Treasury Bill Yield Reactions to the 1997 Capital Gains Tax Rate Reduction

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Abstract

I provide evidence that changes in shareholder-level taxes influence investment returns even when income from the investment is not subject by statute to the rate that is changed. Using an equilibrium model of after-tax investment returns I predict the yields of Treasury bills, which are subject only to ordinary tax rates, will have an inverse reaction to changes in the capital gains tax rate as the income on them becomes increasingly tax-disadvantaged when compared to other investments. In a sample made up of short-term Treasury bills yields appear to increase in response to the May 7, 1997 surprise reduction in capital gains tax rates. The increase is statistically significant and is robust to other macroeconomic and institutional determinants of Treasury bills.

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1. Introduction

The equality of after-tax rates of return described by Miller (1977) has formed the foundation for research seeking to document both the existence of implicit taxes and the effects that shareholder-level taxes have on the pricing of investments.[1] To date accounting research in this area has concentrated on the impact of shareholder-level taxes on investments that are *directly* subject to the tax rate being studied. This paper tests the prediction that investment yields will respond to changes in shareholder-level tax rates even though the investment's income is not subject to the tax by statute, i.e. yields will also respond *indirectly*. This prediction is developed using a theoretical model based on Miller's (1977) original hypothesis and is tested using a sample of daily Treasury bill yields surrounding the May 1997 change in the capital gains tax rate. Regressions on yields surrounding the effective date of the change in rates show that Treasury bill yields decreased with the increase in the capital gains tax rate for individuals. This decrease is consistent with the theoretical model and supports the prediction of an indirect effect.

Extant research suggests there is a direct effect of shareholder-level taxes on investment returns. For example, investors pay taxes at ordinary rates on the dividend income from stocks and on the interest income from bonds, and at capital gains rates on the difference between the sale proceeds and the tax basis for both stocks and bonds. Since the income from investments in both stocks and bonds may be subject to both ordinary and capital gains income taxes these investments are a natural setting for studies

[1] Scholes, Wolfson, Erickson, Maydew and Shevlin (2002) define implicit taxes as those "taxes paid indirectly in the form of lower before-tax rates of return on tax-favored investments."

examining the effects of both ordinary and capital gains taxes on investment pricing.[2] In contrast the income from Treasury bills is taxed only at ordinary income rates. While it is possible to generate *short-term* capital gains and losses on Treasury bill transactions (when the sale price differs from the holder's adjusted basis) the maturity of Treasury bills guarantees that the preferential *long-term* capital gains rate will never be applied to Treasury bill income because the one-year holding period will not be satisfied.[3] This property of Treasury bills makes them ideal for research into the *direct* effects of ordinary tax rates on their yields because the capital gains tax rate is never applied to their income. Since Treasury bills are not subject to the capital gains tax rate they also provide an ideal setting to investigate whether an *indirect* effect on their yields might exist.

These findings contribute to the accounting literature on taxes and investment pricing because they suggest that prices are affected by shareholder-level taxes in ways not investigated by existing research. They also indicate that the effects of changes in ordinary tax rates on asset prices may be misstated in studies using settings where both ordinary and capital gains tax rates change because these changes are hypothesized to affect yields in different directions.

2. Prior research and hypothesis development

2.1. Prior research

Recent studies use a variety of settings to document the existence of implicit taxes and provide evidence that shareholder-level taxes affect investment returns directly. Shackelford (1991) and Guenther (1994) document implicit taxes in the market for ESOP

[2] If the bond's purchase price differs from its face value (e.g. original issue discount bonds and those purchased at a premium or discount) then the taxpayer's basis is adjusted accordingly. This may cause a portion of the gain on sale to be ordinary in nature while the remainder is taxed at capital gains rates.
[3] Short-term capital gains and losses are netted against each other and may be offset by net long-term gains or losses. Short-term capital losses are deductible by an individual from ordinary income subject to limits.

loans and in Treasury bills, respectively. Erickson and Maydew (1998) show that a proposed change in the corporate dividends received deduction affected high-yield preferred stocks but not common stocks. Lang and Shackelford (2000) document that stock prices move inversely with dividend yields in response to decreases in the capital gains tax rates on common stock. Dhaliwal, Li and Trezevant (2002) present results consistent with stock returns increasing with dividend yield and find this return premium decreases as institutional and corporate ownership increases.

Evidence of shareholder-level taxes affecting yields is also found in studies of the relative yields of taxable and tax-exempt bonds. Poterba (1986, 1989) uses proposed tax policy changes from May 1959 through August 1982 in regressions on the taxable-tax exempt yield spread to inform discussion of competing theories of the yield curve (i.e. Bank Arbitrage, "Miller Model I," Preferred Habitat, "Miller Model II"). Using a sample of one-, five-, ten-, and twenty year maturity bonds the author finds that the proposed changes in individual tax rates and policies affected the yield spread in a manner consistent with the Preferred Habitat hypothesis. Mankiw and Poterba (1996) investigate yield spreads using an after-tax equilibrium model that uses the equity market to equate the taxable and tax-exempt bond markets. Using a sample of 20-year, newly issued Treasury securities and prime-grade general obligation tax-exempt bonds they find that the taxable tax-exempt yield spread is an increasing function of the dividend yield on corporate stocks.

