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INCOME TAXES AND CAPITAL ASSET PRICING THEORY: SOME
EMPIRICAL EVIDENCE

The University of Arizona

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INCOME TAXES AND CAPITAL ASSET PRICING THEORY
SOME EMPIRICAL EVIDENCE

by
David Neal Leggett

A Dissertation Submitted to the Faculty of the
DEPARTMENT OF FINANCE AND REAL ESTATE
In Partial Fulfillment of the Requirements
For the Degree of
DOCTOR OF PHILOSOPHY
WITH A MAJOR IN BUSINESS ADMINISTRATION
In the Graduate College
THE UNIVERSITY OF ARIZONA

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As members of the Final Examination Committee, we certify that we have read
the dissertation prepared by David Neal Leggett
entitled Income Taxes and Capital Asset Pricing Theory
Some Empirical Evidence

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SIGNED: _____

A handwritten signature in dark ink, consisting of a large, stylized 'A' or 'D' shape with a horizontal line through it, is written over the signature line.

This effort is dedicated to my daughters,

Tanja Nicole & Maya Danee

ACKNOWLEDGMENTS

I would like to thank all those who during the last two years have encouraged this effort and helped in its completion: the members of my committee at the University of Arizona, Erich Bleck, John Emery, and James Wert; my colleagues at Northeastern University; and especially Kimberly Davidson, my friend and editor, without whose help and support I would not have finished this arduous task.

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ABSTRACT

Capital asset pricing theory assumes a no-tax, after-tax efficiency equivalence; ie., that the efficient information produced in a no-tax analysis is equivalent to that which is produced in an after-tax analysis. However, if the effect of income taxes is not systematic throughout the market, the useful application of the theory may be impaired by this assumption. This research seeks to determine the effect of income tax imposition on the risk-return expectations of individual investors.

If the effect of income tax imposition is to produce non-homogeneous after-tax investor risk-return expectations, then the efficiency equivalence hypothesis must be rejected. This efficiency equivalency hypothesis is evaluated by testing two alternative hypotheses,

1. the systematic riskiness of any individual security, both with and without adjustment for the imposition of income tax, is equivalent, and

2. the no-tax and after-tax expected risk-return rank order of each individual security is the same.

An after-tax capital asset pricing model is derived. This model is based upon the premise that the current income tax laws, which require investors to share with the taxing government the uncertain returns from risky assets, allow investors to reduce the riskiness of those returns. The returns on investment assets are derived from both capital gains and from ordinary income distributions. However, the tax treatment of capital gains (losses) and ordinary income (dividends/interest) is not the same. This results in an unsystematic effect on the risks and returns of investments, thus, the income tax effect is not likely to be homogeneous as an efficiency equivalence hypothesis would imply.

The analysis focuses on the expected risk-return equivalencies for 465 firms, using ex-post data over a 10 year period.

The findings of this study imply that income tax effects on the market are not homogeneous. Income tax differentials are apparent in both the observed beta terms and the risk-return rank-ordering of the securities.

CHAPTER I

INTRODUCTION

Capital asset pricing theory assumes an efficient market in which individual investor perceptions of utility, risk, and expected returns determine the risk-return relationships defined by the capital asset pricing model. In the most common versions of the model, it is generally assumed that these perceptions are viewed homogeneously for all investors, and that all individual investor's risk-return spectrums must therefore also be homogeneous.

Although not widely acknowledged in the literature, there is evidence to support the position that, within the context of efficient capital asset pricing theory, investor risk-return relationships are also determined by the individualized, non-homogeneous tax costs which are associated with the realization of returns on each investment asset. The intent of this study is to offer evidence in support of this non-homogeneous tax effect as a necessary attribute of efficient capital asset pricing theory.

The paper has 6 chapters in addition to this introduction. Chapter 2 examines the contributions relevant to the establishment of capital asset pricing theory. This is followed in chapter 3 with an explanation of the sections of the Internal Revenue Code, 1954, that impact on investor risk-return tradeoffs, and in chapter 4 by a review of the literature which has attempted to evaluate the effect of income taxation on the traditional capital asset pricing theory.

The unique contribution of this work begins in chapter 5 where an after-tax capital asset pricing model is derived. The model is built upon the existing models which have preceded this paper, and takes into account the relevant income tax laws under which investors seek to make their utility maximizing decisions. The chapter concludes with a discussion of the widely accepted hypothesis that utility maximizing investors can make efficient investment decisions without the use of their individualized tax adjustments to risk-return tradeoffs.

In chapter 6, empirical testing of no-tax, after-tax efficiency equivalence is conducted, using 10 years of monthly ex-post returns. The empirical tests evaluate

efficiency equivalence as evidenced by an individual security's riskiness relative to the market, and by portfolio rank order of the individual securities. Finally, chapter 7 contains a discussion of the empirical tests, the results of which are consistent with the conclusion that efficiency equivalence does not exist, and that investors need to consider after-tax information if they hope to make efficient investor decisions.

CHAPTER II
CAPITAL ASSET PRICING THEORY: AN OVERVIEW

The framework from which capital market theory is developed can be traced to the work of von Neumann and Morgenstern [20] in which uncertainty and expected utility were related. Their work is structured on the assumption that individuals are basically risk averse. This assumption allows individual utility functions to be viewed as strictly concave, monotonically increasing functions which can be measured. These utility functions have the implied mathematical properties that:

1. individuals will always prefer more wealth to less..... $[MU(W) > 0]$,
2. marginal utility of wealth decreases as more wealth is accumulated..... $[dMU(W)/dW < 0]$, and
3. that these utility functions can be stated in a form that is consistent with the theories on ordinal utility as developed by John Hicks and R.G.D. Allen.

As a consequence, individuals determine utility preferences, and then seek to maximize their unique expected utility's subject to a given level of perceived risk.

Tobin [19] pioneered the association between the expected utility maximization theory of von Neumann and Morgenstern and the theory of liquidity preference. His work explored the hypothesis that an investor's portfolio preferences might be represented in terms of each portfolio's expected outcome (μ) and its standard deviation (σ). That a relationship exists between a portfolio's expected returns and its standard deviation is the general hypothesis under which capital market theory is developed. Another important contribution provided by Tobin is the Separation Theorem; the concept that utility maximizing wealth should be allocated between a riskless asset and a set of risky assets.

The benchmark upon which the current theories on capital asset pricing are built is the one-period mean-variance efficient portfolio model created by Markowitz [9]. In the context of the Markowitz portfolio model:

1. investors are von Neumann and Morgenstern risk averse; i.e., they should allocate their wealth such that they will maximize their one-period utility, subject to their unique, monotonically increasing, strictly concave utility functions, and

2. that investors' optimal portfolio decisions are based on these utility functions and on the means and standard deviations of one-period portfolio returns.

In an efficient equilibrium setting, these portfolio characteristics determine the market equilibrium relationship between risk and expected returns. While the Markowitz model did not consider differential tax effects explicitly, utility producing wealth must be measured by the relevant after-tax end-of-period wealth.

This seminal form of the capital asset pricing model is developed under certain key assumptions:

1. All investors have identical decision horizons over which individuals' investment expectations and opportunities are also homogeneous.

2. Taken individually, all investors are price takers.

3. That capital markets are perfect, an assumption which eliminates several complications such as transactions cost, unequal distributions of information, and, the focus of this study, differential tax effects.

Sharpe [17], using the aforementioned as a foundation, developed the capital asset pricing model. The major contribution made by the Sharpe model is the derivation of the capital market line (CML); the locus of all efficient risk-return relationships. The Sharpe model views risk as having two distinguishable component parts:

1. Undiversifiable (systematic) risk, the risk associated with the movement of each individual asset's returns as a function of the movement of the returns of the market as a whole (measured as the covariance of returns of an individual asset with the returns of the market portfolio), and

2. A diversifiable (unsystematic) risk, associated with the variability of returns on any individual investment asset. The unsystematic risk includes all sources of variation attributable to the unique characteristics of a firm's securities, rather than changes in the market.

This model assumes a market of von Neumann and Morgenstern risk averse investors who make portfolio decisions based upon the equilibrium relationship between the appropriate measure of the risk of an investment asset and that asset's one-period expected return. Being risk averse, investors will pay a premium to reduce their exposure to the market-reflected systematic risk of the economy as a whole. To reduce their exposure to a security's unsystematic risk, investors need only diversify. Therefore, investors are not willing to pay a premium to reduce their exposure to any risk which is independent of macro-economic conditions.

As used in Sharpe's model, the market portfolio is the combination of all investment opportunities available to the investment community. By definition, the only risk in the market portfolio is systematic risk. Therefore, in static equilibrium, any asset not perfectly correlated with the market portfolio at any point in time will be price adjusted in a manner determined by its correlation with the market; i.e., on an ex-ante basis, all investment assets with identical systematic risk will be priced such that these assets will provide the same expected rate of return.

Lintner [6], independently achieving results similar to those of Sharpe,¹ concluded that the valuation of an individual security is not linearly related to the standard deviation of its returns, but is more appropriately related to its covariance of returns within this market portfolio.

The literature is replete with empirical tests of the capital asset pricing model and its applications. Perhaps one of the most comprehensive examinations of the model is that of Fama and MacBeth [5]. Looking at the set of assumptions and the testability of the model, they conclude

...given that the market portfolio is efficient--or, more specifically, given that our proxy for the market portfolio is at least approximately efficient--we cannot reject the hypothesis that average returns on New York Exchange common stocks reflect the attempts of risk averse investors to hold efficient portfolios....

Further, in support of the Sharpe-Lintner conclusions, Fama and MacBeth found that they could not "....reject the hypothesis that in making a portfolio decision, an investor should assume that the relationship between a security's portfolio risk and its expected return is linear...."

(1) Fama, Eugene F., Risk, Return and Equilibrium: Some Clarifying Comments, The Journal of Finance, March 1968 [pg.40].

The model as established is widely accepted as sound theory, but as theory none-the-less. A critical argument against the usefulness of the model however is presented by Roll [12,13]. Roll points out that the efficiency of the market portfolio and the validity of the capital asset pricing model are joint hypotheses which, because of the difficulty in identifying and measuring the true market, as well as the monumental computational problems, render the model almost impossible to test. The critique does not debate the internal validity of the model; rather, it questions the specificity of the beta coefficient (the term representing the covariance relationship between the variance in the market portfolio returns and the variance of a specific investment asset's returns). Roll concludes that, unless the exact composition of the true market portfolio or its proxy is known, the results of any tests of the model must be interpreted with extreme caution.

An alternative to the capital asset pricing model is the more general model formulated by Ross [15] which he identified as the arbitrage pricing model. This model is derived as a linear function of k factors stated as

$$R(i) = E(R(i)) + b(i,1)F(1) + \dots + b(i,k)F(k) + e(i),$$

where:

$R(i)$ = the random rate of return on the i th asset;

$E(R(i))$ = the expected rate of return on the i th asset;

$b(i,k)$ = the sensitivity of the i th asset's returns to the k th factor;

$F(k)$ = the mean zero k th factor common to the returns of all assets under consideration; and

$e(i)$ = a random zero mean noise term, representing the unsystematic risk, for the i th asset.

Being a more general model, it is not necessary for the arbitrage pricing model to rely on many of the assumptions of the capital asset pricing model. Specifically, in satisfaction of the Roll critique, it does not require the specificity of a market universe of assets. Roll and Ross [14], Chen [4], and others, have done empirical tests of the arbitrage pricing model. These works have provided support for the validity of the arbitrage pricing model, however identification of the factors (k) which explain the returns on all assets is as yet unclear,

making the application of the model at least as suspect as the application of the capital asset pricing model. The arbitrage pricing model does however provide support for the theoretical foundation of the capital asset pricing model.

In the original development of both the traditional capital asset pricing model and the arbitrage pricing model, any differential effects on the security pricing mechanism emanating from the nature of the income taxing mechanism is eliminated by the perfect market assumption. However, the assumption that no efficiency is lost by interpreting the risk-return relationships in the capital markets without imposing the effect of income taxes is beginning to attract attention. If the effect of this assumption on the useful application of the model can be identified, it might then be possible to amend the traditional model to encompass the effects of differential income taxes. The balance of this work focuses on the effect of this perfect market assumption. It is appropriate to begin with a short discussion of income tax law in general and its impact on investor decision making.

CHAPTER III
INCOME TAXES: A TRANSACTION COST¹

The Sixteenth Amendment to the Constitution of the United States, ratified in 1913, gave Congress the power to tax "income from whatever source derived."

Beginning with the Income Tax Revenue Act of 1913, Congress has included within the reaches of the Sixteenth Amendment, gains from the sale of investment properties, including but not limited to securities. In 1921, the Supreme Court of the United States upheld the inclusion of gains from the isolated sale of property as within the reaches of both the Sixteenth Amendment and the Income Tax Act of 1916 (Merchants Loan and Trust Co. v. Smietanka, 205 U.S. 509). Also in 1921, presumably in response to cases similar to Merchants Loan and Trust Co., Congress distinguished for the first time the isolated sale of property from the recurring sales of property. Their action imposed a lower, preferential tax on "Long Term Capital Gains" arising from the occasional sale of property than was

(1) The discussion of relevant income tax law is done for the period beginning January 1, 1972, and ending December 31, 1981.

imposed on the ordinary income arising from recurring sales. This distinction has been maintained in the 1954 codification of the income tax laws under which investors evaluate risk-return tradeoffs today.

Section 1222 (3), I.R.C. 1954, defines long term capital gain as the "gain from the sale or exchange of a capital asset held more than 1 year,...".² Furthermore, Section 1221, I.R.C. 1954, defines securities not held as inventory as capital assets. As a consequence, the gains from the disposition of securities which have been held by an investor for more than the statutory period qualify for taxation as "Long Term Capital Gains".

Section 1202, I.R.C. 1954, determines the preferential tax treatment afforded individual taxpayers' capital gains, and has been amended several times in the last decade. For the period January 1, 1971 until October 31, 1978, the law provided for the inclusion of only one-half of the total gain in taxable income, with a maximum tax of 25% on the first \$50,000 of the gain. The amount of gain in excess of the first \$50,000 was taxed at a maximum rate of 32.5% for 1971, and 35% for the years thereafter.

(2) For periods after June 22, 1984 and before December 31, 1987, the holding period defined in Section 1222 (3), I.R.C. 1954 has been changed to "...more than six months...."

Effective November 1, 1978, the excluded portion of the total gain was increased to 60%, such that only 40% of the total gain was included in taxable income. This reduced the effective maximum tax on the total capital gain to 28% (40% of 70%). For the period after June 9, 1981, the maximum tax was reduced further, to 20%. For the entire period, January 1, 1971, to December 31, 1981, the excluded portion of the total capital gain was subject to a minimum tax, an example of which is shown in Table 2.

The law also provided that, for the entire period January 1, 1971 to December 31, 1981, only 50% of the total long term capital losses could be deducted from ordinary income. This results in an effective maximum benefit equal to 35% of the total long term capital loss. The "Long Term Capital Loss" deduction is also subject to an annual limitation; however, unused losses can be carried forward for an unlimited period of time.

The data in Table 1 shows the effective differential marginal tax rates for both ordinary income and capital gains as they existed during the period January 1, 1971 to December 31, 1981. Table 2 shows an example of how the effective tax is computed.

TABLE 1
Effective Differential Tax Rates ^a

Period	Marginal Ordinary Income Tax Rates	Marginal Capital Gains Tax Rates
01/01/71-12/31/71	14% to 70%	7.0% to 32.5%
01/01/72-10/31/78	14% to 70%	7.0% to 35.0%
11/01/78-06/09/81	14% to 70%	5.6% to 28.0%
06/10/81-12/31/81	14% to 70%	5.6% to 20.0%

(a) Without the inclusion of either minimum tax or alternative minimum tax on the excluded portion of the total gain.

The returns on all portfolios of stock investments, except those portfolios totally exempt from taxation, can be treated for tax purposes in three different ways. First, under Section 316 I.R.C 1954, "....distributions made by a corporation to its shareholders in money or property out of its earnings and profits for the tax year or accumulated after 2-28-13,..." are taxable, and subject to tax at ordinary income rates. This is the normal result of corporate dividend distributions.

Second, corporate distributions that are not made out of the earnings and profits of the tax year, or

TABLE 2
Computation of Effective Differential Tax

Assume a married individual filing a joint return, with \$100,000 of taxable ordinary income, and a capital gain from the sale of securities of \$100,000, sold on December 31,

	1971	1975	1980	1981
Tax on \$100,000 of ordinary income (a)	\$ 45,180	\$ 45,180	\$ 41,998	\$ 41,998
Tax on first \$50,000 of total cap. gain (max. 25%)	12,500	12,500		
Tax on remaining \$50,000 of total cap. gain (max. 32.5%) (b)	16,200			
Tax on remaining \$50,000 of total cap. gain (max. 35%) (b)		16,200		
Tax on total \$100,000 cap. gain (\$40,000 includable)			25,130	
Tax on total \$100,000 cap. gain (\$40,000 includable) (max. 20%)				20,000
Total regular tax	\$ 79,880	\$ 79,880	\$ 67,128	\$ 61,998
Min. tax on L/T cap. gain (c)	0	0	3,965	4,350
Alternative minimum tax (d)	0	0	0	0
Total tax	\$ 79,880	\$ 79,880	\$ 71,093	\$ 66,348
Tax on \$200,000 ordinary income	\$110,980	\$110,980	\$107,032	\$107,032
Differential due to Preferential tax treatment	\$ 31,100	\$ 31,100	\$ 35,939	\$ 40,684

(a) assumes unearned income not earned income, and therefore not subject to maximum tax.

(b) regular tax on \$100,000 of ordinary income plus \$50,000 of includable gain (1/2 of \$100,000 total gain), is \$76,980. The regular tax on \$100,000 of ordinary income plus \$25,000 of includable gain (1/2 of first \$50,000, with 25% maximum) is \$60,780. The differential is attributed to the remaining \$50,000 of total gain.

