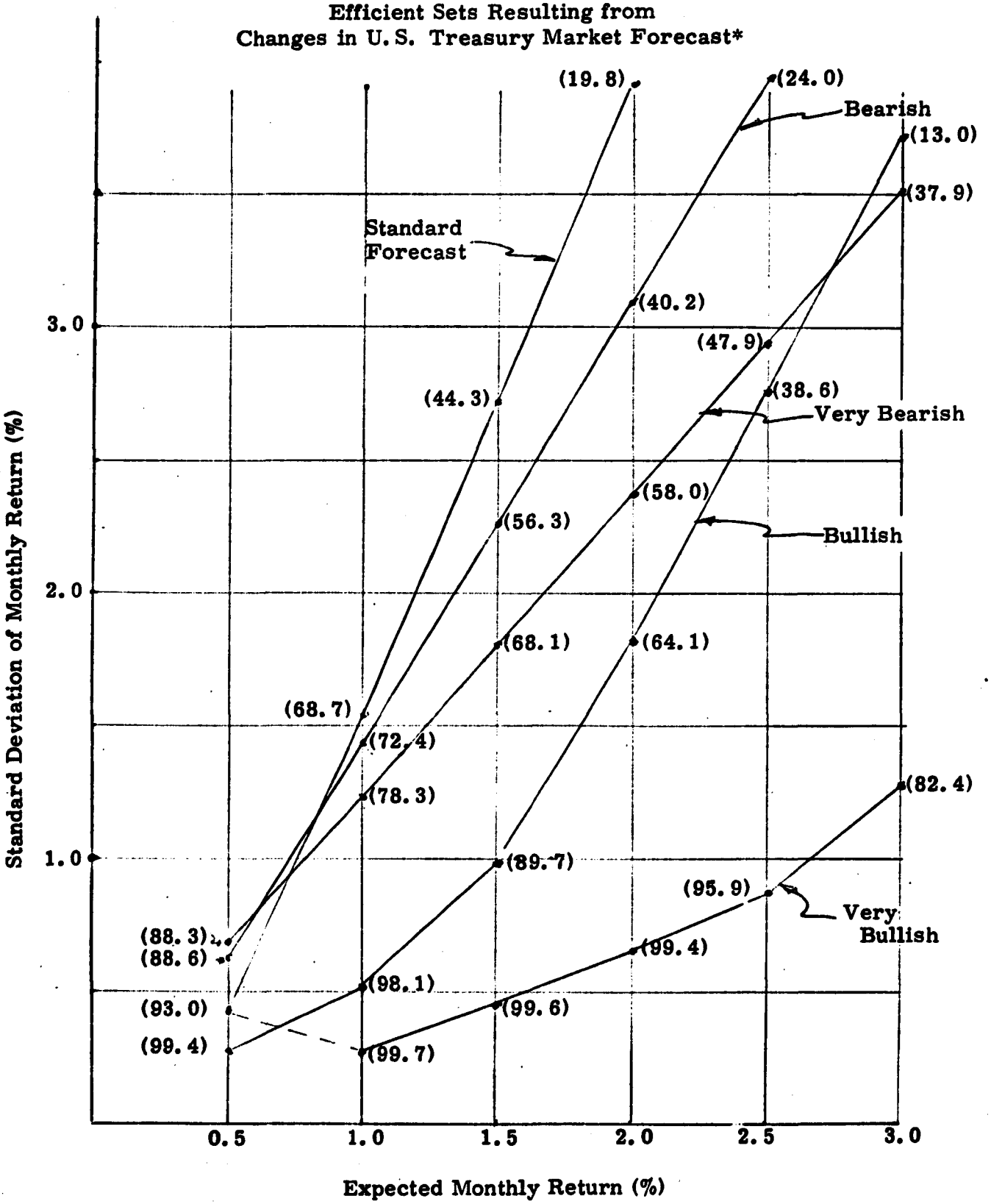
Efficient Sets Resulting from Changes in Corporate Bond Forecast*




*Numbers in parenthesis are percentage investment in bonds for indicated portfolio.

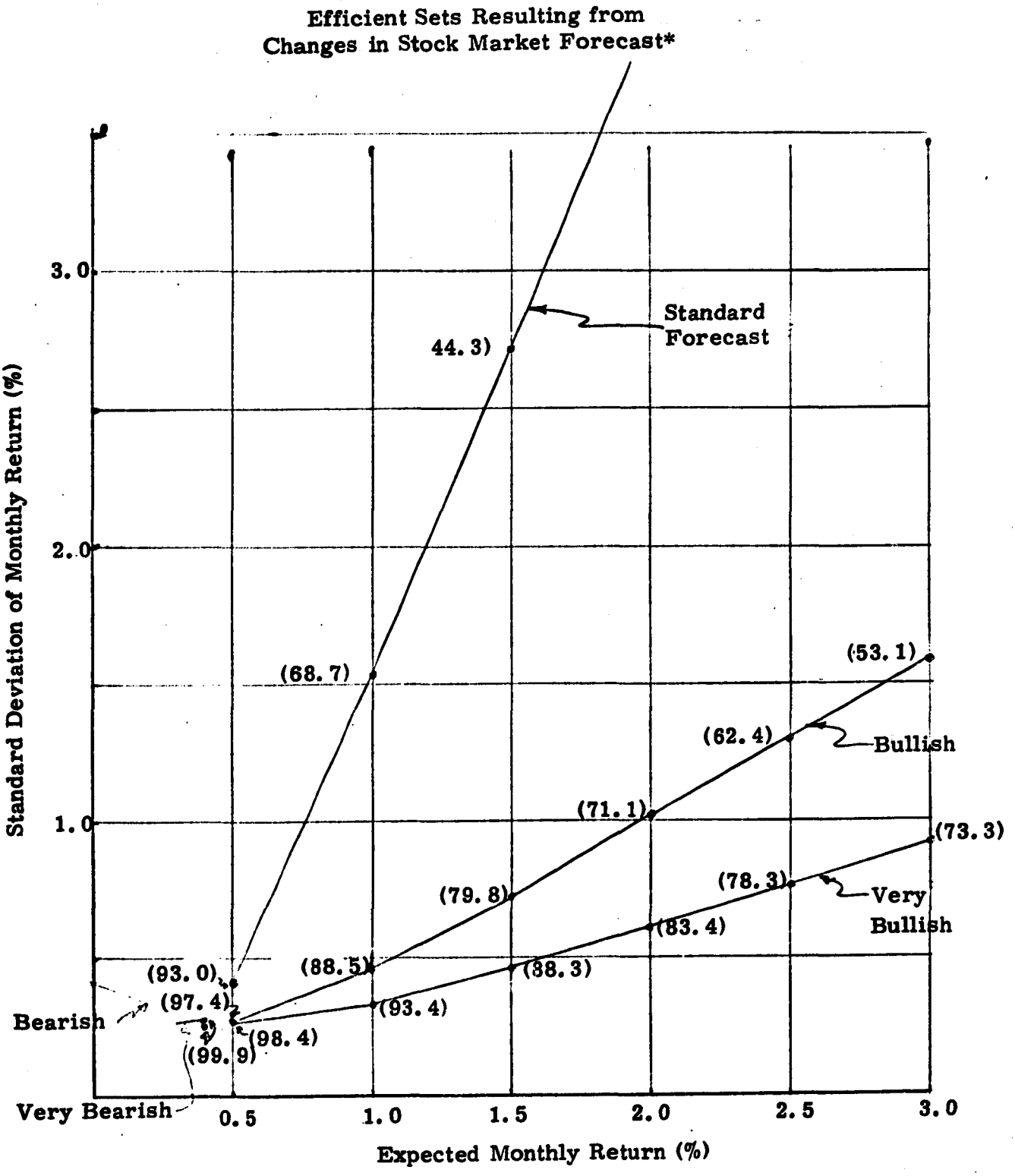
Exhibit 7.5

Efficient Sets Resulting from
Changes in U.S. Treasury Market Forecast*




*Numbers in parenthesis are percentage investment in bonds for indicated portfolio.

Exhibit 7.6




*Numbers in parenthesis are percentage investment in bonds for indicated portfolio.

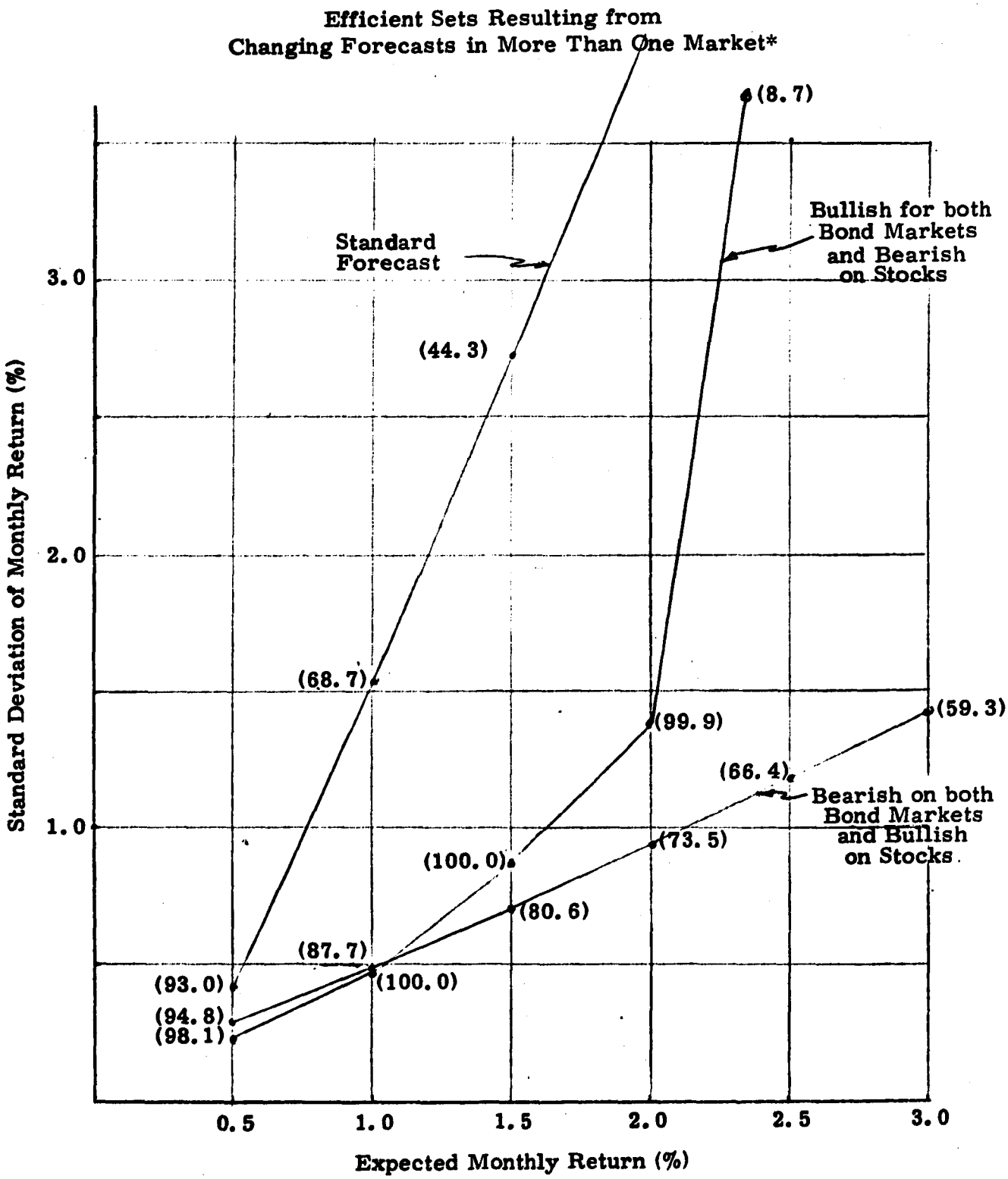
increasingly bearish corporate and government bond market forecasts, respectively, the optimization procedure selects and increasingly emphasizes investments in those equity securities which amount to bond market hedges. For example, EAF, JNJ, KG, MRK, and N all have large, negative corporate bond market sensitivity coefficients. JNJ and KG as well as EK, MOT, PRD, TXN, and XRX all have large, negative government bond market sensitivity coefficients. Although other equity securities have negative bond market coefficients, these particular securities are also distinguished by the unusually large constant terms in their market equations which contribute to portfolio return with no increase in risk. The implication for investment policy is that, aside from prospective developments in the stock market, the careful selection of stocks which move counter to the bond markets can improve portfolio returns materially in a declining bond market.

A further examination of the composition of the efficient set reveals that the bulge in low and medium risk regions generally results from the inclusion of intermediate term U.S. Treasury bonds or long term corporate bonds in the portfolios when the forecasts are bullish for each of these markets. When these forecasts are less favorable, the riskier bonds do not appear in any of the portfolios and the efficient set appears less sharply curved. Under these circumstances, the mid-range of the efficient set consists of portfolios comprising short term U.S. Treasury securities and

low risk stocks. For bullish forecasts in the bond markets, the favorable risk/return trade-off provided by bonds in the medium risk area gradually disappears for higher risk portfolios since there are no bonds with that much risk. At that point the portfolios consist of equity securities which are responsive to bullish bond markets yet possess a less favorable risk/return relationship than the bonds themselves. The slope of the efficient set line consequently tends to be higher beyond the medium risk region, which in turn explains the greater curvature observed under bullish market conditions. The efficient set resulting from a bullish stock market forecast apparently exhibits less curvature since the only change in composition which occurs in creating more risky portfolios along the efficient set is the addition of more of essentially the same kind of security, namely stocks, and in some cases more of the same particular security.

Exhibit 7.7 shows the effects on the efficient set of selected combination forecasts, specifically a bullish bond with a bearish stock market forecast and vice versa. These combinations were chosen to illustrate the implications for portfolio management if it is assumed, as some believe, that the stock and bond markets are countercyclical. (Note that this belief is contrary to the correlation coefficient evidence presented in Chapter 5.) The efficient set resulting from the bullish stock market and bearish

Exhibit 7.7




*Numbers in parenthesis are percentage investment in bonds for indicated portfolio.

bond market forecast is little different from that corresponding to a bullish stock market forecast alone (compare with Exhibit 7.6) since in neither case are bonds other than short term U.S. Treasury issues included. At any given risk level the expected returns are slightly higher since equity stocks which move counter to the bond market are given moderately greater emphasis.

In the low risk region, the efficient set for a bearish stock market and bullish bond market also slightly dominates the efficient set for bullish forecasts in either bond market as a result of including in liberal proportions the discount corporate bonds which are about equally responsive to positive movements in the corporate and government bond markets. At higher risk levels where there are no longer any bonds available, the slope of the efficient set turns sharply upward where the efficient portfolios are invested largely in one stock, namely CIT, which is peculiar in that it is less responsive to stock market movements -- in this case, bearish -- than it is to movements in both bond markets.

## 7.3 Effects of Market Forecast on Composition of Efficient Portfolios

Having briefly examined the effects on the location and shape of the efficient set of varying market forecasts, it is now appropriate to look more closely at the composition of efficient portfolios resulting from different market conditions. Of particular interest will be the indicated overall division of a portfolio between stocks and bonds.

The most striking characteristic of nearly all the efficient portfolios determined under a wide variety of market conditions, is the extraordinarily large proportion of the investments held in fixed-income securities. The least attractive efficient set among those considered in the study is that corresponding to the standard forecast in which each of the indexes was set at its average rate of change over the eight-year sample period. This forecast would be appropriate for an investor who adopts a long range viewpoint and believes that the future is unlikely to differ much from the past. Such a forecast might understandably be labelled a "passive" forecast.

With the standard market forecast, a conservative investor seeking to hold portfolio risk to a standard deviation of expected returns of about 1.0 percent would hold nearly 90 percent of his portfolio in bonds, specifically short term U.S. Treasury securities. Such a portfolio would be expected to yield approximately 0.75 percent per month which would appear to be fairly attractive for such a low level of market risk. An aggressive investor willing to accept a standard deviation of expected returns as high as 4.0 percent would still hold about 15 percent of his portfolio in short term U.S. Treasury issues and could expect to earn about 2.0 percent per month. Even though most institutions probably are not this aggressive, it is clear that bonds play a role

in even an extreme case. Using the same forecast, approximately one-half the portfolio would be held in bonds for an investor seeking about 1.4 percent return per month and accepting a standard deviation of approximately 2.25 percent.

In general, when an investor takes a more active role in forecasting than that implied in the standard forecast, the percentage invested in bonds tends to be even higher at all risk levels than indicated above. The percentage of the total portfolio invested in bonds is indicated on Exhibits 7.4 - 7.7 by the numbers in parentheses alongside particular efficient portfolios. Specific security holdings for selected efficient portfolios using the standard as well as bullish and bearish forecasts of each market index are listed in Tables 7.4 - 7.5. The following discussion of efficient portfolio composition will, however, also draw on results found for other portfolios.

At the low risk level where a standard deviation of expected return equals 1.0 percent, bullish forecasts in the corporate bond, government bond, and stock markets produce indicated proportional bond holdings of approximately 96, 90 and 71 percent, respectively[2]. The corresponding proportions at the same risk level for bearish forecasts in the corporate and government bond markets are 80 percent in both cases. The efficient portfolio for the particular

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2. These percentages, and some of those which follow, are based on a linear interpolation between neighboring calculated efficient portfolios and, although estimates, should be quite close to the actual values.

