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Capital Gains Taxes and Stock Return Volatility

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Abstract

We demonstrate that capital gains tax changes inversely affect stock return volatility. A capital gains tax cut reduces the risk sharing between investors and the government and increases stock return volatility. The tax effect on return volatility also differs depending upon the characteristics of stocks such as dividend distribution and embedded capital gains and losses. Using the Tax Relief Act of 1997, we empirically show that the return volatility of the market index and industry portfolios increases after the capital gains tax cut. Furthermore, non- or lower dividend-paying stocks experience larger increase in return volatility than higher dividend-paying stocks and stocks with large embedded capital losses see larger increases in return volatility than stocks with small embedded capital losses.

1. Introduction

This paper examines the effect of capital gains taxes on asset return volatility. Existing studies on the effects of capital gains taxes on asset prices have primarily focused on the level of asset returns and on trading volume. The goal of this study is to investigate the relation between asset return volatility and capital gains taxes. We demonstrate that imposing capital gains taxes reduces asset return volatility because the government shares the gains and losses in assets held by investors subject to taxation upon realization. Our analysis relies on the role of financial markets in facilitating risk sharing between investors and the government in the presence of capital gains taxes. A capital gains tax rate cut reduces risk sharing between investors and the government and has an adverse effect on individual investors' consumption smoothing. This leads to a more volatile individual consumption growth rate and stochastic discount factor, resulting in a higher asset return volatility. Using the Tax Relief Act of 1997, we uncover strong evidence that a capital gains tax rate cut significantly increases the volatility of asset returns and the magnitude of increases in return volatility differs depending upon the characteristics of assets such as dividend distribution and embedded capital losses and gains. To our knowledge, this is the first study of the relation between asset return volatility and the capital gains taxes.

There is an increasing literature about how capital gains taxes affect asset prices. Existing theoretical studies suggest that the effect of capital gains taxes on asset price is likely to be ambiguous because introducing capital gains taxes decreases both the demand and the supply of assets. Empirical investigations on the effect of capital gains taxes have produced conflicting results. Several studies (Lang and Shackelford (2000), Ayers, Lefanowicz, and Robinson (2003), among others) report that the presence of capital gains taxes reduced stock price and current stock return, while other studies document that imposing capital gains taxes increases stock price and current stock return (Feldstein, Slemrod, and Yitzhaki (1980), Reese (1998), Klein (2001), Jin (2005), among others). Further, Dhaliwal and Li (2006) investigate the relation between investor tax heterogeneity and ex-dividend day trading volume and document a concave relation between ex-dividend day trading volume and investor tax heterogeneity measured by institutional ownership. In a recent study, Dai, Maydew, Shackelford, and Zhang (2007) investigate the effect of capital gains taxes on asset price and trading volume by jointly considering the impact on demand and supply of assets. Using the Taxpayer Relief Act of 1997 as the event, they find that stock returns are higher in anticipation of a tax cut and stocks with large embedded capital gains and high tax sensitive investor ownership experience a lower return after the lower tax rate became effective. They also document that a capital gains tax cut increases the trading volume the week before and immediately after the tax cut announcement.

However, none of the existing studies has examined the relation between asset return volatility and capital gains taxes. Asset return volatility is one of the key determinants of investors' demand and supply of risky assets. If the presence of capital gains taxes affects asset return volatility, it will certainly impact investors' demand and supply of risky assets and ultimately influence asset returns. In this paper, we first discuss the relation between the capital gains taxes and asset return volatility focusing on the risk sharing role of the capital gains taxes between investors and the government. Based on our analysis, we develop hypotheses on the relation between the capital gains taxes and asset return volatility. We then empirically test the predictions using the Taxpayer Relief Act of 1997 as our event.

Overall, our analysis suggests the following testable implications when the capital gains tax rate is reduced.

- Return volatility is increased for the market index and industrial portfolios.
- Non- or lower dividend-paying stocks will experience higher volatility increase than higher dividend-paying stocks.
- Stocks with large embedded capital losses (gains) will have higher volatility increase than stocks with small embedded capital losses (gains).

The first prediction focuses on the effect of a capital gains tax rate cut on the return volatility of portfolios and the market index. Thus, it represents the effect of a capital gains tax rate cut on the volatility of the broad financial market. The next two predictions focus on the effect of a capital gains tax rate cut on individual stock return volatility and constitute the cross-sectional implications of a capital gains tax rate cut on stock return volatility.

Our predictions are closely related to the roles played by the financial markets. From investors' perspective, financial markets have two important functions: risk sharing and consumption smoothing. In addition to actively sharing risk with other market participants, in the presence of the capital gains taxes, investors also share the risk of holding risky stocks with the government (passively). This is clearly exemplified when the investors' asset holdings have depreciated in value. In this case, the investors' net losses are less than the decrease in the market value of the asset because a fraction of the loss is borne by the government in the form of reduced capital gains taxes or even tax rebate from the government. When the capital gains tax rate is cut, risk sharing between investors and the government is reduced. Investors thus experience more volatile consumption growth rates resulting in increased volatility for the stochastic discount factor. This then leads to an increase in stock return volatility.

Because the risk sharing role associated with the capital gains taxes varies with stocks with different characteristics, the impact of a capital gains tax change on stock return volatility also differs correspondingly. Specifically, the capital gains tax change matters to the extent that investors anticipate the capital gains tax rate change affecting future returns. For example, suppose investors receive all returns as dividends, then capital gains taxes are irrelevant and changes in the capital gains tax should have no impact on risk or return volatility. Conversely, if all future returns are expected to be taxed at the new capital gains tax rate, then we will expect the rate change to substantially increase risk and return volatility. In our tests, we assume that firms will maintain their current dividend policy. Thus, we predict that, *ceteris paribus*, non- and lower dividend-paying stocks are riskier and will experience larger increases in return volatility than higher dividend-paying stocks after the capital gains tax rate is reduced.

Similarly, stocks with large embedded capital gains and losses are likely to trigger larger capital gains and losses when investors sell than stocks with little or no appreciation or depreciation. Thus, we expect that stocks with large, embedded capital gains and loses become riskier when the capital gains tax rate is lower because there is less risk sharing with the government. Therefore, we predict that these stocks will experience higher volatility increases.

Our empirical analysis on stock return volatility surrounding the 1997 capital gains tax rate cut provides strong support for our predictions on the effect of the capital gains tax change on stock return volatility using data between January 1993 and December 2002. For the market portfolio, we find the volatility of monthly excess return of the value-weighted CRSP stocks is more than 3.4 percentage points higher when the capital gains tax rate for individual investors is reduced from 28 percent to 20 percent, after controlling for several variables which are widely documented to be important determinants of stock return volatility and the state of the economy. Consistent with the finding on realized market volatility, the monthly implied volatility for the Standard & Poors index options (VIX) is also increased by 2.8 percentage points after the capital gains tax cut, controlling for the same set of variables. For our entire sample period, the average monthly volatility is 4.3 percent for the excess returns of the value-weighted CRSP stocks and 5.9 percent for the implied volatility for the Standard and Poors index options. Further, for five industry portfolios formed based on 4-digit SIC code including consumer industry, manufacturing industry, high tech industry, healthcare industry, and other industries, the monthly return volatility is higher for all five portfolios when the capital gains tax rate is reduced, controlling for variables often identified to be important factors affecting return volatility. The increase in monthly return volatility ranges from 2.2 percentage points for the healthcare industry to 4.6 percentage points for the high tech industry. In the meantime, the average monthly return volatility for the time period is 5.2 percent for the healthcare industry and 6.9 percent for the high tech industry. In addition, the increase in return volatility for all five industries is statistically significant.