(c) 15% of the difference between the \$60,000 excluded portion of the total gain, and the greater of \$10,000 or 1/2 the total regular tax. For the period 1971 thru 1978, the minimum tax was 10% of the difference between the excluded portion of the total gain, and the greater of \$30,000 or the regular tax.

(d) alternative minimum taxable income would be computed as the taxable income plus the excluded portion of the total capital gain. The alternative minimum tax is then 0% of the first \$20,000; 10% of the next \$40,000; 20% of the next \$40,000; and 25% of the balance, less regular taxes paid, and less minimum taxes paid.

accumulated since 2-28-13, are capital distributions. These capital distributions are treated as either a partial return of basis (cost), or a complete return of basis. Such distributions of capital reduce the basis in the investor's stock, and are not taxable unless the aggregate of such dividends received exceeds the basis in the stock. A good example of this would be the dividends paid on the common stock of many capital intensive public utility firms who, due to large depreciation and amortization deductions, have cash available for distribution which is in excess of their earnings and profits. However, because the non-taxable capital distributions received reduce basis, they have the effect of increasing the potential capital gain on disposition, and are hence not really non-taxable distributions.

Lastly, the returns can be in the form of an incremental value (capital gains) which is realized when an individual investment asset is disposed of, or when non-taxable corporate distributions are received in excess of basis. If the holding period of the individual security has been less than the required statutory period, these capital gains are taxed at ordinary tax rates. However, if the security has been held for a period which is at least equal to the qualifying period, these returns are taxed at

the preferential tax rates afforded "Long Term Capital Gains".

The disparity evident between the treatment of different types of returns, and between marginal ordinary tax rates and marginal capital gains rates, gives investors subject to current taxation a strong impetus to seek out investments which convert ordinary income returns from dividends, interest, and short term trading, into less certain, deferred, capital gains. The preference for such conversion becomes stronger as the investor's marginal tax rate increases. However, the question as to the dominance of any one tax rate investor in the market, or in any segment thereof, over any other tax rate investor is primarily an empirical one.

To impose the implications of income tax law on the capital asset pricing model is to add more complexity to a model which is already suspect. To not impose the implications of income tax law on the capital asset pricing model is to ignore a major market determinant, which, if income taxes affect the relationships between risk and return, does not add to the creditability of the model in real world applications. The chapters which follow examine the inclusion of income taxes on the relationship between risk and return within capital asset pricing theory.

CHAPTER IV

EFFECT OF TAX IMPOSITION ON THE CAPITAL ASSET PRICING MODEL

The perfect market assumption that individual investor's perceptions of capital asset pricing efficiencies are not effected by differential income taxes is not intuitively acceptable. For this assumption to hold, individual investor's expectations should be the same with respect to both (1) an individual investment's market relative risk premium, and (2) the investment's risk-return rank order. The model developed in Chapter 5, and tested in Chapter 6, provides empirical evidence that investor's expectations of both relative riskiness and risk-return rank order should not be assumed to be unaffected by differential income taxes.

The first derivation of an after-tax capital asset pricing model is properly credited to Brennan [3]. His work extended the Modigliani and Miller [11] analysis of the effects of income taxation on corporate capital structure and dividend policy, to an analysis which included relevant personal tax implications on the valuation of corporations. More importantly, his analysis recognized the impact of the

asymmetric tax treatment of incomes received by investors in the form of dividends as opposed to incomes received in the form of capital gains.

The equation which Brennan uses to express the effect of differential marginal income tax brackets on the uncertain market valuation expectations for any security j , is stated as:

$$R(j) - r = H \text{Cov}(R(j), R(m)) + T(d(j) - r)$$

where:

$$T = (T(d) - T(g)) / (1 - T(g));$$

$T(d)$ = weighted average of investors
marginal tax rates on dividends;

$T(g)$ = weighted average of investors
marginal tax rates on capital gains;

$$H = R(m) - r - T(d(m) - r);$$

$R(m)$ = expected return on a value-weighted
market portfolio; and

$d(m)$ = expected dividend yield on a
value-weighted market portfolio.

This expression by Brennan recognizes that, in addition to the covariance of returns between security j and the market, the risk premium expected by investors on security j is a function of an investor's weighted tax on capital gains and his weighted tax on dividends. His findings are summarized in his conclusion that "....for any given level of risk, investors require a higher total return on a security the higher is its prospective dividend yield, because of the higher rate of tax levied on dividends than on capital gains."

This seminal work by Brennan was followed by a proliferation of income tax implication research, both theoretical and empirical. In these new works, dividend yield and dividend policy are looked at in a new light, one in which differential income tax rates are viewed as having a possible effect on the efficiency of the capital asset pricing mechanism.

One of the first empirical studies questioning the effect of income taxes on the model is the work done by Black and Scholes [2]. Their study examines corporate dividend policy as an attribute of capital asset pricing theory under the hypothesis that rational investors prefer capital gains to dividends for tax reasons. The results of this work argue that a taxable investor who concentrates his

portfolio on low current yield securities (low dividend yield) cannot tell whether he is increasing or decreasing his expected after-tax return by doing so. As a consequence, they conclude that dividend policy cannot unambiguously be said to affect stock price. They conclude further, that because of the uncertainty about the direction and the magnitude of the effect of its dividend policy, corporations may simply decide to ignore the effect of dividend policy on its stock price.

Following the hypotheses developed and tested by Brennan, and the empirical evidence reported by Black and Scholes, the next major contribution was made by Long [8]. In his work, Long concluded that an "efficiency equivalence" between no-tax and after-tax capital asset pricing evaluation exists; i.e., "portfolios that are mean-variance efficient on a no-tax basis are also efficient on an after-tax basis and visa-versa." Long examined the relationship between no-tax efficient portfolios and after-tax efficient portfolios under the following assumptions:

1. the one-period dividend yield on a security is perfectly predictable at the beginning of the period,
2. taxes on dividends are a constant function of dividend income,

3. taxes on capital gains are a constant function of capital gains income, and

4. all taxes are paid at the end of the period.

From the empirical evidence gathered in the study, he observed that "....investors with different tax rates may rank portfolios differently on the basis of expected after-tax return, and thus may face different after-tax efficient sets." Although seemingly obvious in hindsight, this observation was an important development in the context of efficient market theory.

He further observed that risk, as measured by the variance of after-tax returns, will maintain the same rank order in after-tax terms as in no-tax terms. This second observation may have empirical validity with Long's set of assumptions; however, the model developed and tested in this work provides empirical evidence to the effect that it may not be true under conditions of uncertain dividends and differential income tax rates.

Long's propositions imply:

(i) the greater the risk level of a before-tax efficient portfolio, the less efficient it is on any given after-tax basis, [and]

(ii) any given before-tax efficient portfolio will be less efficient on an after-tax basis the greater the difference between an investor's marginal tax rates on dividends and capital gains.

In the context of the traditional Sharpe-Lintner capital market line, where all investors are assumed to be price-takers, the Long results imply that any given investment asset will have multiple market rates of return at any point in time. These multiple returns depend upon the tax bracket of the investor, and whether the returns will be taxed at capital gains rates or ordinary income rates. This leads to the further implication that, when returns are adjusted for ordinary income and capital gains tax imposition, the security market line is a band, with multiple rates of return for each level of acceptable risk (Figure 1) rather than a point continuum security market line as suggested by Sharpe. The result, in after-tax terms, is that investor expectations of return and risk are not homogeneous, that every investor will have a slightly different security market line within the spectrum, and that, therefore, a static equilibrium cannot exist.

Litzenberger and Ramaswamy [7] derived an after-tax capital asset pricing model using observed betas as estimations of expected relative risk functions. Consistent with the results reported by Long, their work found the existence of a positive relationship between increases in required return expectations and increases in dividend yields. Further, their results confirmed Brennan's conclusion that high tax bracket investors choose stocks

Figure 1

After-Tax "Security Market Band"

$E(R(i,j))$ = after tax expected rate of return on security i , for investor j .

$\sigma(i)\sigma(m)$ = covariance of returns between security i , and the market portfolio, without tax adjustment on returns.

with low dividend yields, and low tax bracket investors choose stocks with high dividend yields. Unfortunately, their findings are impaired by two of their basic assumptions (similar to those made by Long) that;

1. "dividends on securities...are known with certainty at the beginning of the period," and that

2. "there are no taxes on capital gains."

These convenient assumptions allowed them to eliminate the effect of taxes on their covariance measurements of risk (and therefore on beta), because none of the variability of return on any individual security, or on the market, could be attributed to a taxable return.

With these limiting assumptions, the slope of the capital market line for any tax exempt investor will always be greater than the slope of any capital market line for an investor with a positive marginal tax bracket. This follows because the tax-paying investor must share the premium for additional risk assumption with the tax-levying government. Therefore, any investment whose returns are reduced by a positive tax imposition can never find its way to an efficient point in the spectrum of risk-return space. Additionally, the implication is that the higher the investor's marginal tax rate, the lower the required

marginal expected returns for any marginal risk assumption;
i.e.,

$$\frac{d E(R(i, \text{zero tax}))}{d(\sigma(i) \sigma(m))(\text{zero tax})} > \frac{d E(R(i, > \text{zero tax}))}{d(\sigma(i) \sigma(m))(> \text{zero tax})}$$

More recently, Singer [18] created a "model of investor behavior in the context of after-tax mean-variance efficiency." Abstracting from the effects of differentials between ordinary income tax rates and capital gains tax rates, Singer concluded that the required risk premium on any security i is dependent not only upon the market relationships, but also on the individual's tax function; i.e., a clientele effect exists, and

...unlike the clientele effect indicated by Miller and Modigliani [10], and by Brennan, the clientele effect identified here does not merely depend on the firm's dividend policy but is determined by all the risk characteristics of the firm including, but not limited to the firm's dividend policy.

In other words, individual investor's tax functions affect not only their expected after-tax returns on security i , but also their individual perceptions of the risk associated with achieving those expected returns.

It is this conclusion with respect to risk and returns which this work seeks to extend.

CHAPTER V
AN AFTER-TAX CAPITAL ASSET PRICING MODEL

In deriving an after-tax capital asset pricing model, the assumptions of the traditional capital asset pricing model can be retained with a modification only to the assumptions with respect to tax imposition on investors' returns and risk perceptions.

Traditional Assumptions

The traditional capital asset pricing model, identified in this work as the no-tax capital asset pricing model, assumes that:

- (i) Each individual investor is free to borrow or lend an unlimited amount at an exogenously determined riskless rate of interest, R .

Although the assumption of an unrestricted, risk-free rate of interest is used in the traditional

development of the capital asset pricing model, Black [1] showed that the model does not require this assumption. Black derived a capital asset pricing mechanism with the use of a two-factor, zero-beta model. This pricing mechanism produced expected individual security returns as a linear combination of the expected returns on two sets of assets:

1. the market portfolio, and
2. a unique, minimum-variance, zero-beta portfolio which is uncorrelated with the market portfolio.

This zero-beta portfolio is necessarily composed of both long and short positions in risky assets, thus requiring the relaxation of the restriction on short sales which existed in earlier models. Ross [16] has shown that absent the assumption of either a risk-free asset or a relaxation of the restriction on short sales, the capital asset pricing model does not hold up.

The no-tax capital asset pricing model assumes further that:

- (ii) Each investor can invest any fraction of his capital in any or all of a finite set of risky securities paying a stochastic rate of return, r .

(iii) The market supply, in terms of numbers of shares, of each risky asset is exogenously determined.

(iv) All investors make all purchases and sales at discrete points in time, the time period being identical for all investors.

(v) All assets are traded in a single competitive market.

(vi) Investors have already determined the dollar amount of capital they intend to use for speculative purposes.

(vii) Each investor's decisions are made on the basis of the mean and variance of his portfolio return.

(viii) Investors are able to assess the relevant expectations, variances and covariances of each risky asset's rate of return.

(ix) All investors are risk averse.

(x) Investors possess homogeneous expectations.

Simplified Income Tax Assumptions

In order to allow for a tax function, Singer (1979) modified assumptions (vi), (vii), (viii) and (x) to become:

(vi') Investors have already determined the dollar amount of capital they intend to use for speculative purposes. This amount is assumed to be independent of the investor's tax function.

(vii') Each investor's decisions are made on the basis of the mean and variance of his after-tax portfolio returns.

(viii') Investors are able to assess the relevant expectations and movements of each asset's before-tax joint probability distribution of return.

(x') All investors have identical assessments of the probability distribution of each asset's before-tax rate of return.

Necessary Additional Differential Tax Assumptions

Two additional assumptions added by this work are necessary to define the effect of income tax imposition:

(xi) Each investor is subject to a non-homogeneous tax liability which is a monotonically increasing function of the investor's income from capital over the period. All sources of income from capital are assumed to be realized at the end of the

period, and all taxes are assumed to be payable at the end of the period.

(xii) Income from capital (in dollars) is the sum of capital gains, dividends, and interest, generated from speculative capital over the period. Income from dividends and interest are taxed at rate T ; and income from capital gains is taxed at rate C ; where $0 < C < T < 1$.

These basic assumptions are necessary to distinguish the model generated in this work as an after-tax capital asset pricing model. Their inclusion will allow for a test of the effect of differential income taxes as the only non-homogeneous constraints on investors seeking to maximize after-tax returns, subject to an accepted level of after-tax risk.

Traditional Model

In the traditional model developed by Sharpe, the expected return from a security is an increasing function of its systematic (undiversifiable) risk as measured by its covariance of returns with the market. In other words, the more systematic risk a security has, the greater the expected returns investors require. This definition can be expressed mathematically as:

$$R(i) = R(f) + \{\sigma(i) \sigma(m) / \sigma(m)^2\} \{R(m) - R(f)\} \quad (1)$$

where:

$R(i)$ is the estimate of the expected return on security i ;

$R(f)$ is an estimate of a risk-free rate of return;

$R(m)$ is the expected return on the market portfolio;

$\sigma(m)^2$ is the variance of market portfolio returns; and

$\sigma(i)\sigma(m)$ is the covariance of returns on security i and the returns on the market portfolio.

The one-period returns on security i can be stated as

$$r(i) = \{d(i) + (p(n) - p(n-1))\} / p(n-1) \quad (2)$$

where:

$d(i)$ is the expected one-period dividend on security i ;

$p(n)$ is the price of security i at the end of the period; and

$p(n-1)$ is the price of security i at the beginning of the period.

In a similar manner, the one-period returns on the market portfolio can be stated as

$$r(m) = \sum w(i)r(i) \quad (3)$$

where $w(i)$ is the weighted value of security i , relative to the total value of the market portfolio.

Adjustment To Traditional Model For Taxes

To answer the questions raised in this work, the no-tax model needs to be augmented to include the effect of income tax implications on investor expectations. Unlike previous works, the model derived herein distinguishes between the type of tax being imposed. Consistent with applicable federal income tax laws, the model considers the differences between the ordinary tax rates on dividends and the capital gains (losses) tax rates on price changes. When imposing taxes on the model however, the non-homogeneity between investors' tax consequences causes the model to

produce investor analyses which are not necessarily homogeneous.

Restating the no-tax capital asset pricing model with equations in after-tax terms for investor j , $r(i)$ becomes;

$$r(i,j) = \{d(i)(1-T(j)) + (p(n) - p(n-1))(1-C(j))\} / p(n-1) \quad (2')$$

where:

$T(j)$ is the ordinary income tax rate for investor j ; and

$C(j)$ is the capital gains tax rate for investor j .

From the adjustment to the universe of $r(i)$ terms, $r(m)$ becomes;

$$r(m,j) = w(i)r(i,j) \quad (3')$$

Therefore, the expected after-tax return on security i for investor j becomes;

$$R(i,j) = R(f)(1-T(j)) + \frac{\sigma(i,j)\sigma(m,j)}{\sigma(m,j)^2} \{R(m,j) - R(f)(1-T(j))\} \quad (1')$$

where $\sigma(i,j)\sigma(m,j)$ is the covariance of after-tax returns on security i and the after-tax returns on the market portfolio for investor j .

Result Of Tax Imposition On The Model

Since $\sigma(i,j)\sigma(m,j)$ is unambiguously less than $\sigma(i)\sigma(m)$, the investor's reduced individualized after-tax returns are being compensated for by reduced individualized after-tax risk. The relative magnitude of the reduction in the investor's individualized risk will be a function of:

(i) The investor's individualized marginal tax rates on ordinary income and capital gains;

(ii) The fraction of the total expected return made up of dividends or interest;

(iii) The fraction of the total expected return made up of capital gains; and

(iv) The magnitude of the before-tax covariance of returns on security i .

The effect of income taxes on the individualized risk-return tradeoffs of investors is less subject to estimation than the impact of any other dependent variable. In general, it can be said that, for any individual investor, the intercept on the vertical axis of the

risk-return space, will be affected only by the imposition of a positive marginal tax on the risk-free return. However, the imposition of differential income taxes on the returns of all individual investment assets in the market will cause a reduction in the the covariance of returns (systematic risk) of any individual investment asset having a positive no-tax covariance of returns with the market. This reduction in systematic risk provides compensation for the reduction in the individual investment asset's expected returns. Mechanically, this reduction in the after-tax covariance of returns will cause all points which identify the efficient after-tax risk-return relationships to move to the left at the same time the points are moving down in response to the imposition of taxes on the individual investment's returns. Because the intercept on the vertical axis does not change with respect to an after-tax risk adjustment, this results in a change in the slope of the security market locus of the after-tax risk-return relationships, the change being an ambiguous function of the factors identified above (Figure 2).

Hypothesis Testing

The underlying hypothesis developed and tested in previous works, is that investors can make efficient investment decisions without the use of tax adjustments to

Figure 2

After-Tax "Multiple Security Market Lines"

$E(R(i,j))$ = after-tax expected rate of return on security i , for investor j .

$\sigma(i)\sigma(m)$ = covariance of returns between security i , and the market portfolio, without tax adjustment on returns.

risk-return tradeoffs. This hypothesis appears to be broadly accepted, as evidenced by the fact that the major market research firms active in the securities marketplace today seldom include no-tax/after-tax risk-return considerations explicitly in their investment recommendations. As a consequence, investors are using pre-tax risk-return determinants of efficiency, while seeking to maximize their after-tax utilities.

