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I am submitting herewith a dissertation written by Robert Anthony Kunkel entitled "The Relevance of Dividends: A Test Using an Arbitrage Investment Strategy." I have examined the final copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Business Administration.

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THE RELEVANCE OF DIVIDENDS: A TEST USING AN ARBITRAGE INVESTMENT STRATEGY

A Dissertation

Presented for the

Doctor of Philosophy

Degree

The University of Tennessee, Knoxville

Robert Anthony Kunkel

August 1994

DEDICATION

This dissertation is dedicated to my mother and father,

Louise Thelma Kunkel

and

Joseph Conrad Kunkel

for their love, support, and encouragement.

ACKNOWLEDGEMENTS

I would like to thank my major professor, Dr. Michael C. Ehrhardt, for his assistance and guidance over the past four years. I would also like to thank the other committee members: Dr. Phillip R. Daves, Dr. Charles B. Garrison, Dr. Deborah L. Gunthorpe, and Dr. James W. Wansley, for their comments and assistance during the course of my dissertation work. I would like to thank my wife's parents, David and Lori Coates, for their support and encouragement. Lastly, I would like to express my thanks to my loving wife, Erin Elizabeth, for her support, understanding, and patience these past four years.

ABSTRACT

This dissertation analyzes the relationship between dividend yields and stock returns. Black and Scholes (1974) test the *Dividends are Irrelevant Theory* and conclude that dividend yields are irrelevant because they find no relationship between stock returns and dividend yields. Conversely, Litzenberger and Ramaswamy (1979) test the *Dividends Increase Returns Theory* and conclude that dividend yields are relevant because they find a positive relationship between stock returns and dividend yields. Thus, the results of these studies are ambiguous and conflicting.

This dissertation uses a multi-index model and a linear program to construct an *Investment Strategy* which consists of a long and short portfolio of high and low dividend yield stocks, respectively. The *Investment Strategy* is tested ex-ante by purchasing the high yield portfolio and by selling short the low yield portfolio. Several tests are employed to analyze the monthly returns on the *Investment Strategy* and test the relevance of dividend yields.

The tests do not support the *Dividends Increase Returns Hypothesis*. The t-test concludes that the -0.0427 mean return on the *Investment Strategy* is not significantly greater than zero and the binomial t-test concludes that the 0.425 proportion of positive returns is not significantly greater than fifty percent.

The tests of the *Dividends are Irrelevant Hypothesis* have conflicting results. The t-test concludes that the -0.0427 mean return on the *Investment Strategy* is not significantly different than zero at the five percent level, but is at the ten percent level. The binomial t-test concludes that the 0.425 proportion of positive returns is significantly different than fifty percent at both the five and ten percent levels. Three alternative asset pricing models are employed and none of the tests reject the *Dividends are Irrelevant Theory*.

In summary, four asset pricing models are employed to test the relevance of dividend yields. The tests of all four models reject the *Dividends Increase Returns Theory*. However, the test results of the *Dividends are Irrelevant Theory* are not robust with respect to the particular multi-index model. The tests of three models support the *Dividends are Irrelevant Theory*, however the tests of one model does not. The conclusions of the *Dividends are Irrelevant Theory* depend upon the particular model selected.

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CHAPTER I

BACKGROUND

1.1 Introduction

The relationship between stock returns and dividend policies is a puzzle that remains unsolved after over thirty years of theoretical modeling and empirical testing. The unresolved controversy is whether dividends and dividend policies affect the value of the firm. The theoretical models developed to date give conflicting effects. The studies of Miller and Modigliani (1961) and Miller and Scholes (1978) conclude that dividend policies are irrelevant. Conversely, the studies of Walter (1956), Lintner (1956), Farrar and Selwyn (1967), Bhattacharya (1979), and Miller and Rock (1985) conclude that dividend policies are relevant. Therefore, empirical research must determine which theoretical models best explain the corporate market. There are several empirical issues that researchers have analyzed.

The first empirical issue that researchers have analyzed is how dividend changes affect stock returns. Although Watts (1973) finds no significant positive (negative) returns associated with dividend increases (decreases), most later empirical studies[1] using event study methodology conclude that dividend increases (decreases) result in increased (decreased) stock returns. For example, Aharony and Swary (1980) find that firms that increase (decrease) dividends preceding earnings announcements realize statistically significant cumulative average abnormal returns of 1.03 (-2.82) percent over a two day announcement period.[2]

The second empirical issue deals with dividend levels (or dividend yields) and how they affect stock returns. Tests of the *Dividends are Irrelevant Theory* by Watts (1973) and Black and

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[1] See Aharony and Swary (1980), Kwan (1981), Brickley (1983), Kalay and Loewenstein (1986), and Christie (1990).

[2] Another empirical issue deals with specially designated dividends (SDDs) which are not distributed annually. The empirical studies of Jayaraman and Shastri (1988), Lakonishok and Vermaelen (1990), and Howe, He, and Kao (1992) conclude that SDDs are relevant because firms which pay SDDs experience significant positive returns.

Scholes (1974) conclude that dividend yields are irrelevant because they find that there is no relationship between stock returns and dividend yields. Conversely, tests of the *Dividends Increase Returns Theory* by Stone and Bartter (1979) and Litzenberger and Ramaswamy (1979) conclude that dividend yields are relevant because they find a significant positive relationship between stock returns and dividend yields. Thus, the results of these studies are ambiguous and conflicting. This dissertation uses a newer and more robust methodology to analyze dividend yields and to determine whether they are relevant.

1.2 Motivation

Recent empirical research on dividends has concentrated on dividend changes and how these changes affect stock returns. Conversely, there has been little recent research on dividend yields which is an important and unresolved issue. The objective for this dissertation is to analyze the relationship between stock returns and dividend yields.

A linear program and a multi-index model are used to form an *Investment Strategy*[3] which is subsequently used to analyze the relationship between dividend yields and stock returns. The application of a linear program and a multi-index model contributes to the dividend literature in three major ways.

First, the multi-index model accounts for much more variance of stock returns than the single-index market model. By controlling for different and more sources of risk, the power of the tests are much stronger than the earlier studies.

Second, the increased power permits the testing of the relationship between dividend yields and stock returns, an issue that has previously been subject to ambiguous results and conflicting conclusions. For example, Watts (1973) and Black and Scholes (1974) find that dividend yields are irrelevant. Conversely, Stone and Bartter (1979) and Litzenberger and Ramaswamy (1979) find that dividend yields are relevant and support that it is an omitted variable

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[3] The *Investment Strategy*, by construction, consists of a long portfolio of high dividend yield stocks and a short portfolio of low dividend yield stocks. In theory, the *Investment Strategy* has a net zero dollar investment. See section *3.4.4 Formulation of the Investment Strategy* for more details.

in the Capital Asset Pricing Model (CAPM).

Third, the linear program and data from the multi-index model permit an *Investment Strategy* that has implications for market efficiency. To preclude arbitrage, the return on the *Investment Strategy* should not be significantly different from zero.

If dividend yields do not affect stock returns, then the *Investment Strategy* should not earn a return significantly different from zero. This would be consistent with the *Dividends are Irrelevant Theory*. If dividend yields positively affect stock returns, then the *Investment Strategy* should earn a return significantly greater than zero. This would be consistent with the *Dividends Increase Returns Theory*.

1.3 Organization of Dissertation Proposal

The rest of the dissertation is divided into four chapters. Chapter II provides a complete literature review on dividends. Chapter III explains the methodology and estimation procedures. Chapter IV reports the empirical results. Chapter V provides the conclusions. A more detailed breakdown for each chapter is described below.

Chapter II provides a complete review of the three major theories and is divided into three sections. Section 2.1 discusses the *Dividends are Irrelevant Theory*. Section 2.2 discusses the *Tax Clientele Theory*. Section 2.3 discusses the *Informational Content of Dividends Theory*. Theoretical models and empirical research are discussed in each section.

Chapter III explains the methodology and estimation procedures and is subdivided into six major sections. Section 3.1 discusses the data source. Section 3.2 discusses the Capital Asset Pricing Model. Section 3.3 discusses variance reduction with a multi-index model. Section 3.4 discusses the multi-index model. Section 3.5 discusses the results of the pilot study that utilized the single-index market model. Lastly, Section 3.6 discusses the expected results.

Chapter IV reports the empirical results of this dissertation and is subdivided into five major sections. Section 4.1 is an introduction and describes the time period studied and the sample of firms. Section 4.2 tests whether the multi-index model has significantly more explanatory power of observed stock returns than the single-index market model. Section 4.3

discusses data analyzed in the estimation periods. Section 4.4 discusses the empirical results with data from the twenty testing periods. Section 4.5 discusses the testing period results of three alternative models used to replicate the study.

Chapter V gives the conclusions of the dissertation.

CHAPTER II

LITERATURE REVIEW

The relationship between stock returns and dividend policies is a puzzle that remains unsolved after thirty years of theoretical modeling and empirical research. The unresolved controversy is whether dividends and dividend policies affect the value of the firm. This is a real issue that managers face when they decide whether to pay earnings as dividends or to retain earnings for reinvestment into the firm.

The literature review discusses the theoretical development of three major theories: (1) the *Dividends are Irrelevant Theory*; (2) the *Dividend Tax Clientele Theory*; and (3) the *Informational Content of Dividends Theory*. The literature review also discusses the empirical tests of these three theories. There are several issues that researchers have addressed. One, how do *changes in dividend payout* affect the value of the firm? Two, how does the *dividend level of payout* (or dividend yield) itself affect the value of the firm? Three, how do *stock repurchases* and *specially designated dividends* affect the value of the firm?

The rest of the literature review is discussed as follows. The *Dividends are Irrelevant Theory* is discussed in Section 2.1 with the theoretical modeling discussed in Section 2.1.1 and the empirical research discussed in Section 2.1.2. The *Dividend Tax Clientele Theory* is discussed in Section 2.2 with the theoretical modeling discussed in Section 2.2.1 and the empirical research discussed in Section 2.2.2. The *Informational Content of Dividends Theory* is discussed in Section 2.3 and there are three sections. The theoretical modeling is discussed in Section 2.3.1; the empirical research is discussed in Section 2.3.2; and stock repurchases and specially designated dividends is discussed in Section 2.3.3. Lastly, there is a short summary in Section 2.4.

2.1 The Dividends are Irrelevant Theory

The Dividends are Irrelevant Theory claims that changes in dividend yields and the levels of dividend yields do not affect the value or the stock returns of the firm. Section 2.1.1 discusses the theoretical development and Section 2.1.2 discusses the empirical studies that support this theory.

Miller and Modigliani (1961) and Miller and Scholes (1978) are two major studies that develop theoretical models that support the *Dividends are Irrelevant Theory*. These two studies are discussed in Section 2.1.1.

Watts (1973, 1976), Black and Scholes (1974), and Loderer and Mauer (1992) empirically support the *Dividends are Irrelevant Theory*. However, Laub (1976) disagrees with Watts (1973); and Stone and Bartter (1979) disagree with Black and Scholes (1974). Both Laub (1976) and Stone and Bartter (1979) conclude that dividend yields are relevant and reject the hypothesis that dividends are irrelevant. These six papers are discussed in Section 2.1.2.

2.1.1 The Dividends Irrelevant Theoretical Development

Miller and Modigliani (1961) address whether dividend policies affect the value of the firm. Their theoretical model makes the following assumptions: no taxes; no transaction costs when buying and selling securities; rational behavior in that more wealth is preferred to less; firms are all equity firms; investment decisions are exogenous for the firm in that all net present value projects are undertaken; the firm's future investment opportunities portfolio is characterized by symmetric information available to investors and management.

Miller and Modigliani's model can be explained with the use of *Sources and Uses of Funds*. They assume that a firm operates at the point where the marginal revenue of production equals the marginal cost of production. This means that there are two sources of funds for the firm, net operating income (NOI) and the proceeds of new stock issues. Additionally, there are two uses of funds, investments in real projects and dividends to investors. The uses of funds must equal the sources of funds:

$$\text{NOI} + \text{New Stock Issues} = \text{Investment} + \text{Dividends.} \qquad \text{(II-1)}$$

Another way to view this is that net operating income minus investment plus new stock issues equals dividends:

$$\text{NOI} - \text{Investment} + \text{New Stock Issues} = \text{Dividends.} \qquad \text{(II-2)}$$

Since net operating income and investment are exogenous to the model, the only avenue for management to control dividend levels is through new stock issues. Unexpected increases in dividend payouts can occur only through increases in new stock issues, and unexpected decreases in dividend payouts can only occur through decreases in new stock issues. Through the following argument, they conclude the *Sources and Uses of Funds* model illustrates that the dividend policy does not affect the value of the firm.

When the amount of dividends to be paid to stockholders is temporarily larger than NOI, the firm can issue new stock and pay this generated revenue to the stockholders. When the projected NOI is greater than required for investments, the firm can pay a higher dividend or repurchase stock. A stock repurchase reduces the number of stocks outstanding and raises the price of the stocks via a capital gains.

In summary, the dividend policy is a function of how new stock issues and the difference between NOI and investment are managed. Stockholders receive their return on stock either as a dividend or a capital gain. In a world of no taxes, investors are indifferent to the form of return. Therefore the dividend policy does not affect the value of the firm.

Miller and Modigliani's study was done with the most basic assumptions. The assumption of a world with no taxes immediately drew criticism. Many researchers extended the model by including corporate and personal taxes; those studies are discussed later in the Chapter. However, Miller and Modigliani's study helped lay a foundation for explaining how dividend policy affects the value of the firm.

Miller and Scholes (1978) address the issue of why firms pay taxable dividends to shareholders while simultaneously issuing new capital. They note: " In 1976 ... corporations paid the Treasury 43 percent of their earnings of $111 billion in corporation income taxes. From the after-tax remainder, they then paid out $31 billion in dividends, thereby subjecting a substantial fraction of their stockholders to still another tax bite under the personal income tax. ... at the same time that corporations were shoveling $31 billion of dividends out the front door, they were raking some $47 billion in through the back door in the form of new equity issues, new bond issues and new bank credit. " (Miller and Scholes, 1978, p. 107-108.)

Farrar and Selwyn (1967) propose that low dividend payouts maximize the firm's value in periods where the capital gains tax rate is substantially lower than the dividend tax rate. However, the corporate sector does not follow this policy and the failure to transform dividends into capital gains cannot be attributed to a mismatching of the funds and opportunities in the corporate sector.

Miller and Scholes explain that high dividend payouts by firms do not subject stockholders to double taxation. Their model has two sets of assumptions. The first set of assumptions are those used in previous research, which include: no transaction costs; local insatiability; investment decisions are exogenous to the firm; full information; there is personal debt, but no corporate debt; there are corporate taxes, ordinary personal income taxes, but no capital gains tax (or alternatively, a capital gains tax rate much lower than the ordinary income tax rate); the firm faces a budget constraint where net operating income and new stock issues equals investments and dividends.

The second set of assumptions are the unique assumptions that extend earlier research. These unique assumptions include: there is only one mutual fund which owns all the equity shares in the entire economy; a class of investors called *accumulators* with high risk tolerance own all the mutual fund shares; another class of investors called *non-accumulators* with low risk tolerance buy only low risk debt securities; only *accumulators* issue debt securities which the *non-accumulators* purchase; interest expense is tax deductible only up to the amount of investment income earned; debt is riskless and the riskless rate equates the demand and supply of debt securities between the two groups; investors may invest in stocks, bonds or *insurance policies*, and the investment income from an *insurance policy* is riskless and not taxed as long as the insurance remains in force; the cash value of *insurance policies* borrowed by an investor is not taxable. These *insurance policies* include pension funds, IRAs, and life insurance policies with cash value buildups.

Their resulting model shows that the bond return equals the *insurance policy* return, but the taxes on the *insurance policy* can be deferred. *Non-accumulators* do not purchase the *insurance policies* because they prefer current bond income to help meet living expenses. Conversely, *accumulators* purchase *insurance policies* because they want to defer income. They can meet their living expenses with their salaries and wages. Additionally, they can offset their dividend income with tax deductible interest payments.

The following scenario of Miller and Scholes shows that dividend policies have no affect on the wealth or economic welfare of its shareholders. First, a firm makes an announcement concerning its investment decision and its decision to increase their dividend payout. There are two cases that can occur for *accumulators* who do not invest in debt securities.

Case 1: The *accumulators* could have a surplus of interest deductions which would offset the increased dividend payment, so their wealth is unaffected. They trade capital gain income for dividend income and the taxes they pay remain the same.

Case 2: The *accumulators* could have just enough interest deductions to offset their previous investment income, so now they issue additional debt to the point where the level of interest deductions equals the investment income. The *accumulators* invest the proceeds from the debt issuance in an *insurance policy* which earns the riskfree rate of interest which is equal to the interest rate they pay on the debt. *Accumulators* can pay the interest on the new debt issued by several methods: borrowing their *insurance policy's* cash value, using their salary and wages, or using the additional dividends.

In both cases, the total wealth of the stockholders remains constant and there is no optimal dividend policy. Miller and Scholes conclude that firms may pay large dividends because firms realize that their stockholders are not really subject to another round of taxes. They note that although the Farrar and Selwyn (1967) model seemed very logical, it does not explain what actually occurs in the corporate sector. Miller and Scholes develop an intuitive and theoretical explanation for what may occur in the corporate sector.

Miller and Scholes conclude that dividend policies do not affect the value of the firm. However, it is the inclusion of *insurance policies* that support this conclusion rather than the absence of taxes as in Miller and Modigliani (1961). An article by Nussbaum and Dobrzynski (1987) supports that owners of *insurance policies*, such as pension funds, do indeed own a large part of the stock market.

Nussbaum and Dobrzynski report that pension funds increased their assets from $548 billion in 1970 to more than $1.5 trillion in 1987 and that over one third of their funds are invested in equities. These pension funds, which are not subjected to taxes, owned twenty-five percent of the total corporate equity in 1987 which is up from six percent in 1965, and could rise to fifty percent by the year 2000.

2.1.2 Empirical Support for the Dividends are Irrelevant Hypothesis

Several studies provide empirical support for the *Dividends are Irrelevant Theory*. These include Watts (1973, 1976), Black and Scholes (1974), and Loderer and Mauer (1992). However, Laub (1976) refutes Watts (1973) and Stone and Bartter (1979) refute Black and Scholes (1974). Following is a discussion of each paper.

Watts (1973) is an early study that empirically tests the Lintner (1956) hypothesis that dividends convey informational content about the firm's future earnings. Lintner (1956), which is discussed in section *2.3 Informational Content of Dividends Theory*, concludes that current dividends are a function of both current and past earnings. Thus, Watts tests whether a model with current and past dividends is significantly more accurate in predicting future earnings than a model with only earnings information.

Watts studies 310 firms over the 1945 to 1968 period. For each firm, he obtains annual dividends per share and monthly returns from the CRSP tapes and annual earnings per share from the COMPUSTAT tapes. Watts restricts his data to annual dividends and earnings per share based on Laub (1970) who concludes that dividend changes cluster around the end of the fiscal year. There are three major parts to Watts' study.

In part one, Watts uses ordinary least squares to estimate the following regression:

$$E_{i,t+1} = \alpha_i + \beta_{1,i}\, E_{i,t} + \beta_{2,i}\, E_{i,t-1} + \beta_{3,i}\, D_{i,t} + \beta_{4,i}\, D_{i,t-1} + v_{i,t} \qquad \text{(II-3)}$$

where t equals years 1947 to 1966, i equals firms from 1 to 310, E equals earnings per share, D equals dividends per share, and v is the error term. An analysis of the cross-sectional distribution of the ordinary least squares estimates reveals that $\beta_{3,i}$, the mean parameter on the current dividend variable, is positive, but not significantly. Furthermore the positive relationship does not persist across all firms as $\beta_{3,i}$ is negative for over twenty-five percent of the firms in the sample.

Conversely, $\beta_{1,i}$, the mean parameter on the current earnings variable, is significantly positive. Additionally, the positive relationship for $\beta_{1,i}$ persists across all firms. Thus, Watts concludes that dividend yields do not convey significant information to the market about next year's earnings.

In part two, Watts analyzes dividend changes by estimating dividends using both the Lintner (1956) and the Fama and Babiak (1968) models, because Fama and Babiak conclude that their model, which deletes the intercept term and adds a lagged earnings term, has more predictive power. Watts estimates the following first pass regression for the Lintner model and the Fama and Babiak model, respectively:

$$D_{i,t} - D_{i,t-1} = \alpha_i + \beta_{1,i} D_{i,t-1} + \beta_{2,i} E_{i,t} + u_{i,t} \qquad \text{(II-4)}$$

$$D_{i,t} - D_{i,t-1} = \beta_{1,i} D_{i,t-1} + \beta_{2,i} E_{i,t} + \beta_{3,i} E_{i,t-1} + u_{i,t} \qquad \text{(II-5)}$$

In both models, t equals 1947 to 1966 and the error terms can be interpreted as the unexpected change in dividends in year t that may be attributed to the information content of dividends. Since the results are similar for both models, only the results of the Fama-Babiak model are reported.

Next, Watts regresses the changes in earnings for year $t + 1$ on the residuals of the first pass regression above:

$$E_{i,t+1} - E_{i,t} = \alpha_i + \beta_i u_{i,t} + w_{i,t+1} \qquad \text{(II-6)}$$

An analysis of the cross-sectional distribution of the ordinary least squares estimates reveals that the mean parameter on the first pass regression residual term is not significantly positive. From this he concludes that dividend changes do not convey information about next year's earnings.

In part three, Watts analyzes whether the unexpected dividend change for the year and the abnormal return for the corresponding month are independent. The following market model regression is estimated using ordinary least squares:

$$\tilde{R}_{jt} = \alpha_j + \beta_j \tilde{R}_{mt} + \tilde{\varepsilon}_{jt} \qquad \text{(II-7)}$$

where: t equals July 1945 to June 1968; $\tilde{R}_{jt}$ is the monthly rate of return for firm j in month t; $\tilde{R}_{mt}$ is the monthly return of Fisher's Arithmetic Investment Performance Index in month t; and $\tilde{\varepsilon}_{jt}$ is the error term for firm j in period t.

If dividends signal significant information, then a positive unexpected dividend change should accompany a positive abnormal return in the corresponding month. Conversely, a negative unexpected dividend change should accompany a negative abnormal return in the corresponding month. To account for informational sources other than dividends, Watts calculates and tests cumulative abnormal returns over the fiscal year and the following twelve months.

A monthly abnormal performance index is calculated by cumulating abnormal returns of the 310 firms for each month during the fiscal year. A second monthly abnormal performance index is calculated by summing the abnormal returns of all the firms that experience an unexpected dividend increase. Similarly, a third monthly abnormal performance index is calculated for firms that experience an unexpected dividend decrease. In only two of the twenty-four months can the chi-square statistic reject the null hypothesis that the unexpected dividend change for the year and the abnormal return for the particular month are independent. Furthermore, in one of the two significant cases the direction is wrong. Thus, this test on dividend changes concludes that the informational content of dividends is trivial.

Watts puts forth a theoretical explanation why the informational content of dividends may be trivial. He assumes a modified version of the Lintner model and Fama and Babiak model where:

$$D_{it} = D_{i,t-1} + ß_i \, (r_i \, E^*_{i,t+1} - D_{i,t-1}) + z_{it} \qquad \text{(II-8)}$$

where: D_{it} is the amount of dividends paid by firm i in year t; ß is the speed of adjustment of dividend payments to the desired dividend payments for firm i; r is the target payout ratio for firm i; E^* is firm i's expected earnings for year t+1; and z represents an error term that captures other factors.

Now Watts assumes that earnings follow a first-order moving average process where:

$$E_{i,t+1} = \Sigma^{\infty}{}_{j-0} \, (1 - \Phi) \, \Phi^j \, E_{i,t-1} + e_{i,t+1} \qquad \text{(II-9)}$$

where Φ_i is the moving average parameter and $e_{i,t+1}$ is an serially independent term with mean zero. Watts (1970) and Watts and Ball (1972) conclude that Φ_i is close to zero so the expected value can be rewritten as:

$$\mathrm{E}(E_{i,t+1}) \equiv (1 - \Phi) \, \mathrm{E}_{i,t} + (1 - \Phi^i) \, \Phi_i \, E_{i,t-1} \qquad \text{(II-10)}$$

where $\mathrm{E}(E_{i,t+1})$ is the expected earnings of firm i for year t + 1. Watts now assumes that the independent term, $e_{i,t+1}$, is composed of:

$$e_{i,t+1} = a_{i,t} + v_{i,t+1} \tag{II-11}$$

where $a_{i,t}$ equals managerial information and $v_{i,t+1}$ is the error term.

From the above, Watts formulates management's expectations of the earnings next year as:

$$E^{*}_{(i,t+1)}) \equiv (1 - \Phi)\ \mathrm{E}_{i,t} + (1 - \ \Phi^{i})\ \Phi_i\ E_{i,t-1} + a_{i,t} \tag{II-12}$$

This can be substituted into equation (8) which yields:

$$\begin{aligned}\mathrm{D}_{i,t} = D_{i,t-1} + \beta_i\ r_i\ (1 - \Phi)\ \mathrm{E}_{i,t} + \beta_i\ r_i\ (1 - \ \Phi^{i})\ \Phi_i\ E_{i,t-1}\ - \\ \beta_i\ D_{i,t-1} + \beta_i\ r_i\ a_{i,t} + z_{i,t}\end{aligned} \tag{II-13}$$

This equation is the form presented in equation (II-5) of Fama-Babiak, except the Fama-Babiak model incorporates the estimated residual as:

$$u_{i,t} = \ \beta_i\ r_i\ a_{i,t} + z_{i,t} \tag{II-14}$$

This means that the independent variable, $u_{i,t}$ used in:

$$E_{i,t+1} - E_{i,t} = \alpha_i + \beta_i\ u_{i,t} + w_{i,t+1} \tag{II-15}$$

is not managerial information. Instead the variable is a function of managerial information and the error in the dividend model for the particular year. He then derives the limiting value for β_i in equation (II-15) which is dependent on the speed of adjustment coefficient, β, and the target dividend payout rate, r. The results lead Watts to conclude that the information content of dividends is trivial because the market cannot determine whether the change in dividends is due to information or noise.

In summary, Watts finds that there is no significant positive relationship between next year's earnings and the current unexpected dividend changes, which leads him to conclude that the informational content of dividends is trivial. Based on the abnormal returns, he concludes that any information about future earnings that unexpected dividend changes convey to the market is trivial because the value of the information is less than the transaction costs to act upon it. Watts concludes the reason that the informational content is trivial is that the noise of the dividend signaling model cannot be separated from the inside information of management.

Laub (1976) disagrees with the conclusion in Watts (1973) that the dividend model for a firm should be based on annual data and that the informational content of dividends is trivial. Watts' first conclusion regarding annual data is based on Laub (1970) which studies data on thirty firms from 1946 to 1965. Laub (1970) finds that one-third of the changes in dividends occur over the second and third quarter which Watts regards as minute. However, Laub (1976) believes the contrary and concludes that this favors a quarterly dividend model.

Based on the above, Laub develops a dividend model where quarterly dividends and quarterly earnings explain the dividend adjustment process. Laub then compares his model to modified forms of the Fama-Babiak (1968) and Watts (1973) models. Laub determines his model is most appropriate, since it achieves the lowest mean squared error. He argues that this supports that quarterly dividends and quarterly earnings substantially improve forecasted annual earnings. Lastly, Laub concludes that in his model the informational content of dividends is nontrivial, which is the opposite of Watts (1973).

Watts (1976) is a response to Laub (1976), who disagrees with the results of Watts (1973). Watts defends his 1973 conclusion that the informational content of dividends is trivial. First, Watts argues that the annual data in his study are appropriate as accountants oftentimes extrapolate many of the preceding year's expenses to determine quarterly earnings. Thus, this information is often less accurate than expectations on annual earnings where there is no extrapolation. Furthermore, quarterly earnings may incorporate a seasonal element and the amount of the seasonal component is hard to calculate accurately. Watts points out that two-thirds of regular dividend changes and ninety percent of extra dividend payments occur in the first and last quarter of the year which suggests that managers do depend on annual data to make their dividend decisions and that the quarterly model of Laub (1976) is misspecified.

Concerning Laub's mean squared error criterion for the three models (the Laub quarterly period model, the Fama-Babiak (1968) annual period model, and the Watts (1973) annual period model), Watts points out that these models are not similar and that Laub has predetermined the results by design. The annual data models are not directly estimated on annual earnings, rather the parameters of the two models are obtained via an indirect method which most likely injects more measurement error. For Laub to prevent prejudice in his results, Watts argues that Laub should have chosen similar models for both the quarterly and annual data.

Lastly, Watts asserts that true information in the dividend changes should be reflected in the stock price. "In other words, triviality depends on the value of the information" (Watts, 1973, p. 83) He points out that Laub's disagreement relates to the association between future earnings changes and dividend changes. Even if Laub's argument is correct, it does not affect the stock price, as Watts (1973) has shown, and the information should be declared trivial.

In summary, after his examination of Laub's study, Watts finds no evidence to change the conclusions of his 1973 study.

Black and Scholes (1974) argue that research to date on dividends suggest that there are three basic schools of thought. The first school is that investors prefer dividends to capital gains because of the higher transaction costs associated with rebalancing portfolios.

The second school is that investors prefer a lower dividend payout since dividends have a higher differential tax rate than capital gain income. Thus, firms with low dividend payout ratios have higher stock prices than firms with high dividend payouts.

The third school is that investors form clienteles and invest in firms with dividend payout policies that they find most desirable. This market reaches an equilibrium where firms cannot increase their stock price by changing their dividend policy because of the so-called *supply effect.*

The clienteles may consist of the following types of investors when all else is held constant. Investors that would prefer high dividend payouts include: corporations that receive exclusions on dividend income, but not capital gain income; trust and endowment funds where beneficiaries receive only the dividends and income earned from the funds; individuals who incorporate their stock earnings into their consumption pattern and prefer dividend income because it is cheaper and easier than selling or borrowing against their stock.

Investors that would prefer low dividend payouts include individuals that pay higher tax rates on dividend income than on capital gains income.

Investors that are indifferent to dividend payout policies include tax exempt investors and institutions.

Black and Scholes show that investors cannot construct a high dividend yield portfolio and a low dividend yield portfolio that are perfectly correlated because there are systematic differences between the two types of stocks. They call this the diversification effect.

They introduce a new methodology to test whether increasing the dividend reduces the firm's expected stock return. They modify the CAPM into the following equation:

$$E(R_i) = \tau_0 + [E(R_m) - \tau_0]\ \beta_i + \tau_1\ (\delta_i - \delta_m)/\delta_m \qquad \text{(II-16)}$$

where $E(R_i)$ and $E(R_m)$ equal the expected return on portfolio i and the market index, respectively; τ_0 is the intercept term; and δ_i and δ_m equal the dividend yield on portfolio i and the market, respectively. They argue that if the coefficient on the dividend term is insignificant, then this test supports that dividend policy does not affect the firm's expected stock return.

They construct the portfolio to meet the following three conditions. One, the expected portfolio return equals the return they want to estimate. Two, the stocks in the portfolio are selected based on information available at the time to avoid biases. Three, the portfolio selected has the smallest variance possible. These three conditions result in unbiased and efficient estimators. The required weights, W_i, for the estimation of τ_1 can be written as:

$$\text{minimize:} \quad \Sigma_{ij}\ W_i\ W_j\ \sigma_{ij} \qquad \text{(II-17)}$$

$$\text{subject to:} \quad \Sigma_i\ W_i\ E[R_i] = \tau_1 \qquad \text{(II-18)}$$

Equation (II-16) can be substituted into equation (II-18) and becomes:

$$\text{subject to: } \Sigma_i W_i(\tau_0 + [E(R_m)-\alpha_0]\beta_i + \tau_0(\delta_i-\delta_m)/\delta_m) = \tau_1 \qquad \text{(II-19)}$$

All values of τ_1 and $E(R_m)$ can satisfy equation (II-19) if the following three equations are satisfied:

$$\Sigma_i\ W_i = 1 \qquad \text{(II-20)}$$

$$\Sigma_i\ W_i\ \beta_i = 0 \qquad \text{(II-21)}$$

$$\Sigma_i\ W_i\ \delta_i = \delta_m \qquad \text{(II-22)}$$

Thus, Black and Scholes must solve the following set of four equations:

$$\text{minimize:} \quad \Sigma_{ij}\ W_i\ W_j\ \sigma_{ij} \qquad \text{(II-23)}$$

$$\text{subject to:} \quad \Sigma_i\ W_i = 1 \qquad \text{(II-24)}$$

$$\Sigma_i\ W_i\ \beta_i = 0 \qquad \text{(II-25)}$$

$$\Sigma_i\ W_i\ \delta_i = \delta_m \qquad \text{(II-26)}$$

They form a lagrangian equation and set up the first order conditions to form the system of equations they solve. They form twenty-five intermediate portfolios which are used to solve the system of equations. Before the weights on each intermediate portfolio can be determined (so they can find an unbiased efficient estimator for τ_1), they must estimate the following for each intermediate portfolio: beta, dividend payout, and variance. The same process applies for the intercept term, τ_0, except the sum of the weights are required to equal zero. The methodology they use to estimate β_i, δ_i, and σ_i is as follows.

They rank all the NYSE firms according to their dividend yields, which are estimated based on the dividends received over the past twelve months. Then the firms are placed into five groups, with the first group having the firms with the highest dividend yields and the last group having the lowest dividend yields. Within each group, the firms are ranked according to their betas, which are estimated with the CAPM and the previous sixty months of data. Then the firms are placed into five subgroups, with the first subgroup having the firms with the highest betas and the last group having the lowest betas. These twenty-five subgroups are the intermediate portfolios. Next, they calculate the returns and the dividends on the twenty-five intermediate portfolios over the next twelve months.

They roll this methodology ahead until they have thirty-five years of monthly returns and dividend yields on the twenty-five portfolios. Now the beta and the annual dividend yield of each intermediate portfolio is calculated using the same methodology applied to individual firms. The end result is thirty annual betas and dividend yields for each intermediate portfolio. These are the estimates of the betas, β_i, and the annual dividend yields, δ_i, that are used to solve the first order conditions. The remaining variable that needs to be estimated is the variance of each portfolio. They assume the diagonal elements of the variance/covariance matrix are equal to $\beta^2_i\sigma_{mm}+\sigma_{\varepsilon\varepsilon}$ where σ_{mm} is the estimated variance of the market return and $\sigma_{\varepsilon\varepsilon}$ is the constant residual variance term. They assume the off-diagonal elements are equal to $\beta_i\beta_j\sigma_{mm}$.

Now the weights of intermediate portfolios are determined and an unbiased efficient estimator for the intercept, τ_0, and the coefficient on the dividend term, τ_i are estimated. The methodology assures that the characteristics of portfolios are stable. The results are that the long positions in intermediate portfolios are in high yield portfolios and the short positions are in low yield portfolios. Additionally, the weights of the long position equals that of the short, the beta of the weighted portfolios are equivalent to zero, and the variance of the returns on the portfolio is small.

The estimated coefficients on the dividend term is not significantly different from zero over the 1936 to 1966 time period or several subperiods of this time period. Black and Scholes conclude that there is no significant difference between the returns on high yield stocks and returns on low yield stocks. They perform an additional test to determine whether the dividend variable is significant in explaining stock returns. They regress abnormal portfolio returns on their betas and the dividend parameter, and find the coefficient on beta significant, but the coefficient on the dividend parameter insignificant.

These test results support the conclusion that firms cannot increase their stock price by increasing their dividends. The dividend yield and dividend policy are irrelevant.

Stone and Bartter (1979) investigate whether the dividend yield is an omitted variable in the capital asset pricing model. Their methodology is an improvement over the earlier study by Black and Scholes (1974). Stone and Bartter point out that Black and Scholes time-series approach obscures dividend yield effects because Black and Scholes arbitrarily scale the stock yield which restricts the yield of their zero-beta portfolios to equal the market yield and fails to reflect yield variation in their intercept estimator of yield effects.

Stone and Bartter employ a unique methodology. They use a linear program to assign all firms to one of sixteen portfolios and to maximize the dividend yield between the sixteen portfolios subject to several constraints.

The constraints include: (1) the increment in the dividend yield across the sixteen portfolios must be equal; (2) the systematic risk of all the portfolios must be the same; (3) the number of securities in all the portfolios must be the same; (4) all securities must be assigned to at least one portfolio; and (5) short selling is not allowed.

Each portfolio is defined as a isobeta portfolio, because each portfolio has the same beta. There are several advantages to using the portfolios. The dividend effect is clearly identified and is not confused with beta dependent misspecifications. There are no multicollinearity problems between yield and beta; i.e., their sample correlation is zero. Any error that occurs due to misspecifying the return is the same for all portfolios.