For the cross-sectional implications of a capital gains tax cut on stock returns, we construct portfolios based on a firm's dividend distribution and embedded capital gains or losses. We find that non-dividend paying stocks experience higher volatility increase than dividend-paying stocks, consistent with the prediction of our analysis. Specifically, non-dividend paying stocks experience 1.7 percentage points higher monthly return volatility than dividend-paying stocks, on average, after controlling for variables widely documented to be important determinants of stock return volatility, the state of the economy, and variables specific to the portfolios such as the debt-asset ratio, turnover, percentage bid-ask spread, and the growth option. Further, we find that stocks with large embedded capital losses (with losses in the upper 25 percentile) experience 3.3 percentage points higher monthly return volatility increase than stocks with small embedded capital losses (with losses in the lower 25 percentile). For stocks with embedded capital gains, we find that the monthly return volatility increase is 1.4 percentage points higher for stocks with large embedded gains (with gains in the upper 25 percentile) than for stocks with small embedded gains (with gains in the lower 25 percentile).

It is worth noting that the stock return volatility increase associated with a capital gains tax cut does not necessarily imply that investors are worse off when the capital gains tax rate is lower. This is because a capital gains tax cut may increase the after-tax stock return. Consequently, investors may experience the same or improved return and risk trade-off and thus face the same or better investment opportunities.

The paper is organized as follows. In section 2, we discuss the mechanism that the capital gains taxes affect stock return volatility and develop hypotheses on the effects of a capital gains tax cut on return volatility both for market index and industry portfolios and the cross-section of individual stocks. Section 3 presents empirical methodology to test the predictions of our analysis. Section 4 discusses the results of the empirical analysis. Conclusion remarks are provided in Section 5.

2. Capital Gains Taxes and Stock Return Volatility

Financial markets and the financial assets traded in those markets serve two important roles for investors: consumption smoothing and risk sharing. Some individuals earn more than they currently wish to spend, while others spend more than they currently earn. Trading in financial assets allows these individuals to shift their purchasing power from high-earnings periods to low-earnings periods of life by buying financial assets in high-earning periods and selling these assets to fund their consumption needs in low-earning periods. Financial markets and the financial assets also allow investors to allocate risks among themselves so that risk in their portfolio is commensurate with the return to the portfolio, i.e., investors with high risk tolerance hold riskier assets such as stocks and those with low risk tolerance hold more less risky assets such as money market instruments. In an economy without government taxation, consumption smoothing and risk sharing are achieved among market participants through trading of financial assets on financial markets.

In the presence of taxation, the government, however, plays an important role in influencing the consumption smoothing and risk sharing among market participants. Capital gains taxes in particular have a large impact on consumption smoothing and risk sharing of investors participating in the financial markets and financial asset trading. In the United States, capital gains taxes are levied upon selling an asset based on the appreciation or depreciation on the asset. Specifically, in the case of common stocks, if a stock has appreciated in value, the investor pays capital gains taxes on the appreciation upon selling. On the other hand, if the stock has depreciated in value upon selling, the investor can use the realized losses to offset realized gains on other assets. If the realized losses exceed the realized gains, the losses can be used to reduce the taxable ordinary income up to a limit with the remaining losses carried forward to offset future gains and ordinary income.[1] The tax treatment of the gains and losses on stocks thus offers a risk sharing mechanism between investors and the government. Consequently, the capital gains taxes will affect the consumption smoothing of stock market participants.

The risk sharing between investors and the government associated with the capital gains taxes will ultimately affect the stock return volatility. Under no arbitrage condition, Harrison and Kreps (1979) demonstrate that there exist stochastic discount factors that can be used to price the stochastic payoffs associated with any assets. Subsequently studies have suggested that the stochastic discount factors (or pricing kernels) can take different specifications depending upon investors' preferences, consumption profiles, and various forms of market frictions, among others. In particular, recent studies suggest that the consumption growth rate of stock market participants is an important determinant of

[1] Individuals, the only investors affected by the reduction in the capital gains tax rate studied in this paper, face no limit on the amount of capital losses that they can use to offset capital gains. If capital losses remain after offsetting all capital gains, then individuals can apply up to $3,000 of capital losses against ordinary income. In practice, this constraint is rarely binding (Poterba [1987] and Auerbach, Burman and Siegel [2000]). The Internal Revenue Service [1999a, 1999b] reports that in the year of the capital gains rate reduction (1997), individuals in the maximum tax bracket (39.6 percent), who accounted for 61 percent of all net capital gains, reported $169 billion of long-term capital gains and only $5 billion of long-term capital losses and $16 billion of short-term capital gains and only $8 billion of short-term capital losses. In short, individual investors had far more capital gains than they had capital losses to offset them. Thus, for our purposes, it is reasonable to assume that realized capital losses can be used to offset realized capital gains.

stochastic discount factors (Mankiw and Zeldes, 1991, Jacobs, 1999, and Brav, Constantinides, and Geczy, 2002, among others). In general, these studies document that the stochastic discount factor using the more volatile consumption growth rates for stockholders explains the volatile stock returns better than the aggregate consumption growth rate. This suggests a positive relation between the volatility of the consumption growth rate and the stock return volatility. Because the capital gains taxes affect the risk sharing between investors and the government and the consumption smoothing of stock market participants, the change in the capital gains taxes will impact the volatility of the consumption growth rates of these investors and consequently the stock return volatility.

To facilitate the development of our hypotheses on the relation between the capital gains taxes and stock return volatility, we focus on some extreme cases and then offer insights on general situations. We start with the effect of the capital gains taxes on the broad financial market and then discuss the cross-sectional implications of a change in the capital gains taxes on individual stock return volatility. Our discussions above suggest that the government serves as a partner in sharing the return of stock investments with the taxable investor partner in the presence of the capital gains taxes. Suppose the capital gains tax rate is close to 100 percent. The government "partner" thus gets almost all the returns of investments made by taxable investors. Consequently, it bears almost all the risk while the risk borne by taxable investors is negligible. On the other hand, suppose that the capital gains tax rate is 0. Then the taxable investor "partner" receives all the returns and bears all the risk. In reality, the capital gains tax rate is typically positive but well below 100 percent. When the capital gains tax rate increases, the government "partner" receives a larger fraction of the return and bears more risk. The taxable investor "partner" receives a lower fraction of the return and bears less risk. When the capital gains tax rate is reduced, however, the government "partner" gets a smaller fraction of the return and bears less risk while the taxable investor "partner" receives a larger fraction of the return and bears more risk. Because capital gains taxes apply to all stocks, in the case of a capital gains tax cut, taxable investors will receive a larger fraction of returns on all stocks and bears more risk on all the stocks, leading to a more volatile consumption growth rates for these investors. As a result, we have the following hypothesis on the relation between the capital gains taxes and the return volatility for the broad stock market.

