

Evidence of Implicit Taxes on Equity
Using Data from Futures Markets to Control for Risk

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Abstract

In this paper we investigate the existence and magnitudes of implicit taxes on equity. Specifically, using futures market data to control for risk, we test whether the pre-tax returns on bonds are higher than the pre-tax returns on four stock indices during the period 1993-1999. We compare the risk-free stock index returns (on perfectly hedged portfolios) to risk-free returns on taxable bonds, and estimate implicit taxes on equity. We find a moderate but significantly positive implicit tax for each stock index. Moreover, we find that cross-sectionally, implicit taxes are much larger for the low-dividend NASDAQ 100 than for the other three, substantially higher dividend-yielding indices. We also find that estimated implicit taxes have fallen significantly during the sample period. Our findings are consistent with a multiple clientele explanation, in which more than one tax clientele is the marginal investor in the stock market.

I. INTRODUCTION

Financial market investors bear taxes on the returns they receive that vary depending on the assets they acquire. Bond returns (other than municipals) are taxed at ordinary rates while stock returns are largely taxed at lower capital gains rates on a deferred basis. In a market equilibrium, it is reasonable to expect that pre-tax returns on bonds should be higher than pre-tax returns on stocks to compensate for this tax differential. This difference in pre-tax returns, if it exists, is commonly referred to as an implicit tax on equity. Its existence depends on whether or not the marginal investor does in fact face differential taxation (tax-exempt institutions do not, for example), a heretofore unresolved question. The purpose of this paper is to determine whether implicit taxes exist and to infer characteristics of marginal investors. Using futures data that enables us to calculate ex-ante risk-free stock index returns, we estimate implicit taxes on those indices. We also compare between the four indices' risk-free stock returns to determine whether dividend yields affect the magnitude of implicit taxes. Using data

from 1993 to 1999, we find evidence of small but significant implicit taxes on equity that are significantly larger for the low-yield NASDAQ 100 than for the relatively high-yield S&P 500 index.

There is substantial empirical research on the issue of how taxes affect financial market variables, including prices and returns. Studies of implicit taxes on equity have focussed on the effect of dividend yield on stock returns, either by comparing average returns for stocks with different yields, or by analyzing ex-dividend date effects. Early studies in this regard are based on Brennan's (1970) CAPM-based model in which dividend yield linearly (positively) affects stock returns due to the adverse tax effects of dividends relative to capital gains. This is a model of differences in implicit taxes across equities, rather than a model of the implicit tax on equity relative to debt. Tests for an implicit tax effect of dividends include Naranjo, Nimalendran, and Ryngaert (1998), Chen, Grundy, and Stambaugh (1990), Miller and Scholes (1982), Gordon and Bradford (1980), Blume (1980), Litzenberger and Ramaswamy (1979), and Black and Scholes (1974). These papers have used a variety of specifications in an attempt to control for risk premia, and have found results across the spectrum, with some finding substantial effects of dividends on returns (*e.g.*, Naranjo, Nimalendran, and Ryngaert) and some finding no significant effects (*e.g.*, Chen, Grundy, and Stambaugh).

More recently, there have been several recent studies analyzing whether dividend and capital gains taxes affect common stock prices (known as tax capitalization). Many of these studies have provided evidence supporting the existence of tax capitalization using panel studies (Harris and Kemsley, 1999, Harris, Hubbard, and Kemsley, 1999, and Collins and Kemsley, 2000), event studies (Lang and Shackelford, 2000, and Ayers,

Cloyd, and Robinson, 2000), and time series (Williams, 2001a), while other studies have questioned the robustness of some of these findings (Dhaliwal, Erickson, Myers, and Bany, 2001, and Hanlon, Myers, and Shevlin, 2001). Apart from whether tax capitalization occurs, or its magnitude, the question of whether common stocks bear implicit taxes is a fundamentally different one. Tax capitalization is an *absolute* effect (stock prices fall in response to taxes), while an implicit tax is a *relative* effect (stock returns fall relative to bond returns in response to taxes).¹ Thus, any evidence on tax capitalization in equity prices is only indirectly related to the question of whether stocks bear implicit taxes.

Another line of research related to implicit taxes on equities involves event studies of ex-dividend date price changes (Bali and Hite, 1997, Lasfer, 1995, Lamdin and Hiemstra, 1993, Shaw, 1991, Barclay, 1987, Poterba and Summers, 1984, Kalay, 1982, and Elton and Gruber, 1970). If the marginal clientele pays lower taxes on capital gains than dividends, then the stock price should fall by less than the amount of the dividend paid, since part of the dividend's value is lost to taxes. Thus, the ex-dividend studies do not estimate implicit taxes, but seek to resolve the related question of who the marginal clientele is. As with the dividend yield studies, the findings of the ex-dividend studies are mixed. Moreover, this methodology offers limited insight into the question of whether implicit taxes exist, since these studies can only suggest which clientele is

¹ As Kemsley and Williams (2001b) note, in an economy with multiple clienteles, it is possible for substantial tax capitalization to occur at the same time that implicit taxes are zero. In Kemsley and Williams' model, the marginal clientele between stocks and bonds includes tax-exempts, leading to no implicit tax, while the marginal clientele between consumption and investment includes individuals, leading to positive tax capitalization.

actively trading the stock around the ex-dividend date itself (which could be very different from the marginal clientele during the remainder of the year).²

There have also been several empirical studies of whether assets other than common stocks bear implicit tax. Tax-free municipal bonds bear substantial implicit tax (Trczinka, 1982, Fortune, 1988, and Mankiw and Poterba, 1996), while preferred stock bears moderate implicit tax (Engel, Erickson, and Maydew, 1999). Both of these securities differ from common stock in that they both have obvious tax clienteles, high tax-rate individuals and corporations for municipal bonds and corporations (with the dividend received deduction) for preferred stock, leading to clear expectations that implicit taxes should occur. In contrast, the marginal clientele for common stock is less apparent, since both individuals and tax-exempt institutions hold substantial amounts of stock. Accordingly, there is no obvious prediction regarding the existence of common stock implicit taxes.

Municipal bonds and preferred stock offer another advantage to researchers, relative to common stock. Neither security possesses the magnitude of risk associated with common stock. Risk confounds estimation of implicit tax, both by introducing noise (which can be overcome by a sufficiently large sample), and introducing risk premia (which create a bias that can never be overcome by sample size). Municipal bond studies have generally controlled for risk by using sufficiently short-term bonds, so that default is unlikely, while Engel, Erickson, and Maydew's (1999) study of preferred stock

² Indeed, if ex-dividend activity is dominated by tax-exempts capturing the dividend and then selling, while the stock is owned by individuals the rest of the year, there would be substantial implicit tax (since the individual owners are avoiding dividend taxes and only paying capital gains) simultaneous with no ex-dividend date effect.

controlled for risk by comparing securities issued by the same companies with nearly identical terms.

