A NEW ANALYSIS OF THE EFFECT OF DIVIDEND TAX POLICY ON THE RELATIONSHIP BETWEEN DIVIDEND AND TREASURY YIELDS

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Abstract

We investigate the relationship between relationship between U.S. Treasury bill yields and the dividend yield of the S&P 500 in the period before and after the passage of the Jobs Growth Tax Relief Reconciliation Act (JGTRRA) in 2003. The results suggest that there is an upward pressure on the Treasury yields when capital gains are tax-favored over dividends. An increase in the portion of stock returns attributable to capital gains makes an equity portfolio more tax-efficient, placing upward pressure on competing Treasury bill yields. Our results are robust to a battery of additional tests, including the level of stock prices. These analyses provide new insights into the complex relationship between investment returns and tax rates on interest, dividends and capital gains, and suggest a public policy favoring dividend tax cuts may have the inadvertent effect of increasing the cost of debt.

Data Availability: The data are available from public sources identified in this study.

INTRODUCTION

The Jobs & Growth Tax Relief Reconciliation Act of 2003 (JGTRRA) was enacted in May 2003. It reduced the top tax rate for individuals on dividend income from 38.6 to 15 percent and that on net capital gains from 20 to 15 percent. The tax rates on ordinary income, however, only dropped from 38.6 percent to 35 percent. U.S. individual investors report yields (interest income) from Treasury bill as ordinary income and JGTRRA 2003 provides us with a unique opportunity to observe the effect of a significant reduction in both dividend and capital gain rates while the tax rates on ordinary interest are kept virtually unchanged.

Guenther (1994) found that Treasury bill yields were affected by the major changes in the U.S income tax rates in 1981 and 1986. Novack (2005) investigates the extent to which returns on Treasury bills might be impacted by a change in the capital gain tax on stocks. He reports that Treasury bill yields increased on the day that Congress announced the 1997 reduction in the tax rate on long-term capital gains (May 2, 1997) and again on the day that the tax cut became effective (May 7, 1997). In this study, we extend this line of inquiry of Guenther (1997) and examine the effect of taxes on equity returns in the Treasury market.

Our analysis contributes to the body of knowledge in several ways. First, a new empirical research in this area is needed given the facts that the holdings of Treasury securities by tax-advantaged pension funds have been reduced significantly since 1997 when Novack conducted his study. Based on Treasury bulletin (2002), the estimated ownership of U.S. Treasury securities by pension funds (private and state/local governments combined) has declined to 297.5 billion in June 2002 from 350.7 billion, representing a decline of more than 15%. Thus, a new research study is warranted to reflect the new market equilibrium between tax-advantaged investors such as pension funds and taxable individual investors on the Treasury market.

Second, we develop and test a new theoretical perspective on the relationship between dividend yields and yields of taxable bonds. Mankiw and Poterba (1996), for example, find that the yield spread between taxable and tax-exempt bonds is positively related to the dividend yield on corporate stocks. This conclusion, however, is based on the assumption that taxable investors hold tax-exempt bonds and tax-exempt investors hold taxable bonds, while both investors hold equities. We extend the theoretical model in which the yields on taxable Treasury bills are inversely related with dividend yields, consistent with a tax parameter of market participants whose dividend income is tax-disadvantaged compared with capital gains. Taken together, this new analysis of the effect of dividend tax policy may inform policy makers. A tax policy that intentionally favors dividends and capital gains over interest income may affect yields in the Treasury bill market, thus affecting the cost of government borrowing.

BACKGROUND AND LITERATURE REVIEW

Market Reactions to Tax Law Changes

The extent to which personal taxes impact asset prices has been the subject of considerable theoretical and empirical research. Theory holds that market prices reach equilibrium on an after-tax basis such that a non tax-favored investment needs to provide a higher pre-tax return than a tax-favored investment. For example, "if 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." (Miller, 1977, p. 267)

The empirical issue is complicated; however, because the tax code not only treats returns from different investment differently, it also treats returns to different investors differently. Corporate investors pay tax on returns at corporate tax rates, individuals at different rates, and some institutional traders such as pension funds, do not pay taxes at all. As a result, while most researchers agree that individual taxes influence individual investors' portfolio choices, the question is essentially an empirical examination about whether individual taxable investors play a large enough role in the capital markets for changes in their tax rates to affect market prices over time.

Although Guenther (1994) concluded that individuals are not the marginal investors in the Treasury bill market, he still found that Treasury bill yields appear to have been affected by the changes in individual tax rates enacted in 1981 and 1986. Similarly, Lang and Shackelford (2000) find that stock returns increased significantly, especially for non-dividend-paying stocks, during the period surrounding the 1997 decrease in the long-term capital gains.

Several other papers have suggested that stock prices increased and the cost of equity capital declined during the period surrounding JGTRRA (Dhaliwal et al. 2007; Auerbach and Hassett 2007; and Lightner et al. 2008). Thus, research to date has generally supported the idea that individual taxes impact individual investors' demand for different types of investment assets, and that changes in these taxes tend to be followed by price changes in asset categories affected by the tax change.

Few studies, on the other hand, have examined the potential that a change in the tax treatment of one type of investment may affect expected returns on an alternative type of investment. For example, a reduction in the tax on equity returns may result in an increase in the pre-tax required returns on bonds, as investors shift capital from bonds to stocks, exerting downward pressure on bond prices. Novack (2005) investigated this very question, analyzing the extent to which returns on bonds might be impacted by a change in the capital gain tax on stocks. He reports that Treasury bill yields increased on the day that Congress announced the 1997 reduction in the tax rate on long-term capital gains (May 2, 1997) and again on the day that the tax cut became effective (May 7, 1997).