Collectively, these studies demonstrate that taxes affect investment pricing when the tax is applied by statute to income from these investments (i.e. both long-term bonds and stocks will generate both ordinary and capital income). In Miller's (1977) after-tax

equilibrium, however, it is also possible that an investment's return will respond to changes in tax rates even if those rates are not applied directly to the income from that investment. This *indirect* influence of changing tax rates on investment income is suggested in Miller's (1977, 267) original description of the equilibrium:

> …investors hold securities for the "consumption possibilities" they generate and hence will evaluate them in terms of their yields net of all tax drains. If, therefore, the personal tax on income from common stocks is less than that on income from bonds, then the *before-tax* return on taxable bonds has to be high enough, other things equal, to offset this tax handicap. Otherwise, no taxable investor would want to hold bonds.[4]

It is the investor's evaluation of available returns "net of all tax drains" that implies an investment's price may be dependant not just on those shareholder tax rates under which its income is subject by statue, but may also be dependant on those rates which are applied to competing investments.[5] This study combines a test based on Miller's (1977) equilibrium with a sample of investments that will only generate income taxed under ordinary rates in order to determine whether investment returns behave as if this is indeed the case.

2.2. Hypothesis development

Miller's (1977) equality of after-tax returns suggests an equilibrium model of returns between equity securities and other investments. The taxable return for an individual stock, R, is made up of its dividends, d, and any capital gains, g, such that $R=g+d$. Now assume r is the taxable return on an ordinary income investment, t_d is the

[4] Quotes, italics and punctuation are as published originally.
[5] This effect is similar to anecdotal evidence described by Lang and Shackelford (2000, third footnote) concerning the impact of the 1997 reduction of the capital gains tax rate on dividend paying stocks. The *Wall Street Journal* (May 5, 1997, C12) quoted a market participant's opinion that the rate decrease would shift investor dollars away from dividend-paying stocks towards those with higher capital appreciation.

marginal tax rate on dividend income, and t_g is the effective tax rate on capital gains. On an after-tax basis the rates would be in equilibrium such that:

$$(1-t_g)g + (1-t_d)d = (1-t_d)r\,. \tag{1}$$

When R is substituted into equation (1) and the terms are rearranged the return on the ordinary income investment can be expressed as:

$$r = \frac{(1-t_g)R}{(1-t_d)} - \frac{(t_d - t_g)d}{(1-t_d)}\,. \tag{2}$$

When the derivative of (2) with respect to t_g is taken the following obtains:

$$\frac{\partial r}{\partial (t_g)} = \frac{(d-R)}{(1-t_d)} < 0\,. \tag{3}$$

Which generates the following hypothesis:

> H_1: The yield on an ordinary income investment will move inversely with changes in the capital gains tax rate.

It may seem counterintuitive that a change in the capital gains tax rate can influence the yield of an investment that only generates ordinary income. However, a decrease in the capital gains rate makes capital gains more attractive and could shift investor preferences away from ordinary income. In the case of Treasury bills this would cause demand to decrease and their price to drop, causing higher yields. Therefore, even though capital gains do not affect Treasury bill yields *directly* they could affect them *indirectly* because investment returns compete on an after-tax basis.[6]

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[6] This model is also consistent with Guenther's (1994) hypothesis – the derivative of Equation (2) with respect to t_d is positive supporting an increase in yields in response to an increase in the ordinary tax rate. Some other partial derivatives of Equation (2) also support prior research. For example, the partial derivative of R with respect to t_d is negative, supporting both Erickson & Maydew (1998) and Ayers, Cloyd & Robinson (2000). Support for Lang & Shackelford (2000) is found in the positive partial derivatives of R with respect to t_g and t_d. When t_d and t_g are interpreted as marginal tax rates their (negative and positive, respectively) partial derivatives with respect to d support Dhaliwal, Erickson and Trezevant (1999). Intuitively, the partial derivatives of R with respect to r, and r with respect to R, are positive.

This comparison of two investments assumes that they are of equal risk and, for application of long-term capital gains tax rates, that their holding periods are of similar durations. This is a difficult issue because stocks and Treasury bills are dissimilar in the extreme. However, if it's assumed that the risk of stocks and Treasury bills differs by a constant amount then such a constant would disappear when the derivative of equation (2) is taken to arrive at equation (3).[7] In addition, while the holding of a Treasury bill cannot exceed its term, and is therefore short-term by definition, it is not unrealistic to assume an individual may invest in a fund that holds solely Treasury bills. In this way maturing balances would be continually reinvested in new bills.

Given that the comparison is valid, initial estimates of the Treasury bill yield response to the 1997 change in capital gains tax rates can be obtained by solving equation (3) for known values. During 1997 the average dividend yield was 1.56% while overall the market return was 27.79%.[8] The ordinary tax rate was 39.6% while the capital gains tax rate decreased from 28% to 20%. When equation (3) is solved using these values a 0.43% decrease in yield is predicted in response to an increase of 1% in the capital gains tax rate.[9] For the 8% decrease in the capital gains tax rate on May 7, 1997 this would suggest a 3.47% increase in the May 6 average yield, from 5.14% to 8.61%.

This initial estimate of a 3.47% increase assumes that both stocks and Treasury bills will react identically to the change in the capital gains tax rate. This is not a reasonable assumption because Treasury bill income will only be taxed at ordinary rates.

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[7] This is not a novel assumption. For example, Mankiw & Poterba (1996) assume an equity risk premium in equating the yields of taxable bonds and equity investments (equation (2)) then assume the premium is constant when defining their regression equation (equation (6)).

[8] Yield information is taken from Dhaliwal, Li and Trezevant (2003) and includes dividend and non-dividend paying stocks.