Table 7.4

Selected Efficient Portfolios for
Three Different Corporate Bond Market Forecasts*

| | Bearish Corporate Bond Market Forecast (-1.89 ppm) | | | Standard Forecast (Corp. bonds, -0.14 ppm) | | | Bullish Corporate Bond Market Forecast (1.61 ppm) | | |
|---|---|---|---|---|---|---|---|---|---|
| Expected Monthly Portfolio Return | 0.5 | 1.5 | 2.5 | 0.5 | 1.5 | 2.5 | 0.5 | 1.5 | 2.5 |
| Std. Dev. of Expected Return | 0.37 | 1.98 | 3.68 | 0.42 | 0.72 | 5.13 | 0.31 | 1.18 | 3.51 |
| Percentage invested in bonds | 94.7 | 58.5 | 22.3 | 93.2 | 44.3 | 0.0 | 98.8 | 95.6 | 43.0 |
| Security | | | | | | | | | |
| TREA01 | 94.7% | 58.5% | 22.3% | 93.2% | 44.3% | - | 86.8% | 7.9% | - |
| AAOUTL | - | - | - | - | - | - | 2.0 | 74.9 | 43.0% |
| AOOIND | - | - | - | - | - | - | 2.5 | - | - |
| BAAUTL | - | - | - | - | - | - | 7.5 | 12.8 | - |
| CIT | - | - | - | - | - | - | - | - | 11.5 |
| DAL | - | 2.0 | 4.1 | - | 4.2 | 11.2% | - | - | - |
| DLT | - | - | - | - | - | - | - | - | 1.1 |
| EAF | 0.9 | 8.5 | 16.0 | 0.5 | 5.2 | 10.2 | - | - | - |
| FCF | - | - | - | - | - | - | - | - | 0.7 |
| GP | - | - | - | - | 5.6 | 9.4 | - | - | 32.8 |
| JNJ | 1.4 | 7.2 | 13.0 | 2.0 | 12.1 | 20.0 | 0.4 | 1.3 | - |
| KG | 1.0 | 8.3 | 15.6 | 2.0 | 16.3 | 33.8 | - | 1.7 | 4.1 |
| MRK | 1.1 | 7.9 | 14.5 | 0.6 | 4.0 | - | - | - | - |
| N | 0.3 | 6.6 | 12.9 | - | - | - | - | - | - |
| PRD | - | - | - | 0.4 | 0.9 | - | - | - | - |
| XRX | 0.3 | 1.0 | 1.6 | 1.1 | 7.3 | 15.4 | 0.3 | 1.2 | 6.9 |

*The government bond and stock market forecasts are held in all cases at the standard forecasts of 0.24 and .35 percent per month, respectively. The bearish and bullish forecasts include a reduction of 25%, relative to that in the standard forecast, in the standard deviation of the expected corporate bond market chage, that is used in the covariance matrix.

Table 7.5

Selected Efficient Portfolios for
Three Different Government Bond Market Forecasts*

| | Bearish Government Bond Market Forecast (-0.82 ppm) | | | Standard Forecast (Gov't bonds, 0.24 ppm) | | | Bullish Government Bond Market Forecast (1.30 ppm) | | |
|---|---|---|---|---|---|---|---|---|---|
| Expected Monthly Portfolio Return | 0.5 | 1.5 | 2.5 | 0.5 | 1.5 | 2.5 | 0.5 | 1.5 | 2.5 |
| Std. Dev. of Expected Return | 0.63 | 2.26 | 3.93 | 0.42 | 2.72 | 5.13 | 0.28 | 0.99 | 2.75 |
| Percentage invested in bonds | 88.6 | 56.3 | 24.0 | 93.2 | 44.3 | 0.0 | 99.4 | 89.7 | 38.6 |
| **Security** | | | | | | | | | |
| TREA01 | 88.6% | 56.3% | 24.0% | 93.2 | 44.3 | - | 89.4% | - | - |
| TREA05 | - | - | - | - | - | - | - | 89.7% | 38.6% |
| AOOIND | - | - | - | - | - | - | 5.5 | - | - |
| BAAUTL | - | - | - | - | - | - | 4.5 | - | - |
| BMY | 0.3 | 0.7 | 1.2 | - | - | - | - | - | - |
| CCB | - | - | - | - | - | - | - | - | 0.9 |
| CIT | - | - | - | - | - | - | - | - | 2.0 |
| CSR | - | - | - | - | - | - | - | 4.0 | 25.7 |
| DAL | - | - | - | - | 4.2 | 11.2 | - | 1.1 | 3.8 |
| DLT | - | 0.7 | 1.2 | - | - | - | - | - | - |
| EAF | - | - | - | 0.5 | 5.2 | 10.2 | - | 1.6 | 4.2 |
| EK | 0.3 | 1.6 | 2.8 | - | - | - | - | - | - |
| FCF | - | - | - | - | - | - | - | - | 1.0 |
| GP | - | - | - | - | 5.6 | 9.4 | - | 0.4 | 5.7 |
| GTU | - | - | - | - | - | - | - | - | 4.3 |
| JNJ | 3.8 | 14.3 | 24.7 | 2.0 | 12.1 | 20.0 | - | - | - |
| KG | 1.8 | 7.1 | 12.5 | 2.0 | 16.3 | 33.8 | - | 2.1 | 5.0 |
| MOT | 1.0 | 3.8 | 6.6 | - | - | - | 0.3 | - | - |
| MRK | - | - | - | 0.6 | 4.0 | - | - | - | - |
| MSU | - | - | - | - | - | - | - | 1.0 | 9.0 |
| PRD | 1.7 | 6.4 | 11.1 | 0.4 | 0.9 | - | - | - | - |
| TXN | 0.3 | 1.2 | 2.1 | - | - | - | - | - | - |
| XRX | 2.0 | 7.9 | 13.7 | 1.1 | 7.3 | 15.4 | - | - | - |

/cont'd

Table 7.5 (cont'd)

*The corporate bond and stock market forecasts are held in all cases at the standard forecasts of -0.14 and 0.35 percent per month, respectively. The bearish and bullish forecasts include a reduction of 25%, relative to that in the standard forecast, in the standard deviation of the expected government bond market change that is used in the covariance matrix.

Table 7.6

Selected Efficient Portfolios for Three Different Stock Market Forecasts*

| | Bearish Stock Market Forecast (-3.27 ppm) | Standard Forecast (Stocks, 0.35 ppm) | | | Bullish Stock Market Forecast (3.97 ppm) | | |
|---|---|---|---|---|---|---|---|
| Expected Monthly Portfolio Return | 0.38 | 0.5 | 1.5 | 2.5 | 0.5 | 1.5 | 2.5 |
| Std. Dev. of Expected Return | 0.28 | 0.42 | 2.72 | 5.13 | 0.28 | 0.72 | 1.29 |
| Percentage invested in bonds | 100.0 | 93.2 | 44.3 | 0.0 | 97.4 | 79.8 | 62.4 |
| **Security** | | | | | | | |
| TREA01 | 100.0% | 93.2% | 44.3% | - | 97.4% | 79.8% | 62.4% |
| BMY | - | - | - | - | 0.3 | 1.5 | 2.4 |
| CCB | - | - | - | - | - | - | 0.8 |
| DAL | - | - | 4.2 | 11.2% | - | 0.7 | 1.6 |
| DLT | - | - | - | - | - | - | 0.3 |
| EAF | - | 0.5 | 5.2 | 10.2 | - | 0.9 | 1.8 |
| EK | - | - | - | - | - | 1.7 | 2.9 |
| GIS | - | - | - | - | - | 0.5 | 1.0 |
| GP | - | - | 5.6 | 9.4 | - | - | 0.9 |
| IBM | - | - | - | - | 0.4 | 2.1 | 3.3 |
| ITT | - | - | - | - | 0.3 | 0.8 | 1.0 |
| JNJ | - | 2.0 | 12.1 | 20.0 | 0.5 | 2.4 | 4.1 |
| KG | - | 2.0 | 16.3 | 33.8 | - | 1.6 | 3.0 |
| KN | - | - | - | - | - | 0.5 | 1.0 |
| MOT | - | - | - | - | - | 0.4 | 0.5 |
| MRK | - | 0.6 | 4.0 | - | - | 2.0 | 3.6 |
| N | - | - | - | - | - | 0.3 | 0.9 |
| PEP | - | - | - | - | - | 0.8 | 1.4 |
| PKN | - | - | - | - | - | 0.6 | 1.0 |
| PRD | - | 0.4 | 0.9 | - | 0.3 | 0.9 | 1.5 |
| SGL | - | - | - | - | - | - | 0.3 |
| TXN | - | - | - | - | - | 0.8 | 1.2 |
| UCL | - | - | - | - | - | - | 0.4 |
| XRX | - | 1.1 | 7.3 | 15.4 | - | 1.2 | 2.0 |

/cont'd

Table 7.6 (cont'd)

*The corporate and government bond market forecasts are held in all cases at the standard forecasts of -0.14 and 0.24 percent per month, respectively. The bearish and bullish forecasts include a reduction of 25%, relative to that in the standard forecast, in the standard deviation of the expected stock market change that is used in the covariance matrix.

magnitude of bearish stock market forecast is non-existent at this risk level. At the higher risk level where a standard deviation of expected returns equals 3.0 percent, a bullish forecast in the corporate bond market suggests a holding of about 53 percent in bonds; in the government bond market, 30 percent; and in the stock market, the proportion is probably near zero although the calculation was not made for such a high expected return. Bearish forecasts in corporate and government bonds produce portfolios at that high risk level which contain 37 and 42 percent bonds, respectively. Again, the efficient set for stocks is non-existent for the same reason as above. In summary, virtually all portfolios resulting from a wide variety of forecasts and having an indicated standard deviation of 1.0 percent or less are comprised of more than 75 percent of fixed-income securities. At higher levels of risk in the neighborhood where a standard deviation is 3 percent, it is common to have portfolios about 40 percent invested in bonds except where the stock market is clearly and strongly bullish, in which case the allocation to bonds may drop to near zero. It should be emphasized that at either the conservative or the aggressive risk level the expected portfolio returns can be quite high, even with large bond holdings.

Of the unusually large proportional investment in bonds observed above, generally the largest and most frequently appearing particular bond holding is in the shortest maturity (one-year)

U.S. Treasury issue. Most of the efficient portfolios with standard deviations of less than 0.5 percent and expected returns of 0.5 percent are invested almost entirely in the one-year U.S. Treasury bond. At higher levels of risk and return, the short term government issue diminishes in participation to nearly zero for most market forecasts. The most interesting exception is that the efficient set resulting from a bullish stock market forecast still contains more than 50 percent in short term bonds for a portfolio with an expected return of 3.0 percent per month. The bullish behavior of the stocks produces a very high expected return but also a commensurately high market risk. In order to keep the risk at an acceptable level, it is necessary to mix in with the stocks a substantial proportion of short term government bonds which have low risk and produce a modest expected return. The model shows that to minimize risk it is insufficient to diversify only among stocks, as seems to be a common practice, since such a strategy fails to account for unexpected movements of the entire stock market itself. It seems common to think of bonds, particularly short term instruments, as stand-by or reserve investments held while waiting for the stock market to improve. The above example illustrates, however, that even in a bullish stock market bonds, by broadening the scope for diversification, share with stocks the primary function of minimizing risk while producing an efficient expected return.

The relative risk/return trade-off of bonds compared to stocks suggests that the portfolio objective is achieved with a higher proportion invested in bonds than might normally be expected. Although no systematic research has been undertaken on the question as a part of this study, it is generally recognized that most institutional investors were reducing their bond/equity ratios during the decade of the 60's, if not eliminating bond holdings altogether. This was a period when most market forecasts were bullish for stocks and neutral or bearish for bonds although, of course, there were interim swings in market expectations. For institutions which had the necessary flexibility in their investment policies, it is probably reasonable to suppose that during the recent decade they had less than one-fourth of their portfolios invested in bonds on average. In the light of the above results, it is apparent that such a strategy implied that the investors were holding non-efficient portfolios or that they were investing at a point on the efficient set which was far more risky than anything investigated here. It seems unlikely, however, that there were many institutional investors who sought portfolio returns in excess of 3 percent per month. The tentative conclusion which must be drawn, then, is that the former argument that investors generally held non-efficient portfolios of too small a proportion in bonds is valid.

Although the short term U.S. Treasury issue is by far the most active portfolio participant under a wide range of market conditions, longer term bonds are found in several portfolios when the forecast is appropriate. When the forecast for the government bond market is bullish, the short term 1-year as well as the 2-, 3-, and 5-year U.S. Treasury bonds play a large role in portfolios with moderate market risk. In one case where the standard deviation is about 1.0 percent, 90 percent of the portfolio is held in the 5-year U.S. Treasury bond. For another more risky portfolio with a standard deviation of 3.7 percent, the 5-year issue still received 13% of the total portfolio investment. (Note that since the return on the 5-year U.S. Treasury bond is also used as the government bond market index, this particular security is probably treated somewhat preferentially and should not be too narrowly distinguished from, for example, the 4-year or 10-year issues). For a very bullish forecast, these same government issues appear in many of the portfolios and the 10-year issue is found (12 percent of the portfolio) in the portfolio at the most risky end of the range of portfolios covered here.

When the forecast for both bond markets is bullish and the stock market outlook is bearish, large proportions of the low risk portfolios are invested in 1-, 2-, 4-, and 5 year U.S. Treasury issues. Five percent of a medium risk portfolio is

held in the 30-year U.S. Treasury bond. Most of these portfolios also comprise material holdings of corporate bonds. Corporate discount bonds tend to participate in a portfolio only when both bond markets are bullish. As opposed to some of the other sample forecasts in which only one or the other of the bond markets has a bullish or bearish forecast, the nature of the investment in discount bonds is important since the coincident movement of the two bond markets is highly likely. (The correlation coefficient between the two bond market indexes is 0.44. Discount bonds appear in none of the portfolios consequent to a bullish forecast in only one of the bond markets.) In such circumstances and for low risk portfolios, the greatest emphasis is generally placed on the deepest discount, lowest coupon bond. The extent of participation diminishes for bonds with coupons in the intermediate range but then increases again for the highest coupon bond (5.06 percent) included in the sample. For portfolios of moderate and higher risk, the pattern of participation reverses with intermediate coupon bonds (3.25 and 4.25 percent) receiving a greater fraction of the funds than other discount bonds. These observations are consistent with the expectations developed from an examination of the mean and standard deviations of the raw return data in Chapter 5.

Utility and industrial bonds of various quality levels appear in largest size when the corporate bond market alone is

bullish. The pattern of participation is different, however, than that expected following the analysis of the raw return data. In Chapter 5, it was observed that industrial bonds of all quality levels had a higher average total return and lower standard deviation of returns during the sample period than comparable quality utility bonds. Nevertheless, utility bonds appear more frequently and in greater size than industrial bonds.

The apparent reason for this inconsistency is that the statistical analysis in Chapter 5 focussed on average behavior during the sample period and failed to account for the sensitivity of individual bonds to market movements. The measurement of the sensitivity of security returns to market changes was, of course, the purpose of building the regression-based security models in Chapter 6. An examination of the relative magnitudes of the corporate bond index sensitivity coefficients shows that at each quality level those for utility bonds exceed those for industrial bonds. Although utility bonds may in fact be more sensitive to corporate bond market forecasts than industrial bonds, this conclusion must be accepted cautiously since the use of the Aa-utility returns as the corporate bond index undoubtedly means that the utility bond security models are superior to those for industrial bonds -- at each quality level the coefficients of determination, $R^2$, are higher -- and that the efficient portfolio calculation is probably

biased in favor of utility bonds. For the same reason it is likely that the Aa quality level, as represented in the models, probably shares some of the characteristics of the A and Aaa quality levels. With these qualifications in mind, the indicated portfolio allocations to either type of corporate bond at the various quality levels should be interpreted as "tendencies" rather than precise conclusions.

For a bullish corporate bond market forecast, the least risky portfolio constructed in this study contains 2 percent of the Aa and 7.5 percent of the Baa utility bond and 2.5 percent of the A-rated industrial bond. At higher risk levels, the industrial bond disappears and both the utility bonds increase in participation until the most risky portfolios are reached. For example, a portfolio with a standard deviation of 1.2 percent and an expected return of 1.5 percent per month contains 75 percent in Aa and 13 percent in Baa utility bonds. The pattern of participation is essentially the same for a very bullish corporate bond market forecast but the amount of investment in these bonds is larger.

The only other occurrences of corporate-bond participation are for a bullish government bond market when Baa utility bonds and A industrial bonds appear and for bullish government and corporate bond markets with a bearish stock market when Aa and Baa utilities are found. In all of these instances, however, the proportional investment is quite small.

It may be that the procedure for selecting bond data could account for a portion of the high proportional participation of bonds in efficient portfolios, but it is believed that the effect is insignificant. The use of the standard deviation of returns on a composite of individual bonds underestimates the volatility of the individual bonds to the extent that the bonds are not perfectly correlated which, of course, they are not. Based on some rough assumptions it was estimated that the sample standard deviation for the composite may be about 88 percent of the standard deviation for an individual bond on average. Although the magnitude of this discrepancy is somewhat disturbing, its impact on the efficient set composition is negligible since bonds that would be characterized by this error seldom appear in efficient portfolios. The bonds most subject to the underestimation of risk are those from the Moody's series and, to a lesser extent, the bonds with different coupon levels from the Salomon Brothers' series. The data for the U.S. Treasury bonds should be unaffected since they are obtained from yield curves which very nearly reflect the yields on individual bonds. The largest proportion of the bond holdings in the efficient sets is composed of U.S. Treasury issues. It therefore appears that the one major (unavoidable) bias in this study in the treatment of bonds and stocks did not noticeably affect the conclusions.

## Chapter 8

## The Role of Bonds and the Organization of Investment Activities

The previous chapter was devoted to determining the implications for portfolio composition of measuring risk and return for both bonds and stocks in a uniform manner. This was accomplished by constructing efficient risk/return portfolios from both sets of securities taken together. It was found that over a wide range of risk levels and under a variety of market conditions efficient portfolios contained an apparently large proportion of bonds, larger than is probably the case for many institutional portfolios. Implicit in the analysis was the assumption that the sample securities were generally representative of the range of investment options open to the typical institutional investor. Specifically, when such an investor strategically decides to increase his "reserves", he probably looks first to the broad class of bonds and maybe more narrowly at short term obligations which behave much like the short term U.S. Treasury issues included in the sample. Although such investments generally are less risky than other securities, it is apparent that they are still risky. In this Chapter, a riskless asset -- meaning one with zero standard deviation -- is added to the investment options in order to isolate the role of risky bonds within the efficient portfolio of risky assets.

The purposes of this Chapter are to determine the extent to which the bonds held in efficient portfolios may be serving the function of the riskless asset and to evaluate the residual function of bonds as a risky asset. These two issues will be investigated with the aid of the Separation Theorem which will be reviewed briefly. An additional objective is to determine whether the expected performance of integrated efficient portfolios can be approximated first by constructing separate efficient bond and stock portfolios and then by combining these into a single portfolio. The intention is to evaluate the costs of decentralizing a strategic element of the investment decision.