Taxes and the Pricing of Treasury Bills

Based on Miller (1977) and Novack (2005), we use an after-tax framework for investors' relative valuation between dividends, capital gains and ordinary interest income. For a taxable investor to be indifferent between an equity investment and a debt instrument of equal risk whose yield is taxed as ordinary income, the equilibrium must be such that:

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

t_o= the tax rate on ordinary income (e.g., interest income)
r = the yield of an investment that is taxed as ordinary income
t_g= the tax rate on capital gainsg
g = the capital gain yield on an equity investment
t_d= the tax rate on dividends
d = the dividend yield on an equity investment

Assume that R is the total stock return, and is equal to the sum of g and d (terms defined above):

$$R = g + d \tag{2}$$

Rearranging terms, and incorporating taxes as in equation (1), we get:

$$(1-t_o)\cdot r = (1-t_g)\cdot R - (t_d - t_g)\cdot d \tag{3}$$

The partial derivative between r and d can be described as:

$$\frac{\partial r}{\partial d} = -\frac{t_d - t_g}{1-t_o} \tag{4}$$

Note that so long as the tax rate on dividend income (t_d) is higher than the tax rate on capital gains (t_g), the partial derivative of r with respect to changes in dividend yield (d) is less than zero. Accordingly, we would expect a negative relationship between taxable bond yield and dividend yield in the pre-JGTRRA period when td>tg. In the post-JGTRRA period when tg= td, this equation equals zero, and we would expect no relationship between the yield on a portfolio of taxable bonds and the dividend yield on a stock portfolio such as the S&P 500(or any other portfolio of dividend-yielding stocks). The intuition behind our extension is that a lower dividend yield indicates a decreased value-relevance of dividend taxation on expected stock returns and an increased value-relevance for capital gains tax (Lang and Shackelford 2000, Amoako-Adu et al. 1992). Thus, in equilibrium, a lower dividend yield will make equity investment more tax-efficient due to the differential tax treatment of dividends and capital gains. As a result, Treasury bills will appear less attractive to taxable investors and would therefore need to offer a higher yield.

The equations 1 through 4 suggest that the composition of stock returns, namely the relative portion of returns attributable to dividend yield vs. capital gains, may affect the tax efficiency of equity returns (R) and thus their competitiveness with Treasury bill yields (r). Treasury bills are government debt securities with maturities under one year, issued at a discount and without coupons. The yield (Y) from a Treasury bill realized at sale or upon maturity is taxed under the Internal Revenue Code as ordinary income.1Thus, we re-write equation (3) to compare the yields on a fund investing solely in Treasury bills with the returns on a stock market portfolio under the assumption of equal risk:

$$(1-t_o)Y = (1-t_g)R_m - (t_d - t_g)d_m \qquad (5)$$

where Y is the return on a fund investing in Treasury bills, R_m is the return on a stock market portfolio and d_m is the portfolio's dividend yield. When each Treasury bill reaches its maturity, we assume that the balance is reinvested into new bills. Of course, Treasury bills do differ from a stock portfolio in terms of risk, and the risk difference may be adjusted by the beta on Rm in the multi-factor return-generating model in the tradition of Fama and French (1993). We thus write the following return generating model in the form of first difference:

$$\Delta Y_t = \beta_0 + \sum_{j=1}^{J} \beta_j (\Delta R_{j,t}) + \tau \Delta d_{m,t-1} + \varepsilon_t \qquad (6)$$

The coefficient β_j is the sensitivity or relative risk, of the Treasury bill yield to the changes in the jth factor R_j. Following

Fama and French (1993), we include the term factor and the default factor in addition to the returns on the S&P 500 as the common factors associated with the expected returns on government bonds. We expect that the beta on *Rj* will be substantially lower than one because Treasury bills are less risky than a stock market portfolio. The market dividend yield information available to investors at the beginning of the period ($d_{m,t-1}$) is measured and included in the empirical model. If a dividend tax effect exists ($t_d > t_g$), then the estimate of τ should be negative. This can be explained based on equation (5) and (6):

$$\tau = -\frac{t_d - t_g}{(1 - t_o)} \tag{7}$$

A negative estimate for τ suggests that investors take the dividend yield information available to them at the beginning of time t to form expectations of their dividend tax liabilities. With all else equal, the lower the dividend yield, the lower the portion of the stock return that will be subject to unfavorable dividend taxation compared with that on capital gains. Therefore, Treasury bills will have to offer higher yields to maintain equilibrium. In this case (where τ is negative), the estimated scale of τ may be interpreted as the weighted average of investor's tax parameter in equation (7).

Alternatively, a positive sign on dividend yield in the regression estimate may suggest another working hypothesis that two investment vehicles offer competing yields without reflecting investors' tax disadvantage from dividend income. For example, corporate investors' effective tax rate on dividend income can be lower than that on capital gains due to the dividends-received deduction. Similarly, to the extent that tax-exempt or tax deferred institutional investors such as governments, pension fund and other institutional investors are the marginal investors in the market for Treasury securities, the change in individual tax rates would not be important in determining yield. The research task then becomes, as Guenther (1994) notes, to evaluate the hypotheses based on market evidence.

Prior Empirical Analyses of the U.S. Treasury Bill Market

Guenther (1994) finds that tax-exempt investors do not completely dominate the yield-setting process in the Treasury bill market. He compares yields for Treasury bills maturing in the last week of December to those of bills maturing in the first week of January. He finds a negative spread (i.e., lower yields in January) in the years immediately following implementation of the Economic Recovery Tax Act of 1981 (ERTA) and the Tax Reform Act of 1986 (TRA86), both of which lowered individual income tax rates (and thus the income tax rate on interest income from Treasury bills). In years unaffected by such tax changes, the spread between January and December yields was positive. Since December returns for both of these periods would be subject to higher tax rates than those earned on January maturities, the negative spreads suggested that investors were willing to accept lower pre-tax returns (in January), in order to maintain their pre-change after-tax returns. He noted, however, that the negative spreads for the ERTA and TRA86 year-ends were not sufficient to fully offset the decrease in individual tax rates, suggesting that investment by institutional (tax-exempt) investors partially offset the actions of individual (taxable) investors.