H1: *A capital gains tax cut will lead to a higher return volatility for the market index and industry portfolios*.

Because different stocks have different tax liabilities, a capital gains tax rate change will have different impact on risk sharing between investors and the government. For example, firms with different dividend payouts will likely have different impact on the risk sharing between taxable investors and the government in the case of a capital gains tax cut. Imagine that taxable investors receive all returns from a firm as dividends. In this case, no income received is subject to capital gains taxes. Consequently, the government bears no risk related to capital gains or losses and the capital gains taxes will have little direct effect on the volatility of the stock return. On the other hand, if the taxable investors receive no dividends and the entire return is in the form of capital gains, all income will be subject to capital gains taxes and the government bears the maximum risk associated with the capital gains. In this case, a capital gains tax change will have a large effect on the risk sharing between the taxable investors and the government and the consumption growth rate of the taxable investors. Consequently, it will have a large impact on the stock return volatility. In general, the greater the percentage of profits taxed as capital gains, the more that a reduction in the capital gains tax rate reduces the amount that the government shares in the risk and increases the individual stock return volatility. This leads to the following hypothesis on the relation between the individual stock return volatility and the dividend payouts of these firms.

H2: *A capital gains tax cut will increase the return volatility of non- or lower dividend-paying stocks more than that of higher dividend-paying stocks.*

In addition, firms with different embedded capital gains or losses also will have different effects on the risk sharing between taxable investors and the government in the case of a capital gains tax cut. Suppose that the sale proceeds of a taxable investor in a stock are equal to the taxable investor's tax basis (the cost of purchasing the stock). The investor would have no income subject to capital gains taxes upon realization because the gain or loss is zero. The government also bears no risk. However, if the investor's sale proceeds are equal to the gains (the cost of purchasing the stock is almost zero relative to the sale proceeds) or the investor's sale proceeds are almost zero (the loss is equal to the cost of purchasing the stock), all income are subject to the capital gains taxes or all losses can be used to reduce tax liabilities (first realized capital gains and then ordinary income). In this case, the government bears the maximum risk. A capital gains tax change will have a large impact on the risk sharing and consumption smoothing of the taxable investors on these stocks. Thus, the effect of a capital gains tax change will have a large impact on the return volatility of these stocks. We therefore have the following hypothesis on the relation between stock return volatility and embedded capital gains or losses in the case of a capital gains tax rate cut.

H3: *A capital gains tax cut will increase stock return volatility of firms with large embedded capital losses (gains) more than that of firms with small embedded capital losses (gains).*

In the next section, we discuss empirical methodology to test three hypotheses discussed above.

3. Empirical Methodology

To empirically test the effect on stock return volatility of a change in the capital gains tax rate, we use the Taxpayer Relief Act of 1997 (TRA97) as our event. The TRA97 lowered the top tax rate on capital gains for individual investors from 28 percent to 20 percent for assets held more than 18 months. TRA97 is particularly attractive for an event study because the capital gains tax cut was large and relatively unexpected, and the bill included few other changes that might confound our analysis. Often U.S. tax legislation follows a protracted process with gradual changes in the probability of a particular bill becoming a law. In TRA97, however, Congress provided researchers with an attractive setting by coming to rapid agreement on a large, relatively unexpected reduction in capital gains tax rates. For the Taxpayer Relief Act of 1997 (TRA97), little information was released until Wednesday, April 30, 1997, when the Congressional Budget Office (CBO) surprisingly announced that the estimate of the 1997 deficit had been reduced by $45 billion. Two days later on May 2, the President and Congressional leaders announced an agreement to balance the budget by 2002 and, among other things, reduce the capital gains tax rate. These announcements greatly increased the probability of a capital gains tax cut. On Wednesday, May 7, 1997, Senate Finance Chairman William Roth and House Ways and Means Chairman William Archer jointly announced that the effective date on any reduction in the capital gains tax rate would be May 7, 1997.

The empirical implications we derived above apply not only to the broad financial market, they also apply to the cross-section of stocks with certain characteristics. In our empirical analysis, we first examine return volatility at market level using the value-weighted market index and the implied volatility of Standard & Poors index options (VIX), we then move down to industry level using five industry portfolios (consumer, manufacturing, high tech, health, and others), classified based on 4-digit SIC code, and finally we examine return volatility of stock portfolios constructed based on a firm's dividend distribution in the prior year and embedded capital gains (losses) in the past 18 months.[2] Specifically, to test the hypothesis on the effect of a capital gains tax cut on the return volatility of non- or lower dividend-paying stocks relative to the dividend and high dividend-paying stocks, we construct the non-dividend paying portfolio and the dividend-paying portfolio based on a firm's dividend distribution in the prior year. For the dividend-paying portfolio, we further form low dividend yield portfolio and high dividend yield portfolio using the median dividend yield at each month as a threshold. To mitigate the confounding effect on return volatility associated with capital gains tax cut on stocks with large price changes, on this hypothesis test we restrict our attention to stocks with share price changes (either positive or negative) to be less than 5 percent in the past 18 months from the current month. Next, to test the hypothesis on the effect of a capital gains tax cut on the return volatility of firms with large embedded capital gains or losses versus small embedded gains or losses, we form four quartile (25 percentile) portfolios for non-dividend paying stocks with price appreciation (positive price change) in the past 18 months, called gains portfolios, and four quartile portfolios for non-dividend paying stocks with price depreciation (negative price change) in the past 18 months, called losses portfolios We choose to focus on non-dividend paying stocks to mitigate the confounding effect on stock return volatility from a firm's dividend

[2] We use 18-month price changes to form our portfolios because TRA97 established 18 months as the minimum holding period for investors to apply the lower long-term capital gains tax rate. In our sensitivity tests, we have also used 12- and 24-month price changes in our analysis.

distribution. At each level, we use daily returns to construct monthly volatility measure. The sampling period used in our empirical analysis spans from January 1993 to December 2002. To avoid the transient effect caused by the capital gains tax cut announcement, we exclude April and May of 1997 from our analysis.[3]

Let r_{itj} be the excess return relative to the risk free rate on stock (or industry) portfolio *i* on day *j* in month *t* and σ_{it} be stock (or industry) portfolio *i*'s return volatility in month *t*. We construct the monthly stock (or industry) portfolio return volatility for each portfolio-month as follows

$$\sigma_{it} = \sqrt{\sum_{j=1}^{J_t} (r_{itj} - \bar{r}_{it})^2}\,, \tag{1}$$

where $\bar{r}_{it} = \frac{1}{J_t} \sum_{j=1}^{J_t} r_{itj}$ is the sample mean excess return for stock (or industry) portfolio *i* in month *t*, J_t is the number of observations in month *t*. For the market index, we construct the monthly market return volatility for each month *t*, σ_t, as follows

$$\sigma_t = \sqrt{\sum_{j=1}^{J_t} (r_{tj} - \bar{r}_t)^2 + 2\sum_{j=1}^{J_t - 1} (r_{tj} - \bar{r}_t)(r_{t(j+1)} - \bar{r}_t)}\,, \tag{2}$$

where r_{tj} is the market excess return on day *j* of month *t* and $\bar{r}_t = \frac{1}{J_t} \sum_{j=1}^{J_t} r_{tj}$ is the sample mean excess return for the market index in month *t*. Note that the market return volatility thus defined (including the extra cross-product terms in the expression) adjusts for the first-order autocorrelation in daily returns associated with nonsynchronous trading among stocks included in the index.[4] In addition, we also use the implied volatility for the Standard & Poors index options (VIX) at month *t* as an alternative measure for the volatility of the market portfolio.