Stone and Bartter form the sixteen isobeta portfolios for each year from 1947 to 1970. For each year they use sixty months of past returns and twelve months of future returns. They estimate the beta and dividend yield for each firm on the CRSP tape with the past sixty months of data. They form 100 intermediate portfolios based on the estimated dividend yields. Then these 100 intermediate portfolios are input to the linear program to form sixteen portfolios which meet the objective function and constraints outlined above.

Stone and Bartter analyze the abnormal returns and excess dividend yields over 1947 to 1970 period. They plot the average annual abnormal returns against the annual average excess dividend yield of the sixteen portfolios and find a positive relationship between the return and yield. They regress the abnormal return on the excess dividend yield and find that there is a significantly positive relationship. They also regress the change in abnormal return on the change in the excess dividend yield and find that there is a significantly positive relationship.

This study concludes that the dividend yield is a significant omission from the standard capital asset pricing model. They do not conclude that markets are inefficient, but rather the model to test market efficiency is incomplete or that markets are inefficient given the valuation model. The implication for investors is that tax neutral investors with long investment horizons should invest in intermediate or high yield stocks.

Loderer and Mauer (1992) investigate whether firms use a strategy of coordinating dividend and stock offering announcements to obtain a higher price on the new stock issue and whether the market reaction justifies such a strategy. Using a market model they find no evidence that issuing firms pay or increase dividends more often than non-issuing firms. Furthermore, they find little evidence that the firms that do coordinate new stock issues and dividend announcements benefit from this strategy.

To test their hypotheses, they use a sample which includes 350 firms that announce 450 new stock issues and compare their sample to a control group of non-issuing firms which includes all the remaining firms listed on the CRSP tapes (except utilities and financial firms) from January 1 to December 31 for any given year from 1973-1984. The average annual percentage of non-issuing firms that pay dividends is 76.3 percent compared to 78.3 percent for the issuing firms. They further sub-divide the firms that pay dividends and find that 21.4 percent of non-issuing firms increase their dividends versus 22.2 percent of the issuing firms. A chi-square test indicates that new stock issuing firms are not more likely to pay dividends than non-issuing firms.

Thus, this supports the Miller and Modigliani (1961) *Sources and Uses of Funds* model in that firms that announce a dividend increase cannot signal a higher firm value to the market when they are subsequently issuing new equity.

2.2 The Tax Dividend Clientele Theory

The Tax Dividend Clientele Theory has been developed with the assumption that there are corporate taxes and two kinds of personal taxes; ordinary income taxes and capital gains taxes. Section 2.2.1 discusses Farrar and Selwyn (1967). They develop a series of complex tax structures and examine their impact on a hypothetical corporation's optimal dividend policies. This was one of the first major papers to correct for the no tax assumption made by Miller and Modigliani. Section 2.2.2 discusses Litzenberger and Ramaswamy (1979, 1980) and Bajaj and Vijh (1990). These studies find empirical support for the *Dividend Tax Clientele Theory*. However, Lamoureux (1990) fails to find support for the theory. The following sections discuss these papers in detail.

2.2.1 The Dividend Tax Clientele Theoretical Development

Farrar and Selwyn (1967) introduce corporate taxes and two kinds of personal taxes; ordinary income taxes and capital gains taxes. They assume capital gains taxes are paid when capital gains are accrued rather than when they are paid to the investor. They also assume: there exist corporate debt and personal debt; there are no transaction costs; there is local insatiability; investment decisions are exogenous to the firm; and there is full information available to investors and managers.

Farrar and Selwyn develop a model that maximizes an investor's after-tax income. When debt is introduced, investors face two real choices: (i) the amount of personal leverage versus corporate leverage; and (ii) the form of payment from the firm.

The intuition of the model is as follows. Disregard the debt issue for the moment and assume that firms operate at the point where the marginal revenue of production equals the marginal cost of production. Firms finance all net present value projects with income earned and are left with a net per share operating income (NOI)[4]. Now if the firm has undertaken corporate debt (D_c), it has to pay the per share interest expense (iD_c) from the net per share operating income. The difference between the per share net operating income and the per share interest expense is the per share before-tax cash flow of the firm. After paying corporate taxes (T_c), the firm has a per share after-tax cash flow with which to pay dividends. The per share before-tax income to investors is the per share dividend income less the per share interest expense on per share personal debt (iD_p). This remaining income is subjected to the personal income tax (T_{pi}). The remaining amount is the per share after-tax dividend income (Y_i^d) to the investor.

$$Y_i^d = [(NOI - iD_c)(1-T_c) - iD_p](1-T_{pi}) \tag{II-27}$$

The evaluation formula can be rewritten for investor per share after-tax dividend income (Y_{id}) and per share after-tax capital gain income (Y_{ig}):

$$Y_i^d = (NOI - iD_c)(1-T_c)(1-T_{pi}) - iD_p(1-T_{pi}) \tag{II-28}$$

$$Y_i^g = (NOI - iD_c)(1-T_c)(1-T_{gi}) - iD_p(1-T_{pi}) \tag{II-29}$$

With these two formulas it is possible to evaluate the different tax scenarios.

Scenario I assumes that there are corporate, personal income, and capital gains taxes. Furthermore, the personal income tax rate equals the capital gains tax rate. Thus, investors are indifferent between dividends and capital gains. This means the dividend policy is irrelevant as any policy maximizes the firm's value.

Scenario II assumes that there are corporate, personal income, and capital gains taxes.

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[4] Note this differs from Miller and Modigliani (1961) who define NOI as total operating income.

Furthermore, the personal income tax rate is greater than the capital gains tax rate. Thus, investors prefer capital gains over dividends. This means the dividend policy is relevant and firms can maximize their value by paying out small dividends.

Scenario III assumes that there are corporate, personal income, and capital gains taxes. Furthermore, the personal income tax rate is less than the capital gains tax. Thus, investors prefer dividends over capital gains. This means the dividend policy is relevant and firms can maximize their value by paying out large dividends.

In summary, the dividend policy is a function of the corporate and personal tax structure. The capital gain tax rate and the dividend tax rate determine the appropriate dividend policy for firms. Therefore the dividend policy may be relevant or irrelevant depending on the particular tax structure at the time.

This study greatly improved on Miller and Modigliani (1961). One should note that currently the capital gains tax rate and personal income tax rate are equal, but unlike Farrar and Selwyn's assumption, the capital gain is not taxed until it is received by the investor. Thus, an investor can postpone paying taxes until a later date. The advantage is twofold: (1) it allows an investor to earn income on the tax since the tax can be deferred; (2) with different tax brackets assumed, it allows the investor to postpone paying taxes until he is in a lower tax bracket. Thus, Farrar and Selwyn's paper support the conclusion that firms can maximize their value with a low dividend payout and high capital gains payout.

2.2.2 Dividend Tax Clientele Empirical Research

Several studies empirically test the *Dividend Tax Clientele Theory*. Three studies that support the theory include Litzenberger and Ramaswamy (1979, 1980) and Bajaj and Vijh (1990). One study that refutes the theory is Lamoureux (1990) which is included here because the results do not support one of the other two theories. Following is a discussion of the above four studies.

Litzenberger and Ramaswamy (1979, 1980) address the tax issues discussed in several earlier studies. Previous research, such as Cottle, Dodd, and Graham (1962) and Gordon (1963), suggests that investors bid up the price of high yield securities relative to low yield securities because investors prefer certain dividend returns over uncertain future dividends. Conversely, Miller and Modigliani (1961) argue that dividend policies do not affect the price of stock for firms when the investment decision is given and the economy is without taxes and transaction costs. Additionally, Miller and Modigliani argue that in a world of different personal tax rates, firms would find clienteles of investors that desire each firm's particular dividend policy.

Black and Scholes (1974) argue that firms operate in an equilibrium where no firm can affect its stock price by marginal changes in its payout policy. Brennan (1970) was one of the earliest models that extended the capital asset pricing model to include the taxation of dividends. Brennan built his model with the assumptions of proportional personal tax rates, known dividend payments, and unlimited borrowing at the riskfree interest rate. The model is as follows:

$$E(\tilde{R}_i) - r_f = b\beta_i + \tau(d_i - r_f) \qquad \text{(II-30)}$$

where $\tilde{R}_i$ is the before tax return of security i, β_i is the systematic risk, d_i is the dividend yield, r_f is the riskfree asset, and $b = [E(R_m) - r_f - \tau(d_m - r_f)]$ is the after-tax excess rate of return on the market portfolio and the subscript m denotes the market portfolio.

The empirical evidence of the above model has been inconsistent. Black and Scholes (1974) conclude that it is impossible to show that the expected returns of stocks with high dividend yields are different from the expected returns of stocks with low dividend yields in either a before or after tax setting. Conversely, Brennan's empirical tests fail to reject the null hypothesis that $\tau = 0$ and also fail to reject the null hypothesis that $\tau = 0.5$. Rosenberg and Marathe (1979) use an instrumental variables approach to overcome the errors in variables problem and specify the variance-covariance matrix more completely. Rosenberg and Marathe find a statistically significant dividend term in equation (II-30).

Litzenberger and Ramaswamy (1979) extend the methodology of these three earlier studies and develop an after tax version of the capital asset pricing model to determine if before-tax expected rate of returns are linearly related to systematic risk and dividend yield. Their model includes a progressive tax scheme and borrowing constraints are placed on investors according to both their wealth and income. The first constraint is that an investor's maximum interest on riskfree borrowing is set equal to his dividend income. The second constraint is that a margin is required from investors that finance stock investments via borrowing. This improves the assumptions used by Brennan (1970). Litzenberger and Ramaswamy estimate the expected dividend yield by basing the ex-dividend monthly yields on prior information and setting the other monthly yields to zero. This is an improvement of the Black and Scholes (1974) and Rosenberg and Marathe (1978) methods.

The specification model is:

$$E(\tilde{R}_i) - r_f = a + b\beta_i + c(d_i - r_f) \quad \text{(II-31)}$$

The intercept term, a, tells whether the margin constraint is binding for some investors. If a = 0, then the margin constraint does not bind investors. Additionally, if a = 0 and $\beta = 0$ and $d_i = r_f$, then a is the excess return. The parameter b equals $[E(R_m) - r_f - c(d_m - r_f) - a]$ and may be viewed as the expected after-tax rate of return on a hedge portfolio which is long in the market portfolio and short in a zero beta portfolio where the dividend yield equals the riskfree rate of return. Lastly, c can be interpreted as the tax rate. The null hypotheses are a > 0, b > 0, and c > 0.

The model estimated is:

$$\tilde{R}_{it} - r_{ft} = \delta_0 + \delta_1\beta_{it} + \delta_2(d_{it} - r_{ft}) + \varepsilon_{it} \quad \text{(II-32)}$$

where $\tilde{R}_{it}$ is the before tax return of security i for period t, β_{it} is the systematic risk, d_{it} is the dividend yield, r_{ft} is the riskfree asset, and ε is the error term. Litzenberger and Ramaswamy use monthly returns for all firms on the CRSP tapes and the value weighted index for the market return. They use monthly returns of high grade commercial paper and T-bills with one month to maturity to proxy the riskfree rate of return. They estimate all the firm betas and their standard errors using sixty months of prior data for the period from 1936 to 1977.

Litzenberger and Ramaswamy (1979) calculate the parameters by using ordinary least squares (OLS), generalized least squares (GLS), and maximum likelihood estimation (MLE). They note that the OLS and GLS estimators are biased and inconsistent because of the measurement error in betas, whereas the MLE estimators are consistent. They find that their estimates of the OLS and GLS models are consistent with the results of earlier studies. For all three models, they find that δ_0 is significantly different from zero, that investors are risk averse via the δ_1 estimate which is significant, and that dividend payouts are significantly and positively associated with stock returns. This counters the findings of Black and Scholes (1974) that show that the dividend effect is nonsignificant.

Litzenberger and Ramaswamy (1979) conclude that before tax expected returns of common stock are significantly related to dividend yields in a positive direction. Furthermore, their results imply that when dividends increase a stock's return by one dollar, investors require an additional twenty-three cents in before tax return. They find no noticeable trend over the time period. Lastly, the evidence suggests that there is a tax clientele effect such that investors with high marginal tax rates purchase stocks with low dividend yields and vice versa.

Litzenberger and Ramaswamy (1980) further examine whether there is a nonlinear relationship between before-tax expected returns and dividend yields. Elton and Gruber (1970) find evidence that the relationship is nonlinear, which is inconsistent with the results Brennan (1970) and Litzenberger and Ramaswamy (1979). This study finds that with divergent tax rates and restrictions on short sales the inconsistency can be resolved.

Litzenberger and Ramaswamy (1980) develop a tax clientele capital asset pricing model based on similar assumptions of Litzenberger and Ramaswamy (1979) except the tax structure is not proportional, but progressive, and investors are not permitted to sell short equities.

Litzenberger and Ramaswamy (1980) assume that there are five tax clienteles, each of which owns twenty percent of the market value of the NYSE stocks. The first clientele is assumed to own stocks that have the lowest dividend yield. The second clientele to own the next lowest dividend yield stocks and so on. The most general theoretical model developed is:

$$E(\tilde{R}_i) - r_f = b_g \beta_{im} + T(d_i - r_f) \tag{II-33}$$

and the models estimated are:

$$\tilde{R}_{it} - r_{ft} = \delta_{0g} + \delta_{1g}\beta_{igt} + \delta_{2g}(d_{it} - r_{ft}) + \varepsilon_{igt} \tag{II-34}$$

$$\tilde{R}_{it} - r_{ft} = \delta_{0g} + \delta_{1g}\beta_{imt} + \delta_{2g}(d_{it} - r_{ft}) + \varepsilon_{igt} \tag{II-35}$$

where $\tilde{R}_{it}$ is the before tax return of security i for period t, β_{igt} is the group beta of stock i with respect to its group portfolio return, β_{imt} is the beta of stock i with respect to the market return, d_{it} is the dividend yield, r_{tf} is the riskfree asset, and ε is the error term. The hypotheses are: (i)

$\delta_{1g} > 0$ which supports that investors are risk averse, (ii) $1 > \delta_{21} > \delta_{22} > \delta_{23} > \delta_{24} > \delta_{25} \geq 0$ which supports the tax clientele effect. They use the same econometric tests and data as described in Litzenberger and Ramaswamy (1979).

Litzenberger and Ramaswamy (1980) find the coefficient estimates are similar for both models. Group I, which owns the stocks with the lowest dividend yields, face a larger tax rate than the other groups. Group V, which owns the stocks with the highest dividend yields, face a smaller tax rate than the other groups. The tax rate for Group II is smaller than Group I, but larger than the rest. It does appear that Group III and IV face the same tax rate. These results are consistent with the tax clientele effect.

Bajaj and Vijh (1990) investigate 54,058 dividend announcements from July 1962 to June 1987. For over 45,548 there is no change in the dividend announcement, for 7,322 there is an increase in the dividend announcement, and for 1,188 there is a decrease in the dividend announcement. All 54,058 dividend announcements are for stocks traded on the NYSE and AMEX and the returns are obtained from the CRSP daily master file provided they meet the following conditions: (1) daily return data for the 300 trading days prior to the announcement are available; (2) the dividend announcement does not occur within 15 trading days of any noncash distribution; (3) the announcement does not represent a dividend initiation or omission; and (4) the announcement date is prior to the ex-dividend date by at least eight trading days.

They categorize stocks into low, medium, or high anticipated-yield groups by ranking the firms based on their anticipated yield. They measure abnormal returns using a market model. They estimate the firm's beta with the equal weighted market index. The price reaction to the dividend announcement depends on whether the anticipated yield is low, medium, or high. For example, assume a firm announces a decreased dividend payment to stockholders. A firm with a high anticipated dividend yield exhibits significantly larger negative abnormal returns than a firm with a medium anticipated dividend yield. In turn, a firm with a medium anticipated dividend yield exhibits significantly larger negative abnormal returns than a firm with a low anticipated dividend yield.

They also analyze whether low-priced firms (which they assume are small firms) may bias the above results. In other words, would the subsetting of high anticipated dividend yield firms into small and large firms significantly change the results. They find that the stock price affects the market's response to dividend changes, but it can not fully explain the abnormal returns due to dividend changes.

They also investigate the dividend announcement following a decreased dividend announcement. They find that low anticipated dividend yield firms are more likely to announce an increased dividend than high anticipated dividend yield firms. This means that dividend decreases are more permanent for high dividend yield firms than low dividend yield firms.

Their study indicates that there are dividend clienteles and that such dividend yield based clienteles do affect stock prices. They find that firms did not regularly change their dividend policy over the 1962 to 1987 period. However, if firms change their dividend policy, there are significant effects on the firm's stock price. Furthermore, the effect of a dividend decrease is significantly greater for firms with high anticipated dividend yields (-2.57%) than for firms with low anticipated dividend yields (-0.53%). When anticipated dividend yield groups are subdivided into small and large firms, they find that the clientele effect is stronger for small firms. Using a multivariate analysis, they find that anticipated dividend yield, firm size, and stock price are approximately equal in explaining abnormal returns of firms' that change their dividend. This paper supports the dividend tax clientele effect.

Lamoureux (1990) fails to find support for the dividend tax clientele effect. He modifies the portfolio theory of Markowitz (1952) and Sharpe (1963) to allow for differential tax treatment of dividends and capital gains. He estimates the market model:

$$r_{it} = \alpha_i + \beta_i r_{It} + e_{it} \tag{II-36}$$

where r denotes the monthly rate of return, the i subscript represents a particular stock, I represents the market index, and e is an error term.

By definition the total rate of return on a stock is:

$$r_{it} = g_{it} + d_{it} \tag{II-37}$$

where g_{it} represents the capital gain rate of return on security i in period t, and d_{it} represents the dividend yield on security i in period t. Lamoureux assumes that the tax rate on capital gains is zero and τ is the marginal tax rate on dividends. Thus, the after-tax rate of return is:

$$r'_{it} = g_{it} + (1\text{-}\tau)\ d_{it}, \text{ and similarly} \tag{II-38}$$

$$r'_{It} = g_{It} + (1\text{-}\tau)\ d_{It}. \tag{II-39}$$

This means that investors are concerned with r' rather than r, and substitute it into the portfolio problem. Thus, the modified market model to determine stock returns is:

$$r'_{it} = \alpha'_i + \beta'_i\ r'_{It} + \mu_{it}. \tag{II-40}$$

Lamoureux then selects optimal after-tax basis portfolios using the modified market model and sixty months of actual stock market data. The three five-year sub-periods of 1970-1974, 1975-1979, and 1980-1984 are used because there are significant tax differentials between dividends and realized long-term capital gains. He estimates the above equation with ordinary least squares, the equal weighted CRSP index, and τ equal to zero for the first regression and τ equal to fifty percent for the second regression. The results are virtually identical for all three time periods.

For τ equals zero percent, the expected monthly market index return is 0.01597 and the variance of the expected monthly market index return is 0.00246. Forming an efficient frontier results in some 160 corner portfolios with around 200 stocks included in at least one efficient portfolio.

When τ equal fifty percent, the expected monthly market index return is 0.01416 and the variance of the expected monthly market index return is 0.00245. Forming an efficient frontier results in some 160 corner portfolios with 200 stocks included in at least one efficient portfolio.

He then compares six corner portfolios from each efficient frontier. Contrary to the tax clientele theory, he finds that investors in the fifty percent marginal tax bracket should hold stocks with high dividends to maintain an optimal portfolio. The risk-return trade-offs appear to be independent of the dividend income tax. In fact, for these six portfolios, seventy-eight percent to ninety-one percent of the assets would be the same whether the marginal dividend tax rate was zero percent or fifty percent.

Had the clientele hypothesis been supported, one would expect the dividend yield of optimal portfolios to differ for the two investor tax rates. Furthermore, if an investor in the fifty percent marginal tax bracket dropped to the zero percent bracket, one would expect his portfolio composition to change dramatically. This is not the case, and he finds that an investor in the fifty percent tax bracket does not formulate a zero-dividend yield portfolio.

In summary, Lamoureux finds little in the way of a systematic tax-related link between dividend yield and security return. However, dividends are important for mean-variance maximizing investors with relatively high degrees of risk aversion who exhibit a higher preference for dividend yield. Thus, he finds no support for the dividend tax clientele theory.

2.3 The Informational Content of Dividends Theory

The *Informational Content of Dividends Theory* supports that dividend yield increases (decreases) the signal of an increase (decrease) in the firm's value. This section is subdivided into three categories. Section 2.3.1 discusses the theoretical development, Section 2.3.2 discusses the empirical studies that support this theory, and Section 2.3.3 discusses stock repurchase and special dividend models. Following are discussions of these three categories.

2.3.1 Informational Content of Dividends Theoretical Development

The studies in the 1950s and the 1960s developed rational models with symmetric information. When the investors' required rate of return is higher than the rate of return on additional capital, the firm should pay dividends to investors. Some of the models included the preference of investors to receive dividends since investors incorporated this income into their consumption pattern. Walter (1956) and Lintner (1956) were two of the early studies that developed symmetric information models.

In the 1970s and 1980s, researchers questioned the rationality of paying dividends, since there are tax advantages to capital gains. These later studies offer an alternative model that explains why firms may pay dividends. The second group of rational models conclude that there is asymmetric information between management and investors. Bhattacharya (1979) and Miller and Rock (1985) are two of the early studies that develop asymmetric information models.

Following are discussions of the following papers: Walter (1956), Lintner (1956), Bhattacharya (1979), and Miller and Rock (1985).

Walter (1956) develops a theoretical model to show the relationship between dividend policies and common stock prices. He develops his theory on the fundamental principle that the stock price represents the present value of expected dividends.

This means that growth stocks maintain low dividend payouts because shareholders benefit more when earnings are reinvested rather than paid as dividends. The stock price is mathematically expressed as:

$$\text{Stock Price} = [\text{Dividends} + (K_a/K_m)(\text{Earnings-Dividends})]/K_m \qquad \text{(II-41)}$$

where K_a is the discount rate on additional investment and K_m is the market's discount rate. Whenever the discount rate on additional investment is greater than the market's discount rate, the lower the dividend payout, the higher the stock price.

However, retained earnings result in unbalanced portfolios for investors who then must incur costly transactions to readjust their portfolios. Thus, Walter revises the stock price formula to cover the additional readjustment cost investors incur to balance their portfolios. This formula is as follows:

$$\text{Stock Price} = [\text{Dividends} + (K_a/(K_m+p))(\text{Earnings-Dividends})]/K_m \qquad \text{(II-42)}$$

where p is the premium related with the cost of diversification.

Next, Walter incorporates two effects that occur as a result of the preferential tax treatment of capital gains. The first is that the tax treatment of capital gains reduces investors total taxes. The second is that the capital gains treatment enables investors to time their stock sales to minimize their total tax burden. These effects result in another relationship between the discount rate of additional capital and the market's discount rate. The relationship is described as:

$$(1-T_g)\,(K_a/K_m) = (1-T_d) \qquad \text{(II-43)}$$

Thus, when the capital gains tax rate is less than the dividend tax rate, it may be advantageous for the firm to reinvest retained earnings even when the discount rate on additional capital, K_a, is less than market's discount rate, K_m. Walter defines a stock as a growth stock when the discount rate on additional capital is greater than market's discount rate and as an intermediate stock when the discount rate on additional capital is less than the market's discount rate.

Walter also introduces the tax advantages of debt over equity. He neutralizes problems between shareholders and bondholders by assuming that firms are conservatively financed: i.e., bankruptcy risk is minimal. He also assumes that lending rate is less than both the discount rate on additional capital and the market's discount rate. Thus, with debt financing, it may be advantageous for firms to retain earnings when the discount rate on additional capital is less than the market's discount rate. This occurs when the firm can earn a greater return on additional capital than what they are required to pay to debt holders.

In summary, Walter's concludes that firms face unique optimal dividend payout ratios. High growth firms face incentives to pay low dividends, while low growth firms face incentives to pay medium to high dividend ratios. Tax and debt financing issues modify the models of Walter, but do not alter the results. In this model dividends are relevant because the firm should maximize its value by paying out its natural dividend payout ratio.

Lintner (1956) reviews the academic and nonacademic literature on corporate financial policies and Harvard's case files. He identifies fifteen factors that appear to affect dividend policy. He analyzes 600 firms and deliberately selects twenty-eight firms so that there are at least three firms within each of the fifteen factor groups. He studies these twenty-eight firms over 1947 to 1953 and identifies when dividend changes were considered and what factors entered into the decision making process. His field study of the twenty-eight firms includes many interviews with people within these firms. The time period studied was one of great uncertainty as World War II had just ended, there were still price controls in the United States, and the Korean conflict was emerging.

Lintner finds that the ultimate question managers ask when considering dividend changes is whether the existing rate of payment is optimal for the firm and/or shareholders? If management decides to change the dividend payout, then the second question managers asked is how much should the dividend payout ratio be changed?

These concerns of management lead Lintner to believe that shareholders prefer a reasonably stable dividend payout rate and the market rewards a stable or gradual growth in the dividend rate. Furthermore, during this time period researchers assumed that investors incorporated dividend payments into their consumption patterns and believed that constant dividend payments conveyed that the firm was financially healthy. Thus, management strives to stabilize dividend distributions and minimize adverse shareholder reactions.

Through interviews with managers of the sample firms, Lintner concludes that managers believe that shareholders desire earnings in the form of dividends. Thus, the main reason for a change in dividend payout is a change in current net earnings which is usually reported quarterly and widely publicized. This means the reason for a change in dividend payout is made known to both shareholders and the market, and both agree with the firm's decision to change the dividend payout.

Once management decides to change the dividend payout, the second decision is how much to change the dividend payout. The most important single factor that determines the size of the change is the relationship between current earnings and the existing dividend rate. Through his interviews, Lintner concludes that most firms have a defined target ratio of dividends to current earnings. Furthermore, the firm moves gradually toward the target as earnings change rather than making abrupt changes in dividend payout. This requires that dividend payouts be adjusted by some percent of the difference between the last period's payment and the rate based on current earnings. The target payout ratio ranged from twenty percent to eighty percent for the twenty-eight firms.

The different target payout ratios and adjustment rates are a function of several factors such as the growth prospects for the industry and the growth and earnings of the particular firm. A target payout ratio and the speed of adjustment are based on the firm's experience regarding these factors.

Utilizing information from his field study, Lintner sets up a theoretical corporate model of dividend behavior. He uses the following mathematical expression to explain changes in dividend payout:

$$D_{it} - D_{i,t-1} = \alpha_i + \beta_i \, (r_i \, E_{it} - D_{i,t-1}) + u_{it} \qquad \text{(II-44)}$$

where: D_{it} is the amount of dividends paid by firm i in year t; α is zero or positive, because companies try to avoid reducing dividend payouts or desire gradual growth of dividend payments; β indicates the percent of the difference between the target dividend $(r_i \, E_{it})$ and the actual dividend payment in the lag year; r is the target payout ratio; E is firm i's earnings after taxes in year t; and u represents an error term that capture other factors.

Lintner estimates the regression; a summary of his results follow. Twenty-six of the twenty-eight firms had a specific value of the target payout ratio established as a matter of policy. Twenty-two of twenty-six firms adjust dividends year by year whereas the other four did it every two to three years. Twenty-four of twenty-six did not change the target payout ratio in the postwar years. Twenty-four of twenty six did not change their dividend adjustment rate in the postwar years. Twenty of twenty-eight firms had a reasonably definite dividend adjustment value. Note that eighty-five percent of the company years can be explained with the model with only moderate discrepancies. Lastly, Lintner concludes that little statistical significance can be attached to the above observations because of the small sample numbers.

The asymmetric informational dividend models of Bhattacharya (1980) and Miller and Rock (1985) built on the signaling theory of Akerloff (1970) and Spence (1973). Akerloff (1970) first applied asymmetric information to the market for products and Spence (1973) applied signaling to the job market.

The signaling models above were built on the work of Ross (1977). Ross showed that management with asymmetric information may use debt to signal firm value to the market. Ross concluded that managers use debt (capital structure) as a signal to tell the market the true value of the firm. Therefore the capital structure of the firm is not randomly selected, but serves the purpose of signaling the firm's true value. When the capital structure is changed, a new signal is sent to the market about the firm's value. The more successful the firm, the higher leverage ratio (debt/asset) the firm can support without going bankrupt and the stronger the signal it can send.

Additionally, Ross (1977) shows that shareholders have several reasons to be concerned about using capital structure as a signal to the market. Stockholders of a firm with a high true value, but a low market value want managers to signal the true market value so their stock is not undervalued. Some stockholders plan to sell their stock and want to receive all the capital gain rightfully theirs. Conversely, shareholders of a firm with a low true value do not want management to signal that the firm has a high value because then the firm could go bankrupt and shareholders could lose money. Following is a discussion of Bhattacharya (1980) and Miller and Rock (1985).

Bhattacharya (1979) develops a financial signaling model very similar to Ross (1977), but the model is based on the concept that dividends signal the expected cash flows of firms in an imperfect-information setting. Similar to debt, shareholders can have several reasons to be concerned with using dividends as a signal to the market. Shareholders of a firm with a high true value, but low market value want managers to signal the true market value of the firm so their stock is not undervalued. Furthermore, some of these shareholders want to receive all the capital gain rightfully theirs. Conversely, stockholders of a firm with low true value do not want management to signal a high value, because the firm then must incur expenses to raise external funds in order to pay the dividends. It is important to note that dividend signaling is not costless to high value firms as dividends may be taxable to shareholders at a higher tax rate than if shareholders took all the increased value in the form of capital gains. Nevertheless, the benefits of dividend signaling are shown to be greater than the cost of dividends being taxed at the ordinary income tax rate.

The dividend signaling model requires a special assumption that differs from previous studies, which is that management has asymmetric information about the firm's current earnings and future opportunities, but cannot convey this information without revealing it to the entire market. This assumption replaces previous studies' assumption that the firm's future investment opportunity portfolio is available to investors and management which is known as full information. Other assumptions are that shareholders are risk-neutral, firms generate perpetual streams of cash, shareholders have a single-period, there are sufficient investment opportunities so that all profits can be rationally reinvested, the firm's internal investment decision is exogenous, the communication of investment opportunities is costly because dividend payouts are assumed to be taxed at a higher tax rate than capital gains, and lastly, the signaling benefit of dividends is that investors receive a higher dividend.

Bhattacharya's model can best be explained with an example. Suppose that Firm A has an unique investment opportunity by drilling into a discovered oil pool and management estimates the future cash flow to be $\tilde{X}$. Firm A then announces a dividend increase of D based on the expected cash flow, $\tilde{X}$, and the market increases Firm A's value by V(D). At the end of the period, the true value of the cash flow is revealed which is X. If X is greater than the incremental dividend commitment made due to the new project, then D is paid to shareholders and external financing is reduced by (X - D). If X is less than the incremental dividend commitment made due to the new project, then D is paid to shareholders, but external financing is increased by (D - X). The increase in unanticipated external financing results in cost to current shareholders of $(1 + \beta)(D - X)$. It is reasonable for the cost of increased unanticipated external financing to be greater than the benefit of an unanticipated cash-flow surplus of equal amounts because a frictionless capital market does not exist.

Bhattacharya describes the incremental part of the objective function of current shareholders and their agents as:

$$E(D) = 1/(1+r)\ [\ V(D) + \alpha D + {}_D\!\int^{\bar{X}} (X-D)\ f(X)\ dX$$

$$+ {}_X\!\int^{D} (X-D)\ f(X)\ dX\ ] \qquad \text{(II-45)}$$

$$= 1/(1+r)\ [\ V(D) + M - (1-\alpha)D - \beta\ {}_X\!\int^{D} F(X)\ dX] \qquad \text{(II-46)}$$

where f(X) and F(X) is the probability distribution functions of X, M is the mean cash flow of the proceeds from project X until the end of the period, and r is the per period rate of interest after personal income taxes. Management chooses D to maximize E(D). The marginal signaling cost is $[(1-\alpha) + \beta F(D)]$ from the above equation which must be strictly negatively related to the mean cash flow M. This condition can be met with reasonable assumptions about the distribution functions and that the equilibrium implications of today's dividends for future dividends are such that the true value of future cash flows is positively related to M. Thus, the cost for a true high value firm to signal its value is cheaper than the cost for a low value firm.

In summary, Bhattacharya develops a realistic model where dividends are linked to expected cash flows of the firm and the structure is consistent with the assumption of an exogenously costly dividend-signaling equilibrium.

Miller and Rock (1985) develop a financial signaling model very similar to Ross (1977), but the model is based on the concept of net dividends. It improves upon Bhattacharya's model in that it combines dividends and capital structure to show that they are merely two sides of the same coin. They made the following assumptions: no transaction costs; local insatiability; there are personal and corporate debt; there are corporate, income, and capital gain taxes, and investment decisions are exogenous for the firm.

Miller and Rock's special assumption was that management has asymmetric information about the firm's current earnings and future opportunities and cannot convey that information to stockholders without revealing it to the whole market. This assumption replaces the earlier one that the firm's future investment opportunities portfolio is symmetric information available to investors and management.

They utilize the following sources and uses of funds constraint similar to those described in the earlier papers:

$$\text{NOI} + \text{New Equity Issued} + \text{New debt} = \text{Investment} + \text{Dividends} \qquad \text{(II-47)}$$

where NOI is net operating income. Rearranging the equation forms the following net cash flow and net dividend equation:

$$\text{NOI} - \text{Investment} = \text{Dividends} - \text{New equity issued} - \text{New Debt} \qquad \text{(II-48)}$$

$$\text{Net Dividend} = \text{Dividends} - \text{New equity issued} - \text{New Debt} \qquad \text{(II-49)}$$

Investors are concerned with net dividends and investors monitor whether new equity or debt is issued to support higher dividend payouts.

The underlying idea is that management can signal strong future earnings with increased dividend payouts. Firms in the same industry cannot successfully mimic these signals because they get caught when they issue more debt or equity to finance the dividends. Miller and Rock also introduce the assumption that investment decisions are endogenized. This nullified the Fisher separation principle which states that investment decisions are separate from financing decisions and management takes all positive net present value projects. Management can hold back positive net present value investment projects to increase dividend payouts. Miller and Rock discuss disclosure laws, management compensation schemes, and management contracts to entice management to undertake all net present value projects. These tactics should help eliminate agency problems between shareholders and managers. This model also assumes that management cannot convey information to the stockholders without revealing it to the whole market. Thus, signaling actions do not necessarily benefit stockholders, and in some cases can hurt stockholders.

With this signaling model, Miller and Rock have arrived at another way which may explain why companies are shoveling out dividends to their stockholders. An increased dividend policy is a signal that future earnings are strong and that the firm is more valuable. Weaker, less profitable firms cannot successfully mimic these signals; therefore, larger dividend payouts increase the firm's value and reduced dividend payouts decrease the firm's value.

The signaling theory has received much support in the literature and is considered a plausible explanation to why firms pay such large amounts of dividends.

2.3.2 Informational Content of Dividends Empirical Research

Several studies provide empirical support for the *Informational Content of Dividends*. These include Fama and Babiak (1968); Ezzell (1974); Kalay (1980); Arahony and Swary (1980); Kwan (1981); Kane, Lee, and Marcus (1984); Richardson, Sefcik, and Thompson (1986); Kalay and Loewenstein (1986), Lang and Litzenberger (1989) and Christie (1990). Following is a discussion of these papers.

Fama and Babiak (1968) empirically test the partial adjustment model of Lintner (1956). They note that Lintner's model was developed to explain dividend decisions of firms, yet most of Lintner's empirical work used aggregate data. They rigorously test this model with individual firm data to determine its accuracy. They test several modified designs of the model. They estimate models with different definitions of earnings, without a constant term, and different lag structures.

They run simulations of several models to test the following: the lagged variable biases, the appropriateness of the constant term, the lagged structure, the serial dependence of the estimated regression residuals, and efficient methods to estimate the parameter estimates.

Fama and Babiak use several models to predict dividend changes of firms in 1965. They determine that the best measure of earnings is net income and that serial dependence in the residuals does not seem to be a serious problem. Lastly, they determine that the best prediction model is a modified Lintner's model that includes an additional lagged earnings variable and omits the constant intercept term. The specific model is:

$$D_{it} = \beta_1 \left(E_{it} + \beta_2 E_{i,t-1} + \beta_2^2 P_{i,t-2} + \ldots\right) + u_{it} \qquad \text{(II-50)}$$

where β_1 is the target payout ratio, β_2 are weights placed on past earnings, and the remaining terms are the same as in the Lintner model.

Ezzell (1974) tests an implication of the informational content of dividends hypothesis, which is that there should a positive association between unexpected dividends in year t and unexpected earnings in year (t+1). Lintner (1956) suggests that managers avoid changing dividend payouts that would need to be reversed within the next two years. This suggests that somehow management can accurately forecast next year's profit and that current dividend payouts can be informative about next year's profit.