In order for investors to make efficient risk-return decisions under these conditions, the market's relative risk terms (betas) for all investments must be the same (or approximately so) for an investor subject to a positive marginal tax rate as it is for the tax-exempt investor; i.e.,

$$B(T>0) / B(T=0) = 1$$

If $B(T>0) / B(T=0)$ is not equal to 1, the conclusion that investors are not losing efficiency by using pre-tax risk-return determinants in structuring their portfolios can be rejected. Additionally, if the relationship between $B(T>0)$ and $B(T=0)$ is not constant, the evidence might imply that a clientele income tax effect exists.

The results of this work will answer two questions:

1. Is the market after-tax mean-variant efficient?
2. Are there investment assets in the market portfolio which are mean-variant efficient for some investors but not for all investors because of investor's different income tax brackets?

CHAPTER VI

AN EMPIRICAL TEST

In order to test empirically the effect of income tax implications on the efficiency of investor risk-return tradeoff perceptions, it is necessary to identify the differences in the ex-ante expectations produced by the no-tax capital asset pricing model, expressed by the equation:

$$R(i) = R(f) + \{\sigma(i)\sigma(m)/\sigma(m)^2\}\{R(m) - R(f)\}, \quad (1)$$

as compared with the expectations produced by the expression of the capital asset pricing model augmented to include the differential income tax implications on investor j:

$$R(i,j) = R(f)(1-T(j)) + \frac{\sigma(i,j)\sigma(m,j)}{\sigma(m,j)^2} \{R(m,j) - R(f)(1-T(j))\}. \quad (1')$$

Pre-Tax Market Data Base

To construct a homogeneous market portfolio database which could be subjected to analysis under both equations (1) and (1'), 466 company's consecutive month-end stock price and dividend payment records for the period January, 1972 through December, 1981, were drawn from the COMPUSTAT stock tapes. Only those stocks which were included in the Standard and Poor's 500 Composite Group for each month in the 10 year period are included in the sample portfolio. By thus restricting inclusion in the database, a consistent 120 one-period observations for each factor of each security in the database is provided. These securities were then grouped into sub-portfolios which are identical to the sub-portfolios within the Standard and Poor's 500 Composite Group, as follows;

1. S & P FINANCIALS (27)
2. S & P UTILITIES (18)
3. S & P TRANSPORTATIONS (30)
4. S & P INDS. [DPS/EPS > 50%]¹ (68)
5. S & P INDS. [DPS/EPS < 50%] (323)

(1) The use of a 50% dividend payout ratio as the distinguishing factor for firms included as high dividend payout firms versus low dividend payout firms was arbitrary. The results indicate that such a differentiation is not necessary because both of these portfolios seem to behave consistently.

The purpose for creating these sub-portfolios within the total portfolio of securities was to identify economic sectors and/or corporate dividend policies which are more sensitive to income tax effects than others.

The security characteristics needed for inclusion in the database were:

1. $d(i)$, the dividends paid during the period on security i , and
2. $p(i)$ the closing price of security i on the last day of each month in the period.

These security characteristics were used to compute the ex-post one-period returns for each of the 120 months in the period by the use of the equation:

$$r(i) = \{d(i) + (p(n) - p(n-1))\} / p(n-1) \quad (2)$$

As an estimation of the ex-post one-period returns on the market for each of the comparative 120 monthly periods, the month-end closing Standard and Poor's 500 composite index was used as a proxy for the relative value of the market at the end of each period. The change in index value was used as a proxy for the change in the relative value of the market. The dividends as derived by the Standard and Poor's four-quarter moving totals for the

securities included in the composite index were compiled as a proxy for the value relative distributions paid on the market portfolio. The ex-post, monthly, value relative return for each of the 120 periods was then computed as:

$$r(m) = \{d(m) + (I(n) - I(n-1))\} / I(n-1) \quad (4)$$

The mean monthly ex-post return on the market proxy was used as an estimate for the ex-ante no-tax return on the market, $R(m)$. During the 120 monthly periods, the mean no-tax return on the Standard and Poor's composite 500 index was 7.44%.

From the 120 $r(i)$ terms for each security, the standard deviation of actual ex-post no-tax returns, $\sigma(i)$, is computed, and is used as an estimate of the variability of ex-ante expected returns on each security i . The standard deviation of the ex-post returns on the market proxy, $\sigma(m)$, is used as an estimate for the ex-ante variability of the market. During the 120 monthly periods, the ex-post standard deviation of returns on the market proxy, $\sigma(m)$, was 4.4%.

The ex-post covariance of returns between security i , and the market, $\sigma(i)\sigma(m)$, computed for each security in the database portfolio as shown in Appendix A, was used as an estimate of the ex-ante, efficient portfolio, diversifiable riskiness of security i .

An estimate of the risk-free rate of return, $R(f)$, comes from the 30 day U.S. Treasury bill rate, which during the data period ranged from just under 4% to almost 15%, having an arithmetic mean of 5.43%.

Given the model for expected returns on any security i described by the equation:

$$R(i) = R(f) + \{ \sigma(i) \sigma(m) / \sigma(m)^2 \} \{ R(m) - R(f) \}, \quad (1)$$

the efficient, ex-ante risk-return expectations for each security in the marketplace produce the capital market line depicted in Figure 3. This no-tax capital market line is based upon the estimates for the ex-ante covariance measurements of risk, the excess return multipliers (betas), and the expected returns found in Appendix A, an excerpt of which is shown in Table 3.

Table 3
No-Tax Investor
(excerpt of Appendix A)

RANK ^a	SEC #	VARIANCE	CO- VARIANCE	BETA	EXPECTED RETURNS
	Market	0.001942	0.001942	1.00000	0.074395
20	8140	0.009000	0.004180	2.15288	0.097562
19	744567	0.008955	0.004170	2.14751	0.097454
43	453258	0.008653	0.004099	2.11096	0.096719
131	32172	0.007928	0.003924	2.02060	0.094903
283	375046	0.017313	0.005798	2.98597	0.114302

(a) The rankings shown in Table 3 are the security's ranking within the sub-portfolios.

Figure 3

Security Market Line/No-Tax Investor

This line is the traditionally derived no-tax capital market line.

Because the data used in these estimates were computed, and the results expressed without incorporating the consequences of any income tax implications, the capital market line depicted in Figure 3 could be said to represent the risk-return expectations of a tax-exempt portfolio manager.

After-Tax Market Data Base

If the investor efficiency equivalence hypothesis is valid (as concluded by Long [8]), the incorporation of income tax implications into this no-tax empirical analysis should produce the following results:

1. equivalent risk-return tradeoffs relative to all other investments available in the market, and
2. equivalent order-ranking of all securities, relative to their risk-return tradeoffs.

In order that this efficiency equivalence can be examined, the database previously described in the analysis involving the no-tax model is evaluated by the use of the expanded, income tax inclusive model, with the ex-post, after-tax returns for each security i , recomputed as:

$$r(i,j) = \{d(i)(1-T(j)) + (p(n) - p(n-1))(1-C(j))\} / p(n-1). \quad (2')$$

From these after-tax ex-post returns, the standard deviations were computed as estimates for the ex-ante after-tax variability of returns on security i , for investor j .

The equation:

$$r(m) = \{d(m)(1-T(j)) + (I(n) - I(n-1))(1-C(j))\} / I(n-1), \quad (4')$$

which is the no-tax equation (4) adjusted for the imposition of both ordinary income tax on dividends, and capital gains (losses) tax on the change in the relative value from one period to the next, was used to estimate the ex-post after-tax returns on the market. The ex-ante after-tax market expectations for investor j , $R(m,j)$, are derived from this equation. Using the Standard and Poor's Index as described previously for the no-tax model, the expected return on the market for an investor whose marginal ordinary income tax rate is 50%; resulting in a marginal capital gains tax rate is 20% and a marginal capital loss tax benefit is 25%, is computed to be 5.53%, with a standard deviation of 3.45%.

The ex-ante risk-free rate of return expectation is cut in half by the assumed 50% tax bracket, to 2.715%.

The after-tax model for expected returns, represented by the equation;

$$R(i,j) = R(f)(1-T(j)) + \frac{\{\sigma(i,j)\sigma(m,j)\}}{\sigma(m,j)^2} \{R(m,j) - R(f)(1-T(j))\} \quad (1')$$

will produce an after-tax capital market line.

If the investor is assumed to have a 50% marginal ordinary income tax rate; a 20% marginal capital gains tax rate; and a 25% marginal capital loss tax benefit, the risk-return tradeoffs for each security in the marketplace will produce the capital market line depicted in Figure 4. This after-tax capital market line is based upon the estimates for the after-tax covariance measurements of risk, the excess return multipliers, and the expected returns found in Appendix B, an excerpt of which is shown in Table 4.

Table 4
50% Tax Investor
(excerpt of Appendix B)

RANK ^a	SEC #	VARIANCE	CO-VARIANCE	BETA	EXPECTED RETURNS
	Market	0.001154	0.001154	1.00000	0.055342
23	8140	0.004186	0.002198	1.90432	0.080837
15	744567	0.002642	0.001746	1.51295	0.069803
45	453258	0.005225	0.002456	2.12760	0.087132
129	32172	0.004800	0.002354	2.03916	0.084638
275	375046	0.009988	0.003395	2.94160	0.110080

(a) The rankings shown in Table 4 are the security's ranking within the sub-portfolios.

Figure 4

Security Market Line/50% Tax Investor

This is the capital market line derived from the model which adjusts both expected returns and the variation in expected returns for the effect of differential income taxes.

The fact that some degree of the systematic variability of the expected returns on any security i is being assumed by the government can easily be seen by a comparison of the covariance term of each security in Table 3, to the covariance term of the same security in Table 4. Table 5 shows the relationship between the covariance terms for the sample of securities and the market for the 50% tax investor as compared to the no-tax investor.

Table 5
Covariance Term Relationship
($\text{cov}(i, m, .50) / \text{cov}(i, m, .00)$)

=====	
Sec #	cov/cov
=====	
market	.59423
8140	.52584
744567	.41871
453258	.59917
32172	.59990
375046	.58555

The non-homogeneous effect of taxes on the covariance terms, as shown by the after-tax versus no-tax covariance relationships in Table 5, implies that the amount of systematic risk being assumed by the government is not the same among securities.

One additional, non-statistical observation is the differing position of $\beta = 1$ (the market portfolio's β) relative to the comparative covariance measurements on each graph. This difference, as well as the relationships shown

in Table 5, reflects the lower riskiness of the market portfolio resulting from the imposition of income taxes.

If the government's risk assumption is in fact non-homogeneous, as these observations imply, efficiency equivalence cannot exist. The next chapter statistically evaluates the question of homogeneous risk assumption and the implications on the assumption of efficiency equivalence.

CHAPTER VII

EMPIRICAL RESULTS

Unlike the empirical results found by Long, and by Litzenberger and Ramaswamy, the evidence produced by the comprehensive empirical evaluation performed in this work leads to the conclusion that the reduction in risk resulting from the taxation of investment returns is not homogeneous throughout the market. This result is caused by the differential effect of the taxation of ordinary income versus the taxation of "Long Term capital Gains". Perhaps the most easily identified result is that the no-tax/after-tax capital market lines (Figures 3 and 4), which are derived from the same database are not the same. The points depicted in each line were derived as a point continuum of the ex-post risk-return tradeoffs for each security i , with unique, differential tax adjusted slopes computed as follows:

1. For the no-tax portfolio,

$$R(i) = .0543 + 10.348 \text{ cov}(i,m), \text{ or}$$

$$R(i) = .0543 + .02010 \text{ beta } (i),$$

and,

2. For the after-tax (50%) portfolio,

$$R(i) = .0272 + 24.424 \text{ cov}(i,m), \text{ or}$$

$$R(i) = .0272 + .02820 \text{ beta } (i).$$

More importantly, these results lead to the conclusion that, for the analysis conducted in this work,

1. the relative riskiness of security i to the market cannot be said to be equivalent in an after-tax analysis of the data to what it is in a no-tax analysis of the same data, and

2. the risk-return order ranking of each security i cannot be relied upon to be the same in an after-tax analysis as it is in a no-tax analysis.

Relative Riskiness

In order for the relative riskiness (beta) of security i to the market to be equivalent in an after-tax analysis of the data to what it is in a no-tax analysis of the same data, the variance of returns of any security i , $\sigma(i)$, and the variance of returns on the market, $\sigma(m)$, would need to be approximately homogeneously affected by the imposition of income taxes. If this homogeneous affect is present, $\text{beta } (i)$ in a no-tax analysis would be approximately equal to $\text{beta } (i,j)$ in an after-tax analysis

(or alternatively, $\beta(i, T=.50) / \beta(i, T=.00) = 1$). Intuitively however, one would not expect the impact of taxes to be homogeneous throughout the market unless a homogeneous relationship between dividend payout and capital gain expectations exists between all securities in the market.

Table 6, which is an excerpt of Appendix C, shows, for each security i , the comparative beta terms for the after-tax and no-tax portfolios, and their relative relationship.

TABLE 6
50% Tax Investor/No-Tax Investor
Comparative Beta Terms
(excerpt of Appendix C)

SEC #	B (.5)	B (.0)	B/B
market	1.0000	1.0000	1.00000
8140	1.9043	2.1529	0.88455
744567	1.5129	2.1475	0.70451
453258	2.1276	2.1110	1.00788
32172	2.0392	2.0206	1.00918
375046	2.9416	2.9860	0.98514

The relationships in Table 6 are consistent with the intuitive impression that the effect of taxes on the variability of returns throughout the market is not always

identical. If the effect of taxes was homogeneous, the relative beta relationships (B/B) for each security would be 1.00000, the same as for the total market. Figure 5, which plots the dispersion of the 50% tax investor beta against the no-tax investor beta, shows the observed relationships for the securities included in this sample.

Figures 6(a) to 6(f) show the distributions of the comparative beta terms, computed as:

$$\text{beta } (i, T=.50) / \text{beta } (i, T=.00),$$

for each of the sub-portfolios as well as for the total S & P Composite portfolio. For the total portfolio, these comparative beta terms vary around a mean of .9737, with a standard deviation of .0876. Of particular interest is that for three of the sub-portfolios, the S & P Financials, the S & P Utilities, and the S & P Transportations, all of the securities tested had less systematic risk when analyzed with the after-tax model than they had when analyzed with the no-tax model. However, the two sub-portfolios of S & P Industrials show ambiguous no-tax/after-tax systematic risk relationships.

FIGURE 5

Regression of Beta (T=.50)/Beta (T=.00)

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MIDDLE OF INTERVAL	NUMBER OF OBSERVATIONS	
0.5626	0	
0.6459	2	**
0.7292	8	*****
0.8125	10	*****
0.8958	4	****
0.9791	3	***

FIGURE 6(a)
Comparative Beta Measurements
(S & P Financials)
Histogram of observations around
the mean by standard deviation

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MIDDLE OF INTERVAL	NUMBER OF OBSERVATIONS	
0.6885	1	*
0.7577	0	
0.8269	4	****
0.8961	6	*****
0.9653	6	*****

FIGURE 6(b)
Comparative Beta Measurements
(S & P Utilities)
Histogram of observations around
the mean by standard deviation

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MIDDLE OF INTERVAL	NUMBER OF OBSERVATIONS	
0.5901	0	
0.6323	1	*
0.6745	8	*****
0.7167	13	*****
0.7589	6	*****
0.8011	1	*
0.8433	1	*

FIGURE 6(c)
Comparative Beta Measurements
(S & P Transportations)
Histogram of observations around
the mean by standard deviation

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MIDDLE OF INTERVAL	NUMBER OF OBSERVATIONS	
0.98637	0	
0.99183	1	*
0.99729	4	****
1.00275	14	*****
1.00821	32	*****
1.01367	12	*****
1.01913	5	*****

FIGURE 6(d)
 Comparative Beta Measurements
 (S & P Industrials (>.50))
 Histogram of observations around
 the mean by standard deviation

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EACH * REPRESENTS 5 OBSERVATIONS

MIDDLE OF INTERVAL	NUMBER OF OBSERVATIONS	
0.98411	4	*
0.99004	4	*
0.99597	13	***
1.00190	47	*****
1.00783	158	*****
1.01376	85	*****
1.01969	10	**
1.02562	1	*

FIGURE 6(e)
 Comparative Beta Measurements
 (S & P Industrials (<.50))
 Histogram of observations around
 the mean by standard deviation

=====

EACH * REPRESENTS 5 OBSERVATIONS

MIDDLE OF INTERVAL	NUMBER OF OBSERVATIONS	
0.79742	2	*
0.80290	1	*
0.80838	2	*
0.81385	0	
0.81932	0	
0.82480	1	*
0.83027	4	*
0.83575	1	*
0.84122	0	
0.84670	3	*
0.85217	0	
0.85765	1	*
0.86312	1	*
0.86860	0	
0.87407	2	*
0.87955	1	*
0.88502	1	*
0.89050	1	*
0.89597	1	*
0.90145	0	
0.90692	0	
0.91240	1	*
0.91787	2	*
0.92335	0	
0.92882	0	
0.93430	0	
0.93977	0	
0.94525	0	
0.95072	1	*
0.95620	0	
0.96167	4	*
0.96715	1	*
0.97262	1	*
0.97810	1	*
0.98357	5	*
0.98905	5	*
0.99453	10	**
1.00000	30	*****
1.00548	137	*****
1.01095	159	*****
1.01643	41	*****
1.02190	4	*
1.02737	1	*

FIGURE 6(f)
 Comparative Beta Measurements
 (S & P Composite)
 Histogram of observations around
 the mean by standard deviation

To test for efficiency equivalence as a function of systematic risk, a student's t-test was used at the 95% level of significance, with $n-2$ degrees of freedom. If the no-tax model is equivalently efficient relative to the after-tax model, the null hypothesis that $\beta(i, T=.50) / \beta(i, T=.00) = 1$ should be accepted. However, based upon the results of the analyses in this work, the null hypothesis cannot be accepted; i.e., no-tax ex-ante systematic risk expectations are not equivalent to after-tax ex-ante systematic risk expectations.