In sum, our study is unique along three important dimensions. First, we control for risk premia by calculating ex-ante returns on stock portfolios that are perfectly hedged with futures. Second, under this approach we can compare ex-ante stock returns to ex-ante bonds returns to estimate implicit taxes. Third, using our estimates of implicit taxes we can identify the marginal clientele in bonds in stocks.

The remainder of this paper is organized as follows: Section II lays out our research approach; section III develops our hypotheses; section IV describes our sampling rules and estimation procedures; section V presents our results; and section VI provides a conclusion.

II. RESEARCH APPROACH

Controlling for Risk

The challenge we face in estimating implicit taxes on equity *vis a' vis* debt is to perfectly control for risk in measuring returns on both classes of securities. The problem with using ex-post returns for stocks is that there is no clear statistical measure that we could use to estimate the magnitude of risk premia. While the finance literature offers numerous models of risk (e.g., the CAPM and APT with various risk factors), none of these models has been empirically shown to identify all risk premia.³ Since we cannot definitively control for risk statistically with ex-post returns, we use ex-ante returns of

³ Of course, if we use a model that omits a priced risk factor, our estimate of the implicit tax would be biased.

stock portfolios that are perfectly hedged, so that they bear no risk and consequently no risk premia. This approach relieves us of the need to estimate risk premia entirely.

We construct hedged equity portfolios using stock indices (the S&P 500, S&P Midcap 400, NASDAQ 100, and NYSE Composite) combined with short positions in their corresponding futures contracts.⁴ These hedged positions have a deterministic payout up to the date of futures contract maturity. Therefore, given the prices of the stock index and its futures contract on any given day, we can calculate a rate of return for the remaining maturity period that is completely risk-free. Moreover, this return is taxed as the underlying stock index is taxed,⁵ so the risk-free return we calculate should differ from the risk-free return on taxable bonds by the exact amount of the implicit tax on the underlying stock index (of course the bid-ask spread in futures prices will introduce noise into the implicit tax estimate on any given day).

Our approach is similar to that used by Cornell and French (1983) to estimate differences in risk-free stock and bond returns in the first year of stock index futures trading. Consistent with the existence of an implicit tax on equity, Cornell and French find evidence of a lower risk-free return on stocks than bonds. However, their study is limited in several respects: It only considers the first year of futures trading (when volume was light and market efficiency was questionable); does not provide a cross-

⁴ An alternative way to hedge is through the use of options. The problem with options is the fact that American options can be exercised early. This early exercise opportunity has value that distorts the option price. Any empirical estimate of implicit taxes using an option hedge would be biased if it is not adjusted for the early exercise value. No such problem exists for futures.

⁵ This is due to the fact that the tax treatment of the futures contract is irrelevant so long as it is symmetric. This is because a futures contract has no investment basis, so taxes merely scale the payouts, both positive and negative proportionately toward zero. Investors can rescale their futures positions to offset the effect of any tax. Note that investors cannot offset taxes on stock (or other assets) in this manner, since rescaling a stock investment requires contributing more capital and bearing the additional time-value of money cost. The zero-basis property of futures means that rescaling requires no additional commitment of capital, and is

sectional comparison of different indices with substantially varying dividend yields (since only the S&P 500 and NYSE indices were available at that time); and uses a risk-free bond proxy (the T-bill rate) that, as we discuss below, is flawed and creates substantial bias. By adding several years of data, using widely varying indices, and employing a more defensible proxy for the risk-free bond return measure, we are able to derive more robust findings and test further hypotheses regarding implicit taxes and marginal clienteles.⁶

Proxy for Risk-Free Bond Rate

A viable interest rate candidate for measuring the risk-free bond rate must be free from reasonable expectation of default (interest rate risk is negligible since we only use short-term securities), fully taxed, and have liquidity characteristics comparable to stock and futures. T-bills fail two of these criteria. They are not fully taxed (exempt from state taxation), and because they are not the most liquid securities, they bear significant liquidity premia (see Kamara, 1994, and Duffie, 1996).⁷ For these reasons, T-bill rates are likely to be substantially below the true risk-free rate.⁸ Corporate bonds also fail two of the criteria, since they do entail default risk and are generally less liquid than stocks (firm specific bonds have systematically lower trading volume than their corresponding

therefore costless. This tax-irrelevance property of futures was first noted by Cox, Ingersoll, and Ross (1981).

⁶ Several papers examined the efficiency of the market for stock index futures and the profitability of index arbitrage. Chung (1991) tests the efficiency of the MMMi index (largest 20 NYSE firms) between 7/84 and 8/86. He reports that the persistence of ex post violation of no arbitrage has decreased significantly during the period. Although, for 0.5% transaction costs, there is evidence of a profitable strategy. Regarding the efficiency of the market, Envine and Rudd (1985) find that the S&P 100 between 6/84 and 8/84 displayed substantial mispricing, Saunders and Mahajan (1988) find that between 10/82 and 9/84 the index futures on the S&P 500 was efficiently priced, while Yadav and Pope (1991) contradict this finding. These studies suggest the possibility of moderate inefficiency in the early years of index futures trading, but no studies suggest the continuation of inefficiency (if any) into the 1990s (the period of our study).

⁷ The T-bill market is the largest and most heavily transacted market in the world. Further, regulated entities (such as banks) are often required or encouraged to invest in the T-bill market.

stocks). The LIBOR rate (commonly used as a benchmark) is also deficient in that its tax treatment is different (it is based on interbank loans in England) and there have been LIBOR associated defaults in the past.

That leaves two other common interest rate benchmarks, the swap rate and the repo rate. The swap rate combines both a high volume market and low default risk. The estimated notional amount of interest rate swaps in 1996 exceeded \$26 trillion. In addition, an interest rate swap is a zero-risk instrument in which one party does not pay the other party to enter into the contract, while both parties place collateral to protect against default in the event of extreme market movements. The repo rate used in this paper is the general collateral short-term rate for an investor that borrows money in the repo market. When the investor borrows money in the repo rate, he must provide collateral in the form of liquid securities. The repo rate is a short term rate and is available at most for a period of three months compared to six months for the swap rate. There has never been a recorded default associated with either an interest rate swap or a repo loan, consistent with the collateralized nature of both. Since both the swap and repo rates meet our three criteria, we use both in our empirical analysis.