Ezzell studies 375 firms that paid a cash dividend and reported positive earning for each year from 1952 to 1971. D_t is actual dividends in year t, $E(D_t)$ is expected dividends in year t, and $X_t = D_t - E(D_t)$ is the dividend prediction error in year t. Similarly, E_{t+1} is actual earnings in year t+1, $E(D_{t+1})$ is expected dividends in year t+1, and $Y_t = E_{t+1} - E(E_{t+1})$ is the earnings prediction error in year t+1. If $E(D_t)$ is independent of $E(E_{t+1})$ and $E(E_{t+1})$ is independent of $E(D_t)$ and D_t, then the dividend and earnings prediction errors, X_t and Y_{t+1} respectively, should have the same algebraic signs.

Ezzell employs four dividend expectation models to determine the four different dividend prediction errors against three earnings models to determine three different earnings prediction errors. This means there are twelve models to analyze. However, only three models are significant. Furthermore, two of the three models are of the wrong direction which means that dividends which are less than expected are associated with earnings that are greater than expected in the following period. This study finds weak support that unexpected dividend changes signals information about the future earnings of the firm.

Aharony and Swary (1980) determine whether managerial decisions to change the dividend yields provides information beyond the information provided by earnings announcements. Aharony and Swary note that managers have discretion over the dividend decisions and in turn dividend announcements. Thus, dividend announcements should provide more information signals than earnings announcements. If it is true that dividends provide valuable information, then in an efficient capital market, stock prices should change at the time of the public announcement.

Aharony and Swary use a dividend expectations model where the expected dividend for quarter *t* is the actual dividend paid in quarter *t-1*. This is consistent with the assertion that managers are reluctant to change dividends unless they believe that there is a change in the firm's prospects over the next several years. Thus, a dividend increase signals a optimistic view of the firm's prospects and a dividend decrease signals a pessimistic view of the firm's prospects.

Previous studies such as Watts (1973, 1976) use annual data and argue that dividend announcements do not convey valuable information to the market. Conversely, Pettit (1972, 1976), and Laub (1976) use quarterly data and argue that dividends convey valuable information to the market. The major difference in the above studies is the methodology used to identify and control the information conveyed by earnings announcements. In this study, Aharony and Swary employ a methodology different from the previous papers to more accurately examine the informational content of dividend changes.

Since earnings announcements may contaminate the information surrounding dividend announcements, only firms with different announcement dates of quarterly earnings and dividends are included. The dividend announcement effect is further isolated by requiring that there be at least eleven trading days between the two announcements. Lastly, the data are grouped according to whether the earnings announcement proceeded the dividend announcement or vice verse.

Aharony and Swary use 176 firms that have quarterly earnings per share and quarterly cash dividends per share available from 1963 to 1976. The firms also have daily returns available from CRSP over the same period. They determine that there are 3399 dividend and earnings announcement dates using information obtained from *Moody's Dividend Record* and the Wall Street Journal Index.

They use ordinary least squares to estimate the following market model over the 1963 to 1976 period for each firm, excluding the thirty-one day trading period centered around the dividend announcement date:

$$\tilde{R}_{jt} = \alpha_j + \beta_j \tilde{R}_{mt} + \tilde{\varepsilon}_{jt} \qquad \text{(II-51)}$$

where: $\tilde{R}_{jt}$ is the geometric mean of the daily rates of return for firm *j* over a five consecutive trading-day period, *t*; $\tilde{R}_{mt}$ is the geometric mean of the daily rates of returns of the S&P Stock Price Index over five a consecutive trading-day period, *t*; and $\tilde{\varepsilon}_{jt}$ is the error term for firm *j* in period t.

There are three concerns with their methodology. First, the estimates for alpha and beta are assumed to remain stable over the 1963 to 1976 period. Second, they did not use the Scholes and Williams (1977) methodology to correct for the nonsynchronous trading problem. Third, since they find significant abnormal returns surrounding the earnings announcement date, they should not assume that the expected value of the error term at the time of the earnings announcement is equal to zero. Thus, similar to the treatment of dividend announcements, they should not include the trading days returns surrounding the earnings announcement when estimating the market model.

Next, Aharony and Swary estimate the abnormal returns of each firm over the twenty-one days centering the dividend announcement date. From the abnormal returns they calculate the average abnormal return across sample members and quarters. They calculate t-test statistics to test the null hypothesis that the average abnormal return is equal to zero which means that dividend announcements signal no informational content to the market.

Their results reject the hypothesis that dividends do not signal information to the market. More specifically, they find that firms that announce dividend decreases experience significant and negative average abnormal returns. Conversely, firms that announce dividend increases experience significant and positive average abnormal returns. As expected, firms that do not change their dividend payout do not experience significant average abnormal returns in either direction. This suggests that the market interprets no change in dividend payout to signal no significant change in the firm's prospects. Analysis of cumulative abnormal returns further support the above results. Firms with dividend decreases experience negative cumulative abnormal returns, firms with dividend increases experience positive cumulative abnormal returns, and firms with no change in dividend payout experience little change in cumulative abnormal returns.

For completeness, they replicate the tests replacing the dividend announcement dates with earnings announcement dates and as before they calculate average abnormal returns around the earnings announcement date where both quarterly announcements are positive. They assume a earnings expectation model as described for dividends. They find that firms experience significant and positive returns around the earnings announcement dates whether this date proceeds or follows the dividend announcement date. This further supports their hypothesis that dividend announcements provide informational content to the market beyond what earnings announcements may signal.

In summary, they find empirical support that dividend changes signal informational content to the market beyond the information provided by earnings announcements.

Kalay (1980) note that Beaver, Kettler, and Scholes (1970), Black (1976), Fama, Fisher, Jensen, and Roll (1964), Friend and Puckett (1964) make the assumption that managers are reluctant to reduce dividends. Furthermore, in the Fama, Fisher, Jensen, and Roll (1964) study, this assumption is the foundation for their informational content of dividends hypothesis. However, there is no sound empirical evidence that managers are reluctant to reduce dividends. Kalay employs a new empirical test that tests the null hypothesis that managers are reluctant to reduce dividends. He fails to reject the hypothesis that reduced dividend payments signal information in a signaling equilibrium model.

Kalay applies the Ross (1977) signaling incentive model to the dividend decision. In this model managers are compensated by a known incentive schedule. Thus, managers of a firm with a high intrinsic value, but low market value want to signal the high intrinsic value because their compensation is greater than if they signal a lower value. Conversely, managers of a low intrinsic firm and a high market value want to signal the low intrinsic value because their compensation is greater than if they signal a higher value.

However, Kalay shows that a signaling equilibrium cannot exist without the assumption that managers are reluctant to reduce dividends. Therefore, if empirical evidence is found that supports that managers are reluctant to reduce dividends, then the signaling equilibrium can exist. Conversely, if empirical evidence rejects the hypothesis that managers are reluctant to reduce dividends, then the signaling equilibrium cannot exist, and in a signaling equilibrium model, dividends cannot signal information.

The Lintner (1956) partial adjustment model is the widely cited as evidence that managers are reluctance to reduce dividends. Lintner's estimated the following model:

$$D_{it} - D_{i,t-1} = \alpha_i + \beta_i \, (r_i \, E_{it} - D_{i,t-1}) + u_{it} \qquad \text{(II-52)}$$

where: D_{it} is the amount of dividends paid by firm i in year t; ß indicates the speed of adjustment coefficient; r is the target payout ratio; E is firm i's earnings after taxes in year t; and u represents an error term that capture other factors. Lintner's results conclude that ß is zero or positive and the reason for this is because companies are reluctant to reduce dividend payments.

However, Fama-Babiak (1968) eliminate the constant term and include a lagged earnings variable. Their model predicts changes in dividends more accurately than the Lintner model. Fama and Babiak estimate the following model:

$$D_{it} = \beta_1 \, (E_{it} + \beta_2 \, E_{i,t-1} + \beta_2^2 \, P_{i,t-2} + ...) + u_{it} \qquad \text{(II-53)}$$

where β_1 is the target payout ratio, β_2 are weights placed on past earnings, and the remaining terms are the same as in the Lintner model.

Kalay forms an adjustment model which is empirically indistinguishable from Lintner's model which is:

$$D_{it} = \beta_1 \, P_{it} + \beta_1 \, \beta_2 \, P_{i,t-1} + \beta_2^2 \, P_{i,t-2} + (1 - \beta_1 \, \beta_2) \, u_{it} \qquad \text{(II-54)}$$

In this model, adjustments do not necessarily reflect the assertion that firms are reluctanct to reduce dividends. In fact, this assertion is consistent with an alternative explanation which is that the managers might face a binding constraint that forces a reduction of dividends. These types of binding restraints can occur because of protective covenants listed in bond indentures. Such covenants can reduce bondholder/shareholder agency costs which reduces the cost of debt and in turn allows shareholders to maximize their wealth. Dividend payments are usually based on the amount of equity raised, earnings, and previous dividends paid by the firm. However, debt and investment financed dividends are usually constrained. Additionally, other restrictions involve minimum net worth requirements, minimum working capital ratios, etc.

Data for Kalay's study is obtained from the *Moody's Industrial Manuals* which reports the corporate funds available for dividend payment. Then, Kalay tests the hypothesis that managers cannot pay the same dividend as the previous period because of a binding constraint which they have no control over. Thus, such dividend reductions cannot signal information to the market about their future expectations about the future earnings.

To determine the percentage of forced dividend reductions because of a binding dividend constraint, information on one-hundred firms was collected over a sixteen year period. For each firm, Kalay calculates the difference between the annual dividend paid in year t and year t-1. He determines that there are 550 dividend payment increases, 501 unchanged, and 197 decreases.

A forced dividend payment is defined as a dividend decrease that results when the amount of funds available for dividend payments is zero or smaller than the amount needed to maintain last period dividends. Kalay finds that only ten of the 197 dividend decreases can be defined as forced dividend payment. Thus, he cannot reject the null hypothesis that dividend reductions convey information.

Kwan (1981) is an extension of Watts (1973) who concludes that dividends contain trivial information. Watt's conclusion is contrary to a number of other studies such as Pettit (1972), Griffen (1976), Charest (1978), and Aharony and Swary (1980) who earlier concluded that dividends contain nontrivial information. Kwan makes three methodological improvements to Watts (1973). The first improvement is the use of quarterly earnings and dividend data rather than annual data. The second improvement is the use of a filtering process based on the concept of prediction intervals to reduce misclassification of information due to inherent noise. The third improvement is the isolation of dividend information from other public information about the firm, such as earnings information.

Similar to the Watts (1973) model, Kwan uses revised models of Lintner (1956) and Fama-Babiak (1968) with quarterly data. The respective models are as follows:

$$D_{q,t} - D_{q,t-1} = \alpha_0 + \alpha_1 D_{q,t-1} + \alpha_2 E_{q,t} + \varepsilon_{q,t} \tag{II-55}$$

$$D_{q,t} - D_{q,t-1} = \beta_1 D_{q,t-1} + \beta_2 E_{q,t} + \beta_3 E_{q,t-1} + e_{q,t} \tag{II-56}$$

where $D_{q,t}$ is the sum of the firm's four consecutive quarterly announced dividends ending at quarter q of year t, $E_{q,t}$ is the sum of the firm's four consecutive quarterly earnings ending at quarter q of year t, and $\varepsilon_{q,t}$ and $e_{q,t}$ are the error terms in quarter q of year t. He also incorporates his filtering technique and isolation of dividend information which requires a minimum of five days between the dividend announcement and other public information.

Kwan formulates two portfolios, using the regular dividend changes estimated with the revised Fama-Babiak and Lintner models with data over the period of 1973 to 1977. Since the results are similar, he only reports the Fama-Babiak results. The first portfolio consists of positive dividend announcements and the second portfolio consists of negative dividend announcements. Next, he formulates two similar portfolios, except a filtering refinement technique is employed to correct for misclassification. One portfolio consists of the filtered positive dividend announcements and the other portfolio consists of the filtered negative dividend announcements. To be included in a portfolio, the firm that made the dividend announcement must be reported in *Moody's Handbook of Common Stocks* and listed on the NYSE. Furthermore, the dividend announcement had to be listed in the *Wall Street Journal Index.* Kwan then uses a market adjusted returns model to estimate abnormal returns on these four portfolios from day -15 to day 25. Daily stock returns were obtained from the Financial Research Institute data base and the market proxy was the NYSE Composite Index.

The filtering refinement technique reveals that there is a severe misclassification problem. The unfiltered negative dividend change portfolio appears to experience no market reaction to announced decreased dividends. However, when corrected the filtered negative dividend portfolio experiences large negative abnormal returns.

Kwan then switches from the moving annual dividend to the annualized dividend for the four portfolios and re-estimates the abnormal returns. This adjustment further improves the adjustment models of Lintner and Fama-Babiak. More specifically, the two unfiltered portfolios were distinctly different from the post-announcement period. However, when the filtering refinement technique is used to correct for the misclassification problem it becomes clear that the filtered negative portfolio experiences significantly negative cumulative abnormal returns on day -1 and day 0. Conversely, the filtered positive portfolio experiences significantly positive abnormal return on day 1.

The empirical evidence of this study is that dividend announcements are important. Kwan's examination of the market reaction to dividend changes show that the market values the positive information associated with a dividend change and that his revised Lintner and Fama-Babiak models are useful for analysis of this.

Kane, Lee, and Marcus (1984) note that there is a large body of literature to date that supports that firms that report favorable earnings or favorable dividend payouts experience positive abnormal stock returns[5]. In fact, Kwan (1981) makes specific improvements to Watts (1976) with his method of isolating dividend information from other public information about the firm. Kwan requires a minimum of five days between the dividend announcement and other public information. However, none of these studies analyze abnormal returns that surround contemporaneous earnings and dividend announcements in order to ascertain whether the market evaluates the two announcements in relation to each other.

Kane, Lee, and Marcus analyze the consistency of these two announcements and how the market reacts to differing combinations of signals. Their sample consists of 352 observations of quarterly earnings and dividend announcements from quarter four of 1979 to quarter two of 1981. The two announcements of the firm must be within ten days of each other and the firm must be listed on both the CRSP and COMPUSTAT tapes over the 1973 to 1981 period.

Rather than constructing their own model, they base their unanticipated earnings and dividend models on earlier models that have been tested and validated elsewhere. The unanticipated earnings model is based on Foster (1977), which Watts (1976) concludes has the best predictive power and that the forecast errors are very similar to those of abnormal stock market returns. The unanticipated dividend model is based on the Aharony and Swary (1980) model that can successfully predict abnormal stock performance. Kane, Lee, and Marcus employ the following capital asset pricing model to calculate abnormal returns:

$$AR_{jt} = R_{jt} - [R_{ft} + \beta_j (R_{mt} - R_{ft})] \qquad \text{(II-57)}$$

where AR_{jt} is the abnormal return on day t for firm j, R_{jt} is the total return on day t for firm j, R_{ft} is the Treasury bill rate on day t, β_j is the estimated beta for the stock of firm j, and R_{mt} is the market return on day t as measured by the S&P 500 index.

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[5] For the effect of earnings announcements see Brown (1978), Watts (1978), and Rendleman, Jones, and Latane (1982). For the effect of dividend announcements see Pettit (1972), Pettit (1976), Charest (1978), Aharony and Swary (1980), and Kwan (1981).

They calculate the cumulative abnormal returns (CAR) and model the CARs as a function of unanticipated dividends, unanticipated earnings. Next, they re-model the CARs as a function of the unanticipated dividends and earnings and the dummy variables that represent the interaction of the unanticipated announcements. There are six combinations of surprised earnings and dividend announcements. The first, second, and third possibilities consists of firms with negative surprise earnings and negative, zero, and positive surprise dividends, respectively. The fourth, fifth, and six possibilities consists of firms with positive surprise earnings and negative, zero, and positive surprise dividends, respectively.

The first model's *t*-test statistics support that the unanticipated earnings and dividends variables are significant in explaining abnormal returns at the one percent significance level. However, the *F*-test statistic that measures the joint significance of two variables is nonsignificant.

The second model's *t*-test statistic indicates that the unanticipated earnings and dividends variables are nonsignificant in explaining abnormal returns. Conversely, five of the six dummy variables are significant. The only nonsignificant dummy variable is the one with positive unanticipated earnings and negative unanticipated dividends. The only significantly negative dummy variable is the one with both negative unanticipated earnings and dividends. The remaining four dummy variables are significantly positive. Additionally, the *F*-test statistic that measures the joint significance of all the variables is significant at the five percent level.

The empirical evidence indicates that unanticipated earnings and dividend variables together are insignificant in explaining abnormal returns. Conversely, the interaction terms can significantly explain abnormal returns. This means that earlier researchers may have been correct in isolating dividend or earnings announcements. However, those that want to model the joint effects of dividend and earnings announcements should incorporate the interaction effects of the earnings and dividend announcements.

Richardson, Sefcik, and Thompson (1986) introduce an interesting model to analyze clientele theories. Such theories imply that changes in the dividend policy result in marked increases in trading volume as the shareholder clienteles shift their holdings to rebalance their portfolios. They analyze 192 firms that announce a cash dividend for the first time. They find that there is a significant increase in trading volume and a significant increase in the firm's value during the announcement week.

Increased trading volume could take place because investors are rebalancing their portfolios as argued by the clientele hypothesis. More specifically, investors in the high tax bracket who desire the capital gains of growth firms are likely to divest themselves of the stock. Conversely, investors in the low or zero tax brackets who desire dividend payments may now invest in the firm.

Within a *Dividends are Irrelevant Theory* of equilibrium such as Black and Scholes (1974), an economy of value maximizing firms ensure dividends irrelevancy by setting their dividend payouts so that, at the margin, there are no stock price gains to be made by switching from one payout policy to another. Therefore, a firm that changes its dividend policy does not change the firm's value. However, investors must rebalance their portfolios if they wish to maximize their earnings. This means that a clientele hypothesis may argue that stock prices do not change, but that trading volume should increase as investors rebalance their portfolios.

Their sample obtained from the Annual Compustat Industrial Tape includes 192 firms that paid dividends for the first time in five years between 1969 and 1982. Dividend yield is calculated by dividing the dividend amount by the previous day's closing stock price. Seventy-five percent of the firms continue to pay uninterrupted dividends through 1982, the end of their time period. They measure stock trading volume in percentage terms of shares traded per week. Next, they normalize the volume statistics .

They estimate the volume trading reaction to the announcement of a cash dividend and the following interval to the ex-dividend date. The normalized trading volume of the firm during any week is a function of: (1) the trading volume of the market; (2) a dummy variable identifying whether the week was the announcement week; and (3) a variable identifying whether the week was during the interval of the announcement week and the ex-dividend week.

The mean abnormal trading volume for the announcement week is 0.315 which had a t-statistic of 6.87. This means that volume trading increased from 0.10 percent per day over non-announcement dates to 0.135 percent per day over the announcement week which is a thirty-five percent increase in trading. Additionally, sixty-eight percent of the firms experienced increased volume trading which results in a z-statistic of 4.91 for the binomial test of equal probabilities.

The mean abnormal trading volume for the interval from the dividend announcement to the ex-dividend date is 0.233 with a t-ratio of 2.05. This means that the abnormal trading would be about eighteen percent per week above normal trading volume. However, only fifty-five percent of the firms experienced increased volume trading which results in a z-statistic of 1.44 for the binomial test of equal probabilities.

Richardson, Sefcik, and Thompson estimate abnormal returns using an extended market model that includes a lagged market return and a lead market return which are intended to correct nonsynchronous trading problems. They estimate model parameters over the 240 trading days following the ex-dividend date. They analyze abnormal returns over an eighty-one day window centered around the announcement date. The event period is defined as the announcement day, the prior three days, and the following day. The mean cumulative return for the event period is four percent with a t-statistic of 7.03. Additionally, sixty-seven percent of the abnormal returns are positive and generate a z-statistic of 4.76 for the binomial test of equal probabilities. This result is consistent with the traditional information content of dividends.

To test the tax clientele hypothesis, Richardson, Sefcif, and Thompson separate the influence of the information content of dividend changes from the tax clientele effects. To do this they design their model on the theoretical basis of Hakansson, Kunkel, and Ohlson (1982) who demonstrate that public announcements result in trading volume reactions because of two reasons: investors trade in response to heterogeneity of beliefs and a desire to alter their risk-sharing arrangements. If heterogeneity of beliefs exists, then Hakansson, Kunkel, and Ohlson model's predicts an increase in trading volume around announcements that signal changes in investors' perception of security and return. Richardson, Sefcik, and Thompson define the information content of a dividend announcement as the signal contained in the announcement about these variables.

Richardson, Sefcik, and Thompson estimate models that separate the volume reaction into several components. The first component is related to the degree of abnormal returns and represents abnormal trading volume resulting from the information content of a dividend announcement. The second component is unrelated to the degree of abnormal returns and represents abnormal trading volume resulting from the information content of a shift in dividend clientele. The third component is the relationship between dividend yield and abnormal return where a positive relationship is assumed to be tax clientele related. The last component is the relationship between prior capital gains and abnormal trading volume where a negative relationship is assumed to be tax clientele related.

Their tests find weak support for increased trading that can be attributed to the clientele effect. The announcement period tests support that increased trading volume is due to both information content and clientele effects. However, interval period tests support that increased trading volume is due to only information content of the dividends.

In summary, during the week of the firm's first dividend announcement, there is a significant increase in trading volume on average. Furthermore, during the period from the announcement period to the ex-dividend date, there is a significant increase in trading volume on average. Abnormal trading volume during the announcement week is related to the information content of the dividend announcement, however, a significant portion of the abnormal trading volume cannot be attributed to the information content. Abnormal trading volume and the size of the dividend are positively related while abnormal trading volume and capital gains are negatively related. Lastly, abnormal volume trading during the interval is explained by proxies for information content in dividend announcements, as measured by abnormal returns while the component unrelated to information content is insignificant.

Kalay and Loewenstein (1986): Many studies support the hypothesis that dividends signal information to the market about future dividends and earnings. However, these studies examine the stock prices around the announcement of unexpected dividend changes. Kalay and Loewenstein's study is similar to the earlier studies in that it examines stock prices, but it differs in that it examines whether the timing of announcements signal information to the market. For example, does information signaled unexpectedly late differ from information that is conveyed on time? If so, is this information efficiently incorporated by the market?

Kalay and Loewenstein determine that they can accurately predict the timing of the next dividend announcement by analyzing the past pattern of dividend announcements. In fact their predictions are more accurate than those of value line. They use 969 firms that trade over the 1978 to 1981 period and form five portfolios. Portfolio I is the group of firms that makes their dividend announcement exactly on the predicted date. Portfolio II (III) is the group of firms that make their dividend announcement at least five days earlier (later) than predicted. Portfolio IV (V) is the group of firms that make their dividend announcement earlier (later) than the predicted date, but by no more than five days.

They utilize a mean-adjusted returns model to test the null hypothesis that dividend announcements do not affect security returns. They obtain daily stock returns on the CRSP tapes. They estimate the mean return over the pre-event period which is from day -60 to day -16 with day 0 being the dividend announcement day. Next, equally-weighted portfolios are formed from the individual standardized daily abnormal returns in event time. The Student *t* test statistic is used to determine if the daily mean abnormal return is significantly different from zero.

They find that the three portfolios with dividend announcements dates prior to or exactly on the predicted announcement date have significant abnormal returns. However, they place a disclaimer that the findings are consistent with the hypothesis that the higher returns on the event period could merely reflect higher risk levels rather than information signaling (Kalay and Loewenstein, 1985).

Conversely, the two portfolios with late announcements experience abnormal returns nonsignificantly different from zero on the announcement date. However, when the test is replicated with the market model, the returns on Portfolio III (firms that announce at least five days after the predicted date) experience significantly negative abnormal returns at the five percent level. As Kalay and Loewenstein note, if the market expects bad news to be announced late, then it rationally interprets this when the firms are late in making dividend announcements. Therefore, the price of the stock should gradually drop from the predicted announcement date and the actual later announcement date. They find that the cumulative average abnormal return between day -10 and day 0 is significantly negative. Furthermore, the unexpected announced dividend reductions of firms that make announcements five days later than the predicted date is significantly greater than firms with announcement made on time at the one percent level. Similarly, the dividend increases by firms with early announcements are significantly greater than the dividend increases by firms with late announcements.

Kalay and Loewenstein also use a chi-square test to determine if firms signal information to the market via the timing of dividend announcements, and if so, whether the information positive or negative. They find evidence that the information conveyed via dividend announcements at least five days after the predicted date is significantly more negative than the information conveyed via announcements made over the eleven-day period centered around the predicted date. Surprisingly, the information revealed in dividend announcements more than five days before the predicted date is not significantly different from the information revealed in announcements more than five days after the predicted date. Therefore, they look at the magnitude of the dividend changes which the chi-square test does not take into account. The mean percentage increase for very early announcements is 0.02% compared to -8.88% for the very late announcements. The *t*-test statistic rejects the null hypothesis that there is no difference between the two means at the five percent level.

In summary, this study supports that the market expects bad news via dividend announcements to be delivered late. The abnormal returns on the late announcement date are either insignificantly zero or significantly negative depending on the model employed. Conversely, the abnormal returns around the early announcement dates or on time announcement dates are significantly positive. Furthermore, late dividend announcements are associated with significantly more dividend reductions that announcements made on time. Additionally, the study concludes that managers are not able to reduce stock price declines by delaying unfavorable dividend announcements as the market interprets delay of news as negative information. However, the stock price decline on the announcement date is smaller than what the decline would be if the announcement had been made earlier because the market would have decreased the stock price after the predicted date to the announcement date.

Lang and Litzenberger (1989) test the models of two well-developed dividend theories.

The first theory is the dividend signaling theory which includes the models of Bhattacharya (1979), John and Williams (1985), and Miller and Rock (1985), which predict that dividend changes signal information concerning the firm's future earnings. The second theory is the free cash flow theory which includes the model of Jensen (1986) and predicts that dividend changes signal information concerning the firm's future investment projects.

They employ Tobin's *Q*, which is the ratio of the market value of the firm's equity and debt to the replacement cost of the firm's assets, to measure the extent of the firms overinvestment. An average *Q* greater than unity indicates the firm is at a value-maximizing level of investment. An average *Q* less than unity indicates a firm that overinvests.

The sample of firms that they estimate meet the following criteria: (1) they had an absolute dividend change by more than ten percent over the period of 1979 to 1984; and (2) data was available so the firm's *Q* could be calculated. Data were obtained from CRSP and Moody's Bond Record. Their final sample includes 429 dividend announcements. They estimate each firm's average daily risk-adjusted returns on the announcement day using the Scholes-Williams beta and the equally weighted CRSP index returns.

They find that sizable dividend changes have a significant impact on the stock price of firms with an average *Q* less than unity, but little affect for firms with an average *Q* greater than unity. This evidence argues that increased dividend payouts for overinvestment firms signal better investment policies which supports the free cash flow theory.

Christie (1990) examines NYSE firms with stock outstanding between 1926 to 1985. Each month every firm is classified as a zero-dividend firm or a dividend-paying firm. A zero-dividend firm is one that has not declared cash dividends since their listing or has announced that it plans to omit its next dividend. The rest are dividend paying firms and were assigned to yield quartiles.

Zero-dividend firms are classified into three groups: *non-dividend-paying firms* (296) that pay no regular cash dividends; *dividend-initiating firms* (456) whose time period before the first dividend payment exceeds five months; and *dividend-omitting firms* (1,780) that omit a dividend payment.

Next, Christie analyzes the percentage of zero-dividend firms that trade on the NYSE over the 1926 to 1985 period. He notes that by 1933, almost fifty percent of all the NYSE firms had omitted dividends and another twenty percent were non-dividend paying firms. This can be explained by the hard economic times surrounding the depression. He also notes the extreme volatility of zero dividends during the 1936 to 1937 period which is largely due to the Undistributed Profits Tax.

Christie estimates excess returns by estimating a unique size-based expected-returns model over the 1946 to 1985 period. The first advantage is that newly listed zero-dividend firms are included in the study whereas previous studies such as Keim (1983) required that the firm trade for sixty months before systematic risk could be estimated. This results in around fifty percent more non-dividend paying firms and sixty percent more dividend-initiating firms. The second advantage is that the size effect is controlled. Christie shows that most zero-dividend firms are in the smallest size deciles.

Christie measures the differences in risk between zero-dividend and dividend paying firms by estimating the systematic risk of the different portfolios during non-overlapping five year periods via the market-model regression. The equally-weighted monthly mean return on the portfolio is regressed against the equally-weighted monthly mean return of NYSE. All twelve estimated betas for zero-dividend paying firms are significantly greater than unity and the estimated betas of dividend paying firms which are less than one.

Excess returns for the zero-dividend firms are analyzed and the following observations are made: zero-dividend firms earn -0.41 percent less per month when compared to dividend-paying firms and negative excess returns are experienced for every decile and every month except for January. Christie refers to the -0.41 percent as the differential return between zero-dividend and dividend-paying firms.

These results differ from Keim (1983) who concludes that zero-dividend firms earn differential returns of 0.27 percent per month, therefore, Christie reconciles these results. He selects the firms using the same criterion as Keim and the differential returns are 0.36 percent per month. Thus, it is the difference in the firm selection methodology which drives the difference between the two conclusions. Keim's methodology is more restrictive than Christie's in that firms are not allowed into the study until they have five years of trading on the NYSE while with Christie's study they enter the month they start trading. Additionally, dividend-omitting firms are allowed only after twelve months of no cash payments while Christie allows firms into the study in the month the omission is announced. Lastly, Keim studies the period of 1931 to 1978 while Christie studies the 1946 to 1985 period.

The next part of Christie's study is to determine whether or not there is a tax effect that affects the valuation of zero-dividend stocks. He sets the relation between the capital gain marginal tax rate and the dividend marginal tax rate to equate after-tax returns between dividend-paying and zero-dividend firms as:

$$\tau_d = [(1-\tau_c)K]/(D/P) + \tau_c \qquad \text{(II-58)}$$

where τ_d and τ_c are the marginal tax rates on dividends and capital gains, respectively, K is the annualized before-tax return differential, D is the annualized dividend, and P is the price per share. He assumes that (D/P) is 5.77 percent which is the average yield of the firms that yielded the -0.41 percent monthly return differential; K is assumed to be 4.92 percent given the 0.41 percent before-tax monthly return differential (12 months x 0.41 percent/month). With marginal capital gains tax assumed between zero and fifteen percent, Christie finds that the marginal dividend tax rate to be much higher that those observed after 1945. For example, if the marginal capital gain tax rate is set at zero, then the marginal dividend tax rate is eighty-five percent with a ninety-five percent confidence interval extending from twenty-eight percent to 128 percent. As the capital gain tax rate increases the dividend tax rate increases. Therefore, he concludes that a tax effect cannot explain the differential return between zero-dividend and dividend paying firms.

Furthermore, Christie analyzes the return differential during annual intervals relative to a firm's entry into the zero-dividend group. He hypothesizes that a tax-induced differential should not be sensitive to the number of years a firm maintains a zero-dividend status. First, he sorts the abnormal returns of the zero-dividend and dividend-initiating firms into annual intervals and finds that they experience significant negative abnormal returns for the next four years. Next, he sorts the abnormal returns of dividend-omitting firms into annual intervals and finds that they experience negative abnormal returns for the next four years, although only two years are significantly negative. This gives additional support that the negative abnormal returns for zero-dividend firms cannot be attributed to tax effects.

Christie analyzes the abnormal returns of a firm that enters the dividend paying sample and finds that the firm experiences positive abnormal returns in the next six years, although only year four is significant. Additionally, he finds that firms that resume cash dividends earn positive abnormal returns for the next six years, although only the year one is significant.

In summary, Christie uses a size-based market model and all possible zero-dividend months to study abnormal returns. He finds that zero-dividend firms experience on average abnormal returns of -0.41 per month over the 1946 to 1985 period. He does not attribute the abnormal returns to a tax effect. Conversely, this supports that dividends have a credible and positive signal to the market.

2.3.3 Stock Repurchases and Specially Designated Dividends

Two other dividend related areas that have received much attention in the literature includes stock repurchases and specially designated dividends. The dividend yield in this study a function of all cash disbursements made to the stockholder. Thus, stock repurchases do not affect the dividend yield of stocks used in this study. However, two major studies on stock repurchases, Masulis (1980) and Lakonishok and Vermealen (1990), are included for completeness of the literature review. Since specially designated dividends are cash disbursements to all stockholders, the dividend yield is directly affected. Three major studies on specially designated dividends include Brickley (1983), Jayaraman and Shastri (1988), and Howe, He, and Kao (1992). Following is a discussion on these five papers.

Masulis (1980) tests four hypotheses that may explain why firms repurchase stocks. These include the *personal tax savings hypothesis*, *leverage hypothesis*, the *security classes wealth transfer hypothesis*, and the *shareholder wealth transfer hypothesis*.

The personal tax savings hypothesis suggests that some shareholders find it advantageous to receive cash from the firm as a capital gain versus ordinary income while others would prefer the cash in the form of a dividend. A stock repurchase allows the shareholder to determine which method of payment is most beneficial for him. A capital gain allows the shareholder to postpone taxes on the payment and if capital gain taxes are lower than the ordinary tax rate as it was prior to the Tax Reform Act of 1986, the gains are taxed at a lower rate when they are received. Masulis supports this hypothesis and finds significant and positive returns around the announcement period.

The leverage hypothesis suggests that firms engage in stock repurchases to increase their debt to equity ratio. If the firm finances the stock repurchases with debt, then the leverage ratio is even greater than otherwise. This creates value for the firm in two ways. First, since interest expense is tax deductible, the increased leverage increases the tax deductions of the firm. Second, the shift in the firm's capital structure signals that the firm is increasing debt because its capital structure is below its optimal level. Correcting the capital structure increases the after-tax value of the firm which increases the value of the firm's risky securities. Masulis supports this hypothesis and finds that the returns for the debt financed stock repurchases are greater than the returns for nondebt financed stock repurchases.

The *security classes wealth transfer hypothesis* suggests that firms engage in stock repurchases to transfer wealth from the bondholders to the shareholders. If the firm increases its leverage ratio, the firm becomes riskier which increases the value of the equity and reduces the value of the debt. Masulis supports this hypothesis and finds that the announcement period return on convertible securities are greater than the return on nonconvertible securities.

The shareholder wealth transfer hypothesis suggests that firms engage in stock repurchases to transfer wealth between tendering stockholders and nontendering stockholders. If the self tender offer premium paid by the firm is too large, then wealth is transferred from nontendering to tendering shareholders and vice versa. Masulis supports this hypothesis and finds a wealth transfer from nontendering shareholders to tendering shareholders. He finds that the mean announcement period return is significantly negative. He then looks at subsets of the self tender offers and finds for oversubscribed tender offers, the mean announcement return is significantly negative while for undersubscribed or fully subscribed offers the mean announcement return is not significantly different than zero. Lastly, he looks at subsets of the oversubscribed tender offers and finds for pro rata purchases that the mean announcement return is significantly negative while for the complete purchases the mean return is significantly positive.

Lakonishok and Vermaelen (1990) find it difficult to understand Masulis's (1980) conclusion that there is a wealth transfer from nontendering shareholders to tendering shareholders.

It is not intuitive why managers would take action to benefit shareholders they no longer serve at the expense of shareholders that they must continue to work with in the future. They test the *personal tax savings hypothesis* and the *signaling hypothesis.*

They find weak support for the *personal tax savings hypothesis* since on average, seventeen percent of the shares outstanding or eighty-seven percent of the total shares tendered are purchased. This indicates that tax considerations may explain a shareholder's tendering decision. However, it does not fully explain why many tax-exempt shareholders do not tender their shares.

Lakonishok and Vermaelen find strong support for the *signaling hypothesis* which suggests that firms engage in stock repurchases to signal the market that the firm is undervalued. Since management is generally precluded from participating in the repurchase, this adds credibility to the signal that the firm is undervalued. Lakonishok and Vermaelen find that small firms appear to try to signal the market that their stock is undervalued via a stock repurchase. However, this does not appear to be the case with large firms which appear to use stocks repurchase to reduce their free cash flow.

Lakonishok and Vermaelen use a trading strategy where an investor buys shares after the expiration of the tender offer and find that these shares outperform a value-weighted index by (+24.0%) over 24 months. They then adjust the returns for firm size and beta and still find significantly higher returns by the trading strategy versus the index. Thus, management appears to recoup the premium they forego when they do not tender their shares and it appears that they are signaling that the firm's stock is undervalued.

Brickley (1983) studies specially designated dividends (SDDs) which are defined as a dividend increase with a special label by management such as "extra", "special", or "year-end". Traditionally, many researchers have argued that management increases the regular dividend only when they are confident that the increased level can be maintained for the next several years. Based on this argument, Brickley suggests that a regular dividend increase signals positive information about the firm's future outlook. Conversely, he suggests that a SDD may simply be a one time cash distribution to shareholders and may signal very little, if any, positive information about the firm's future outlook.

Brickley has three main motivations for his paper. The first is to improve our understanding of why managers increase (decrease) dividends and how increases (decreases) signal information to the market. The second motivation is to help explain the role of SDDs in corporate finance. For example: Do SDDs convey information about future dividends and earnings, or are SDDs one-time dividend increases that signal no future information about the firm? The third motivation is to provide broader implications for the general topic of financial signaling. For example: If SDDs signal information about the future, is it different from the information signaled by regular dividend increases?