Table 7 shows the results of the student's t-test on the total S & P Composite portfolio as well as on the sub-portfolios. Although the size of the computed "t" varies widely, a comparison of the computed "t" with the critical "t" clearly rejects the hypothesis.

TABLE 7
Results of Student's t-test
After-Tax/No-Tax
Comparative Beta Measurements

Portfolio	Computed t	Critical t + or -
S & P Financials	-11.69	2.060
S & P Utilities	- 6.19	2.120
S & P Transportations	-36.78	2.040
S & P Industrials (>.50)	12.40	2.000
S & P Industrials (<.50)	23.75	1.960
S & P 500 Composite	- 6.48	1.960

Risk-Return Order Ranking

Another measure of efficiency equivalence which has been widely accepted is that the order ranking of ex-ante risk-return expectations is unaffected by income tax imposition. Figure 7 plots the rankings of the risk-return expectations for each security i in a 50% tax analysis against the risk-return rankings for each security i in a no-tax analysis. These rankings are for the entire S & P Composite portfolio and, although Figure 7 shows that some correlation exists, some of the security's systematic risk factors appear to be substantially impacted by income tax imposition such that the risk-return order rankings do not appear to be homogeneous.

The assumption that the rank order is the same, with and without the inclusion of the effect of income taxes, is supported by the second null hypothesis as well as by previous works. To test this hypothesis, a Spearman's rank-order correlation is used at the 95% level of significance, with $n-3$ degrees of freedom. The results of this test are shown in Table 8.

TABLE 8
Results of Student's t-test
After-Tax/No-Tax
Spearman's Rank Order Correlation

Portfolio	Computed T	Critical T + or -
S & P Financials	36.69	2.064
S & P Utilities	20.64	2.131
S & P Transportations	14.51	2.052
S & P Industrials (>.50)	185.82	2.000
S & P Industrials (<.50)	731.08	1.960
S & P 500 Composite	59.42	1.960

The size of the computed "t" relative to the critical "t" leaves little doubt that the null hypothesis must be rejected. This implies that, consistent with the results of the test of comparative risk terms, an efficiency equivalence does not exist between no-tax analysis and after-tax analysis.

FIGURE 7

Order Rank Comparison

CHAPTER VIII

SUMMARY AND CONCLUSION

Traditional capital asset pricing theory assumes that capital markets are perfect, and therefore, that the income taxation of investor returns does not effect the efficiency of the risk-return pricing mechanism. This work has provided a rigorous examination of this assumption, and has presented empirical evidence in support of its findings.

Building on the works of Brennan, Long, Singer, and others, this work has derived a useful model with which to evaluate capital asset prices inclusive of the effect of differential income taxes. This model was then used to empirically test the question of whether information produced by the traditional no-tax analysis is efficiency equivalent to the information produced by an after-tax analysis, with the question as to the effect of differential taxes being isolated as the only difference between the two analyses.

Based upon the empirical evidence produced in this work, the no-tax capital asset pricing model and the after-tax capital asset pricing model cannot be assumed to

be efficiency equivalent. The evidence presented herein suggests that both expectations of risk-return tradeoffs and asset rank-ordering by risk-return expectations are affected by the imposition of relevant differential income taxation. An intuitive implication of these results is that investors who are assumed to make rational, utility maximizing, informed investment decisions, must be doing their risk-return analyses cognizant of their individual income tax positions. Therefore, if a static market efficiency is viewed as existing only when all investors view all investment asset risk-return tradeoffs homogeneously, the market is not mean-variant efficient.

The results obtained herein further suggest that investors should not be viewed as being homogeneous in their after-tax expectations, and that they can expect additional efficiency by the use of the after-tax capital asset pricing model. This observation implies that a clientele effect exists, and that there may be investment assets in the market portfolio which are mean-variant efficient for some investors but not for all investors, the determinant factor being the marginal income tax brackets of the investor.

This work has not sought to answer the questions which have been raised with respect to the problem arising

from the use of a proxy for the undefinable market universe. Nor has it addressed the question of the identification of a pure, risk-free rate of return. These problems still exist. It is hoped however, that the results of this work will encourage those who seek to embark upon a further refinement of the theory of capital asset pricing to recognize that the impact of income taxes is not homogeneous throughout all investors.

Moreover, it is modestly hoped that this work will be accepted as a useful addition to the many contributions which have led to the current knowledge of how investors price, or rather, how investors should price capital assets.

APPENDIX A

PORTFOLIO #11 No-Tax Investor

RANK	SEC #	VARIANCE	CO- VARIANCE	BETA	EXPECTED RETURNS
----	-----	-----	-----	-----	-----
	Market	0.001942	0.001942	1.000000	0.074395
18	66365	0.007059	0.003702	1.906658	0.092614
13	163798	0.004888	0.003081	1.586652	0.086183
27	336072	1.182091	0.047910	24.672976	0.550097
10	616880	0.004102	0.002822	1.453367	0.083505
3	66050	0.002210	0.002072	1.066935	0.075740
15	161610	0.005582	0.003292	1.695441	0.088369
12	173034	0.004521	0.002963	1.525797	0.084960
9	211485	0.003552	0.002626	1.352529	0.081479
16	319455	0.005665	0.003317	1.708078	0.088623
8	320548	0.003095	0.002452	1.262495	0.079669
6	458916	0.002810	0.002336	1.202989	0.078474
11	564809	0.004417	0.002929	1.508251	0.084608
4	585518	0.002356	0.002139	1.101450	0.076433
7	628855	0.003005	0.002416	1.244021	0.079298
2	667332	0.001559	0.001740	0.896151	0.072308
25	319441	0.086718	0.012977	6.682686	0.188587
26	391442	0.172208	0.018286	9.417219	0.243536
21	81721	0.009426	0.004278	2.203237	0.098573
17	441815	0.006277	0.003491	1.797875	0.090428
19	423329	0.007201	0.003739	1.925666	0.092996
5	25816	0.002483	0.002196	1.130847	0.077024
22	893485	0.009886	0.004382	2.256403	0.099642
20	8140	0.009000	0.004180	2.152879	0.097562
1	140186	0.001127	0.001480	0.761927	0.069611
23	211327	0.009907	0.004386	2.258801	0.099690
14	449744	0.004932	0.003095	1.593759	0.086326
24	786429	0.010523	0.004520	2.327895	0.101078

(Appendix A)
 PORTFOLIO #12
 No-Tax Investor

RANK	SEC #	VARIANCE	CO- VARIANCE	BETA	EXPECTED RETURNS
-----	-----	-----	-----	-----	-----
	Market	0.001942	0.001942	1.000000	0.074395
11	121897	0.017847	0.005887	3.031653	0.115220
8	606191	0.009660	0.004331	2.230360	0.099118
12	655694	0.017950	0.005904	3.040354	0.115395
3	802020	0.003740	0.002695	1.387747	0.082186
10	843571	0.010414	0.004497	2.315848	0.100836
2	843673	0.003436	0.002583	1.330281	0.081032
9	907818	0.009726	0.004346	2.237966	0.099271
5	209237	0.005098	0.003146	1.620336	0.086860
15	582103	0.113646	0.014855	7.650210	0.208029
1	769739	0.001381	0.001637	0.843193	0.071244
4	985514	0.004372	0.002914	1.500490	0.084452
16	23771	0.924393	0.042367	21.818474	0.492736
7	247361	0.008097	0.003965	2.042045	0.095334
14	667281	0.101927	0.014069	7.245039	0.199887
18	698057	43.194855	0.289614	*****	3.051350
13	886735	0.039180	0.008722	4.491871	0.144563
17	902550	1.184953	0.047968	24.702833	0.550696
6	291101	0.006333	0.003507	1.805961	0.090590

(Appendix A)
 PORTFOLIO #13
 No-Tax Investor

RANK	SEC #	VARIANCE	CO- VARIANCE	BETA	EXPECTED RETURNS
----	-----	-----	-----	-----	-----
	Market	0.001942	0.001942	1.000000	0.074395
8	155447	0.006587	0.003576	1.841726	0.091309
7	212093	0.006090	0.003439	1.771000	0.089888
3	371028	0.005282	0.003203	1.649240	0.087441
4	913025	0.005443	0.003251	1.674237	0.087943
25	25537	0.011154	0.004654	2.396667	0.102460
6	152357	0.005864	0.003374	1.737790	0.089220
26	202795	0.011675	0.004761	2.452001	0.103572
29	250847	0.015282	0.005447	2.805314	0.110672
14	264399	0.008002	0.003942	2.029950	0.095091
10	341081	0.006856	0.003649	1.879006	0.092058
21	595832	0.009174	0.004221	2.173562	0.097977
24	644001	0.010670	0.004552	2.344089	0.101404
30	677347	0.016875	0.005724	2.947926	0.113538
13	744465	0.007585	0.003838	1.976391	0.094015
16	842400	0.008438	0.004048	2.084537	0.096188
28	842587	0.012053	0.004838	2.491452	0.104365
9	882848	0.006616	0.003584	1.845826	0.091391
20	927804	0.009142	0.004213	2.169842	0.097902
15	28609	0.008105	0.003967	2.043024	0.095354
2	197648	0.005262	0.003197	1.646183	0.087380
1	682678	0.004908	0.003087	1.589865	0.086248
22	694478	0.009321	0.004254	2.190937	0.098326
17	59165	0.008920	0.004162	2.143259	0.097368
5	209111	0.005521	0.003274	1.686128	0.088182
23	653522	0.010042	0.004416	2.274060	0.099997
18	665772	0.008936	0.004166	2.145221	0.097408
12	694308	0.007397	0.003790	1.951703	0.093519
27	717537	0.011780	0.004783	2.463041	0.103794
19	744567	0.008955	0.004170	2.147512	0.097454
11	976656	0.007025	0.003693	1.901973	0.092520

(Appendix A)
 PORTFOLIO #14
 No-Tax Investor

RANK	SEC #	VARIANCE	CO- VARIANCE	BETA	EXPECTED RETURNS
----	-----	-----	-----	-----	-----
	Market	0.001942	0.001942	1.00000	0.074395
43	453258	0.008653	0.004099	2.11096	0.096719
47	651639	0.008932	0.004165	2.14466	0.097396
55	717265	0.010974	0.004616	2.37732	0.102072
51	443654	0.010437	0.004502	2.31839	0.100887
64	134411	0.017263	0.005790	2.98163	0.114215
66	960878	0.017764	0.005873	3.02457	0.115078
4	126149	0.003859	0.002737	1.40974	0.082628
17	209219	0.005869	0.003376	1.73851	0.089235
13	487836	0.005358	0.003225	1.66103	0.087678
37	373712	0.007940	0.003927	2.02214	0.094934
49	22771	0.009593	0.004316	2.22260	0.098963
6	982526	0.004133	0.002833	1.45883	0.083615
10	191216	0.004898	0.003084	1.58824	0.086215
58	256129	0.012072	0.004842	2.49332	0.104403
54	780240	0.010948	0.004611	2.37450	0.102015
31	121691	0.007089	0.003710	1.91063	0.092694
39	575379	0.008161	0.003981	2.05009	0.095496
30	228669	0.006911	0.003663	1.88649	0.092209
23	252669	0.006195	0.003468	1.78612	0.090192
33	961548	0.007696	0.003866	1.99075	0.094304
41	260561	0.008539	0.004072	2.09702	0.096439
22	25321	0.006119	0.003447	1.77512	0.089971
11	263534	0.005051	0.003132	1.61275	0.086708
9	635655	0.004872	0.003076	1.58394	0.086129
45	10202	0.008747	0.004121	2.12235	0.096948
20	150843	0.006025	0.003420	1.76146	0.089696
12	26609	0.005071	0.003138	1.61600	0.086773
29	746252	0.006741	0.003618	1.86322	0.091741
62	13068	0.015007	0.005398	2.78001	0.110164
44	54303	0.008669	0.004103	2.11296	0.096759
16	375766	0.005742	0.003339	1.71964	0.088856
48	909160	0.009467	0.004288	2.20804	0.098670
38	42476	0.007997	0.003941	2.02941	0.095080
21	530000	0.006031	0.003422	1.76232	0.089713
52	483044	0.010743	0.004567	2.35209	0.101565
35	636316	0.007844	0.003903	2.00981	0.094687
26	912027	0.006578	0.003574	1.84056	0.091286
7	457470	0.004559	0.002975	1.53225	0.085090

(Appendix A)
 PORTFOLIO #14
 No-Tax Investor

RANK	SEC #	VARIANCE	CO- VARIANCE	BETA	EXPECTED RETURNS
----	-----	-----	-----	-----	-----
15	458702	0.005702	0.003327	1.71355	0.088733
5	637844	0.003875	0.002743	1.41270	0.082688
19	760779	0.005892	0.003383	1.74198	0.089305
50	761763	0.010270	0.004466	2.29976	0.100513
3	24843	0.003489	0.002603	1.34042	0.081235
65	690020	0.017357	0.005806	2.98978	0.114379
46	629156	0.008886	0.004154	2.13915	0.097286
24	167898	0.006215	0.003474	1.78900	0.090249
60	172172	0.013988	0.005212	2.68393	0.108233
42	300587	0.008637	0.004095	2.10903	0.096680
61	609150	0.014110	0.005234	2.69563	0.108468
67	294098	0.018353	0.005970	3.07429	0.116077
2	459200	0.003287	0.002526	1.30108	0.080445
40	580628	0.008219	0.003995	2.05732	0.095641
36	852206	0.007877	0.003911	2.01402	0.094771
8	578592	0.004651	0.003005	1.54757	0.085398
32	749285	0.007341	0.003776	1.94439	0.093372
57	989399	0.011985	0.004824	2.48436	0.104222
18	158663	0.005869	0.003376	1.73854	0.089236
27	359370	0.006620	0.003585	1.84639	0.091403
34	800	0.007730	0.003874	1.99524	0.094394
53	1688	0.010832	0.004586	2.36179	0.101759
1	30177	0.001439	0.001672	0.86087	0.071599
68	410252	0.022402	0.006595	3.39654	0.122553
59	725701	0.012965	0.005018	2.58397	0.106224
56	572342	0.011422	0.004710	2.42532	0.103036
28	549577	0.006702	0.003607	1.85776	0.091631
25	931422	0.006449	0.003539	1.82239	0.090920
63	2050	0.015582	0.005501	2.83277	0.111224
14	264830	0.005488	0.003264	1.68114	0.088082

(Appendix A)
 PORTFOLIO #15
 No-Tax Investor

RANK	SEC #	VARIANCE	CO- VARIANCE	BETA	EXPECTED RETURNS
----	-----	-----	-----	-----	-----
	Market	0.001942	0.001942	1.00000	0.074395
215	23127	0.010836	0.004587	2.36230	0.101770
263	43413	0.015422	0.005472	2.81820	0.110931
250	257075	0.013571	0.005133	2.64366	0.107424
271	437614	0.016146	0.005599	2.88357	0.112245
258	276461	0.014970	0.005392	2.77656	0.110094
289	656780	0.018447	0.005985	3.08219	0.116236
225	368820	0.011604	0.004747	2.44460	0.103424
122	374280	0.007677	0.003861	1.98836	0.094256
288	590655	0.018368	0.005972	3.07557	0.116103
180	853734	0.009331	0.004257	2.19208	0.098349
164	868273	0.008762	0.004125	2.12422	0.096986
301	379352	0.020663	0.006334	3.26205	0.119850
294	755281	0.019236	0.006112	3.14739	0.117546
273	815246	0.016551	0.005669	2.91950	0.112967
59	806857	0.006099	0.003441	1.77220	0.089912
304	958043	0.021251	0.006424	3.30814	0.120776
319	486170	0.032034	0.007887	4.06167	0.135918
317	912061	0.031703	0.007846	4.04061	0.135495
216	20771	0.010873	0.004595	2.36626	0.101849
266	343861	0.015811	0.005541	2.85347	0.111640
254	350244	0.014635	0.005331	2.74535	0.109467
98	406216	0.007066	0.003704	1.90764	0.092633
37	74077	0.005364	0.003227	1.66210	0.087699
7	134429	0.003699	0.002680	1.38024	0.082035
28	369856	0.005030	0.003125	1.60950	0.086642
46	370334	0.005779	0.003350	1.72519	0.088967
18	629525	0.004722	0.003028	1.55934	0.085635
203	668707	0.010440	0.004503	2.31871	0.100894
61	721510	0.006176	0.003463	1.78336	0.090136
141	747402	0.008297	0.004014	2.06706	0.095837
22	904784	0.004795	0.003051	1.57141	0.085877
207	296470	0.010568	0.004530	2.33292	0.101179
4	99599	0.003176	0.002483	1.27884	0.079998
17	143483	0.004721	0.003028	1.55917	0.085631
10	237410	0.003888	0.002748	1.41498	0.082734
33	423074	0.005203	0.003178	1.63686	0.087192
108	861504	0.007278	0.003759	1.93597	0.093203
26	751277	0.005000	0.003116	1.60458	0.086544