This conclusion (Guenther 1994) is also consistent with other studies of the average tax rate of market investors. For example, Green and Odegaard (1997) estimated the average tax rate of the "representative" investor in the government bond market to be as high as 40 percent before TRA86. Following that act, which reduced the maximum tax rate on individuals to 28 percent, they estimated an average tax rate of zero for the representative investor. Both of these results suggest that as tax rates change, individual investors shift their portfolios to or from government securities to take advantage of the new tax regime. As market prices shift to reflect these changes, nontaxable investors also react and prices reach a new equilibrium that does not reflect the presence of the same investor clienteles as before the tax change.

Most previous studies have focused on changes in ordinary income tax rates, since those are the rates at which individual investors pay tax on interest income from government bonds. However, individual investors are also likely to adjust the portion of their portfolios invested in government bonds following a change in capital gains rates. For example, Novack (2005) has shown that Treasury bill yields appear to have increased following the 1997 surprise reduction in the capital gains rate (from 28to 20 percent). His results are consistent with the expectation that investors reacted to that rate change by shifting their investments from Treasuries to stocks, thus driving down the price of Treasuries and driving up the yields.

HYPOTHESES DEVELOPMENT

We formulate the effect of dividend tax on Treasury yields under the setting of JGTRRA. For most of the history of the U.S. income tax, dividend income received by individual taxpayers has been taxed at the recipient's ordinary marginal tax rate. Thus, the reduction in the tax rate on dividends implemented in 2003 marked the first time that dividends and interest income have been subject to differential tax rates.[2] This enables us to ascertain a dividend tax penalty effect ($t_d > t_g$) as reflected in $-\frac{t_d - t_g}{1 - t_o}$ while the tax rates on ordinary interest income (t_o) are kept virtually unchanged.

Following JGTRRA, the dividend tax penalty faced by market investors would be significantly reduced due to the reduction in the statutory tax rates and/or a possible change of investor clientele between taxable and tax-exempt investors. We test the prediction of our theoretical model by first estimating the potential tax parameter (τ) of market investors before JGTRRA. We predict that due to the removal of the dividend tax penalty by JGTRRA and a shift in the investment clientele, the tax parameter of market investors should be reduced significantly. JGTRRA reduced the marginal rate on qualified dividends from 38.6 to 15 percent. The tax rate on net capital gains was also reduced from 20 to 15 percent. The marginal tax rate on ordinary income, however, only changed slightly from 38.6 to 35 percent. These differentials in tax rates provide an ideal setting for us to test how dividend taxes may affect Treasury yields.

H1 *(in the null form): The relationship between Treasury bill yields and dividend yields before JGTRRA does not reflect the tax disadvantage of dividend income.*

The null hypothesis can be supported if tax-exempt or tax deferred institutional investors, or corporate investors whose effective tax rates on dividends are lower than capital gains dominate the pricing process and set the market price. The alternative hypothesis, however, suggests that the tax parameter of market investors reflects the tax disadvantage of dividend income ($t_d > t_g$) preceding the enactment of JGTRRA. Furthermore, the passage of JGTRRA and the equalization between t_d and t_g should be associated with a reduction in the estimated tax parameter τ

H2 *(in the null form): The relationship between Treasury bill yields and dividend yields is the same before and after JGTRRA.*

EMPIRICAL ANALYSES

Sample and Measurement of Variables

The daily Treasury bill yield and maturity data in this study are drawn from the GovPX historical database. GovPX is set up by all the primary dealers and major interdealer brokers serving the U.S. Treasury market. GovPX supplies transaction-based daily U.S. Treasury securities information and thus provides us with an accurate measure of market clearing prices. We use the daily average of the actual bid and ask quotes for each Treasury bill issue that are reported by GovPX in discount yield based on a 360-

day year. Each of the daily average bid/ask discount yield pairs is converted to bid/ask prices according to Roll (1970) and Guenther (1994):

$$P_{n,t} = 100 - (n/360)R_{n,t} \tag{8}$$

In the above model, $P_{n,t}$ is the current price of a \$100 (at maturity) Treasury bill that matures in *n* days as of day *t*. $R_{n,t}$ is the actual discount yield provided by GovPX in percentage points based on a 360-day year. The mean of each bid/ask pair ($P^*_{n,t}$) is used to find a continuously compounded annualized (365-day year) yield-to-maturity (Y_t) as measured on day *t* for Treasury bill issue *i* as follows:

$$Y_t = (365/n)\ln(100/P^*_{n,t}) \tag{9}$$

The calculated annualized yield is then converted to basis points. We select Treasury bills that are auctioned initially by the Treasury with maturities of 13 and 26 weeks as they are the most actively traded. Each Treasury bill issue is identified by its cusip number in the GovPX database.

The daily dividend yield on the S&P 500 is calculated based on the relevant data items in CRSP. We follow the practice of the Wall Street Journal to measure a stock's daily dividend yield. The annualized dividend yield, in basis points, for firm *j* going into day *t* (at the beginning of day *t*) is defined as:

$$DY_{j,t-1} = \frac{4 * D_{j,t-1}}{P_{j,t-1}} \tag{10}$$

$D_{j,t-1}$ is the most recent regular quarterly taxable cash dividend amount (CRSP distribution code 1232) for firm *j*, and $P_{j,t-1}$ is the previous trading day's (*t*-1) closing price for firm *j* listed on the S&P 500, both known at the beginning of *t*. We also require firms to have CRSP share code 10 or 11 to exclude non-corporate distributions and distributions by foreign incorporated firms whose dividends may not qualify for the reduced dividend tax rate under JGTRRA. Both dividends and prices are adjusted by using CRSP's cumulative factor. This practice will prevent any potential bias that may exist in previous studies that failed to adjust for both while measuring firm-level dividend yields. To prevent our measure of dividend yield from having stale information on dividend distributions, we set a firm's dividend yield to zero if a firm has not declared a regular quarterly dividend for more than three months since its previous ex-dividend month. The daily dividend yield on S&P 500 ($d_{m,t-1}$), known at the beginning of t, is the weighted average of the daily dividend yield $DY_{j,t-1}$ of the firms on the S&P 500 using their market capitalizations at the end of t-1 as weights.