Brickley points out that there is no direct evidence that management consciously uses dividends to signal the firm's future prospects. He notes that regular dividend increases and SDDs are both management dividend decisions which result in cash payments to shareholders with identical tax consequences. Thus, any difference in the market reaction of a regular dividend increase and specially designated dividend can be attributed to the signal sent by management via the label. Any such evidence would support that management is consciously aware of the signaling information that dividends send to the market. Furthermore, SDDs account for a large proportion of increased dividend payments. More specifically, each year over the 1969 to 1979 period, SDDs accounted for twenty-five to fifty percent of the 2,000 to 4,000 increases in quarterly dividends.

To test his hypothesis, Brickley uses three samples. The first sample consists of 165

SDDs announced over the 1969 to 1979 period. The second sample is a control group of one-hundred observations where the firm announces a regular quarterly dividend increase. The third sample is a control group of one-hundred firms that announce no change in their quarterly dividend payout.

Brickley determines that SDDs disclose positive information to the market. To conclude this he analyzes daily stock returns, obtained from CRSP, over 121 trading days centered around the declaration date of the SDDs. The mean rate of return for each of the 121 trading days is calculated as the arithmetic mean of the individual securities' raw returns on their common dates in event time. The "announcement period return" is defined as the two day return of day 0 and day +1 which is 2.11 percent. The "pre-announcement period return" is defined as the mean of the non-overlapping two-day average returns over the fifty days from day -60 to day -11 which is 0.10 percent. The null hypothesis that the "announcement period return" equals the "pre-announcement period return" is rejected with a *t*-test statistic at the one percent significance level. Additional support is provided when the announcement period has the largest number of firms with positive two-day returns when compared to all other non-overlapping two-day periods during the pre-announcement period. More specifically, Brickley rejects the null hypothesis that the return distributions are identical for the pre-announcement period and the announcement period at the four percent significance level. The above evidence supports that SDDs signal positive information to the market.

Next, Brickley determines whether the information a SDD conveys is a more positive piece of information than information simply based on a temporary and unanticipated dividend. To determine this, he tests and rejects the null hypothesis that the announcement period return is equal to the SDD as a percentage of the stock price at the one percent significance level. In fact, Brickley finds that the average market reaction is too favorably large to be explained by a temporary, unanticipated dividend.

Brickley goes on to determine that SDDs signal less positive information than a regular dividend increase. The estimated equation with ordinary least squares is:

$$\underset{}{RET2D} = \underset{(79.0)}{0.99} + \underset{(1.9^{*})}{0.016}\ REGINC + \underset{(2.0^{*})}{0.048}\ SZREL,\ R_2 = 0.05 \qquad \text{(II-59)}$$

where RET2D is the announcement period return relative to the stock price; REGINC is a dummy variable which is equal to 1 if the observation is a regular increase and 0 if it is a SDD; SZREL is a relative size variable which is the dividend increase divided by the regular dividend declared in the previous quarter; and * is a one-tailed *p*-value of three percent. This means that the labeling of a dividend increase signals information to the market. More specifically, an unlabeled dividend increase signals more positive information to the market than a SDD of similar size.

Brickley found that SDDs signal more information than one would expect from a temporary, unanticipated cash payment and that SDDs signal less information than an unlabeled dividend increase of similar size. He then determines that this nature of SDDs is based on the perceived future earnings and dividends. He analyzes the dividend performances following the 165 SDDs and finds that in the succeeding four quarters only one percent of the firms decrease their dividend payout. Conversely, twenty to sixty-six percent of the firms in each quarter made larger payments than the previous quarter's regular payment. This is consistent with the Lintner (1956) model that firms are reluctant to reduce dividends.

Because one may expect dividend payouts following SDDs to be abnormally positive, Brickley's formulates three dividend performance measures to compare dividend payouts following SDDs with payouts following decisions not to change the dividend. All three measures reject the null hypothesis that the dividend performance following a SDD is the same or worse than following a decision not to change the dividend. The first dividend performance measure is the "following quarter measure" which is the relative dividend yield for the quarter immediately following the initial announcement of a SDD or of no dividend change. The second dividend performance measure is the "anniversary quarter measure" which is the relative dividend yield in the anniversary quarter of the initial announcement. The third dividend performance measure is the "following year measure" which is the relative dividend yield over the twelve month period following the initial announcement.

He recognizes a possible bias since the no change firms may include firms that have a long history of paying the same dividend and are very reluctant to increase their dividends. The other bias recognized is that firms that declare SDDs usually have experienced good earnings performances in the previous periods, whereas the group of no dividend change firms contains firms with positive and negative earnings performances. These firms that experience decreased earnings are less likely to increase their dividend payout in the next twelve-months. To correct for these two possible biases, Brickley looks at a subsample of thirty-six no change firms that had earning increases and raised their dividend sometime within the previous two-year period before the announcement date that the firm would not change the dividend. Again, all three dividend performance measures reject the null hypothesis that the dividend performance following a SDD is the same or worse than following a decision not to change the dividend.

Similar to above, one may expect dividend payouts following a regular dividend to be significantly positive, in addition to those following SDDs. Therefore, the three dividend performance measures are used to compare dividend payouts following SDDs with payouts following decisions to change the dividend. All three measures reject the null hypothesis that the dividend performance following an increased dividend announcement is the same or worse than that following a SDD.

To ensure that increased dividend payouts and SDDs, not earning changes, are signaling information to the market about future dividends and earnings, Brickley analyzes the earning patterns around these two events. He analyzes the change in earnings per share between fiscal year -1 and fiscal year 0. If earnings are driving this reaction, then we would expect the regular dividend group to have larger positive earning changes than the SDD group over the next twelve months. However, Brickley cannot reject the null hypothesis that the average earnings change over the period is the same for both groups. Next, he compares earning changes from fiscal year 0 and fiscal year +1 for both groups. Contrary to above, here we find that there is a significant difference between the change in earnings for the two groups. The change for the regular dividend increase groups is significantly larger than the SSD group so Brickley rejects the null hypothesis that the average earnings change for the SDD group is the same or greater than the regular dividend increase group. This tends to support the belief that SDDs represent more just a transitory increase in earnings and dividends potential of the firm and that a regular dividend increase signals more positive information than a SDD of similar size.

In summary, Brickley finds that not only do increased dividend payouts signal information about future dividends and earnings, but that the labeling of the dividend as either a SDD or regular dividend increase sends additional information. Although both SDDs and regular dividend increases tend to follow a period of good earnings which are not significantly different, the regular dividend increase group signals more positive information than the SDD group. This is confirmed when returns at the time of the announcement period of the regular dividend increase group are found to be significantly greater than those of the SDD group. One explanation why the regular increased dividend group has greater positive information signaled is that the dividend payouts in the year following the announcement are significantly greater than the SDD group. Similarly, the regular increased dividend group has significantly greater earnings in the year following the announcement than the SDD group. Further analysis of the market's reaction to SDDs suggests that a SDD represents more than a transitory increase in dividends and earnings because earnings remain stable and dividend increases are likely in the year following the announcement.

Jayaraman and Shastri (1988) also analyze specially designated dividends and extend Brickley's (1983) study. They examine whether SDDs increase the value of the firm's stock by its information content or through a wealth transfer from bondholders to stockholders. Jayaraman and Shastri analyze both stock and bond price reactions to SDD announcements. The information content hypothesis would be rejected and the wealth transfer hypothesis accepted if there are negative announcement period returns on bonds (and vice versa).

Jayaraman and Shastri analyze 2023 special dividend announcements by 660 firms that are listed on the NYSE or the AMEX between 1962 and 1982. The bond sample includes 154 bonds issued by 63 of the above firms. The mean adjusted returns model is used to predict the normal returns of the SDD and normal bond prices around the announcement period. Their results support the information content hypothesis. Almost all the gains of the information content accrues to the stockholders.

Howe, He, and Kao (1992) analyze specially designated dividends to test the Jensen (1986) free cash-flow theory. They extend the research of Lang and Litzenberger (1989) who find support for the free cash-flow theory with a sample of firms that announce dividend increases. Howe, He, and Kao expand the sample to include firms that pay specially designated dividends. They divide their sample into low-Q (overinvesting) and high-Q (value maximizing) firms. They use an event study methodology and find that the two-day abnormal returns around the announcement date of low-Q firms is not significantly greater than those of the high-Q firms. The results are consistent with the information signaling theory, but are inconsistent with the free cash-flow theory. For the free cash-flow theory to hold, the abnormal returns on the low-Q firms should be significantly greater because these firms that tend to overinvest, would have less cash flow to waste.

2.4 Summary

The effect of dividends and dividend policies on the value of the firm is a puzzle that remains unsolved after over thirty years of theoretical and empirical modeling. The theoretical models developed to date give conflicting effects. The studies of Miller and Modigliani (1961) and Miller and Scholes (1978) conclude that dividends are irrelevant. Conversely, the studies of Walter (1956), Lintner (1956), Farrar and Selwyn (1967), Bhattacharya (1979), and Miller and Rock (1985) conclude that dividends are relevant. Therefore, empirical research must determine which theoretical models best explain the corporate market.

One empirical issue that researchers have analyzed is how dividend changes affect stock returns. Watts (1973) finds no significant positive (negative) returns associated with dividend increases (decreases). However, Aharony and Swary (1980) and others, using event study methodology, conclude that dividend increases (decreases) result in increased (decreased) stock returns. For example, Aharony and Swary (1980) find that firms that increase (decrease) dividends preceding earnings announcements realize cumulative average abnormal returns of 1.03 (-2.82) percent over a two day announcement period. Another empirical issue deals with specially designated dividends (SDDs) which are not distributed annually. Brickley (1983) and others conclude that firms which pay SDDs experience significant positive returns.

Another empirical issue that researchers have analyzed is how dividend yields affect stock returns. Watts (1973) and Black and Scholes (1974) conclude that dividend yields are irrelevant and do not affect stock returns. Conversely, Stone and Bartter (1979) and Litzenberger and Ramaswamy (1979) find that dividend yields are relevant and positively related to stock returns. This dissertation differs from these studies in that a new and more robust methodology is used to analyze dividend yields.

CHAPTER III

METHODOLOGY AND ESTIMATION PROCEDURES

The methodology and estimation procedures are subdivided into six major sections. Section 3.1 discusses the data source. Section 3.2 discusses the capital asset pricing model. Section 3.3 discusses variance reduction with a multi-index model. Section 3.4 discusses the multi-index model and has six subsections. Section 3.4.1 discusses estimation of the indexes and the index scores. Section 3.4.2 discusses the selected time period. Section 3.4.3 discusses the estimation period. Section 3.4.4 discusses the formulation of the *Investment Strategy*. Section 3.4.5 discusses the testing period. Section 3.4.6 discusses rolling the procedure ahead one year. Section 3.5 illustrates the methodology by explaining a pilot study that utilizes the single-index market model. Lastly, Section 3.6 discusses the expected results.

3.1 Data Source

The data for this dissertation are obtained from the Center for Research in Security Prices (CRSP), Graduate School of Business, University of Chicago. The 1990 CRSP monthly New York Stock Exchange (NYSE) stock file contains month-end security information for the period from December 1925 to December 1990 for around 6500 securities. The data from the NYSE is available for the entire period from December 1925 to December 1990.

The CRSP Stock Files are a database available on computer tapes and contain over twenty-five million pieces of information. The files contain five kinds of data on individual securities. First, there is identifying information such as the name histories, historical CUSIPS, share classes, tickers, and SIC codes. Second, there are price histories, holding period returns with or without dividends, and trading volumes for the period that the security traded on the New York Stock Exchange. Third, there is information explaining why the security stopped trading. Fourth, there is complete distribution histories which includes all dividends, stock splits, and special distributions. Fifth, there is information on the shares outstanding values and year-end market capitalization.

The CRSP Stock Files data are highly accurate. Data are checked for internal consistency and checked against secondary sources. These sources include the CUSIP Directory, Moody's Dividend Record, Commerce Clearing House's Capital Changes Reporter, Moody's Manuals, the New York Stock Exchange Weekly Bulletin, the American Stock Exchange Weekly Bulletin, Bank and Quotation Record, the Wall Street Journal, and The Commercial and Financial Chronicle. The CRSP Stock Files are updated at the end of each calendar year at which time any noted errors are corrected. Each spring the new CRSP Stock Files are available to subscribers.

3.2 Capital Asset Pricing Model

Before describing the multi-index model that is used, the popular single-index model called the capital-asset pricing model (CAPM) is discussed. Knowledge of the CAPM framework is beneficial to understanding the multi-index model. The CAPM differs from the multi-index model in several ways. The major difference is that the CAPM defines security returns as a linear function of only one index, the market return index. Also, all securities have the same intercept term, which is the riskfree rate. Conversely, the multi-index model defines security returns as a linear function of several various indexes; also each security can have a different intercept. The CAPM can be considered a special case of the multi-index model, if the number of indexes equals one, the index is the market return, and all securities have an intercept equal to the risk-free rate.

The CAPM was suggested by Markowitz (1952) and developed by Sharpe (1964). It is one of the most widely used empirical models for the return-generating process. The model is based on several assumptions about investors and the market. First, investors exist in a one period model where they maximize the expected utility of their end of period wealth. Second, markets are perfect with no transaction costs, no taxes, no margin requirements, and no short sale restrictions. Third, there is a fixed supply of market securities which are marketable and divisible. Fourth, security returns are distributed jointly normal and investors have homogeneous expectations about each security's expected return and its expected variance. Fifth, there is a risk-free asset, and investors may borrow and lend at rate of return earned on the risk-free asset.

The results of the CAPM model are that the expected return of an individual security can be described as a linear function of: the riskfree rate of return, R_f, which is a rate of return for time; and the expected market return less the riskfree rate, $(E[R_m]-R_f)$, which is the price of risk, multiplied by a constant, β_i, which is the relevant quantity of risk for firm i. The CAPM is written as follows:

$$E[R_i] = R_f + (E[R_m]-R_f)\ \beta_i \tag{III-1}$$

Furthermore, the actual return, $\tilde{R}_i$, of an individual security can written as a function of the expected return and ε_i, which is an independent and normally distributed (NID) random variable with mean zero and constant variance:

$$\tilde{R}_i = E[R_i] + \varepsilon_i \tag{III-2}$$

Equation (III-2) can be rewritten with the expected return replaced with equation (III-1) such that:

$$\tilde{R}_i = R_f + (E[R_m]-R_f)\ \beta_i + \varepsilon_i \tag{III-3}$$

This means that the total variance of an individual security's return can be divided into two components and written as:

$$\sigma^2{}_i = \beta^2{}_i\ \sigma^2{}_m + \sigma^2{}_{\varepsilon i} \tag{III-4}$$

The first component is systematic risk, $\beta^2{}_i\sigma^2{}_m$, which cannot be diversified away even in a completely diversified portfolio. The second component is unsystematic or unique risk, $\sigma^2{}_{\varepsilon i}$, which can be eliminated through efficient diversification.

For an equally-weighted portfolio that is well diversified, its expected return, E[Rp], can be written as:

$$E[R_p] = \Sigma^N{}_{i=1}\ (1/N)\ E[R_i] \tag{III-5}$$

where N is the number of stocks (assets) in the portfolio. Furthermore, the actual return of a portfolio can be written as:

$$\tilde{R}_p = E[R_p] + \varepsilon_p \tag{III-6}$$

which can be rewritten as:

$$\tilde{R}_p = \Sigma^N{}_{i=1}\ (1/N)\ E[R_i] + \Sigma^N{}_{i=1}\ (1/N)\ \varepsilon_i \tag{III-7}$$

$$\tilde{R}_p = R_f + (E[R_m]-R_f)\ \Sigma^N{}_{i=1}\ (1/N)\ \beta_i + \Sigma^N{}_{i=1}\ (1/N)\ \varepsilon_i \tag{III-8}$$

The variance of the portfolio can be written as:

$$\sigma^2_p = \beta^2_p \sigma^2_m + \Sigma^N_{i=1} (1/N^2) \sigma^2_{\varepsilon i} \qquad \text{(III-9)}$$

where $\beta^2_p\sigma^2_m$ is the systematic risk of the portfolio and $\Sigma^N_{i=1}(1/N^2)\sigma^2_{\varepsilon i}$ is the unsystematic risk of the portfolio. Suppose the $\sigma^2_{\varepsilon i}$ is bounded above by some large S^2, then:

$$\Sigma^N_{i=1} (1/N^2) \sigma^2_{\varepsilon i} \leq \Sigma(1/N^2) S^2 \qquad \text{(III-10)}$$

$$\Sigma^N_{i=1} (1/N^2) \sigma^2_{\varepsilon i} \leq (1/N^2) N S^2 = S^2/N \qquad \text{(III-11)}$$

where S^2/N approaches zero as N becomes large. Thus, as the number of stocks, N, in the portfolio becomes large, the unsystematic risk for the portfolio approaches zero. This means that the relevant risk for the portfolio is the systematic risk which can be measured by the beta of the portfolio:

$$\beta_p = \Sigma^n_{i=1} (1/N) \beta_i \qquad \text{(III-12)}$$

where β_i equals the covariance of the firms's return and the market return divided by the variance of the market:

$$\beta_i = \text{Covariance}(R_i,R_m)/\text{Variance}(R_m) \qquad \text{(III-13)}$$

Furthermore, since the error terms, ε_i, are NID with a mean zero and their variance approaches zero at the limit, the actual return on the equally weighted portfolio can be written as:

$$\tilde{R}_p \approx R_f + (E[R_m]-R_f) \Sigma^N_{i=1} (1/N) \beta_i \qquad \text{(III-14)}$$

The results of the model are that investors are risk-averse and have a linear risk-return relationship. This relationship is used to form the Security Market Line, which is a linear efficient set of portfolios in which investors may invest. The Security Market Line shows that investors can only obtain a higher expected return by investing in a portfolio with higher risk. This means that two portfolios with the same systematic risk, as measured by beta, should have the same expected return. Additionally, if both portfolios are well diversified, then they should have the same actual return. However, the effectiveness of diversification depends on how well the CAPM can explain the variance of the stock returns.

The CAPM has been used extensively to study dividend issues. Often, the model is slightly modified to include a dividend variable and/or to exclude the risk-free rate of return. Some studies that include either the CAPM or a modified version of the CAPM are: Watts (1973); Brennan (1970); Black and Scholes (1974); Stone and Bartter (1979); Litzenberger and

Ramaswamy (1979, 1980); Aharony and Swary (1980); Kane, Lee, and Marcus (1984); Richardson, Sefcik, and Thompson (1986), Christie (1990); Bajij and Vigh (1990); and Lamoureux (1990). A more complete detail of their methodology is discussed in Chapter II.

3.3 Variance Reduction with a Multi-index Model

Roll and Ross (1980) and Hughes (1982) are two early studies which support that multi-index model can explain a greater portion of the variance of stock returns in a time-series regression than the CAPM. These studies show that time-series specification with around five indexes can explain over fifty percent of the variance of stock returns in a portfolio. In contrast, Ehrhardt (1991) finds that the CAPM explains around twenty-nine percent. Both Roll and Ross, and Hughes use factor analysis to statistically extract around five indexes that explain the variance. Neither study tried to identify the indexes, rather their objective was to determine whether more indexes may better explain the variance of stock returns.

These studies suggest that the CAPM may not sufficiently explain the variance of stock returns in a time-series specification and that a multi-index model may be both more appropriate and more powerful in explaining stock returns. The multi-index model has been instrumental in explaining some test results obtained in the CAPM framework. For example, in the CAPM framework, previous research concluded that there was a small firm effect where small firms annually earned around twelve percent more than large firms after adjusting for risk via the CAPM. However, Chan, Chen, and Hsieh (1985) argue that a multi-index model can explain this small firm effect.

Chan, Chen, and Hsieh (1985) select six indexes a priori that may explain stock returns. The indexes include the market index, an industrial production index, a risk premium index, a term structure index, an unanticipated inflation index, and a change in expected inflation index. They find there is a large difference in average monthly returns between small firms and large firms. However, their results show that the risk premium index can explain the difference in returns between small and large firms. With the risk premium included in the model there is no significant difference between average return residual of the small and large firm portfolios. Their model appears to account for the twelve percent return difference between small and large firms. They conclude that small firms have greater returns because they have more risk.

It is the conclusions of these papers and others that have led to the application of the multi-index model to issues that have been extensively analyzed with the CAPM. The multi-index model assumes that an individual security's return is a linear function of various indexes and can be written:

$$\tilde{R}_i = \alpha_i + \Gamma_k\, \beta_{ki} + \varepsilon_i \qquad \text{(III-15)}$$

where: $\tilde{R}_i$ is a (T x 1) vector containing T monthly returns on security *i*; α_i is a (T x 1) vector of constant scalars; Γ_k is a (T x K) matrix containing T monthly values (often called scores in the field of factor analysis) on K indexes; β_{ki} is an (K x 1) vector of coefficients where β_{ki} represents the sensitivity of security *i* to the k^{th} index, and ε_i is an independent and normally distributed (NID) random variable with mean zero and constant variance for security *i*. Let σ_k denote the standard deviation of the k^{th} index. The variance of an individual security return can be written as:

$$\sigma^2{}_i = \Sigma^k{}_{i=1}\, \beta^2{}_{ki}\, \sigma^2{}_k + \sigma^2{}_{\varepsilon i} \qquad \text{(III-16)}$$

The expected return on an equally weighted portfolio that is well diversified with many stocks can be written as:

$$E[R_p] = \Sigma^N{}_{i=1}(1/N)\alpha_i + \Sigma^N{}_{i=1}(1/N)\beta_{1i}\Gamma_1 + \ldots + \Sigma^N{}_{i=1}(1/N)\beta_{ki}\Gamma_k \qquad \text{(III-17)}$$

where α_i is the intercept term for firm i and β_{ik} is the coefficient on index k for firm *i*. The actual return can be written as:

$$\tilde{R}_p = E[R_p] + \Sigma^N{}_{i=1}(1/N)\varepsilon_i \qquad \text{(III-18)}$$

The indexes are constructed so they are orthogonal to one another. Thus, with no loss of generality, the variance of the portfolio can be written as:

$$\sigma^2{}_p = \Sigma^N{}_{i=1} w^2{}_i \beta^2{}_{1i} \sigma^2{}_1 + \ldots + \Sigma^N{}_{i=1} w^2{}_i \beta^2{}_{ki} \sigma^2{}_k + \Sigma^N{}_{i=1} w^2{}_i \sigma^2{}_{\varepsilon i} \qquad \text{(III-19)}$$

Similar to the CAPM, it can be shown that a well diversified equally weighted portfolio with a large number of stocks can eliminate the variance of the errors. The variance of the portfolio can be written as:

$$\sigma^2{}_p = \beta^2{}_{1P}\, \sigma^2{}_1 + \ldots + \beta^2{}_{13P}\, \sigma^2{}_{13} + \Sigma^N{}_{i=1}\, (1/N^2)\, \sigma^2{}_{\varepsilon i} \qquad \text{(III-20)}$$

where $\beta^2_{pi}\sigma^2_i$ is the variance of the portfolio return attributed to index i and $\Sigma^N_{i=1}(1/N^2)\sigma^2_{\varepsilon i}$ is the variance of the error terms. Suppose the $\sigma^2_{\varepsilon i}$ is bounded above by some large S^2, then:

$$\Sigma^N_{i=1} (1/N^2)\, \sigma^2_{\varepsilon i} \leq \Sigma(1/N^2)\, S^2 \qquad \text{(III-21)}$$

$$\Sigma^N_{i=1} (1/N^2)\, \sigma^2_{\varepsilon i} \leq (1/N^2)\, N\, S^2 = S^2/N \qquad \text{(III-22)}$$

where S^2/N approaches zero as N becomes large. Thus, as the number of stocks in the portfolio become large, the variance of the error terms quickly approach zero. Furthermore, since the error terms are NID with a mean zero and their variance quickly approaches zero as the number of stocks in the portfolio becomes large, then the actual return on the portfolio can be approximated as:

$$\tilde{R}_p \approx \Sigma^N_{i=1}(1/N^2)\alpha_i + \Sigma^N_{i=1}(1/N^2)\beta_{1i}\Gamma_1 + \ldots + \Sigma^N_{i=1}(1/N^2)i\beta_{ki}\Gamma_k \qquad \text{(III-23)}$$

3.4 The Multi-index Model

The application of a multi-index model that reduces variance and analyzes dividend levels contributes to the dividend literature in three major ways.

First, the multi-index model will account for much more variance of stock returns than the capital asset pricing model. By controlling for different and more sources of risk, the power of the test will be much stronger than the earlier studies.

Second, the increased power will permit the testing of the relationship between dividend yields and stock returns, an issue that has previously been subject to ambiguous results and conflicting conclusions. For example, Watts (1973) and Black and Scholes (1974) find that dividend yields are irrelevant. Conversely, Stone and Bartter (1979) and Litzenberger and Ramaswamy (1979) find that dividend yields are relevant and suggest that it is an omitted variable in the CAPM.

Third, the test permits an *Investment Strategy* that will have implications for market efficiency. To preclude arbitrage, the return on the *Investment Strategy*, which is explained later in this chapter, should not be significantly different from zero.

The indexes for the multi-index model can be determined in either of two ways. First, the indexes may be selected a priori, such as Chan, Chen, and Hsieh (1985), and Chen, Roll, and

Ross (1986). For example, the indexes may include such variables as the market return, the short term interest rate, and the inflation rate. Second, statistical computations such as principal components analysis or factor analysis can be employed to extract the desired number of indexes. The only data required by principal component and factor analysis are the observed stock returns.

The choice of the methods depends on the goals of the researcher. If one wants to explain the maximum amount of variance of stock returns, then selection via principal components analysis or factor analysis is appropriate because these indexes have more explanatory power than an identical number of indexes selected a priori. If one wants to explain what specific indexes drive the return generating process of returns, then selection of the indexes a priori, based on some theory, is preferred. Since the objective of this methodology is to explain the maximum amount of the variance of stock returns, principal components analysis is employed to select the indexes.

The multi-index model employed in this study assumes that an individual security's returns, excluding dividends, are a linear function of several indexes and can be written:

$$\tilde{R}_{it} = \alpha_i + \beta_{1i}\,\Gamma_{1t} + \beta_{2i}\,\Gamma_{2t} + \ldots + \beta_{ki}\,\Gamma_{kt} + \varepsilon_{it} \tag{III-24}$$

where: $\tilde{R}_{it}$ is monthly return based on price changes of firm i for period t; α_i is the intercept term for firm i; β_{ki} is the coefficient term on index k for firm i, Γ_{kt} is index score on index k for period t; and ε_{it} the error term for firm i.

3.4.1 Estimation of Indexes and Index Scores

The number of indexes, k, selected is thirteen. The objective of the multi-index model is to explain as much of the variance of stock returns as possible in a time-series specification. Thirteen should account for a much larger amount of the stock returns than previous models that included the market index and a dividend variable. By way of comparison to the CAPM, the coefficients are analogous beta and the index scores are analogous to the monthly returns of the market index. The extraction of the coefficients is a three step procedure and the extraction of the index scores is a four step procedure. The three step procedure for the coefficients is as follows:

Step 1: Sixty consecutive monthly returns without dividends over the period of

1965 to 1969 will be obtained for fifty-two NYSE firms that are available on the 1990 Monthly CRSP tape. The method to select the fifty-two firms is very specific. All the firms in the sample, denoted *N*, are sorted from the firm with the lowest return over the sixty month period to the firm with the highest return. Firms with the same return are then sorted by their dividend yield over the sixty month period. Next, the integer value from (firms in the sample, *N*) divided by (fifty-three) is calculated, denoted *integer(N/53)*. The first firm selected is firm number: [1 x *integer(N/53)*]. The second firm selected is firm: [2 x *integer(N/53)*]. This continues until the last firm selected is firm number: [52 x *integer(N/53)*]. Alternatively, approximately every nineteenth firm in the sample is selected to make up the fifty-two firm sample.[6] The number of firms selected is less than the number of monthly stock returns or the correlation matrix is singular. Principal components analysis requires that the correlation matrix be invertable.

Step 2: A (52 x 52) correlation matrix is formed using Fortran's IMSL subroutine CORVC. Each stock return, $\tilde{R}_{it}$, is assumed to have a mean u_i and variance σ^2_i. With these assumptions, subroutine CORVC estimates the sample mean as:

$$\bar{R} = \Sigma^{N}_{t=1} R_{it} \tag{III-25}$$

where N equals the number of firms. The sample correlation between firm *i* and *j*, ρ_{ij}, is defined as:

$$\rho_{ij} = (s_{ij}) \;/\; (s^2_{ii}\, s^2_{jj})^{0.5} \tag{III-26}$$

where s_{ij} is the sample covariance of between firms *i* and *j*; s^2_{ii} is the variance for firm *i*; and s^2_{jj} is the variance for firm *j*.

Step 3: The IMSL subroutine PRINC extracts fifty-two indexes (principal components) from the monthly returns via the correlation matrix of the monthly returns. When original stock returns are regressed against all fifty-two indexes, one-hundred percent of the variance is explained. The indexes are selected in a deterministic order, where the first factor has the most explanatory power of the variance of the observed

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6 In section *4.5 Alternative Models*, two alternative multi-index models are introduced which sort and select the firms differently.

stock returns of the fifty-two firms and the last factor has the least explanatory power of the variance. This method differs from factor analysis in that the errors can be correlated.

The four step procedure to extract the index scores is as follows:

Step 1: IMSL subroutine FCOEF is used to estimate a matrix of index score coefficients that are inputted into the IMSL subroutine FSCOR. The matrix of index score coefficients are estimated using the regression method as follows:

$$\beta = S^{-1} A \, T \, (T^T T)^{-1} \qquad \text{(III-27)}$$

where S denotes the correlation matrix of the sixty monthly returns from the 52 firms, T is an identity matrix, and A is a matrix (52 x 13) of unrotated index loadings from the subroutine PRINC.

Step 2: IMSL subroutine FSCOR is used to estimate a set of index scores given the index score coefficient matrix.

Step 3: The monthly stock return data of the fifty-two firms is standardized to a mean of zero and variance of one.

Step 4: The index score coefficient matrix is multiplied by the standardized data which gives us the index scores.

The methodology results in sixty index scores for each of the thirteen indexes. Again, in the CAPM framework, the monthly returns of the market index are analogous to the index scores.

The next step is to estimate the multi-index model for each stock by regressing the corresponding monthly stock returns of a firm on these thirteen indexes. As expected, the time series regression of the multi-index model has significantly more explanatory power than the time series regression of the CAPM. For example, the average R^2 of the multi-index regression for all NYSE firms over the 1984 to 1988 period is approximately fifty-four percent. Conversely, the average R^2 of the CAPM model for these same firms over the same period is approximately twenty-nine percent, which means the multi-index model has over sixty percent more explanatory power.

3.4.2 The Selected Time Period

This dissertation analyzes the twenty-five year period from 1965 to 1989. This period is segmented into twenty overlapping six year periods. Each six year period is divided into a five year estimation period and a one year testing period. To be included in the six year period, the firm must be listed on the NYSE and have no missing returns over the seventy-two month period.

This time period is selected because this time period allows different fiscal policies regarding the tax code to be analyzed. For example, the Tax Reform Act of 1986 eliminated the sixty percent exclusion on long-term capital gains. Additionally, the tax exemption of dividends received by a corporation has changed over this time period. Thus, the long time period helps mitigate potential erroneous conclusions that might be due to a particular period.

The choice of estimation/holdout period is consistent with Black, Jensen, and Scholes (1972) and Stone and Bartter (1979). Black, Jensen, and Scholes, and Stone and Bartter segment their time period into overlapping six year periods. Each six year period is divided into an estimation period and a testing period. The estimation period is the first five years and a CAPM time series regression is estimated by regressing sixty monthly returns of individual stocks on a market index. Both studies then form portfolios based on the estimated parameters. The testing period is the sixth year and both studies estimate and examine monthly returns on each portfolio during these twelve months.

3.4.3 The Estimation Period

The estimation period is the first five years of each six year period and the first testing period is January 1965 to December 1969. In the estimation period, an *Investment Strategy* is formulated and implemented to test the relationship between dividend yields and stock returns. There are four items that must be computed prior to the formulation of the *Investment Strategy*. First, the predicted annual dividend yield for the sixth year for each firm is calculated. Second, the multi-index model parameters for each firm is estimated. Third, the year-end capitalization is calculated for each firm. Fourth, every firm is classified into one of ten industries. After the previous four items have been computed, the *Investment Strategy* is formulated and implemented for the sixth year. The rest of this section explains how each of the above items are computed.

The first item calculated is the predicted annual dividend yield for the sixth year for each sample firm. This calculation is based on Bajaj and Vijh (1990) who find that only 1188 out of 54,058 (or 2.2%) dividend announcements over the July 1962 to June 1987 period were decreases in dividend payouts. Conversely, 45,548 (or 84.3%) of the dividend announcements were for no change in the payout level. Therefore, a two-step process is used to calculate the annual dividend yield for each firm. First, for each firm the CRSP monthly stock return without dividends is subtracted from the CRSP monthly stock return with dividends for each of the first sixty months of the six year period. Second, an annual geometric mean dividend yield over the five year period is calculated and used as the predicted annual dividend yield for the sixth year. Dividends reported on CRSP include all cash disbursements that are taxed as dividends. This includes all monthly, quarterly, semi-annual, year-end, final, extra, special, interim, and non-recurring cash dividends. Additionally, all cash dividends received in foreign currency are converted to U.S. dollars. Other sources of cash disbursements included in the definition of dividends are cash received in a merger, plan of reorganization, or a spin-off and where the cash is taxable as a dividend. The dividends also include the cash value received for the rights to buy units of: (i) this stock, (ii) another stock on file, or (iii) another stock at market value. However, the rights must also be taxable as dividends. Lastly, dividends include stock dividends in which the investor had the option of recieving cash dividends, but chose to recieve stocks.

The second item estimated is the multi-index model parameters for each sample firm. This is a two step procedure. First, thirteen indexes and their sixty scores are extracted from fifty-two firms and sixty monthly returns as described in Section 3.4.1. Second, ordinary least squares are used to estimate the fourteen multi-index parameters (the intercept and thirteen index coefficients) for each firm in the sample. More specifically, each firm's sixty monthly returns without dividends are regressed on the thirteen indexes.

The third item calculated is the year-end capitalization for each sample firm. In each six year period, the year-end capitalization is calculated as the year-end share price multiplied by the year-end shares outstanding at the end of the sixth year. Since the year-end capitalization of firms can change over time, the year-end capitalization reported by CRSP for the sixth year is used for each firm. This is appropriate since this is the year-end capitalization for the firm over the testing period.

The fourth item computed is the industry classification of the sample firms. This is based on Sharpe (1982) as modified by Daves, Ehrhardt, Kuhlemeyer, and Kunkel (1993). In each six year period, all firms are classified into one of ten industries based on the two-digit Standard Industrial Classification (SIC) code reported by CRSP. SIC codes were developed by the Office of Management and Budget so that firms can be classified according to their activity. Since the activity (and SIC code) of firms can change over time, the SIC code reported for the sixth year is used for each firm. This is appropriate since this is the industry classification for the firm over the testing period. The ten industries are as follows:

1. Basic Goods Industry consists of firms in the following areas (their associated three digit SIC codes are in parentheses): metals and coal (100 - 122); mining (140 - 149), paper and forest products (260 - 269); chemicals, textile-synthetic fibers (280 - 282, 287 - 289); steel (330 - 339); firms with SIC codes missing or equal to zero are also included.

2. Non High-Tech Capital Goods Industry consists of firms in the following areas (their associated three digit SIC codes are in parentheses): metal fabricating (340, 341, 344 -349); machinery (350 - 359); electrical and electronics (360, 361, 362); wholesale (508, 510 - 512); advertising and commercial services (730 - 736, 738, 739).

3. Construction Industry consists of firms in the following areas (their associated three digit SIC codes are in parentheses): operative builders, general building contractors, heavy construction, miscellaneous construction, electrical work (150 - 199); lumber and wood products, sawmills, millwork, veneer, plywood, mobile houses, prefab wood buildings (240 - 249); glass products, cement, clay, pottery, concrete, plaster, brick, heating equipment, plumbing fixtures, furnaces (322 - 329, 343); wholesale chemicals and allied products, wholesale petroleum bulk stations, retail lumber building materials (516, 517, 521).

4. Service Consumer Products Industry consists of firms that are not listed in any of the other nine industries.

5. Energy Industry consists of firms in the following areas (their associated two digit SIC codes are in parentheses): crude petroleum and natural gas, drilling oil and gas wells, oil and gas exploration services (13); petroleum refining, asphalt paving, and roofing materials (29).