[9] $[1.56\% - 27.79\%] \div [100\% - 39.6\%] = -0.43\%$

However, the change in yields can also be calculated for a hypothetical "capital gains" bill which only generates income subject to the capital gains tax rate. The after-tax yield on the May 6th average equals 3.10%.[10] Assuming a "capital gains" bill, Miller (1977) implies that its after-tax rate would also equal 3.10%, and its pre-tax yield, prior to the capital gains tax-rate reduction, would therefore equal 4.31%.[11] Assuming that the capital gains tax rate reduction left this pre-tax yield unchanged its after-tax yield the day of the reduction would equal 3.45%.[12] Again, according to Miller (1977), the after-tax yield on this "capital gains" bill would equal the after-tax yield on the real bill, so that the after-tax Treasury bill yield would also equal 3.45%. This implies that the before-tax Treasury bill yield would equal 5.71%.[13] This change in after-tax returns, from 5.14% to 5.71%, indicates a .57% increase in yield for a hypothetical "capital gains" bill.[14] This is much lower than the 3.47% increase implied by the initial estimate and is a more reasonable way of looking at how capital gains tax rates might affect Treasury bills.

However, given that a significant relationship exists any measured increase in yields is likely to be smaller than this, and in fact the actual increase between May 6th and 7th is only .037%. Treasury bill yields reflect a wide spectrum of day-to-day information, the impact of which is difficult to control in a research setting. This increases the amount of noise in the research setting, which makes measurement difficult and biases against a significant finding.

3. Description of research setting

3.1. Treasury bills

[10] [5.14% x (1-.396)] = 3.10%
[11] [3.10% ÷ (1-.28)] = 4.31%
[12] [4.31% x (1-.20)] = 3.45%
[13] [3.45% ÷ (1-.396)] = 5.71%
[14] I thank Jeff Doyle for suggesting this alternate way of considering the change in yields.

As Erickson & Maydew (1998) note, empirical studies seeking to document the existence of implicit taxes in stocks must separate tax effects from cross-sectional differences in risk. In light of these concerns Treasury bills make an attractive research setting because they are essentially risk-free and trade with almost no liquidity premium. Treasury bills are nearly homogenous and differ only in their measurement dates and their days-to-maturity. By including variables for the bills' maturities and the macroeconomic differences between measurement dates the differences in risk among them may be controlled, thus providing a potentially cleaner environment than tests using stock prices do.

The liquidity of the Treasury bill markets decreases the chances that market frictions will delay a price response and their institutional details are so well known that there is little uncertainty for market participants. Since 1972 three- and six-month Treasury bills have been auctioned weekly (one-year bills are auctioned monthly but are not included in this sample). These auctions are announced on Tuesdays, conducted the following Monday, and closed the following Thursday. In the ten days between the Monday announcement and the Thursday delivery there is an active forward market in the bills called the "when-issued" market. These when-issued yields increase the liquidity of the primary Treasury bill market by decreasing participants' uncertainty of the eventual clearing price.[15]

As in Guenther (1994, 383) an implied condition for changes in the capital gains tax rate for individuals to affect Treasury bill yields is that the marginal investor be an

[15] Cook 1998 cites evidence that up to 40% of the positions closed on the Thursday delivery days have already been cleared in the when-issued market.

individual.[16] Table 1 in Guenther (1994, 384) presents Federal Reserve Board data that indicates individuals held 10.5% of all marketable public debt (including Treasury bills, bonds and notes) in 1981 and that this number fell to 4.4% in 1986. More recently the Board of Governors of the Federal Reserve System reported that the household sector's share of outstanding Treasury issues (including Treasury bills, bonds and notes but excluding savings bonds) was approximately 16% in 1997 and ranged from 15% to 19% in the period from 1995 to 1999.[17] Cook (1998) cites Treasury bills' low denomination, their exemption from state and local taxes and the ease of purchase without service fees (none is charged through purchases at Federal Reserve Bank branches) as reasons why individuals hold Treasury bills more than any other money market instrument.

However, Guenther (1994, 392) concludes that the marginal investor in Treasury bills is *not* an individual because the implied tax rate reduction (calculated using the last rate in December and the first rate in January) is much lower than the actual statutory rate reduction. While his significant findings support the influence of changes in the ordinary tax rate for individuals on Treasury bill rates the implied rate reduction suggests other marginal investors with ordinary tax rates lower than those for individuals. The existence of marginal investors other than individuals makes the search for a capital gains rate effect on Treasury bills more difficult. Given Guenther's (1994) findings, though, and the level of individual investment, the search for an indirect effect on Treasury bill yields is reasonable.

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[16] "The assumption that changes in individual tax rates affect pre-tax returns implies marginal investors in Treasury bills are individuals. If marginal investors are tax-exempt pension funds, or accrual basis corporations, changes in individual tax rates will not affect prices of Treasury bills." Guenther (1994, 383)

[17] Guenther (1994) cites Tables 1.41 and 1.42 of the *Federal Reserve Bulletin* from June of 1982 and 1987. The 1995-1999 range cited here is based on Table L.209 from the September, 2002 *Flow of Funds Accounts of the United States*.

3.2. The 1997 decrease in the capital gains tax rate

The May 1997 decrease in the capital gains tax rate is a useful research setting because rates on ordinary income for individuals remained unchanged and because the announcement of the decrease was unexpected. This suggests that any corresponding response by Treasury bill yields to the tax decrease is concentrated on the day of the change. If instead the market anticipated the rate change then the impact on yields would be more difficult to detect, biasing against a significant finding.