## 8.1 The Separation Theorem

The Separation Theorem was orginally articulated and proven by Tobin[1] and a proof of its broader applicability has been provided more recently by Lintner[2]. On the basis of essentially the same assumptions about market and investor behavior that are used in this study, Lintner showed that given a riskless asset the optimal mix of risky securities was the same for all investors who have identical market forecasts. Each investor satisfies his own

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1. Tobin, James, "Liquidity Preference as Behavior Toward Risk", Review of Economic Studies, XXVI (Feb., 1958), pp. 65-86.

2. Lintner, John, "The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets," Review of Economics and Statistics, February, 1965, pp. 13-37.

risk/return preference by leveraging the optimal portfolio of risky securities through either lending or borrowing at the rate of return on the riskless asset. Lintner demonstrated that all portfolios on an efficient set of risky securities except one, the optimal risky portfolio, would be dominated by a linear combination, often called the market opportunity line, of the optimal risky portfolio and the riskless asset. The general nature of this relationship is illustrated in Exhibit 8.1. For those institutions which are not permitted to borrow, the market opportunity line does not extend above the point of the optimal portfolio.

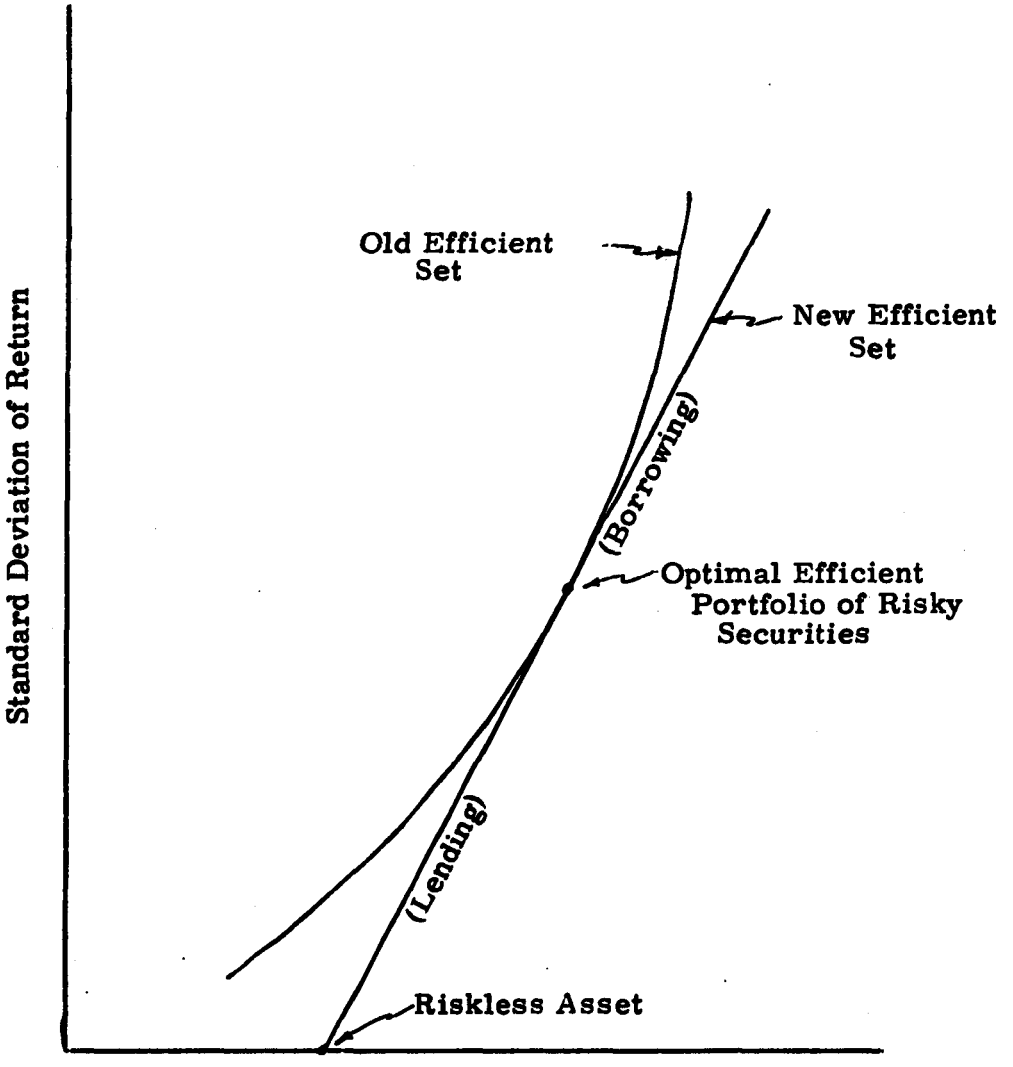
Inclusion of a riskless asset in the set of portfolio opportunities implies that the investment decision is properly made in two separate stages, hence the Separation Theorem: first, the optimal portfolio of risky assets is identified at the point of tangency of a line through the rate of return of the riskless asset with the efficient set of risky securities; and second, the optimal portfolio of risky assets is combined with the riskless asset to obtain the desired trade-off between risk and return on the overall portfolio.

## 8.2 The Role of Bonds as a Riskless vs. Risky Asset

The Separation Theorem can be used to help explain the large proportional investment in bonds observed in the previous chapter. This approach is suggested by the fact that the one-year U.S. Treasury bond, the shortest maturity bond used in this study,

Exhibit 8.1

Application of the Separation Theorem



comprised much of the bond holdings and may thus have assumed the role of the riskless asset in the Separation Theorem. Furthermore, the apparent near straightness of some of the efficient sets suggests that at least one security in the portfolios, presumably the short term Treasury issue, has a near zero standard deviation or a zero correlation coefficient with all other securities. This observation is also consistent with the possibility that these bonds are not truly a part of the risky asset portfolio. Two related methods -- the first inferential and the second more direct -- of isolating the riskless and risky asset roles of bonds are used.

The first method of determining the role of bonds as a riskless asset is structured as follows. Beginning with an efficient set containing only equity securities -- the class of securities traditionally thought of as risky assets in applications of the Separation Theorem -- a riskless asset is added and the proportion of the total investment held in this security at each risk level is observed. The riskless asset most appropriate to this study would be the 30-day U.S. Treasury bill. Since the 30-day maturity corresponds exactly to the investment horizon used here, the monthly total return on a Treasury bill purchased at the beginning of the month is known precisely (the standard deviation is zero). This step will show how much of a riskless bond (the Treasury bill being just a special kind of bond) is needed in an efficient portfolio of equity securities

to obtain any given level of portfolio risk.

At each risk level the amount of Treasury bills held is compared with the amount of bonds found in the integrated efficient portfolio, meaning one containing both bonds and stocks. If at each risk level the amount of bonds held is less than an or equal to that for the Treasury bill, then the bonds in integrated efficient portfolios of risky assets would seem to serve primarily the function of the riskless asset. If on the other hand the amount invested in bonds is greater, then it will generally be important to include bonds in order to obtain the most efficient portfolios.

Before reporting the results of this first method of comparing riskless and risky bond holdings, an important difficulty encountered in the analysis should be mentioned. The above approach for analyzing the efficient portfolio role of bonds was devised after the computer program for calculating efficient sets was no longer available. The analysis was therefore limited to those efficient sets which had already been calculated. For a given market forecast, efficient sets of stocks alone and of stocks and bonds together are needed. One pair of efficient sets prepared for use in the last section of this chapter and one other pair are suitable for the present analysis. The range of market forecasts covered by these two pair of efficient sets is narrow so the conclusions drawn from the analysis can only be considered suggestive.

A less important difficulty is that in neither of the above cases was the efficient set for stocks alone extended far enough into the high risk, high return region to determine precisely the tangency point for the market opportunity line. Although the slope of this line could be estimated reasonably well from the available data, the proportion of total funds invested in riskless assets at any given risk level is sensitive to errors in estimating this slope. For this reason as well, then, the conclusions are only tentative.

Exhibits 8.2 and 8.3 each show efficient sets for stocks alone and for bonds and stocks combined. In each Exhibit the market forecast is the same for both efficient sets. The market forecast used in Exhibit 8.2 represents approximately equal expected monthly returns in all three market sectors: corporate bonds, 0.750 percent; U.S. Treasury bonds, 0.646 percent; and stocks, 0.719 percent. (The basis for this forecast will be explained in the next section where this example is used more extensively.) The forecast used in Exhibit 8.3 is relatively more bullish for bonds than for stocks: corporate bonds, 1.61 percent; U.S. Treasury bonds, 1.30 percent; and stocks, 0.35 percent. If risky bonds do make an important contribution to the efficient portfolio, it should be apparent under the latter market conditions.

The estimated locations of the market opportunity lines are also shown in Exhibits 8.2 and 8.3. The lines originate at the

riskless rate of return of 0.35 percent per month which was the average return on 30-day U.S. Treasury bills during the eight-year sample period.

The proportion of funds in an efficient portfolio invested in the riskless asset is directly proportional to the distance of that portfolio from the riskless asset along the market opportunity line. For a zero-risk efficient portfolio, all funds would be invested in the Treasury bill. If the acceptable risk equals the risk of the optimal portfolio of risky assets, none of the riskless asset would be held. For intermediate levels of risk, the proportional investment in Treasury bills would be scaled accordingly.

At selected risk levels, the proportional investment in Treasury bills is shown in Table 8.1 for the two sets of market forecasts used in Exhibits 8.2 and 8.3. Based on the efficient set of stocks and bonds taken together, the proportional holding of bonds at corresponding risk levels are also shown. For both sets of forecasts and over a wide range of risk levels, the proportion of funds held in bonds exceeds that invested in U.S. Treasury bills and the difference in the proportions increases with increasing risk. These observations suggest that bonds play a role beyond that of the riskless asset used in the Separation Theorem. The value of that extended role is suggested by the increase in expected return at each risk level, which is reported in the Table, that results from including bonds. Although the increase in expected portfolio

Table 8.1

Comparative Investment in U.S. Treasury Bills (the Riskless Asset) at Selected Risk Levels for Two Market Forecasts

| Market Forecast | Portfolio Risk Level (Std. Dev.) | Investment in U.S. Treas. Bills based on Market Opportunity Line | Investment in Bonds based on Integrated Efficient Set | Increase in Expected Return Resulting from the Inclusion of Bonds |
|---|---|---|---|---|
| **Approximately equal expected returns in each market (Exhibit 8.2)** | | | | |
| | 1.13 | 73.4% | 79.1% | 0.05% |
| | 2.05 | 51.7 | 61.1 | 0.05 |
| | 2.98 | 29.8 | 43.3 | 0.05 |
| **Relatively bullish forecast for both bond markets (Exhibit 8.3)** | | | | |
| | 0.79 | 77.4 | 95.4 | 0.10 |
| | 1.16 | 66.8 | 93.7 | 0.34 |
| | 1.72 | 50.8 | 86.1 | 0.44 |

Exhibit 8.2

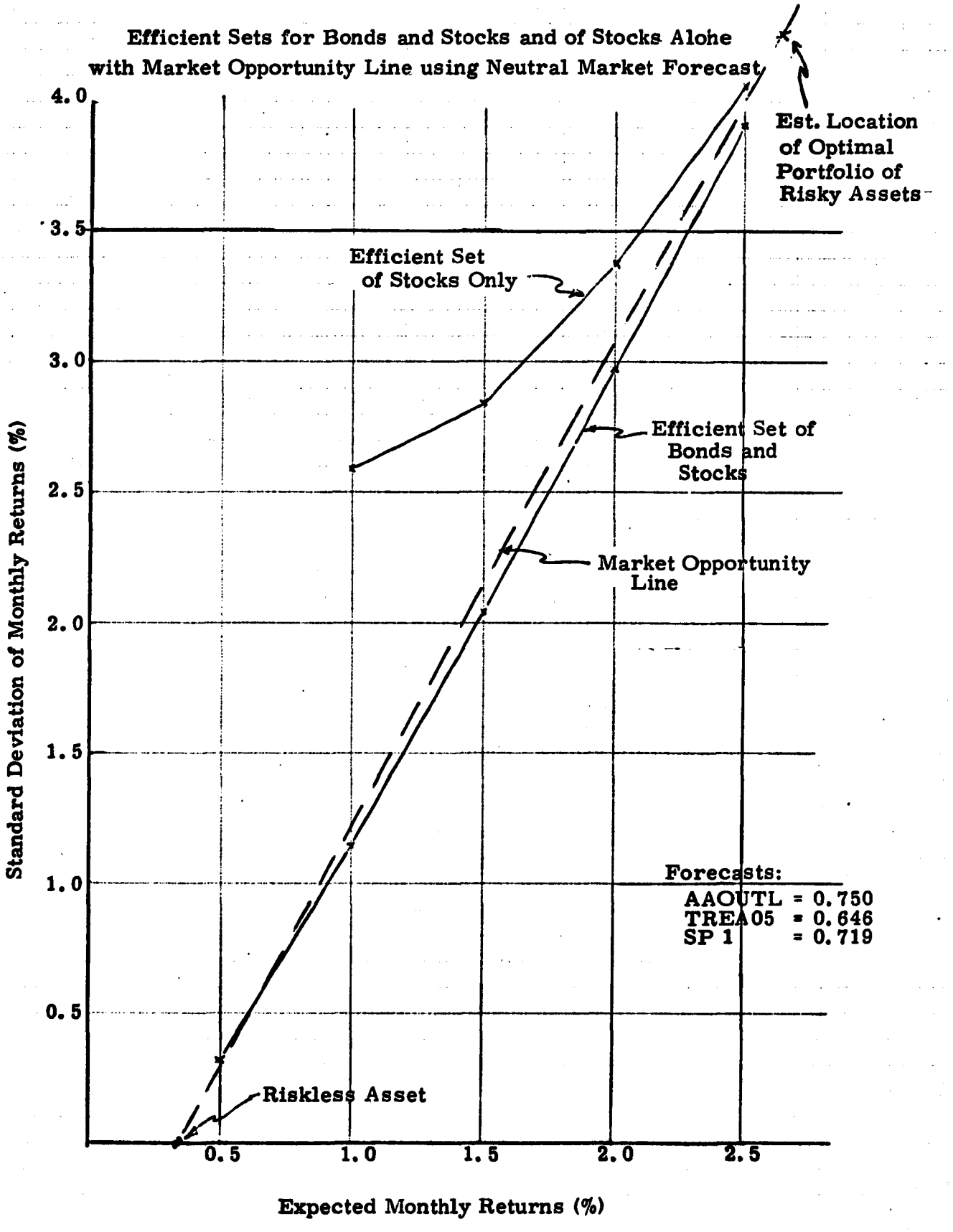
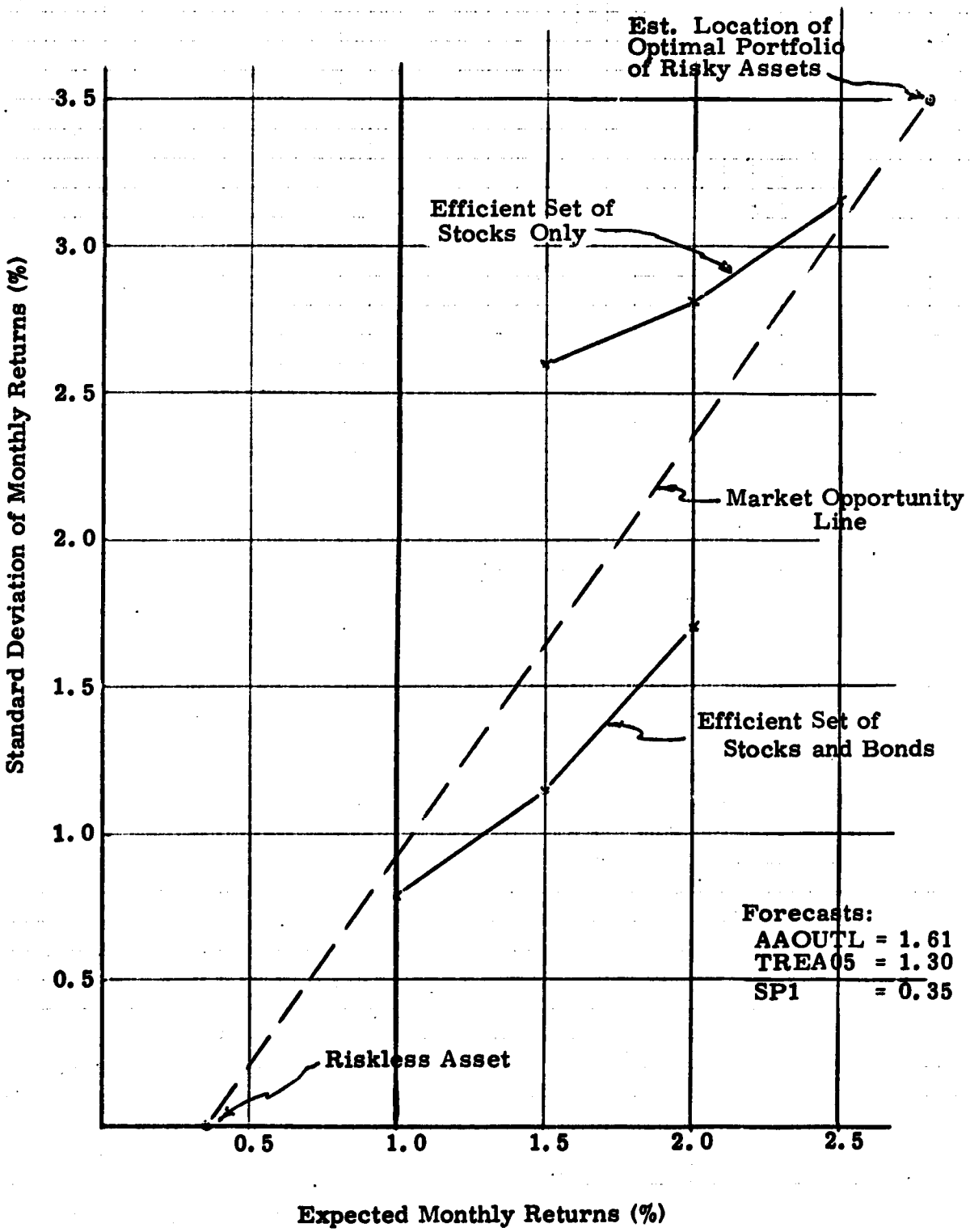

Efficient Sets for Bonds and Stocks and of Stocks Alone
with Market Opportunity Line using Neutral Market Forecast
Est. Location of Optimal Portfolio of Risky Assets
Efficient Set of Stocks Only
Efficient Set of Bonds and Stocks
Market Opportunity Line
Riskless Asset
Forecasts:
AAOUTL = 0.750
TREA05 = 0.646
SP 1 = 0.719
Standard Deviation of Monthly Returns (%)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.5
1.0
1.5
2.0
2.5
Expected Monthly Returns (%)

Exhibit 8.3

Efficient Sets of Bonds and Stocks and of Stocks Alone
with Market Opportunity Line using Bullish Bond Market Forecast



return is nominal when the expected changes in the market indexes are approximately equal, the addition of bonds accounts for up to 20 percent of the expected return when the bond markets are expected to be relatively bullish.