(Appendix A)
 PORTFOLIO #15
 No-Tax Investor

RANK	SEC #	VARIANCE	CO- VARIANCE	BETA	EXPECTED RETURNS
----	-----	-----	-----	-----	-----
131	32172	0.007928	0.003924	2.02060	0.094903
321	436092	0.033008	0.008006	4.12290	0.137148
77	427866	0.006503	0.003554	1.83001	0.091073
201	39483	0.010397	0.004493	2.31391	0.100797
100	35229	0.007090	0.003710	1.91080	0.092697
212	693715	0.010763	0.004572	2.35432	0.101609
259	806823	0.015103	0.005415	2.78888	0.110342
189	428182	0.009842	0.004372	2.25127	0.099539
128	811850	0.007910	0.003919	2.01835	0.094858
127	931647	0.007849	0.003904	2.01044	0.094699
293	369352	0.019230	0.006111	3.14691	0.117536
78	713448	0.006556	0.003568	1.83747	0.091224
1	24703	0.002877	0.002364	1.21728	0.078761
16	718167	0.004551	0.002973	1.53092	0.085063
6	761753	0.003511	0.002611	1.34465	0.081320
81	206813	0.006631	0.003588	1.84788	0.091433
295	547779	0.019300	0.006122	3.15264	0.117651
45	758556	0.005760	0.003344	1.72223	0.088908
96	851783	0.007026	0.003694	1.90218	0.092524
129	860163	0.007918	0.003921	2.01926	0.094876
57	955465	0.006068	0.003433	1.76776	0.089823
238	95293	0.012549	0.004936	2.54214	0.105384
230	189486	0.012060	0.004839	2.49216	0.104379
200	416162	0.010368	0.004487	2.31073	0.100734
83	458506	0.006683	0.003602	1.85517	0.091579
292	479898	0.019125	0.006094	3.13831	0.117363
233	527364	0.012282	0.004884	2.51497	0.104838
226	918204	0.011697	0.004766	2.45429	0.103618
168	158525	0.008899	0.004157	2.14073	0.097317
149	373298	0.008452	0.004051	2.08624	0.096222
72	962166	0.006372	0.003517	1.81142	0.090700
309	339099	0.024159	0.006849	3.52722	0.125179
323	757640	0.035230	0.008271	4.25945	0.139892
279	830830	0.017083	0.005759	2.96601	0.113901
272	501026	0.016352	0.005635	2.90188	0.112613
205	608030	0.010551	0.004526	2.33097	0.101140
185	97383	0.009519	0.004299	2.21409	0.098792
195	313693	0.010052	0.004418	2.27525	0.100020
69	460146	0.006331	0.003506	1.80558	0.090583

(Appendix A)
 PORTFOLIO #15
 No-Tax Investor

RANK	SEC #	VARIANCE	CO- VARIANCE	BETA	EXPECTED RETURNS
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30	494368	0.005076	0.003139	1.61676	0.086788
196	582834	0.010085	0.004425	2.27891	0.100094
143	737628	0.008357	0.004028	2.07456	0.095988
97	793453	0.007062	0.003703	1.90701	0.092621
192	809877	0.009897	0.004384	2.25759	0.099666
63	905530	0.006284	0.003493	1.79888	0.090448
103	81437	0.007136	0.003722	1.91699	0.092821
209	574055	0.010699	0.004558	2.34727	0.101468
114	139861	0.007532	0.003824	1.96950	0.093876
21	364730	0.004794	0.003051	1.57122	0.085873
194	499040	0.009924	0.004390	2.26067	0.099728
133	887360	0.008051	0.003954	2.03622	0.095217
169	589433	0.008912	0.004160	2.14233	0.097350
138	887224	0.008276	0.004009	2.06449	0.095785
151	411631	0.008475	0.004057	2.08909	0.096280
228	554790	0.011893	0.004806	2.47478	0.104030
116	580645	0.007565	0.003833	1.97373	0.093962
144	784150	0.008361	0.004029	2.07506	0.095998
95	19087	0.006974	0.003680	1.89517	0.092383
34	260543	0.005209	0.003180	1.63780	0.087211
121	302491	0.007672	0.003860	1.98774	0.094243
50	383883	0.005874	0.003377	1.73932	0.089251
124	427056	0.007761	0.003882	1.99917	0.094473
79	611662	0.006568	0.003571	1.83911	0.091256
74	693506	0.006406	0.003527	1.81637	0.090800
106	857721	0.007205	0.003740	1.92620	0.093007
31	905581	0.005126	0.003155	1.62469	0.086948
49	2824	0.005873	0.003377	1.73918	0.089248
80	110097	0.006574	0.003573	1.84001	0.091275
40	532457	0.005657	0.003314	1.70687	0.088599
27	589331	0.005026	0.003124	1.60884	0.086629
71	717081	0.006361	0.003514	1.80985	0.090668
67	806605	0.006317	0.003502	1.80366	0.090544
186	812302	0.009649	0.004329	2.22915	0.099094
56	832377	0.006055	0.003429	1.76592	0.089786
159	852245	0.008731	0.004117	2.12042	0.096909
110	859264	0.007352	0.003778	1.94581	0.093400
135	915302	0.008179	0.003985	2.05232	0.095541
52	934488	0.005939	0.003396	1.74888	0.089443

(Appendix A)
 PORTFOLIO #15
 No-Tax Investor

RANK	SEC #	VARIANCE	CO- VARIANCE	BETA	EXPECTED RETURNS
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222	189054	0.011435	0.004712	2.42671	0.103064
113	194162	0.007520	0.003821	1.96793	0.093845
2	742718	0.002935	0.002387	1.22933	0.079003
104	165339	0.007146	0.003725	1.91840	0.092850
275	302808	0.016769	0.005706	2.93868	0.113352
92	459506	0.006936	0.003670	1.88997	0.092279
13	761525	0.004497	0.002955	1.52175	0.084879
155	824348	0.008654	0.004099	2.11106	0.096721
322	320891	0.034323	0.008164	4.20426	0.138783
140	459884	0.008278	0.004009	2.06466	0.095789
208	969457	0.010568	0.004530	2.33293	0.101180
51	48825	0.005934	0.003394	1.74808	0.089427
154	173036	0.008620	0.004091	2.10692	0.096638
3	302290	0.003091	0.002450	1.26159	0.079651
60	402460	0.006107	0.003444	1.77343	0.089937
217	546268	0.010941	0.004609	2.37369	0.101999
55	607059	0.005985	0.003409	1.75557	0.089578
139	718507	0.008277	0.004009	2.06457	0.095787
15	780257	0.004526	0.002965	1.52667	0.084978
176	822635	0.009151	0.004215	2.17082	0.097922
101	853683	0.007110	0.003716	1.91355	0.092752
65	853700	0.006301	0.003498	1.80135	0.090498
172	866762	0.009045	0.004191	2.15830	0.097670
36	880370	0.005325	0.003216	1.65593	0.087575
54	881694	0.005977	0.003407	1.75450	0.089556
136	907770	0.008209	0.003993	2.05610	0.095617
227	933169	0.011773	0.004781	2.46226	0.103779
62	318315	0.006185	0.003466	1.78468	0.090163
142	382388	0.008350	0.004027	2.07366	0.095970
29	382550	0.005062	0.003135	1.61456	0.086744
58	115657	0.006080	0.003436	1.76946	0.089857
307	371532	0.023055	0.006691	3.44574	0.123541
245	585745	0.013289	0.005080	2.61603	0.106868
111	219327	0.007460	0.003806	1.96005	0.093687
53	690768	0.005951	0.003399	1.75065	0.089479
160	451542	0.008732	0.004118	2.12052	0.096911
156	542290	0.008667	0.004102	2.11270	0.096754
90	565020	0.006883	0.003656	1.88267	0.092132
107	690734	0.007264	0.003756	1.93415	0.093166

(Appendix A)
 PORTFOLIO #15
 No-Tax Investor

RANK	SEC #	VARIANCE	CO- VARIANCE	BETA	EXPECTED RETURNS
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86	42170	0.006782	0.003629	1.86890	0.091855
134	87509	0.008136	0.003975	2.04690	0.095432
179	224399	0.009330	0.004256	2.19198	0.098347
161	667528	0.008741	0.004120	2.12172	0.096935
99	912656	0.007083	0.003709	1.90988	0.092678
270	963150	0.016135	0.005597	2.88259	0.112225
117	13716	0.007569	0.003834	1.97437	0.093974
68	22249	0.006326	0.003505	1.80499	0.090571
234	483008	0.012303	0.004888	2.51713	0.104881
5	211452	0.003326	0.002541	1.30879	0.080600
93	228255	0.006944	0.003672	1.89107	0.092301
184	635128	0.009444	0.004282	2.20529	0.098615
220	574599	0.011328	0.004690	2.41533	0.102835
253	580033	0.014482	0.005303	2.73092	0.109177
39	109043	0.005581	0.003292	1.69534	0.088367
269	117043	0.016121	0.005595	2.88131	0.112199
224	200273	0.011588	0.004744	2.44282	0.103388
213	231021	0.010811	0.004582	2.35951	0.101714
285	879335	0.017770	0.005874	3.02506	0.115088
130	244199	0.007927	0.003923	2.02045	0.094900
206	576216	0.010560	0.004528	2.33204	0.101162
152	19645	0.008503	0.004063	2.09262	0.096351
202	118745	0.010427	0.004500	2.31724	0.100864
223	481196	0.011566	0.004739	2.44057	0.103343
19	149123	0.004725	0.003029	1.55998	0.085647
187	57264	0.009785	0.004359	2.24475	0.099408
87	261597	0.006784	0.003629	1.86912	0.091859
119	181396	0.007582	0.003837	1.97596	0.094006
182	449168	0.009434	0.004280	2.20415	0.098592
177	4626	0.009203	0.004227	2.17700	0.098046
148	91797	0.008435	0.004047	2.08419	0.096181
246	115223	0.013407	0.005102	2.62757	0.107100
283	375046	0.017313	0.005798	2.98597	0.114302
290	704562	0.019081	0.006087	3.13472	0.117291
235	962898	0.012396	0.004906	2.52660	0.105071
158	216669	0.008694	0.004109	2.11601	0.096821
89	456866	0.006846	0.003646	1.87761	0.092030
70	761688	0.006336	0.003508	1.80632	0.090597
20	887389	0.004736	0.003033	1.56172	0.085682

(Appendix A)
PORTFOLIO #15
No-Tax Investor

RANK	SEC #	VARIANCE	CO- VARIANCE	BETA	EXPECTED RETURNS
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42	122781	0.005695	0.003325	1.71247	0.088712
305	538021	0.021491	0.006460	3.32681	0.121151
162	724479	0.008749	0.004122	2.12267	0.096954
242	212363	0.013009	0.005026	2.58833	0.106312
255	237688	0.014664	0.005336	2.74803	0.109521
320	238100	0.032542	0.007949	4.09370	0.136562
178	253849	0.009210	0.004229	2.17783	0.098063
118	428236	0.007574	0.003835	1.97502	0.093987
236	438506	0.012400	0.004907	2.52696	0.105079
85	848355	0.006738	0.003617	1.86283	0.091733
315	862111	0.029872	0.007616	3.92220	0.133116
318	933696	0.031820	0.007861	4.04802	0.135644
313	313135	0.027811	0.007349	3.78445	0.130347
237	892892	0.012402	0.004907	2.52718	0.105083
24	291011	0.004899	0.003084	1.58839	0.086218
14	369604	0.004515	0.002961	1.52486	0.084942
146	383492	0.008369	0.004031	2.07607	0.096018
165	960402	0.008817	0.004138	2.13082	0.097118
150	384802	0.008456	0.004052	2.08680	0.096234
251	829302	0.014027	0.005219	2.68772	0.108309
145	963320	0.008366	0.004030	2.07561	0.096009
197	963626	0.010151	0.004440	2.28636	0.100244
105	31897	0.007190	0.003737	1.92428	0.092968
308	875382	0.024095	0.006840	3.52259	0.125086
260	934436	0.015171	0.005428	2.79514	0.110468
102	460470	0.007116	0.003717	1.91427	0.092767
198	413875	0.010159	0.004441	2.28725	0.100262
276	552618	0.016807	0.005713	2.94198	0.113418
181	620076	0.009341	0.004259	2.19329	0.098374
167	755111	0.008879	0.004152	2.13835	0.097270
311	458140	0.025162	0.006990	3.59971	0.126635
316	637640	0.029996	0.007632	3.93035	0.133279
132	882508	0.007972	0.003934	2.02617	0.095015
44	884315	0.005732	0.003336	1.71805	0.088824
199	278749	0.010242	0.004460	2.29665	0.100451
287	27627	0.018026	0.005916	3.04680	0.115525
282	171196	0.017255	0.005788	2.98091	0.114201
47	345370	0.005788	0.003353	1.72649	0.088993
9	370442	0.003868	0.002741	1.41132	0.082660

(Appendix A)
 PORTFOLIO #15
 No-Tax Investor

RANK	SEC #	VARIANCE	CO- VARIANCE	BETA	EXPECTED RETURNS
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147	459578	0.008419	0.004043	2.08217	0.096141
153	693718	0.008608	0.004088	2.10549	0.096609
219	826622	0.011298	0.004684	2.41215	0.102772
41	81689	0.005665	0.003317	1.70808	0.088623
43	99725	0.005729	0.003335	1.71767	0.088816
120	235811	0.007592	0.003840	1.97730	0.094033
48	278058	0.005810	0.003359	1.72974	0.089059
306	748369	0.022002	0.006536	3.36611	0.121941
38	774347	0.005538	0.003279	1.68872	0.088234
112	872649	0.007499	0.003816	1.96515	0.093789
88	913017	0.006813	0.003637	1.87310	0.091939
204	97023	0.010464	0.004508	2.32141	0.100948
267	369550	0.015820	0.005543	2.85433	0.111657
264	400181	0.015432	0.005474	2.81908	0.110949
249	580169	0.013540	0.005128	2.64065	0.107363
163	883203	0.008756	0.004123	2.12350	0.096971
183	29717	0.009439	0.004281	2.20472	0.098603
64	32177	0.006301	0.003498	1.80134	0.090497
73	573275	0.006396	0.003524	1.81483	0.090768
241	75815	0.012973	0.005019	2.58475	0.106240
218	714041	0.011099	0.004642	2.39078	0.102342
123	370838	0.007703	0.003867	1.99165	0.094322
299	808655	0.020505	0.006310	3.24960	0.119600
191	879131	0.009881	0.004380	2.25574	0.099629
193	26681	0.009909	0.004386	2.25896	0.099693
243	67383	0.013120	0.005047	2.59935	0.106533
115	71892	0.007538	0.003826	1.97026	0.093892
76	75887	0.006430	0.003534	1.81977	0.090868
8	478160	0.003833	0.002728	1.40492	0.082532
25	277461	0.004917	0.003090	1.59135	0.086278
23	604059	0.004824	0.003060	1.57610	0.085971
262	731095	0.015302	0.005451	2.80714	0.110709
84	984121	0.006709	0.003609	1.85876	0.091651
277	451650	0.017026	0.005750	2.96108	0.113802
278	601753	0.017038	0.005752	2.96213	0.113823
280	890278	0.017125	0.005767	2.96969	0.113975
175	449268	0.009123	0.004209	2.16758	0.097857
214	24735	0.010817	0.004583	2.36022	0.101728
32	124845	0.005164	0.003167	1.63082	0.087071

(Appendix A)
 PORTFOLIO #15
 No-Tax Investor

RANK	SEC #	VARIANCE	CO-- VARIANCE	BETA	EXPECTED RETURNS
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188	224003	0.009808	0.004364	2.24739	0.099461
239	591690	0.012783	0.004982	2.56573	0.105858
211	873635	0.010756	0.004570	2.35359	0.101595
268	882593	0.015860	0.005550	2.85792	0.111729
247	115885	0.013415	0.005104	2.62837	0.107116
265	941063	0.015650	0.005513	2.83889	0.111347
171	372460	0.009008	0.004182	2.15388	0.097582
240	717425	0.012875	0.005000	2.57500	0.106044
298	299209	0.020283	0.006276	3.23193	0.119245
125	19519	0.007777	0.003886	2.00121	0.094514
157	45573	0.008689	0.004108	2.11538	0.096808
231	146227	0.012203	0.004868	2.50687	0.104675
91	314099	0.006920	0.003666	1.88779	0.092235
170	556139	0.008930	0.004164	2.14451	0.097393
137	577778	0.008235	0.003999	2.05933	0.095682
94	708160	0.006962	0.003677	1.89348	0.092349
12	812387	0.004402	0.002924	1.50556	0.084554
190	239753	0.009845	0.004372	2.25169	0.099547
82	482584	0.006657	0.003595	1.85158	0.091507
109	980881	0.007334	0.003774	1.94346	0.093353
252	390064	0.014402	0.005288	2.72333	0.109025
173	477196	0.009062	0.004195	2.16023	0.097709
126	501044	0.007820	0.003897	2.00682	0.094627
11	786514	0.003987	0.002782	1.43287	0.083093
35	974280	0.005237	0.003189	1.64219	0.087299
75	2040	0.006427	0.003533	1.81922	0.090857
281	171583	0.017206	0.005780	2.97670	0.114116
261	248703	0.015190	0.005431	2.79689	0.110503
296	376109	0.020035	0.006237	3.21213	0.118847
257	571630	0.014920	0.005382	2.77188	0.110000
166	580135	0.008821	0.004139	2.13130	0.097128
244	30096	0.013121	0.005048	2.59939	0.106534
174	278764	0.009091	0.004202	2.16372	0.097779
229	761338	0.011937	0.004814	2.47938	0.104122
286	767754	0.017921	0.005899	3.03791	0.115346
300	152312	0.020638	0.006331	3.26012	0.119811
256	432848	0.014729	0.005348	2.75416	0.109644
284	435081	0.017461	0.005823	2.99868	0.114558
310	751328	0.024430	0.006888	3.54698	0.125576

(Appendix A)
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 No-Tax Investor

RANK	SEC #	VARIANCE	CO- VARIANCE	BETA	EXPECTED RETURNS
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314	205363	0.028393	0.007425	3.82383	0.131139
232	53015	0.012240	0.004875	2.51061	0.104750
248	285659	0.013420	0.005105	2.62886	0.107126
302	902384	0.020816	0.006358	3.27411	0.120092
312	198279	0.025675	0.007061	3.63621	0.127369
66	402064	0.006306	0.003499	1.80209	0.090512
210	552653	0.010725	0.004564	2.35018	0.101526
221	254687	0.011432	0.004712	2.42639	0.103058
303	27429	0.021124	0.006405	3.29829	0.120578
274	441065	0.016590	0.005676	2.92292	0.113035
297	444859	0.020115	0.006250	3.21854	0.118976
291	636886	0.019124	0.006094	3.13820	0.117361