Given our measures of the risk-free returns on different stock indices and bonds for each day, we can estimate average implicit tax rates for each index and for different time periods. Since futures markets are not perfectly frictionless (there are bid-ask spreads and autocorrelated daily deviations from “fair” value), our daily implicit tax estimates are noisy and autocorrelated. As a consequence, we take averages over multiple years to produce reliable (that is, narrow confidence interval) implicit tax rate

⁸ Indeed, if we use T-bills in our analysis, we estimate negative implicit taxes, which is clearly implausible, but unsurprising given the bias in the T-bill rate.

estimates and conduct hypothesis tests. We not only compare the magnitude of implicit taxes to predictions based on various models and theories (developed in section III), but also analyze the cross-sectional variation in implicit taxes and relate it to differences in dividend yields as well as the time series pattern of implicit taxes. This complete array of analyses allows us to vet several different theories and hypotheses regarding tax clienteles and implicit taxes and determine which of these are or are not consistent with the evidence.

III. HYPOTHESIS DEVELOPMENT

Implicit Tax Rate

The objective of this section is to develop hypotheses regarding the magnitude of equity implicit tax and the relationship between the implicit tax and dividend yield. The first step is to provide a definition of implicit tax rate, which will be used throughout the paper. The implicit tax rate on equity is defined as

$$t_i \equiv \frac{r_b - r_z}{r_b}, \quad (1)$$

where r_b is the risk-free bond return and r_z is the risk-free stock return. Depending on the theoretical model, the implicit tax rate could be a function of a stock's dividend yield, d , in which case we denote the function as $t_i(d)$

Implicit Tax Models

There are a variety of theories regarding the magnitude of the implicit tax on equity. Below, we outline several alternative models, based on different assumptions regarding financial market structure, and develop predictions for each model as to the magnitude of the implicit tax and the derivative of the implicit tax with respect to

dividend yield. There are two types of implicit tax models, based on either supply or demand side equilibrium.

Consider first the supply side, developed in Miller (1977) and extended by Kemsley and Williams (2001a) to consider dividends. Firms choose capital structures to minimize their cost of capital. Setting aside non-tax considerations, they face a tradeoff between the corporate tax shield benefits of debt and the implicit tax benefits of equity (the implicit tax lowers the pre-tax cost of equity capital). Either firms reach a corner solution of all equity or all debt (or at least reach a point where the probability of utilizing the debt tax shield is sufficiently small) or the implicit tax equals the corporate tax rate. In Miller's model, firms don't pay dividends, but Kemsley and Williams demonstrate that the equilibrium condition is the same for all firms regardless of dividend yield. Thus, we have the following predictions:

Supply side model: $H_{1S}: t_i = t_c.$ $H_{2S}: t_i'(d) = 0.$

where t_c is the corporate tax rate. Note that throughout our sample period (1993-1999), the corporate tax rate was 35 percent.

There are two varieties of demand side models, single and multiple clientele models. The traditional single clientele model assumes that a single class of taxpayers (*e.g.*, top-bracket individuals or tax-exempts) arbitrages the stock and bond markets, forcing after-tax returns to equalize across all assets. The appendix derives the following measure of the implicit tax as a function of the marginal clientele's tax rates and a stock's dividend yield:

$$t_i = \frac{t_p - t_g}{1 - t_g} \left(1 - \frac{d}{r_b} \right) \tag{2}$$

where t_p is the tax rate on ordinary income and t_g is the capital gains tax rate (accrual equivalent). This equation is equation (A3) in the appendix. The exact implicit tax predictions of the single clientele paradigm depend on the identity of the marginal clientele and its tax rates. There are three common views.

First, since individuals are the largest group of stock investors, and high-income individuals are the dominant investors in that group, one possibility is that the marginal clientele faces top-bracket tax rates. In that case, $t_p = 39.6\%$ throughout the sample period (1993-1999). If we adopt the standard quartering convention for accrual equivalent capital gains (that is, we assume that the present value of the capital gains tax is 25% of the statutory rate), $t_g = 7\%$ from 1993-April 1997 and 5% from May 1997-1999. This difference in tax rates has minimal effect on the predicted implicit taxes, which are approximately (based on the average r_b , as measured by the swap rate over the sample period, of 6%):

Top-bracket marginal clientele: $H_{1T}: t_i \approx 0.36 - 6d.$ $H_{2T}: t_i'(d) \approx -6.$

Alternatively, the marginal clientele could include tax-exempt institutions, such as pensions. These tax-exempts have substantial stock holdings (roughly 1/3 of the market in 1999, according to the Flow of Funds Accounts, Board of Governors, 2000) and dominate the taxable bond market (where individuals have much smaller holdings according to the Flow of Funds). Thus, investment holdings suggest that tax-exempts are more likely to be marginal between the stock and bond markets. In that case, predictions for the implicit tax are straightforward:

Tax-exempt marginal clientele: $H_{1E}: t_i = 0.$ $H_{2E}: t_i'(d) = 0.$

Note that the same predictions arise if the marginal clientele includes short-term traders rather than tax-exempts. These investors face $t_g = t_p$, so there would be no implicit tax.

A popular compromise view is to assume that implicit taxes are based on the “average” clientele, a weighted average of tax characteristics of all equity investors (with weights based on magnitude of investment). While this perspective is *ad hoc* and has no theoretical basis, it offers intuitive appeal and provides us with a predicted range of implicit taxes.⁹ Unfortunately, it is unclear what the weighted average tax rate is, but a rough estimate is half the top rate.¹⁰ Based on this rough estimate, the average clientele theory suggests implicit taxes in the following ballpark:

Average clientele: $H_{1A}: t_i \approx 0.18 - 3d.$ $H_{2A}: t_i'(d) \approx -3.$

Finally, a more sophisticated model of implicit taxes involves multiple clienteles that arbitrage different financial market margins. In such a model, implicit taxes on particular assets can depend on the tax characteristics of several marginal clienteles, and implicit taxes can depend non-linearly on dividend yield. Dybvig and Ross (1986) first developed the concept of a multi-marginal clientele model, and Williams (2001b) derived a dividend yield-based model in this framework. Below is a synopsis of the relevant part of Williams’ model.

There are three clienteles in the model, individuals, tax-exempts, and corporations (who benefit from the dividend received deduction, DRD). Each clientele is attracted to

⁹ While no extant theoretical model predicts that the average clientele tax attributes should determine implicit taxes, Kemsley and Williams (2001b) develop a model in which the degree of tax capitalization depends on a weighted average of investor tax characteristics.

¹⁰ This is based on the fact that individuals have roughly twice the stock holdings of tax-exempts, but many individuals are lower-bracket investors or short-term traders. There are also short-term traders facing equal ordinary and capital gains tax rates. Thus, half of the top rate is likely in the ballpark of the average rate.

assets relatively tax-favorable for them. Thus, tax-exempts buy all taxable bonds (no implicit taxes) while individuals and corporations buy all municipal bonds (no explicit taxes). Each clientele has sufficient capital to also invest in the stock market, but they do not invest in the same stocks. Corporations prefer high-yield stocks since they receive the DRD. Individuals prefer low-yield stocks since they receive favorable capital gains treatment. Tax-exempts do not care about dividends *per se* but acquire mid-yield stocks, since neither of the other clienteles prefers these. Each clientele arbitrage all securities that it acquires to ensure an equal after-tax return on each. Thus, each clientele is the marginal investor within its own domain (and the clienteles' domains do not overlap).