The relative magnitudes of the proportional investments in Treasury bills and bonds suggest, however, that a large fraction of the bonds may be playing the role of the riskless asset. This is consistent with the observation in the previous chapter that for most market forecasts bond investments are concentrated in the one-year U.S. Treasury bond, the shortest maturity bond used in the efficient set analysis. It therefore appears that the one-year U.S. Treasury bond -- and, to a smaller extent, other short term U.S Treasury bonds -- serve as surrogates for the riskless asset, even though they have been considered risky assets in the integrated efficient set.

An estimate of the role of bonds as risky assets may be obtained by eliminating the bonds that apparently behave like the riskless asset. It is assumed that of the total bond holdings an amount equal to the proportion held in Treasury bills, as determined from the market opportunity line, serves as the riskless asset. The remaining bonds would be those that actually contribute to portfolio risk along with equities. The proportion of risky assets invested in "risky" bonds is shown in Table 8.2 for the two market forecasts and for selected risk levels. This proportion increases from

Table 8.2

Estimation of the Implied Investment in "Risky" Bonds

| Market Forecast | Risk Level (std. dev.) | Investment in Riskless Asset (1) | Investment in Bonds (2) | Implied Investment in Risky Bonds (3)=(2)-(1) | Risky Bonds as Proportion of Risky Assets (4)=(3)÷(100-(2)) |
|---|---|---|---|---|---|
| **Approximately equal expected returns in each market (Exhibit 8.2)** | | | | | |
| | 1.13 | 73.4% | 79.1% | 5.7% | 21.4% |
| | 2.05 | 51.7 | 61.1 | 9.4 | 19.5 |
| | 2.98 | 29.8 | 43.3 | 13.5 | 19.2 |
| **Relatively bullish forecast for both bond markets (Exhibit 8.3)** | | | | | |
| | 0.79 | 77.4 | 95.4 | 18.0 | 79.6 |
| | 1.16 | 66.8 | 93.7 | 26.9 | 81.0 |
| | 1.72 | 50.8 | 86.1 | 35.3 | 71.7 |

20 percent for the neutral forecast up to about 80 percent when the outlook for bonds is bullish.

Based on the limited evidence available, it may be concluded tentatively that a large fraction of the role played by bonds in the efficient sets found in Chapter 7 is attributable to the function of the riskless asset used in the Separation Theorem. Depending on the market forecast, however, it seems that the remaining bonds may comprise an important part of the risky assets. It appears that an investor with an essentially passive market forecast may invest only a small proportion of his funds in risky bonds, a proportion (at about one-fifth) that would seem to be roughly in line with observed practice. On the other hand, an investor who undertakes a more active market forecast may substantially alter the composition of his risky assets between equities and bonds. Although this balanced role of bonds and equities seems more reasonable than the consistently large holdings of bonds found in Chapter 7, it has been achieved with commitment to a riskless asset which, depending on the amount of acceptable risk, may be quite large relative to typical portfolio practice.

The second method of identifying the riskless and risky asset roles of bonds is to determine directly the optimal risky asset portfolio of bonds and stocks which should be combined with Treasury bills. The attractions of this method are that the Treasury bill alone will fill the role of the riskless asset and that the optimal portfolio

will contain only those bonds, if any, which act as a risk asset.

Although the same difficulty in identifying the optimal portfolio of risky assets at the point of tangency with the market opportunity line exists as it did above, the Separation Theorem procedure can be applied in this method to the efficient sets resulting from the full range of market forecasts used in Chapter 7. At two levels of portfolio risk -- one presumed to be appropriate to a conservative and the other to an aggressive investor -- the allocation of funds to Treasury bills, bonds and equities is shown in Table 8.3. It is assumed that the investor can not borrow funds to leverage the returns on the optimal portfolio. Thus, when the desired level of portfolio risk exceeds that on the optimal portfolio of risky assets, the efficient portfolio is taken from the efficient set rather than the market opportunity line.

The role of a portion of the bonds in efficient portfolios as a riskless asset is apparent in the results shown in Table 8.3. For the standard market forecast and when either of the bond market forecasts is bearish, bonds, as a risky asset, are virtually supplanted by Treasury bills which do appear in substantial proportions in portfolios at the selected risk levels. On the other hand, for bullish bond market forecasts, bonds play a significant role as a risk asset; Treasury bills play only a limited role in one case. When

Table 8.3

Allocation of Funds Amoung U.S. Treasury Bills, Bonds and Equities at Selected Risk Levels for a Variety of Market Forecasts*

| Market Forecast | Portfolio Risk: 1.0 Std. Dev. Treasury Bills | Bonds | Equities | Portfolio Risk: 2.5 Std. Dev. Treasury Bills | Bonds | Equities |
|---|---|---|---|---|---|---|
| "Standard"** | 74.4% | 5.1% | 21.5% | 35.9% | 12.7% | 51.4% |
| Corporate | | | | | | |
| Bullish | 15.2 | 81.1 | 3.7 | 0.0 | 64.8 | 35.2 |
| Bearish** | 78.0 | 0.9 | 21.1 | 35.0 | 2.3 | 62.7 |
| U.S. Treasury | | | | | | |
| Bullish | 0.0 | 88.5 | 11.5 | 0.0 | 45.9 | 54.1 |
| Bearish** | 79.2 | 1.7 | 19.1 | 48.0 | 4.2 | 47.8 |
| Stocks | | | | | | |
| Bullish** | 37.5 | 33.6 | 28.9 | 0.0 | 20.0 | 80.0 |
| Bearish | 0.0 | 99.9 | 0.1 | 0.0 | 99.9 | 0.1 |

*The market forecasts for the efficient sets on which the tabulated data are based correspond to those shown in Exhibits 7.4-7.6 and are shown in detail in Table 7.3.

**The efficient sets for these forecasts are so nearly straight that the optimal efficient portfolio tended to fall outside the range of available data. The tabulated data are based on a very rough estimation of the location of the optimal efficient portfolio and its composition.

the outlook for the stock market is bullish, the role of bonds as a risk asset is reduced in favor of the riskless asset for the conservative portfolio and is limited to only a moderate proportion at the higher risk level. Significantly, in those cases where bonds play an important role as a risky asset, the bonds tend to be the intermediate and long term U.S. Treasury issues and corporate obligations. The exception occurs for a bearish stock market forecast in which case bond holdings are limited to short term U.S. Treasury issues since the bond market forecasts are insufficiently bullish to warrant investing in longer term issues.

Based on the two approaches examined above, it may tentatively be concluded that a large portion of the bonds appearing in the efficient portfolios of Chapter 7 was serving as a surrogate for the riskless asset. Thus, rather than being surprised at the large investment in bonds, it seems that the extent of investment in a riskless asset to achieve reasonable levels of portfolio risk is quite substantial. Having isolated the role of bonds as a riskless asset, however, it is also apparent that bonds, like stocks, play an important role as a risky asset. Rather than appearing in efficient portfolios under almost any market circumstances, as seemed to be the case in Chapter 7, the proportional investment in bonds rises and falls depending primarily on the market forecast in a manner

very much like that for stocks. With regard to the foremost objective of this study, the available evidence seems sufficiently reliable to draw the broad conclusions that stocks and bonds share the risk asset role and that the allocation of funds is quite sensitive to the forecast in both markets.

## 8.3 The Feasibility of Separating Bond and Stock Investment Decisions

The conclusion that stocks and bonds should be evaluated together when constructing efficient portfolios of risky assets runs counter to the practices of many investing institutions. The issue to be examined in this section is whether investment decisions regarding bonds and stocks as a risky asset, can be made separately and, if so, under what conditions.

The investment function in most if not all large financial institutions is subdivided into departments according to market sector. Thus, the research on and selection of bonds, stocks, and mortgages among other securities are conducted separately. The allocation of total funds among departments typically is determined by an investment policy committee which may be comprised of members from each of the departments as well as senior executives of the firm. The basis for the allocation decision will generally be the forecast for each of the market sectors.

The reasons underlying the division of investment responsibility according to market sector were reviewed in Chapter 2, but among the most important would seem to be the fact that investment

managers have gained their experience vertically -- that is, by long association with the securities of a particular sector -- rather than horizontally, meaning across several sectors. An argument favoring the horizontally developed expertise would have to show that the general problems of analyzing risk and return at the portfolio level and matching these portfolio characteristics to investor preferences are more critical than the selection of individual securities.

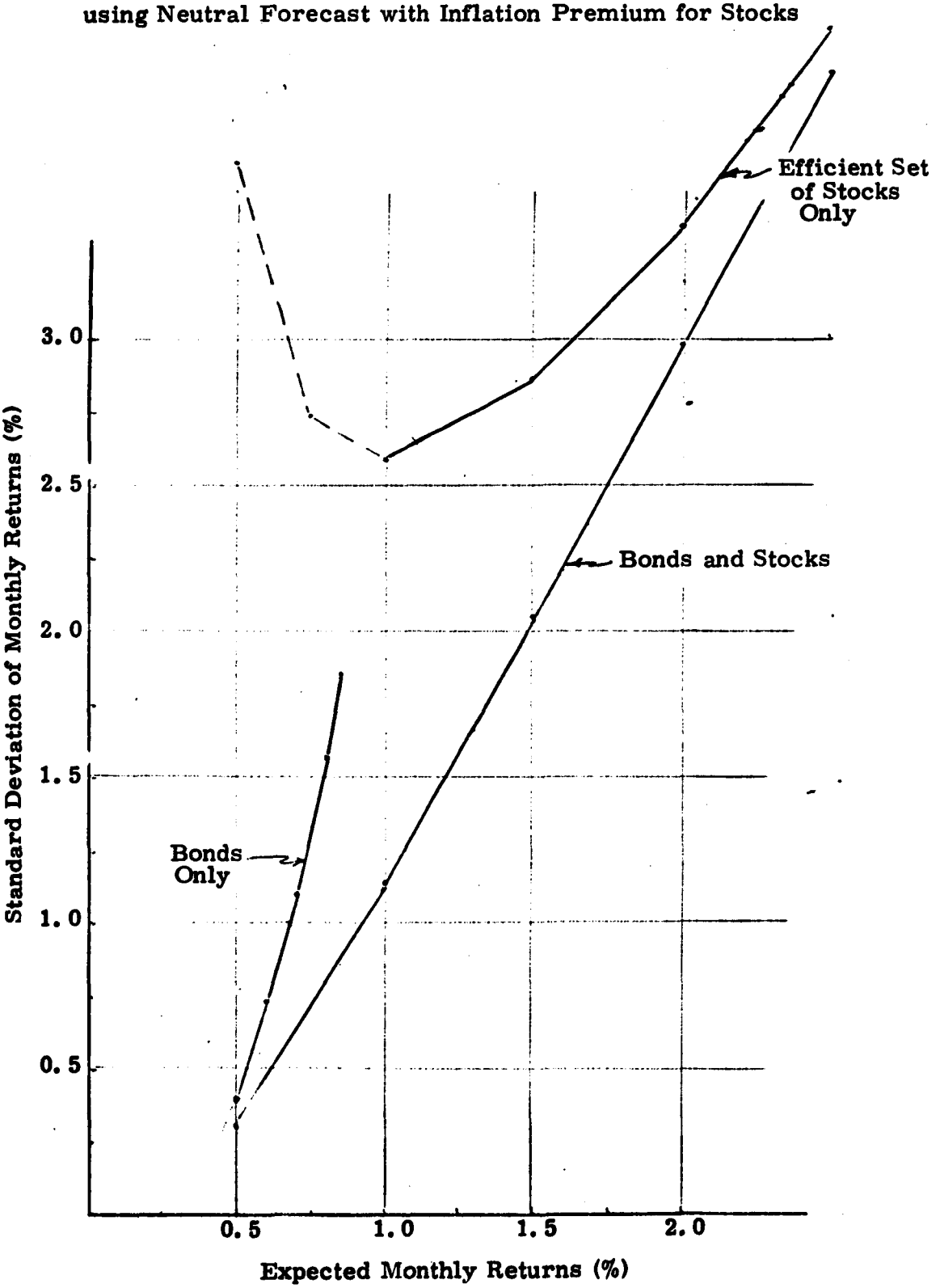
In any event, the issue that is raised by the conclusions of the prior section is the cost of departmentalizing the investment function where cost is measured relative to the investment performance that may be achieved by evaluating all types of securities together. To pose the question more positively, and recognizing that the existing structure of the investment function is most likely rather rigid, what policies might be adopted such that the portfolios offered by each department might be combined to approximate efficient portfolios? Essentially, the problem is to compare suboptimally constructed portfolios with the integrated efficient portfolios generated according to the procedures described in this study. In the following paragraphs, the consequences of suboptimization resulting from the separation of bonds and stocks will be studied and recommendations for improving portfolio efficiency subject to the constraint of departmentalization will be made.

Using the methodology of this study, departmentalization is achieved simply by separating the stocks and bonds and computing an efficient set for each group of securities. No attempt is made to model the actual investment decision-making process since it would then be difficult to distinguish which aspect of the process caused the differential performance relative to the optimal approach. In both the suboptimal and the integrated efficient set models, the same equations are used to represent each security's sensitivity to the markets, identical market forecasts are used, and the procedures for selecting efficient portfolios is the same. The only difference between the two approaches in constructing efficient portfolios is that bonds and stocks are separated. Consequently, the contribution to portfolio risk that comes from the correlated movement of returns between securities of the two classes is bypassed within the efficient portfolio calculation and thus must be supplied independently.

An efficient set for bonds and one for stocks, which together represent the best opportunities for the equity and bond investment departments acting independently, along with the integrated efficient set are shown in Exhibit 8.4. The market outlook used is the same for each efficient set. The market forecast is the same as that used in one of the examples (see Exhibit 8.2) in the prior section. Specifically, the investor is assumed to have no specific

Exhibit 8.4

**Efficient Sets for Bonds and Stocks Separately and Combined using Neutral Forecast with Inflation Premium for Stocks**



feelings about expected price changes in either of the bond markets or the stock market. The expected total return on each market index is set equal to its current yield last month (June 1970) except that, on the assumption that an inflation premium already is built into the current yields on the bond indexes, the current yield on stocks is adjusted to reflect the current rate of inflation. This basis for a market forecast might characterize an essentially passive investor. The forecasted monthly rate of change in percent for each index is 0.750 for corporate bonds, 0.646 for U.S. Treasury bonds, and 0.719 for stocks. A comparison with the efficient sets in Exhibits 7.4 - 7.7 shows that the integrated efficient set resulting from this forecast produces at each level of portfolio risk a slightly higher expected portfolio return than that corresponding to the standard forecast which was previously used as a reference but a somewhat lower expected return than for most other efficient sets. To that extent it is reasonably typical of the efficient sets that have been evaluated previously.

The efficient set of bonds and the efficient set of stocks are both dominated by the integrated efficient set as would be expected. It is important to note that, at least for this particular forecast, the separated efficient sets do not overlap one another. The efficient stock portfolio of minimum risk has a higher standard deviation

and higher expected return than the efficient bond portfolio of maximum risk. The fact that bonds as a class are not dominated by stocks is further evidence of the distinctive role played by bonds in investment portfolios, especially for those investors having a low risk threshold. Sample portfolios from each of the separate efficient sets are shown in Tables 8.4 and 8.5.