Regression Model

We test the above two hypotheses using the following regression model:

$$\Delta Y_{i,t} = \beta_0 + \beta_1 \Delta R_{m,t} + \tau \Delta d_{m,t-1} + \beta_2 \Delta TERM_t + \beta_3 \Delta DEF_t + \beta_4 JGTRRA_{i,t} + \beta_5 JGTRRA_{i,t} * \Delta d_{m,t-1} + \varepsilon_{i,t} \quad (11)$$

The dependent variable is the daily change in the yield-to-maturity of Treasury bill i measured at day t. Following Campbell and Shiller (1991) we use a first differences measure of Treasury bill yields because the level of Treasury bill yields might not be a stationary process and thus could produce upwardly biased t-statistics in regression coefficient estimates (Granger and Newbold1974). $\Delta R_{m,t}$ is the daily change of the value-weighted return on the S&P 500 including dividends. $\Delta d_{m,t-1}$ is the daily change in the S&P 500 dividend yield on day t-1, known at the beginning of t. The term spread (*TERM*) is defined as the spread between the 10-year and one-year Treasury constant maturity rates. The default spread (*DEF*) is defined as the spread between the Moody's Baa corporate bond yield and the 10-year constant maturity Treasury bond yield. Fama and French (1993) identify that empirical proxies for the term and default factors explain a larger portion in the variation of government bond returns. Both the term spread and the default spread have been widely used in the empirical literature as proxies for the term and default factors and as indicators of general economic conditions (e.g. Jensen et al. 1996; Hahn and Lee 2003). The default spread is related to general credit conditions and is found to be high (low) when credit conditions are weak (strong). The term spread is more associated with monetary policy (Goodfriend 1998) and captures the near-term fluctuations in the business conditions, while the default spread also tracks the more persistent part of business conditions (Fama and French 1989).

As explained previously, if tax-exempt and corporate investors dominate the market process, τ will be positive. A negative estimate for τ reflects the tax disadvantage of dividend income compared with capital gains, the magnitude of which may be interpreted as the weighted average tax rates among market participants. We also test whether there is a significant structural shift in τ after the passage of JGTRRA, as the act significantly reduced the tax rates on qualified dividend income compared with that on capital gains and equalized the two tax rates. To detect such an effect, we use an indicator variable (*JGTRRA*) that is one for periods after the passage of JGTRRA and zero otherwise. We then interact *JGTRRA* with $\Delta d_{m,t-1}$to test the effect of different dividend taxation regimes on the relative valuation of Treasury bills.

We note that inclusion of this interaction term will strengthen the interpretation of our results. If unfavorable dividend taxation is reflected in the tax parameter preceding JGTRRA, then not only should the sign on $\Delta d_{m,t-1}$be negative as described above, but the sign on the interaction term $JGTRRA*\Delta d_{m,t-1}$ should be positive and significant, reflecting a reduction in the estimated dividend tax rate of market participants.

We define the indicator variable JGTRRA as one if measured on or after May 23, 2003, and zero otherwise. May 23, 2008 is the first trading day after the Senate passed JGTRRA. Prior to this date, there was much uncertainty regarding the success of the bill. Indeed, it was passed 51-50 in the Senate, with Vice-president Cheney casting the tie-breaking vote. Following this date, there was no doubt that the bill would be signed by President Bush as he had strongly voiced support for dividend tax relief. Both Brown et al. (2007) and Blouin et al. (2004) use May 23, 2003 as the date for a tax regime cut-off.

We set our sample period as one-year before and one-year after the passage of JGTRRA in May 2003. Specifically, it begins on the first trading day in June 2002 and ends on the last trading day in May 2004 for a total of 10,648 issue-day Treasury bill observations. The sample period is chosen so as to be safely distant from the trough in the business cycle in November 2001 set by the NBER, since having sample periods overlapping with a recognized business cycle trough may confound the interpretation of our empirical results. Table 1, Panel A reports descriptive statistics for the variables analyzed in this study. The results of the t-tests in Panel B of Table 1 indicate no significant differences in the means of the independent variables in the period after-JGTRRA versus before-JGTRRA.

Results

We use generalized least squares to estimate our regression model[3]. Table 2 reports regression model results relating changes in daily Treasury bill yields to changes in the daily dividend yield on the S&P 500, and the interaction between the indicator variable (*JGTRRA*) and changes in the dividend yield.

Column (a) in Table 2 reports the regression estimates using sample observations before May 23, 2003 and column (b) reports the estimates for observations on and after May 23, 2003. In the period prior to JGTRRA, there is a negative and significant relationship between changes in Treasury bill yields and changes in the dividend yield. The coefficient estimate on dividend yield in column (a) is -0.1321 and statistically distinguishable from zero. Thus we may safely reject the null hypothesis (H1) that investors did not take into consideration their higher dividend tax rates compared with capital gains rates preceding JGTRRA. We also predict that the negative coefficient on dividend yield will be significantly moderated following passage of the JGTRRA (τ=0 when t_d=t_g). Consistent with this expectation, we find that the coefficient on dividend yield is not statistically distinguishable from zero in the post-JGTRRA period, consistent with expectations based on the disappearance of the dividend tax penalty.

As a further test of this interpretation, we re-estimate the parameters of our model over the entire period, inserting an interaction between implementation of JGTRRA and the dividend yield coefficient (*JGTRRA* * $\Delta d_{m,t-1}$). These results are reported in column (c) of Table 2. Consistent with expectations, the estimated coefficient on the interaction term is positive and significant and we can reject the second null hypothesis (H2) that the relationship between Treasury bill yields and dividend yields is the same before and after JGTRRA.