This is illustrated in Figure 1. Individuals with a preference for capital gains own low dividend yield stocks (below L), thus those low-yield stocks bear implicit tax that decreases with dividend yield. Corporations that prefer dividends own high dividend yield stocks (above H), hence these high-yield stocks bear implicit tax that increases with dividend yield. Tax exempts own all shares with dividend yields above L and below H and bonds, hence, these stocks bear no implicit taxes.

In this model, some stocks bear no implicit tax at all, while the other stocks bear attenuated amounts of implicit tax. That is, the implicit tax on low-yield stock is driven by individual investment but is much less than the implicit tax on such stock would be if individuals were the only marginal clientele.¹¹

¹¹ Consider the following example. If individuals are taxed at 40%, but not taxed on capital gains, the implicit tax rate on zero-dividend stock will be 40%. If the risk-free interest rate is 5% and the boundary between tax-exempt and individual investors in Williams' model (L in Figure 1) occurs at a dividend yield of 2%, that model predicts an implicit tax rate of only 16%. That is because individuals are not arbitraging zero-dividend stocks with bonds, but with 2% yielding stocks. Equivalently, high-yield stock bears much less implicit tax than it would if corporations were the only marginal clientele. This prediction for high-yield stock is consistent with the moderate implicit tax estimates for preferred stock found by Engel, Erickson, and Maydew (1999).

Deriving predictions for implicit taxes for this model comparable to those derived for the above models is not straightforward in part because we don't know L . Moreover, our stock indices include shares in regions both above and below L (the region above U is likely to be dominated by preferred stock). Thus, in cross-sectional comparisons of indices, those with higher average yields are likely to have lower implicit taxes, but the entire distribution of yields within the index, not just the average, is relevant.

Nevertheless, as a rough estimate, consider that individuals have roughly 2 to 1 stock holdings relative to tax-exempts (according to the Flow of Funds Accounts). Two-thirds of all stocks on the combined NYSE-NASDAQ (value-weighted) had dividend yields of roughly 2% or less on average during our sample period, 1993-1999 (see Table 3). Using this as our estimate of L , and using the same estimates for the other parameters employed in the top-bracket clientele calculations earlier, we can derive the following ballpark predictions:

Multiple marginal clienteles:

H_{1M} : $t_i \approx 0.12 - 6d$ if $d < 0.02$; $t_i = 0$ otherwise.

H_{2M} : $t_i'(d) \approx -6$ if $d < 0.02$; $t_i'(d) = 0$ otherwise.

We have outlined five different theories regarding the implicit tax and developed predictions based of them. For some of the theories, the predicted values are definite (*e.g.*, the tax-exempt clientele theory), while for others, we have derived back of the envelope estimates (*e.g.*, the multiple clientele theory), that provide us with the expected order of magnitude, but should not be regarded as precise predictions.

IV. DATA AND ESTIMATES

Sampling Rules

We obtained the futures data from two sources. The first source, the Futures Industry Institute provided future data for the S&P 500, S&P Midcap 400, and the NASDAQ 100 futures indices. The second source, Tick Data Inc. provided us with futures data on an index of all the NYSE firms. The S&P 500 future index and the S&P Midcap 400 future index data are from January 1993 to December 1999, the NASDAQ 100 future index data are from April 1996 to December 1999, and the NYSE future index data are from June 1994 to December 1999. The data sources for the value-weighted dividend yield on the indices were as follows: Standard & Poors company for the S&P 500 and S&P MidCap 400, CRSP for the NASDAQ 100 and the NYSE index.¹²

The sample period, 1993 to 1999, is chosen to provide a largely consistent tax regime (only the capital gains tax rate varied during this period). We also include only contracts that are between 30 to 120 calendar days to expiration.¹³ Finally, only days with at least 100 contracts traded are included in our analyses to ensure that the price of the last futures trade is not too stale.

¹² The value-weighted dividend yield for the NASDAQ 100 is not calculated by any financial source. Hence we obtained the names of the firms that comprise the index from 1996 onward and using CRSP calculated the value-weighted dividend yield. The Futures Industry Institute provided us with the Russell 2000 futures index, but since the value-weighted dividend yield was unavailable and the above procedure was impractical, we do not use the Russell 2000 future index in our study.

¹³ As we discuss below, the method for estimating an implicit tax involves construction of an annual rate from the implied rate of return on the hedged position for the life of the contract. If the life is one month, for example, the annual rate is the twelfth power of the period return (to compound it up to a year). If we use shorter contracts than one month, the degree of compounding required can produce very large errors. We exclude contracts longer than 120 days to prevent overlapping observations (that is, we want at most one observation per day) since contracts expirations are usually 91 days apart.

We observe the stock index price at time t as P_t . Also at time t , we observe the futures prices for expiration date $t+m$ as $F_{m,t}$. We assume that dividends in the interval from $t+1$ to $t+m$ are known at time t , and comprise the sequence D_s for dates $t < s \leq t+m$.

Estimating Risk-Free Returns

Our objective is to infer the rate of return from an investment in the index at t combined with a short position in the futures at the same time (the risk-free equity return). Cash outflow at t is P_t . Cash inflow at $t+m$ is $F_{m,t}$.¹⁴ Dividends are also cash inflows, and we assume that they are immediately reinvested at a rate of return equal to the rate of return on the overall investment for the remainder of the futures maturity.

Thus, the risk-free equity return (on a daily basis) solves:

$$P_t = (1+r)^{-m} F_{m,t} + \sum_{i=1}^m (1+r)^{-i} D_{t+i}.$$

This equation can be simplified greatly through an approximation that ignores compounding of interest between the end dates for the dividend stream. In particular, we can use the approximation that

$$(1+r)^{-i} \approx 1 + [(1+r)^{-m} - 1] \frac{i}{m}.$$

Substituting this in yields:

$$P_t \approx (1+r)^{-m} F_{m,t} + \sum_{i=1}^m \left\{ 1 + [(1+r)^{-m} - 1] \frac{i}{m} \right\} D_{t+i}.$$

$$P_t - \sum_{i=1}^m \frac{m-i}{m} D_{t+i} \approx (1+r)^{-m} \left(F_{m,t} + \sum_{i=1}^m \frac{i}{m} D_{t+i} \right)$$

¹⁴ Technically, futures contracts settle daily. However, the daily settlements have a certainty equivalent value of zero. Thus, we can regard them as occurring at any time without changing the discounted cash flow; and accounting for them at the expiration date is innocuous.

$$r \approx \left[\frac{F_{m,t} + \sum_{i=1}^m \frac{i}{m} D_{t+i}}{P_t - \sum_{i=1}^m \frac{m-i}{m} D_{t+i}} \right]^{\frac{1}{m}} - 1.$$

In essence, the above approximation apportions part of the dividends to t and part to $t+m$, in proportion to the proximity of those dates to the date of dividend receipt. The approximation is highly accurate for short maturities. Defining r^* as the approximation of r , $(r^* - r) / r$ is slightly less than 0.00002 at $m = 90$, $r = 8$ percent and dividend yield = 5% (smooth over the time period). The error increases with the square of m and r and proportionally with the dividend yield.