APPENDIX B

PORTFOLIO #11 After-Tax Investor

RANK	SEC #	VARIANCE	CO- VARIANCE	BETA	EXPECTED RETURNS
-----	-----	-----	-----	-----	-----
	Market	0.001154	0.001154	1.000000	0.055342
18	66365	0.002733	0.001776	1.538868	0.070534
12	163798	0.001600	0.001359	1.177367	0.060343
27	336072	0.678522	0.027986	24.245308	0.710677
10	616880	0.001369	0.001257	1.089145	0.057855
4	66050	0.000720	0.000912	0.789689	0.049413
16	161610	0.002379	0.001657	1.435606	0.06723
13	173034	0.001752	0.001422	1.232140	0.01887
8	211485	0.001190	0.001172	1.015269	0.055773
15	319455	0.002331	0.001640	1.421219	0.067217
7	320548	0.001058	0.001105	0.957184	0.054135
6	458916	0.000938	0.001040	0.901392	0.052562
11	564809	0.001404	0.001273	1.102889	0.058243
3	585518	0.000646	0.000863	0.748087	0.048240
9	628855	0.001229	0.001191	1.031870	0.056241
2	667332	0.000410	0.000688	0.595737	0.043945
25	319441	0.047693	0.007420	6.427924	0.208367
26	391442	0.095073	0.010476	9.075556	0.283009
22	81721	0.004178	0.002196	1.902618	0.080789
17	441815	0.002388	0.001660	1.438336	0.067700
19	423329	0.003423	0.001988	1.722016	0.075697
5	25816	0.000807	0.000965	0.836040	0.050720
20	893485	0.004077	0.002169	1.879331	0.080132
23	8140	0.004186	0.002198	1.904321	0.080837
1	140186	0.000403	0.000682	0.590522	0.043798
21	211327	0.004137	0.002185	1.893267	0.080525
14	449744	0.001871	0.001470	1.273118	0.063042
24	786429	0.005247	0.002461	2.132073	0.087258

(Appendix B)
 PORTFOLIO #12
 After-Tax Investor

RANK	SEC #	VARIANCE	CO- VARIANCE	BETA	EXPECTED RETURNS
----	-----	-----	-----	-----	-----
	Market	0.001154	0.001154	1.000000	0.055342
12	121897	0.009965	0.003392	2.938256	0.109986
9	606191	0.004555	0.002293	1.986491	0.083153
11	655694	0.008883	0.003202	2.774085	0.105357
3	802020	0.001515	0.001322	1.145488	0.059444
10	843571	0.004762	0.002344	2.031124	0.084412
2	843673	0.001459	0.001298	1.124330	0.058847
7	907818	0.004261	0.002218	1.921325	0.081316
6	209237	0.002546	0.001714	1.485193	0.069021
15	582103	0.061313	0.008413	7.288220	0.232621
1	769739	0.000624	0.000849	0.735176	0.047876
5	985514	0.001995	0.001517	1.314563	0.064210
16	23771	0.523737	0.024587	21.301109	0.627674
8	247361	0.004450	0.002266	1.963404	0.082503
14	667281	0.043572	0.007092	6.144005	0.200363
18	698057	24.297623	0.167470	*****	4.117456
13	886735	0.021593	0.004992	4.325199	0.149087
17	902550	0.669779	0.027805	24.088594	0.706259
4	291101	0.001918	0.001488	1.289047	0.063491

(Appendix B)
 PORTFOLIO #13
 After-Tax Investor

RANK	SEC #	VARIANCE	CO- VARIANCE	BETA	EXPECTED RETURNS
----	-----	-----	-----	-----	-----
	Market	0.001154	0.001154	1.000000	0.055342
8	155447	0.001913	0.001486	1.287482	0.063447
5	212093	0.001614	0.001365	1.182402	0.060484
2	371028	0.001378	0.001261	1.092680	0.057955
1	913025	0.001370	0.001258	1.089437	0.057864
20	25537	0.003023	0.001868	1.618269	0.072772
3	152357	0.001505	0.001318	1.141892	0.059342
27	202795	0.003407	0.001983	1.718049	0.075585
29	250847	0.005034	0.002411	2.088376	0.086026
13	264399	0.002290	0.001626	1.408468	0.066858
14	341081	0.002625	0.001741	1.507896	0.069661
19	595832	0.002876	0.001822	1.578424	0.071649
24	644001	0.003317	0.001957	1.695239	0.074942
30	677347	0.005086	0.002423	2.099019	0.086326
11	744465	0.002120	0.001564	1.355204	0.065356
18	842400	0.002872	0.001821	1.577348	0.071619
28	842587	0.003763	0.002084	1.805525	0.078052
9	882848	0.001993	0.001517	1.314093	0.064197
21	927804	0.003035	0.001872	1.621438	0.072862
25	28609	0.003329	0.001960	1.698335	0.075030
4	197648	0.001513	0.001321	1.144766	0.059423
6	682678	0.001695	0.001399	1.211829	0.061314
26	694478	0.003341	0.001964	1.701363	0.075115
16	59165	0.002678	0.001758	1.523095	0.070089
7	209111	0.001861	0.001466	1.269663	0.062945
23	653522	0.003213	0.001926	1.668445	0.074187
17	665772	0.002703	0.001766	1.530200	0.070290
12	694308	0.002148	0.001575	1.364187	0.065609
22	717537	0.003132	0.001901	1.647182	0.073588
15	744567	0.002642	0.001746	1.512950	0.069803
10	976656	0.002117	0.001563	1.354188	0.065327

(Appendix B)
 PORTFOLIO #14
 After-Tax Investor

RANK	SEC #	VARIANCE	CO- VARIANCE	BETA	EXPECTED RETURNS
----	-----	-----	-----	-----	-----
	Market	0.001154	0.001154	1.00000	0.055342
45	453258	0.005225	0.002456	2.12760	0.087132
47	651639	0.005425	0.002502	2.16787	0.088267
55	717265	0.006678	0.002776	2.40524	0.094959
50	443654	0.006252	0.002686	2.32736	0.092763
64	134411	0.010328	0.003453	2.99132	0.111482
66	960878	0.010945	0.003554	3.07924	0.113961
4	126149	0.002315	0.001635	1.41608	0.067072
18	209219	0.003543	0.002022	1.75206	0.076544
13	487836	0.003271	0.001943	1.68339	0.074608
38	373712	0.004812	0.002357	2.04172	0.084710
49	22771	0.005771	0.002581	2.23603	0.090188
6	982526	0.002497	0.001698	1.47081	0.068615
9	191216	0.002954	0.001847	1.59976	0.072251
58	256129	0.007291	0.002901	2.51322	0.098003
53	780240	0.006511	0.002741	2.37498	0.094106
31	121691	0.004218	0.002206	1.91159	0.081042
39	575379	0.004914	0.002382	2.06331	0.085319
30	228669	0.004192	0.002200	1.90574	0.080877
23	252669	0.003755	0.002082	1.80372	0.078001
33	961548	0.004681	0.002324	2.01375	0.083922
43	260561	0.005203	0.002451	2.12315	0.087006
20	25321	0.003642	0.002050	1.77639	0.077230
11	263534	0.003043	0.001874	1.62375	0.072927
10	635655	0.002982	0.001855	1.60743	0.072467
44	10202	0.005222	0.002455	2.12700	0.087115
21	150843	0.003644	0.002051	1.77672	0.077240
12	26609	0.003064	0.001880	1.62913	0.073079
29	746252	0.004155	0.002190	1.89737	0.080641
62	13068	0.009152	0.003250	2.81576	0.106532
41	54303	0.005146	0.002437	2.11154	0.086679
15	375766	0.003409	0.001984	1.71848	0.075598
48	909160	0.005562	0.002534	2.19506	0.089033
37	42476	0.004811	0.002356	2.04147	0.084703
22	530000	0.003698	0.002066	1.78981	0.077609
52	483044	0.006429	0.002724	2.36003	0.093684
36	636316	0.004787	0.002351	2.03652	0.084564
28	912027	0.004063	0.002166	1.87621	0.080044
7	457470	0.002749	0.001781	1.54322	0.070657

(Appendix B)
 PORTFOLIO #14
 After-Tax Investor

RANK	SEC #	VARIANCE	CO- VARIANCE	BETA	EXPECTED RETURNS
----	-----	-----	-----	-----	-----
17	458702	0.003525	0.002017	1.74755	0.076417
5	637844	0.002366	0.001653	1.43174	0.067514
19	760779	0.003630	0.002047	1.77338	0.077145
51	761763	0.006294	0.002695	2.33512	0.092982
3	24843	0.002114	0.001562	1.35347	0.065307
65	690020	0.010543	0.003488	3.02222	0.112353
46	629156	0.005385	0.002493	2.15986	0.088041
24	167898	0.003758	0.002083	1.80437	0.078019
60	172172	0.008251	0.003086	2.67362	0.102525
42	300587	0.005180	0.002445	2.11845	0.086874
61	609150	0.008328	0.003100	2.68610	0.102877
67	294098	0.011108	0.003581	3.10216	0.114607
2	459200	0.001985	0.001514	1.31148	0.064124
40	580628	0.004965	0.002394	2.07393	0.085618
35	852206	0.004759	0.002344	2.03059	0.084397
8	578592	0.002782	0.001792	1.55242	0.070916
32	749285	0.004441	0.002264	1.96146	0.082448
57	989399	0.007270	0.002897	2.50956	0.097900
16	158663	0.003521	0.002016	1.74657	0.076390
26	359370	0.003997	0.002148	1.86090	0.079613
34	800	0.004733	0.002337	2.02489	0.084236
54	1688	0.006550	0.002750	2.38220	0.094309
1	30177	0.000863	0.000998	0.86459	0.051525
68	410252	0.013429	0.003937	3.41083	0.123309
59	725701	0.007874	0.003015	2.61176	0.100781
56	572342	0.006923	0.002827	2.44898	0.096192
27	549577	0.004054	0.002163	1.87413	0.079986
25	931422	0.003871	0.002114	1.83139	0.078781
63	2050	0.009484	0.003309	2.86642	0.107960
14	264830	0.003314	0.001956	1.69441	0.074919

(Appendix B)
 PORTFOLIO #15
 After-Tax Investor

RANK	SEC #	VARIANCE	CO- VARIANCE	BETA	EXPECTED RETURNS
----	-----	-----	-----	-----	-----
	Market	0.001154	0.001154	1.00000	0.055342
217	23127	0.006683	0.002777	2.40623	0.094987
265	43413	0.009375	0.003290	2.84988	0.107494
248	257075	0.008049	0.003048	2.64070	0.101597
271	437614	0.009809	0.003365	2.91506	0.109332
260	276461	0.009165	0.003252	2.81774	0.106588
291	656780	0.011368	0.003622	3.13824	0.115624
224	368820	0.007015	0.002846	2.46532	0.096653
122	374280	0.004651	0.002317	2.00728	0.083740
289	590655	0.011094	0.003579	3.10023	0.114552
180	853734	0.005642	0.002552	2.21094	0.089481
159	868273	0.005277	0.002468	2.13806	0.087427
300	379352	0.012297	0.003768	3.26397	0.119168
293	755281	0.011655	0.003668	3.17762	0.116734
276	815246	0.010022	0.003401	2.94654	0.110219
60	806857	0.003714	0.002070	1.79370	0.077718
299	958043	0.012173	0.003748	3.24741	0.118701
319	486170	0.019391	0.004731	4.09866	0.142700
318	912061	0.019339	0.004725	4.09316	0.142545
214	20771	0.006536	0.002747	2.37966	0.094238
268	343861	0.009649	0.003337	2.89125	0.108661
252	350244	0.008528	0.003137	2.71815	0.103781
100	406216	0.004296	0.002227	1.92924	0.081539
36	74077	0.003233	0.001932	1.67352	0.074330
7	134429	0.002200	0.001593	1.38043	0.066067
29	369856	0.003061	0.001880	1.62855	0.073062
49	370334	0.003521	0.002016	1.74647	0.076387
18	629525	0.002849	0.001814	1.57117	0.071445
206	668707	0.006381	0.002714	2.35116	0.093434
61	721510	0.003728	0.002074	1.79704	0.077813
136	747402	0.004985	0.002399	2.07812	0.085737
22	904784	0.002902	0.001830	1.58558	0.071851
210	296470	0.006480	0.002735	2.36945	0.093950
4	99599	0.001915	0.001487	1.28808	0.063464
17	143483	0.002814	0.001802	1.56147	0.071171
9	237410	0.002353	0.001648	1.42766	0.067399
31	423074	0.003094	0.001890	1.63731	0.073309
109	861504	0.004444	0.002265	1.96225	0.082470
26	751277	0.002983	0.001856	1.60758	0.072471

(Appendix B)
PORTFOLIO #15
After-Tax Investor

RANK	SEC #	VARIANCE	CO- VARIANCE	BETA	EXPECTED RETURNS
-----	-----	-----	-----	-----	-----
129	32172	0.004800	0.002354	2.03916	0.084638
321	436092	0.020709	0.004889	4.23568	0.146563
77	427866	0.003916	0.002126	1.84191	0.079077
201	39483	0.006192	0.002673	2.31611	0.092446
99	35229	0.004288	0.002225	1.92741	0.081488
208	693715	0.006449	0.002728	2.36374	0.093789
258	806823	0.009077	0.003237	2.80418	0.106206
190	428182	0.005940	0.002618	2.26852	0.091105
131	811850	0.004825	0.002360	2.04454	0.084790
126	931647	0.004700	0.002329	2.01786	0.084038
295	369352	0.011727	0.003679	3.18741	0.117010
78	713448	0.003971	0.002141	1.85476	0.079440
1	24703	0.001764	0.001427	1.23611	0.061999
14	718167	0.002763	0.001786	1.54710	0.070766
6	761753	0.002104	0.001558	1.35006	0.065211
85	206813	0.004092	0.002173	1.88274	0.080228
297	547779	0.011926	0.003710	3.21428	0.117768
48	758556	0.003510	0.002013	1.74378	0.076311
94	851783	0.004209	0.002204	1.90955	0.080984
128	860163	0.004761	0.002344	2.03095	0.084407
55	955465	0.003627	0.002046	1.77271	0.077127
238	95293	0.007653	0.002972	2.57484	0.099740
230	189486	0.007220	0.002887	2.50098	0.097658
202	416162	0.006210	0.002677	2.31943	0.092540
82	458506	0.004013	0.002152	1.86452	0.079715
292	479898	0.011516	0.003646	3.15855	0.116196
231	527364	0.007283	0.002899	2.51189	0.097966
227	918204	0.007137	0.002870	2.48658	0.097252
170	158525	0.005442	0.002506	2.17123	0.088362
152	373298	0.005142	0.002436	2.11070	0.086655
69	962166	0.003840	0.002105	1.82389	0.078569
310	339099	0.014634	0.004110	3.56067	0.127533
323	757640	0.021181	0.004945	4.28372	0.147917
281	830830	0.010314	0.003450	2.98925	0.111423
274	501026	0.009913	0.003383	2.93052	0.109768
205	608030	0.006338	0.002705	2.34326	0.093212
186	97383	0.005817	0.002591	2.24480	0.090436
195	313693	0.006055	0.002644	2.29033	0.091719
67	460146	0.003830	0.002103	1.82168	0.078507

(Appendix B)
PORTFOLIO #15
After-Tax Investor

RANK	SEC #	VARIANCE	CO- VARIANCE	BETA	EXPECTED RETURNS
----	-----	-----	-----	-----	-----
30	494368	0.003073	0.001883	1.63166	0.073150
194	582834	0.006034	0.002639	2.28644	0.091610
147	737628	0.005067	0.002418	2.09512	0.086216
97	793453	0.004244	0.002213	1.91745	0.081207
191	809877	0.005955	0.002622	2.27145	0.091187
66	905530	0.003817	0.002099	1.81847	0.078417
104	81437	0.004356	0.002242	1.94271	0.081919
209	574055	0.006463	0.002731	2.36617	0.093858
114	139861	0.004558	0.002294	1.98722	0.083174
21	364730	0.002890	0.001826	1.58238	0.071761
192	499040	0.005984	0.002628	2.27680	0.091338
133	887360	0.004876	0.002372	2.05528	0.085093
169	589433	0.005412	0.002499	2.16540	0.088197
141	887224	0.005024	0.002408	2.08617	0.085964
146	411631	0.005062	0.002417	2.09421	0.086190
226	554790	0.007064	0.002856	2.47389	0.096894
115	580645	0.004565	0.002295	1.98858	0.083212
135	784150	0.004956	0.002392	2.07213	0.085568
96	19087	0.004212	0.002205	1.91018	0.081002
34	260543	0.003157	0.001909	1.65390	0.073777
121	302491	0.004640	0.002314	2.00492	0.083673
51	383883	0.003591	0.002036	1.76387	0.076877
125	427056	0.004696	0.002328	2.01701	0.084014
79	611662	0.003975	0.002142	1.85579	0.079469
75	693506	0.003896	0.002121	1.83716	0.078944
101	857721	0.004301	0.002228	1.93030	0.081569
32	905581	0.003096	0.001890	1.63771	0.073320
46	2824	0.003483	0.002005	1.73711	0.076123
80	110097	0.004000	0.002149	1.86165	0.079634
41	532457	0.003406	0.001983	1.71767	0.075575
27	589331	0.003044	0.001874	1.62384	0.072930
71	717081	0.003845	0.002107	1.82517	0.078605
65	806605	0.003802	0.002095	1.81491	0.078316
185	812302	0.005810	0.002590	2.24356	0.090401
59	832377	0.003710	0.002069	1.79282	0.077693
158	852245	0.005241	0.002460	2.13085	0.087223
110	859264	0.004458	0.002269	1.96534	0.082557
134	915302	0.004898	0.002378	2.05992	0.085224
53	934488	0.003614	0.002042	1.76937	0.077032