If the individual stock and bond efficient sets are accepted as representing the range of best possible portfolio opportunities offered by the equity and bond management departments respectively, the problem faced by the investment policy committee is the combination of specific stock and bond portfolios to obtain the overall portfolio risk/return parameters desired. Since it is difficult to quantify investor preferences reliably, some fiduciary portfolio managers group their clients according to the amount of risk each is willing to assume as judged subjectively. The funds of investors in a particular risk group are then invested in a portfolio suitable to their needs. Thus, there may be one high risk portfolio for aggressive investors and another of lower risk for more conservative investors. Variations in portfolio combination, of course, may be implemented to meet the special needs of particular investors but the starting point would generally be one of two or three standard portfolios rather than the continuum inherent in the complete efficient set. For the institution which manages its own investments, of

TABLE 8.4

Selected Suboptimally Efficient Portfolios of Bonds

| Expected Total Return | 0.50 | 0.60 | 0.70 | 0.80 | 0.85 |
|---|---|---|---|---|---|
| Std. Dev. | 0.40 | 0.73 | 1.10 | 1.56 | 1.85 |
| Security | | | | | |
| TREAO1 | 65.4 % | 18.6 % | - | - | - |
| TREAO2 | 15.8 | 12.2 | - | - | - |
| TREAO3 | 11.0 | 49.2 | 55.0 % | - | - |
| TREAO5 | - | - | - | 17.5 % | - |
| AAOUTL | 6.3 | 5.4 | - | - | - |
| AA2.81 | 0.4 | 4.3 | 10.5 | 14.2 | - |
| AA3.25 | - | 2.1 | 10.4 | 22.9 | 48.2 % |
| AA3.75 | - | - | 2.1 | 7.6 | - |
| AA4.69 | 0.9 | 7.0 | 20.7 | 37.8 | 51.8 |
| AA5.06 | - | 1.1 | 1.3 | - | - |
| | 100.0 % | 100.0 % | 100.0 % | 100.0 % | 100.0 % |

TABLE 8.5

Selected Suboptimally Efficient Portfolios of Stocks

| Expected Total Return | 1.0 | 1.5 | 2.0 | 2.5 |
|---|---|---|---|---|
| Std. Dev. | 2.59 | 2.86 | 3.38 | 4.07 |
| Security | | | | |
| AYP | 7.2 % | 4.7 % | 1.7 % | - |
| CCB | - | - | - | 2.9 % |
| CIP | 3.6 | 0.9 | - | - |
| CIT | - | 6.8 | 11.2 | 15.3 |
| CLL | 1.5 | - | - | - |
| CSR | 1.0 | 2.1 | 1.2 | - |
| DAL | - | - | 0.4 | 2.9 |
| EAF | - | 0.6 | 1.6 | 2.1 |
| EK | 0.2 | 1.9 | 1.5 | - |
| GIS | 0.7 | 4.6 | 6.2 | 5.7 |
| GP | - | 2.6 | 11.2 | 19.9 |
| HOU | - | 1.8 | 3.1 | 2.0 |
| JNJ | 2.3 | 5.3 | 6.9 | 7.2 |
| K | 3.9 | 5.0 | 5.0 | 3.5 |
| KG | 1.3 | 7.7 | 12.0 | 16.2 |
| LSG | 1.4 | 0.2 | - | - |
| MRK | 1.2 | 2.6 | 2.4 | 0.1 |
| NNG | 1.5 | 3.2 | 3.3 | 1.4 |
| NSP | 26.1 | 22.7 | 19.2 | 11.4 |
| PEP | 1.1 | 0.6 | - | - |
| PG | 7.4 | 2.7 | - | - |
| SB | 3.1 | 4.0 | 3.8 | 1.4 |
| SCG | 3.8 | 0.2 | - | - |
| SD | 2.3 | - | - | - |
| T | 15.5 | 8.1 | 0.2 | - |
| WBC | - | 1.7 | 2.7 | 2.4 |
| WIN | 14.9 | 8.1 | 2.4 | - |
| XRX | - | 2.0 | 4.0 | 5.7 |
| | 100.0 % | 100.0 % | 100.0 % | 100.0 % |

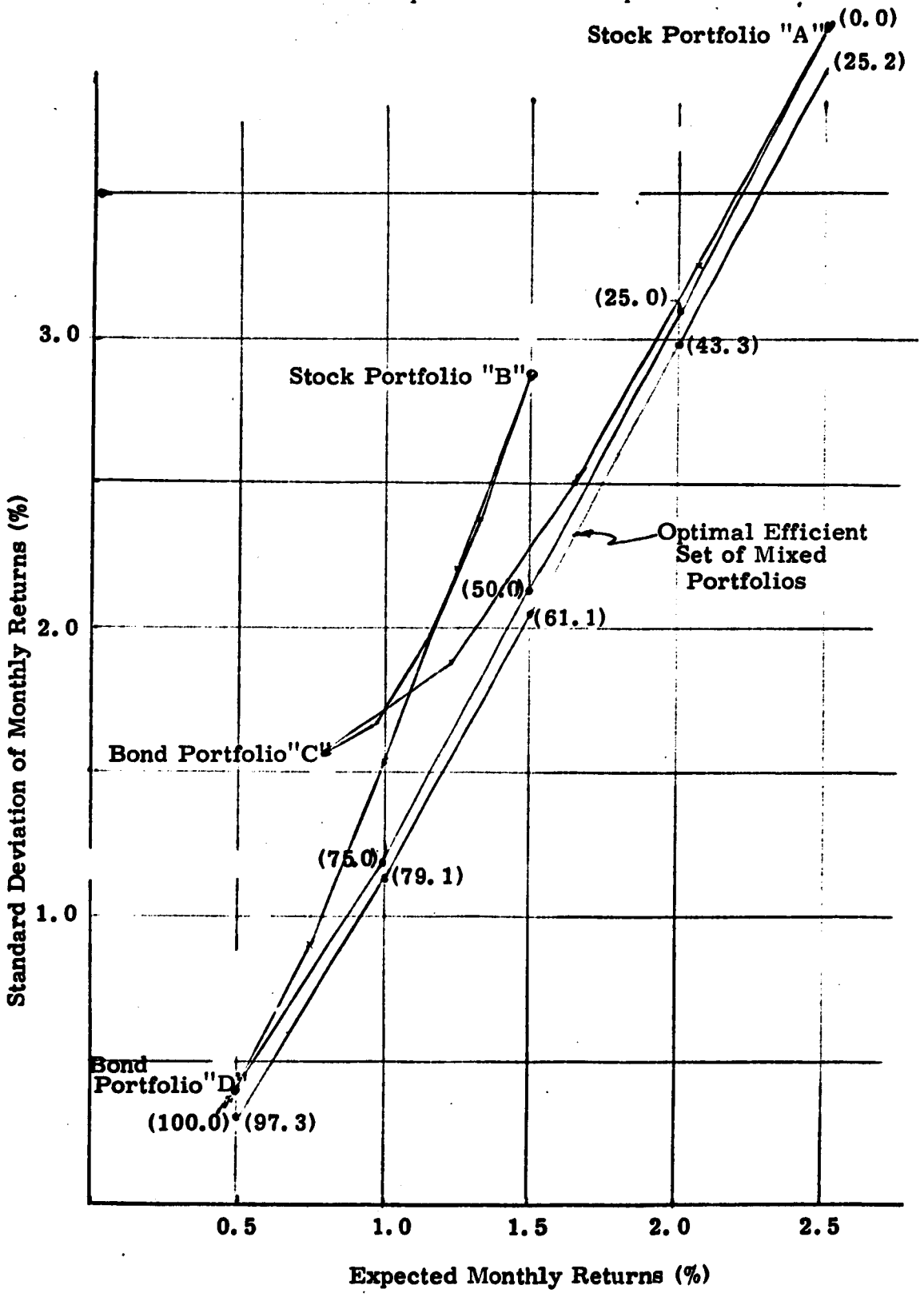
course, it need only consider that portfolio which most closely approximates the acceptable level of risk.

It will be shown that the most efficient combination of bond and stock portfolios is obtained by mixing a very high risk stock portfolio with a very low risk bond portfolio. A portfolio appropriate to a particular type of investor is then created by altering the proportionate mixture of these two portfolios. Conversely, it is inappropriate for either the equity or the bond management departments to recommend a portfolio from its own efficient set in an attempt to match risk preferences prior to accounting for the contribution of the portfolio from the other department.

Possible combinations of particular bond and stock portfolios are illustrated in Exhibit 8.5. The suboptimal efficient sets are calculated by treating the selected bond and stock portfolios as if they were single securities having risk and return characteristics that are derived by weighting the characteristics of the component securities by their proportional representation in the particular portfolio. The problem is thus nothing more than finding the efficient combinations of two "securities" except that the covariance -- which in this case is not computed internally -- must be estimated or calculated independently. In this case, the actual covariances for each pair of portfolios were calculated with the aid of the computer program used in constructing efficient portfolios.

Exhibit 8.5

The Costs and Implications of Suboptimization*




*Numbers in parenthesis are percentage investment in bonds for indicated portfolio.

Using these convariances, the portfolio parameters of four suboptimal efficient sets were calculated using paired combinations of high and low risk stock portfolios with high and low risk bond portfolios. These are shown in Exhibit 8.5. Of the sample efficient sets resulting from the combination of selected stock with selected bond portfolios, the combination of the high risk stock portfolio with the low risk bond portfolio (combination "A-D" in the Exhibit) dominates all other combinations.

Although it is mathematically possible that a contrary example could be designed, the dominance of A-D type portfolio combinations may be considered the general case for three reasons. Firstly, at the extremes of portfolio risk, the suboptimally efficient portfolios are likely to lie very near the integrated efficient set since the integrated efficient portfolio will be composed almost entirely of the security class representative of that extreme, namely, stocks at the high risk end and bonds at the low risk end of the efficient set. Secondly, at these extremes, for a given expected portfolio return the portfolio risk will be about the same for both the suboptimal and the integrated efficient portfolios since the covariance that has been overlooked by separating bonds and stocks has little impact in portfolios composed primarily of one type of security. Finally, unless the addition of the covariance factor in combinations of low risk stock portfolios and high risk bond portfolios, such as "B-C" in the Exhibit, can provide a significant reduction of total portfolio risk,

these particular portfolios are unlikely to appear in a dominantly efficient combination. The specified exception would have an impact only if the covariance were very small or possibly negative relative to that between the extreme portfolios. The detailed evidence underlying Table 5.4, however, indicates that the correlation coefficients between high risk bonds and low risk stocks tend to be of about the same magnitude or somewhat larger than those between stocks and bonds of more dissimilar risk. Furthermore, the product of the standard deviations (the remaining component of the covariance factor) is higher for high risk bond and low risk stock portfolios than it is for the more extreme combinations. These two points taken together suggest that the reduction in risk resulting from the covariance factor generally will be less for combinations of bond and stock portfolios of nearly similar risk than for the more extreme combinations. The conclusion, which seems unlikely to be affected materially by the market forecast, is that the most efficient suboptimal set of portfolios will be obtained by combining a high risk stock portfolio with a low risk bond portfolio in varying proportions.

Having developed the best procedure for combining suboptimal efficient stock and bond portfolios, certain limited observations regarding the cost of this approach, measured in terms of sacrificed efficiency, may be made. The suboptimal combination of portfolios A and D is only nominally less efficient than the integrated

efficient set. The only issue is how much less efficient a combination of portfolios such as A and D might be.

A comparison of the A-D portfolio combination and the integrated efficient set shows that for all risk levels the sacrificed expected portfolio return is on the order of 0.10 percent per month. For many investors the loss of portfolio return equivalent to more than 1.0 percent per year would be considered significant, but probably not drastic. It is likely, however, that this illustration using a rather neutral or passive market forecast reflects only the minimum cost of departmentalizing the investment decision. Although further analysis is required, the loss of portfolio efficiency would probably be larger for the active forecaster during bullish bond or stock markets due to the greater impact of the covariance term.

If, in spite of the costs, an institution delegates to individual investment departments the responsiblity for recommending a portfolio of securities from its sector according to the procedure developed above, a question arises regarding the differences in composition of risky asset portfolios between the suboptimal combination and the integrated efficient set. For comparative purposes, the compositions of the integrated and suboptimal efficient portfolios shown in Exhibit 8.5 are reported in Table 8.6 at four different risk levels. (The use of equal risk portfolios in the comparison assumes the investor has a utility function which sets a ceiling on the risk he will accept, a very simplistic assumption. The results of the

TABLE 8.6

Comparative Compositions of Selected Suboptimal and Optimal Efficient Portfolios

| | Optimal | Suboptimal | Optimal | Suboptimal | Optimal | Suboptimal | Optimal | Suboptimal |
|---|---|---|---|---|---|---|---|---|
| Std. Dev. (%) | 1.13 | 1.13 | 2.05 | 2.05 | 2.98 | 2.98 | 3.92 | 3.92 |
| Expected Return (%) | 1.00 | 0.98 | 1.50 | 1.45 | 2.00 | 1.94 | 2.50 | 2.42 |
| Security | | | | | | | | |
| TREAO1 | 76.0 % | 51.2 % | 48.5 % | 34.3 % | 20.8 % | 18.3 % | - | 2.5 % |
| TREAO2 | 2.0 | 12.2 | 6.7 | 8.3 | 1.0 | 4.4 | - | 0.6 |
| TREAO3 | - | 8.5 | 1.4 | 5.8 | 14.1 | 3.1 | 14.6 % | 0.4 |
| AAOUTL | - | 4.9 | - | 3.3 | - | 1.8 | - | 0.2 |
| AA2.81 | - | 0.3 | - | 0.2 | - | 0.1 | - | 0.0 |
| AA3.25 | 1.1 | - | 4.5 | - | 7.4 | - | 10.6 | - |
| AA4.69 | - | 0.7 | - | 0.5 | - | 0.3 | - | 0.0 |
| CCB | 1.4 | 0.7 | 2.8 | 1.4 | 4.1 | 2.1 | 5.6 | 2.8 |
| CIT | 3.4 | 3.5 | 6.5 | 7.3 | 9.7 | 11.0 | 12.9 | 14.7 |
| DAL | 1.3 | 0.7 | 2.4 | 1.4 | 3.5 | 2.1 | 4.7 | 2.8 |
| EAF | 0.3 | 0.5 | 0.6 | 1.0 | 0.9 | 1.5 | 1.2 | 2.0 |
| FCP | - | - | 0.2 | - | 0.4 | - | 0.7 | - |
| GIS | 0.0 | 1.3 | - | 2.7 | - | 4.1 | - | 5.5 |
| GP | 6.4 | 4.5 | 12.2 | 9.5 | 17.8 | 14.3 | 23.6 | 19.1 |
| HOU | - | 0.5 | - | 1.0 | - | 1.4 | - | 1.9 |
| JNJ | 1.6 | 1.6 | 2.4 | 3.4 | 3.3 | 5.2 | 4.0 | 6.9 |
| K | - | 0.8 | - | 1.7 | - | 2.5 | - | 3.4 |
| KG | 4.7 | 3.7 | 8.5 | 7.7 | 12.4 | 11.7 | 16.3 | 15.1 |
| MRK | - | 0.0 | - | 0.0 | - | 0.1 | - | 0.1 |
| NNG | - | 0.3 | - | 0.7 | - | 1.0 | - | 1.3 |
| NSP | - | 2.6 | - | 5.4 | - | 8.2 | - | 11.0 |
| SB | - | 0.3 | - | 0.7 | - | 1.0 | - | 1.3 |
| WBC | - | 0.5 | - | 1.1 | - | 1.7 | - | 2.3 |
| XRX | 1.9 | 1.3 | 3.2 | 2.7 | 4.6 | 4.1 | 5.9 | 5.5 |
| | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |

comparison, however, should not be sensitive to this assumption since the suboptimal and integrated efficient sets are so close together.)

At each risk level, the differences in portfolio structure are surprisingly small. The following distinctions, however, are worth noting. The portfolios have very nearly the same bond/equity ratio at low levels of risk, but at higher levels, where the suboptimal portfolio includes virtually no bonds, 25 percent of the integrated portfolio is still invested in bonds. At low risk levels, suboptimal portfolios are comprised of a higher allocation to slightly more risky bonds, such as intermediate U.S. Treasury bonds and a small amount of corporate bonds. As portfolio risk increases, this relationship is reversed. Thus, it appears that for conservative investors, the suboptimal strategy involves assuming a greater proportion of total portfolio risk and seeking more of the total expected return via fixed income securities as compared to the integrated strategy. For more aggressive investors, nearly all of the risk and return in the suboptimal portfolio are derived from equity investments. This relationship seems consistent with observed investment practice. At high levels of risk, the comparisons indicate, however, that portfolio performance could be improved modestly by taking more risk and seeking more return by using bonds more aggressively.

In the equity portions of the suboptimal and integrated efficient portfolios, it is surprising that there are not more major

differences. Almost exactly the same set of stocks, in varying proportions, appears in both portfolios at all risk levels. The most outstanding exception is NSP which appears in the suboptimal portfolio only and in rather large size at high risk levels. In Chapter 6 (See Table 6.8), it was found that NSP and several other minor exceptions in the comparison (CIT, HOU, K, KG, MRK, NNG, and SB) all possess security characteristics that are more like those of U.S. Treasury bonds than stocks. The government bond-like behavior of NSP was particularly strong. It appears, therefore, that in the suboptimal strategy the diminished role of bonds in high risk portfolios is supplanted by stocks which in fact behave very much like bonds. Relative to the integrated efficient portfolios, the stocks are nevertheless inefficient and it probably would be better if they were replaced by the securities, namely bonds, which exhibit the more efficient portfolio characteristics.

The conclusions of this Chapter may be summarized as follows. The bonds found in the efficient portfolios of Chapter 7 primarily serve the function of the riskless asset used in the Separation Theorem. But, more importantly for the purposes of this study, bonds also play a significant role as a risky asset; the division of risky assets between bonds and stocks is very sensitive to the forecast in <u>both</u> the bond and stock markets. In a separate analysis, it was found that the costs of departmentalizing the bond and stock portfolio decisions would probably be considered significant,

but maybe not prohibitive, by most institutional investors. Finally, decentralized portfolio decisions seemed to lead to a greater investment in common stocks, including several which behave very much like bonds, than would be the case in an integrated portfolio.

## Chapter 9

## Stability of the Securities Market Model and Implications for the Efficient Set

In Chapter 5, the raw return data for individual securities were analyzed. The average values and standard deviations of the total returns and the correlation coefficients for the sample period and for each half of the period were examined. It was observed that several fundamental changes occurred between the two halves of the period in the behavior of the securities market. The return volatility of bonds relative to stocks increased substantially. Returns on equity securities became more uniformly correlated although the range of correlation coefficients remained about the same when bonds were included in the security set. Changes in the pattern of behavior of individual securities were also observed. The purpose of the present Chapter is to determine the implications of the changing market structure for the securities market model constructed in Chapter 6 and the efficient sets that were calculated in Chapter 7.

The dynamic character of the securities markets makes the task attempted in Chapter 6 of modelling the relationship between individual securities and the overall market difficult. Nevertheless, if the selection of information about the security-to-market relationship is chosen carefully regarding the purpose for which it is to be used, a greater understanding of the relationship may be gained from the

modelling process than is likely to result from a less analytical approach. Having undertaken the more rigorous analysis, however, it is necessary to take cognizance of its limitations.

## 9.1 The Securities Market Models for Each Half of the Sample Period

One of the more controversial issues in constructing regression equations of security returns is whether the resulting market index coefficients exhibit sufficient stability over time to possess practical value. If practical application is the criterion of meaningfulness, the problem would seem to revert back to determining what is meant by coefficient stability "over time". The assumption made in the present study is that by using return data from a reasonably large number of periods equal in length to the investment horizon (in this case, one month), the market index coefficients for a particular security are unlikely to change significantly during the next investment horizon period. This assumption may be challenged easily, particularly if one accepts the theory of the random nature of security returns, but it is probably the most reasonable assumption that could be made.