We calculate r for each index on each date and subtract it from the quoted interest rate (either the swap or the REPO rate) for the most closely matching maturity (e.g., if $m = 60$ days, we use the available interest rate for the time period closest to two months). This provides us with a time series of implicit tax estimates for each day of the sample for each stock index compared to each risk-free interest rate. These implicit tax time series are the basis for our results.

One issue that should be noted regarding the four indices in our study is the degree of liquidity for the futures contract associated with each. The S&P 500 and Nasdaq 100 have highly liquid futures contracts during our sample period, while the Midcap 400 and NYSE futures are far less liquid.¹⁵ Illiquidity in the latter two indices makes their futures price data less reliable than the data for the first two indices. To limit the prospect of stale prices influencing our results, we eliminate dates on which fewer

¹⁵ The S&P 500 has average daily contract volume ranging from 23,576 in 1993 to 47,719 in 1999. The NASDAQ 100 has average volume ranging from 1,413 in 1996 to 5,414 in 1999. In contrast, average volume for the Midcap 400 ranges from 513 in 1993 to 1,046 in 1999 and for the NYSE ranges from 465 in 1994 to 107 in 1999.

than 100 contracts trade, notwithstanding that this creates a lot of holes in the Midcap and NYSE samples that raises further questions regarding the reliability of the data for these two indices.¹⁶

V. RESULTS

Estimates of Implicit Taxes

Table 1 provides estimates of the implicit tax for each of the four indices over the entire sample period, using both the swap rate (Panel A) and the REPO rate (Panel B). Note that both the mean and median estimates of the implicit tax are highly significantly positive for each index (using either risk-free interest rate), thereby contradicting the tax-exempt marginal clientele hypothesis (H_{1E}). It is also apparent that the implicit tax estimates are too small to conform to either the supply side hypothesis (H_{1E}) or the top-bracket marginal clientele hypothesis (H_{1T}). Based on the dividend yields of the indices, we can test these hypotheses and reject them with p-values of 0.001 for each index and bond rate. Thus, the implicit tax estimates in Table 1 can only be explained by either the average clientele hypothesis (H_{1A}) or the multiple clientele hypothesis (H_{1M}). However, we do not have sufficiently precise predictions for the average implicit tax from either theory to allow us to discriminate between these competing hypotheses based on point estimates alone.¹⁷

¹⁶ Roughly half of the NYSE sample and one-third of the Midcap sample is dropped by this filter. In contrast, less than one-tenth of the other two indices' samples are dropped by this filter. The results reported in the paper are virtually invariant to the volume filter in the case of the S&P 500 and NASDAQ, but moderately sensitive to the filter for the NYSE and Midcap. Thus, we regard the S&P 500 and NASDAQ data to be more reliable than the data for the other two indices.

¹⁷ The futures data exhibits significant autocorrelation, thus we adjust out t-statistics accordingly. In addition, in an unreported analysis, we run all our tests by grouping the data by days to expiration and deriving the median implicit tax in each group (64 total). This procedure produces a data series without

Testing Hypotheses on Derivatives

In section III, we also developed hypotheses regarding the derivative of the implicit tax with respect to the dividend yield. For the top-bracket and average clientele theories, there is a predicted negative linear relationship. For the multiple clientele theory, the predicted relationship is more complex, negative for low dividend yields (below roughly 2%), zero for higher yields, and positive for very high yields (although few common stocks are likely to be in this range). Thus, for indices that combine a variety of stocks, the implicit tax should increase in the frequency of low dividend stocks within the index. To test these predictions, Table 2 reports both a difference in means t-test and a paired sign test for each pairing of our four indices. The sample period used in each pairwise comparison is the intersection of the dates on which data is available for each of the two indices (recall that the indices have different start dates and any date with less than 100 contracts traded is dropped from the sample). This is an important point because, as we show later, there is time series variation in the level of implicit taxes over time. Hence, it is misleading to simply compare the implicit tax estimates given in Table 1. Note that in the matched pairwise comparison, the bond interest rate drops out of the calculation (*i.e.*, the difference in implicit taxes is the difference in the risk-free returns of the two indices), so the choice of interest rate is irrelevant.

The NASDAQ 100's implicit tax is significantly higher than each of the other three indices, consistent with each of H_{2T} , H_{2A} , and H_{2M} (note from Table 1 that the average dividend yield of the NASDAQ 100 is far less than the other three indices'

either autocorrelation or outliers and yields nearly identical implicit taxes estimates and t-statistics as reported in Table 1.

yields). Once again, the results contradict the supply side and tax-exempt clientele hypotheses, H_{2S} and H_{2E} (which suggest no dividend yield effect).

The comparison of the other three indices (S&P 500, Midcap 400, and NYSE) offers less clear evidence. The S&P 500 and the Midcap 400 are insignificantly different, while the NYSE's estimated implicit tax is significantly higher than both (although the difference between the three is much smaller than the difference between each of them and the NASDAQ). The NYSE's ranking relative to the other two indices is particularly striking given that the NYSE has the highest average dividend yield of all the indices in our sample. Both the top-bracket and average clientele hypotheses, H_{2T} and H_{2A} , would predict that the NYSE have the lowest implicit tax. Thus, the evidence for the NYSE contradicts these two hypotheses.

The remaining hypothesis, H_{2M} , from the multiple clientele model has a less obvious prediction for the ranking of implicit taxes related to these three indices. That model suggests that the spread of dividend yields, not the average yield, within the index should determine its implicit tax. Table 1 displays the standard deviation of the dividend yield within each index. It is much higher for the NYSE than for the S&P 500 and especially, the Midcap. Given that the NYSE has higher average yield and more spread than the other indices, the multiple clientele theory offers no definitive prediction for the ranking of implicit taxes for the three indices. Note that the NASDAQ 100 has a very low standard deviation, but that is because a majority (by market capitalization) of NASDAQ 100 firms pay no dividends at all (so they don't vary much from each other). A very small percentage of firms in the other three indices (in terms of market capitalization) pay no dividends.

To summarize briefly, none of the cross-sectional evidence is inconsistent with the multiple clientele model, while the evidence is only partially consistent with the average and top-bracket clientele theories, and completely inconsistent with the supply side and tax-exempt clientele theories.