6. Finance Industry consists of firms in the following areas (their associated two digit SIC codes are in parentheses): banks, savings institutions, federal credit agencies, personal credit institutions, mortgage bankers, finance services, security and commodity brokers, security dealers, investment advice, insurance, hospital and medical service plans, real estate, royalty traders, patent owners and lessors (60 - 69).

7. Transportation Industry consists of firms in the following areas (their associated three digit SIC codes are in parentheses): aircraft equipment, boating equipment, railroad equipment, space equipment, trucking equipment, miscellaneous transportation equipment (372 - 374, 376 - 379, 400 - 479).

8. Utilities Industry consists of firms in the following areas (their associated three digit SIC codes are in parentheses): radiotelephone communications, phone communications (480 - 482); electric services, natural gas transmission and distribution, electric service, water supply, sanitary services, refuse service, and hazardous waste management (490 - 499).

9. High-Tech Capital Goods Industry consists of firms in the following areas (their associated three digit SIC codes are in parentheses): computers, accessories, and software (357, 367, 369, 381, 737); lab apparatus, medical apparatus (382, 384).

10. Non-Service Consumer Products Industry consists of firms in the following areas (their associated three digit SIC codes are in parentheses): agricultural services (700); radio and television broadcasting stations, cable and other pay television services, communications services (483 - 489); eating and drinking places (580 - 589); hotels, other lodging places, auto repairs, auto rent and leasing, motion pictures, videotape production, theaters, amusement and recreation services, health services, nursing care facilities, hospitals, medical laboratories, educational services, management services, management consulting (700 - 709, 720 - 729, 750 - 999).

The next step is to formulate an *Investment Strategy* that includes a purchased long portfolio of stocks and a sold short portfolio of stocks. The portfolio returns are assumed follow the same process described earlier, such that:

$$\tilde{R}_{Lt} = \Sigma^{N}_{i=1} w_{iL}\alpha_i + \Sigma^{N}_{i=1} w_{iL}\beta_{1i}\Gamma_{1t} + \ldots + \Sigma^{N}_{i=1} w_{iL}\beta_{13,i}\Gamma_{13,t} + \Sigma^{N}_{i=1} w_{iL}\varepsilon_{it} \quad \text{(III-28)}$$

$$\tilde{R}_{St} = \Sigma^{N}_{i=1} w_{iS}\alpha_i + \Sigma^{N}_{i=1} w_{iS}\beta_{1i}\Gamma_{1t} + \ldots + \Sigma^{N}_{i=1} w_{iS}\beta_{13,i}\Gamma_{13,t} + \Sigma^{N}_{i=1} w_{iS}\varepsilon_{it} \quad \text{(III-29)}$$

where: $\tilde{R}_{tL}$ and $\tilde{R}_{tS}$ are the monthly returns without dividends on the long and short portfolios, respectively; α_i is the intercept term for firm i; β_{ki} is the coefficient term on index k for firm i; Γ_{kt} is index score on index k for period t; and ε_{it} is the specific error for firm i for period t.

The objective of the *Investment Strategy* is to maximize the dividend yield between the long and short portfolios subject to several conditions.

Condition 1: The investment in the long portfolio must equal the investment in the short portfolio so that this *Investment Strategy* has a zero net investment.

Condition 2: To ensure diversification with at least fifty stocks, two percent is the maximum amount that can be invested in any single stock. Other levels will also be explored.

Condition 3: To ensure diversification across at least four industries, thirty percent is the maximum amount that can be invested in any one of ten industries. The industry classifications are discussed in the Testing Period.

Condition 4: To minimize the variance of the *Investment Strategy*, the long and short portfolios should face similar risk as measured by estimated multi-index model parameters. This means that the weighted average of the parameters on the long portfolio must equal the weighted average of the parameters on the short portfolio. Thus, an economic shock via one of the thirteen indexes should not alter the price on the *Investment Strategy* because a shock that increases (decreases) the price on the long portfolio would be offset by a proportional decrease (increase) in price on the short portfolio.

3.4.4 Formulation of the *Investment Strategy*

The most effective method to form an *Investment Strategy* that maximizes the dividend yield between the long portfolio and the short portfolio and is subject to several constraints is with linear programming. The IBM Mathematical Programming System Extended/370 will be utilized to formulate the *Investment Strategy.*

The objective function of the *Investment Strategy* is to maximize the dividend yield between the long and short portfolios.

$$\text{Maximize OBJ: } \Sigma^{N}_{i=1} Y_i w_{iL} - \Sigma^{N}_{i=1} Y_i w_{iS} \qquad \text{(III-30)}$$

where Y_i is the dividend yield on Firm i; w_{iL} and w_{iS} are the percentages of the portfolio in Firm i for the long and short portfolios, respectively; and i equals firms 1 through N which are in the sample.

The first and second constraints ensure that the *Investment Strategy* has a net zero investment. This is accomplished by requiring the investment in the long portfolio to equal the investment in the short portfolio.

$$\text{C1:} \quad \Sigma^{N}_{i=1} w_{iL} = 1.0 \qquad \text{(III-31)}$$

$$\text{C2:} \quad \Sigma^{N}_{i=1} w_{iS} = 1.0 \qquad \text{(III-32)}$$

The third and fourth constraints ensure that both the long and short portfolios are well diversified with at least fifty stocks. Thus, two percent is the maximum amount that can be invested in any single stock.

$$\text{C3:} \quad w_{iL} \leq 0.02; \qquad \text{for } i = 1,\ldots,N \qquad \text{(III-33)}$$

$$\text{C4:} \quad w_{iS} \leq 0.02; \qquad \text{for } i = 1,\ldots,N \qquad \text{(III-34)}$$

The fifth and sixth constraints ensure that both the long and short portfolios are diversified across ten industries. Thus, thirty percent is the maximum amount that can be invested in any single Industry, *I*.

$$\text{C5:} \quad \Sigma^{N}_{i=1} w_{iL} I_j \leq 0.30 \qquad \text{for } j = 1,\ldots,10 \qquad \text{(III-35)}$$

$$\text{C6:} \quad \Sigma^{N}_{i=1} w_{iS} I_j \leq 0.30 \qquad \text{for } j = 1,\ldots,10 \qquad \text{(III-36)}$$

The seventh through twentieth constraints minimize the variance of the return on the *Investment Strategy*. To ensure that the long and short portfolios face similar risks, the estimated multi-index model parameters must be equal for each portfolio. This means that the weighted average of the parameters on the long portfolio must equal the weighted average of the parameters on the short portfolio. More specifically, the constraints are:

$$\text{C7:} \quad \Sigma^{N}_{i=1} w_{iL} \alpha_i - \Sigma^{N}_{i=1} w_{iS} \alpha_i = 0 \tag{III-37}$$

$$\text{C8:} \quad \Sigma^{N}_{i=1} w_{iL} \beta_{1i} - \Sigma^{N}_{i=1} w_{iS} \beta_{1i} = 0 \tag{III-38}$$

$$\vdots$$

$$\text{C20:} \quad \Sigma^{N}_{i=1} w_{iL} \beta_{13i} - \Sigma^{N}_{i=1} w_{iS} \beta_{13i} = 0 \tag{III-39}$$

The solution to the linear program will be the composition of stocks in the long portfolio and the short portfolio. The program will maximize the dividend yield between the two portfolios subject to the nine constraints.

However, one must look at the future returns of the *Investment Strategy* to determine if this methodology provides any ex-ante information beyond the ex-post information. Therefore, the return on the *Investment Strategy* over the next twelve months are analyzed and discussed.

3.4.5 The Testing Period

The testing period is the sixth year of each six year period. The estimation period used ex-post data to form the *Investment Strategy*. Now, ex-ante the *Investment Strategy* is implemented by selling short the low dividend yield stocks in the short portfolio and purchasing the high dividend yield stocks in the long portfolio. Thus, the *Investment Strategy* has a net zero dollar investment and the variance of the returns on the *Investment Strategy* should be very small. Next, the monthly returns on the *Investment Strategy* are calculated by using the monthly returns with dividends on the long and short portfolios. The first estimation period will be January 1970 to December 1970.

3.4.6 Rolling the Procedure

Next, the six year time period is rolled ahead one year to include January 1966 to December 1971. The estimation period is from January 1966 to December 1970. Again, predicted annual dividend yields, multi-index model parameters, and the *Investment Strategy* are estimated using ex-post data available over these five years. During the test period from January 1971 to December 1971, the returns on the *Investment Strategy* are calculated. The twentieth and final six year period includes January 1984 to December 1989.

3.5 An Illustration Using the Single-Index Market Model Pilot Study

A small pilot study is conducted over the five year period from 1983 to 1987 using the single-index market model which is a modified form of the CAPM. The *Investment Strategy* is formulated with the long portfolio of stocks with high dividend yields and the short portfolio of stocks with low dividend yields.

More specifically, an annual dividend yield was calculated for each firm. Next, the two parameters of the following market model were estimated for each firm.

$$\tilde{R}_{it} = \alpha_i + R_{mt}\,\beta_i + \varepsilon_{it} \qquad \text{(III-39)}$$

where α_i is the intercept term for firm *i*; β_i is the systematic risk faced by firm *i*; R_{it} and R_{mt} are the monthly returns, excluding dividends, of firm *i* and the equal weighted NYSE market index, respectively, for month *t*; and ε_{it} is an error term. Data over the 1983 to 1986 period were used in the above calculations.

The input for the linear program included each firm's estimated dividend yield, intercept parameter, and beta parameter. The linear program maximized the dividend yield between the long and the short portfolios subject to several constraints. Three of the constraints were: (1) that the systematic risk, β_p, be equal for both portfolios; (2) that the intercept term, α_p, be equal for both portfolios; and (3) that there be at least fifty stocks in each portfolio by restricting the maximum investment in any firm to be two percent.

The linear program found a feasible solution and the annual dividend yield difference between the long and stock portfolio was 12.4 percent. However, one must look at the future returns of the portfolios to determine if this *Investment Strategy* provides any ex-ante information. Thus, the returns of each portfolio were estimated over the next twelve months.

The results over the 1987 testing period are discussed below. The price change (which excludes dividends) for the short portfolio was 7.6 percent higher than the price change for the long portfolio. However, the dividend yield for the long portfolio was 11.5 percent higher than the dividend yield on the short portfolio. Thus, the annual return of the long portfolio was 3.9 percent larger than the short portfolio. However, the monthly return of the long portfolio was not always greater than the monthly return of the short portfolio. One possible reason for this is that the one-index market model does not explain enough of the variance of stock returns. Therefore, this dissertation proposes to use a multi-index model to explain more variance of the stock returns.

3.6 The Expected Results

Empirical research on dividend yields have had ambiguous results. The studies of Watts (1973) and Black and Scholes (1974) conclude that the dividend yield is irrelevant. Conversely, the studies of Stone and Bartter (1979) and Litzenberger and Ramaswamy (1979) conclude that stock returns are postively related to dividend yields. Based on these studies, the results of this study may support either that dividends are irrelevant or that dividends increase stock returns. Therefore, both possible results and their implications are discussed.

Dividends are Irrelevant

Based on Watts (1973), Black and Scholes (1974), and market efficiency, one would expect to find that dividend yields are irrelevant. This means that the zero *Investment Strategy* would not earn a return significantly different from zero. This result would reject the conclusions of Stone and Bartter (1979) and Litzenberger and Ramaswamy (1979).

The difference between these results and those of Stone and Bartter (1979) and Litzenberger and Ramaswamy (1979) may be attributable to the different methodologies. The two latter studies employ modified CAPMs which are not as robust in explaining the variance of stock returns as the proposed multi-index model in this study. The inability of the modified capital asset pricing model to properly account for the variance of stock returns may have precipitated their results. The application of a more robust model such as the multi-index model may be required to accurately test the relationship between dividend yields and stock returns.

The implication for market efficiency is that the market is efficient when analyzed in a multi-index framework and that the *Investment Strategy* in this study cannot be used to earn excess returns.

Dividends Increase Returns

Based on Stone and Barter (1979) and Litzenberger and Ramaswamy (1979), one would expect to find that stock returns are positively related to dividend yields. This means that the zero *Investment Strategy* would earn a return significantly greater than zero. Thus, the long high dividend stock portfolio will have a higher pre-tax return than the short low dividend stock portfolio with the same return generating process.

This result would reject the conclusions of Watts (1973) and Black and Scholes (1974). Again, the different results may be attributed to the different methodologies. Watts (1973) and Black and Scholes (1974) use modified CAPMs which are not as robust in explaining the variance of stock returns as the proposed multi-index model in this study. The inability of the modified capital asset pricing model to properly account for the variance of stock returns may have precipitated their results. Again, it is the application of a more robust model such as the multi-index model that is required to test accurately the relationship between dividend yields and stock returns.

The result also has implications for market efficiency. To preclude arbitrage, one would expect the return on the investment portfolio to be zero. Thus, this would support that there is a market anomaly related to dividend yields.

CHAPTER IV

EMPIRICAL RESULTS

The empirical results of this dissertation are discussed and reported in Chapter IV. There are three major analyses. The first major analysis determines whether the multi-index model has significantly more explanatory power of observed stock returns than the single-index market model. The second major analysis tests the *Dividends Increase Returns Theory*. The third major analysis tests the *Dividends are Irrelevant Theory*. This chapter is subdivided into five major sections.

Section *4.1 Introduction* describes the time period studied and the sample of firms. Several characteristics are reported on the sample of firms for the different time periods. Sample statistics on the sample firms are included in this section.

Section *4.2 The Explanatory Power of the Mult-index Model* tests whether the multi-index model has significantly more explanatory power of observed stock returns than the single-index market model and is divided into three subsections. Section 4.2.1 discusses the explanatory power of the single-index market model. Section 4.2.2 discusses the explanatory power of the multi-index model. Section 4.2.3 discusses several analyses employed to determine whether the explanatory power of the multi-index model is significantly greater than the single-index market model.

Section *4.3 The Estimation Period Results* discusses data analyzed in the estimation period and is divided into four sub-sections. Section 4.3.1 discusses results related to the linear program which includes the characteristics of the long and short portfolios that make up the *Investment Strategy*. Section 4.3.2 discusses the ex-post returns on the *Investment Strategy*, the Long Portfolio, and the Short Portfolio over the twenty estimation periods. Section 4.3.3 discusses the variance reduction of returns with the *Investment Strategy*. Section 4.3.4 discusses estimation period hypothesis testing.

Section *4.4 The Testing Period Results* discusses the empirical results with data from the twenty testing periods and is divided into four sub-sections. Section 4.4.1 is gives an introduction to the testing periods. Section 4.4.2 discusses the tests used to analyze the *Dividends Increase Returns Theory*. Section 4.4.3 discusses the tests used to analyze the *Dividends are Irrelevant Theory*. Section 4.4.4 compares the testing period returns of the *Investment Strategy* to business cycles.

Section *4.5 Alternative Models* discusses the testing period results of three alternative models used to replicate the study and is divided into three sections. Section 4.5.1 discusses the *alternative 1 multi-index model* and the testing period results. Section 4.5.2 discusses the *alternative 2 multi-index model* and the testing period results. Section 4.5.3 discusses the *alternative 3 single-index market model* and the testing period results.

4.1 Introduction

Several items are discussed in this section. First, the time period analyzed in this dissertation is discussed. Second, the sample of firms used in this dissertation is discussed. Third, several characteristics of the sample of firms are discussed including predicted annual dividend yields, mean ex-post annualized returns, year-end capitalizations, and industry classifications.

The time period analyzed in this dissertation is from 1965 to 1989. This time period is segmented into twenty overlapping six year periods. Each six year period is divided into a five year estimation period and a one year testing period. The first six year period is 1965 to 1970 and the twentieth is 1984 to 1989. Likewise, the first testing period is 1970 and the twentieth is 1989. A firm may be included in as few as one or in as many as twenty testing period samples. Thus, each testing period has its own sample of firms.

For a firm to be included in a testing period sample, the firm must trade on the New York Stock Exchange (NYSE) and have no missing monthly returns over the six year period. The number of firms for each testing period sample ranges from 929 (for the 1970 testing period) to 1202 (for the 1979 testing period) and are reported in Table IV-1. The mean number of firms for each testing period is around 1095 firms.

Table IV-1: Statistics on the Predicted Annual Dividend Yield of the Sample Firms for Each Testing Period.

Testing Period	Number of Firms	Predicted Annual Dividend Yield for the Testing Period			
		Mean	Minimum	Maximum	Variance
1970	929	0.031275	0.0	0.127725	0.000267
1971	963	0.032798	0.0	0.114736	0.000303
1972	997	0.031897	0.0	0.176933	0.000338
1973	1,021	0.031142	0.0	0.204933	0.000381
1974	1,071	0.032222	0.0	0.090785	0.000402
1975	1,113	0.036578	0.0	0.111351	0.000511
1976	1,115	0.039485	0.0	0.120811	0.000602
1977	1,163	0.042023	0.0	0.126946	0.000685
1978	1,185	0.045059	0.0	0.132016	0.000716
1979	1,202	0.047786	0.0	0.138571	0.000762
1980	1,184	0.047530	0.0	0.117899	0.000733
1981	1,162	0.047847	0.0	0.114147	0.000770
1982	1,167	0.049846	0.0	0.122460	0.000893
1983	1,157	0.051332	0.0	0.135569	0.001049
1984	1,140	0.049447	0.0	0.139768	0.001162
1985	1,114	0.047333	0.0	0.146538	0.001261
1986	1,091	0.044823	0.0	0.148780	0.001230
1987	1,082	0.041708	0.0	0.428585	0.001291
1988	1,035	0.037556	0.0	0.163686	0.001029
1989	1,018	0.037375	0.0	0.294910	0.001154
Mean	1,095.5	0.0412	0.0	0.1578	0.0007

The predicted annual dividend yield of each firm for the testing period is the annual geometric mean of the monthly dividend yields over the estimation period. The dividend yield is based on all cash disbursements that are taxed as dividends. This includes all monthly, quarterly, semi-annual, year-end, final, extra, special, interim, and non-recurring cash dividends. Additionally, all cash dividends received in foreign currency are converted to U.S. dollars. Other sources of cash disbursements included in the definition of dividends are cash received in a merger, plan of reorganization, or a spin-off and where the cash is taxable as a dividend. The dividends also include the cash value received for the rights to buy units of: (i) this stock, (ii) another stock on file, or (iii) another stock at market value. However, the rights must also be taxable as dividends. Lastly, dividends include stock dividends in which the investor had the option of recieving cash dividends, but chose to recieve stocks. The statistics on the predicted annual dividend yields are discussed below and reported in Table IV-1. The mean predicted annual dividend yield for the twenty testing periods ranges from 0.0311 (for the 1973 testing period) to 0.0513 (for the 1983 testing period). The overall mean yield of the twenty mean predicted annual dividend yields is 0.0412. The variance of the predicted annual dividend yields for each of the twenty testing periods ranges from 0.0003 (for the 1970 testing period) to 0.0013 (for the 1987 testing period). The minimum predicted annual dividend yield for each testing period is 0.0000. The maximum predicted annual dividend yield for each testing period ranges from 0.0908 (for the 1974 testing period) to 0.4286 (for the 1987 testing period).

There are many firms in each testing period that have a predicted annual dividend yield of zero. The statistics of the firms that have a predicted annual dividend yield of zero are discussed below and reported in Table IV-2. The number of firms that have a predicted annual dividend yield of zero ranges from 66 (for the 1979 testing period) to 121 (for the 1988 testing period). Alternatively, the percentage of firms that have a predicted annual dividend yield of zero ranges from 5.5 percent (for the 1979 testing period) to 11.7 percent (for the 1988 testing period). The mean number and mean percentage of firms with a predicted annual dividend yield of zero for the twenty testing periods is 85.75 firms and 7.8 percent, respectively.

Table IV-2: The Number and Percent of Firms with a Predicted Annual Dividend Yield of Zero for Each Testing Period.

Testing Period	Number of Firms in the Testing Period	Number of Firms with a Predicted Annual Dividend Yield of Zero	Percent of Firms with a Predicted Annual Dividend Yield of Zero
1970	929	67	7.2
1971	963	69	7.2
1972	997	79	7.9
1973	1,021	87	8.5
1974	1,071	82	7.7
1975	1,113	89	8.0
1976	1,115	93	8.3
1977	1,163	93	8.0
1978	1,185	74	6.2
1979	1,202	66	5.5
1980	1,184	72	6.1
1981	1,162	71	6.1
1982	1,167	71	6.1
1983	1,157	73	6.3
1984	1,140	80	7.0
1985	1,114	91	8.2
1986	1,091	102	9.4
1987	1,082	116	10.7
1988	1,035	121	11.7
1989	1,018	119	11.7
Mean	1,095.5	85.8	7.8

The mean ex-post annualized return for each firm in each sample group is the annual geometric mean of the monthly returns over the estimation period. The statistics on the mean ex-post annualized returns are discussed below and reported in Table IV-3. The mean ex-post annualized return for each of the twenty estimation periods ranges from -0.0869 (for the 1970 to 1974 estimation period) to 0.2478 (for the 1975 to 1979 estimation period). The overall mean return of the twenty mean ex-post annualized returns is 0.0912. The variance of the mean ex-post annualized return for each of the twenty estimation periods ranges from 0.0135 (for the 1966 to 1970 estimation period) to 0.0347 (for the 1982 to 1986 estimation period). The minimum ex-post annual returns for each estimation period ranges from -0.1429 (for the 1965 to 1969 estimation period) to -0.6957 (for the 1984 to 1989 estimation period).
The maximum ex-post annualized return for each estimation period ranges from 0.3960 (for the 1969 to 1973 estimation period) to 1.1383 (for the 1976 to 1980 estimation period).

The year-end capitalization of each firm for each sample period is calculated by multiplying the year-end share price by the year-end shares outstanding as reported by CRSP. Since the year-end capitalization of firms can change over time, the year-end capitalization reported for the sixth year of sample period is used. This is appropriate since this is the year-end capitalization of the firm for the testing period. The statistics on the year-end capitalizations are discussed below and reported in Table IV-4. The mean year-end capitalization for each of the twenty testing periods ranges from $409 million (for the 1974 testing period) to $2.295 billion (for the 1989 testing period). The overall mean capitalization of the twenty mean year-end capitalizations is around one billion dollars. The minimum year-end capitalization for each of the twenty testing periods ranges from is $161 thousand (for the 1989 testing period) to $5.804 million (for the 1982 testing period). The maximum year-end capitalization for each of the twenty testing periods ranges from $24.979 billion (for the 1974 testing period) to $95.607 billion (for the 1985 testing period). Lastly, a firm's capitalization is not calculated if either the year-end share price or the year-end shares outstanding are not available. For the average sample period, there are less than nine firms (or 0.71 percent of the total firms) that do not have the year-end capitalization reported by CRSP.

Table IV-3: Statistics on the Ex-post Mean Annualized Return of the Sample Firms for Each Estimation Period.

Estimation Period	Number of Firms	Ex-post Annualized Return of Sample Firms over the Estimation Period			
		Mean	Minimum	Maximum	Variance
1965 - 1969	929	0.093620	-0.142919	0.756511	0.016419
1966 - 1970	963	0.037087	-0.353116	0.583020	0.013475
1967 - 1971	997	0.087441	-0.365663	0.749931	0.019247
1968 - 1972	1,021	0.026694	-0.442187	0.603725	0.018254
1969 - 1973	1,071	-0.077237	-0.533647	0.396017	0.020204
1970 - 1974	1,113	-0.086871	-0.565739	0.497896	0.018720
1971 - 1975	1,115	-0.002122	-0.393625	0.452441	0.014016
1972 - 1976	1,163	0.028903	-0.387950	0.527394	0.014521
1973 - 1977	1,185	0.019645	-0.382921	0.401027	0.013640
1974 - 1978	1,202	0.112886	-0.375647	0.840462	0.018713
1975 - 1979	1,184	0.247839	-0.158820	0.923947	0.026517
1976 - 1980	1,162	0.199818	-0.279241	1.138265	0.031189
1977 - 1981	1,167	0.125474	-0.389372	0.744625	0.019143
1978 - 1982	1,157	0.163279	-0.297291	0.815947	0.018782
1979 - 1983	1,140	0.202690	-0.274525	0.785229	0.018262
1980 - 1984	1,114	0.142865	-0.450553	0.709356	0.021104
1981 - 1985	1,091	0.150947	-0.467376	0.688185	0.030807
1982 - 1986	1,082	0.167529	-0.577970	0.785879	0.034689
1983 - 1987	1,035	0.101699	-0.642730	0.530302	0.025802
1984 - 1988	1,018	0.086376	-0.695722	0.538277	0.023896
Mean	1,095.5	0.0913	-0.4228	0.6690	0.0211

Table IV-4: Statistics on the Year-End Capitalization of the Sample Firms for Each Testing Period (in millions).

Testing Period	Number of Firms	Year-End Capitalization Calculated in the Testing Period			
		Mean	Minimum	Maximum	Variance
1970	922	577.037	4.245	36,218.416	3,987,571.2
1971	955	640.273	3.850	38,696.160	4,425,931.6
1972	988	733.736	1.750	46,700.736	6,231,710.8
1973	1,012	589.099	2.310	35,831.552	4,157,701.9
1974	1,065	409.096	1.486	24,979.152	2,032,722.0
1975	1,108	547.735	1.756	33,289.232	3,394,447.8
1976	1,109	684.661	3.354	41,999.104	5,143,837.0
1977	1,156	613.900	5.083	40,333.312	4,284,469.2
1978	1,178	622.524	4.169	43,524.288	4,522,116.4
1979	1,195	714.249	3.967	37,568.928	4,309,784.3
1980	1,178	920.430	4.232	39,625.904	6,832,700.2
1981	1,156	858.458	2.645	47,887.600	5,794,828.3
1982	1,159	982.099	5.804	57,981.568	8,577,859.5
1983	1,147	1,188.938	5.434	74,508.488	12,418,835.0
1984	1,130	1,138.812	3.404	75,436.960	10,126,677.0
1985	1,103	1,409.616	3.025	95,607.152	15,388,940.0
1986	1,078	1,636.286	1.620	72,710.752	15,388,546.0
1987	1,069	1,632.411	0.775	69,815.360	16,458,398.0
1988	1,021	1,857.729	0.529	72,165.472	19,431,259.0
1989	1,004	2,294.853	0.161	62,581.600	27,926,067.0
Mean	1,086.7	1,002.597	2.980	52,373.087	9,041,720.11

All the firms in each of the twenty samples are classified into one of ten industries. The industry classifications are based on Sharpe (1982) as modified by Daves, Ehrhardt, Kuhlemeyer, and Kunkel (1993) and include: (1) *basic goods*; (2) *non high-tech capital goods*; (3) *construction*; (4) *consumer products*; (5) *energy*; (6) *finance*; (7) *transportation*; (8) *utilities*; (9) *high-tech capital goods*; and (10) *non-service consumer products*. The classification of each firm is based on the two- and three- digit Standard Industrial Classification (SIC) codes as reported by CRSP. See section *3.4.3 The Estimation Period* for the SIC codes and corresponding types of firms in each industry. Since the SIC code of firms can change over time, the SIC code reported for the sixth year of each sample period is used. This is appropriate since this is the industry classification of the firm for the testing period.

The mean annual percentage for each industry over the twenty testings periods is discussed below and reported in Table IV-5. The individual mean annual percentage industry breakdown for each of the twenty testing periods is discussed below and reported in Table IV-6. As one would expect, the number of firms in an industry is not equal across the ten industries. The next three paragraphs discuss: (i) the five industries with the smallest number of firms; (ii) the four industries with an average number of firms; and (iii) the industry with the largest number of firms.

The five industries with the smallest number of firms include: *construction*; *energy*; *transportation*; *high-tech capital goods*; and *non-service consumer products*. Altogether, these five industries account for less than twenty-four percent of the total firms in the sample. More specifically, the mean percentage of firms in these five industries ranges from 3.5 (for *non-service consumer products*) to 5.7 (for *transportation*). The standard deviation of the twenty percentages ranges from 0.3 percent (for *energy*) to 0.7 percent (for *transportation*). Thus, the number of firms in these industries has been very consistent over the twenty year time period.

The four industries with an average number of firms include: *basic goods*; *non high-tech capital goods*; *finance*; and *utilities*. Altogether, these four industries account for over forty-five percent of the total firms in the sample. More specifically, the mean percentage of firms in these four industries ranges from 10.0 (for *non high-tech capital goods*) to 12.6 (for *utilities*).

Table IV-5: Industry Classifications and the Overall Mean Annual Percentage for Each Industry over the Twenty Testing Periods.

Industry Classification*	Overall Mean Annual Percentage	Standard Deviation
1. Basic Goods	11.0	1.3
2. Non High-Tech Capital Goods	10.0	0.6
3. Construction	4.2	0.4
4. Service Consumer Products	31.5	2.7
5. Energy	4.2	0.3
6. Finance	11.7	3.9
7. Transportation	5.7	0.7
8. Utilities	12.6	0.5
9. High-Tech Capital Goods	5.6	0.6
10. Non-Service Consumer Products	3.5	0.6

* See section *3.4.3 The Estimation Period* for the SIC codes and corresponding types of firms in each industry.

Table IV-6: Annual Percentage of Firms in Each Industry for Each Testing Period by Industry Classification.

Industry Classification	Testing Period									
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
1. Basic Goods	13.1	13.0	12.9	13.0	12.5	12.2	11.8	11.3	10.6	10.5
2. Non Hi-Tech Capital Goods	9.9	10.2	10.0	10.4	11.0	10.8	10.5	10.4	10.7	10.2
3. Construction	4.7	4.8	4.6	4.7	4.7	4.4	4.1	4.3	4.3	4.1
4. Consumer Products	34.3	34.4	35.0	34.8	34.3	34.1	33.5	33.0	32.8	31.8
5. Energy	4.3	4.3	4.2	4.0	3.8	4.2	4.3	4.0	3.9	3.8
6. Finance	6.6	6.3	6.1	6.3	7.3	7.8	8.3	10.1	11.4	13.4
7. Transportation	7.0	6.6	6.5	6.5	6.0	6.1	6.1	5.9	5.8	5.9
8. Utilities	12.2	12.4	12.2	12.1	12.1	12.0	12.4	12.0	12.0	12.1
9. Hi-Tech Capital Goods	5.3	5.3	5.7	5.7	5.5	5.3	5.6	5.5	5.1	4.7
10. Non-Service Consumer Products	2.6	2.7	2.8	2.5	2.8	3.1	3.4	3.5	3.4	3.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table IV-6: (continued).

Industry Classification	Testing Period									
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1. Basic Goods	10.3	10.2	10.5	10.5	10.3	10.4	10.0	9.7	8.9	9.0
2. Non Hi-Tech Capital Goods	10.3	9.8	9.5	9.6	9.9	10.1	9.5	8.9	8.9	9.2
3. Construction	4.1	4.5	4.3	4.1	4.2	4.1	3.8	3.7	3.3	3.2
4. Consumer Products	31.1	30.6	31.3	30.8	29.5	28.9	28.5	28.2	27.0	26.2
5. Energy	4.0	4.1	4.2	4.1	4.0	3.9	4.0	4.3	4.7	4.9
6. Finance	13.9	13.9	13.5	14.1	13.9	14.1	15.9	16.8	17.4	17.8
7. Transportation	5.5	5.4	4.9	5.0	5.5	5.5	5.0	4.8	4.8	4.5
8. Utilities	12.3	12.6	12.9	12.4	12.6	12.7	12.7	13.1	13.9	13.8
9. Hi-Tech Capital Goods	4.7	5.1	5.1	5.6	6.1	6.5	6.6	6.5	6.5	6.5
10. Non-Service Consumer Products	3.8	3.8	3.8	3.8	4.0	3.8	4.0	4.0	4.6	4.9
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

The standard deviation of the twenty percentages ranges from 0.5 percent (for *utilities*) to 3.9 percent (for *finance*). Thus, the number of firms in some of these industries has been very stable while in the other industries there has been some change. More specifically, the percentage of utilities and non high-tech capital goods firms has been very consistent over the twenty year time period. However, the percentage of basic goods firms has declined from 13.1 (for the 1970 testing period) to 9.0 (for the 1989 testing period). Conversely, the percentage of finance firms has increased from 6.6 (for the 1970 testing period) to 17.4 (for the 1989 testing period).

The industry with the largest number of firms is *service consumer products*. The mean percentage of firms over the twenty testing periods is 31.5 percent which is greater than the five smallest industries combined. The standard deviation of the twenty percentages is 2.7 which means there has been some change over the twenty year period. More specifically, the percentage of consumer products firms has declined from 34.3 (for the 1970 testing period) to 27.0 (for the 1989 testing period).

4.2 The Explanatory Power of The Multi-index Model

This section addresses whether the multi-index model has significantly more explanatory power of observed stock returns than the single-index market model. Roll and Ross (1980) conclude that a multi-index model explains much more variability of stock returns than the single-index market model. However, earlier research on dividend yields, such as Black and Scholes (1974) and Litzenberger and Ramaswamy (1979), has been limited to a single-index market model that has been modified to include a dividend variable. Thus, the multi-index model used in this dissertation should be a more powerful test with which to analyze the relationship between stock returns and dividend yields.

Section 4.2 is divided into three subsections to test whether the multi-index model has significantly more power of observed stock returns than the single-index market model. In section 4.2.1 the explanatory power of the single-index market model is estimated for each firm in each sample period. In Section 4.2.2 the explanatory power of the multi-index model is estimated for each firm in each sample period. In Section 4.2.3 several analyses are employed to determine whether the explanatory power of the multi-index model for stock returns is significantly greater than the single-index market model.

4.2.1 The Single-Index Market Model

The single-index market model is estimated over the five year estimation period for each firm in each sample. The following model is estimated for each estimation period:

$$\tilde{R}_{it} = \alpha_i + R_{mt}\,\beta_i + \varepsilon_{it} \qquad \text{(IV-1)}$$

where α_i is the intercept term for firm *i*; β_i is the systematic risk faced by firm *i*; R_{it} and R_{mt} are the returns based on the price changes of firm *i* and the equal weighted NYSE market index, respectively, for month *t*; and ε_{it} is a sequence of independent, normally distributed random variables with mean zero and constant variance.

The explanatory power of the observed stock returns with the single-index market model is denoted by the R^2 value of the regression. The statistics of the R^2s are discussed below and reported in Table IV-7. The mean R^2 of the single-index market model calculated for each of the twenty estimation periods ranges from 24.861 (for the 1980 to 1985 estimation period) to 39.086 (for the 1973 to 1977 estimation period). The variance of the R^2 calculated for each of the twenty estimation periods ranges from 135.357 (for the 1965 to 1969 estimation period) to 268.416 (for the 1983 to 1988 estimation period). The overall mean R^2 of the twenty mean R^2s is 32.954 and the mean variance of the twenty mean variances of the R^2 is 185.684.

4.2.2 The Multi-Index Model

The multi-index model is estimated over the five year estimation period for each firm in each sample. The following model is estimated for each estimation period:

$$\tilde{R}_{it} = \alpha_i + \beta_{1i}\,\Gamma_{1t} + \beta_{2i}\,\Gamma_{2t} + \dots + \beta_{ki}\,\Gamma_{kt} + \varepsilon_{it} \qquad \text{(IV-2)}$$

where: $\tilde{R}_{it}$ is return based on price changes of firm *i* for month *t*; α_i is the intercept term for firm *i*; β_{ki} is the coefficient term on index *k* for firm *i*, Γ_{kt} is index score on index *k* for period *t*; and ε_{it} is a sequence of independent, normally distributed random variables with mean zero and constant variance.

Table IV-7: Statistics on the Mean R^2s for the Single-Index Market Model and the Multi-Index Model for Each Estimation Period.

Estimation Period	Firms	Single-Index Model		Multi-Index Model		T-Test Statistics[a]	Prob > |T|
		Mean R^2	Variance	Mean R^2	Variance		
1965 - 1969	929	29.582	135.357	50.144	147.040	55.341	0.001
1966 - 1970	963	33.162	135.866	52.983	130.213	56.669	0.001
1967 - 1971	997	34.384	138.843	52.639	126.804	59.018	0.001
1968 - 1972	1021	32.912	148.945	51.419	148.248	64.443	0.001
1969 - 1973	1071	36.633	181.091	55.732	143.695	56.721	0.001
1970 - 1974	1113	35.681	160.995	56.217	131.524	65.934	0.001
1971 - 1975	1115	36.925	215.596	58.555	141.753	63.866	0.001
1972 - 1976	1163	37.938	229.659	60.417	155.673	63.188	0.001
1973 - 1977	1185	39.086	235.023	61.169	141.008	66.664	0.001
1974 - 1978	1202	38.189	211.165	60.763	143.360	67.713	0.001
1975 - 1979	1184	37.872	216.039	59.195	151.348	65.044	0.001
1976 - 1980	1162	34.314	185.659	55.838	135.659	56.022	0.001
1977 - 1981	1167	31.076	155.598	55.140	144.170	60.758	0.001
1978 - 1982	1157	32.306	164.453	54.751	150.048	53.071	0.001
1978 - 1983	1140	27.216	145.541	50.758	144.062	61.510	0.001
1979 - 1984	1114	25.912	159.046	49.776	169.885	57.031	0.001
1980 - 1985	1091	24.861	170.890	46.935	166.501	62.965	0.001
1981 - 1986	1082	25.018	202.327	48.082	187.004	59.345	0.001
1982 - 1987	1035	32.383	253.170	52.112	190.909	49.434	0.001
1983 - 1988	1018	33.634	268.416	55.617	195.810	50.652	0.001
Mean	1,095	32.954	185.684	54.412	152.236	----	----

[a] Null hypothesis for the one-tailed paired comparison t-test is: H_o: $\mu_{R2\ \text{multi-index model}} - \mu_{R2\ \text{single-index model}} \leq 0$.