Lang and Shackelford (2000) use this same week for their event study and provide important details on the rate decrease. Although the original 1998 budget did not include a decrease in the capital gains tax rate, speculation about such a decrease surfaced in the press when the Congressional Budget Office released new figures on April 30, 1997 showing that the Federal deficit for 1997 would be much lower than expected, and that similar reductions were in order for the years 1998 to 2002. On May 2 the President announced an agreement with Congressional leaders to balance the budget and reduce the capital gains tax rate by an unspecified amount. On May 7 Congressional leaders announced that the lower rate, although not yet specified, would be effective as of that same day. Speculation about the new tax rate ranged from 15% to 20%. In August 1997 the Taxpayer Relief Act of 1997 (TRA97) was passed and included a drop in the capital gains tax rate from 28% to 20%. Lang and Shackelford (2000) find that stock returns increased significantly in the period around the announcement, consistent with the effect of the announcement being concentrated in a short period.

In the days preceding the May 7 announcement there were indications in the press that the Treasury markets were responding to various economic events. *The New York*

Times reported on May 3 that the announcement of a balanced budget had affected the Treasury markets because the unimagined size of the deficit reduction implied the government would need to sell fewer debt instruments. This anticipated scarcity of supply drove prices up and yields lower. Partly in response to this, *The New York Times* reported that the Treasury auction on May 5 of new three- and six-month bills went better than expected, with prices increasing and rates decreasing because of strong investor demand. These reports suggest an environment of decreasing yields on Treasury bills, biasing against finding an increase in yields due to the announcement.

Earlier in the year the Federal Reserve Open Market Committee (FOMC) took the unusual step of increasing the Federal Funds Rate between meetings (from 5.25 to 5.50 on February 5, 1997). Since Treasury bills are sensitive to FOMC actions there was some uncertainty in the market about what the Committee would do at the May 20, 1997 meeting. However, *The New York Times* reported on May 6, 1997 that bond prices climbed the week before because of new statistics suggesting that consumer prices were in check and that the economy might be slowing down. A slowing economy decreases the chance of action by the FOMC, and in fact the rate remained constant for the rest of 1997. This suggests that during the week of the announcement the market was relatively secure in its anticipation of no future action by the Federal Reserve Bank.

3.3. Sample description

The data used in this study was collected from the *Wall Street Journal* and consists of daily bid and ask quotes for each of 26 Treasury bills and their associated maturity dates. The sample period begins 30 trading days prior to the announcement date

and ends 30 trading days after the effective date, from March 21, 1997 to June 18, 1997 for a total of 1,586 Treasury bills.

Figure 1 illustrates the average of the Treasury bill yields during the period surrounding the May 7, 1997 change in capital gains tax rates. Generally the yields are decreasing, consistent with news reports during this time period. On May 2, the date of the budget agreement announcement, the average yield flattens somewhat but then continues its downward trend. On May 7, the effective date of the capital gains rate decrease, yields spike sharply. This indicates that prices decreased suddenly and is consistent with H_1. The average of the 26 one-day differences for May 7 is 0.034%, which is below the 3.47% increase suggested by equation (3). This is consistent with the relationship between capital gains taxes and Treasury bill yields being less than first-order and with individuals not being the marginal investor in Treasury bills. Whether the cause of the May 7 increase in yields is the decrease in capital gains rates or other known determinants of yields is the subject of the multivariate analyses in this study.

4. Empirical specification

The following regression model provides a test of the effect of a change in the capital gains tax rate on Treasury bill yields (sign predictions in parentheses) while attempting to control for the other known determinants of yields:[18]

$$\Delta Yield = a_0 + a_1 TaxChange + a_2 DaysMat + a_3 EndMonth$$
$$(+) \qquad (+) \qquad (-)$$
$$+ a_4 \Delta Pdebt + a_5 \Delta TSpread + a_6 \Delta AaaBaa + a_7 \Delta DivYld$$
$$(+) \qquad (-) \qquad (+) \qquad (+)$$

[18] While Guenther's (1994) sample is attractive because each individual bill has measurement and maturity dates that "straddle" the tax-change dates his methodology is not usable in this setting because the effective date of the decrease in the tax rate was a surprise. However, the model specified was also run on a sample of daily Treasury bill yields for November, December and January for the yearends of 1981/82, 1985/86 and 1986/87. These results (not reported) are consistent with Guenther's (1994) findings.

where all variables are defined as follows and Δ indicates their first difference:

ΔYield = the annualized yield of a Treasury bill on a specific measurement date, in basis points
TaxChange = 1 if the yield was measured on May 2 or May 7, 1997 and zero otherwise
DaysMat = the difference between the maturity and measurement dates
EndMonth = 1 if the Treasury bill matures at the end of the month and zero otherwise
ΔPdebt = the natural log of the daily level of The United States Federal Government's public debt
ΔTSpread = the daily spread between the Treasury's 30 year and three month rates
ΔAaaBaa = the daily spread between Moody's Aaa and Baa corporate bond indices
ΔDivYld = the daily dividend yield on the S&P 500

4.1. Dependent variable

Yield is calculated with bid/ask quotes collected from the *Wall Street Journal* and using the same method as in Guenther (1994). Each quote is published in percentage points (R) and represents an annual yield calculated using a 360-day year, where the quoted yield for a bill with n days to maturity is R_n. Each of the bid/ask pairs is converted to bid/ask prices using Roll's (1970) formula, $P_n = 100 - (n/360)R_n$, where P_n is the current price of a \$100 (at maturity) Treasury bill that matures in n days. The mean of each bid/ask yield pair (P_n^*) is then used to find a continuously compounded annualized yield (Y_n) for that maturity as measured on that day, using a formula adapted from Roll (1970), $Y_n = (365/n)\ln(100/P_n^*)$. This annualized yield is then multiplied by 10,000 in order to express it as basis points. The first difference of *Yield* is taken to create *ΔYield*, which becomes the dependent variable in the changes model.