One further note of caution in interpreting the cross-sectional results is to recall the discussion in Section IV, in which we demonstrated that the NYSE and Midcap indices are relatively illiquid. Thus, only limited weight should be given to the evidence from the NYSE and Midcap comparisons that conflicts with the top-bracket and average clientele hypotheses (indeed, a very large fraction of the sample, around 41%, is dropped for their comparison to each other due to low volume on one or the other index). In contrast, the evidence involving the S&P 500 and the NASDAQ 100 is much more solid.

Time Series Analysis

The final analysis in our study involves a time-series comparison. The capital gains tax rate changed in 1997, falling from 28% to 20%. We would expect this to cause the implicit tax to increase, since stocks became more tax-advantaged relative to debt. Another change during our sample period is evident from Table 3. Over time, the distribution of dividend yields in the stock market has shifted steadily down. That is, dividends have fallen significantly for firms across the board. How this should affect the implicit tax depends on the particular hypothesis.

The supply side and tax-exempt clientele theories would predict no effect, the top-bracket and average clientele theories would predict an increase in implicit tax over time, while the multiple clientele model would predict a decrease in implicit tax over time. This decrease in implicit tax is due to the fact that as the dividend distribution shifts

down, the boundary between taxable and tax-exempt investors, L , shifts down (see Figure 2). As that occurs, the implicit tax on low-dividend stocks falls, reducing the average implicit tax. If at the extreme, enough firms stop paying dividends to push L down to zero, there would be no implicit tax on any stock (except stocks with very high yields). A third possible change over time is a change in the relative magnitude of the different clienteles in the stock market. That would be important for both the average clientele and multiple clientele hypotheses, but according to the Flow of Funds Accounts, the ratio of individual to tax-exempt investment in the stock market remained virtually unchanged during the sample period (2.23 in 1993 and 2.31 in 1999).¹⁸ Thus, the primary time series changes likely to affect the implicit tax are the capital gains tax rate and the distribution of dividend yields.

To test whether the implicit tax increased or decreased during the sample period, we divide our sample into two equal halves (split at the middle of 1996). This closely correlates with the 1997 capital gains rate cut, so if that tax change is relevant, we would expect a higher implicit tax in the second half. Table 4 displays the average implicit tax for the S&P 500 in each period.¹⁹ Our results indicate a substantial (and highly statistically significant) *decline* in the implicit tax over time. This sharply contrasts with our prediction based on tax rate changes and based on the dividend yield changes for the top-bracket and average clientele hypotheses. However, this evidence is consistent with the multiple clientele model.

¹⁸ This is based on the ratio of combined corporate equity and mutual fund shares for the household sector (Table L100) to the combined corporate equity and mutual fund shares for life insurance companies and private and government pension funds (L117, L119, and L120).

¹⁹ We do not display the other indices because they do not have a substantial presence over the entire sample period. The NASDAQ 100 only starts in 1996, the Midcap has very low volume in the early years of the sample, while the NYSE has very low volume in the later years. Nevertheless, unreported results

VI. CONCLUSION

In this study, we have used futures market data to construct estimates of risk-free equity returns and consequently, implicit taxes on equity. We have found evidence of a highly significant but modest implicit tax that varies across different stock indices.

Cross-sectionally, we have found that the low-dividend NASDAQ has a substantially higher implicit tax than the other indices, with higher dividend yields. We have also found evidence that the implicit tax declined significantly during the 1990s.

We have used these results to test predictions of five different views in the extant literature. Our results are completely inconsistent with the theory that implicit taxes are driven by capital structure equilibrium (as in Miller, 1977) as well as with theories that either tax-exempt institutions or top-bracket individuals are the single marginal clientele in the stock market. Instead, the moderate but significant size of the implicit tax suggests that implicit taxes are influenced by the tax characteristics of multiple clienteles.

Moreover, the apparently non-linear nature of the implicit tax's relationship with dividend yield suggests that a simple averaging of tax characteristics does not occur.

Likewise, the time series evidence, of declining implicit taxes concurrent with declining dividend yields, is inconsistent with an average clientele story. Rather, the evidence in this study is generally consistent with the predictions of a model in which multiple clienteles are marginal with respect to different stocks, with individuals arbitraging returns on low-yield stocks and tax-exempts arbitraging returns on higher-yield stocks.

Furthermore, the multiple clientele model is also consistent with observed clientele

indicate significant declines for each of these indices between the first and second halves of their samples, consistent with the S&P 500 evidence.

sorting in the stock market by dividend yield (see, *e.g.*, Dhaliwal, Erickson, and Trezevant, 1999).

Our study has important implications. First, it offers additional evidence that investor taxes are important variables in financial market equilibrium,²⁰ and in particular in relative stock and bond returns.²¹ Second, it offers insight into the nature of the marginal clientele in the stock market, a heretofore unresolved issue. Our findings suggest that there is no single marginal clientele, but multiple clienteles operating on different margins, with the result that implicit taxes entail complex mixtures of tax characteristics of these different clienteles. Third, it suggests that models of stock returns in the finance literature that employ the risk-free bond rate (such as the CAPM and APT) are flawed (they are based on the assumption of zero implicit tax). Empirical use of these models with the risk-free bond rate instead of the risk-free equity rate (which is common practice) can introduce bias (depending on the application of the model). Our approach can be used to construct risk-free equity returns to correct this mis-specification.

²⁰ As discussed in Section 1, several studies have found evidence of tax effects in the level of stock prices and in preferred stock and municipal bond relative returns.

²¹ As discussed in Section 1, the only studies directly on the issue of relative returns in the stock market have been the dividend yield studies with equivocal findings.

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APPENDIX

Throughout this section, we shall use the following definitions:

$U(W)$	investor utility function in wealth (assumed monotone increasing)
W_0	initial investor wealth
W_I	terminal wealth after investment
B	investment in bonds
E	investment in stocks
F	futures position (normalized such that $F = 1$ represents a long position corresponding to \$1 of stock)
r_b	risk-free return on bonds
r_e	expected return on stock
r_f	expected profit from a long futures position: (E[stock price at maturity] - futures price) / current stock price
r_z	risk-free return on stock
ε	unexpected return on stock (zero mean)
t_c	corporate tax rate
t_p	personal tax rate
t_g	personal capital gains tax rate (accrual equivalent)
t_f	personal tax rate on futures profits (short-term capital gains)
t_i	implicit tax rate on equity ($\frac{r_b - r_z}{r_b}$)
d	dividend yield

Consider an investor facing the following portfolio decision problem:

Max $EU(W_1)$ subject to

$$W_1 = [1 + (1 - t_p)r_b]B + [1 + (1 - t_p)d + (1 - t_g)(r_e + \varepsilon - d)]E + (1 - t_f)(r_f + \varepsilon)F,$$

$$B + E = W_0,$$

$$B \geq 0, E \geq 0.$$

We can redefine after-investment wealth as

$$\begin{aligned} W_1 &= W_0 + (1 - t_p)r_b B + [(1 - t_p)d + (1 - t_g)(r_e - r_f - d)]E + (r_f + \varepsilon)N; \\ N &\equiv (1 - t_f)F + (1 - t_g)E. \end{aligned} \tag{A1}$$

N is the net risk exposure of the agent to the stock. Given E , any N can be chosen by selecting an appropriate F . In particular, by choosing $F = -(1 - t_g)/(1 - t_f)E$, the agent can eliminate all risk in his portfolio regardless of his debt and equity holdings. The pre-tax return on a stock position perfectly hedged in this way will be $r_z = r_e - r_f$. We can interpret r_f as the risk premium on the stock. It is easy to demonstrate (see Williams, 2001c) that the choice of N (and implicitly F) is completely separable from the choice of B and E ; that is, optimizing risk and optimizing risk-free returns are independent decisions. Therefore, we can and will ignore the choice of N in subsequent analysis.