The critical value is 3.090 at the 0.001 significance level.

All the t-test statistics are significant at the 0.001 level.

The multi-index model has thirteen indexes and each index has sixty monthly index scores. Principal components analysis is used to extract the indexes and index scores from the monthly stock returns of fifty-two firms. The fifty-two firms are selected in the following manner. All the firms in the sample, denoted *N*, are sorted from the lowest return to the highest return. Firms with the same return are then sorted by their dividend yield. Next, the integer value from (the firms in the sample, *N*) divided by (fifty-three) is calculated, denoted *integer(N/53)*. The first firm selected is firm number: [1 x *integer(N/53)*]. The second firms is firm number: [2 x *integer(N/53)*]. This continues until the last firm selected is firm number: [52 x *integer(N/53)*]. Alternatively, approximately every nineteenth firm from the sorted sample is selected for the fifty-two firm sample.

Principal components analysis extracts fifty-five indexes and sixty index scores on each index. The indexes are selected in a deterministic order with the first factor having the most explanatory power of the observed stock returns of the fifty-two firms and the last factor having the least explanatory power. Additionally, if the stock returns of the fifty-two firms are regressed against these indexes, one-hundred percent of the variance is explained. See section *3.4.1 Estimation of Indexes and Index Scores* for more detail on the principal components analysis.

The explanatory power of the observed stock returns with the multi-index model is denoted by the R^2 value of the regression. By construction, the explanatory power of the multi-index model is much greater for the fifty-two firms used with principal components analysis than that of the sample firms. When the multi-index model is estimated with the fifty-two firms used with principal components analysis, the mean R^2 ranges from 71.392 (for the 1982 to 1986 estimation period) to 80.644 (for the 1973 to 1977 estimation period) and are reported in Table IV-8. Additionally, the overall mean R^2 of these twenty mean R^2s is 76.107.

The multi-index model is estimated with the sample of firms for each of the twenty estimation periods. The statistics of the R^2s are discussed below and reported in Table IV-7. The mean R^2 ranges from 46.935 (for the 1980 to 1985 estimation period) to 61.169 (for the 1973 to 1977 estimation period). The variance of the R^2s ranges from 126.804 (for the 1967 to 1971 estimation period) to 195.810 (for the 1983 to 1988 estimation period).

Table IV-8: The Explanatory Power of the Multi-Index Model with the Fifty-Two Firms from which the Indexes and Index Scores were Extracted via Principal Components Analysis.

Testing Period	Explanatory Power (Mean R^2) of the Multi-index Model for the Fifty-Two Firms	Explanatory Power (Adjusted Mean R^2) of the Multi-index Model for the Fifty-Two Firms
1970	73.265	65.710
1971	74.211	66.922
1972	74.257	66.982
1973	75.063	68.016
1974	77.387	70.996
1975	77.353	70.953
1976	77.992	71.773
1977	80.366	74.818
1978	80.644	75.173
1979	79.928	74.255
1980	78.556	72.496
1981	74.828	67.714
1982	76.487	69.842
1983	77.899	71.653
1984	73.679	66.241
1985	76.050	69.281
1986	71.628	63.610
1987	71.392	63.307
1988	75.512	68.591
1989	75.649	68.767
Mean	76.107	69.355

Additionally, the overall mean R^2 of the twenty mean R^2s is 54.412 and the overall mean variance of the twenty mean variances of the R^2 is 152.236. Although the R^2s of the fifty-two firms are much greater than the R^2s of the sample of firms, the important issue is whether the multi-index model has significantly more explanatory power for all the firms in the sample than the single-index market model.

4.2.3 Explanatory Power: Single-Index and Multi-Index Models

One of the contributions of this dissertation is to use a more powerful methodology than the earlier studies such as Black and Scholes (1974) and Litzenberger and Ramaswamy (1979). Thus, three analyses are employed to determine whether the explanatory power of the multi-index model is significantly more powerful for all the firms in the sample than the explanatory power of the single-index market model. The first analysis is a set of paired comparison t-tests used to test the differences of the R^2s between the single-index market model and the multi-index model for the firms in each estimation period. The second analysis is conducted on the overall mean R^2 of the twenty estimation periods for both the single-index market model and the multi-index model. The third analysis is conducted on the variances of the R^2s of both the single-index market model and the multi-index model. These analyses are discussed in the following three paragraphs.

The first analysis is set of paired comparison t-tests[7] used to test the difference of the R^2s between the single-index market model and the multi-index model for the firms in each estimation period. The null and alternative hypotheses are:

H_0: the explanatory power of the multi-index model is not significantly greater than that of the single-index market model

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[7] The formula for the paired comparison t-tests used in this dissertation is:

$$t = \frac{\bar{X}}{[\; S \,/\, (N)^{0.5} \;]} \qquad \text{(IV-3)}$$

where $\bar{X}$ is the mean R^2 difference between paired observations of the single-index market model and the multi-index model; S is the standard deviation of the R^2 differences; N is the sample size; and the degrees of freedom is equal to $(N - 1)$.

$$H_o: \mu_{R2\ multi} - \mu_{R2\ single} \leq 0$$

H_a: the explanatory power of the multi-index model is significantly greater than that of the single-index market model

$$H_a: \mu_{R2\ multi} - \mu_{R2\ single} > 0$$

The one-tailed paired comparison t-test statistics range from 49.434 (for the 1982 to 1987 estimation period) to 67.713 (for the 1974 to 1978 estimation period) and are reported in Table IV-7. Thus, all twenty t-test statistics exceed the 0.001 critical value of 3.090 and reject the null hypothesis that the explanatory power of the multi-index model is not significantly greater than that of the single-index market model at the 0.001 level. This analysis provides strong support that the explanatory power of the multi-index model is significantly greater than that of the single-index market model.[8]

The second analysis is conducted on the overall mean R^2 of the twenty mean R^2s for both the single-index market model and the multi-index model. The overall mean R^2 of the twenty mean R^2s for the multi-index model over the twenty estimation periods is 54.412 versus 32.954 for the single-index market model. This analysis also provides support that the R^2 or explanatory power of the multi-index model is greater than the R^2 of the single-index market model.

The third analysis is conducted on the variances of the R^2s of both the single-index market model and the multi-index model for the twenty estimation periods. As reported in Table IV-7, the variance of the R^2s for the multi-index model is *always* smaller than the variance of the R^2s for the single-index model for every estimation period. Additionally, the mean variance of the twenty variances of the R^2s for the multi-index model over the twenty estimation periods is 152.236 versus 185.684 for the single-index market model. Thus, this analysis supports that the R^2s of sample firms estimated via the multi-index model have less volatility than those estimated with the single-index market model.

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8 The paired comparison t-tests are replicated with the differences of the adjusted R^2s of the multi-index model and the R^2s of the single-index market model for the firms in each estimation period. All twenty t-test statistics reject the null hypothesis that the explanatory power of the multi-index model is not significantly greater than that of the single-index market model at the 0.001 level.

These three analyses provide strong evidence that the multi-index model employed in this study is more powerful and robust than the single-index market model. Not only does the multi-index model have significantly more explanatory power of observed stock returns than the single-index market model, but the R^2s of the firms estimated with the multi-index model also have much less volatility than those of the single-index market model. Thus, employing the multi-index model, which controls for different and more sources of risk, to test the relationship of stock returns and dividend yields is both an innovative and more powerful methodology than those employed by Black and Scholes (1974) and Litzenberger and Ramaswamy (1979). These earlier studies modify the Capital Asset Pricing Model to include a dividend variable. Furthermore, the *Investment Strategy* employed in this dissertation has strong implications for market efficiency. In the absence of arbitrage, the *Investment Strategy* should not earn an abnormal return significantly different from zero.

4.3 The Estimation Period Results

This section discusses the empirical results with data from the estimation period. Several items are completed during the estimation period. First, the predicted annual dividend yield for the testing period is calculated. Second, the fourteen parameters of the multi-index model are estimated. Third, each firm is classified into one of ten different industries. Fourth, the items from the above three steps are used as input for the linear program that form an *Investment Strategy* which consists of a long portfolio of high dividend stocks and a short portfolio of low dividend stocks. See section *3.4.3. The Estimation Period* for a more detailed description of these calculations. Fifth, the ex-post monthly returns on the *Investment Strategy* are calculated over the five year estimation period. Sixth, the variance reduction of returns with the *Investment Strategy* is discussed.

Section 4.3 Estimation Period Results is subdivided into four sections. Section 4.3.1 discusses results related to the linear program which includes the characteristics of the long and short portfolios that make up the *Investment Strategy*. Section 4.3.2 discusses the ex-post returns of the *Investment Strategy*, the long portfolio, and short portfolio over the estimation periods.

Section 4.3.3 discusses the variance reduction of returns with the *Investment Strategy*. Section 4.3.4 discusses estimation period hypothesis testing.

4.3.1 The Linear Program

A linear program is used to form an *Investment Strategy* that includes a purchased long portfolio of stocks with high dividend yields and a sold short portfolio of stocks with low dividend yields for each sample period. The objective function of the linear program is to maximize the predicted annual dividend yield between the long and short portfolios subject to several conditions. Condition one is that the investment in the long portfolio must equal the investment in the short portfolio so there is a zero net investment. Condition two requires that both the long and short portfolios be diversified with at least fifty stocks to eliminate unique risk, i.e., two percent is the maximum amount that can be invested in any single stock. Condition three requires that both the long and short portfolios be diversified across several industries, i.e., thirty percent is the maximum amount that can be invested in any single industry. Condition four minimizes the variance of the *Investment Strategy* by requiring the weighted average of the estimated parameters of the multi-index model on the long portfolios to equal those of the short portfolios.

The linear program delivers a solution for each sample period. The solution includes several components. The first component includes the firms that make up the *Investment Strategy*. The second component is the weight of each firm in the *Investment Strategy*. The third component is the predicted annual dividend yield of the *Investment Strategy* for the testing period. This can also be viewed as the dividend yield of the long portfolio less the dividend yield of the short portfolio. The rest of this section discusses the linear program solutions and the characteristics of the firms in the *Investment Strategies*, the long portfolios, and the short portfolios.

Investment Strategy

The number of firms that the linear program includes in the *Investment Strategy* ranges from 107 firms to 111 firms and is reported in Table IV-9. The mean number of firms in the *Investment Strategy* over the twenty estimation periods is 108.9 firms.

Table IV-9: Dividend Yields Determined by the Linear Program for Each *Investment Strategy*, Long Portfolio, and Short Portfolio for Each Estimation Period.

Estimation Period	Number of Firms included in the *Investment Strategy*	Dividend Yield on the *Investment Strategy*	Dividend Yield on the Long Portfolio	Dividend Yield on the Short Portfolio
1965 - 1969	108	0.04855	0.05300	0.00445
1966 - 1970	108	0.04976	0.05418	0.00442
1967 - 1971	108	0.05231	0.05625	0.00394
1968 - 1972	108	0.05823	0.06131	0.00308
1969 - 1973	109	0.05781	0.06162	0.00381
1970 - 1974	109	0.06637	0.07215	0.00488
1971 - 1975	108	0.07169	0.04634	0.00465
1972 - 1976	108	0.07834	0.08432	0.00598
1973 - 1977	109	0.08219	0.08830	0.00611
1974 - 1978	110	0.07856	0.08718	0.00862
1975 - 1979	110	0.07429	0.08276	0.00847
1976 - 1980	110	0.07197	0.08032	0.00835
1977 - 1981	110	0.07753	0.08498	0.00745
1978 - 1982	108	0.08255	0.09109	0.00854
1979 - 1983	107	0.08802	0.09864	0.01062
1980 - 1984	111	0.09562	0.10238	0.00676
1981 -1985	111	0.09726	0.10452	0.00726
1982 - 1986	108	0.11139	0.11585	0.00446
1983 - 1987	110	0.09922	0.10262	0.00340
1984 - 1988	108	0.11030	0.11461	0.00431
Mean	108.9	0.0776	0.0821	0.0059

The maximum weight of any firm in the *Investment Strategy* is two percent. The predicted annual dividend yield of the *Investment Strategy* from the linear program ranges from 0.0485 (for the 1965 to 1969 estimation period) to 0.1114 (for the 1982 to 1986 estimation period) and is reported in Table IV-9. The mean predicted annual dividend yield of the *Investment Strategy* over the twenty estimation periods is 0.0776.

The Long and Short Portfolios

The following items are discussed in this section: (i) the predicted annual dividend yields of the long and short portfolios from the linear program; (ii) the number of firms that the linear program includes in the long and short portfolios; (iii) the variances of the monthly stock returns explained by the multi-index model for the long and short portfolios; (iv) the year-end capitalizations of the long and short portfolios; and (v) the industry classifications of the long and short portfolios.

The predicted annual dividend yield of the long portfolios from the linear program ranges from 0.0530 (for the 1965 to 1969 estimation period) to 0.1158 (for the 1982 to 1986 estimation period) and is reported in Table IV-9. The mean predicted annual dividend yield of the long portfolio over the twenty estimation periods is 0.0821. The predicted annual dividend yield of the short portfolios from the linear program ranges from 0.0031 (for the 1968 to 1972 estimation period) to 0.0106 (for the 1979 to 1983 estimation period) and is reported in Table IV-9. The mean predicted annual dividend yield of the short portfolio over the twenty estimation periods is 0.0059.

The number of firms that the linear program includes in the long portfolios ranges from 51 firms to 57 firms and is reported in Table IV-10. The number of firms in the short portfolio ranges from 53 firms to 57 firms and is reported in Table IV-10. The mean number of firms in the long and short portfolios are 53.6 and 55.3, respectively. The maximum weight of any firm in the long portfolio or short portfolios is two percent.

The R^2s of the multi-index model for firms in the long and short portfolios are estimated for all twenty estimation periods. The mean R^2 for the long portfolio firms ranges from 43.971 (for the 1982 to 1986 estimation period) to 64.786 (for the 1978 to 1982 estimation period) and

Table IV-10: Statistics on the Explanatory Power (R^2) of the Firms in the Long and Short Portfolios for Each Estimation Period.

Estimation Period	Firms in Long Portfolio	Mean R2 of Firms in the Long Portfolio	Firms in Short Portfolio	Mean R2 of Firms in the Short Portfolio	Firms in Long and Short Portfolios
1965 - 1969	55	52.036	53	43.831	108
1966 - 1970	54	55.023	54	46.599	108
1967 - 1971	52	52.118	56	48.448	108
1968 - 1972	53	54.146	55	45.319	108
1969 - 1973	53	56.086	56	49.764	109
1970 - 1974	56	55.229	53	51.549	109
1971 - 1975	53	62.099	55	52.498	108
1972 - 1976	51	62.976	57	53.642	108
1973 - 1977	52	64.462	57	57.299	109
1974 - 1978	54	64.295	56	53.154	110
1975 - 1979	53	62.888	57	53.713	110
1976 - 1980	57	59.052	53	48.257	110
1977 - 1981	54	60.419	56	49.617	110
1978 - 1982	54	64.786	54	45.924	108
1979 - 1983	52	56.618	55	43.124	107
1980 - 1984	54	55.734	57	42.347	111
1981 - 1985	54	48.589	57	34.961	111
1982 - 1986	53	43.971	55	32.699	108
1983 - 1987	55	47.489	55	36.495	110
1984 - 1988	53	47.898	55	39.877	108
Mean	53.60	56.296	55.30	46.456	108.90

is reported in Table IV-10. The mean R^2 of the short portfolio firms ranges from 35.970 (for the 1982 to 1986 estimation period) to 57.299 (for the 1973 to 1977 period) and is reported in Table IV-10. The overall mean R^2 of the twenty mean R^2s of the long and short portfolios are 56.296 and 46.456, respectively. It is important to note that the mean R^2 of the long portfolio firms is greater than that of the short portfolio firms in every estimation period. This means that the multi-index model has more explanatory power for the observed stock returns of the long portfolio firms than for those of the short portfolio firms.

The year-end capitalizations for the firms in the long and short portfolios is calculated for all twenty testing periods. The year-end capitalizations of the firms in the long portfolio range from \$118 million (for the 1970 testing period) to \$1.494 billion (for the 1989 testing period) and are reported in Table IV-11. The year-end capitalizations of the firms in short portfolio range from \$364 million (for the 1974 testing period) to \$1.211 billion (for the 1980 test period) and are reported in Table IV-11. The overall mean year-end capitalization of the twenty mean year-end capitalizations of the firms in the long and short portfolios are \$466 million and \$782 million, respectively. Although the short portfolio's mean year-end capitalization is greater than the long portfolio's in seventeen of the twenty periods, the magnitude is less than 1.7 times larger. In a dollar amount, the average difference of the year-end capitalization between the short and long portfolio is \$316 million.

Based on year-end capitalizations, the firms in the short portfolio are somewhat larger than the firms in the long portfolio. This is a little surprising as one would have thought that the high dividend firms would be in the maturity stage of the life cycle of the firm. Thus, these firms would have little reason to retain earnings for growth and dividends would be paid to stockholders. Alternatively, one would have thought that the low dividend firms would have been in the growth stage of the life cycle of the firm. Thus, these firms would want to retain earnings for growth and no or small dividends would be paid out to stockholders.

The mean industry investment percentages of the firms in the long and short portfolios are discussed below and reported in Table IV-12. The long portfolios include firms mainly from four industries which, on average, account for 75.8 percent of the total investment.

Table IV-11: Statistics on the Year-end Capitalization of the Firms in the Long and Short Portfolios for Each Testing Period (in millions).

Testing Period	Long Portfolio: Year-end Capitalization		Short Portfolio: Year-end Capitalization		Difference: Long Portfolio Minus Short Portfolio
	Mean	Standard Deviation	Mean	Standard Deviation	
1970	118.106	140.954	407.500	1,620.416	-289.394
1971	191.036	206.455	630.077	2,253.243	-439.041
1972	136.496	154.843	627.638	1,677.438	-491.142
1973	186.423	236.352	489.813	1,535.730	-303.390
1974	167.619	237.342	363.766	900.445	-196.147
1975	217.799	271.456	806.594	2,559.323	-588.795
1976	249.112	299.504	663.847	1,385.826	-414.735
1977	225.894	335.354	647.925	1,299.427	-422.031
1978	215.492	296.456	818.979	1,508.638	-603.487
1979	256.770	325.930	584.758	936.630	-327.988
1980	298.331	452.333	1,210.821	3,176.775	-912.490
1981	334.845	446.473	765.469	1,393.114	-430.624
1982	452.246	619.498	953.299	2,400.333	-501.053
1983	642.032	996.096	733.654	1,440.520	-91.622
1984	649.412	996.194	1,061.769	2,097.703	-412.357
1985	1,494.016	5,536.954	1,110.633	2,077.611	383.383
1986	961.050	1,384.484	978.292	2,056.205	-17.242
1987	721.928	1,007.149	705.262	1,502.259	16.666
1988	843.086	1,183.226	815.949	1,443.789	27.137
1989	960.274	1,431.717	1,256.885	2,332.359	-296.611
Mean	466.098	827.939	781.647	1,779.889	-315.548

Table IV-12: Industry Investment Percentages of the Firms in the Long Portfolios, Short Portfolios, and the Sample Firms over the Twenty Testing Periods.

Industry Classification*	Long Portfolios		Short Portfolios		Sample Firms	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
1. Basic Goods	10.4	5.9	9.7	5.7	11.0	1.3
2. Non Hi-Tech Capital Goods	8.0	3.8	8.7	2.7	10.0	0.6
3. Construction	4.4	4.4	3.5	2.8	4.2	0.4
4. Consumer Products	19.4	5.9	27.7	3.5	31.5	2.7
5. Energy	1.6	2.8	7.9	4.8	4.2	0.3
6. Finance	22.8	7.6	17.5	4.7	11.7	3.9
7. Transportation	5.7	5.5	8.0	3.6	5.7	0.7
8. Utilities	23.2	11.0	1.6	2.2	12.6	0.5
9. Hi-Tech Capital Goods	2.7	1.7	7.3	2.3	5.6	0.6
10. Non-Service Consumer Products	1.9	1.1	8.1	4.1	3.5	0.6

* See section *3.4.3 The Estimation Period* for the SIC codes and corresponding types of firms in each industry.

These four industries are *basic goods*, *service consumer products*, *finance*, and *utilities* with mean investment percentages, on average, of 10.4, 19.4, 22.8, and 23.2, respectively. It is not surprising that utilities make up the largest percentage of the long portfolios because they typically pay high dividends yields. Conversely, the short portfolios are diversified across more industries. More specifically, the mean investment percentage of seven industries for the short portfolio ranges from 7.3 percent to 17.5 percent. These seven industries, on average, account for 67.2 percent of the total investment in short portfolios. These seven industries include *basic goods*, *non hi-tech capital goods*, *energy*, *finance*, *transportation*, *hi-tech capital goods*, and *non-service consumer products*. The only industry with over twenty percent invested in short portfolios is *service consumer products*, which on average makes up 27.7 percent. This implies that the short portfolio is made up of growth firms across the industry that retain dividends for capital reinvestment. Not surprisingly, short portfolios include very few utilities which typically pay high dividend yields. The industry breakdown of firms in the long and short portfolios over the twenty years are reported in Table A-1 and Table A-2, respectively.

4.3.2 The Ex-post Returns

Over each five year estimation period, the ex-post monthly returns with dividends for each *Investment Strategy*, long portfolio, and short portfolio are calculated. The next three sections discuss the returns over the twenty estimation periods and the overall mean returns of the *Investment Strategy*, the long portfolio and the short portfolio, respectively.

Investment Strategy

The mean monthly return of the *Investment Strategy* over the twenty estimation periods ranges from 0.0040 (for the 1965 to 1969 estimation period) to 0.0094 (for the 1984 to 1988 estimation period) which translate into mean annual returns of 0.047 and 0.113, respectively. The overall mean monthly return of the twenty mean monthly returns is 0.0063 which translates into an overall mean annual return of 0.076. These returns are reported in Table IV-13. The variances of the annual returns over the twenty estimation periods range from 0.0036 to 0.0060. The mean variance of the twenty variances of the annual returns is 0.0048.

Table IV-13: Statistics on the Returns Including Dividends of the *Investment Strategy* for Each Estimation Period.

Estimation Period	Mean Annual Return	Variance of the Annual Return	Mean Monthly Return	Variance of the Monthly Return	T-Test[a]
1965 - 1969	0.0468	0.0060	0.003969	0.000530	1.335**
1966 - 1970	0.0480	0.0036	0.004063	0.000326	1.744*
1967 - 1971	0.0504	0.0048	0.004267	0.000490	1.493**
1968 - 1972	0.0564	0.0048	0.004741	0.000419	1.793*
1969 - 1973	0.0564	0.0036	0.004711	0.000393	1.840*
1970 - 1974	0.0636	0.0060	0.005387	0.000570	1.747*
1971 - 1975	0.0696	0.0060	0.005812	0.000541	1.936*
1972 - 1976	0.0756	0.0060	0.006334	0.000568	2.058*
1973 - 1977	0.0792	0.0060	0.006626	0.000507	2.279*
1974 - 1978	0.0756	0.0048	0.006322	0.000458	2.289*
1975 - 1979	0.0708	0.0048	0.005993	0.000401	2.318*
1976 - 1980	0.0684	0.0036	0.005797	0.000316	2.527*
1977 - 1981	0.0744	0.0036	0.006232	0.000399	2.418*
1978 - 1982	0.0792	0.0036	0.006651	0.000374	2.663*
1979 - 1983	0.0840	0.0036	0.007070	0.000346	2.944*
1980 - 1984	0.0912	0.0048	0.007679	0.000473	2.735*
1981 - 1985	0.0924	0.0048	0.007794	0.000475	2.768*
1982 - 1986	0.1104	0.0048	0.009297	0.000440	3.433*
1983 - 1987	0.0996	0.0060	0.008309	0.000518	2.826*
1984 - 1988	0.1128	0.0036	0.009415	0.000370	3.790*
Mean	0.0756	0.0048	0.0063	0.0004	-----

a Null hypothesis for the one-tailed t-test is: H_o: $\mu_{monthly\ return} \leq 0$
The critical values are 1.645 and 1.282 for the five and ten percent significance levels, respectively.

* Significant at the five percent level.

** Significant at the ten percent level.

Long Portfolio

The mean monthly return of the long portfolio over the twenty estimation periods ranges from -0.0035 (for the 1969 to 1973 estimation period) to 0.0257 (for the 1975 to 1979 estimation period) which translate into annual mean returns of -0.041 and 0.307, respectively. The overall mean monthly return of the twenty mean monthly returns is 0.0137 which translates into an overall mean annual return of 0.164. These returns are reported in Table IV-14. The variances of the annual returns over the twenty estimation periods range from 0.0014 to 0.0054. The mean variance of the twenty variances of the annual returns is 0.0384.

Short Portfolio

The mean monthly return of the short portfolio over the twenty estimation periods ranges from -0.0082 (for the 1969 to 1973 estimation period) to 0.0197 (for the 1975 to 1979 estimation period) which translate into mean annual returns of -0.097 and 0.235, respectively. The overall mean monthly return of the twenty monthly mean returns is 0.0074 which translates into an overall mean annual return of 0.089. These returns are reported in Table IV-15. The variances of the annual returns over the twenty estimation periods range from 0.0168 to 0.0636. The mean variance of the twenty variances of the annual returns is 0.0372.

4.3.3 The Variance Reduction of Returns with the *Strategy Investment*

Another contribution of this dissertation is to use an *Investment Strategy* which consists of a long and short portfolio of stocks that have the same risk characteristics as measured by the multi-index model. The monthly returns on the *Investment Strategy* should have a much smaller variance than either the long portfolio or the short portfolio of stocks. As reported in Table IV-16, the variance of the monthly returns on the *Investment Strategy* is smaller than the variances of either the long portfolio or the short portfolio in all twenty estimation and testing periods.

More specifically, the mean variance of the twenty variances of monthly returns over the twenty estimation periods is 0.0031 and 0.0032 for the long and short portfolios, respectively, versus 0.0004 for the *Investment Strategy.*

Table IV-14: Statistics on the Returns Including Dividends of the Long Portfolio for Each Estimation Period.

Estimation Period	Mean Annual Return	Variance of the Annual Return	Mean Monthly Return	Variance of the Monthly Return	T-Test: (H_0: Mean Annual Return = 0)	Prob > |T|
1965 - 1969	0.1596	0.0348	0.013325	0.002974	1.892	0.0633
1966 - 1970	0.1164	0.0408	0.009703	0.003439	1.282	0.2050
1967 - 1971	0.1620	0.0432	0.013541	0.003614	1.745	0.0862
1968 - 1972	0.0864	0.0312	0.007201	0.002666	1.081	0.2839
1969 - 1973	-0.0408	0.0336	-0.003476	0.002871	-0.502	0.6173
1970 - 1974	-0.0252	0.0372	-0.002194	0.003182	-0.301	0.7642
1971 - 1975	0.0732	0.0552	0.006198	0.004604	0.708	0.4820
1972 - 1976	0.1332	0.0588	0.011191	0.004904	1.238	0.2207
1973 - 1977	0.1200	0.0636	0.010080	0.005377	1.065	0.2913
1974 - 1978	0.2208	0.0564	0.018447	0.004759	2.071	0.0427
1975 - 1979	0.3072	0.0468	0.025666	0.003980	3.151	0.0026
1976 - 1980	0.2556	0.0360	0.021382	0.003047	3.001	0.0039
1977 - 1981	0.2016	0.0312	0.016832	0.002644	2.535	0.0139
1978 - 1982	0.2436	0.0396	0.020338	0.003327	2.731	0.0083
1979 - 1983	0.2556	0.0288	0.021319	0.002428	3.351	0.0014
1980 - 1984	0.2100	0.0252	0.017593	0.002124	2.957	0.0045
1981 - 1985	0.2244	0.0180	0.018732	0.001551	3.684	0.0005
1982 - 1986	0.2196	0.0156	0.018387	0.001353	3.872	0.0003
1983 - 1987	0.1908	0.0252	0.015937	0.002110	2.687	0.0093
1984 - 1988	0.1824	0.0252	0.015289	0.002119	2.572	0.0126
Mean	0.1644	0.0372	0.0137	0.0031		

Table IV-15: Statistics on the Returns Including Dividends of the Short Portfolio for Each Estimation Period.

Estimation Period	Mean Annual Return	Variance of the Annual Return	Mean Monthly Return	Variance of the Monthly Return	T-Test: (H_0: Mean Annual Return =0)	Prob > |T|
1965 - 1969	0.1116	0.0396	0.009356	0.003371	1.248	0.2169
1966 - 1970	0.0672	0.0432	0.005640	0.003600	0.728	0.4695
1967 - 1971	0.1104	0.0432	0.009274	0.003666	1.186	0.2402
1968 - 1972	0.0288	0.0336	0.002468	0.002835	0.359	0.7209
1969 - 1973	-0.0972	0.0360	-0.008187	0.003036	-1.151	0.2544
1970 - 1974	-0.0900	0.0384	-0.007582	0.003225	-1.034	0.3053
1971 - 1975	0.0036	0.0576	0.000386	0.004827	0.043	0.9658
1972 - 1976	0.0576	0.0600	0.004857	0.005034	0.530	0.5979
1973 - 1977	0.0408	0.0636	0.003454	0.005302	0.367	0.7146
1974 - 1978	0.1452	0.0552	0.012125	0.004681	1.373	0.1750
1975 - 1979	0.2352	0.0480	0.019673	0.004072	2.388	0.0202
1976 - 1980	0.1860	0.0372	0.015585	0.003120	2.161	0.0347
1977 - 1981	0.1272	0.0324	0.010600	0.002767	1.561	0.1239
1978 - 1982	0.1632	0.0408	0.013687	0.003400	1.818	0.0741
1979 - 1983	0.1704	0.0288	0.014250	0.002436	2.236	0.0291
1980 - 1984	0.1188	0.0264	0.009914	0.002245	1.621	0.1104
1981 - 1985	0.1308	0.0180	0.010938	0.001578	2.133	0.0371
1982 - 1986	0.1080	0.0168	0.009090	0.001444	1.853	0.0689
1983 - 1987	0.0912	0.0264	0.007628	0.002280	1.237	0.2209
1984 - 1988	0.0696	0.0288	0.005874	0.002405	0.928	0.3573
Mean	0.0888	0.0384	0.0074	0.0032	-----	-----

Table IV-16: Variances of the Monthly Returns of the Long Portfolio, Short Portfolio, and the *Investment Strategy* for Each Estimation Period and Each Testing Period.

Six Year Period	Variances of the Monthly Returns over the Estimation Period			Variances of the Monthly Returns over the Testing Period		
	Long Portfolio	Short Portfolio	*Investment Strategy*	Long Portfolio	Short Portfolio	*Investment Strategy*
1965 - 1970	0.002974	0.003371	0.000530	0.004397	0.007976	0.000999
1966 - 1971	0.003439	0.003600	0.000326	0.003540	0.004179	0.000193
1967 - 1972	0.003614	0.003666	0.000490	0.001293	0.002056	0.000532
1968 - 1973	0.002666	0.002835	0.000419	0.002118	0.004302	0.000887
1969 - 1974	0.002871	0.003036	0.000394	0.003054	0.007987	0.001789
1970 - 1975	0.003182	0.003225	0.000572	0.007417	0.010465	0.001248
1971 - 1976	0.004604	0.004827	0.000541	0.002335	0.006667	0.001522
1972 - 1977	0.004904	0.005034	0.000568	0.000815	0.001753	0.000511
1973 - 1978	0.005377	0.005302	0.000507	0.002904	0.005875	0.001319
1974 - 1979	0.004759	0.004681	0.000458	0.002733	0.003712	0.000545
1975 - 1980	0.003980	0.004072	0.000401	0.003492	0.004692	0.001081
1976 - 1981	0.003047	0.003120	0.000316	0.002068	0.004019	0.000780
1977 - 1982	0.002644	0.002767	0.000399	0.003431	0.003835	0.000392
1978 - 1983	0.003327	0.003400	0.000374	0.001026	0.001612	0.000266
1978 - 1984	0.002428	0.002436	0.000346	0.001660	0.002165	0.000930
1979 - 1985	0.002124	0.002245	0.000473	0.001350	0.001253	0.000330
1980 - 1986	0.001551	0.001578	0.000476	0.001969	0.002198	0.001161
1981 - 1987	0.001353	0.001444	0.000440	0.003966	0.009901	0.002052
1982 - 1988	0.002110	0.002280	0.000519	0.000634	0.001381	0.000301
1983 - 1989	0.002119	0.002405	0.000370	0.001390	0.001082	0.000569
Mean	0.0031	0.0032	0.0004	0.0025	0.0043	0.0008

Additionally, the mean variance of the twenty variances of monthly returns over the twenty testing periods is 0.0025 and 0.0043 for the long and short portfolios, respectively, versus 0.0008 for the *Investment Strategy*. Thus, the mean variance of the returns for the *Investment Strategy* over the estimation period is around eight times smaller than either the long or short portfolios. The mean variance of the returns for the *Investment Strategy* over the testing periods is three and five times smaller than those of the long and short portfolios, respectively. This shows that *Investment Strategy* further reduces the variance of monthly stock returns from that which could be achieved only through either a long portfolio or a short portfolio.

4.3.4 The Estimation Period Hypothesis Testing

This subsection discusses hypothesis testing of the relationship between stock returns and dividend yields over the estimation periods. However, the conclusions from hypothesis testing of the returns over the twenty estimation periods are not meaningful for the following reason. By construction, the *Investment Strategy* should have a positive return over all twenty estimation periods. The predicted annual dividend yields and the fourteen estimation period multi-index model parameters for every firm are used as input for the linear program. The linear program's objective function maximizes the dividend yield between a long and short portfolio of firms. Additionally, the linear program's constraints control the price changes of the *Investment Strategy* by requiring the fourteen multi-index model parameters on the long portfolio to equal those of the short portfolio. In effect, any price change on the long portfolio of stocks is offset by an equal price change on the short portfolio of stocks which results in a zero price change on the *Investment Strategy*. Thus, the return of the *Investment Strategy* is based solely on dividends, which by construction is positive.

Two analyses are conducted which confirm that the *Investment Strategy* has positive returns over the estimation periods. The first analysis includes one-tailed t-tests which are conducted on the twenty mean monthly returns of the *Investment Strategy* for the twenty estimation periods. As reported in Table IV-13, all twenty one-tailed t-tests reject the hypothesis that the mean monthly return of the *Investment Strategy* over the estimation period is not significantly greater than zero at the ten percent level and eighteen of the twenty t-tests even reject the null hypothesis at the five percent level. The second analysis includes a one-tailed binomial t-test[9] which tests the observed proportion of positive mean monthly returns against the expected proportion. The number of positive mean monthly returns is twenty out of twenty, so the observed proportion of positive mean returns is 1.000 and the binomial t-test statistic is 4.472 which exceeds the one percent critical value of 2.528. Thus, the binomial t-test rejects the null hypothesis that the mean monthly returns of the *Investment Strategy* follow a binomial distribution with the proportion of positive mean returns not significantly greater than fifty percent at the one percent level.

In summary, both analyses support that over the estimation periods there is a positive relationship between stock returns and dividend yields and that the *Investment Strategy* can generate returns significantly greater than zero. However, by construction of the *Investment Strategy*, these results are expected. Thus, the conclusions are not meaningful. The important issue to address is whether the *Investment Strategy* provides any ex-ante information that investors can use to trade on. Therefore, one must look to the future testing period returns of the *Investment Strategy* to determine if dividend yields are relevant. The next section analyzes whether the *Investment Strategy* provides any ex-ante information and whether dividends are relevant.

4.4 The Testing Period Results

Section 4.4 discusses the empirical results with data from the twenty testing periods and is divided into four sub-sections. Section 4.4.1 gives an introduction to the testing periods. Section 4.4.2 discusses the tests used to analyze the *Dividends Increase Returns Theory*. Section

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9 The formula for the binomial t-tests used in this dissertation is:

$$t^2 = \frac{O - \pi}{[\, \pi\, (1 - \pi) \,/\, N \,]^{0.5}} \qquad \text{(IV-4)}$$

where O is the observed sample proportion; π is the expected sample proportion; N is the sample size; and the degrees of freedom is equal to $(N - 1)$.