4.2. Tax effect variable

The dummy variable *TaxChange* is used to capture the effects of the change in the capital gains tax rate for individuals. Although the cut was made effective as of May 7 it was announced on May 2. Since the market knew a cut was forthcoming it's possible that its effects on Treasury bill yields began to be felt as soon as May 2. *TaxChange* equals

one for all Treasury bill yields calculated on either May 2 or May 7, 1997 in order to test for a market reaction on both of these days. *TaxChange* is hypothesized to be positive.

4.3. Other control variables

The following variables are included in the model as controls for the determinants of Treasury yields identified by previous research:

DaysMat is included to control for the normally upward sloping nature of the yield curve and is predicted to be positive. Cohen, Kramer and Waugh (1966) conclude the best regression models are those that include days to maturity, supporting the inclusion of *DaysMat*. In addition, Simon (1991) shows that holders of Treasury bills do not view bills of adjacent maturities to be substitutes, and concludes that participants have a preference for the specific maturity currently held.

EndMonth is included to control for the "kink" in the yield curve when it crosses month ends, as documented by Park and Reinganum (1986), and is predicted to be negative. This kink is explained by Ogden (1987) as the result of aggregate operational payments (e.g. salaries, rent) occurring at the end of each month. These payments create extra demand for Treasury bills maturing at those times, suppressing their yields as prices are bid up. This yield discount disappears along with the excess demand at the start of the next month.

Pdebt is included to control for the relationship between debt yields and the supply of debt and is predicted to be positive.[19] Fair and Malkiel (1971) compare U.S. Government debt instruments to high quality industrial and utility bonds of the same maturities to investigate the causes of yield differentials between debt of the same maturity. They find the current level of outstanding debt issued by all three entities as

[19] Daily public debt data is available at http://www.publicdebt.treas.gov.

well as the expected future supply of utility bonds within the next six months positively influences the differentials. Based on this work Cook and Hendershott (1978) include a relative supply variable in their investigation of rate differentials and find that it is positively related to the spread between yields on utility bonds and newly issued U.S. debt. *ΔPdebt* is the first difference of *Pdebt*.

TSpread is included to control for the market's expectation of long-term inflation and is predicted to be negative.[20] Long-term inflation expectation makes shorter-term investments more popular, decreasing their yields. As the expectation of inflation increases *TSpread* will get larger as the yields on long-term investments increase to attract investment. *ΔTSpread* is the first difference of *TSpread*.

AaaBaa equals the yield differential between Moody's highest- and medium-grade corporate bond indices and is included to proxy for investors' risk preferences.[21] A decrease in this spread indicates investors are moving towards safer debt investments, including Treasury bill yields, which will cause their yields to decrease. *AaaBaa* is predicted to be positive. *ΔAaaBaa* is the first difference of *AaaBaa* and is expected to be negative.

DivYld equals the daily dividend yield on the S&P 500 and is included to control for the effect of competing investments.[22] Mankiw and Poterba (1996) find that dividend yield is positively associated with the taxable tax-exempt yield spread. As indicated by Equation 3, as dividends increase yields will also have to increase as Treasury bill prices

[20] Daily 30 year and three month Treasury rates are obtained from http://www.economagic.com.
[21] Daily yields on Aaa and Baa rated bonds are available at http://www.economagic.com.
[22] *DivYld* is calculated using a firm's annual dividend on common stock (Compustat #21) and dividing it by the firm's daily market capitalization (CRSP, prc*comout). A daily average is then created using those stocks which were included in the S&P500 index on that day.

drop, therefore *DivYld* is predicted to be positive. *ΔDivYld* is the first difference of DivYld.

5. Empirical results

5.1. Descriptive statistics

Table 1 provides descriptive statistics for the sample period. Of the 1,586 daily Treasury bill yield observations available, 13 are lost in differencing *Yield* because they are new issuances that lack a prior measurement date, resulting in a final sample of 1,573. The mean of the primary tax event variable, *TaxChange* (0.0331), is consistent with the number of Treasury bills tested during the event periods. The mean of *ΔYield* (-0.7372) reflects the overall downward trend during the sample.

5.2. Diagnostic tests

In tests for multicollinearity the condition index equals 1.48. While criteria for the condition index are somewhat arbitrary these values are certainly well below the index of 30 that is often mentioned as an indicator of serious multicollinearity problems.[23] Graphs of the error terms (not reported) from the models indicate even dispersion around the axis, indicating that no heteroscedasticity is present.

The Durbin-Watson statistic for the regression model is 1.23. Since this value is below the lower limit for the Durbin-Watson test (at the 1% confidence level) the null hypothesis of no heteroscedasticity may be rejected. To correct for serial correlation the regression models reported in the tables are all estimated using a first-order autoregressive error term. As reported in Table 2, the new Durbin-Watson statistics are

[23] Freund and Little (1992) cite 30 as a threshold for multicollinearity problems. They also cite Myers (1990), who describes 1,000 as the ceiling for the square of the condition index, beyond which severe multicollinearity exists.

all in excess of the upper limit (at the 1% confidence level), indicating that the null hypothesis of no serial correlation may not be rejected.