The research design we use to test our hypotheses on the change in stock return volatility in response to the capital gains tax cut is to define a dummy variable $Post_t$ which takes value 0 on and before 3/31/1997 and value 1 on and after 6/1/1997. Note that

[3] We have also performed our analysis by excluding June, July, and August in addition to April and May to account for the actual signing of the tax cut bill. The results are qualitatively similar.

[4] Similar measures are used in French, Schwert and Stambaugh (1987) and Guo and Whitelaw (2006), among others.

this is different from standard event study on stock returns which focuses on announcement effect. We actually take out those event months from our examination because we are interested in the change of volatility level before and after the event. Another important difference between stock return and the volatility of stock return is that the latter has significant persistence which may cause problems in the statistical inference if not appropriately accounted for. To allow for the serial correlation in stock return volatility, we use lagged demeaned volatility as explanatory variable in our analysis.

Specifically, the specification we use for market index and the implied volatility index for the Standard & Poors index options (VIX) is:

$$\sigma_t = \alpha + \beta Post_t + \sum_{j=1}^{p} \rho_j \Delta\sigma_{(t-j)} + \sum_{j=1}^{q} \delta_j \bar{r}_{t-j} + \gamma' X_t + \varepsilon_t, \tag{3}$$

where $\Delta\sigma_t = \sigma_t - \frac{1}{T}\sum_{k=1}^{T}\sigma_k$ is the demeaned volatility measure for the market index (or the implied volatility index), subscript *j* refers to its lags, and subscript *k* refers to the months. Existing empirical asset pricing studies suggest that large negative stock price changes tend to be followed by periods of high stock return volatility. In other words, stock return volatility is asymmetric in stock return performance. This is sometimes referred to as the leverage effect. To account for this effect, we allow stock return volatility to depend on lagged stock returns ($\bar{r}_{t-j}$). Finally, X_t refers to a vector of aggregate control variables. In our regression analysis the aggregate control variables include the consumption-wealth ratio (*CAY*), the stochastically detrended risk free rate (*RREL*), and the industrial production growth rate (*GIP*). Based on the capital asset pricing theory, Lettau and Ludvigson (2001) propose that the consumption-wealth ratio be used as a determinant for stock returns. They further demonstrate that the *CAY* variable is a better predictor than the dividend yield, the term premium, the default premium, and other previously widely used predictors combined. Campbell and Shiller (1988) document that the stochastically detrended risk free rate is an important predictor for stock returns. We also include the growth rate of the industrial production to account for the state of the economic activities.

For each industry portfolios *i*, we use the following specification:

$$\sigma_{it} = \alpha + \beta Post_t + \sum_{j=1}^{p} \rho_j \Delta\sigma_{(t-j)} + \sum_{j=1}^{q} \delta_j \bar{r}_{(t-j)} + \sum_{j=1}^{m} \theta_j \Delta\sigma_{i(t-j)} + \sum_{j=1}^{n} \eta_j \bar{r}_{i(t-j)} + \gamma' X_t + \varepsilon_{it}. \quad (4)$$

Note that, in addition to the explanatory variables included in the specification for the market index and the implied volatility of index options, we have also included lagged demeaned industry portfolio volatility ($\Delta\sigma_{i(t-j)}$) and lagged industry portfolio returns ($\bar{r}_{i(t-j)}$) to account for volatility persistence and leverage effect at industry level.

For both the market index and industry portfolios, our discussions suggest that the return volatility will be higher after the capital gains tax rate is cut. This implies that the estimated coefficient for *Post* is positive, i.e., $\beta > 0$.

For portfolios constructed based on a firm's dividend distribution and embedded capital gains or losses, we consider the following model on the monthly return volatility of portfolio *i*:

$$\begin{aligned}\sigma_{it} = \alpha + \beta Post_t + \sum_{j=1}^{p} \rho_j \Delta\sigma_{(t-j)} + \sum_{j=1}^{q} \delta_j \bar{r}_{(t-j)} + \sum_{j=1}^{m} \theta_j \Delta\sigma_{i(t-j)} + \sum_{j=1}^{n} \eta_j \bar{r}_{i(t-j)} \\ + \gamma' X_t + \varphi' Z_{it} + \varepsilon_{it}.\end{aligned} \quad (5)$$

Similar to the specification for the industry portfolios, we include lagged demeaned portfolio volatility and lagged portfolio returns to account for possible return persistence and leverage effect at portfolio level, in addition to all the control variables we use in the equation for the return volatility of the market index. We have also included a vector of Z_{it} which consists of portfolio-specific characteristics as of time *t*. These portfolio specific control variables include the value weighted averages of firms' debt-asset ratios, turnover, percentage bid-ask spread, and proxy for firm's growth potential.

On the return volatility of stock portfolios constructed above, our discussions suggest that portfolios of non- or lower dividend-paying stocks and portfolios with large embedded capital gains or losses will likely experience increased return volatility after the capital gains tax cut. For these portfolios, the estimated coefficient for the dummy variable *Post* will likely be positive, i.e., $\beta > 0$. However, for portfolios of high dividend-paying stocks or portfolios of stocks with small embedded gains or losses, a capital gains tax cut may have a negligible effect on the return volatility of these portfolios. The estimated coefficient for the dummy variable *Post* on these portfolios may be insignificant.

To test the cross-sectional implications stated in hypotheses 2 and 3, we need to compare the return volatility increases for different portfolios. For ease of exposition, we introduce the following notations. Denote by subscript "*b*" the benchmark portfolio and subscript "*h*" an alternative portfolio with possibly larger return volatility increase under the hypothesis. Let "*HVP*" (or High Volatility Portfolio) be a dummy variable which takes value of zero if an observation belongs to the benchmark portfolio and one otherwise, "*BP*" be a dummy variable representing the benchmark portfolio so that "*BP = 1-HVP*." We also expand the variables used in the regression analysis for a single portfolio case by stacking the observations for the two portfolios with the observations for the benchmark portfolio on the bottom. For example, we have now $\sigma = [\sigma_h' \ \ \sigma_b']'$ representing the expanded return volatility (the dependent variable) for two portfolios, and $Z = [Z_h' \ Z_b']'$ representing the portfolio specific control variables for two portfolios. We use the following model to test hypotheses 2 and 3 stated in the previous section:

$$
\begin{aligned}
\sigma = {} & \alpha + \beta_1 Post + \beta_2 HVP + \beta_3 Post \times HVP \\
& + \sum_{j=1}^{p} \rho_{hj} HVP \times \Delta\sigma + \sum_{j=1}^{q} \delta_{hj} HVP \times \bar{r} + \sum_{j=1}^{m} \theta_{hj} HVP \times \Delta\sigma_i + \sum_{j=1}^{n} \eta_{hj} HVP \times \bar{r}_i \\
& + \sum_{j=1}^{p} \rho_{bj} BP \times \Delta\sigma + \sum_{j=1}^{q} \delta_{bj} BP \times \bar{r} + \sum_{j=1}^{m} \theta_{bj} BP \times \Delta\sigma_i + \sum_{j=1}^{n} \eta_{bj} BP \times \bar{r}_i \\
& + \gamma_h' HVP \times X + \varphi_h' HVP \times Z_i + \gamma_b' BP \times X + \varphi_b' BP \times Z_i + \varepsilon.
\end{aligned} \tag{6}
$$