In order to obtain a better understanding of the impact of the changing structure of the market during the sample period on the relationships of individual security returns to the market indexes, regression equations for each security were calculated for each half of the sample period. Although it is possible that a different set of market indexes might have produced superior results for one or both of the subperiods -- superior in the sense used in Chapter 6 of

minimizing the correlations among residual terms--the same index structure used for the entire period was used for both subperiods. This procedure permits a direct measure of the changes that took place between the subperiods. The Chi-square measures of the independence of residual terms were 1887 in the first half of the period and 2213 in the second half. Because of the smaller number of observations underlying each model and, hence, the fewer degrees of freedom, these Chi-square values should not be compared with that for the period as a whole in judging relative superiority. It is fair to say, however, that the particular three-index model was somewhat more effective in the first half of the period in reducing residual term interdependencies.

The equations for each half of the period of each security are reported in Table 9.1 along with related statistical measures. Although the Chi-square statistic reveals that the model for the earlier period is superior in the sense of its consistency with the theoretical assumptions, the $R^2$ statistic is higher for nearly every security in the second half of the period indicating that a greater portion of the return variability is explained by the movements in the three market sectors. In a few instances, the coefficients of determination in the first half of the period are so low (less than 0.10 for DLT, NSP, PRO, and UA) that it becomes seriously questionable whether the equations have any useful predictive value, even though the equations do satisfy the theoretical requirements. This shortcoming is not of great concern in the present study, however, since the purpose is to capture the

TABLE 9.1

Security Market Model Equations for 1962-66 and 1966-70

| Security | Period | Constant Term | Index | | | $R^2$ | Std. Error |
|---|---|---|---|---|---|---|---|
| | | | AAOUTL | SP1 | TREAO5 | | |
| **U. S. Treasury bonds:** | | | | | | | |
| TREAO1 | 62-66 | .25* | -.01 | -.01* | .19* | .47 | .09 |
| | 66-70 | .40* | .01 | .00 | .20* | .73 | .19 |
| TREAO2 | 62-66 | .17* | .02 | .00 | .43* | .58 | .15 |
| | 66-70 | .28* | .01 | .00 | .45* | .90 | .23 |
| TREAO3 | 62-66 | .10* | .02 | .00 | .65* | .80 | .13 |
| | 66-70 | .20* | .00 | .02* | .68* | .94 | .26 |
| TREAO4 | 62-66 | .04* | .01 | .00 | .84* | .93 | .10 |
| | 66-70 | .09* | .01 | .00 | .85* | .99 | .13 |
| TREAO5 | 62-66 | .00* | .00 | .00 | 1.00* | 1.00 | .00 |
| | 66-70 | .00* | .00 | .00 | 1.00* | 1.00 | .00 |
| TREA10 | 62-66 | -.08 | -.14* | -.03* | 1.20* | .61 | .39 |
| | 66-70 | -.19* | .08 | .00 | 1.15* | .83 | .82 |
| TREA20 | 62-66 | -.15* | -.06 | .01 | 1.36* | .57 | .48 |
| | 66-70 | -.30 | .21* | .01 | 1.10* | .59 | 1.62 |

*Indicates coefficient is significantly different from zero at 90 percent level of confidence.

| Security | Period | Constant Term | Index | | | $R^2$ | Std. Error |
|---|---|---|---|---|---|---|---|
| | | | AAOUTL | SP1 | TREAO5 | | |
| TREA30 | 62-66 | -.22* | -.01 | .01 | 1.56* | .53 | .59 |
| | 66-70 | -.42* | .25* | .00 | 1.25* | .67 | 1.59 |
| Corporate Bonds: | | | | | | | |
| AAAIND | 62-66 | .02 | .44* | .01 | .35* | .54 | .33 |
| | 66-70 | -.01 | .63* | .02 | .05 | .76 | .89 |
| AAOIND | 62-66 | .01 | .53* | .01 | .40* | .67 | .29 |
| | 66-70 | -.06 | .60* | .01 | .03 | .78 | .79 |
| AOOIND | 62-66 | .05 | .60* | .02 | .10 | .67 | .31 |
| | 66-70 | -.06 | .61* | -.02 | .00 | .74 | .88 |
| BAAIND | 62-66 | .15* | .44* | .05* | .12 | .40 | .46 |
| | 66-70 | -.05 | .50* | -.02 | .26* | .59 | 1.18 |
| AAAUTL | 62-66 | -.01 | .82* | .00 | .06 | .79 | .30 |
| | 66-70 | -.13* | .80* | .01 | .15* | .91 | .65 |
| AAOUTL | 62-66 | .00 | 1.00* | .00 | .00 | 1.00 | .00 |
| | 66-70 | .00* | 1.00* | .00* | .00 | 1.00 | .00 |
| AOOUTL | 62-66 | -.01 | 1.12* | .01 | -.19* | .84 | .34 |
| | 66-70 | .00 | .99* | -.01 | .03 | .88 | .90 |
| BAAUTL | 62-66 | .17* | .81* | .02 | -.51* | .71 | .38 |
| | 66-70 | -.03 | .82* | -.05 | -.09 | .74 | 1.09 |

| Security | Period | Constant Term | Index | | | $R^2$ | Std. Error |
|---|---|---|---|---|---|---|---|
| | | | AAOUTL | SP1 | TREAO5 | | |
| AA2.81 | 62-66 | -.08 | .73* | .00 | .67* | .56 | .52 |
| | 66-70 | -.07 | .73* | -.04 | .48* | .76 | 1.23 |
| AA3.25 | 62-66 | -.15* | .88* | .00 | .75* | .68 | .48 |
| | 66-70 | -.22 | .71* | -.08 | .83* | .66 | 1.75 |
| AA3.75 | 62-66 | -.11* | .75* | .00 | .75* | .66 | .45 |
| | 66-70 | -.15 | .65* | .01 | .64* | .73 | 1.36 |
| AA4.25 | 62-66 | -.16* | .65* | .02 | .84* | .66 | .43 |
| | 66-70 | -.22 | .71* | -.04 | .71* | .77 | 1.31 |
| AA4.69 | 62-66 | -.06 | .55* | .03* | .58* | .67 | .33 |
| | 66-70 | -.11 | .74* | -.01* | .58* | .79 | 1.20 |
| AA5.06 | 62-66 | .09* | .19* | .02 | .46* | .32 | .36 |
| | 66-70 | -.07 | .65 | -.04 | .43* | .72 | 1.20 |
| **Common Stocks:** | | | | | | | |
| A | 62-66 | 1.04 | 1.33 | 1.61* | -1.58 | .44 | 5.95 |
| | 66-70 | -.48 | -.51 | 1.24* | .77 | .36 | 7.20 |
| ACY | 62-66 | .34 | 1.27* | 1.32* | -.09 | .52 | 4.01 |
| | 66-70 | .51 | .57 | .89* | -.48 | .33 | 6.09 |
| AMR | 62-66 | 2.49* | -2.86* | 1.84* | .43 | .40 | 6.48 |
| | 66-70 | -.62 | -.36 | 1.97* | .36 | .41 | 10.19 |

| Security | Period | Constant Term | Index | | | $R^2$ | Std. Error |
|---|---|---|---|---|---|---|---|
| | | | AAOUTL | SP1 | TREAO5 | | |
| APX | 62-66 | -.22 | 2.20 | 1.65* | -1.36 | .28 | 9.03 |
| | 66-70 | .28 | -1.01* | 2.03* | -.40 | .47 | 8.54 |
| AYP | 62-66 | -.29 | -.16 | .58* | 1.50 | .17 | 3.79 |
| | 66-70 | .07 | .50* | .46* | -.54 | .31 | 4.73 |
| BA | 62-66 | 2.66* | 1.38 | 1.00* | -1.51 | .13 | 8.90 |
| | 66-70 | -2.62* | -.44 | 1.64* | -.36 | .35 | 9.11 |
| BMY | 62-66 | .79 | .33 | 1.10* | 1.74 | .39 | 4.16 |
| | 66-70 | .87 | -.28 | 1.29* | -1.07* | .47 | 5.39 |
| CCB | 62-66 | 2.69* | -.69 | 1.27* | -1.61 | .30 | 5.92 |
| | 66-70 | 1.17 | .20 | 1.61* | -1.45* | .51 | 8.02 |
| CDA | 62-66 | -1.17* | 1.75* | .67* | .06 | .41 | 3.11 |
| | 66-70 | .39 | -.26 | 1.98 | -1.21 | .43 | 9.19 |
| CIP | 62-66 | -.73 | .35 | .74* | 2.16* | .27 | 3.80 |
| | 66-70 | -.25 | .13 | .44* | 1.31* | .30 | 5.13 |
| CIT | 62-66 | -.37 | 2.25* | -.02 | -.45 | .17 | 3.46 |
| | 66-70 | 2.09 | .92 | .72 | 1.28 | .39 | 7.04 |
| CLL | 62-66 | -.12 | 1.33* | .71* | .87 | .26 | 4.24 |
| | 66-70 | -.67 | -.55 | .75 | 1.16 | .38 | 4.78 |

| Security | Period | Constant Term | Index | | | $R^2$ | Std. Error |
|---|---|---|---|---|---|---|---|
| | | | AAOUTL | SP1 | TREAO5 | | |
| CSR | 62-66 | .03 | .52 | .45 | .67 | .13 | 3.78 |
| | 66-70 | -.71 | -.61* | .51* | 3.05* | .50 | 5.05 |
| CWE | 62-66 | -.01 | .17 | .70* | .13 | .33 | 2.99 |
| | 66-70 | -.92* | .07 | .49* | 1.92* | .50 | 4.20 |
| DAL | 62-66 | 4.89* | -2.90* | 1.44* | .12 | .21 | 8.16 |
| | 66-70 | -.51 | -.55 | 1.58 | 1.30 | .50 | 7.19 |
| DLT | 62-66 | .89 | .36 | -.67* | -3.11 | .07 | 7.71 |
| | 66-70 | 5.29* | .66 | 2.78* | -2.75* | .39 | 14.73 |
| EAF | 62-66 | 3.00* | -4.61* | 1.23* | 2.79 | .25 | 7.33 |
| | 66-70 | .36 | -.86* | 1.26* | .56 | .28 | 8.61 |
| EAL | 62-66 | 2.30 | -1.61 | 2.06* | 3.19 | .22 | 11.16 |
| | 66-70 | -2.02 | -.01 | 1.90* | 1.76 | .44 | 10.78 |
| EK | 62-66 | 1.63* | -1.28* | 1.16* | -.11 | .46 | 3.63 |
| | 66-70 | .59 | .15 | .86* | -.45 | .42 | 4.37 |
| FCF | 62-66 | -2.11* | -.15 | 1.86* | 3.07 | .30 | 8.95 |
| | 66-70 | 4.02* | 1.67* | 1.63* | 3.15* | .50 | 12.31 |
| GEN | 62-66 | 1.25* | .85 | 1.05* | -1.62 | .52 | 3.35 |
| | 66-70 | -1.02* | .17 | .96* | 1.48* | .61 | 4.45 |

| Security | Period | Constant Term | Index | | | $R^2$ | Std. Error |
|---|---|---|---|---|---|---|---|
| | | | AAOUTL | SP1 | TREAO5 | | |
| GIS | 62-66 | 1.43* | 1.85* | .66* | .35 | .30 | 3.94 |
| | 66-70 | .28 | .18 | .84* | -.06 | .39 | 4.75 |
| GO | 62-66 | -.19 | -1.01* | 1.27* | 1.56 | .54 | 3.37 |
| | 66-70 | -.01 | -.57* | .83* | .94* | .40 | 4.66 |
| GP | 62-66 | -.12 | -.38 | 1.44* | 2.53* | .42 | 4.96 |
| | 66-70 | 3.03* | 1.17* | .95* | .94 | .54 | 6.08 |
| GTU | 62-66 | .47 | 1.20 | .35* | .86 | .11 | 4.38 |
| | 66-70 | -.72 | -.45 | .76* | 2.20* | .38 | 6.34 |
| HOU | 62-66 | -.30 | 1.53* | .62* | 2.76* | .31 | 3.76 |
| | 66-70 | -.38 | .28 | .53* | 1.77* | .49 | 4.60 |
| IBM | 62-66 | -.04 | -.70 | 1.47* | .83 | .62 | 3.34 |
| | 66-70 | 1.32* | -.29 | 1.15* | -.72* | .55 | 4.12 |
| INA | 62-66 | -.31 | .26 | .78* | -1.55 | .28 | 4.11 |
| | 66-70 | -.11 | .15 | .69* | .83 | .15 | 9.24 |
| ITT | 62-66 | 1.31* | -1.92* | 1.50* | -3.68* | .57 | 4.19 |
| | 66-70 | .75 | -.06 | 1.45* | -.97* | .58 | 4.99 |
| JNJ | 62-66 | 2.22* | -.14 | .86* | -3.40* | .26 | 5.20 |
| | 66-70 | 2.27* | -.36 | 1.16* | -.81 | .38 | 5.82 |

| Security | Period | Constant Term | Index | | | $R^2$ | Std. Error |
|---|---|---|---|---|---|---|---|
| | | | AAOUTL | SP1 | TREAO5 | | |
| K | 62-66 | -.45 | .22 | 1.00* | 2.63 | .22 | 5.67 |
| | 66-70 | .88 | .57* | .47* | -.01 | .27 | 4.67 |
| KG | 62-66 | 2.20* | -1.10 | 1.05* | -.05 | .15 | 7.11 |
| | 66-70 | 2.56* | -.14 | .90* | .02 | .23 | 6.95 |
| KN | 62-66 | .63 | .38 | 1.32* | -1.62 | .54 | 3.86 |
| | 66-70 | .97 | -.41 | .93* | .69 | .22 | 7.78 |
| LSG | 62-66 | -.07 | 1.49* | .32 | -.24 | .22 | 2.99 |
| | 66-70 | .28 | .13 | .76* | .90 | .28 | 6.65 |
| MHP | 62-66 | 2.15* | -1.20 | .77* | -.24 | .17 | 5.00 |
| | 66-70 | -1.45 | -.27 | 1.42* | .30 | .40 | 7.42 |
| MMM | 62-66 | .24 | .00 | 1.28* | -1.30 | .43 | 4.54 |
| | 66-70 | .06 | -.38 | 1.06* | .36 | .49 | 4.58 |
| MOT | 62-66 | 2.09* | -2.83* | 1.64* | 1.78 | .30 | 7.26 |
| | 66-70 | .36 | .96* | 1.71* | -3.04* | .40 | 9.49 |
| MRK | 62-66 | 2.45* | -1.70* | 1.08* | -1.78 | .30 | 5.14 |
| | 66-70 | .47 | -.52* | .96* | .17 | .47 | 4.14 |
| MSU | 62-66 | .52 | 1.75* | .59* | .07 | .31 | 3.54 |
| | 66-70 | -.58 | -.60 | .80* | 2.58* | .42 | 6.30 |

| Security | Period | Constant Term | Index | | | $R^2$ | Std. Error |
|---|---|---|---|---|---|---|---|
| | | | AAOUTL | SP1 | TREAO5 | | |
| N | 62-66 | .05 | -.98 | 1.38* | -.03 | .49 | 4.07 |
| | 66-70 | .06 | -.98* | .93* | 1.06* | .49 | 4.42 |
| NNG | 62-66 | -.56 | -.79 | 1.16* | 2.08 | .38 | 4.25 |
| | 66-70 | .53 | .64* | .37* | .77 | .32 | 4.93 |
| NSP | 62-66 | .01 | .38 | .21* | .42 | .06 | 2.96 |
| | 66-70 | -.34 | .29 | .17 | 1.26* | .34 | 3.77 |
| PEP | 62-66 | -.42 | -.56 | 1.23* | 2.82 | .27 | 5.91 |
| | 66-70 | 1.62 | .04 | .89 | -.62 | .35 | 5.02 |
| PG | 62-66 | -.82* | -.05 | .80* | 1.00 | .33 | 3.12 |
| | 66-70 | 1.23* | .01 | .70* | .18 | .33 | 4.51 |
| PKN | 62-66 | .58 | -1.16 | 1.32* | 2.53 | .23 | 7.00 |
| | 66-70 | .99 | -.56 | 1.69* | -.88 | .43 | 7.69 |
| PRD | 62-66 | 3.46* | -.71 | .99* | -.53 | .09 | 9.15 |
| | 66-70 | .58 | -.29 | 1.58* | -1.87* | .38 | 8.19 |
| RD | 62-66 | -.21 | 1.19* | .83* | .98 | .34 | 3.88 |
| | 66-70 | 1.00 | -.11 | .93* | .45 | .42 | 4.98 |
| SB | 62-66 | -.19 | 2.04* | .57* | -.33 | .32 | 3.58 |
| | 66-70 | 1.47* | .40 | .78* | -.17 | .31 | 5.53 |

| Security | Period | Constant Term | Index | | | $R^2$ | Std. Error |
|---|---|---|---|---|---|---|---|
| | | | AAOUTL | SP1 | TREAO5 | | |
| SCG | 62-66 | -.04 | .11 | .40* | 2.48* | .10 | 4.30 |
| | 66-70 | -.33 | -.15 | .75* | .70 | .27 | 5.85 |
| SD | 62-66 | -.20 | .74 | .75* | 1.16 | .30 | 3.63 |
| | 66-70 | -.56 | -.52* | .80* | .89* | .44 | 4.14 |
| SGL | 62-66 | 1.74 | 1.59 | 1.55* | -1.63 | .21 | 9.81 |
| | 66-70 | .72 | .18 | 1.49* | -.01 | .31 | 9.95 |
| SO | 62-66 | -.34 | .85 | .79* | 1.73* | .39 | 3.20 |
| | 66-70 | -.67 | -.03 | .82* | 1.46* | .44 | 5.41 |
| SR | 62-66 | -.42 | 1.37* | 1.03* | -.86 | .45 | 3.88 |
| | 66-70 | .76 | .35 | .93* | -.30 | .35 | 5.83 |
| T | 62-66 | -.36 | .72 | .56* | .19 | .35 | 2.50 |
| | 66-70 | .15 | .71* | .42* | .32 | .50 | 3.23 |
| TFB | 62-66 | 1.93* | 1.68 | 1.63* | -2.13 | .33 | 7.64 |
| | 66-70 | -.10 | -.06 | 1.55* | .19 | .36 | 9.04 |
| TWA | 62-66 | 4.10* | -1.39 | 2.64* | -1.50 | .39 | 9.74 |
| | 66-70 | -3.00* | .30 | 1.87* | .30 | .46 | 9.22 |
| TX | 62-66 | .23 | 1.19* | .59* | .68 | .24 | 3.74 |
| | 66-70 | -.48 | -.42* | .87* | 1.15* | .51 | 4.17 |