5.3. Regression results

The results of the regression tests are shown in Table 2. The tax event variable *TaxChange* is significantly positive at the 1% level, supporting the hypothesis that a decrease in the capital gains tax rate has a positive effect on Treasury bill yields. The coefficient on *TaxChange* (expressed in basis points) indicates that Treasury bill yields increased by .0345%, when controlling for other yield determinants, during the period of the capital gains tax rate decrease.

Surprisingly, given the amount of prior research, *DaysMat*, *EndMonth* and *ΔPDebt* are all insignificant. *ΔTSpread*, *ΔAaaBaa* and *ΔDivYld* are all significant at the 1% level and in the predicted directions. The significance of *ΔDivYld* supports the findings of Mankiw and Poterba (1996) and buttresses the predictions of the model in this paper.

6. Sensitivity analyses

6.1. Other factors affecting the Treasury bill market

Since 1972 three- and six-month Treasury bills have been sold at weekly auctions that are announced on Tuesdays and are conducted the following Monday. Since each of these announcement and auction days are a potential source of new information that might influence the Treasury bill market additional tests are performed to measure their effects. Two dummy variables equal to one if the bill was measured on a Monday or Tuesday, respectively, and zero otherwise, were included in the same regression used to

test for the tax effects of the decrease in capital gains rates. There is no sign prediction for either *Monday* or *Tuesday* so two-tailed t-tests for these variables are conducted.

Since each announcement also includes the volume of bills for sale at the upcoming auction it is possible the market's knowledge of this pending amount may influence yields. In order to investigate this possibility a new variable called *Visible* was calculated. For each day after an auction announcement *Visible* equals the dollar volume of Treasury bills that will be for sale at the next auction date. Prior work by Fair and Malkiel (1971) indicates the pending supply of debt for sale has a positive influence on yields. *ΔVisible* is the first difference of *Visible* and is predicted to be positive.

Figure 1 shows that Treasury bill yields increased sharply on May 13, 1997 as well as on the May 7 event day. On May 14, 1997 *The New York Times* reported that Treasury prices fell the previous day on new data that described "surprisingly strong business for manufacturers," a possible indicator of inflation. A new dummy variable, *May13*, that equals one for yields measured on May 13 and zero otherwise, was included in the regressions to investigate whether the May 13 increase might influence the results and also to test whether the explanatory variables are successful in explaining this large increase.

The results of regressions including these new control variables are shown in Table 2 in the columns labeled "Market." *TaxChange* remains significant at the 1% level in the new model when the additional variable are included. *ΔTSpread*, *ΔAaaBaa* and *ΔDivYld* all remain significant at the 1% level. Of the new control variables only *Monday* is significant, at the 1% level, while *Tuesday* and *ΔVisible* are insignificant. Perhaps most interesting is the non-significance of *May13*, which indicates that the control variables

are successful at explaining the other factors influencing yields in this sample. This suggests that the model is isolating the change in the capital gains tax rate for individuals effectively, and that these results are not spurious.[24]

7. Economic effects[25]

Guenther (1994) assumes a $10,000 Treasury bill maturing in 91 days to calculate the economic effect on yields when ordinary income tax rates for individuals decreased from 70% to 50% across the 1981/82 yearend. The last bill to mature in December 1981 has a price of $9,667 while the first bill to mature in January 1982 has a price of $9,672, based on respective average yields of 13.579% and 13.374%. The price of the January bill is $5 greater than the December bill, indicating investors received $333 and $328 in interest from the December and January bills, respectively. Assuming that the investor's tax rate dropped from 60% to 50% suggests that the after-tax interest received equals $133 and $164 from the December and January bills, respectively, indicating an increase in after-tax income of $31.

In the sample used in this study the average price of a Treasury bill was $9,873.50 and $9,872.60 on May 6 and 7 when average yields were 5.139% and 5.176%, respectively. Since ordinary tax rates remained constant and only the capital gains rate was changed this represents a decrease in after-tax income of 90 cents, or roughly 2.9% of the after-tax effect found in Guenther (1994).

While informative these comparisons of means do not separate the tax effects from the overall economic effects that also influence Treasury bill yields. Since the

[24] A similar null variable was also defined for the smaller increase on April 28, 1997. This null was also insignificant, while results were qualitatively unchanged otherwise. This further supports the use of these control variables in isolating the effects of the change in the capital gains tax rate for individuals.
[25] This discussion is modeled after Guenther 1994 (391 – 392).

regression analyses performed in this study attempt to control for the impact of macro-economic influences on Treasury bill yields a better estimate of the tax effect alone may be gained by using the coefficient from the tax variable to calculate the dollar change in the price of the Treasury bill. Using levels regression results for the 1981/82 data by itself the coefficient on *YearEnd* is –43.54 (others results not reported). This suggests a decrease in yield of 0.4354% and a corresponding price increase of $10.84 – more than double what Guenther (1994) reports using a simple comparison of means. For the 1997 sample period the coefficient from Table 2 is 3.4498, suggesting an increase in yield of 0.034498%. This indicates a price decrease of 87 cents or about 8% of the 1981/82 amount, as determined by the regression.