This specification allows us to test hypotheses 2 and 3 by examining the coefficient estimate for the interaction term $Post \times HVP$. For hypothesis 2, if we choose the dividend-paying portfolio as the benchmark portfolio and the non-dividend paying portfolio as the alternative portfolio, under the null hypothesis, the non-dividend paying portfolio will experience a larger increase in return volatility than the dividend-paying portfolio. This implies that the interaction term $Post \times HVP$ will have a positive coefficient because *HVP* takes a value of one for the non-dividend paying portfolio and a positive coefficient indicates a higher volatility for the *HVP* portfolio. Consequently, testing the hypothesis 2 is equivalent to testing if $\beta_3 > 0$. Similarly, for hypothesis 3, we can choose the portfolio with the lowest embedded gains (or losses) as the benchmark portfolio and the portfolio with the highest embedded gains (or losses) as the alternative portfolio. Under the null hypothesis that stocks with large embedded gains (losses) experience larger return volatility increase than stocks with small embedded gains (or losses), the coefficient estimate for $Post \times HVP$ will be positive, i.e., $\beta_3 > 0$.

In a recent paper on stock return volatility, Campbell, Lettau, Malkiel, and Xu (2001) document that over the period from 1962 to 1997 there has been a noticeable increase in firm idiosyncratic volatility relative to market volatility.[5] They suggest several factors as possible explanations. These factors include changing discount rates, a shift towards reliance on external as opposed to internal capital markets, firms' growth potentials, changes in executive compensation, firms' leverage position, and the increased share of institutional ownership. Cohen, Hall, and Viceira (2000) find the changes in executive compensation have statistically significant effect on the risks of their firms' activities. But the effect is small in magnitude. Dai, Maydew, Shackelford, and Zhang (2006) find that turnover has a significant effect on stock returns. Xu and Malkiel (2003) and Cao, Simins, and Zhao (2006) document that firms' growth options have significant effect on idiosyncratic risk of equity. Further, between June 1997 and August 1997, both the New York Stock Exchange and the Nasdaq reduced the tick size for stock trading. To capture these effects, we include the value-weighted firm's debt-asset ratio (*D/A*), turnover in the most recent past month (*Turnover*), the average monthly bid-ask spread in the most recent past month (*BidAskSpread*), and analysts' forecasted firm's operating income growth rate (*GrowthOption*) in the regression analysis for each constructed portfolio. For all specifications (equations (3) to (6)), we also include year dummies to control for possible trend and monthly dummies to account for calendar effect.

Finally, recall that the 1997 capital gains tax rate reduction only applies to individual investors. It follows that companies owned solely by individuals should have experienced an increase in stock return volatility while companies owned solely by other stockholders (e.g., pensions) should not have been affected by the legislation. Specifically, the capital gains tax rate change should only affect stock return volatility if the marginal investor is an individual. Since the marginal investor is unobservable, we

[5] Similar results are also documented in Pastor and Veronesi (2006) for the more recent periods until 2002.

test whether return volatility is increasing in individual stock ownership. Specifically, we divide the non-dividend paying and dividend paying portfolios, according to the median detrended individual ownership in each month, to form four portfolios: non-dividend paying low individual ownership portfolio, non-dividend paying high individual ownership portfolio, dividend-paying low individual ownership portfolio, and dividend-paying high individual ownership portfolio. We then apply regression analysis to the four portfolios as we do for all other constructed portfolios.

Unfortunately our measure of tax-sensitive investors using individual stock ownership is flawed. First, the returns on many institutional holdings are subject to the individual income tax (e.g., street name holdings by brokerage houses on behalf of individual investors). Thus, we measure tax-sensitive investors with measurement errors. Second, Gompers and Metrick (2001) and Xu and Malkiel (2003) document that institutional ownership increases idiosyncratic volatility. Since they find a positive correlation between institutional ownership and volatility and we predict a negative relation, our tests are biased against rejecting the null. (Note that the null is that there is no relation between institutional ownership and volatility, while we predict that volatility will rise with the number of investors in the firm affected by the legislation). Thus, if we reject the null hypothesis, this will provide strong evidence that the 1997 rate reduction increased volativity. Conversely, we may fail to reject the null because our tests lack sufficient power to discriminate between the extant finding and our prediction.

4. Empirical Analysis

4.1. Sample and Summary Statistics

To empirically test the effect of TRA97 on stock return volatility, we use all stocks included in the CRSP data base. The excess return on the market index is constructed as the market return of the value-weighted portfolio of stocks included in the CRSP data base after the risk free rate is subtracted. The monthly implied volatility index for the Standard & Poors index options (VIX) is the average implied annualized volatility for different call and put options on the index with expiration date in a month. The five industry portfolios are formed using the 4-digit SIC code and consist of (1) consumer industry (consumer durables, non-durables, wholesale, retail, and some services such as laundries, repair shops), (2) manufacturing industry (manufacturing, energy, and utilities), (3) high tech industry (business equipment, telephone and television transmission), (4) health care industry (healthcare, medical equipment, and drugs), and (5) other industries (mines, construction, building materials, transportation, hotels, business services, entertainment, finance).[6] We construct monthly excess returns and volatility for non-dividend paying and dividend-paying portfolios, low dividend yield and high dividend yield portfolios, quartile gains portfolios, and quartile losses portfolios as discussed in the previous section. These are value-weighted portfolios using daily individual stock return data.[7] We use the sample from January 1993 to December 2002 for our empirical analysis. We choose the sample period based on two considerations. First, we want to avoid the confounding effects from the tax policy changes both prior and after the TRA97. Second, we want to choose the sample period so that we have about the same observations before and after the announcement. In other words, the event months fall in the middle of our sample period.

For the aggregate control variables, we obtain the consumption-wealth ratio (*CAY*) from Martin Lettau's website. Since the consumption-wealth ratio is at quarterly frequency, we use linear interpolation to obtain monthly observations. The stochastically detrended risk free rate is constructed by removing the average risk free rate in the prior twelve months from the risk free rate in month *t* as in Campbell and Shiller (1988). The growth rate of the industrial production is calculated using the monthly industrial production index obtained from the Federal Reserve Bank of St. Louis.

We obtain daily individual stock return data from the daily CRSP data base. Dividend and stock price are extracted from the monthly CRSP data base. We compute a firm's dividend yield based on dividend distribution in the prior year and the stock price in the most recent month. We construct the embedded capital gains and losses using a firm's most recent 18 month stock price change prior to month *t*. We perform robustness check using the past 12 month and 24 month price changes to calculate the measure of

[6] The excess return on the value-weighted market index and returns on industry portfolios are obtained from Kenneth French's website.