Substituting the stock/bond allocation constraint, $E = W_0 - B$, into (A1) yields

$$W_1 = [(1 - t_p)d + (1 - t_g)(r_e - r_f - d)]W_0 + [(1 - t_p)(r_b - d) - (1 - t_g)(r_z - d)]B + (r_f + \varepsilon)N.$$

Maximizing utility with respect to B yields

$$\frac{\partial EU(W_1)}{\partial B} = \frac{\partial W_1}{\partial B} EU'(W_1) = [(1 - t_p)(r_b - d) - (1 - t_g)(r_z - d)]EU'(W_1). \tag{A2}$$

Since the utility function is monotone increasing and the term in brackets is a constant, there are three possibilities. The agent could choose to invest in stock exclusively, or bonds exclusively, or invest in both (and be indifferent between the two assets) if the term in brackets is 0. If there is only one tax clientele in the economy, the third

possibility must occur in equilibrium. With multiple tax clienteles in the economy, one clientele will be marginal in the sense of being indifferent between stocks and bonds and this clientele will arbitrage the three securities markets, so the marginal clientele's tax rates will determine the relative prices of the securities and implicit taxes that they bear.

For the marginal clientele, (A2) implies

$$(1-t_p)(r_b - d) - (1-t_g)(r_z - d) = 0.$$

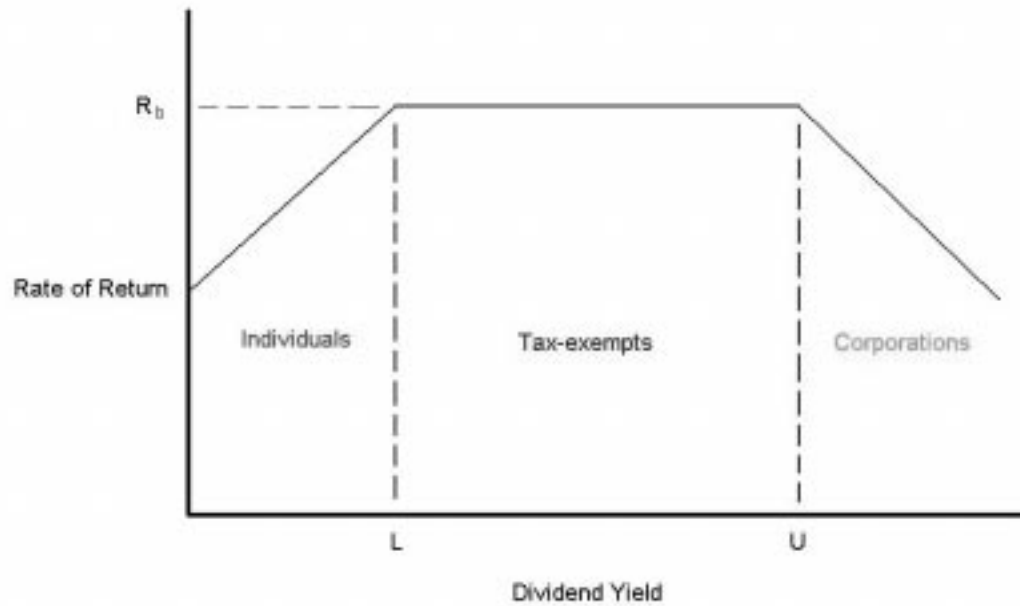
$$r_z = \frac{1-t_p}{1-t_g} r_b + \frac{t_p - t_g}{1-t_g} d.$$

$$t_i \equiv \frac{r_b - r_z}{r_b} = \frac{t_p - t_g}{1-t_g} \left(1 - \frac{d}{r_b} \right) \tag{A3}$$

The implicit tax rate is positive if $t_p > t_g$ and is decreasing in the dividend yield (assuming that a tax difference exists).

Figure 1

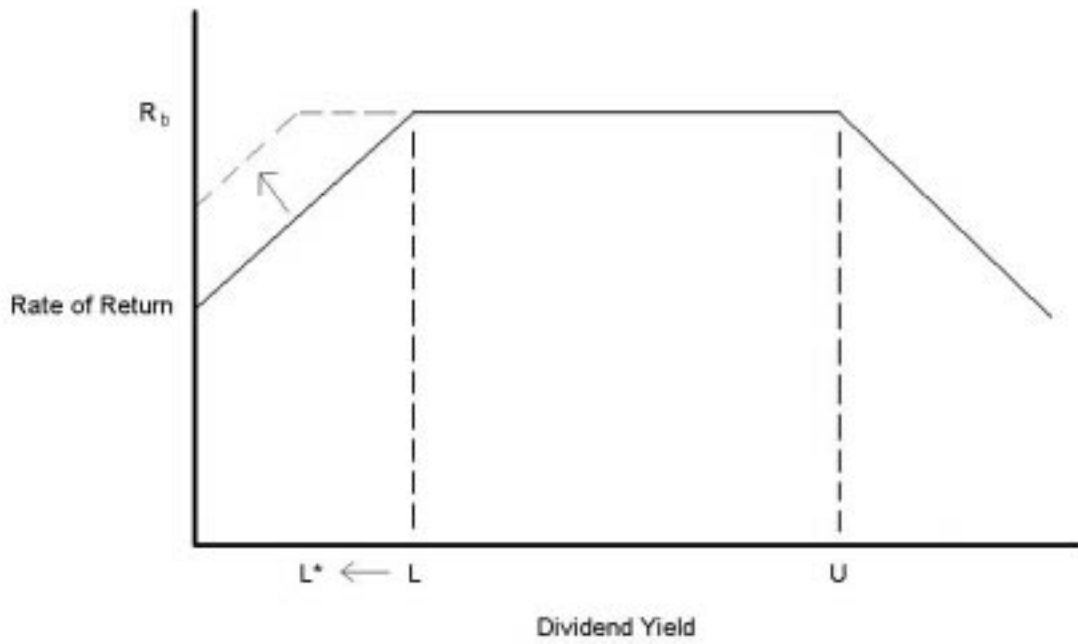
Relationship between Implicit Taxes and Dividend Yield



Excerpted from Williams (2001b).