(Appendix B)
 PORTFOLIO #15
 After-Tax Investor

RANK	SEC #	VARIANCE	CO- VARIANCE	BETA	EXPECTED RETURNS
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219	189054	0.006736	0.002788	2.41574	0.095255
113	194162	0.004555	0.002293	1.98643	0.083152
2	742718	0.001765	0.001427	1.23664	0.062013
103	165339	0.004355	0.002242	1.94245	0.081912
279	302808	0.010269	0.003443	2.98276	0.111240
93	459506	0.004181	0.002197	1.90318	0.080805
13	761525	0.002698	0.001765	1.52892	0.070254
154	824348	0.005211	0.002452	2.12465	0.087048
322	320891	0.020816	0.004902	4.24659	0.146871
145	459884	0.005061	0.002417	2.09398	0.086184
207	969457	0.006420	0.002722	2.35841	0.093639
54	48825	0.003616	0.002043	1.77005	0.077051
160	173036	0.005277	0.002468	2.13822	0.087431
3	302290	0.001864	0.001467	1.27071	0.062974
63	402460	0.003759	0.002083	1.80460	0.078026
216	546268	0.006611	0.002762	2.39324	0.094621
52	607059	0.003598	0.002038	1.76562	0.076927
143	718507	0.005042	0.002413	2.09010	0.086074
16	780257	0.002772	0.001789	1.54976	0.070841
178	822635	0.005637	0.002551	2.20980	0.089449
102	853683	0.004349	0.002240	1.94099	0.081871
73	853700	0.003855	0.002109	1.82739	0.078668
174	866762	0.005497	0.002519	2.18233	0.088675
37	880370	0.003270	0.001943	1.68314	0.074601
56	881694	0.003655	0.002054	1.77943	0.077316
137	907770	0.004998	0.002402	2.08085	0.085814
229	933169	0.007187	0.002880	2.49522	0.097496
57	318315	0.003683	0.002062	1.78636	0.077511
144	382388	0.005043	0.002413	2.09028	0.086079
28	382550	0.003046	0.001875	1.62457	0.072950
58	115657	0.003702	0.002067	1.79081	0.077637
307	371532	0.013873	0.004002	3.46679	0.124886
245	585745	0.007985	0.003036	2.63023	0.101302
111	219327	0.004490	0.002277	1.97239	0.082756
50	690768	0.003546	0.002023	1.75276	0.076564
162	451542	0.005280	0.002469	2.13884	0.087449
157	542290	0.005239	0.002459	2.13053	0.087214
88	565020	0.004150	0.002189	1.89608	0.080605
107	690734	0.004406	0.002255	1.95374	0.082230

(Appendix B)
 PORTFOLIO #15
 After-Tax Investor

RANK	SEC #	VARIANCE	CO- VARIANCE	BETA	EXPECTED RETURNS
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92	42170	0.004180	0.002196	1.90288	0.080796
139	87509	0.005001	0.002403	2.08158	0.085834
182	224399	0.005678	0.002560	2.21795	0.089679
168	667528	0.005356	0.002486	2.15413	0.087879
106	912656	0.004379	0.002248	1.94773	0.082061
273	963150	0.009887	0.003378	2.92672	0.109661
116	13716	0.004572	0.002297	1.99011	0.083255
68	22249	0.003833	0.002103	1.82221	0.078522
237	483008	0.007538	0.002950	2.55550	0.099195
5	211452	0.001997	0.001518	1.31536	0.064233
95	228255	0.004210	0.002204	1.90979	0.080991
179	635128	0.005641	0.002552	2.21058	0.089471
221	574599	0.006874	0.002817	2.44036	0.095949
255	580033	0.008837	0.003194	2.76688	0.105154
39	109043	0.003376	0.001974	1.71021	0.075365
269	117043	0.009710	0.003348	2.90038	0.108918
223	200273	0.006938	0.002830	2.45176	0.096270
211	231021	0.006490	0.002737	2.37124	0.094000
286	879335	0.010875	0.003543	3.06949	0.113685
132	244199	0.004831	0.002361	2.04575	0.084824
203	576216	0.006227	0.002681	2.32273	0.092633
150	19645	0.005124	0.002432	2.10695	0.086549
204	118745	0.006311	0.002699	2.33836	0.093073
225	481196	0.007019	0.002846	2.46596	0.096671
20	149123	0.002865	0.001819	1.57554	0.071568
188	57264	0.005905	0.002611	2.26175	0.090914
87	261597	0.004138	0.002185	1.89339	0.080529
120	181396	0.004617	0.002309	1.99999	0.083534
183	449168	0.005696	0.002564	2.22145	0.089777
176	4626	0.005593	0.002541	2.20124	0.089208
148	91797	0.005096	0.002425	2.10115	0.086386
247	115223	0.008036	0.003046	2.63858	0.101537
275	375046	0.009988	0.003395	2.94160	0.110080
290	704562	0.011293	0.003610	3.12784	0.115330
234	962898	0.007437	0.002930	2.53830	0.098710
163	216669	0.005292	0.002471	2.14115	0.087514
89	456866	0.004164	0.002192	1.89927	0.080694
64	761688	0.003797	0.002093	1.81358	0.078279
19	887389	0.002860	0.001817	1.57405	0.071526

(Appendix B)
 PORTFOLIO #15
 After-Tax Investor

RANK	SEC #	VARIANCE	CO- VARIANCE	BETA	EXPECTED RETURNS
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43	122781	0.003443	0.001993	1.72700	0.075838
305	538021	0.013204	0.003904	3.38220	0.122501
156	724479	0.005239	0.002459	2.13038	0.087210
243	212363	0.007915	0.003023	2.61865	0.100975
256	237688	0.008888	0.003203	2.77488	0.105380
320	238100	0.019999	0.004805	4.16248	0.144499
177	253849	0.005596	0.002542	2.20182	0.089224
119	428236	0.004602	0.002305	1.99668	0.083441
236	438506	0.007526	0.002947	2.55348	0.099138
84	848355	0.004090	0.002173	1.88247	0.080221
315	862111	0.017913	0.004547	3.93937	0.138209
317	933696	0.018416	0.004611	3.99433	0.139759
313	313135	0.016727	0.004394	3.80671	0.134469
232	892892	0.007426	0.002928	2.53647	0.098659
25	291011	0.002968	0.001851	1.60354	0.072357
15	369604	0.002765	0.001786	1.54772	0.070784
149	383492	0.005117	0.002430	2.10554	0.086510
164	960402	0.005311	0.002476	2.14503	0.087623
151	384802	0.005141	0.002436	2.11036	0.086646
251	829302	0.008508	0.003134	2.71492	0.103690
142	963320	0.005026	0.002409	2.08675	0.085980
199	963626	0.006166	0.002668	2.31120	0.092308
105	31897	0.004358	0.002243	1.94312	0.081931
308	875382	0.014066	0.004029	3.49086	0.125565
259	934436	0.009117	0.003244	2.81035	0.106380
98	460470	0.004246	0.002214	1.91797	0.081222
197	413875	0.006077	0.002649	2.29458	0.091839
270	552618	0.009770	0.003358	2.90926	0.109168
181	620076	0.005650	0.002554	2.21243	0.089523
167	755111	0.005352	0.002486	2.15333	0.087857
311	458140	0.015215	0.004191	3.63063	0.129505
316	637640	0.018241	0.004589	3.97525	0.139221
130	882508	0.004819	0.002358	2.04323	0.084753
44	884315	0.003461	0.001999	1.73168	0.075970
198	278749	0.006134	0.002661	2.30524	0.092140
287	27627	0.010923	0.003551	3.07624	0.113876
284	171196	0.010545	0.003489	3.02256	0.112362
45	345370	0.003480	0.002004	1.73634	0.076101
10	370442	0.002362	0.001651	1.43055	0.067480

(Appendix B)
 PORTFOLIO #15
 After-Tax Investor

RANK	SEC #	VARIANCE	CO- VARIANCE	BETA	EXPECTED RETURNS
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140	459578	0.005007	0.002404	2.08281	0.085869
153	693718	0.005205	0.002451	2.12349	0.087016
220	826622	0.006792	0.002800	2.42578	0.095538
42	81689	0.003430	0.001990	1.72390	0.075750
40	99725	0.003383	0.001976	1.71207	0.075417
117	235811	0.004576	0.002298	1.99104	0.083282
47	278058	0.003487	0.002006	1.73814	0.076152
306	748369	0.013388	0.003931	3.40573	0.123165
38	774347	0.003345	0.001965	1.70226	0.075140
112	872649	0.004520	0.002284	1.97890	0.082939
86	913017	0.004131	0.002184	1.89178	0.080483
200	97023	0.006171	0.002669	2.31210	0.092333
267	369550	0.009621	0.003332	2.88701	0.108541
264	400181	0.009347	0.003285	2.84564	0.107375
250	580169	0.008187	0.003074	2.66317	0.102230
161	883203	0.005280	0.002469	2.13878	0.087447
184	29717	0.005711	0.002567	2.22425	0.089856
70	32177	0.003841	0.002106	1.82423	0.078579
74	573275	0.003870	0.002114	1.83111	0.078773
241	75815	0.007848	0.003010	2.60746	0.100660
218	714041	0.006711	0.002783	2.41124	0.095128
124	370838	0.004671	0.002322	2.01165	0.083863
296	808655	0.011830	0.003695	3.20141	0.117405
193	879131	0.005997	0.002631	2.27929	0.091408
196	26681	0.006061	0.002645	2.29157	0.091754
242	67383	0.007895	0.003019	2.61536	0.100883
118	71892	0.004593	0.002303	1.99482	0.083388
76	75887	0.003910	0.002124	1.84037	0.079034
8	478160	0.002298	0.001629	1.41085	0.066925
24	277461	0.002963	0.001850	1.60231	0.072323
23	604059	0.002906	0.001832	1.58671	0.071883
263	731095	0.009211	0.003261	2.82480	0.106787
83	984121	0.004068	0.002167	1.87742	0.080078
277	451650	0.010046	0.003405	2.95018	0.110322
278	601753	0.010262	0.003442	2.98168	0.111210
282	890278	0.010368	0.003459	2.99700	0.111642
175	449268	0.005563	0.002534	2.19540	0.089043
215	24735	0.006593	0.002759	2.38988	0.094526
33	124845	0.003131	0.001901	1.64706	0.073584

(Appendix B)
PORTFOLIO #15
After-Tax Investor

RANK	SEC #	VARIANCE	CO- VARIANCE	BETA	EXPECTED RETURNS
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187	224003	0.005892	0.002608	2.25939	0.090847
240	591690	0.007792	0.002999	2.59810	0.100396
212	873635	0.006530	0.002745	2.37841	0.094203
266	882593	0.009535	0.003317	2.87407	0.108176
249	115885	0.008056	0.003049	2.64181	0.101628
261	941063	0.009189	0.003257	2.82146	0.106693
173	372460	0.005475	0.002514	2.17780	0.088547
239	717425	0.007766	0.002994	2.59383	0.100276
301	299209	0.012339	0.003774	3.26959	0.119327
127	19519	0.004736	0.002338	2.02560	0.084256
155	45573	0.005213	0.002453	2.12510	0.087061
233	146227	0.007435	0.002929	2.53795	0.098700
90	314099	0.004172	0.002194	1.90113	0.080747
166	556139	0.005347	0.002484	2.15231	0.087828
138	577778	0.005000	0.002402	2.08134	0.085827
91	708160	0.004177	0.002196	1.90231	0.080780
12	812387	0.002643	0.001747	1.51323	0.069811
189	239753	0.005914	0.002613	2.26361	0.090966
81	482584	0.004009	0.002151	1.86372	0.079692
108	980881	0.004410	0.002256	1.95461	0.082255
253	390064	0.008686	0.003166	2.74321	0.104487
171	477196	0.005462	0.002511	2.17523	0.088474
123	501044	0.004657	0.002319	2.00866	0.083778
11	786514	0.002394	0.001662	1.44014	0.067751
35	974280	0.003168	0.001912	1.65675	0.073857
72	2040	0.003846	0.002107	1.82530	0.078609
280	171583	0.010292	0.003447	2.98606	0.111334
262	248703	0.009190	0.003257	2.82170	0.106700
298	376109	0.012141	0.003743	3.24315	0.118581
257	571630	0.009050	0.003232	2.80010	0.106091
165	580135	0.005335	0.002481	2.14981	0.087758
244	30096	0.007931	0.003026	2.62119	0.101047
172	278764	0.005473	0.002513	2.17751	0.088539
228	761338	0.007141	0.002871	2.48723	0.097270
285	767754	0.010712	0.003516	3.04642	0.113035
303	152312	0.012523	0.003802	3.29381	0.120010
254	432848	0.008784	0.003184	2.75855	0.104920
283	435081	0.010505	0.003482	3.01672	0.112198
309	751328	0.014624	0.004109	3.55946	0.127499

(Appendix B)
 PORTFOLIO #15
 After-Tax Investor

RANK	SEC #	VARIANCE	CO- VARIANCE	BETA	EXPECTED RETURNS
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314	205363	0.017286	0.004467	3.86987	0.136250
235	53015	0.007476	0.002938	2.54499	0.098899
246	285659	0.007998	0.003038	2.63228	0.101360
304	902384	0.012659	0.003823	3.31161	0.120511
312	198279	0.015682	0.004255	3.68590	0.131064
62	402064	0.003739	0.002078	1.79987	0.077892
213	552653	0.006533	0.002746	2.37904	0.094220
222	254687	0.006904	0.002823	2.44574	0.096101
302	27429	0.012409	0.003785	3.27876	0.119585
272	441065	0.009883	0.003378	2.92617	0.109645
294	444859	0.011722	0.003678	3.18677	0.116992

APPENDIX C

50% Tax Investor/No-Tax Investor Comparative Beta Terms

SEC #	B (.5)	B (.0)	B/B
66365	1.5389	1.9067	0.80710
163798	1.1774	1.5867	0.74204
336072	24.2453	24.6730	0.98267
616880	1.0891	1.4534	0.74939
66050	0.7897	1.0669	0.74015
161610	1.4356	1.6954	0.84674
173034	1.2321	1.5258	0.80754
211485	1.0153	1.3525	0.75064
319455	1.4212	1.7081	0.83206
320548	0.9572	1.2625	0.75817
458916	0.9014	1.2030	0.74929
564809	1.1029	1.5083	0.73124
585518	0.7481	1.1014	0.67918
628855	1.0319	1.2440	0.82946
667332	0.5957	0.8962	0.66477
319441	6.4279	6.6827	0.96188
391442	9.0756	9.4172	0.96372
81721	1.9026	2.2032	0.86356
441815	1.4383	1.7979	0.80002
423329	1.7220	1.9257	0.89424
25816	0.8360	1.1308	0.73930
893485	1.8793	2.2564	0.83289
8140	1.9043	2.1529	0.88455
140186	0.5905	0.7619	0.77504
211327	1.8933	2.2588	0.83817

(Appendix C)
 50% Tax Investor/No-Tax Investor
 Comparative Beta Terms

SEC #	B (.5)	B (.0)	B/B
449744	1.2731	1.5938	0.79881
786429	2.1321	2.3279	0.91588
121897	2.9383	3.0317	0.96919
606191	1.9865	2.2304	0.89066
655694	2.7741	3.0404	0.91242
802020	1.1455	1.3877	0.82543
843571	2.0311	2.3158	0.87705
843673	1.1243	1.3303	0.84518
907818	1.9213	2.2380	0.85851
209237	1.4852	1.6203	0.91660
582103	7.2882	7.6502	0.95268
769739	0.7352	0.8432	0.87190
985514	1.3146	1.5005	0.87609
23771	21.3011	21.8185	0.97629
247361	1.9634	2.0420	0.96149
667281	6.1440	7.2450	0.84803
886735	4.3252	4.4919	0.96289
902550	24.0886	24.7028	0.97513
291101	1.2890	1.8060	0.71377
155447	1.2875	1.8417	0.69906
212093	1.1824	1.7710	0.66765
371028	1.0927	1.6492	0.66254
913025	1.0894	1.6742	0.65071
25537	1.6183	2.3967	0.67522
152357	1.1419	1.7378	0.65709
202795	1.7180	2.4520	0.70067
250847	2.0884	2.8053	0.74444
264399	1.4085	2.0299	0.69384
341081	1.5079	1.8790	0.80250
595832	1.5784	2.1736	0.72619
644001	1.6952	2.3441	0.72320
677347	2.0990	2.9479	0.71203
744465	1.3552	1.9764	0.68570
842400	1.5773	2.0845	0.75669
842587	1.8055	2.4915	0.72469
882848	1.3141	1.8458	0.71193
927804	1.6214	2.1698	0.74726
28609	1.6983	2.0430	0.83128
197648	1.1448	1.6462	0.69541

(Appendix C)
 50% Tax Investor/No-Tax Investor
 Comparative Beta Terms

SEC #	B (.5)	B (.0)	B/B
682678	1.2118	1.5899	0.76222
694478	1.7014	2.1909	0.77655
59165	1.5231	2.1433	0.71064
209111	1.2697	1.6861	0.75301
653522	1.6684	2.2741	0.73369
665772	1.5302	2.1452	0.71331
694308	1.3642	1.9517	0.69897
717537	1.6472	2.4630	0.66876
744567	1.5129	2.1475	0.70451
976656	1.3542	1.9020	0.71199
453258	2.1276	2.1110	1.00788
651639	2.1679	2.1447	1.01082
717265	2.4052	2.3773	1.01174
443654	2.3274	2.3184	1.00387
134411	2.9913	2.9816	1.00325
960878	3.0792	3.0246	1.01808
126149	1.4161	1.4097	1.00449
209219	1.7521	1.7385	1.00780
487836	1.6834	1.6610	1.01346
373712	2.0417	2.0221	1.00968
22771	2.2360	2.2226	1.00604
982526	1.4708	1.4588	1.00821
191216	1.5998	1.5882	1.00725
256129	2.5132	2.4933	1.00798
780240	2.3750	2.3745	1.00020
121691	1.9116	1.9106	1.00050
575379	2.0633	2.0501	1.00645
228669	1.9057	1.8865	1.01020
252669	1.8037	1.7861	1.00985
961548	2.0137	1.9908	1.01155
260561	2.1232	2.0970	1.01246
25321	1.7764	1.7751	1.00071
263534	1.6237	1.6127	1.00682
635655	1.6074	1.5839	1.01483
10202	2.1270	2.1224	1.00219
150843	1.7767	1.7615	1.00866
26609	1.6291	1.6160	1.00813
746252	1.8974	1.8632	1.01833
13068	2.8158	2.7800	1.01286