[7] To remove the influence from extreme values, we winsorize observations at the bottom and the top 5 percent for each portfolio.

the embedded capital gains and losses (results are qualitatively unaltered). To obtain measures of investor ownership, we use institutional investors' ownership information from Form 13F submitted to the Security Exchanges Commission by investment management companies.[8] We compute the individual investor ownership on stock *i* at time *t* (IND_{it}) as follows:

IND_{it} = 1 – Percentage of shares owned by institutional investors at time *t*.

We compute a firm's debt-asset ratio using data from the COMPUSTAT data base. Because the COMPUSTAT data base is only available at quarterly frequency, we assume that a firm's debt-asset ratio remains the same within the quarter. Monthly individual stock turnover is constructed by dividing the monthly trading volume by the shares outstanding at the end of the month. The average monthly percentage bid-ask spread for individual stocks is constructed using the transaction level Trade And Quote (TAQ) data base.[9] For the measure on firms' growth potentials, we use the forecasted operating income growth rate on individual firms obtained from the IBES database as a proxy. For each portfolio, we compute the monthly value weighted averages of firms' debt-asset ratios, turnover, percentage bid-ask spreads, and analysts' forecasted long-term operating income growth rates.

Table 1 presents the summary statistics for the market and industry portfolios and economy-wide control variables used in our regression analysis in Panel A and the univariate tests of mean return volatility changes for the market and industry portfolios in Panel B. Variable definitions are provided at the bottom of the table. The dataset consists of 120 monthly time series observations from January 1993 to December 2002. The average daily excess return for the value-weighted market portfolio is 0.019 percent with a standard deviation of 0.22 percent. The monthly volatility of the market excess return has a mean of 4.3 percent with a standard deviation of 2.3 percent. The monthly implied volatility has a mean of 5.9 percent with a standard deviation of 2.0 percent.[10] The industry portfolios have average daily return ranging from 0.032 percent for the manufacturing to 0.053 percent for the healthcare. The manufacturing industry has the

[8] We thank Rabih Mousssawei for providing us the institutional stock ownership data.
[9] We thank Kam-Ming Wan for providing us the monthly bid-ask spread data on individual stocks.
[10] Because the raw VIX data are for annual return volatility of the Standard & Poors index, we scale the VIX by the square root of 12 to obtain monthly return volatility measure.

lowest standard deviation of 0.19 percent and the high tech industry has the highest standard deviation of 0.40 percent. Consistent with the daily statistics and our intuition, the monthly return volatility is the lowest for the manufacturing industry with an average of 3.5 percent and a standard deviation of 1.7 percent, and is the highest for the high tech industry with an average of 6.9 percent and a standard deviation of 3.8 percent. The *CAY* variable has an average of 0.033 percent and a standard deviation of 2.1 percent. The stochastically detrended risk free rate has a monthly average of -0.008 percent and a standard deviation of 0.071 percent. Over the sample period, the industrial production grew at 0.28 percent per month on average with a standard deviation of 0.53 percent.

The univariate test results in Panel B suggest that both the market and industry portfolios have experienced significant return volatility increase. Specifically, the monthly average of return volatility for the market portfolio increases from 2.7 percent before the capital gains tax rate cut to 5.5 percent after the capital gains tax rate cut. Similarly, the implied volatility also increases from 4.2 percent to 7.3 percent. For industry portfolios, the monthly average of return volatility increases the least for manufacturing industry from 2.2 percent to 4.4 percent and the most for the high technology industry from 3.9 percent to 9.1 percent.

Table 2 reports the summary statistics for the constructed portfolios based on a firm's dividend distribution and the embedded capital gains (losses) in the past 18 months. Panel A presents the summary statistics for the non-dividend paying, dividend-paying, low dividend yield and high dividend yield portfolios. To focus on dividend-paying dimension, we restrict to those stocks with price changes less than 5 percent in the past 18 months. The non-dividend paying portfolio has an average daily return of 0.010 percent with a standard deviation of 0.30 percent. The dividend-paying portfolio has a mean daily return of 0.031 percent with standard deviation of 0.17 percent. Consistent with results on the non-dividend and dividend paying portfolios, the low dividend yield portfolio has a lower mean return of 0.024 percent with standard deviation of 0.20 percent while the high dividend yield portfolio has a higher mean return of 0.037 percent with standard deviation of 0.18 percent. The monthly return volatility for the non-dividend paying portfolio has a mean of 5.9 percent with a standard deviation of 2.5 percent. Both statistics are much higher than that for the dividend-paying portfolio which has a mean of 3.5 percent with a standard deviation of 1.4 percent. The low dividend yield portfolio has a mean return volatility of 4.1 with a standard deviation of 1.5 percent while the corresponding statistics are lower at 3.5 percent and 1.3 percent for the high dividend yield portfolio, respectively.

Panels B and C present summary statistics for the gains and losses portfolios, respectively. To focus on the embedded price change dimension, we restrict to the stocks that are non-dividend paying. For the losses portfolios, the average daily return is the highest at 0.044 percent for the portfolio with the largest embedded capital losses (the upper 25 percentile). For the portfolio with the smallest embedded capital losses (the lower 25 percentile) the average daily return is lower at 0.014 percent. The average monthly return volatility increases from 5.8 percent for the smallest loss portfolio to 7.6 percent for the largest loss portfolio. For the gains portfolios, the average daily returns range from 0.0008 percent for the first quartile portfolio with embedded capital gains in the lowest 25 percentile to 0.078 percent for the fourth quartile portfolio with embedded capital gains in the highest 25 percentile. The portfolio with the largest embedded capital gains also has the highest monthly return volatility of 7.9 percent while the portfolio with the smallest embedded capital gains has a lower monthly return volatility at 5.4 percent. Overall, the results on the gains and losses portfolios provide empirical evidence that higher return is associated with higher risk.

Table 3 presents the summary statistics for portfolio control variables including the value-weighted averages of firms' debt-to-asset ratio (*D/A*), turnover (*Turnover*), percentage bid and ask spread (*BidAskSpread*), and forecasted operating income growth rate (*GrowthOption*). Panel A reports the summary statistics for the non-dividend and dividend paying portfolios. The non-dividend paying portfolio has a lower average debt/asset ratio (*D/A*=0.49) than dividend-paying portfolios (0.64 for the portfolio of all dividend-paying stocks, 0.60 for low yield portfolio and 0.69 for high yield portfolio) with a higher standard deviation. This is consistent with some dividend-paying firms utilizing more debt financing to gain tax benefit associated with issue debt. The non-dividend paying portfolio also has a much higher average turnover (16.1 percent) than dividend-paying portfolios (6.3 percent for all dividend-paying stocks, 7.1 percent for low yield portfolio and 5.7 percent for high yield portfolio). Panels B and C show the summary statistics for the portfolio control variables for both the gains portfolios and losses portfolios. For the losses portfolios, the debt/asset ratio (*D/A*) stays in a narrow range between 0.46 and 0.47. For the gains portfolios the debt/asset ratio steadily decreases from 0.49 to 0.40 as the embedded capital gain increases. The turnover rate is higher at 20 percent for the small losses portfolio and lower at 16 percent for the large losses portfolio. It is however reversed for the gains portfolios which have a lower turnover at 17 percent for the small gains portfolio and a higher turnover at 25 percent for the large gains portfolio. For the losses portfolios, the average percentage bid-ask spread declines steadily from 1.33 percent for the small losses portfolio to 0.65 for the large losses portfolio. The percentage bid-ask spread ranges from 0.49 percent to 0.97 percent for the gains portfolios. It is hump-shaped in the embedded gains. Finally, the growth options for the small losses portfolio have an average of 12 percent while it is slightly higher for the large losses portfolio at 15 percent. For the gains portfolios, the growth options are on average much higher. For the small gains portfolio, the mean forecasted operating income growth rate is 15 percent while it is much higher for the large gains portfolio at 20 percent.