This comparison is informative because it allows the competing effects of changes in the ordinary and capital gains tax rates for individuals to be separated out. During the 1981/82 yearend the ordinary rate fell from 70% to 50% at the same time that the capital gains rate fell from 28% to 20%. This is the same level and magnitude of change in the capital gains rate as in 1997, which occurred without any associated change in the ordinary tax rate. Since changes in the two rates are hypothesized to have opposite effects on Treasury bill yields, studies using yearends where both rates change may misstate the effects of taxes on investment returns. In the case of the 1981/82 yearend results reported by Guenther (1994), for example, both rates decrease. This suggests that the true effect of changes in the ordinary tax rate is larger than that reported by Guenther since the associated decrease in the capital gains rate may have been increasing the yield while the decrease in the ordinary rate may have been decreasing it.

8. Conclusions

This study provides a new test of the equilibrium of after-tax rates of return presented by Miller (1977) by investigating whether a change in tax rates affects the return of an investment asset that is not directly taxed by the rate being changed. Starting with a model of after-tax investment returns I predict the yield of an ordinary-income asset will have an inverse reaction to changes in the capital gains tax rate. This prediction is tested using regressions in a sample of daily Treasury bill yields. The yield on the Treasury bills, which are only subject to the ordinary income tax rate, appear to increase in response to the surprise reduction in capital gains tax rates on May 7, 1997. While small this increase is statistically significant and is robust to other possible macroeconomic and institutional determinants.

These findings contribute to the accounting literature on taxes and investment pricing in several ways. Existing research into asset pricing uses settings in which the investment's return is directly subject to the changing tax rate. The setting in this paper examines the effects of a tax rate change on an asset's yield that is not directly taxed at that rate, providing a potentially cleaner setting to evaluate the effects of shareholder-level taxes on investment pricing. In addition, because both the 1981 and 1986 tax acts changed both the ordinary and capital gains tax rates, studies using those settings may misstate the effect of specific tax changes on investment prices because changes in these rates are hypothesized to have conflicting impacts on prices. Overall these results suggest shareholder-level taxes are impounded into prices in ways not previously considered and should be of interest to researchers investigating the effect shareholder-level taxes have on investment returns.

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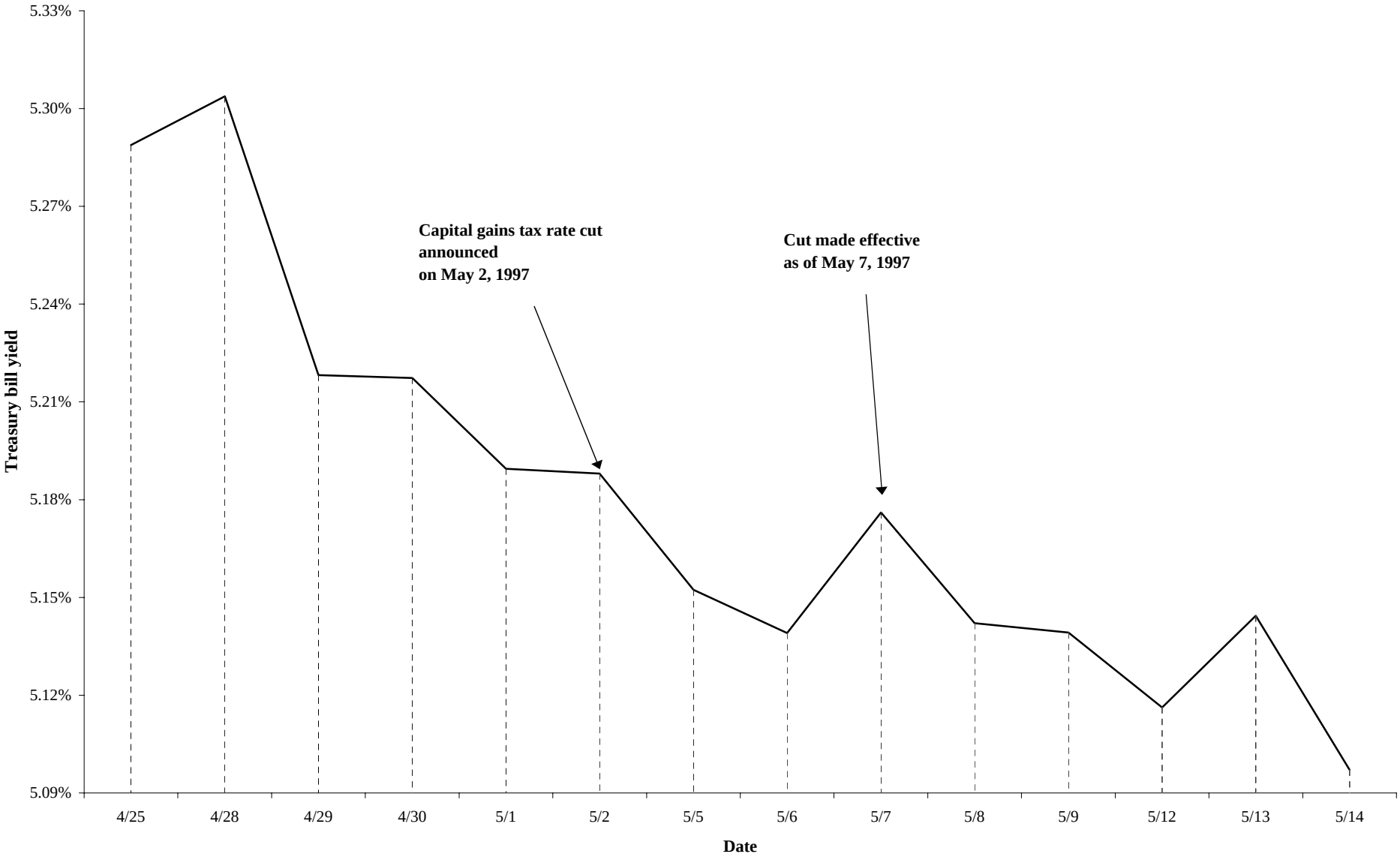