| Security | Period | Constant Term | Index | | | $R^2$ | Std. Error |
|---|---|---|---|---|---|---|---|
| | | | AAOUTL | SP1 | TREAO5 | | |
| TXN | 62-66 | 2.48* | -2.14 | 1.69* | .04 | .26 | 8.29 |
| | 66-70 | -.02 | -.14 | 1.36* | -1.11* | .41 | 6.58 |
| UA | 62-66 | 2.12* | .74 | .58* | .61 | .06 | 7.49 |
| | 66-70 | -2.25* | -.68 | .99* | 1.35 | .22 | 9.05 |
| UAL | 62-66 | 2.87* | -3.73* | 1.93* | .67 | .42 | 6.72 |
| | 66-70 | -2.67* | -.35 | 1.69* | 2.01* | .46 | 9.23 |
| UCL | 62-66 | 1.63* | .59 | 1.11* | 1.15 | .40 | 4.12 |
| | 66-70 | -1.23 | -.76* | 1.17* | .42 | .35 | 6.58 |
| UP | 62-66 | -.51 | 1.27* | .95* | 1.95* | .41 | 3.81 |
| | 66-70 | .69 | .66* | .78* | -.69 | .32 | 5.61 |
| USG | 62-66 | -.77 | .89* | .76* | -.99 | .32 | 3.71 |
| | 66-70 | 1.39* | 1.37* | 1.16* | -.81 | .54 | 5.91 |
| WBC | 62-66 | .08 | 1.93* | .57* | -1.11 | .19 | 5.04 |
| | 66-70 | .74 | .44 | .65* | 1.10* | .31 | 6.46 |
| WIN | 62-66 | -.14 | 1.49* | .71* | .17 | .27 | 4.16 |
| | 66-70 | .19 | -.05 | .41* | .09 | .16 | 4.01 |
| XRX | 62-66 | 4.24* | -2.63 | 1.37* | -.22 | .16 | 9.21 |
| | 66-70 | .69 | .14 | 1.16* | -1.12* | .31 | 7.14 |

behavior of types of securities rather than to reproduce accurately the returns on particular securities. It is paradoxical that in spite of the general increase in the explanatory value of the equations in the latter subperiod, the standard errors of estimate, which measure the differences between calculated and actual returns, also increased from the first to the second half of the period. This combination of changes reflects the even greater increase in the volatility of actual security returns between the subperiods.

The stability of the market index coefficient may be evaluated by comparing the coefficients for the first and second halves of the period. U.S. Treasury bonds of less than 5 years to maturity were slightly more sensitive to movements in the government market in the second subperiod while longer maturity government bonds declined in sensitivity to such changes while gaining in their responsiveness to movements in the corporate bond market. In general, however, none of the coefficients on U.S. Treasury bonds changed markedly.

Industrial bonds at all quality levels increased in the degree of sensitivity to corporate bond market movements while, with the exception of the Baa bond, they declined in sensitivity to changes in the government bond market. The relatively high average total return on the Baa industrial bond noted in Chapter 5 is apparently the result of the comparative strength in the government bond market during the period. The corporate bond market coefficients for utility bonds did not change materially between the subperiods. But, like the industrial

bonds, utility bonds generally became more sensitive to changes in the government bond market in the latter subperiod.

For discount corporate bonds, the pattern of increasing and decreasing coefficients by coupon level is mixed but the changes are generally small and not noteworthy.

The stock market coefficients for all of the bonds are very small and the changes in magnitude between subperiods are insignificant. The constant terms in the equations for U.S. Treasury bonds of less than five years to maturity increased but generally declined for other U.S. Treasury bonds and for corporate bonds. Again, in all cases, the magnitudes of the changes were marginal. Relative to the changes in the coefficients in the equity security equations which are discussed below, it appears safe to conclude that the relationships between bond returns and the market indexes were reasonably stable between the two subperiods.

The behavior of the coefficients in the equity security equations was more erratic. The primary index for common stocks is, of course, that of stock market movements. For the most part, the stock market index coefficients are of roughly the same order of magnitude in both halves of the period. The one extreme exception is DLT for which the index increased from -0.67 to 2.78 between subperiods. There appears to be no general directional pattern in the changes in the stock market coefficients, either for non-utility or utility-type stocks as designated in Chapter 5.

The other index coefficients and the constant terms in the equity security equations are the major source of instability between periods. Not only are the magnitudes of the changes much larger than is the case for the coefficients in the bond equations, but in many cases the coefficients changed sign. In the 66 equity security equations, the signs change for 37 of the constant terms, 31 of the corporate bond market index coefficients, and 26 of the government bond market coefficients. The number of decreases in magnitude for the three factors is approximately the same: 35 of the constant terms, 38 of the corporate bond market coefficents, and 30 of the government bond market coefficients. No strong relationship is apparent between the direction of changes for the corporate and government bond market indexes. Of the 30 decreases in the government bond market index coefficients, 13 are associated with declines and 17 with increases in the corporate bond market index coefficient.

On the basis of these observations, it may be concluded that with respect to the primary index, the S&P, the behavior of the equity security equations is moderately stable, yet not as stable as the bond equations. On the other hand, the secondary coefficients, includihg those for both bond market indexes and the constant term, appear unstable in terms of both magnitude and direction of change.

It must be recognized, however, that the "bonds" examined in this study are actually classes of closely related individual bonds.

One would expect to find more favorable stability characteristics for groups of securities than for individual issues. Since the principle subject of the study is the proper allocation of funds among classes of securities in order to achieve effective market diversification, there need be little concern over the apparent instability of the individual equity issues if as a class equities tend to be reasonably stable. The average values of the coefficients in the common stock equations for each of the subperiods are reported in Table 9.2.

Table 9.2

| | 7/62 - 6/66 | 7/66 - 6/70 |
|---|---|---|
| Constant term | 0.81 | 0.26 |
| AAOUTL | 0.03 | -0.01 |
| SP1 | 1.03 | 1.08 |
| TREA05 | 0.25 | 0.33 |

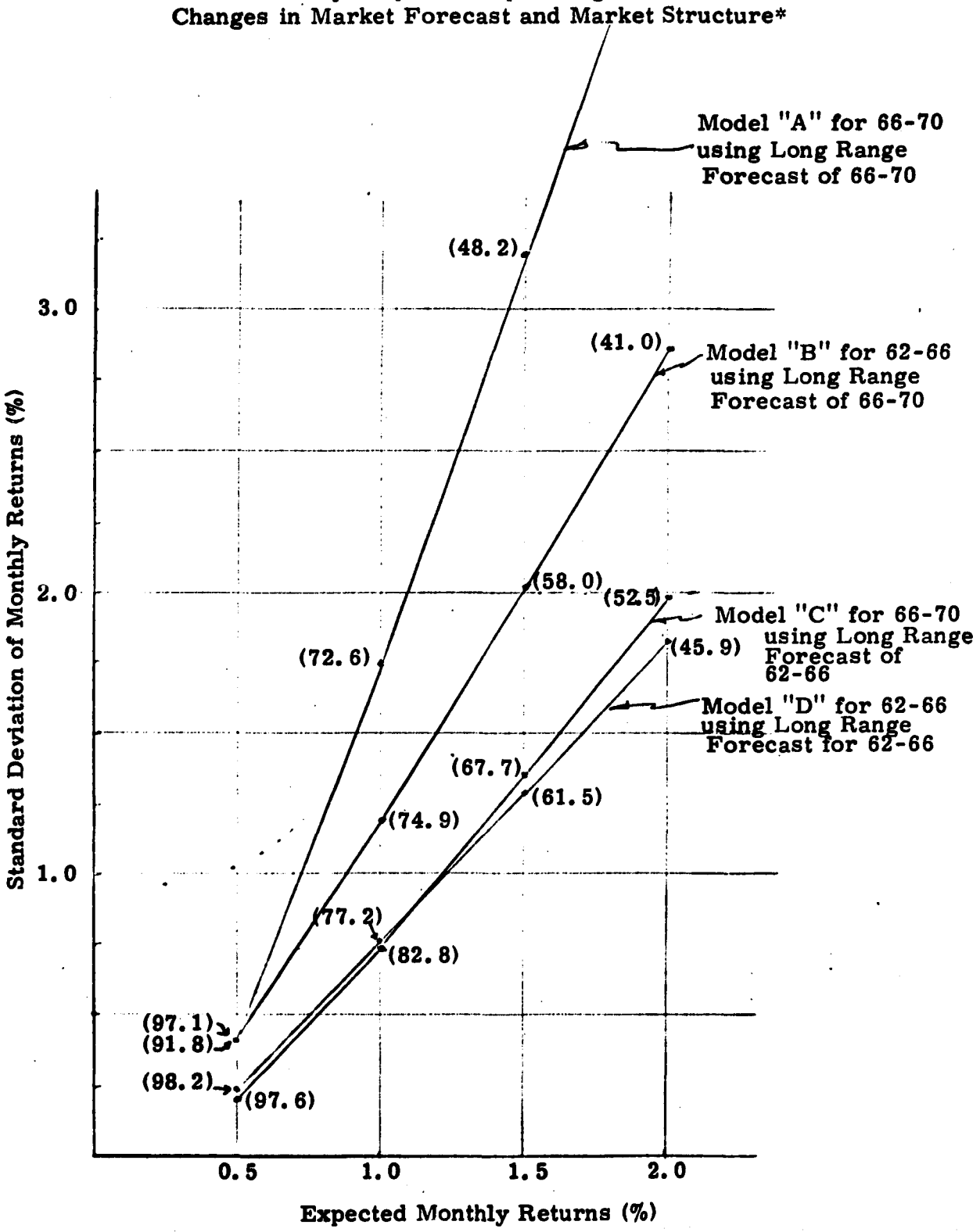
The changes in the average values of each of the three sets of market indexes between the two subperiods are small. As a consequence, although the equity portion of efficient portfolios may exhibit substantial changes in composition between the two halves of the period, the relative roles of bonds and stocks under various market forecasts should be largely unaffected by the problem of stability. The significant decline in the average value of the constant term, however, may result in a generally lower rate of return at high levels of risk where stock holdings are large, and a more steeply sloped efficient set during the second subperiod.

## 9.2 Efficient Sets for Each Half of the Sample Period

Efficient sets of portfolios for each of the subperiods and for selected forecasts are shown in Exhibit 9.1. In order to illustrate the changing character of the securities market model under different market conditions, two forecasts are used. The expected index values and the covariance matrix used in each forecast are set equal to the actual behavior of the indexes during the corresponding subperiod. The forecasts are shown in Table 9.3. The substantial increases in all the terms in the covariance matrix which occurred between the two subperiods are worth noting. Not only did the standard deviations of index changes increase materially, as already noted, but the correlation coefficients of index changes also increased materially. For example, the correlation coefficient for government bond market and stock market changes rose from 0.02 in the first four years of the period to 0.46 in the last four years. The resulting higher values of the covariance terms in the latter subperiod suggests that the portfolio risk at any given level of expected portfolio return would probably also increase (but not necessarily, since the different coefficients in the securities market model could modify the impact of the more volatile market behavior). A further reason to expect lower performance in the second half of the period is that the forecasted expected values of the market indexes are generally more bearish.

Exhibit 9.1

Efficient Sets by Subperiod Separating the Effects of Changes in Market Forecast and Market Structure*




*Numbers in parenthesis are percentage investment in bonds for indicated portfolio.

TABLE 9.3

Market Forecasts Used in Conjunction with Exhibit 9.1

July 1962 - June 1966:

| | Constant Term | AAOUTL | SP1 | TREAO5 |
|---|---|---|---|---|
| Expected Value | 1.00 | 0.13 | 0.88 | 0.21 |
| Covariance | | | | |
| Constant Term | 0.0 | | | |
| AAOUTL | 0.0 | 0.45 | | |
| SP1 | 0.0 | 0.54 | 8.28 | |
| TREAO5 | 0.0 | 0.04 | 0.02 | 0.16 |

July 1966 - June 1970:

| | | | | |
|---|---|---|---|---|
| Expected Value | 1.00 | -0.41 | -0.17 | 0.27 |
| Covariance | | | | |
| Constant Term | 0.0 | | | |
| AAOUTL | 0.0 | 5.54 | | |
| SP1 | 0.0 | 3.59 | 17.57 | |
| TREAO5 | 0.0 | 1.13 | 2.81 | 2.08 |

These expectations are verified by the relative orientations of the efficient sets in Exhibit 9.1. An efficient set corresponding to the securities market model for each subperiod is shown using the market forecast for each subperiod. Two observations may be made: the location of the efficient sets are affected more by the altered behavior of the markets themselves than by the relation of the individual securities to the markets (compare A with C and B with D); and, for a given forecast, the parameters of the securities market model for the June 1966 to July 1970 period produce somewhat more risky portfolios at each level of expected portfolio return than the model for the earlier period (compare A with B and C with D). A slight exception to the latter observation occurs in the lower risk region for the first subperiod forecast.

Due to the computer costs of calculating efficient portfolios and because this portion of the analysis is only of secondary importance to the overall objectives of the study, the general applicablility of the above observations has not been tested thoroughly. It is conceivable, for example, that a different forecast could qualify the tentative conclusions drawn above. In defense of the two conclusions, it should be recognized that each of the two forecasts, which statistically represent what actually occurred, are in a sense neutral positions for the respective subperiods and would therefore serve as the likely reference point for any other forecast. As a result, the implications of this portion of the study are more relevant to the investor whose

forecast at the end of each subperiod differed little from the market performance of recent history.

For such an investor, the portion of his risky asset portfolio which would have been invested in fixed-income securities is indicated in parentheses for several of the portfolios on the efficient sets in Exhibit 9.1. (The choice of the optimal risky asset portfolio and the combination of it with a riskless asset, such as U.S. Treasury bills, is not considered in this Chapter.) With the nominal exception of the lowest risk portfolio resulting from the forecast for the 1962-66 period which is almost entirely invested in bonds, for either forecast a greater proportion of a portfolio at any given risk level would have been invested in bonds in the latter subperiod than formerly. (Compare efficient sets A and B, and C and D.) This conclusion is based in a few instances on an interpolation between efficient sets which assumes that for each efficient set the proportion held in bonds declines linearly with increasing portfolio risk from one calculated efficient portfolio to the next, an assumption which is not strictly true but which would appear to be satisfactory at this level of generality. When the efficient sets (A and D) for each securities market model using the neutral market forecast associated with the time period of each model are compared, the bond proportions are again greater using the model from the second half of the period. When the models are used with the forecast of the opposing period (B vs. C), the bond proportions

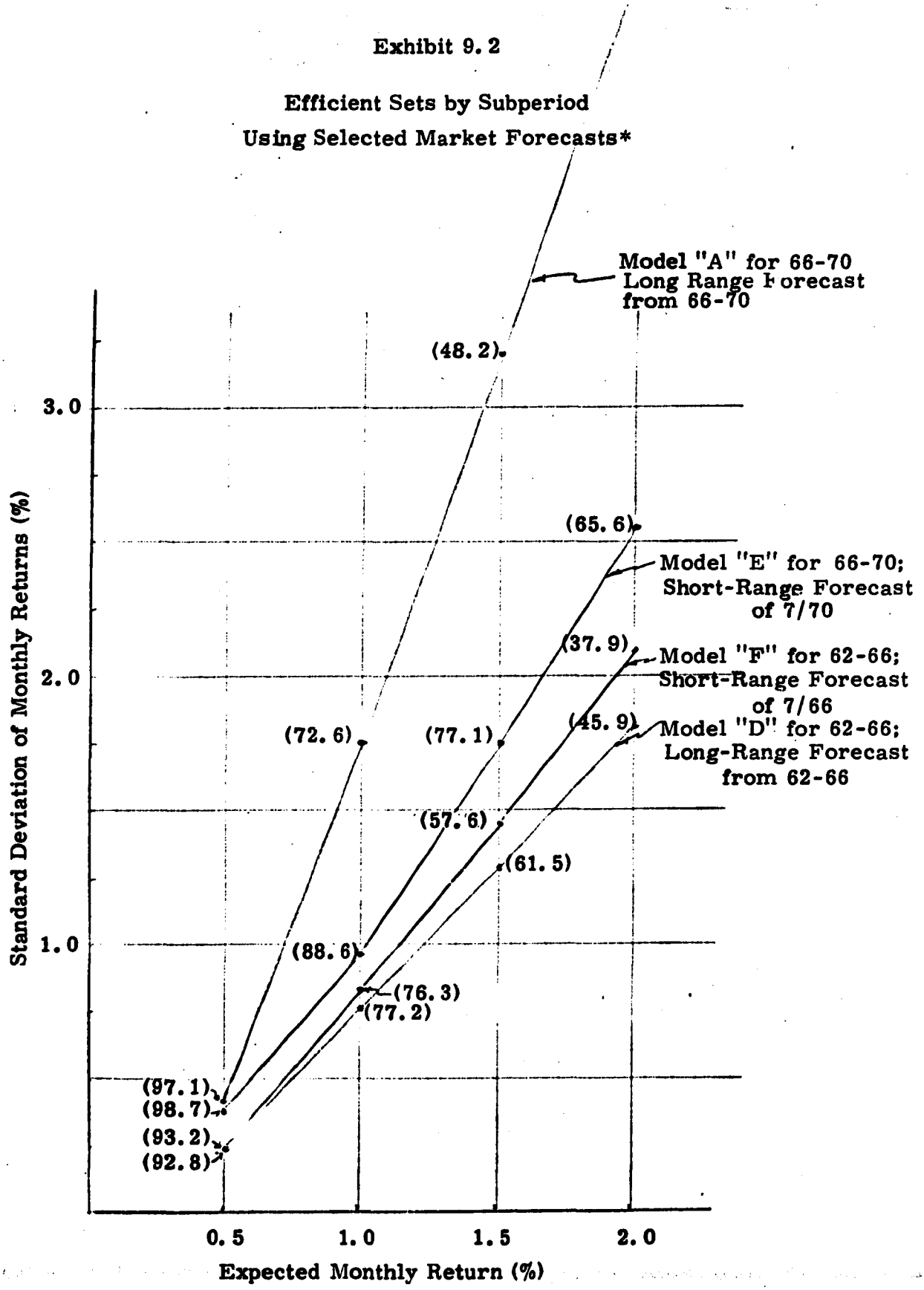
at each level of risk are very nearly the same with possibly a slight edge in favor of greater proportions for the model of the earlier period. Because of the radical change in the covariance structure of the forecasts between the two subperiods, this comparison is probably of little relevance. A limited extension of the comparative role of bonds was undertaken using another set of likely market forecasts in which the expected index values were set equal to the rate of change in the last month of each subperiod, including an inflation premium for the stock index (as in Chapter 8). The covariance matrices were respectively the same as in the forecasts used above. The resulting efficient sets are designated as E and F in Exhibit 9.2. (Efficient sets A and D, taken from Exhibit 9.1, are included for comparion.) Once again, the bond proportions at each level of portfolio risk are larger in the securities market model of the latter subperiod.