4.2. Tax effect on return volatility of market index and industry portfolios

We begin our discussion on the effect of a capital gains tax cut on stock return volatility by first examining the market excess return, the implied volatility index, and the return on five industry portfolios including the consumer industry, the manufacturing industry, the high tech industry, the healthcare industry, and other industries. Table 4 reports the regression results of equation (3) on the volatility of the market excess return (column (1)) and the implied volatility on the Standard & Poors index options (VIX) (column (2)), and the results of equation (4) on the return volatility of five industry portfolios (columns (3) to (7)).

Consistent with the prediction of our analysis, the volatility of the market excess return is higher after the capital gains tax rate is reduced. Specifically, *ceteris paribus*, the monthly volatility of the market excess return is 3.4 percentage points higher after the capital gains tax cut than before the capital gains tax cut (see column (1)). This finding is statistically significant at the 1 percent level. The 3.4 percentage point increase also is economically significant. It exceeds the pre-TRA97 monthly average of return volatility for the market portfolio of 2.7 and accounts for most of the difference between the pre-TRA97 of 2.7 and the post-TRA97 average of 5.5 (see Table 1, Panel B).

For our control variables, the lagged consumption-wealth ratio (*CAY*) has a significant positive effect on the market volatility. The lagged market excess return has a negative and significant effect on the return volatility. This is consistent with the leverage effect which states that return volatility is related to the level of returns. This negative relation also suggests that return volatility is higher when stock market performs poorly (asymmetric return volatility). Consistent with the finding on the realized market excess return volatility, the implied volatility for the S&P index options is also higher by 2.8 percentage points and highly significant after controlling for lagged demeaned volatility index and variables on the state of the economy (see column (2)). This estimate also is economically significant. The 2.8 percentage point increase is ⅔ of the pre-TRA97 mean implied volatility for the S&P index options of 4.1 and accounts for most of the difference between the pre-TRA97 of 4.1 and the post-TRA97 average of 7.3 (see Table 1, Panel B). For the five industry portfolios, the estimated coefficient for the dummy variable is consistently positive indicating that the return volatility is higher after the capital gains tax cut. Specifically, the monthly return volatility is higher by 2.7 percentage points for the consumer industry, 2.5 percentage points for the manufacturing industry, 4.6 percentage points for the high tech industry, 2.2 percentage points for the healthcare industry, and 3.4 percentage points for all other industries after the capital gains tax cut than before the capital gains tax cut. The volatility increase is highly statistically significant for four (consumer, manufacturing, high tech, and other industries) out of five industries with a p-value less than 1 percent. For the healthcare industry, the volatility increase is significant at the 5 percent test level. The lagged consumption-wealth ratio has a significant effect on the monthly return volatility for the consumer, high tech, and the other industries at the 5 percent test level. The coefficient estimates for lagged industry returns $\bar{r}_{i(t-1)}$ and/or $\bar{r}_{i(t-2)}$ are significantly negative for the consumer, healthcare, and others industries at the 5 percent test level, and for the manufacturing industry at 10 percent test level. The results suggest that a negative stock price change for an industry will likely be followed by a high return volatility in that industry, providing empirical support for the asymmetric return volatility with respect to lagged industry return. There is also some evidence of asymmetric volatility of industry returns with respect to the market price change for the manufacturing, high tech, and healthcare industries as indicated by significant negative coefficient estimates for $\bar{r}_{(t-1)}$ and/or $\bar{r}_{(t-2)}$. The return volatility of industry portfolios also exhibit persistence as indicated by the coefficient estimates for demeaned lagged return volatility. For all five industries the coefficient estimates for $\Delta\sigma_{i(t-1)}$ are positive and significant at the 5 percent level for the manufacturing, high tech, and healthcare industries and at 10 percent level for the other industries. Month dummies are not significant at conventional levels indicating insignificant calendar effect for the volatility of the market excess return and the volatility of industry portfolio returns. The year dummies are mostly insignificant lending support to the finding of no long-run evident trend for the volatility of the market index documented by Schwert (1989).

Our results on the effect of the capital gains tax cut on the volatility of market excess return, the implied volatility of S&P index options, and the volatility of industry portfolio returns provide empirical support for the prediction that stock return volatility increases after the capital gains tax rate is reduced. Our findings are consistent with the explanation that a capital gains tax cut reduces the risk-sharing function of financial markets and increases stock return volatility.

4.3. The cross-sectional effect of a tax cut on return volatility

Different firms have different tax liabilities (both current and possible future liabilities) and offer different risk-sharing opportunities. When the capital gains tax rate changes, investors respond differently depending upon firms' characteristics. This leads to different tax effects on the return volatility of stocks with different characteristics. As our discussions above show, while the market and industry portfolios experience increases in their return volatility due to the reduced risk-sharing associated with the capital gains tax cut, the increase in volatility should be larger if the firm pays no dividend and greater if the firm has large embedded capital gains or losses. To test the cross-sectional effect of a capital gains tax change on stock return volatility, we perform regression analysis on the portfolios formed based on firm's dividend distribution in the prior year and the embedded capital gains or losses in the past 18 months using equations (5) and (6).

Table 5 reports the results of the regression analysis on the non-dividend paying, dividend-paying stocks, low dividend yield, and high dividend yield portfolios. For all portfolios the estimated coefficient for the *Post* dummy variable is positive and statistically significant at 1 percent level. Specifically, the non-dividend paying portfolio experiences a 3.5 percentage points higher volatility increases after the capital gains tax cut than before the tax cut. The increase in return volatility is lower at 2.4 percentage points for all dividend-paying stocks. Consistent with our prediction and the empirical result on the volatility increase for non-dividend paying and dividend-paying portfolios, low dividend yield portfolio experiences a higher volatility increase (2.5) than the high dividend yield portfolio does (2.1). Both the non-dividend paying and dividend-paying portfolios exhibit asymmetric return volatility as the coefficient estimates for lagged portfolio returns $\bar{r}_{i(t-1)}$ and/or $\bar{r}_{i(t-2)}$ are significantly negative. For dividend-paying portfolios, turnover also has a significant positive effect on return volatility.

Table 6 presents the results of the regression analysis on the loss portfolios. The estimated coefficients for the *Post* dummy are positive in all four quartile loss portfolios, consistent with a higher return volatility after the capital gains tax cut than before the tax cut. Furthermore, as predicted above, the increase in return volatility is smallest for the portfolio with the smallest losses and largest for the portfolio with the largest losses. Specifically, the return volatility rises from 2.0 percentage points higher for the portfolio with the smallest losses to 3.5 percentage points higher for the next quartile to 4.5 percentage points higher for the next largest quartile to 5.3 percentage points higher for the portfolio with the largest losses. All coefficient estimates are significant (one percent level), except for the portfolio with the smallest losses. The probability that the quartile estimates would increase monotonically with the size of the losses by chance is less than five percent. Looking at the other coefficient estimates, a negative coefficient estimate for $\bar{r}_{(t-1)}$ and/or $\bar{r}_{(t-2)}$ is consistent with asymmetric return volatility with respect to the market.