(Appendix C)
 50% Tax Investor/No-Tax Investor
 Comparative Beta Terms

SEC #	B (.5)	B (.0)	B/B
54303	2.1115	2.1130	0.99933
375766	1.7185	1.7196	0.99933
909160	2.1951	2.2080	0.99412
42476	2.0415	2.0294	1.00594
530000	1.7898	1.7623	1.01560
483044	2.3600	2.3521	1.00337
636316	2.0365	2.0098	1.01329
912027	1.8762	1.8406	1.01937
457470	1.5432	1.5323	1.00716
458702	1.7476	1.7136	1.01984
637844	1.4317	1.4127	1.01348
760779	1.7734	1.7420	1.01802
761763	2.3351	2.2998	1.01538
24843	1.3535	1.3404	1.00974
690020	3.0222	2.9898	1.01085
629156	2.1599	2.1391	1.00969
167898	1.8044	1.7890	1.00859
172172	2.6736	2.6839	0.99616
300587	2.1185	2.1090	1.00447
609150	2.6861	2.6956	0.99646
294098	3.1022	3.0743	1.00907
459200	1.3115	1.3011	1.00799
580628	2.0739	2.0573	1.00807
852206	2.0306	2.0140	1.00823
578592	1.5524	1.5476	1.00314
749285	1.9615	1.9444	1.00878
989399	2.5096	2.4844	1.01015
158663	1.7466	1.7385	1.00462
359370	1.8609	1.8464	1.00786
800	2.0249	1.9952	1.01486
1688	2.3822	2.3618	1.00864
30177	0.8646	0.8609	1.00432
410252	3.4108	3.3965	1.00421
725701	2.6118	2.5840	1.01075
572342	2.4490	2.4253	1.00975
549577	1.8741	1.8578	1.00881
931422	1.8314	1.8224	1.00494
2050	2.8664	2.8328	1.01188
264830	1.6944	1.6811	1.00789

(Appendix C)
 50% Tax Investor/No-Tax Investor
 Comparative Beta Terms

SEC #	B (.5)	B (.0)	B/B
23127	2.4062	2.3623	1.01860
43413	2.8499	2.8182	1.01124
257075	2.6407	2.6437	0.99888
437614	2.9151	2.8836	1.01092
276461	2.8177	2.7766	1.01483
656780	3.1382	3.0822	1.01818
368820	2.4653	2.4446	1.00847
374280	2.0073	1.9884	1.00952
590655	3.1002	3.0756	1.00802
853734	2.2109	2.1921	1.00860
868273	2.1381	2.1242	1.00652
379352	3.2640	3.2621	1.00059
755281	3.1776	3.1474	1.00960
815246	2.9465	2.9195	1.00926
806857	1.7937	1.7722	1.01214
958043	3.2474	3.3081	0.98164
486170	4.0987	4.0617	1.00911
912061	4.0932	4.0406	1.01300
20771	2.3797	2.3663	1.00566
343861	2.8912	2.8535	1.01324
350244	2.7182	2.7454	0.99009
406216	1.9292	1.9076	1.01132
74077	1.6735	1.6621	1.00687
134429	1.3804	1.3802	1.00014
369856	1.6286	1.6095	1.01184
370334	1.7465	1.7252	1.01233
629525	1.5712	1.5593	1.00758
668707	2.3512	2.3187	1.01399
721510	1.7970	1.7834	1.00767
747402	2.0781	2.0671	1.00535
904784	1.5856	1.5714	1.00902
296470	2.3695	2.3329	1.01566
99599	1.2881	1.2788	1.00722
143483	1.5615	1.5592	1.00147
237410	1.4277	1.4150	1.00896
423074	1.6373	1.6369	1.00028
861504	1.9622	1.9360	1.01357
751277	1.6076	1.6046	1.00187
32172	2.0392	2.0206	1.00918

(Appendix C)
 50% Tax Investor/No-Tax Investor
 Comparative Beta Terms

SEC #	B (.5)	B (.0)	B/B
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436092	4.2357	4.1229	1.02735
427866	1.8419	1.8300	1.00650
39483	2.3161	2.3139	1.00095
35229	1.9274	1.9108	1.00869
693715	2.3637	2.3543	1.00400
806823	2.8042	2.7889	1.00549
428182	2.2685	2.2513	1.00767
811850	2.0445	2.0183	1.01298
931647	2.0179	2.0104	1.00369
369352	3.1874	3.1469	1.01287
713448	1.8548	1.8375	1.00941
24703	1.2361	1.2173	1.01547
718167	1.5471	1.5309	1.01057
761753	1.3501	1.3447	1.00402
206813	1.8827	1.8479	1.01886
547779	3.2143	3.1526	1.01955
758556	1.7438	1.7222	1.01251
851783	1.9096	1.9022	1.00387
860163	2.0309	2.0193	1.00579
955465	1.7727	1.7678	1.00280
95293	2.5748	2.5421	1.01286
189486	2.5010	2.4922	1.00354
416162	2.3194	2.3107	1.00377
458506	1.8645	1.8552	1.00504
479898	3.1586	3.1383	1.00645
527364	2.5119	2.5150	0.99878
918204	2.4866	2.4543	1.01316
158525	2.1712	2.1407	1.01425
373298	2.1107	2.0862	1.01172
962166	1.8239	1.8114	1.00688
339099	3.5607	3.5272	1.00948
757640	4.2837	4.2594	1.00570
830830	2.9893	2.9660	1.00783
501026	2.9305	2.9019	1.00987
608030	2.3433	2.3310	1.00527
97383	2.2448	2.2141	1.01387
313693	2.2903	2.2752	1.00663
460146	1.8217	1.8056	1.00892
494368	1.6317	1.6168	1.00922

(Appendix C)
 50% Tax Investor/No-Tax Investor
 Comparative Beta Terms

SEC #	B (.5)	B (.0)	B/B
582834	2.2864	2.2789	1.00331
737628	2.0951	2.0746	1.00991
793453	1.9175	1.9070	1.00548
809877	2.2714	2.2576	1.00614
905530	1.8185	1.7989	1.01089
81437	1.9427	1.9170	1.01342
574055	2.3662	2.3473	1.00805
139861	1.9872	1.9695	1.00900
364730	1.5824	1.5712	1.00710
499040	2.2768	2.2607	1.00714
887360	2.0553	2.0362	1.00936
589433	2.1654	2.1423	1.01077
887224	2.0862	2.0645	1.01050
411631	2.0942	2.0891	1.00245
554790	2.4739	2.4748	0.99964
580645	1.9886	1.9737	1.00753
784150	2.0721	2.0751	0.99859
19087	1.9102	1.8952	1.00792
260543	1.6539	1.6378	1.00983
302491	2.0049	1.9877	1.00864
383883	1.7639	1.7393	1.01411
427056	2.0170	1.9992	1.00893
611662	1.8558	1.8391	1.00907
693506	1.8372	1.8164	1.01144
857721	1.9303	1.9262	1.00213
905581	1.6377	1.6247	1.00801
2824	1.7371	1.7392	0.99881
110097	1.8616	1.8400	1.01176
532457	1.7177	1.7069	1.00633
589331	1.6238	1.6088	1.00932
717081	1.8252	1.8099	1.00846
806605	1.8149	1.8037	1.00623
812302	2.2436	2.2291	1.00647
832377	1.7928	1.7659	1.01523
852245	2.1308	2.1204	1.00492
859264	1.9653	1.9458	1.01004
915302	2.0599	2.0523	1.00370
934488	1.7694	1.7489	1.01171
189054	2.4157	2.4267	0.99548

(Appendix C)
 50% Tax Investor/No-Tax Investor
 Comparative Beta Terms

SEC #	B (.5)	B (.0)	B/B
194162	1.9864	1.9679	1.00940
742718	1.2366	1.2293	1.00594
165339	1.9425	1.9184	1.01254
302808	2.9828	2.9387	1.01500
459506	1.9032	1.8900	1.00699
761525	1.5289	1.5218	1.00471
824348	2.1247	2.1111	1.00644
320891	4.2466	4.2043	1.01007
459884	2.0940	2.0647	1.01420
969457	2.3584	2.3329	1.01092
48825	1.7700	1.7481	1.01257
173036	2.1382	2.1069	1.01486
302290	1.2707	1.2616	1.00723
402460	1.8046	1.7734	1.01758
546268	2.3932	2.3737	1.00824
607059	1.7656	1.7556	1.00572
718507	2.0901	2.0646	1.01236
780257	1.5498	1.5267	1.01513
822635	2.2098	2.1708	1.01796
853683	1.9410	1.9136	1.01434
853700	1.8274	1.8013	1.01445
866762	2.1823	2.1583	1.01114
880370	1.6831	1.6559	1.01643
881694	1.7794	1.7545	1.01421
907770	2.0808	2.0561	1.01204
933169	2.4952	2.4623	1.01338
318315	1.7864	1.7847	1.00094
382388	2.0903	2.0737	1.00801
382550	1.6246	1.6146	1.00620
115657	1.7908	1.7695	1.01207
371532	3.4668	3.4457	1.00611
585745	2.6302	2.6160	1.00543
219327	1.9724	1.9600	1.00630
690768	1.7528	1.7506	1.00121
451542	2.1388	2.1205	1.00864
542290	2.1305	2.1127	1.00844
565020	1.8961	1.8827	1.00712
690734	1.9537	1.9341	1.01013
42170	1.9029	1.8689	1.01818

(Appendix C)
 50% Tax Investor/No-Tax Investor
 Comparative Beta Terms

SEC #	B (.5)	B (.0)	B/B
87509	2.0816	2.0469	1.01694
224399	2.2180	2.1920	1.01185
667528	2.1541	2.1217	1.01527
912656	1.9477	1.9099	1.01982
963150	2.9267	2.8826	1.01531
13716	1.9901	1.9744	1.00797
22249	1.8222	1.8050	1.00954
483008	2.5555	2.5171	1.01524
211452	1.3154	1.3088	1.00503
228255	1.9098	1.8911	1.00990
635128	2.2106	2.2053	1.00240
574599	2.4404	2.4153	1.01036
580033	2.7669	2.7309	1.01317
109043	1.7102	1.6953	1.00877
117043	2.9004	2.8813	1.00662
200273	2.4518	2.4428	1.00366
231021	2.3712	2.3595	1.00497
879335	3.0695	3.0251	1.01468
244199	2.0457	2.0205	1.01252
576216	2.3227	2.3320	0.99601
19645	2.1069	2.0926	1.00685
118745	2.3384	2.3172	1.00912
481196	2.4660	2.4406	1.01040
149123	1.5755	1.5600	1.00997
57264	2.2618	2.2448	1.00757
261597	1.8934	1.8691	1.01299
181396	2.0000	1.9760	1.01216
449168	2.2214	2.2042	1.00785
4626	2.2012	2.1770	1.01113
91797	2.1012	2.0842	1.00814
115223	2.6386	2.6276	1.00419
375046	2.9416	2.9860	0.98514
704562	3.1278	3.1347	0.99781
962898	2.5383	2.5266	1.00463
216669	2.1411	2.1160	1.01188
456866	1.8993	1.8776	1.01153
761688	1.8136	1.8063	1.00402
887389	1.5740	1.5617	1.00789
122781	1.7270	1.7125	1.00848

(Appendix C)
 50% Tax Investor/No-Tax Investor
 Comparative Beta Terms

SEC #	B (.5)	B (.0)	B/B
538021	3.3822	3.3268	1.01665
724479	2.1304	2.1227	1.00363
212363	2.6186	2.5883	1.01171
237688	2.7749	2.7480	1.00977
238100	4.1625	4.0937	1.01680
253849	2.2018	2.1778	1.01102
428236	1.9967	1.9750	1.01097
438506	2.5535	2.5270	1.01049
848355	1.8825	1.8628	1.01055
862111	3.9394	3.9222	1.00438
933696	3.9943	4.0480	0.98673
313135	3.8067	3.7844	1.00588
892892	2.5365	2.5272	1.00367
291011	1.6035	1.5884	1.00954
369604	1.5477	1.5249	1.01500
383492	2.1055	2.0761	1.01419
960402	2.1450	2.1308	1.00667
384802	2.1104	2.0868	1.01129
829302	2.7149	2.6877	1.01012
963320	2.0868	2.0756	1.00537
963626	2.3112	2.2864	1.01086
31897	1.9431	1.9243	1.00979
875382	3.4909	3.5226	0.99099
934436	2.8104	2.7951	1.00544
460470	1.9180	1.9143	1.00194
413875	2.2946	2.2872	1.00321
552618	2.9093	2.9420	0.98888
620076	2.2124	2.1933	1.00872
755111	2.1533	2.1384	1.00700
458140	3.6306	3.5997	1.00859
637640	3.9753	3.9303	1.01143
882508	2.0432	2.0262	1.00842
884315	1.7317	1.7180	1.00794
278749	2.3052	2.2967	1.00374
27627	3.0762	3.0468	1.00966
171196	3.0226	2.9809	1.01397
345370	1.7363	1.7265	1.00571
370442	1.4306	1.4113	1.01363
459578	2.0828	2.0822	1.00031

(Appendix C)
 50% Tax Investor/No-Tax Investor
 Comparative Beta Terms

SEC #	B (.5)	B (.0)	B/B
693718	2.1235	2.1055	1.00855
826622	2.4258	2.4122	1.00565
81689	1.7239	1.7081	1.00926
99725	1.7121	1.7177	0.99674
235811	1.9910	1.9773	1.00695
278058	1.7381	1.7297	1.00486
748369	3.4057	3.3661	1.01177
774347	1.7023	1.6887	1.00802
872649	1.9789	1.9652	1.00699
913017	1.8918	1.8731	1.00997
97023	2.3121	2.3214	0.99599
369550	2.8870	2.8543	1.01145
400181	2.8456	2.8191	1.00942
580169	2.6632	2.6407	1.00853
883203	2.1388	2.1235	1.00720
29717	2.2243	2.2047	1.00886
32177	1.8242	1.8013	1.01270
573275	1.8311	1.8148	1.00897
75815	2.6075	2.5847	1.00879
714041	2.4112	2.3908	1.00856
370838	2.0116	1.9917	1.01004
808655	3.2014	3.2496	0.98517
879131	2.2793	2.2557	1.01044
26681	2.2916	2.2590	1.01444
67383	2.6154	2.5993	1.00616
71892	1.9948	1.9703	1.01247
75887	1.8404	1.8198	1.01132
478160	1.4109	1.4049	1.00422
277461	1.6023	1.5913	1.00689
604059	1.5867	1.5761	1.00673
731095	2.8248	2.8071	1.00629
984121	1.8774	1.8588	1.01004
451650	2.9502	2.9611	0.99632
601753	2.9817	2.9621	1.00660
890278	2.9970	2.9697	1.00920
449268	2.1954	2.1676	1.01284
24735	2.3899	2.3602	1.01257
124845	1.6471	1.6308	1.00996
224003	2.2594	2.2474	1.00534

(Appendix C)
 50% Tax Investor/No-Tax Investor
 Comparative Beta Terms

SEC #	B (.5)	B (.0)	B/B
591690	2.5981	2.5657	1.01262
873635	2.3784	2.3536	1.01055
882593	2.8741	2.8579	1.00565
115885	2.6418	2.6284	1.00511
941063	2.8215	2.8389	0.99386
372460	2.1778	2.1539	1.01111
717425	2.5938	2.5750	1.00731
299209	3.2696	3.2319	1.01165
19519	2.0256	2.0012	1.01219
45573	2.1251	2.1154	1.00459
146227	2.5380	2.5069	1.01240
314099	1.9011	1.8878	1.00707
556139	2.1523	2.1445	1.00364
577778	2.0813	2.0593	1.01069
708160	1.9023	1.8935	1.00467
812387	1.5132	1.5056	1.00509
239753	2.2636	2.2517	1.00530
482584	1.8637	1.8516	1.00655
980881	1.9546	1.9435	1.00574
390064	2.7432	2.7233	1.00730
477196	2.1752	2.1602	1.00694
501044	2.0087	2.0068	1.00091
786514	1.4401	1.4329	1.00507
974280	1.6567	1.6422	1.00886
2040	1.8253	1.8192	1.00334
171583	2.9861	2.9767	1.00315
248703	2.8217	2.7969	1.00887
376109	3.2431	3.2121	1.00966
571630	2.8001	2.7719	1.01018
580135	2.1498	2.1313	1.00869
30096	2.6212	2.5994	1.00839
278764	2.1775	2.1637	1.00638
761338	2.4872	2.4794	1.00317
767754	3.0464	3.0379	1.00280
152312	3.2938	3.2601	1.01033
432848	2.7586	2.7542	1.00159
435081	3.0167	2.9987	1.00601
751328	3.5595	3.5470	1.00352
205363	3.8699	3.8238	1.01204

(Appendix C)
 50% Tax Investor/No-Tax Investor
 Comparative Beta Terms

SEC #	B (.5)	B (.0)	B/B
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53015	2.5450	2.5106	1.01369
285659	2.6323	2.6289	1.00130
902384	3.3116	3.2741	1.01145
198279	3.6859	3.6362	1.01367
402064	1.7999	1.8021	0.99877
552653	2.3790	2.3502	1.01228
254687	2.4457	2.4264	1.00798
27429	3.2788	3.2983	0.99408
441065	2.9262	2.9229	1.00111
444859	3.1868	3.2185	0.99013
636886	3.0784	3.1382	0.98094

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