The slopes on the covariates $\Delta R_{M,t}$, ΔDEF_t and $\Delta TERM_t$ are all significantly different from zero in the pre-May 23, 2003 period. The positive and significant coefficient on $\Delta R_{M,t}$ indicates that Treasury bill yields increase with the value-weighted return on the S&P 500. We also note that the estimated coefficient is less than one, as is expected given that Treasury bills are much less risky than the stock portfolio.

The default spread varies with general credit conditions and an increase in the default spread often serves as a signal of a worsening credit market (Hahn and Lee 2006). Thus the negative and significant coefficient on ΔDEF_t is consistent with investors' tendency to move into Treasury bills as safe havens as credit conditions deteriorate, driving up Treasury prices and depressing Treasury yields.

Column (d) of Table2 reports the interaction of the covariates with the *JGTRRA* dummy variable. This approach allows us to test whether the effect of each covariate is different in the post-JGTRRA period versus in the pre-JGTRRA period. We find no significant difference in the impact of $\Delta R_{M,t}$ and ΔDEF_t on Treasury bill yields in the pre- and post-JGTRRA period.

However, the estimate on $\Delta TERM_t$ is significant in the pre-JGTRRA sample, but not in the post-JGTRRA period. Although we had no expectations regarding the interaction of the *TERM* factor with passage of the JGTRRA, we note that Jensen et al (1996) report that the explanatory power of the term spread is dependent on the Federal Reserve's monetary policy. If so, the significance of this interaction effect may be attributable to the fact that the Federal Reserve cut the federal funds rate by 25 basis points on June 25, 2003.

SENSITIVITY TESTS AND ROBUSTNESS CHECKS

In this section, we conduct additional analyses to test whether this event, or other changes in economic conditions, may provide plausible alternative explanations for our results. In addition to the potential effects of changes in the federal funds rate, we also consider potential confounding effects related to changes in general business conditions and the effect of stock price pressure on Treasury and dividend yields. Finally, we conduct additional tests to rule out the possibility that our results are attributable to dividend initiations and special dividends.

Federal Funds Rate Cut

Our first sensitivity test examines whether a cut in the federal funds rate may provide a plausible alternative explanation for our empirical result on the relationship between Treasury yield and dividend yield. The Federal Open Market Committee (FOMC) only made two changes in the targeted federal funds rate during our sample period. The first action was on November 6, 2002 with a rate reduction of 50 basis points and the second was on June 25, 2003 with a reduction of 25 basis points. To test our explanation that the JGTRRA changed the effect of dividend yield on Treasury bill pricing against the alternative federal funds rate explanation, we focus on the first rate change on November 6, 2002 as the first news on the Bush Administration's proposal on dividend tax relief did not break until December 25, 2002.[4] If a rate cut were to account for our major empirical findings, then we would also expect to observe a significant shift in the coefficient on dividend yield after the FOMC rate cut on November 6, 2002. The results of this analysis are summarized in Table 3.

Table 3 reports the results of this sensitivity test. For the purpose of this analysis, we select our sample period as five-months before and five-months after the rate cut on November 6, 2002, starting from the first trading day in June 2002 and ending on the last trading day in March 2003 to keep a balanced sample period. We define an indicator variable *FedCut* as equal to one if measured after November 6, 2002 and zero otherwise. Following Jensen et al (1996), we interact *FedCut* with $\Delta d_{m,t-1}$, $\Delta TERM_t$ and ΔDEF_t to test whether the slope parameters change after a cut in the federal funds rate in November 2002. Our results indicate that the slope on *FedCut** $\Delta d_{m,t-1}$ is not statistically distinguishable from zero, suggesting that the 50 basis point reduction in the federal funds rate was not associated with a shift in the effect of the dividend yield variable. This result provides us with assurance that the structural shift in the slope parameter of dividend yield documented in Table 2 is unlikely to be due to the 25 basis-point reduction made by the FOMC in late June 2003. [5]

Controlling for Changing Business Conditions and the S&P 500 Stock Price Level

To control for changing business conditions and the effect of inflation on Treasury yields, we introduce the Chicago Fed National Activity Index (CFNAI) as an empirical proxy to check whether the main inference of this paper remains robust. The CFNAI is the successor to the economic index developed by Stock and Watson (1999) on inflation forecasting and is the first principal component of 85 economic indicators. The CFNAI thus provides a contemporaneous summary measure of the common factor in the national economic data and an indicator for changes in inflation pressures. The index value is set to zero if the economy is expanding at its historical trend rate of growth. A negative value in the index suggests below average growth and a positive value indicates above-average growth. Following the empirical practice of the Federal Reserve Bank of Chicago (2008), we report our results using the CFNAI-MA3, the three-month moving average of the CFNAI to track variations in the business conditions. The major inference of the dividend tax effect is unchanged under either the CFNAI-MA3 or the monthly measure of the CFNAI.

We also include the previous day's index level on the S&P 500 as an additional control variable, since the negative relationship between Treasury yields and dividend yields (D/P_{t-1}) could be mostly driven by the changes in the level of stock price at the time (P_{t-1}). This is because there may be a "flight-to-quality" effect in which Treasury price (yield) is high (low) when the stock market price is depressed and the market dividend yield is high. We thus include P_{t-1} in the regression equation to control for such an effect.

Table 4 reports the regression results for the main sample period from June 2002 to May 2004. The positive and significant relationship between average Treasury bill yield changes and the business condition variable CFNAI-MA3 suggests that as the economy grows above its historical trend-line, inflation pressure tends to rise and thus investors require higher yields from Treasury bills.

The inference with respect to the dividend tax effect remains unchanged. The coefficient on $\Delta d_{m,t-1}$ is -0.1284 (p<.0001). The coefficient on JGTRRA* $\Delta d_{m,t-1}$ is also positive and significant. The daily changes in the term spread, however, are no longer significant at the five percent level after including the CFNAI-MA3. Thus, it may be inferred that the explanatory power of $\Delta TERM_t$ in explaining changes in Treasury bill yields mainly comes from its ability to track the near-term variations in the business conditions as suggested by Fama and French (1989). The coefficient estimate for P_{t-1}, although negative, has a t-value of only -1.25. This suggests that changes in the daily dividend yield on the S&P 500 must contain information to marginal investors that is beyond what is already in the stock price. It also suggests that the stock price pressure by itself is inadequate in explaining changes in Treasury bill yields.