Figure 2

Changes in Implicit Taxes as Dividend Yields Decline



This figure shows how the equilibrium shifts as dividend yields decline. The boundary L shifts to L^* , causing implicit taxes for low yield stocks to decline.

Table 1
Estimates of implicit tax rates for each of the four stock indices

Panel A: risk-free bond rate is the swap rate				
	SP500	MIDCAP400	NYSE	NASDAQ 100
Mean	7.9%	7.8%	6.0%	10.0%
Median	7.8%	5.6%	6.7%	10.5%
% > 0	65.6%	59.6%	61.2%	68.4%
Mean dividend yield	1.47%	1.31%	1.92%	0.24%
Std. of dividend yield	1.46%	1.30%	1.90%	0.23%
N	1714	1572	1038	807

Panel B: risk-free bond rate is the repo rate				
	SP500	MIDCAP400	NYSE	NASDAQ 100
Mean	5.4%	5.3%	6.1%	10.5%
Median	4.7%	3.1%	5.9%	10.6%
% > 0	63.9%	55.5%	63.8%	70.3%

SP500 is the S&P 500 index and is for the 1/93-12/99 period.

MIDCAP400 is the futures index for the firms in the S&P MidCap 400 index and is for the 1/93-12/99 period.

NYSE is the New York Stock Exchange Composite index and is for the 6/94-12/99 period.

NASDAQ 100 is index of the 100 largest firms on the NASDAQ stock exchange and is for the 4/96-12/99 period.

The future contracts used include those with days to expiration between 30 and 120 and with a daily volume of at least 100 contracts.

The implicit tax rate estimate is the difference between the swap (or repo) interest rate and the risk-free stock return (for the index) divided by the swap (or repo) rate.

The implied risk-free stock return calculation is as follows:

$$\left[\frac{F_{m,t} + \sum_{i=1}^m \frac{i}{m} D_{t+i}}{P_t - \sum_{i=1}^m \frac{m-i}{m} D_{t+i}} \right]^{\frac{1}{m}} - 1.$$

where $F_{m,t}$ is the future price at time t and expiration at $t+m$, P_t is the index price at time t , m is the number of days from t to contract expiration, and D_{t+i} are the actual dividends from time t to expiration.

N is the number of observations for each index.

The mean and median values are all significant at the 1% level.

Mean dividend yield is the value weighted average dividend yield (for the stocks in the index) averaged over each of the years during which the index is included on the sample. Std. of dividend yield is the value weighted standard deviation of the dividend yield for the stocks in the index.

Table 2

Differences in mean t-test and paired sign test for each pairing of the four indices

	SP500 - SPMID	SP500 - NYSE	SP500 - NASDAQ	SPMID - NYSE	SPMID - NASDAQ	NYSE - NASDAQ
Mean	1.3%	-1.0%	-7.2%	-2.5%	-7.9%	-7.1%
p-value	0.858	0.013	0.001	0.002	0.001	0.001
Median	1.6%	-0.9%	-7.0%	-3.2%	-8.4%	-7.1%
p-value	0.158	0.003	0.001	0.001	0.001	0.001
N	1450	924	786	938	807	690

SP500 is the S&P 500 index and is for the 1/93-12/99 period.

SPMID is the S&P MidCap 400 index and is for the 1/93-12/99 period.

NYSE is NYSE Composite index and is for the 6/94-12/99 period.

NASDAQ is the NASDAQ 100 index and is for the 4/96-12/99 period.

For each pairwise comparison we use only the intersection of the dates on which data is available for the two indices.

The mean and median numbers are for the difference in daily estimated implicit tax rates for the two indexes (specifically, the first listed index minus the second).

The implicit tax rate estimate is the difference between the swap interest rate and the risk-free stock return (for the index) divided by the swap rate. The implied risk-free stock return calculation is as follows:

$$\left[\frac{F_{m,t} + \sum_{i=1}^m \frac{i}{m} D_{t+i}}{P_t - \sum_{i=1}^m \frac{m-i}{m} D_{t+i}} \right]^{\frac{1}{m}} - 1.$$

where $F_{m,t}$ is the future price at time t and expiration at $t+m$, P_t is the index price at time t , m is the number of days from t to contract expiration, and D_{t+i} are the actual dividends from time t to expiration.

Table 3
Value-weighted dividend yield distribution for the 1993-1999 period (NYSE and NASDAQ combined)

	Decile									
	1	2	3	4	5	6	7	8	9	10
93	0.000%	0.132%	0.756%	1.545%	2.179%	2.624%	3.099%	3.761%	4.720%	6.325%
94	0.000%	0.067%	0.685%	1.479%	2.135%	2.666%	2.137%	3.838%	4.986%	7.202%
95	0.000%	0.000%	0.428%	1.055%	1.736%	2.320%	2.789%	3.506%	4.405%	6.819%
96	0.000%	0.000%	0.239%	0.860%	1.280%	1.931%	2.281%	2.906%	3.785%	5.929%
97	0.000%	0.000%	0.127%	0.666%	1.047%	1.428%	1.784%	2.220%	2.958%	5.272%
98	0.000%	0.000%	0.116%	0.470%	0.864%	1.126%	1.430%	1.912%	2.446%	4.426%
99	0.000%	0.000%	0.005%	0.196%	0.563%	0.986%	1.274%	1.647%	2.247%	4.168%

We calculate the dividend yield as follows. First, we rank all the NYSE and NASDAQ firms by their dividend yield. Next, we divide them into ten deciles, where each decile has equal aggregate market values. Finally, in each decile we calculate the mean value-weighted dividend yield.

Table 4
 Implicit tax rates for the SP500 for two equal periods (1/93-6/96 and 7/96-12/99)

	1/93 to 6/96	7/96 to 12/99
Mean	13.3%	2.4%
Median	12.8%	3.3%
p-value for the mean	0.001	0.001
p-value for the median	0.001	0.001
% > 0	75.0%	55.6%

The implicit tax rate estimate is the difference between the swap interest rate and the risk-free stock return (for the index) divided by the swap rate. The implied risk-free stock return calculation is as follows:

$$\left[\frac{F_{m,t} + \sum_{i=1}^m \frac{i}{m} D_{t+i}}{P_t - \sum_{i=1}^m \frac{m-i}{m} D_{t+i}} \right]^{\frac{1}{m}} - 1.$$

where $F_{m,t}$ is the future price at time t and expiration at $t+m$, P_t is the index price at time t , m is the number of days from t to contract expiration, and D_{t+i} are the actual dividends from time t to expiration.