The indicated conclusion is that the relative role of bonds in producing efficient investment performance in mixed portfolios increased during the period under study. To the extent that the various market sectors continue to exhibit characteristics similar to those of the late 1960s, bonds should receive more attention from the investment manager than has been the case in earlier periods.

For the most part the bond portions of the efficient portfolios in the sets shown in Exhibits 9.1 and 9.2 are comprised of the short term U.S. Treasury bond. This is entirely the case for all the

Exhibit 9.2

Efficient Sets by Subperiod
Using Selected Market Forecasts*




*Numbers in parenthesis are percentage investment in bonds for indicated portfolio.

portfolios in efficient sets A, B. C, and D except that the lowest risk portfolio in efficient set C also contains 19.3 percent in the two-year U.S. Treasury bond. Based on the conclusions of Chapter 8, it seems probable that all of these bonds are serving the role of the riskless asset used in the Separation Theorem. For the efficient sets using the short range forecasts which are more bullish for bonds than the other forecasts, efficient set E includes 2.4 percent for the A-rated industrial bond in the lowest risk portfolio in addition to the short term government issue and efficient set F includes amounts of the discount corporate bonds and intermediate term government issues which increase up to 17 percent and 40 percent, respectively, as portfolio risk increases to moderate levels. These limited samples of efficient bond portfolio compositions, which are the product of what are assumed to be reasonable market forecasts in the context of the particular subperiod, suggest that, between the subperiods the commitment to bonds as a riskless asset would have increased and investment in bonds as a risky asset would also have been greater depending on the market forecast.

## Chapter 10

## Summary and Conclusions

During the decade of the 60's institutional portfolio managers shifted large portions of their funds into the equity market believing that bonds no longer made a sufficient contribution to total portfolio performance.

Although part of the widely adopted strategic move from bonds to equities may have been based on an objective forecast of the bond and stock markets, other possible reasons for the shift were discussed in Chapter 2. For example, while market value accounting systems were increasingly used for equity portfolios, bond portfolios were generally evaluated at cost. In such cases the portfolio manager was motivated not to sell his bonds in exchange for a more profitable investment since during the period of generally falling prices, the sale would force the recognition of a possibly sizeable loss all at once but which was in fact incurred over an extended period. Typically, bonds were held to maturity in order to avoid a realized loss. In addition, it appears that most portfolio managers who control the broad composition of institutional portfolios gained their investment experience in the equity markets. Lacking familiarity with the behavior of the bond markets and with the technical determinants of bond prices, it is difficult for the portfolio manager to invest funds in a market where he is unsure of his own skills. These attitudinal biases

against bond investment are rooted in a long tradition in which bonds were assigned the special role of providing current income and capital safety while equities hopefully provided capital appreciation.

The characteristics of bonds and equities and the markets in which they are traded were compared in Chapter 2 to determine whether there is any necessary restriction on the investment role of bonds. An examination of the principal characteristics distinguishing bonds from stocks suggested that the differences are more in degree than in kind. The finite maturity of a bond is largely irrelevant in a market value accounting system where the effective maturity of all decisions is the end of the current accounting period. In addition, for long maturity bonds the discounted present value of the principal received at maturity is an insignificant portion of the current market price. The contractual nature of bond coupon payments only reduces the uncertainty of the expected return on a bond; and, in many cases, stocks may provide a higher and nearly as reliable current income as bonds.

In contrast to the predominant specialist structure of the equity markets, the dealer market for bonds would seem to provide at least the same amount of liquidity for bonds as exists for stocks. The existence of several dealers willing to post competitive bid and offer prices, each on the basis of his own particular portfolio needs, suggests that the pricing mechanism in the bond market is at least as efficient as the stock market. In fact, the presence of many

buyers and sellers often creates opportunities for profitable bond exchanges that might not arise if all securities were cleared through a single pricing mechanism, such as the specialist.

The examination of the generic character of equity and fixed-income securities and of the structure of their respective markets revealed no necessary reason to distinguish the roles of bonds and stocks.

Having found no inherent limitations on the role of fixed-income securities, the remainder of the study was devoted to a rigorous analysis of the actual behavior of bonds and stocks to determine whether any distinction in their respective portfolio roles was warranted. The methodology employed was discussed in Chapter 3. The critical assumptions underlying the entire study were that the portfolio objective is the maximization of total return subject to risk considerations, irrespective of the kinds of securities held, and that the procedure for measuring the performance of bonds and stocks is identical. Total return includes both current income, whether from dividends or coupons, and capital appreciation or loss. Performance is measured using periodic market value accounting which implies that only the forecast of a security's price and not its book cost is relevant to current portfolio decisions.

The empirical analysis was based on 96 monthly observations of total return from July 1962 to July 1970. The selection of

the sample securities and the sources of data were discussed in Chapter 4. Twenty-two bonds and 66 stocks comprised the security sample. Due to the difficulty of obtaining a reliable record of prices or yields on a sufficient number of individual bonds, the "bonds" actually used were Salomon Brothers' and Moody's composites. The sample of bonds included a series for each of the important determinants of bond prices: maturity, quality, and coupon. Both U.S. Treasury and corporate obligations were represented. The 66 stocks were all high grade, NYSE-listed securities that would be likely to appear in almost any institutional portfolio. Included in the sample were several stocks with high current yields, such as utility and financial stocks which are commonly believed to resemble bonds in return behavior.

Procedures developed by Sharpe and Markowitz, which were described generally in Chapter 3 and in mathematical terms in Appendix A to that Chapter, were employed in evaluating the relative contribution of bonds and stocks to portfolio performance. Sharpe assumed that all of the interaction among securities would be captured by relating a security's return to one or more market indexes with regression analysis. The assumption that the residual returns which were "unexplained" in the regression analysis are independent among securities implies that the regression coefficients, or market sensitivity coefficients, contained all the information

necessary for portfolio decisons. Because the residual returns are independent, only the market related returns could be diversified and hence managed.

Employing only these market sensitivity coefficients for each security and forecasts of changes in the market indexes, the Markowitz model of the portfolio selection process was used to generate an efficient set of portfolios. For a given market forecast, an efficient portfolio is one which at a given risk level has the highest expected return, or which at a given level of expected return has minimum risk. The measure of risk used throughout the study is the standard deviation of security, or portfolio, return. The efficient set of portfolios comprises a range of efficient portfolios from which each investor would choose the one most suitable to his risk/return preferences. All other portfolios are inefficient and of no interest. For the purpose of this study the most important result of the Markowitz calculation is the composition, especially with regard to the allocation between bonds and stocks, of efficient portfolios at various levels of risk.

The value of the Sharpe and Markowitz procedures in portfolio management has been a matter of debate for several years. As in most such cases, the controversy centers on the consistency between the theoretical assumptions and market behavior and investment practice. Whether or not these models are suitable as decision-

making tools, they are sufficiently close approximations to the investment process that conclusions regarding the relative roles of bonds and stocks should be unaffected. The principal attraction of these models in the present application is that the procedures treat bonds and stocks in an absolutely unbiased manner.

The criterion for selecting the best market model was the minimum Chi-square value for the distribution of correlations among residual returns. This criterion and the parameters of the resulting market model were discussed in Chapter 6. Although there was no reason to expect the residual returns to actually be independent, use of this criterion permitted selection of the market model which most closely fit Sharpe's theoretical assumption. The Chi-square criterion, which is directed to the issue of a security's value in the portfolio context, was more appropriate to this study than the commonly applied $R^2$ criterion which may be more useful in forecasting security returns.

Three indexes were chosen for the market model: the Standard and Poor's 425 Stock Price Index, Moody's Aa utility index, and Salomon Brothers index of returns on five-year U.S. Treasury bonds. These three indexes cover the three major market sectors represented in the security sample. As expected, the residual returns in the regressions on the historical security returns were not independent. The $R^2$ values were much higher for bonds than

stocks, although the $R^2$ values for the stocks were not out of line with those obtained in similar studies.

An examination of the market sensitivity coefficients led to more specific conclusions regarding the potential role of bonds -- in anticipation of the results of the portfolio selection process -- than had been possible through observations of patterns in the raw returns (see Chapter 5). The principal finding in the analysis of the raw returns was that the range of correlation coefficients between security returns is broadened significantly when stocks and bonds were considered together, thus suggesting the expanded potential for portfolio performance resulting from the inclusion of bonds.

The patterns of market sensitivity coefficients revealed that bonds are largely unaffected by stock market movements. Among bonds, as expected, issues with longer maturities are most sensitive to movements in either bond sector. Although the pattern is slightly irregular, low coupon or deep discount bonds are most responsive to movements in the corporate bond market. There appears to be little difference in the behavior of different quality bonds. Utility bonds of all quality levels are more influenced by changes in the corporate bond market than are industrial bonds.

The degree of bond-like or stock-like behavior of each security was measured by comparing each security's market sensitivity coefficients to the averages for the three types of securities:

common stocks, U. S. Treasury bonds and corporate bonds. Whereas nearly all the bonds were compatible with their nominal classes, several stocks exhibited predominant bond-like behavior. Although nearly all of these bond-like stocks could be included in a group broadly defined as utility-type stocks, not all such stocks exhibited bond-like behavior. The conclusion was that the traditional distinctions between bonds and stocks and among stocks by industry are inappropriate in evaluating a security's return behavior. The evidence suggested that the use of single-index market models for equity securities -- the most common procedure found in the literature -- provides an inadequate description of their behavior since they appear to be strongly affected by changes in interest rates.

The Markowitz model of the portfolio selection process requires the market sensitivity coefficients for each security and an assessment of market conditions. For three market indexes, a total of nine assessments are required: the expected percentage change in each index, the uncertainty regarding the expected change in each index as measured by the standard deviation, and the three correlation coefficients for each pair of indexes, which together with the three uncertainty assessments comprise the covariance structure of the market. In order to establish a standard for subsequent comparisons, a standard market forecast was defined in Chapter 7 as the average behavior of the market indexes during the sample period. Bullish or

bearish forecasts for any market were defined as a change in the expected percentage change in the market index of one standard deviation of the historical fluctuations and a reduction in the uncertainty assessment by 25 percent in order to reflect the increase in forecasting confidence that is likely to accompany either bullish or bearish feelings.

It was found in Chapter 7 that the major impact on the location of the efficient sets in risk/return space resulted from changes in the expected values of the market indexes rather than in the covariance structure. The assumption of an unchanging covariance structure for all non-standard market forecasts therefore seemed justified. As one would expect, increasingly bullish market forecasts produced efficient sets with greater expected returns at each level of risk. Bearish bond market forecasts, however, also result in efficient sets which yielded higher returns than the standard forecast yet not so much as for bullish forecasts. The reason is that in a bearish bond market, some of the more risky bonds are eliminated from the portfolio and are replaced by stocks which are bond market hedges, i.e., stocks which yield higher returns in declining bond markets.

The most striking characteristic about the efficient portfolios in Chapter 7 was the high proportional investment in bonds. The investment in bonds was relatively insensitive to the market

forecast, remaining large even in adverse bond market conditions. Although longer term U.S. Treasury and corporate issues appeared in moderate proportions for bullish bond market forecasts, most of the funds were typically held in the one-year U.S. Treasury bond. It was also observed that the efficient sets tended to be very nearly straight lines except under bullish market conditions. The near straightness of some efficient sets suggested that at least one asset, presumably the one-year U.S. Treasury bond, had either a near zero standard deviation or a near zero correlation coefficient with all other securities.

All of the foregoing observations regarding the structure of the efficient sets and the composition of the efficient portfolios raised a fundamental question of just what role bonds played in the portfolio. In Chapter 8, the Separation Theoren was reviewed and used to isolate the roles of bonds as risky versus riskless assets. The Separation Theorem says that there is one efficient portfolio of risky assets which is optimal in the sense of being more efficient than all others when combined with a riskless asset.

By combining a riskless asset of 30-day U.S. Treasury bills and optimally efficient portfolios of equity securities above for different market forecasts, it was inferred from the large investment in Treasury bills that a significant fraction of the bonds found in integrated efficient portfolios of comparable risk was serving the role

of the riskless asset. This conclusion was confirmed by examining the composition of optimal integrated efficient portfolios. At each level of portfolio risk, much of the former role of bonds was replaced by Treasury bills. Yet, depending on the market forecast, there was very clearly an important residual role for bonds as a risky asset. As a proportion of risky assets, the investment in bonds shifted from nominal to dominant proportions for more bullish bond market forecasts. Instead of so much emphasis on short term Treasury issues, other more risky bonds become of increased importance. The conclusion of this analysis was that bonds do play an important role as a risky asset and that its role was very sensitive to the forecast in both the bond and stock markets.

The efficient sets found in Chapter 7 resulted from an integrated analysis of bonds and stocks. Since the typical institution has separate bond and stock departments, the question arose regarding whether there are procedures which would permit it to select bond and stock portfolios separately yet still approximate the efficient sets obtained from the integrated approach. Using the same market forecast and the same market equations but separating those for bonds from those for stocks, suboptimal efficient sets were generated for bonds and stocks in Chapter 8. It was found that with a proper assessment of the correlation coefficient between the two portfolios the most efficient suboptimal combination would be obtained by pooling a high risk stock

portfolio and low risk bond portfolio.

The cost of decentralizing the bond and common stock portfolio decisions was reflected in the difference in expected returns between the suboptimal and integrated efficient sets which were examined in detail for the one, relatively neutral market forecast. At about 10 basis points per month, it was concluded that the cost of suboptimizing would generally be considered significant. The cost may be somewhat higher, however, under other market conditions, especially those which lead to a sharply curved efficient set.

The compositions of the suboptimal and integrated efficient sets did not differ markedly at each risk level. However, at high risk levels there appeared to be a tendency in the suboptimal portfolio to use stocks which, as previously determined, exhibited predominant bond-like behavior rather than the bonds which were held in the integrated efficient portfolio. The conclusion is that the management of bond and stock portfolios in separate departments should not inhibit the selection of nearly efficient mixed portfolios.

One of the major points of controversy in portfolio theory is the temporal stability of the regression coefficients for each security. In order to determine the possible implications of this study for the stability issue, market models and efficient sets were calculated for each half of the sample period in Chapter 9. It was observed that the relationships between bond returns and market

indexes did not change materially between the two subperiods. Although the behavior of the index coefficients for individual stocks was quite erratic, the average behavior of stocks as a class could be considered reasonably stable. Comparisons of the resulting efficient portfolios (see Exhibit 9.1) revealed that the change in the markets themselves, rather than in the relationships of the securities to the markets, produced a significant increase in portfolio riskiness between the twosubperiods but that, even for the same market forecast, the market model for the latter subperiod produced somewhat more risky portfolios than that of the former subperiod. It also appeared that at each level of risk, a greater portion of the efficient portfolio would be invested in bonds during the second as compared to the first half of the period. The conclusion is that the relative role of bonds in contributing to investment performance increased during the sample period.

The analysis undertaken in this study confirms the original hypothesis: fixed-income securities play a role in portfolios of risky assets which appears to be comparable to that of common stocks and which is sensitive to the market outlook for stocks and bonds.

## 10.1 Suggestions for Further Research

Possibly the most fruitful subject for further investigation would be the improvement of the market model. Although the Chi-square statistic was used to measure the conformity of the model to

the theoretical assumption of residual return independence, it was found that all of the trial market models had substantially dependent residual returns meaning that the differences in Chi-square values between several of the better trial models were essentially immaterial. The market model might therefore be improved by choosing from among the several trial models with reasonably high Chi-square values that trial model which also exhibits the highest general values of the coefficient of determination. The enhanced explanatory power, or forecasting quality, of the market model would probably improve its utility as a decision-making tool.

Most previous studies have concentrated on modelling either stock or bond returns. The current effort attempted to integrate both bonds and stocks in the same market model. The results of this study suggest that more intensive research on the market mechanism for pricing several kinds of securities may be useful. For example, a greater understanding of security price movements might be obtained by integrating the results of Keran's stock price model and of the Feldstein-Eckstein bond yield model which were discussed in Chapter 5.

The lack of a reliable, sufficiently long record of yields or prices on individual bonds was discussed in Chapter 4. Although at the level of generality maintained throughout this study the use of composite bond indexes probably did not materially affect the results,

greater confidence in the results would be obtained if individual bonds could be used. Salomon Brothers is currently preparing a massive, detailed record of bond prices which should be useful in avoiding this possible bias in future research.

Although the market and portfolio selection models were used strictly as analytical tools in this study, the ultimate issue is the value of such models as aids to the decision-making process. This issue, of course, has been the focus of a substantial amount of investigation in recent years. Since the conclusion of this study is that bonds as well as stocks play a major role in the investment portfolio, it is suggested that bonds be included in the security samples used in the further evaluation of the practicality of the market and portfolio selection models.

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