Controlling for Dividend Initiations and Special Dividends

Here we adjust our measure of dividend yield to test whether our results could be driven by dividend initiations and special dividend activity that increased significantly after the passage of JGTRRA in 2003 (e.g. Blouin et al.2004;Chetty and Saez 2005;and Brown et al. 2007). To exclude the effect of dividend initiation and special dividends, we assign a stock that is listed on the S&P 500 to a non-zero dividend yield portfolio if either of the following two criteria are met:[6]

1). A firm has four quarterly dividend declarations in the prior 12 months and no other distribution (excluding stock splits and stock dividends) that was declared in the prior 12 months

2). A firm has four quarterly ex-dividend dates in the prior 12 months and no other distribution (excluding stock splits and stock dividends) that went ex-dividend in the prior 12 months

We balance this new dividend portfolio daily and set a firm's dividend yield to zero following the announcement date if that firm meets either(1) or (2) but announces a distribution event (excluding stock splits and stock dividends) other than a regular quarterly taxable cash dividend (CRSP distribution code 1232) in the current month. The daily dividend yield ($d_{n,t-1}$) on this alternative portfolio is the average of the daily dividend yield of the stocks in the portfolio weighted by market capitalization. Other computation procedures are the same as $d_{m,t-1}$.

Table 5 reports the results using the alternative dividend yield measure. The estimate of the coefficient on $\Delta d_{n,t-1}$ is -0.1484, similar to that of $\Delta d_{m,t-1}$ and the 95 percent confidence intervals of the estimates on $\Delta d_{n,t-1}$ and $\Delta d_{m,t-1}$ overlap. Thus we cannot reject at the conventional significance level that the slope parameters of the two dividend yield measures are the same. To summarize, the major inference of this paper is unchanged by using the alternative dividend yield measure.

CONCLUSIONS

The effect of personal taxes on assets prices has been an important question for empirical tax research in accounting. In this paper, we offer a new analysis on the effect of dividend tax policy on Treasury bill yields. Novack (2005) investigated whether taxes on one form of investment (stocks) impact prices for a competing investment (Treasury bills). His results suggested that they do, at least in the short event window surrounding an exogenous change in the tax rates applicable to capital gains. We extend this line of inquiry and examine whether dividend taxation has a lasting impact on yields in the market for Treasury bills. Our tests provide strong evidence supporting our hypotheses that is robust to tests of alternative explanations.

Specifically, we find an inverse and economically significant relationship between changes in the daily Treasury bill yield and changes in the daily S&P 500 dividend yield prior to JGTRRA. This inverse relationship is consistent with the interpretation that dividend yield may serve as a proxy for the tax-disadvantaged part of stock price and that dividend taxation affects Treasury bill yields. Furthermore, the negative relationship between Treasury yields and dividend yields is significantly moderated following passage of the JGTRRA, which equalized the tax treatment of dividends and capital gains for individual investors.

We contribute to the literature by showing that an exogenous change in dividend taxation is associated with a change in the market equilibrium between Treasury yield and dividend yield. The 2003 dividend tax reduction is a historical opportunity to observe the effect on cost of capital from the differential taxation between dividends, capital gains and ordinary interest income. On a policy level, the differential tax treatment of income from different sources (dividend income, capital gains and ordinary interest income) may have impact on the cost of government borrowing.

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Table 1
Summary Statistics

Panel A.

Variables	Mean	Median	Std Dev	Min	Max
$\Delta Y_{i,t}$	-0.2137	-0.1292	2.035	-26.2556	16.5918
$\Delta R_{M,t}$	0.0056	-0.1284	1.937	-7.1287	8.4301
$\Delta TERM_t$	0.0180	0	4.7234	-21.0000	17.0000
ΔDEF_t	-0.1903	0	3.0932	-14.0000	14.0000
$\Delta d_{m,t-1}$	0.0503	-0.0099	2.5275	-11.2413	10.1523
$\Delta d_{n,t-1}$	0.0714	0.07426	2.9751	-13.7057	12.5585

Panel B.

	Pre-JGTRRA		Post-JGTRRA		Test of Difference in Means	
Variables	Mean	Std Dev	Mean	Std Dev	t-statistic	p-value
$\Delta R_{M,t}$	0.0208	2.4897	-0.009	1.1943	0.17	0.8643
$\Delta TERM_t$	-0.221	4.7167	0.2471	4.7278	-1.11	0.2686
ΔDEF_t	-0.053	3.45	-0.322	2.7087	0.97	0.3333
$\Delta d_{m,t-1}$	0.1377	3.1373	-0.033	1.7591	0.76	0.4506
$\Delta d_{n,t-1}$	0.2073	3.7239	-0.058	2.0133	1.00	0.3190

Table 1 reports summary statistics for the study. Sample period includes the first trading day in June 2002 to the last trading day in May 2004. There are 10,648 observations of $\Delta Y_{i,t}$, defined as the daily yield change for Treasury bill *i* on measurement day *t*, annualized and expressed in basis points. $\Delta R_{m,t}$ is the daily change in the S&P 500 value weighted return inclusive of dividends, in percentage points. $\Delta TERM_t$ and ΔDEF_t are the daily change in the term spread (*TERM*) and default spread (*DEF*), respectively, both in basis points. *TERM* is the spread between 10-year and one-year Treasury constant maturity rates. *DEF* is the constant-maturity spread between Moody's Baa corporate bond yield and 10-year Treasury bond yield. $\Delta d_{m,t-1}$ is the daily change of the value-weighted dividend yield on the S&P 500. $\Delta d_{n,t-1}$ is the daily change of the value-weighted dividend yield of firms on the S&P 500 having four quarterly cash dividends in the prior twelve months and is updated daily to exclude firms that have declared any distribution event other than a regular quarterly cash dividend, a stock split or a stock dividend. Both $\Delta d_{m,t-1}$ and $\Delta d_{n,t-1}$ are annualized and in basis points. Pre-JGTRRA if measured before May 23, 2003. Post-JGTRRA if measured on or after May 23, 2003.