4.4.3 discusses the tests used to analyze the *Dividends are Irrelevant Theory*. Section 4.4.4 compares the testing period returns of the *Investment Strategy* to business cycles.

4.4.1 Introduction to the Testing Periods

The testing period is the sixth year of each six year sample period. In each estimation period, the *Investment Strategy* is formed using ex-post data. Then, at the start of each testing period, the *Investment Strategy* is implemented ex-ante by purchasing the high dividend stocks in the long portfolio and by selling the low dividend stocks in the short portfolio. Next, the monthly returns of the *Investment Strategy* for each testing period are calculated. The monthly return is equal to the monthly return of the long portfolio less the monthly return of the short portfolio. The first testing period is January 1970 to December 1970 and the last one is January 1989 to December 1989. Thus, the *Investment Strategy* has 240 monthly returns with dividends over the January 1970 to December 1989 time period which are reported in Table A-3. Additionally, the 240 monthly returns without dividends on the *Investment Strategy* are reported Table A-3.

The statistics on the 240 monthly returns, with and without dividends, on the *Investment Strategy* over the twenty testing periods are discussed below and reported in Table IV-17. The mean monthly return with dividends over the 240 month period is -0.0036 which translates into a mean annualized return of -0.0427. The minimum and maximum monthly returns with dividends are -0.1072 and 0.1195, respectively. The variance of the monthly returns with dividends is 0.00089 and the coefficient of variation[10] is 8.366. The mean monthly return without dividends is -0.0089 which translates into a mean annualized return of -0.1070. The minimum and maximum monthly returns without dividends are -0.1125 and 0.1138, respectively. The variance of the monthly returns without dividends is 0.00089 and the coefficient of variation is 3.328.

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[10] The coefficient of variation used in this dissertation is the ratio of the standard deviation of the 240 monthly returns over the twenty testing periods to the absolute mean return of the 240 monthly returns. Note that whereas standard deviation is absolute measure of risk, the coefficient of variation is a relative measure of risk. Oftentimes, a relative measure of risk is more relevant than the absolute measure.

Table IV-17: Statistics on the Monthly Returns, with and without Dividends, of the *Investment Strategy*, and Long and Short Portfolios over the Twenty Testing Periods Using the Multi-index Model.

	Investment Strategy w/ Divs	*Investment Strategy* w/o Divs	Long Portfolio w/ Divs	Long Portfolio w/o Divs	Short Portfolio w/ Divs	Short Portfolio w/o Divs
Observations	240	240	240	240	240	240
Mean Monthly Return	-0.003562	-0.008918	0.011559	0.005496	0.015121	0.014414
Variance of Monthly Returns	0.000888	0.000881	0.002565	0.002539	0.004289	0.004290
Coefficient of Variation	8.366	3.328	4.382	9.168	4.331	4.544
T-test[a,b]	-1.852[g]	-4.654[f]	3.536[e,f]	1.690[e,g]	3.577[e,f]	3.409[e,f]
Mean Annualized Return	-0.0427	-0.1070	0.1387	0.0660	0.1815	0.1730
Variance of Annualized Returns	0.0107	0.0106	0.0308	0.0305	0.0515	0.0515
Minimum Monthly Return	-0.107164	-0.112487	-0.163654	-0.169542	-0.283135	-0.283393
Maximum Monthly Return	0.119480	0.113850	0.297609	0.288219	0.312523	0.311804
Proportion of Positive Monthly Returns	0.425	----	----	----	----	----
Binomial T-Test[c,d]	-2.324[h]	----	----	----	----	----

a Null hypothesis A for the one-tailed t-test is: H_o: $\mu_{\text{monthly return}} \leq 0$.
The critical values are 1.645 and 1.282 for the five and ten percent significance levels, respectively.

b Null hypothesis B for the two-tailed t-test is: H_o: $\mu_{\text{monthly return}} = 0$.
The critical values are 1.960 and 1.645 for the five and ten percent significance levels, respectively.

c Null hypothesis C for the one-tailed binomial t-test is: H_o: $\text{observed}_{\%\ \text{positive}} - \text{expected}_{\%\ \text{negative}} \leq 0$.
The critical values are 1.645 and 1.282 for the five and ten percent significance levels, respectively.

d Null hypothesis D for the two-tailed binomial t-test is: H_o: $\text{observed}_{\%\ \text{positive}} - \text{expected}_{\%\ \text{negative}} = 0$.
The critical values are 2.576 and 1.960 for the one and five percent significance levels, respectively.

e Null hypothesis A is rejected at the five percent significance level.
f,g Null hypothesis B is rejected at the five percent and ten significance levels, respectively.
h Null hypothesis D is rejected at the five percent significance level.

The 240 monthly returns with dividends of the *Investment Strategy* over the twenty testing periods are analyzed to test both the *Dividends Increase Returns Theory* and the *Dividend are Irrelevant Theory*.

4.4.2 Dividends Increase Returns

The *Dividends Increase Returns Theory* is supported by the studies of Litzenberger and Ramaswamy (1979) and Stone and Bartter (1979). These studies conclude that there is a positive relationship between stock returns and dividend yields. Thus, the *Dividends Increase Returns Theory* hypothesizes that the mean monthly return of the *Investment Strategy* over the twenty testing periods should be significantly greater than zero and that the returns of the *Investment Strategy* follow a binomial distribution with the proportion of positive returns significantly greater than fifty percent.

Two tests are used to analyze the 240 monthly returns of the *Investment Strategy* and to determine whether dividends increase returns. The first test is a one-tailed t-test conducted on the mean monthly return of the *Investment Strategy* over the 240 months. The second test is a one-tailed binomial t-test conducted on the observed proportion of positive monthly returns on the *Investment Strategy* over the 240 months.

The first test is a one-tailed t-test conducted on the mean monthly return of the *Investment Strategy* over the 240 months. The null and alternative hypotheses are:

H_o: dividends do not increase returns: the mean monthly return of the *Investment Strategy* is not significantly greater than zero

$$H_o\text{: } \mu_{\text{monthly return}} \leq 0$$

H_a: dividends increase returns: the mean monthly return of the *Investment Strategy* is significantly greater than zero

$$H_a\text{: } \mu_{\text{monthly return}} > 0$$

The mean monthly return is -0.0036 and the t-test statistic is -1.852 which does not exceed the ten percent critical value of 1.282 as reported in Table IV-17. Additionally, the sign of the test statistic is negative which is the wrong sign to support the *Dividends Increase Returns Theory*.

Thus, the t-test fails to reject the null hypothesis that dividends do not increase returns at the ten percent significance level. Alternatively, the t-test fails to support: (i) that dividends increase returns; (ii) that the *Investment Strategy* can generate a return significantly greater than zero; or (iii) that there is a positive relationship between stock returns and dividend yields.

The second test is a one-tailed binomial t-test conducted on the observed proportion of positive monthly returns on the *Investment Strategy* over the 240 months. The null and alternative hypotheses are:

H_0: dividends do not increase returns: the returns of the *Investment Strategy* follows a binomial distribution with the proportion of positive returns not significantly greater than fifty percent

$$H_0\text{: } \text{observed}_{\text{proportion}} - \text{expected}_{\text{proportion}} \leq 0$$

H_a: dividends increase returns: the returns of the *Investment Strategy* follows a binomial distribution with the proportion of positive returns significantly greater than fifty percent

$$H_a\text{: } \text{observed}_{\text{proportion}} - \text{expected}_{\text{proportion}} > 0$$

The number of positive returns is 102 out of 240, so the observed proportion of positive returns is 0.425 and the binomial t-test statistic is -2.324 which does not exceed the ten percent critical value of 1.282. Again, the sign of the test statistic is negative which is the wrong sign to support the *Dividends Increase Returns Theory*. Thus, the binomial t-test fails to reject the null hypothesis that dividends do not increase returns at the ten percent significance level. Alternatively, the binomial t-test fails to support: (i) that dividends increase returns; (ii) that the returns of the *Investment Strategy* follow a binomial distribution with the proportion of positive returns significantly greater than fifty percent; or (iii) that there is a positive relationship between stock returns and dividend yields.

In summary, both the t-test and the binomial t-test fail to reject the null hypothesis that dividends do not cause higher returns. Alternatively, the two tests fail to support: (i) that dividends increase returns; (ii) that the *Investment Strategy* can generate a return significantly greater than zero; (iii) that the returns of the *Investment Strategy* follow a binomial distribution with the proportion of positive returns significantly greater than fifty percent; or (iv) that there is a positive relationship between stock returns and dividend yields.

4.4.3 Dividends are Irrelevant

The *Dividends are Irrelevant Theory* is supported by the studies of Watts (1973) and Black and Scholes (1974). These studies conclude that dividends are irrelevant because they find no relationship between stock returns and dividend yields. Thus, the *Dividends are Irrelevant Theory* hypothesizes that the mean monthly return of the *Investment Strategy* over the twenty testing periods should not be significantly different from zero and that the returns of the *Investment Strategy* follow a binomial distribution with the proportion of positive returns not significantly different from fifty percent.

Two tests are used to analyze the 240 monthly returns of the *Investment Strategy* and to determine whether dividends are irrelevant. The first test is a two-tailed t-test conducted on the mean monthly return of the *Investment Strategy* over the 240 months. The second test is a two-tailed binomial t-test conducted on the observed proportion of positive monthly returns on the *Investment Strategy* over the 240 months.

The first test is a two-tailed t-test conducted on the mean monthly return of the *Investment Strategy* over the 240 months. The null and alternative hypotheses are:

H_o: dividends are irrelevant: the mean monthly return of the *Investment Strategy* is not significantly different from zero

$$H_o:\ \mu_{\text{monthly return}} = 0$$

H_a: dividends are not irrelevant: the mean monthly return of the *Investment Strategy* is significantly different from zero

$$H_a:\ \mu_{\text{monthly return}} \neq 0$$

The mean monthly return is -0.0036 and the t-test statistic is -1.852 which does not exceed the five percent critical value of -1.960 as reported in Table IV-17. Thus, the t-test fails to reject the null hypothesis that dividends are irrelevant at the five percent significance level. However, the t-test statistic of -1.852 does exceed the ten percent critical value of -1.645. Thus, the t-test rejects the null hypothesis that dividends are irrelevant at the ten percent significance level. Additionally, it is also important to note that the sign on the t-test statistic is negative which supports the hypothesis that there is a negative relationship between stock returns and dividend yields at the ten percent level. It is concluded that at the ten percent significance level, the t-test rejects: (i) that dividends are irrelevant; (ii) that the *Investment Strategy* cannot generate a return significantly different from zero; and (iii) that there is no relationship between stock returns and dividend yields.

The second test is a two-tailed binomial t-test conducted on the observed proportion of positive monthly returns on the *Investment Strategy* over the 240 months. The null and alternative hypotheses are:

H_o: dividends are irrelevant: the returns of the *Investment Strategy* follow a binomial distribution with the proportion of positive mean returns not significantly different from fifty percent

$$H_o\text{: observed}_{\text{proportion}} - \text{expected}_{\text{proportion}} = 0$$

H_a: dividends are not irrelevant: the returns of the *Investment Strategy* follow a binomial distribution with the proportion of positive returns significantly different from fifty percent

$$H_a\text{: observed}_{\text{proportion}} - \text{expected}_{\text{proportion}} \neq 0$$

The number of positive monthly returns is 102 out of 240, so the observed proportion of positive returns is 0.425 and the binomial t-test statistic is -2.324 which exceeds the five percent critical value of -1.960. Thus, the binomial t-test rejects the null hypothesis that dividends are irrelevant at the five percent significance level. Again, it is also important to note that the sign on the binomial t-test statistic is negative which supports the hypothesis that there is a negative relationship between stock returns and dividend yields. Alternatively, the binomial t-test rejects: (i) that dividends are irrelevant; (ii) that the returns of the *Investment Strategy* follow a binomial distribution with the proportion of positive mean returns not significantly different from fifty percent; and (iii) that there is no relationship between stock returns and dividend yields.

In summary, both the t-test and the binomial t-test reject the null hypothesis that dividends are irrelevant at the ten percent significance level. However, the two tests provide conflicting conclusions at the five percent significance level. The t-test *fails to reject* the null hypothesis that dividends are irrelevant at the five percent level, while the binomial t-test *rejects* the null hypothesis at the five percent level. However, the binomial t-test is a more robust test than the t-test because the binomial t-test does not require that the monthly returns follow a normal distribution.

Based on both the two-tailed binomial t-test result at the five percent significance level and the t-test result at the ten percent significance level, it is concluded that the testing period data rejects the null hypothesis that dividends are irrelevant. Additionally, it is important to note that the signs on the t-test and binomial t-test statistics are negative which supports the hypothesis that there is a negative relationship between stock returns and dividend yields. This means that not only is the pre-tax return on the low dividend portfolio greater than that of the high dividend portfolio, but the post-tax return on the low dividend portfolio is also greater than that of the high dividend portfolio. This is true because of the differential taxation of capital gains and dividends. First, the tax on capital gains can be deferred until the stock is sold whereas dividend income is taxed in the period received. Additionally, there were periods during 1970 to 1989 when capital gains received a large tax exclusion. In fact, prior to 1986, sixty percent of long-term capital gains were exempt from federal taxation.[11] Thus, this implies that some investors prefer a high dividend portfolio even if the portfolio earns a lower return than that of a low dividend portfolio with similar risk. There are several reasons why this relationship may hold.

One reason to explain the negative relationship between stock returns and dividend yields is the free cash flow theory of Jensen (1986). The payment of high dividend yields better aligns management decisions and stockholders interests. By paying high dividend yields, management signals better future investment policies. Conversely, management avoids signaling overinvestment policies. Perhaps, this is why investors may accept a lower return from high dividend firms versus low dividend firms.

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[11] The Tax Reform Act of 1986 repealed the very favorable sixty percent tax exclusion on long-term capital gains.

Another reason to explain the negative relationship between stock returns and dividend yields is that investors may wish to avoid transaction costs associated with rebalancing portfolios. Thus, these investors may prefer portfolios with high dividend yields at the expense of a lower return. An example would be large institutional investors such as pension funds who find it cheaper to receive large dividend payments that can be used to meet future cash outflows versus selling stocks and then rebalancing their portfolios. The same case applies to elderly investors and widows that rely on dividend income to meet current living expenses. By using dividend income, transaction costs associated with the sale of stocks and rebalancing of portfolios can be avoided.

At the ten percent significance level, the t-test and binomial t-test also fail to support market efficiency because the *Investment Strategy* provides ex-ante information for investors to earn returns significantly different from zero on a net zero dollar investment. However, for investors to profit, they must reverse the formulation of the *Investment Strategy*. Rather than buying long the high dividend stocks in the long portfolios, investors must sell short these stocks. Additionally, rather than selling short the low dividend stocks in the short portfolios, investors must buy long these stocks.

In summary, at the ten percent significance level the testing period data support: (i) the hypothesis that there is a negative relationship between stock returns and dividend yields; (ii) that the *Investment Strategy*, which consists of a long and short portfolio with identical risk characteristics as measured by the multi-index model parameters, can generate a return significantly different from zero on a net zero dollar investment; and (iii) the returns of the *Investment Strategy* follow a binomial distribution with the proportion of negative returns significantly greater than fifty percent.

4.4.4 Returns on the *Investment Strategy* and Business Cycles

The testing period returns on the *Investment Strategy* are compared to business cycles. Over time, the United States economy, measured by gross domestic product (GDP) has experienced periods of contraction and expansion which are called business cycles. Since monthly data is not available on the GDP, four other proxies with monthly observations are used to measure business cycles. The first proxy is the composite index of four coincident economic indicators (CEIs) which include: (i) number of employees on nonagricultural payrolls, in thousands; (ii) the index of industrial production, 1987 = 100; (iii) personal income less transfer payments, in billions of 1987$; and (iv) manufacturing and trade sales, millions of 1987$. Three of the four individual CEIs are also used as a proxy for business cycles. Thus, the second proxy is the index of industrial production. The third proxy is personal income less transfer payments and the fourth proxy is manufacturing and trade sales.[12]

The relationship of the testing period monthly returns on the *Investment Strategy* to each proxy of the business cycles is measured by the correlation coefficient. Except for the severe recessions in 1974 and 1975, and again in the early 1980s, the United States economy has steadily expanded over the 1970 to 1989 time period. Likewise, the proxies for the business cycles have steadily increased over the 1970 to 1989 time period with similar contractions. More specifically: the composite index of CEIs has increased from 83.5 (for January 1970) to 133.7 (for December 1989); the index of industrial production has increased from 62.1 (for January 1970) to 108.06 (for 1989); personal income less transfer payments has increased from 2.09 trillion dollars (for January 1970) to 3.46 trillion dollars (for December 1989); and manufacturing and trade sales have increased from 266 billion dollars (for January 1970) to 480 billion dollars (for December 1989). Conversely, the returns on the *Investment Strategy* are very close to zero over the 1970 to 1989 time period. Based on this information, one would expect to find no or very little relationship between the returns and the proxies.

The correlation coefficients between the monthly returns on the *Investment Strategy* and business cycles proxy: (i) the composite index of CEIs is 0.05320; (ii) the index of industrial production is 0.09362; (iii) personal income less transfer payments is 0.00008; and (iv) manufacturing and trade sales is 0.00002. As expected, there is no or very little relationship between the monthly returns on the *Investment Strategy* and each of the four proxies for business

[12] The data for the proxies are obtained from Kolb and Wilson (1993).

cycles over the 1970 to 1989 time period.

4.5 Alternative Models

For completeness, the t-test and the binomial t-test of the *original multi-index model*[13] as described in section *4.4 Testing Period Results* are replicated using three alternative models which are discussed in this section. Section 4.5.1 discusses the *alternative 1 multi-index model* and the testing period results. Section 4.5.2 discusses the *alternative 2 multi-index model* and the testing period results. Section 4.5.3 discusses the *alternative 3 single-index market model* and the testing period results. In all three sections, both the *Dividends Increase Returns Theory* and the *Dividends are Irrelevant Theory* are analyzed.

4.5.1 The *Alternative 1 Multi-index Model* and Testing Period Results

The overall mean annual return of the twenty mean annual returns of the estimation periods using the *original multi-index model* is 0.0756. The mean annual return over the twenty testing periods is -0.0427. This means that the annual return on the *Investment Strategy* shifts by almost twelve percent from the estimation period to the testing period. Thus, the methodology is altered to construct the *Investment Strategy* such that its estimation period return is negative or zero. If the twelve percent shift holds, then this can provide additional insight to the relevance of dividends and the free cash flow theory.

The *alternative 1 multi-index model* is similar to the *original multi-index model* except for three differences. The first difference is that the thirteen indexes and corresponding sixty index scores are extracted from the returns with dividends of fifty-two firms rather than from returns without dividends. The second difference is that the dependent variable in the multi-index

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[13] The *original multi-index model* here refers to the original methodology that has been described up to this point in the dissertation and used to test the relevance of dividends. The major difference between the original methodology and the alternative methodologies is related to the regression model used to estimate the parameters that are used with the linear program. Thus, the models are identified by this major change as *alternative 1 multi-index model, alternative 2 multi-index model*, and *alternative 3 single-index market model.*

regression model is the firm's returns with dividends rather than the firm's returns without dividends. The third difference is that the alpha, i.e., intercept parameter, constraint in the linear program requires that the long portfolio's alpha be less than or equal to the short portfolio's alpha. These three changes force the return on the *Investment Strategy* over the estimation periods to be negative or zero. Then the t-test and binomial t-test are conducted on the 240 monthly returns over the twenty testing periods.

For each estimation period, the linear program delivers the firms that make up the *Investment Strategy*. As expected, the overall mean annualized return of the *Investment Strategy* for the twenty estimation periods -0.0283. Next, at the beginning of the testing period, the *Investment Strategy* is implemented by purchasing the high dividend stocks in the long portfolio and selling the low dividend stocks in the short portfolio. Then, the 240 monthly returns of the *Investments Strategy* are calculated over the January 1970 to December 1989 time period.

The statistics on the 240 monthly returns, with and without dividends, on the *Investment Strategy* over the twenty testing periods are discussed below and reported in Table IV-18. The mean monthly return with dividends is -0.0020 which translates into an annual geometric return of -0.0237. The minimum and maximum monthly returns with dividends are -0.1221 and 0.0898, respectively. The variance of the monthly returns with dividends is 0.00089 and the coefficient of variation is 15.064.

Next, t-tests and binomial t-tests are used to analyze the 240 monthly returns of the *Investment Strategy*. The *Dividends Increase Returns Theory* is not supported by either the one-tailed t-test or the one-tailed binomial t-test. The t-test statistic of -1.029 and the binomial t-test of -1.549 both fail to reject the null hypothesis that dividends do not increase returns at the ten percent significance level. The *Dividends are Irrelevant Theory* is supported by both the two-tailed t-test and the two-tailed binomial t-test. The t-test statistic of -1.029 and the binomial t-test statistic of -1.549 both fail to reject the null hypothesis that dividends are irrelevant at the ten percent significance level. Thus, the results of the *alternative 1 multi-index model* support the *Dividends are Irrelevant Theory*. This is in conflict with the results of the *original multi-index model*. Therefore, the riskiness of the returns on the *Investment Strategy* are analyzed.

Table IV-18: Statistics on the Monthly Returns, with and without Dividends, of the *Investment Strategy*, and Long and Short Portfolios over the Twenty Testing Periods Using the *Alternative 1 Multi-index Model.*

	Investment Strategy w/ Divs	*Investment Strategy* w/o Divs	Long Portfolio w/ Divs	Long Portfolio w/o Divs	Short Portfolio w/ Divs	Short Portfolio w/o Divs
Observations	240	240	240	240	240	240
Mean Monthly Return	-0.001976	-0.007187	0.011981	0.005964	0.013957	0.013151
Variance of Monthly Returns	0.000885	0.000880	0.002573	0.002556	0.003974	0.003975
Coefficient of Variation	15.055	4.128	4.234	8.477	4.517	4.794
T-test[a,b]	-1.029	-3.753[f]	3.660[e,f]	1.828[e,g]	3.430[e,f]	3.231[e,f]
Mean Annualized Return	-0.0237	-0.0006	0.1438	0.0716	0.0477	0.0477
Variance of Annualized Returns	0.0106	0.0106	0.0309	0.0307	0.0477	0.0477
Minimum Monthly Return	-0.122155	-0.127894	-0.174667	-0.177494	-0.264474	-0.264843
Maximum Monthly Return	0.089806	0.087348	0.306466	0.296779	0.249709	0.249130
Proportion of Positive Monthly Returns	0.450	----	----	----	----	----
Binomial T-Test[c,d]	-1.549	----	----	----	----	----

[a] Null hypothesis A for the one-tailed t-test is: H_o: $\mu_{\text{monthly return}} \leq 0$.
The critical values are 1.645 and 1.282 for the five and ten percent significance levels, respectively.

[b] Null hypothesis B for the two-tailed t-test is: H_o: $\mu_{\text{monthly return}} = 0$.
The critical values are 1.960 and 1.645 for the five and ten percent significance levels, respectively.

[c] Null hypothesis C for the one-tailed binomial t-test is: H_o: $\text{observed}_{\%\text{ positive}} - \text{expected}_{\%\text{ negative}} \leq 0$.
The critical values are 1.645 and 1.282 for the five and ten percent significance levels, respectively.

[d] Null hypothesis D for the two-tailed binomial t-test is: H_o: $\text{observed}_{\%\text{ positive}} - \text{expected}_{\%\text{ negative}} = 0$.
The critical values are 1.960 and 1.645 for the five and ten percent significance levels, respectively.

[e] Null hypothesis A is rejected at the five percent significance level.

[f,g] Null hypothesis B is rejected at the five percent and ten significance levels, respectively.

To analyze the riskiness of the returns on the *Investment Strategy*, the coefficients of variation are analyzed. The coefficient of variation for the *original multi-index model* is 8.366 versus 15.064 for the *alternative 1 multi-index model*. This means for every unit of return there are 8.366 units of risk when the *original multi-index model* is used versus 15.064 units of risk when the *alternative 1 multi-index model* is used. This analysis supports that the *original multi-index model* controls for more risk over the twenty testing periods than does the *alternative 1 multi-index model*. Therefore, the *original multi-index model* is considered more robust for analyzing the testing period returns of the *Investment Strategy* and the relevance of dividends.

4.5.2 The *Alternative 2 Multi-index Model* and Testing Period Results

The testing period results in this section are based on the *alternative 2 multi-index model* which is similar to the *original multi-index model* except for the differences described below. In section *3.4.1 Estimation of Indexes and Index Scores*, a very specific method is employed for selecting the fifty-two firms from which the indexes and index scores are extracted. First, all the firms in the sample are sorted primarily by return yields and secondarily by dividend yields. Then, approximately every nineteenth firm is selected. In this section, a different firm selection method is employed. Since the results from the original model show that the linear program selects high and low dividend yield firms, fifty-two firms with high and low dividend yields are selected from which indexes and index scores are extracted. Since these index scores should better explain the stock returns of the particular firms in the *Investment Strategey*, the *alternative 2 multi-model* should further reduce the risk of the returns on the *Investment Strategy*.

Firms are first sorted by dividend yields and secondarily by return yields. Then, rather than selecting firms across the entire sample, twenty-six firms are selected from the low dividend stocks and twenty-six firms are selected from the high dividend stocks. Thus, every eighth low dividend yield firm is selected until twenty-six firms are selected.[14] Next, every fourth high

[14] The goal is to select twenty-six firms with low dividend yields, but not to select twenty-six firms with zero dividend yields. The average number of firms with zero dividend yields for each testing period is 86 firms. Thus, on average, eleven firms with zero dividend yields and fifteen firms with low dividend yields make up the twenty-six low dividend yield firms.

dividend yield firm is selected until twenty-six firms are selected. From these fifty-two firms, the thirteen indexes and sixty index scores are extracted and used in the *alternative 2 multi-index model.* The fourteen parameters are then estimated for every firm in the sample using the *alternative 2 multi-index model.*

The linear program delivers the firms that make up the *Investment Strategy.* Then, at the beginning of the testing period, the *Investment Strategy* is implemented by purchasing the stocks in the long portfolio and selling the stocks in the short portfolio. Next, the 240 monthly returns of the *Investments Strategy* are calculated over the January 1970 to December 1989 time period.

The statistics of the monthly returns, with and without dividends, on the *Investment Strategy* are discussed below and reported in Table IV-19. The mean monthly return with dividends is -0.0014 which translates into an annual geometric return of -0.0173. The minimum and maximum monthly returns with dividends are -0.0789 and 0.0991, respectively. The variance of the monthly returns with dividends is 0.00078 and the coefficient of variation is 19.378.

Next, t-tests and binomial t-tests are used to analyze the 240 monthly returns of the *Investment Strategy.* The *Dividends Increase Returns Theory* is not supported by either the one-tailed t-test or the one-tailed binomial t-test. The t-test statistic of -0.800 and the binomial t-test statistic of -0.899 both fail to reject the null hypothesis that dividends do not increase returns at the ten percent significance level. The *Dividends are Irrelevant Theory* is supported by both the two-tailed t-test and the two-tailed binomial t-test. The t-test statistic of -0.800 and the binomial t-test statistic of -0.899 both fail to reject the null hypothesis that dividends are irrelevant at the ten percent significance level. Thus, the results of the *alternative 2 multi-index model* support the *Dividends are Irrelevant Theory.* This is in conflict with the results of the *original multi-index model.* Therefore, the explanatory power of stock returns for all the firms in the sample of both models are analyzed. Additionally, the riskiness of the returns on the *Investment Strategy* are analyzed.

To test whether the explanatory power of stock returns with the *original multi-index model* is significantly more powerful for all firms than that of the *alternative 2 multi-index model,* one-tailed paired comparison t-tests are employed.

Table IV-19: Statistics on the Monthly Returns, with and without Dividends, of the *Investment Strategy*, and Long and Short Portfolios over the Twenty Testing Periods Using the *Alternative 2 Multi-index Model.*

	Investment Strategy w/ Divs	*Investment Strategy* w/o Divs	Long Portfolio w/ Divs	Long Portfolio w/o Divs	Short Portfolio w/ Divs	Short Portfolio w/o Divs
Observations	240	240	240	240	240	240
Mean Monthly Return	-0.001444	-0.006638	0.012200	0.006251	0.013645	0.012889
Variance of Monthly Returns	0.000783	0.000772	0.002604	0.002574	0.004185	0.004185
Coefficient of Variation	19.378	4.186	4.183	8.116	4.741	5.019
T-test[a,b]	-0.799	-3.701[f]	3.704[e,f]	1.909[e,g]	3.268[e,f]	3.087[e,f]
Mean Annualized Return	-0.0173	-0.0797	0.1464	0.0750	0.1637	0.1547
Variance of Annualized Returns	0.0094	0.0093	0.0312	0.0309	0.0502	0.0502
Minimum Monthly Return	-0.078987	-0.086969	-0.175102	-0.179553	-0.274166	-0.274532
Maximum Monthly Return	0.099063	0.094978	0.271606	0.264916	0.307852	0.307811
Proportion of Positive Monthly Returns	47.1	----	----	----	----	----
Binomial T-Test[c,d]	-0.899	----	----	----	----	----

[a] Null hypothesis A for the one-tailed t-test is: H_o: $\mu_{monthly\ return} \leq 0$.
The critical values are 1.645 and 1.282 for the five and ten percent significance levels, respectively.

[b] Null hypothesis B for the two-tailed t-test is: H_o: $\mu_{monthly\ return} = 0$.
The critical values are 1.960 and 1.645 for the five and ten percent significance levels, respectively.

[c] Null hypothesis C for the one-tailed binomial t-test is: H_o: observed$_{\%\ positive}$ - expected$_{\%\ negative} \leq 0$.
The critical values are 1.645 and 1.282 for the five and ten percent significance levels, respectively.

[d] Null hypothesis D for the two-tailed binomial t-test is: H_o: observed$_{\%\ positive}$ - expected$_{\%\ negative} = 0$.
The critical values are 1.960 and 1.645 for the five and ten percent significance levels, respectively.

[e,f] Null hypothesis A is rejected at the five percent significance level.

[g] Null hypothesis B is rejected at the five percent and ten significance levels, respectively.

The paired comparison t-tests support that the *original multi-index model* has more explanatory power for all the firms in the sample. Eleven of twenty paired comparison t-test statistics reject the null hypothesis that the R^2 *original multi-index model* is not significantly greater than that of the *alternative 2 multi-index model* at the ten percent level and ten of the twenty test statistics even reject the null hypothesis at the five percent level. Conversely, only five paired comparison t-test statistics reject the null hypothesis that the R^2 *alternative 2 multi-index model* is not significantly greater than that of the *original multi-index model* at the ten and five percent levels. Thus, the *original multi-index model* has more explanatory power of stock returns for the firms in the sample than the *alternative 2 multi-index model.* This is not surprising because the fifty-two firms used for index extraction extend over the whole range of stock returns with the *original multi-index model* rather than just extending over low and high dividend stocks.

The most important analysis is on the riskiness of the returns on the *Investment Strategy.* Thus, the coefficients of variation are analyzed. The coefficient of variation for the *original multi-index model* is 8.366 versus 19.378 for the *alternative 2 multi-index model.* Therefore, this analysis supports that the *original multi-index model* controls for more risk over the twenty testing periods than does the *alternative 2 multi-index model.*

The two analyses both support that the *original multi-index model* the more robust methodology for analyzing the testing period returns of the *Investment Strategy* and the relevance of dividends.

4.5.3 The *Alternative 3 Single-index Market Model* and Testing Period Results

The testing period results in this section are based on the *alternative 3 single-index market model* which is similar to the *original multi-index model* except that there are only two parameters estimated with the *alternative 3 single-index market model,* rather than the fourteen parameters estimated with the *original multi-index model.* Thus, there are only two parameter constraints in the linear program rather than the fourteen constraints with the multi-index model. See section *4.2.1 Single-Index Market Model* for a complete description of the single-index market model.

The linear program delivers the firms that make up the *Investment Strategy.* Then, at the beginning of the testing period, the *Investment Strategy* is implemented by purchasing the high dividend stocks in the long portfolio and selling the low dividend stocks in the short portfolio. Next, the 240 monthly returns of the *Investment Strategy* are calculated over the January 1970 to December 1989 time period.

The statistics of the monthly returns, with and without dividends, on the *Investment Strategy* are discussed below and reported in Table IV-20. The mean monthly return with dividends is -0.0030 which translates into an annual geometric return of -0.0366. The minimum and maximum monthly returns with dividends are -0.1233 and 0.1373, respectively. The variance of the monthly returns with dividends is 0.00147 and the coefficient of variation is 12.349.

Dividends Increase Returns

Two tests are used to analyze the 240 monthly returns of the *Investment Strategy* and to test the *Dividends Increase Returns Theory.* The first test is a one-tailed t-test conducted on the mean monthly return of the *Investment Strategy* over the 240 months. The second test is a one-tailed binomial t-test conducted on the observed proportion of positive monthly returns on the *Investment Strategy* over the 240 months.

The one-tailed t-test is conducted on the mean monthly return of the *Investment Strategy* over the 240 months. The null and alternative hypotheses are:

H_o: dividends do not increase returns: the mean monthly return of the *Investment Strategy* is not significantly greater than zero

$$H_o: \mu_{\text{monthly return}} \leq 0$$

H_a: dividends increase returns: the mean monthly return of the *Investment Strategy* is significantly greater than zero

$$H_a: \mu_{\text{monthly return}} > 0$$

The monthly return is -0.0030 and the t-test statistic is -1.255 which does not exceed the ten percent critical value of 1.282 as reported in Table IV-20. Additionally, the sign of the t-test statistic is negative which is the wrong sign to support the *Dividends Increase Returns Theory.*

Table IV-20: Statistics on the Monthly Returns, with and without Dividends, of the *Investment Strategy*, and Long and Short Portfolios over the Twenty Testing Periods Using the *Alternative 3 Single-index Market Model.*

	Investment Strategy w/ Divs	*Investment Strategy* w/o Divs	Long Portfolio w/ Divs	Long Portfolio w/o Divs	Short Portfolio w/ Divs	Short Portfolio w/o Divs
Observations	240	240	240	240	240	240
Mean Monthly Return	-0.003091	-0.009045	0.011179	0.004668	0.014270	0.013713
Variance of Monthly Returns	0.001457	0.001456	0.002227	0.002203	0.004498	0.004502
Coefficient of Variation	12.349	4.219	4.221	10.055	4.700	4.893
T-test[a,b]	-1.255	-3.672[g]	3.670[e,g]	1.541[f]	3.296[e,g]	3.166[e,g]
Mean Annualized Return	-0.0371	-0.1085	0.1341	0.0560	0.1712	0.1646
Variance of Annualized Returns	0.0175	0.0175	0.0267	0.0264	0.0538	0.0540
Minimum Monthly Return	-0.123091	-0.129513	-0.144641	-0.150821	-0.281900	-0.282064
Maximum Monthly Return	0.137257	0.131241	0.278224	0.269346	0.313066	0.313066
Proportion of Positive Monthly Returns	49.6	----	----	----	----	----
Binomial T-Test[c,d]	-0.124	----	----	----	----	----

a Null hypothesis A for the one-tailed t-test is: H_o: $\mu_{\text{monthly return}} \leq 0$.
The critical values are 1.645 and 1.282 for the five and ten percent significance levels, respectively.

b Null hypothesis B for the two-tailed t-test is: H_o: $\mu_{\text{monthly return}} = 0$.
The critical values are 1.960 and 1.645 for the five and ten percent significance levels, respectively.

c Null hypothesis C for the one-tailed binomial t-test is: H_o: $\text{observed}_{\%\ \text{positive}} - \text{expected}_{\%\ \text{negative}} \leq 0$.
The critical values are 1.645 and 1.282 for the five and ten percent significance levels, respectively.

d Null hypothesis D for the two-tailed binomial t-test is: H_o: $\text{observed}_{\%\ \text{positive}} - \text{expected}_{\%\ \text{negative}} = 0$.
The critical values are 1.960 and 1.645 for the five and ten percent significance levels, respectively.

e,f Null hypothesis A is rejected at the five percent and ten significance levels, respectively.

g Null hypothesis B is rejected at the five percent significance level.

Thus, the t-test fails to reject the null hypothesis that dividends do not increase returns at the ten percent significance level. Alternatively, the t-test fails to reject: (i) that dividends do not increase returns; (ii) that the *Investment Strategy* cannot earn a mean return significantly greater than zero; and (iii) that there is no positive relationship between stock returns and dividend yields.