Figure 1: Average Treasury Bill Yield from April 25 to May 15, 1997

TABLE 1
Descriptive Statistics

Variable:[a]	N[b]	Mean	Std. Dev.	Median	Min.	Max.
ΔYield	1,573	-0.73719	6.39873	-0.55295	-59.89855	54.70301
TaxChange	1,573	0.03306	0.17884	0.00000	0.00000	1.00000
DaysMat	1,573	88.179	49.3948	91.000	2.000	182.000
EndMonth	1,573	0.23967	0.42702	0.00000	0.00000	1.00000
ΔPdebt	1,573	-0.0001	0.0014	0.0002	-0.00659	0.004
ΔTSpread	1,573	-0.0005	0.06770	-0.0100	-0.1500	0.3100
ΔAaaBaa	1,573	0.00017	0.00819	0.00000	-0.02000	0.03000
ΔDivYld	1,573	-0.00002	0.00011	-0.00001	-0.00034	0.00036
Monday	1,573	0.18118	0.38529	0.00000	0.00000	1.00000
Tuesday	1,573	0.21424	0.41042	0.00000	0.00000	1.00000
ΔVisible	1,573	-3.40E+05	2.26E+07	8.55E+07	-9.40E+07	1.08E+08
May13	1,573	0.01589	0.12510	0.00000	0.00000	1.00000

[a] *TaxChange* equals 1 if the yield was measured on May 2 or May 7, 1997 and zero otherwise. *Yield* is the annually adjusted yield, in basis points, of the Treasury bill as of a specific measurement date and *ΔYield* is its first difference. *EndMonth* equals 1 if the maturity dates of the bill and the next longer maturity bill adjacent to it are split by the end of a calendar month. *DaysMat* equals the number of days until the bill matures. *Pdebt* equals the natural log of the level of all government debt, and *ΔPdebt* is its first difference. *TSpread* equals the spread between the Treasury's 30 year and three month instruments, and *ΔTSpread* is its first difference. *AaaBaa* equals the difference between Moody's Baa and Aaa bond yield indices, and *ΔAaaBaa* is its first difference. [b] Of the 1,586 daily T Bill yield observations available, 13 are lost in differencing *Yield* for a final sample size of 1,573. Monday and Tuesday equal one if *Yield* was measured on a Monday or Tuesday, respectively, zero otherwise. *Visible* equals the supply of bills available at the next auction date, *ΔVisible* is its first difference. *May13* equals one if *Yield* was measured on May 13, 1997, zero otherwise.

TABLE 2
Regression Results

Variable:[a]	Prediction	H_1	Market
Intercept	n/a	-0.5366	-1.0360
		0.4034	0.4490
TaxChange	+	3.4498 ***	3.9354 ***
		1.2165	1.2256
DaysMat	+	-0.0019	-0.0017
		0.0038	0.0038
EndMonth	-	0.1662	0.1614
		0.2826	0.2823
ΔPdebt	+	219.82	193.37
		157.52	157.7983
ΔTSpread	-	-32.56 ***	-31.024 ***
		3.3898	3.5586
ΔAaaBaa	+	85.775 ***	79.493 ***
		27.203	27.592
ΔDivYld	+	11,980 ***	12,652 ***
		2,053	2,095
Monday	+/-		1.559 †
			0.5915
Tuesday	+/-		0.7041
			0.5988
ΔVisible	+		8.09E-10
			9.69E-09
May13	+		2.2669
			1.7469
Adj. R^2		0.269	0.274
N[b]		1,573	1,573
DW		2.090 ***	2.082 ***

***, **, and * indicate significance at the 1%, 5% and 10% levels, respectively, using a one-sided t test. † indicates significance at the 1% level using a two-sided t test. Standard errors are in small font. [a]*TaxChange* equals 1 if the yield was measured on May 2 or May 7, 1997 and zero otherwise. *Yield* is the annually adjusted yield, in basis points, of the Treasury bill as of a specific measurement date and *ΔYield* is its first difference. *EndMonth* equals 1 if the maturity dates of the bill and the next longer maturity bill adjacent to it are split by the end of a calendar month. *DaysMat* equals the number of days until the bill matures. *Pdebt* equals the natural log of the level of all government debt, and *ΔPdebt* is its first difference. *TSpread* equals the spread between the Treasury's 30 year and three month instruments, and *ΔTSpread* is its first difference. *AaaBaa* equals the difference between Moody's Baa and Aaa bond yield indices, and *ΔAaaBaa* is its first difference. [b]Of the 1,586 daily T Bill yield observations available, 13 are lost in differencing *Yield* for a final sample size of 1,573. Monday and Tuesday equal one if *Yield* was measured on a Monday or Tuesday, respectively, zero otherwise. *Visible* equals the supply of bills available at the next auction date, *ΔVisible* is its first difference. *May13* equals one if *Yield* was measured on May 13, 1997, zero otherwise.