Table 2

	Before JGTRRA	After JGTRRA	Pooled Sample	
Variables	(a)	(b)	(c)	(d)
Intercept	-0.3148*** (0.03253)	-0.1523*** (0.02346)	-0.3170*** (0.02852)	-0.3154*** (0.02853)
$\Delta R_{M,t}$	0.1005*** (0.02019)	0.07503*** (0.02535)	0.1109*** (0.01465)	0.1008*** (0.01819)
$\Delta d_{m,t-1}$	-0.1321*** (0.01526)	0.007119 (0.01727)	-0.1369*** (0.01215)	-0.1317*** (0.01365)
$\Delta TERM_t$	0.02284*** (0.007802)	0.000039 (0.005788)	0.009645** (0.004718)	0.02246*** (0.007021)
ΔDEF_t	-0.1771*** (0.01013)	-0.1644*** (0.01003)	-0.1712*** (0.007092)	-0.1769*** (0.009128)
JGTRRA			0.1603*** (0.03967)	0.1636*** (0.03975)
$JGTRRA * \Delta d_{m,t-1}$			0.1271*** (0.01697)	0.1341*** (0.02397)
$JGTRRA * \Delta R_{M,t}$				-0.01926 (0.03386)
$JGTRRA * \Delta TERM_t$				-0.02137** (0.009614)
$JGTRRA * \Delta DEF_t$				0.01458 (0.01455)
-2 Log Likelihood	22,460.8	21,382.3	44,155.1	44,143

In Table 2, the dependent variable $\Delta Y_{i,t}$ is the daily yield change for Treasury bill *i* on measurement day *t*, annualized and in basis points. $\Delta R_{m,t}$ is the daily change in the S&P 500 value weighted return inclusive of dividends, in percentage points. $\Delta TERM_t$ and ΔDEF_t are the daily change in the term spread and default spread respectively, both in basis points. Term spread is the difference between ten-year and one-year Treasury constant maturity rates. Default spread is the difference between constant-maturity Moody's Baa corporate bond yield and ten-year Treasury bond yield. $\Delta d_{m,t-1}$ is the daily change of the value-weighted dividend yield on the S&P 500, annualized and in basis points.JGTRRA=1 if measured on or after May 23, 2003 and zero otherwise. Column (a) based on 5,152 observations of $\Delta Y_{i,t}$ from the first trading day in June 2002 to May 22, 2003 and Column (b) based on 5,496 observations of $\Delta Y_{i,t}$ from May 23, 2003 to the last trading day in May 2004. ***/**/* indicates significance at the 1%, 5%, and 10% levels. Standard errors are in parentheses. Sample period is from the first trading day in June 2002 to the last trading day in May 2004

Table 3

	Generalized Least Squares		Ordinary Least Squares		
Variables	Estimate	*p* value	Estimate	*p* value	Variance-Inflation Factor
Intercept	-0.1601	0.0016	-0.16424	0.0003	0
$\Delta R_{M,t}$	0.05499	0.0101	0.05951	0.0059	3.00859
$\Delta d_{m,t-1}$	-0.1138	<.0001	-0.11614	<.0001	2.95593
$\Delta TERM_t$	-0.09188	<.0001	-0.09819	<.0001	2.64234
ΔDEF_t	-0.3167	<.0001	-0.31623	<.0001	2.43754
FedCut	-0.1621	0.0234	-0.14694	0.0281	1.07462
FedCut * $\Delta d_{m,t-1}$	0.01539	0.4703	0.01577	0.4637	1.46163
FedCut * $\Delta TERM_t$	0.2669	<.0001	0.28172	<.0001	2.80659
*FedCut** ΔDEF_t	0.2738	<.0001	0.28376	<.0001	2.57191
Sample size	4,352		4,352		
-2 Log Likelihood	18,884.7		Adj. R-square	19.11%	

Table 3 reports our sensitivity test on the federal funds cut in November 2002. The dummy variable "*FedCut*" is defined as 1 if measured after November 6, 2002 and 0 otherwise. The dependent variable is $\Delta Y_{i,t}$, the daily yield change for Treasury bill *i* on measurement day *t*, annualized and expressed in basis points. The sample period starts from the first trading day in June 2002 and ends on the last trading day in March 2003 and there are 4,352 observations of $\Delta Y_{i,t}$. $\Delta R_{m,t}$ is the daily change in the S&P 500 value weighted return inclusive of dividends, in percentage points. $\Delta TERM_t$ and ΔDEF_t are the daily change in the term spread (*TERM*) and default spread (*DEF*), respectively, both in basis points. *TERM* is the spread between 10-year and one-year Treasury constant maturity rates. *DEF* is the constant-maturity spread between Moody's Baa corporate bond yield and 10-year Treasury bond yield. $\Delta d_{m,t-1}$ is the daily change of the value-weighted dividend yield on the S&P 500, annualized and in basis points.