The one-tailed binomial t-test is conducted on the observed proportion of positive monthly mean returns on the *Investment Strategy* over the 240 months. The null and alternative hypotheses are:

H_o: dividends do not increase returns: the returns of the *Investment Strategy* follows a binomial distribution with the proportion of positive returns not significantly greater than fifty percent

$$H_o\text{: observed}_{\text{proportion}} - \text{expected}_{\text{proportion}} \leq 0$$

H_a: dividends increase returns: the returns of the *Investment Strategy* follows a binomial distribution with the proportion of positive returns significantly greater than fifty percent

$$H_a\text{: observed}_{\text{proportion}} - \text{expected}_{\text{proportion}} > 0$$

The number of positive monthly returns is 119 out of 240, so the observed proportion of positive returns is 0.496 and the binomial t-test statistic is -0.124 which does not exceed the ten percent critical value of 1.282. Again, the sign of the test statistic is negative which is the wrong sign to support the *Dividends Increase Returns Theory*. Thus, the binomial t-test fails to reject the null hypothesis that dividends do not increase returns at the ten percent significance level. Alternatively, the binomial t-test fails to reject: (i) that dividends do not increase returns; (ii) that the returns of the *Investment Strategy* follow a binomial distribution with the proportion of positive returns not significantly greater than fifty percent; or (iii) that there is no positive relationship between stock returns and dividend yields.

In summary, both the t-test and the binomial t-test fail to reject the null hypothesis that dividends do not increase returns. Alternatively, the two tests fail to support: (i) that dividends increase returns; (ii) that the *Investment Strategy* can generate a return significantly greater than zero; (iii) that the returns of the *Investment Strategy* follow a binomial distribution with the proportion of positive returns significantly greater than fifty percent; or (iv) that there is a positive relationship between stock returns and dividend yields.

Dividends are Irrelevant

Again, two tests are used to analyze the 240 monthly returns of the *Investment Strategy* and to test the *Dividends are Irrelevant Theory*. The first test is a two-tailed t-test conducted on the mean monthly return of the *Investment Strategy* over the 240 months. The second test is a two-tailed binomial t-test conducted on the observed proportion of positive monthly returns on the *Investment Strategy* over the 240 months.

The two-tailed t-test is conducted on the mean monthly return of the *Investment Strategy* over the 240 months. The null and alternative hypotheses are:

H_o: dividends are irrelevant: the mean monthly return of the *Investment Strategy* is not significantly different from zero

$$H_o:\ \mu_{\text{monthly return}} = 0$$

H_a: dividends are not irrelevant: the mean monthly return of the *Investment Strategy* is significantly different from zero

$$H_a:\ \mu_{\text{monthly return}} \neq 0$$

The monthly return is -0.0030 and the t-test statistic is -1.255 which does not exceed the ten percent critical value of -1.645 as reported in Table IV-20. Thus, the t-test fails to reject the null hypothesis that dividends are irrelevant at the ten percent significance level. Alternatively, the t-test fails to reject: (i) that dividends are irrelevant; (ii) that the *Investment Strategy* cannot generate a mean return significantly different from zero; or (iii) that there is no relationship between stock returns and dividend yields.

The two-tailed binomial t-test is conducted on the observed proportion of positive monthly mean returns on the *Investment Strategy* over the 240 months. The null and alternative hypotheses are:

H_o: dividends are irrelevant: the mean returns of the *Investment Strategy* follow a binomial distribution with the proportion of positive mean returns not significantly different from fifty percent

$$H_o:\ \text{observed}_{\text{proportion}} - \text{expected}_{\text{proportion}} = 0$$

H_a: dividends are not irrelevant: the mean returns of the *Investment Strategy* follow a binomial distribution with the proportion of positive returns significantly greater than fifty percent

$$H_a:\ \text{observed}_{\text{proportion}} - \text{expected}_{\text{proportion}} \neq 0$$

The number of positive monthly returns are 119 out of 240, so the observed proportion of positive returns is 0.496 and the binomial t-test statistic is -0.124 which does not exceed the ten percent critical value of -1.645. Thus, the binomial t-test fails to reject the null hypothesis that dividends are irrelevant at the ten percent significance level. Alternatively, the binomial t-test fails to reject: (i) that dividends are irrelevant; (ii) that the returns of the *Investment Strategy* follow a binomial distribution with the proportion of positive mean returns not significantly different from fifty percent; or (iii) that there is no relationship between stock returns and dividend yields.

In summary, both the t-test and the binomial t-test of the *alternative 3 single-index market model* fail to reject the null hypothesis that dividends are irrelevant. Alternatively, the two tests support: (i) that dividends are irrelevant; (ii) that the *Investment Strategy* cannot generate a return significantly greater than zero; (iii) that the returns of the *Investment Strategy* follow a binomial distribution with the proportion of positive returns not significantly different than fifty percent; and (iv) that there is no relationship between stock returns and dividend yields.

The results of the *alternative 3 single-index model* support the *Dividends are Irrelevant Theory*. This is in conflict with the results of the *original multi-index model*. Therefore, the explanatory power of stock returns for all the firms in the sample of both models are analyzed. Additionally, the riskiness of the returns on the *Investment Strategy* are analyzed.

Section *4.2.3 Explanatory Power: Single-Index and Multi-Index Models* clearly shows that the explanatory power of stock returns with the *original multi-index model* is significantly more powerful for all firms than that of the *alternative 3 single-index model*. The riskiness of the returns on the *Investment Strategy* is also analyzed with the coefficients of variation. The coefficient of variation for the *original multi-index model* is 8.366 versus 12.347 for the *alternative 3 single-index model*. The two analyses both support that the *original multi-index model* is more robust for analyzing the testing period returns of the *Investment Strategy* and the relevance of dividends.

CHAPTER V

CONCLUSIONS

The relationship between stock returns and dividends policies is a puzzle that remains unsolved after over thirty years of theoretical and empirical modeling. The unresolved controversy is how dividends and dividend policies affect the value of the firm. The theoretical models developed to date have conflicting implications. The studies of Miller and Modigliani (1961) and Miller and Scholes (1978) conclude that dividend policies are irrelevant. Conversely, the studies of Walter (1956), Lintner (1956), Farrar and Selwyn (1967), Bhattacharya (1979), and Miller and Rock (1985) conclude that dividend policies are relevant. Therefore, empirical research has tried to determine which theoretical models best explain the relationship between stock returns and dividend policies. There are several empirical dividend issues that researchers have analyzed.

One empirical issue that researchers have analyzed is how *dividend changes* affect stock returns. Watts (1973) concludes there is no relationship between stock returns and *dividend changes* and that *dividend changes* are irrelevant. Conversely, Aharony and Swary (1980), Kwan (1981), Kalay and Loewenstein (1986), and Christie (1990) conclude that there is a significant positive relationship between stock returns and *dividend changes* and that *dividend changes* are relevant. Additionally, Brickley (1983), Jayaraman and Shastri (1988), Lakonishok and Vermaelen (1990), and Howe, He, and Kao (1992) conclude that there is a significant positive relationship between stock returns and specially designated dividends (SDDs) and that SDDs are relevant.

Another empirical issue that researchers have analyzed is how *dividend yields* affect stock returns. The *Dividends are Irrelevant Theory* concludes that *dividend yields* are irrelevant and that there is no relationship between stock returns and *dividend yields.* Conversely, the *Dividends Increase Returns Theory* concludes that *dividend yields* are relevant and that there is a positive relationship between stock returns and *dividend yields.* Thus, the results of these studies are ambiguous and conflicting. This dissertation uses several variations of a newer more robust methodology to test the relevance of *dividend yields.*

Two major hypotheses are tested in this dissertation. The first major hypothesis tested is the *Dividends Increase Returns Theory.* The second major hypothesis tested is the *Dividends are Irrelevant Theory.* To test these hypotheses, a t-test and binomial t-test are employed to determine whether an *Investment Strategy*, which consists of a long portfolio of high dividend yield stocks and a short portfolio of low dividend yield stocks, provides any ex-ante information by which investors can profit.

The process for the tests is as follows. During each estimation period of five years, the *Investment Strategy* is formulated with the use of a linear program that maximizes the dividend yield between the long and the short portfolios subject to several constraints. One set of constraints requires that the weighted mean estimated parameters, for the selected asset pricing model[15], be equal for the long and short portfolios. Then, at the beginning of each testing period of one year, the *Investment Strategy* is implemented ex-ante by purchasing the long portfolio stocks and by selling short portfolio stocks. Next, the monthly returns of the *Investment Strategy* for each testing period are calculated. Since the first and last testing periods are 1970 and 1989, respectively, the *Investment Strategy* has 240 monthly returns, which are then tested with the t-test and binomial t-test.

Since Black and Scholes (1974), Stone and Bartter (1979), and Litzenberger and Ramaswamy (1979) use a modified single-index market model, this dissertation also employs the single-index market model. The parameters of the single-index market model are estimated and then used as input for the linear program. Next, the overall mean annual return on the *Investment Strategy* over the twenty estimation periods is calculated and determined to be 0.0823, which by construction must be positive. Then, the mean annual return on the *Investment Strategy* over the testing periods is calculated. It is important to note that prior to the testing period, one may expect the mean return on the *Investment Strategy* to be positive because the long portfolio includes firms that have had a significantly higher return than the firms in the short portfolio.

[15] There are four different asset pricing models employed in this dissertation: the *original multi-index model*, an *alternative 1 multi-index model*, an *alternative 2 multi-index model*, and an *alternative 3 single-index market model*. See section *4.5 Alternative Models* for a complete description of these models.

However, the return on the *Investment Strategy* is reversed in the testing period. More specifically, the mean annual return is -0.0366 over the testing period which is a twelve percent reversal from the estimation period. Additionally, the proportion of positive monthly returns over the testing period is 0.496.

The t-test concludes that the -0.0366 mean return on the *Investment Strategy* is not significantly different from zero and the binomial t-test concludes that the 0.496 proportion of positive returns is not significantly different from fifty percent. Thus, both tests reject the *Dividends Increase Returns Theory*. Conversely, the t-test and the binomial t-test fail to reject the *Dividends are Irrelevant Theory*.

Although the -0.0366 return is not statistically significantly different from zero, most investors would agree that a -0.0366 return is economically meaningful, particularly given that the investor has none of his own money invested. One reason why the return may not be statistically significant is because of the variation remaining in the returns over the 240 month period. Alternatively stated, the single-index model may lack power in explaining the variance of stock returns. Therefore, a multi-index model that explains more variation of the stock returns is employed to test the relationship between stock returns and dividend yields.

The *original multi-index model* is the first multi-index model discussed and contributes to the dividend literature in three major ways: (i) the multi-index model accounts for significantly more variance of stock returns than the single-index market model which makes the tests results more robust than earlier studies; (ii) the more robust results permit testing the relationship between dividend yields and stock returns, an issue that has had both ambiguous results and conflicting conclusions; and (iii) the return on the *Investment Strategy* has implications for market efficiency, because in the absence of arbitrage, the return should not be significantly different from zero.

Whether the *original multi-index model* accounts for significantly more variance of stock returns than the single-index market model is tested empirically. For each estimation period, the mean R^2 of firms estimated with the *original multi-index model* is significantly greater than those estimated with the *alternative 3 single-index market model*. Additionally, not only does the multi-index model have significantly more explanatory power, but the variation of the R^2s of the firms estimated with the multi-index model is much less than that of the single-index market model. Thus, employing the multi-index model, which controls for different and more sources of risk, to test the relationship of stock returns and dividend yields is both an innovative and more powerful methodology than the modified single-index market model employed by Watts (1973), Black and Scholes (1974), Stone and Bartter (1979), and Litzenberger and Ramaswamy (1979).

The parameters of the *original multi-index model* are used as input for the linear program. Again, the overall mean annual return on the *Investment Strategy* over the twenty estimation periods is calculated and determined to be 0.0756, which by construction must be positive. Then, the mean annual return on the *Investment Strategy* over the testing periods is calculated. Again, one may expect the mean return on the *Investment Strategy* to be positive because the long portfolio includes firms that have had a significantly higher return than the firms in the short portfolio. However, the return on the *Investment Strategy* is reversed again in the testing period. More specifically, the mean annual return is -0.0427 over the testing period which is a twelve percent reversal from the estimation period. The proportion of positive monthly returns over the testing period is 0.425.

The *Dividends Increase Returns Hypothesis* is rejected by both the t-test and the binomial t-test. The t-test concludes that the -0.0427 mean return on the *Investment Strategy* is not significantly greater than zero and the binomial t-test concludes that the 0.425 proportion of positive returns is not significantly greater than fifty percent. Additionally, both signs on the test statistics are negative which is in the wrong direction to support a positive relationship between stock returns and dividend yields. In summary, both tests reject the *Dividends Increase Returns Theory*. Alternatively, the two tests reject: (i) that dividends increase returns; (ii) that the *Investment Strategy* can generate a return significantly greater than zero; (iii) that the returns of the *Investment Strategy* follow a binomial distribution with the proportion of positive returns significantly greater than fifty percent; or (iv) that there is a positive relationship between stock returns and dividend yields.

Tests of the *Dividends are Irrelevant Hypothesis* have conflicting results at the five percent significance level, but the hypothesis is rejected by both the t-test and the binomial t-test at the ten percent level. At the five percent significance levels, the t-test concludes that the -0.0427 mean return on the *Investment Strategy* is not significantly different than zero, but the binomial t-test concludes that the 0.425 proportion of positive returns is significantly different than fifty percent. Conversely, at the ten percent levels, the -0.0427 mean return on the *Investment Strategy* is significantly different from zero and the 0.425 proportion of positive returns is significantly different than fifty percent. Thus, the *Dividends are Irrelevant Theory* cannot be rejected by the t-test statistic at the five percent significance level, but can be rejected at the ten percent level. Conversely, the *Dividends are Irrelevant Theory* is rejected by the binomial t-test statistic at both the five and ten percent significance levels. Thus, the test results are not robust in supporting or rejecting the *Dividends are Irrelevant Theory.*

At the ten percent significance level, both the binomial t-test and the t-test reject that there is no relationship between stock returns and dividend yields. Additionally, both signs on the test statistics are negative which supports the hypothesis that there is a negative relationship between stock returns and dividend yields. This means that at the ten percent significance level, not only is the pre-tax return on the low dividend portfolio greater than that of the high dividend portfolio, but the post-tax return on the low dividend portfolio is also greater than that of the high dividend portfolio. This implies that some investors prefer a high dividend portfolio even if the portfolio earns a lower return than that of a low dividend portfolio with similar risk. There are several reasons why this relationship may hold.

One reason to explain the negative relationship between stock returns and dividend yields is the free cash flow theory of Jensen (1986). The payment of high dividend yields better aligns management decisions and stockholders interests. By paying high dividend yields, management signals better future investment policies. Since more of the free cash flows are "bonded", managers are less likely to waste cash flows on low net present value projects. This is why investors may accept a lower return from high dividend firms versus low dividend firms.

Another reason to explain the negative relationship between stock returns and dividend yields is that investors may wish to avoid transaction costs associated with rebalancing portfolios. Thus, these investors may prefer portfolios with high dividend yields at the expense of a lower return. An example would be large institutional investors such as pension funds who find it cheaper to receive large dividend payments that can be used to meet future cash outflows versus selling stocks and then rebalancing their portfolios. By using dividend income, transaction costs associated with the sale of stocks and rebalancing of portfolios can be avoided.

At the ten percent significance level, the *Investment Strategy* also provides ex-ante information to investors to earn a return greater than zero on a net zero dollar investment. However, for investors to profit, they must reverse the formulation of the *Investment Strategy.* Rather than buying long the high dividend stocks in the long portfolios, investors must sell short these stocks. Additionally, rather than selling short the low dividend stocks in the short portfolios, investors must buy long these stocks.

An alternative multi-index model is also considered to try to further reduce the variance of the stock returns over the testing period. This model is denoted as the *alternative 2 multi-index model* and is identical to the *original multi-index model* except for the selection process of firms from which indexes are extracted. Since it is known that the linear program selects high and low dividend yield firms, only firms with high and low dividend yields are used to estimate the index scores. Thus, the sample of firms are first sorted by dividend yields and secondarily by return yields, rather than vice verse as with the *original multi-index model.* Then, half of the firms are selected from the low dividend yield firms and half are selected from the high dividend yield firms, rather than selecting firms across the entire sample as with the *original multi-index model.* Then the tests are replicated using the *alternative 2 multi-index model.*

The overall mean annual return on the *Investment Strategy* over the twenty estimation periods is calculated and determined to be 0.0751, which by construction must be positive. Then, the mean annual return on the *Investment Strategy* over the testing periods is calculated. Again, one may expect the mean return on the *Investment Strategy* to be positive because the long portfolio includes firms that have had a significantly higher return than the firms in the short portfolio. However, return on the *Investment Strategy* is -0.0173 over the testing period which is a nine percent reversal from the estimation period. Additionally, the proportion of positive monthly returns over the testing period is 0.471.

The t-test concludes that the -0.0173 mean return on the *Investment Strategy* is not significantly different from zero and the binomial t-test concludes that the 0.471 proportion of positive returns is not significantly different from fifty percent. Thus, both tests reject the *Dividends Increase Returns Theory*. Conversely, the t-test and the binomial t-test fail to reject the *Dividends are Irrelevant Theory*.

The *alternative 1 multi-index model* is the next multi-index model employed and requires that the return on the *Investment Strategy* over the estimation period to be zero or negative. Thus, if the large return reversal from the estimation period to the testing period holds, then the mean return on the testing period should be significantly large. This model is identical to the *original multi-index model* except for three differences. The first difference is that the indexes are extracted from the stock returns with dividends rather than from stock returns without dividends. The second difference is that the dependent variable in the multi-index regression model is the firm's stock returns with dividends rather than the returns without dividends. The third difference is that the alpha parameter constraint in the linear program requires that the long portfolio's alpha be less than or equal to the short portfolio's alpha.

For each estimation period, the linear program delivers the firms that make up the *Investment Strategy*. As expected, the overall mean annualized return of the *Investment Strategy* over the estimation periods is -0.0283. However, the mean annual return over the testing periods is only -0.0237. Thus, the return change from the estimation period to the testing period is only five percent. The large return change observed with the previous three models does not occur with this model. The proportion of positive monthly returns is 0.450.

The t-test concludes that the -0.0273 mean return on the *Investment Strategy* is not significantly different from zero and the binomial t-test concludes that the 0.450 proportion of positive returns is not significantly different from fifty percent. Thus, both tests reject the *Dividends Increase Returns Theory*. Conversely, the t-test and the binomial t-test cannot reject the *Dividends are Irrelevant Theory*.

In summary, four asset pricing models are employed in this dissertation. The test results of all four asset pricing models reject the *Dividends Increase Returns Theory*. Alternatively stated, all four models reject: (i) that dividends are positively associated with high returns; (ii) that the *Investment Strategy* can generate a return significantly greater than zero; (iii) that the returns of the *Investment Strategy* follow a binomial distribution with the proportion of positive returns significantly greater than fifty percent; or (iv) that there is a positive relationship between stock returns and dividend yields.

The test results for the *Dividends are Irrelevant Theory* are not as robust across the four models. The t-tests and binomial t-tests of three models clearly fail to reject the *Dividends are Irrelevant Theory.* However, the t-test of the *original multi-index model* rejects the null hypothesis that dividends are irrelevant at the ten percent significance level, but not at the five percent level. Additionally, the binomial t-test of the *original multi-index model* rejects the null hypothesis that dividends are irrelevant at both the ten and five percent significance levels. Thus, the test results do not clearly reject or fail to reject: (i) that dividends are irrelevant; (ii) that the *Investment Strategy* can generate a return significantly different from zero; (iii) that the returns of the *Investment Strategy* follow a binomial distribution with the proportion of positive returns not significantly different from fifty percent; or (iv) that there is no relationship between stock returns and dividend yields. The conclusion is dependent upon the model selected.

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APPENDIX

Table A-1: The Industry Classifications and the Mean Annual Percentage for Each Industry of the Long Portfolio for Each Testing Period.

Industry Classification	Testing Period									
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
1. Basic Goods	18.5	16.7	20.4	20.0	21.9	10.8	12.0	8.0	2.3	8.7
2. Non Hi-Tech Capital Goods	12.0	4.7	11.9	6.0	14.0	8.5	5.4	8.0	7.7	8.3
3. Construction	14.0	16.0	10.0	6.0	0.0	2.0	0.0	2.0	0.0	2.0
4. Consumer Products	23.0	24.3	30.0	23.4	22.7	30.0	21.3	24.8	24.8	18.8
5. Energy	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6. Finance	10.0	19.3	12.0	16.0	14.0	8.0	16.0	22.0	29.2	24.2
7. Transportation	18.5	14.8	10.0	10.0	12.0	10.0	12.0	1.2	2.0	2.0
8. Utilities	0.0	0.0	0.0	14.6	10.6	28.3	29.0	28.0	30.0	30.0
9. Hi-Tech Capital Goods	2.0	2.0	4.0	2.0	2.8	2.4	2.3	4.0	2.0	4.0
10. Non-Service Consumer Products	2.0	2.2	0.0	2.0	2.0	0.0	2.0	2.0	2.0	2.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table A-1: (continued).

Industry Classification	Testing Period									
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1. Basic Goods	10.0	2.6	6.2	6.0	5.0	6.0	4.0	8.0	8.5	12.0
2. Non Hi-Tech Capital Goods	15.0	14.0	12.0	8.4	2.0	6.0	4.0	4.0	4.0	4.0
3. Construction	0.0	6.0	6.0	0.0	2.0	2.7	4.0	6.0	4.0	6.0
4. Consumer Products	20.3	16.7	10.0	17.2	17.9	12.0	12.0	12.3	13.3	12.7
5. Energy	0.0	0.1	0.0	0.0	2.0	3.1	4.0	2.7	8.0	10.0
6. Finance	21.2	24.4	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
7. Transportation	0.0	0.2	2.0	0.0	4.0	4.9	6.0	4.0	0.0	0.0
8. Utilities	29.5	30.0	29.8	30.0	30.0	30.0	30.0	30.0	30.0	23.3
9. Hi-Tech Capital Goods	2.0	6.0	4.0	6.4	4.0	1.3	2.0	1.0	0.0	0.0
10. Non-Service Consumer Products	2.0	0.0	0.0	2.0	3.1	4.0	4.0	2.0	2.2	2.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table A-2: The Industry Classifications and the Mean Annual Percentage for Each Industry of the Short Portfolio for Each Testing Period.

Industry Classification	Testing Period									
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
1. Basic Goods	18.0	14.7	20.0	18.2	16.7	20.0	7.6	8.6	10.0	8.1
2. Non Hi-Tech Capital Goods	8.0	10.0	8.0	6.0	8.0	8.0	10.0	7.3	6.0	4.0
3. Construction	0.0	2.0	2.0	5.6	4.0	2.0	0.0	0.0	0.0	2.0
4. Consumer Products	28.1	29.9	30.0	24.0	30.0	24.4	16.6	30.0	30.0	28.2
5. Energy	12.7	10.0	9.1	4.9	5.8	4.5	17.3	14.0	12.9	16.0
6. Finance	13.8	7.0	10.2	23.5	23.2	24.0	22.0	15.2	17.8	15.7
7. Transportation	2.0	6.0	8.0	9.8	4.3	6.9	13.2	9.7	14.0	12.0
8. Utilities	6.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9. Hi-Tech Capital Goods	2.6	10.0	10.7	6.0	6.0	5.5	7.3	5.2	7.3	6.0
10. Non-Service Consumer Products	8.8	6.4	2.0	2.0	2.0	4.7	6.0	10.0	2.0	8.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table A-2: (continued).

Industry Classification	Testing Period									
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1. Basic Goods	4.0	6.0	6.1	6.0	1.8	6.0	4.3	6.0	5.4	6.0
2. Non Hi-Tech Capital Goods	10.2	9.8	14.6	13.7	9.8	7.2	12.0	7.3	9.2	4.0
3. Construction	0.0	4.0	6.0	4.0	4.0	6.0	8.0	6.3	10.0	4.0
4. Consumer Products	30.0	30.0	30.0	30.0	30.0	30.0	29.6	24.6	26.4	22.9
5. Energy	12.0	7.5	7.6	0.0	4.6	4.0	2.0	7.7	2.0	4.0
6. Finance	15.0	14.0	20.2	23.6	20.4	14.7	15.3	13.7	22.1	19.1
7. Transportation	10.0	10.7	1.2	4.0	3.7	9.4	6.3	10.0	6.0	11.8
8. Utilities	0.0	0.0	0.0	2.0	2.0	2.0	2.0	4.0	4.0	6.9
9. Hi-Tech Capital Goods	6.3	10.0	8.3	8.1	12.0	8.0	6.0	6.4	4.0	9.3
10. Non-Service Consumer Products	12.5	8.0	6.0	8.6	11.7	12.7	14.5	14.0	10.9	12.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table A-3: Monthly Returns, with and without Dividends, of the *Investment Strategy* over the Twenty Testing Periods which is over January 1970 to December 1989 using The Multi-index Model.

Date	Monthly Return with Dividends	Monthly Return without Dividends	Date	Monthly Return with Dividends	Monthly Return without Dividends
Jan 1970	-0.003538	-0.005207	Jan 1972	-0.044317	-0.046418
Feb 1970	-0.045102	-0.048787	Feb 1972	-0.038352	-0.043648
Mar 1970	-0.011742	-0.016780	Mar 1972	0.007916	0.003903
Apr 1970	0.071839	0.069301	Apr 1972	0.005404	0.004375
May 1970	-0.013951	-0.017693	May 1972	-0.039843	-0.044871
Jun 1970	0.015457	0.009894	Jun 1972	-0.005833	-0.010207
Jul 1970	-0.034000	-0.035632	Jul 1972	0.009717	0.008031
Aug 1970	-0.034145	-0.039149	Aug 1972	0.015641	0.011013
Sep 1970	-0.034336	-0.040949	Sep 1972	-0.010466	-0.015153
Oct 1970	-0.003255	-0.004433	Oct 1972	0.007863	0.005918
Nov 1970	0.004772	-0.001683	Nov 1972	0.021744	0.014932
Dec 1970	0.012454	0.007394	Dec 1972	0.007267	0.002842
Jan 1971	-0.027217	-0.033553	Jan 1973	-0.007730	-0.011205
Feb 1971	-0.031258	-0.035329	Feb 1973	0.017387	0.010497
Mar 1971	-0.027960	-0.035659	Mar 1973	-0.000123	-0.004391
Apr 1971	-0.017350	-0.018142	Apr 1973	0.036075	0.033545
May 1971	0.010104	0.006678	May 1973	0.015003	0.008551
Jun 1971	-0.002134	-0.006689	Jun 1973	-0.012380	-0.018381
Jul 1971	-0.000005	-0.001437	Jul 1973	-0.073013	-0.075837
Aug 1971	-0.000462	-0.005142	Aug 1973	-0.009143	-0.017206
Sep 1971	-0.018248	-0.022704	Sep 1973	-0.018345	-0.022648
Oct 1971	-0.007100	-0.008773	Oct 1973	-0.049830	-0.054935
Nov 1971	-0.005282	-0.012364	Nov 1973	0.008331	0.000210
Dec 1971	0.005542	0.002319	Dec 1973	0.006837	0.001876

Table A-3: (continued).

Date	Monthly Return with Dividends	Monthly Return without Dividends	Date	Monthly Return with Dividends	Monthly Return without Dividends
Jan 1974	-0.015158	-0.020945	Jan 1976	-0.107160	-0.112490
Feb 1974	0.010708	0.005489	Feb 1976	-0.056060	-0.059410
Mar 1974	0.033354	0.027566	Mar 1976	-0.023720	-0.030810
Apr 1974	0.021924	0.016066	Apr 1976	0.031760	0.026790
May 1974	0.034084	0.028011	May 1976	0.010290	0.007090
Jun 1974	0.017201	0.010096	Jun 1976	-0.017370	-0.024220
Jul 1974	0.038969	0.034689	Jul 1976	0.003970	-0.000690
Aug 1974	0.027146	0.019790	Aug 1976	0.035370	0.030740
Sep 1974	0.055540	0.049480	Sep 1976	-0.020120	-0.025690
Oct 1974	-0.105070	-0.111380	Oct 1976	0.006860	0.001860
Nov 1974	0.019950	0.010860	Nov 1976	0.001570	-0.004460
Dec 1974	0.049550	0.042270	Dec 1976	-0.003610	-0.008720
Jan 1975	-0.014910	-0.023580	Jan 1977	0.038320	0.032540
Feb 1975	-0.045740	-0.051730	Feb 1977	-0.004720	-0.007930
Mar 1975	-0.023260	-0.032050	Mar 1977	0.003960	-0.001300
Apr 1975	0.015450	0.011210	Apr 1977	-0.004910	-0.009430
May 1975	-0.046890	-0.052890	May 1977	-0.016590	-0.020330
Jun 1975	0.035850	0.027440	Jun 1977	-0.028140	-0.032240
Jul 1975	0.012300	0.008580	Jul 1977	0.012320	0.008070
Aug 1975	0.045340	0.040480	Aug 1977	-0.006300	-0.011000
Sep 1975	0.061610	0.053940	Sep 1977	-0.006230	-0.009410
Oct 1975	0.007680	0.003890	Oct 1977	0.048050	0.043000
Nov 1975	0.030080	0.023980	Nov 1977	-0.022250	-0.026040
Dec 1975	0.035330	0.027620	Dec 1977	0.002770	-0.001450

Table A-3: (continued).

Date	Monthly Return with Dividends	Monthly Return without Dividends	Date	Monthly Return with Dividends	Monthly Return without Dividends
Jan 1978	-0.007040	-0.013540	Jan 1980	-0.035605	-0.043555
Feb 1978	-0.011880	-0.014060	Feb 1980	-0.024236	-0.027042
Mar 1978	-0.054640	-0.060440	Mar 1980	0.028704	0.022042
Apr 1978	-0.053470	-0.058620	Apr 1980	0.025144	0.017800
May 1978	-0.057960	-0.061970	May 1980	0.001788	-0.001688
Jun 1978	0.008980	0.002620	Jun 1980	0.028600	0.022009
Jul 1978	-0.055380	-0.059970	Jul 1980	-0.032992	-0.038859
Aug 1978	0.036870	0.034140	Aug 1980	-0.078212	-0.080918
Sep 1978	-0.031970	-0.037560	Sep 1980	-0.004581	-0.009936
Oct 1978	0.051210	0.044950	Oct 1980	-0.027358	-0.033643
Nov 1978	-0.019000	-0.023710	Nov 1980	-0.048048	-0.053025
Dec 1978	-0.023620	-0.031020	Dec 1980	-0.014049	-0.019764
Jan 1979	0.007100	-0.001440	Jan 1981	-0.013617	-0.020619
Feb 1979	-0.004290	-0.006900	Feb 1981	-0.000400	-0.003159
Mar 1979	-0.015850	-0.020180	Mar 1981	-0.033253	-0.041743
Apr 1979	-0.039450	-0.047580	Apr 1981	-0.024423	-0.031395
May 1979	-0.013154	-0.015943	May 1981	0.002757	-0.001563
Jun 1979	-0.011818	-0.019276	Jun 1981	0.018282	0.011027
Jul 1979	-0.010461	-0.017700	Jul 1981	-0.009076	-0.014966
Aug 1979	-0.045227	-0.046197	Aug 1981	0.038903	0.033240
Sep 1979	-0.017940	-0.023041	Sep 1981	0.021992	0.015399
Oct 1979	0.009182	0.000100	Oct 1981	-0.024473	-0.031995
Nov 1979	-0.029573	-0.034425	Nov 1981	0.043358	0.036264
Dec 1979	-0.073207	-0.077114	Dec 1981	0.046512	0.040067

Table A-3: (continued).

Date	Monthly Return with Dividends	Monthly Return without Dividends	Date	Monthly Return with Dividends	Monthly Return without Dividends
Jan 1982	-0.013404	-0.019906	Jan 1984	-0.029800	-0.037250
Feb 1982	0.037213	0.034228	Feb 1984	0.034810	0.031140
Mar 1982	-0.006491	-0.014377	Mar 1984	-0.040580	-0.047330
Apr 1982	-0.018341	-0.027615	Apr 1984	-0.028340	-0.035210
May 1982	-0.004654	-0.008311	May 1984	0.041950	0.035610
Jun 1982	0.003519	-0.003494	Jun 1984	-0.025460	-0.031710
Jul 1982	0.021173	0.015705	Jul 1984	0.010320	0.004350
Aug 1982	0.035549	0.029505	Aug 1984	0.018210	0.012100
Sep 1982	-0.006051	-0.011537	Sep 1984	0.021000	0.014160
Oct 1982	-0.009600	-0.017165	Oct 1984	0.034660	0.028410
Nov 1982	-0.020064	-0.025938	Nov 1984	0.039860	0.035580
Dec 1982	-0.009850	-0.015469	Dec 1984	0.019280	0.013260
Jan 1983	-0.021701	-0.026534	Jan 1985	-0.010150	-0.017110
Feb 1983	-0.017942	-0.023672	Feb 1985	0.002330	-0.002230
Mar 1983	-0.000546	-0.007092	Mar 1985	0.015180	0.007660
Apr 1983	-0.013999	-0.018774	Apr 1985	0.007240	0.000850
May 1983	-0.037735	-0.043172	May 1985	-0.015220	-0.020700
Jun 1983	-0.022863	-0.028201	Jun 1985	0.031240	0.025240
Jul 1983	0.013346	0.008599	Jul 1985	-0.013390	-0.018930
Aug 1983	0.005441	0.000082	Aug 1985	-0.031250	-0.036980
Sep 1983	-0.026766	-0.032184	Sep 1985	-0.019940	-0.026460
Oct 1983	0.009737	0.004525	Oct 1985	0.019440	0.013000
Nov 1983	-0.018835	-0.024297	Nov 1985	-0.011550	-0.016990
Dec 1983	-0.026811	-0.033253	Dec 1985	-0.008040	-0.014340

Table A-3: (continued).

Date	Monthly Return with Dividends	Monthly Return without Dividends	Date	Monthly Return with Dividends	Monthly Return without Dividends
Jan 1986	0.054940	0.049100	Jan 1988	-0.039540	-0.045080
Feb 1986	-0.022340	-0.029110	Feb 1988	-0.012440	-0.018870
Mar 1986	0.013940	0.007420	Mar 1988	-0.008930	-0.014010
Apr 1986	-0.010690	-0.015170	Apr 1988	0.002690	-0.002390
May 1986	-0.026920	-0.033700	May 1988	0.021570	0.015970
Jun 1986	0.016250	0.012120	Jun 1988	-0.007310	-0.012030
Jul 1986	0.048770	0.044820	Jul 1988	0.013030	0.007120
Aug 1986	0.046630	0.039190	Aug 1988	-0.007170	-0.013570
Sep 1986	-0.037650	-0.041780	Sep 1988	0.005087	0.001384
Oct 1986	-0.017830	-0.022370	Oct 1988	-0.001574	-0.007648
Nov 1986	0.022470	0.016710	Nov 1988	0.014128	0.008382
Dec 1986	-0.037050	-0.041090	Dec 1988	-0.026991	-0.032442
Jan 1987	0.011450	0.006190	Jan 1989	-0.000188	-0.010268
Feb 1987	-0.049630	-0.055210	Feb 1989	-0.001013	-0.006176
Mar 1987	-0.004910	-0.008870	Mar 1989	-0.024895	-0.029716
Apr 1987	-0.001660	-0.006660	Apr 1989	-0.017019	-0.021837
May 1987	-0.013240	-0.018570	May 1989	0.002529	-0.008486
Jun 1987	-0.040820	-0.045950	Jun 1989	0.054466	0.048631
Jul 1987	-0.010090	-0.015650	Jul 1989	0.008852	0.002952
Aug 1987	-0.022320	-0.027080	Aug 1989	-0.011145	-0.015984
Sep 1987	-0.013750	-0.017660	Sep 1989	-0.024161	-0.028983
Oct 1987	0.119480	0.113850	Oct 1989	-0.031095	-0.034856
Nov 1987	0.046570	0.040180	Nov 1989	0.001651	-0.002666
Dec 1987	-0.029640	-0.036670	Dec 1989	0.025423	0.023656

VITA

Robert Anthony Kunkel was born in Spring Valley, Illinois on March 14, 1961. He graduated from Tiskilwa High School in June 1979. Bob attended Illinois Valley Community College at Oglesby and graduated with an Associate in Science in May 1981. He then transferred to the University of Illinois at Champaign-Urbana where he received his Bachelor of Science in Agriculture in May 1983. After graduation, Bob worked for the Farmers Home Administration (FmHA), an agency of the United States Department of Agriculture, until May 1990. He was an FmHA Assistant County Supervisor in Illinois at the offices in Carthage, Freeport, Monmouth, Princeton, and Rushville. For several years, Bob also served as the FmHA County Supervisor in the office in Macomb, Illinois. While in Macomb, he attended Western Illinois University and received his Master of Business Administration in December 1989. In May 1990, Bob entered the Ph.D. program in Finance at The University of Tennessee at Knoxville. While at The University of Tennessee, he received a Master of Arts in Economics in December 1993 and his Doctor of Philosophy in Finance in August 1994.

Robert is currently employed as an Assistant Professor of Finance in the College of Business at Minot State University in Minot, North Dakota.