Table 4: Controlling for Macroeconomic Conditions

Variables	Estimate	p-value
Intercept	0.3721 (0.4268)	0.87
$\Delta R_{M,t}$	0.1127 (0.01478)	<.0001
$\Delta d_{m,t-1}$	-0.1284 (0.01508)	<.0001
$\Delta TERM_t$	0.009085 (0.004727)	0.0546
ΔDEF_t	-0.1718 (0.00709)	<.0001
JGTRRA	0.008468 (0.06951)	0.9030
$JGTRRA * \Delta d_{m,t-1}$	0.1169 (0.01843)	<.0001
CFNAI-MA3	0.4565 (0.0946)	<.0001
$CFNAI\text{-}MA3 * \Delta d_{m,t-1}$	0.03382 (0.02669)	0.2051
P_{t-1}	-0.00056 (0.000445)	0.2125
-2Log Likelihood	44,125.1	

The dependent variable is $\Delta Y_{i,t}$ defined as the daily yield change for Treasury bill *i* on measurement day *t*, annualized and in basis points. Sample period is from the first trading day in June 2002 to the last trading day in May 2004.There are 10,648 observations of $\Delta Y_{i,t}$; $\Delta R_{m,t}$ is the daily change in the S&P 500 value weighted return inclusive of dividends, in percentage points. $\Delta TERM_t$ and ΔDEF_t are the daily change in the term spread (*TERM*) and default spread (*DEF*), respectively, both in basis points. *TERM* is the spread between 10-year and one-year Treasury constant maturity rates. *DEF* is the constant-maturity spread between Moody's Baa corporate bond yield and 10-year Treasury bond yield. CFNAI-MA3 is the three-month moving average of the Chicago Fed National Activity Index. P_{t-1} is previous day's closing S&P 500 index level. $\Delta d_{m,t-1}$ is the daily change of the value-weighted dividend yield on the S&P 500, annualized and in basis points. JGTRRA=1 if measured on or after May 23, 2003 and zero otherwise. Standard errors are in parentheses.

Table 5: Controlling for Dividend Initiation and Special Dividends

	Panel A			Panel B		
Variables	**Estimate**	**95% Conf. Interval**		**Estimate**	**95% Conf. Interval**	
Intercept	-0.1574 (0.0418)	-0.2401	-0.0747	-0.1428 (0.0418)	-0.2255	-0.0600
$\Delta R_{M,t}$	0.1150 (0.0146)	0.0862	0.1438	0.1154 (0.0146)	0.0865	0.1442
$\Delta d_{m,t-1}$	**-0.1286 (0.0150)**	**-0.1581**	**-0.099**	----	----	----
$\Delta d_{n,t-1}$	----	----	----	**-0.1484 (0.0133)**	**-0.1747**	**-0.1222**
$\Delta TERM_t$	0.0095 (0.0047)	0.0003	0.0187	0.0101 (0.0047)	0.0009	0.0193
ΔDEF_t	-0.1714 (0.0070)	-0.1853	-0.1575	-0.1686 (0.0071)	-0.1826	-0.1547
JGTRRA	-0.0437 (0.0555)	-0.1526	0.0651	-0.05489 (0.0555)	-0.1639	0.0540
*JGTRRA** $\Delta d_{m,t-1}$	**0.1166 (0.0184)**	**0.0804**	**0.1527**	----	----	----
*JGTRRA** $\Delta d_{n,t-1}$	----	----	----	**0.1572 (0.0192)**	**0.1195**	**0.1950**
CFNAI-MA3	0.3814 (0.0730)	0.2383	0.5245	0.3883 (0.073)	0.2452	0.5315
*CFNAI-MA3** $\Delta d_{m,t-1}$	0.03364 (0.0266)	-0.0186	0.0859	----	----	----
*CFNAI-MA3** $\Delta d_{n,t-1}$	----	----	----	-0.0611 (0.0259)	-0.1120	-0.0102

Table 5 reports the results of Robustness Checks. Sample period is from the first trading day in June 2002 to the last trading day in May 2004. There are 10,648 observations of $\Delta Y_{i,t}$, defined as the daily yield change for Treasury bill*i* on measurement day *t*, annualized and in basis points. $\Delta R_{m,t}$ is the daily change in the S&P 500 value weighted return inclusive of dividends, in percentage points. $\Delta TERM_t$ and ΔDEF_t are the daily change in the term spread and default spread respectively, both in basis points. *TERM* is the difference between ten-year and one-year Treasury constant maturity rates. *DEF* is the difference between constant-maturity Moody's Baa corporate bond yield and ten-year Treasury bond yield. CFNAI-MA3 is the three-month moving average of the Chicago Fed National Activity Index. $\Delta d_{m,t-1}$ is the daily change of the value-weighted dividend yield on the S&P 500. $\Delta d_{n,t-1}$ is the daily change of the value-weighted dividend yield of firms on the S&P 500 having four quarterly cash dividends in the prior twelve months and is updated daily to exclude firms that have declared any distribution event other than a regular quarterly cash dividend, a stock split or a stock dividend. Both $\Delta d_{m,t-1}$ and $\Delta d_{n,t-1}$ are annualized and in basis points. JGTRRA=1 if measured on or after May 23, 2003 and zero otherwise; standard errors in parentheses.

Endnotes

[1]Internal Revenue Code Section 1271(a)(3)(A).

[2]Prior to 1986, Section 116 of the *Internal Revenue Code* allowed individuals to exclude up to $100 of dividends from gross income (and thus from taxable income). Dividends in excess of the exclusion amount, however, were taxed at the recipient's marginal ordinary tax rate.

[3] Each issue of Treasury bills of a given maturity forms one cluster and we use clustered standard error estimates to adjust for the correlation in the error terms for the same Treasury bill through time,[3] which are shown to be unbiased in the regression analysis using panel data sets by Petersen (2009).

[4]The New York Times was the first to report that the Bush Administration planned to reduce dividend tax by 50%

[5]It is also unlikely that the insignificance of the coefficient on $FedCut^{*}\,\Delta d_{m,t-1}$ is due to a lack of statistical power, as the coefficients on $FedCut^{*}\Delta TERM_t$ and $FedCut^{*}\Delta DEF_t$ are both significantly different from zero. Table 3 also shows the ordinary least squares estimates with variance inflation factors (VIF) on each estimate. The VIFs are all within the acceptable range and thus we may rule out that the insignificance of $FedCut^{*}\Delta d_{m,t-1}$ is due to multicollinearity.

[6] Both the quarterly dividend dates and ex-dividend dates are for regular taxable cash dividend (CRSP distribution code 1232).