Inferences are similar when we review Table 7, which provides the results of the regression analysis on the gains portfolios. For all four gains portfolios, the estimated coefficient for the *Post* dummy variable is positive indicating a higher return volatility after the capital gains tax cut. As with the embedded losses in Table 6, the increase in return volatility increases with the size of the embedded gains. Specifically, the return volatility rises from 0.2 percentage points higher for the portfolio with the smallest gains to 1.9 percentage points higher for the next quartile to 2.6 percentage points higher for the next largest quartile to 3.0 percentage points higher for the portfolio with the largest gains. The coefficient estimates are only significant for the two quartiles with the largest gains (five percent level). Once again, the probability that the quartile estimates would increase monotonically with the size of the gains by chance is less than five percent. Overall, the cross-sectional results for both losses in Table 6 and gains in Table 7 add confidence to our prior inferences that the 1997 capital gains tax rate reduction increased stock return volatility.

In summary, the empirical results documented above suggest that, after the capital gains tax rate reduction, the non-dividend paying portfolio experienced a higher return volatility increase relative to the dividend-paying portfolio, portfolios with larger losses experienced higher return volatility increases relative to the portfolios with smaller losses, and portfolios with larger gains experienced higher return volatility increases relative to the portfolios with smaller gains.

Next, we test whether the higher volatility increases between different portfolios are statistically significant. We apply equation (6) to the above pair-wise portfolios to test the significance of difference in return volatility increases. Table 8 reports the results of these hypothesis tests. Panel A shows the result of the return volatility increase in the non-dividend paying portfolio relative to that of the dividend-paying portfolio. According to equation (6), the dividend-paying portfolio is the benchmark portfolio indexed by "*b*" and the non-dividend paying portfolio is the alternative portfolio indexed by "*h*". The interaction term $Post \times HVP$ is positive and statistically significant at the 10 percent test level. Further, the coefficient estimate suggests that the non-dividend paying portfolio experiences 1.7 percentage points higher return volatility than the dividend-paying portfolio after the capital gains tax cut. Panel B shows the return volatility increase of the non-dividend paying portfolio relative to the high dividend yield portfolio. Consistent with our prediction, the estimated coefficient for the interaction term $Post \times HVP$ is positive and higher at 1.8 percentage points and also significant at 10 percent test level.

To test if the return volatility increase is significantly higher for the large losses portfolio relative to the small losses portfolio, we use the small losses portfolio as the benchmark portfolio and the large losses portfolio as the alternative portfolio. Panel C shows the estimation result. The interaction term $Post \times HVP$ is positive and statistically significant at the 5 percent test level. The estimated coefficient indicates that the largest losses portfolio experiences a 3.3 percentage points higher return volatility increase than the smallest losses portfolio after the capital gains tax cut. Finally, we test if the large gains portfolio experiences a higher return volatility increase than the small gains portfolio by using the later as the benchmark portfolio and the former as the alternative portfolio. The estimated coefficient for the interaction term $Post \times HVP$ is positive at 1.4, though insignificant. As a robustness check, we use the prior 12 and 24 month price changes to calculate the embedded gains and losses and form portfolios. We find the untabulated results are qualitatively similar.

4.4. Investor ownership and the effect of a capital gains tax cut on return volatility

The capital gains rate reduction in the TRA97 is only applied to income that is reported on personal tax returns, i.e., capital gains from the selling of shares held directly by individuals or held indirectly by individuals in flow-through entities, such as mutual funds, partnerships, trusts, S corporations, or limited liability corporations that pass income to investors' personal tax returns. Capital gains taxes are not levied on tax-deferred accounts (e.g., qualified retirement plans, including pensions, IRAs and 401(k)), tax-exempt organizations, and foreigners. Corporations pay capital gains taxes; however, the rate reduction in TRA97 did not apply to corporations. Thus, portfolios of stocks with more tax sensitive investor ownership may experience higher return volatility than portfolios of stocks with less tax sensitive investor ownership. We now examine if investor ownership has additional effect on the return volatility increase associated with the capital gains tax cut. To achieve this objective, we use a measure of individual investor ownership as a proxy for tax sensitive ownership and then form portfolios based on the tax sensitive ownership measure. Specifically, we compute the detrended individual investor ownership and then sort individual stocks included in the non-dividend paying portfolio and the dividend-paying portfolio constructed above into four portfolios based on the median detrended individual investor ownership. They are (a) non-dividend paying, low individual ownership portfolio; (b) non-dividend paying, high individual ownership portfolio; (c) dividend-paying, low individual ownership portfolio; and (d) dividend-paying, high individual ownership portfolio. We then apply the regression model specified in equation (5) to analyze the effect of the capital gains tax cut on return volatility of each portfolio.

Table 9 reports the results from testing the relation between stock return volatility and individual ownership. The first two columns show the results for the two non-dividend paying portfolios. The last two columns show the results for the two dividend paying portfolios. All four *Post* coefficient estimates are positive. Each is significant at the 5 percent level, except for the non-dividend paying, high individual ownership portfolio. However, contrary to expectations, in both cases, the portfolios with the higher level of individual ownership have smaller estimated coefficients for the *Post* dummy than the portfolios with the lower level of individual ownership. That said, neither difference is statistically significant. We infer that these tests provide no evidence that the increase in stock return volatility varied cross-sectionally with the individual ownership as a proxy for the tax-sensitivity of the stockholders.

These results suggest that high individual investor ownership does not contribute to higher stock return volatility in the event of a capital gains tax rate cut. There are several possible explanations for this failure to reject the null hypothesis. First, from a theoretical perspective, as long as the marginal investor of a stock is tax sensitive, the stock return volatility will respond to a capital gains tax change, regardless of the percentage of individual investor ownership on the stock. Second, the individual investor ownership may not be a good proxy for the tax sensitive ownership because of measurement error. Third, individual investors are subject to the "disposition effect" and may not be tax-savvy. Finally, the fact that idiosyncratic volatility increases in institutional ownership (Gompers and Metrick (2001) and Xu and Malkiel (2003)) may mean that our institutional ownership measure is confounded by non-tax effects and thus a poor measure of tax-sensitive stock ownership.

5. Conclusion

We analyze the effect of capital gains taxes on the volatility of stock returns. Our analysis predicts that reducing capital gains taxes increases the stock return volatility because a capital gains tax cut reduces the risk sharing role of financial markets between investors and the government. The effect of a capital gains tax change on stock return volatility varies depending upon dividend distribution and the size of the embedded capital gains and losses. Using the Tax Relief Act of 1997, we empirically test the predictions on the stock return volatility of a capital gains tax cut. Our empirical analysis provides strong support for the predictions of our analysis for both the return volatility of the market index, the implied volatility of Standard & Poors index options, industry portfolios, and the cross-sectional implications for individual stock return volatility. Non- or lower dividend-paying stocks experience a larger increase in return volatility than high dividend-paying stocks, and stocks with large embedded capital gains or losses show a larger increase in return volatility after a capital gains tax rate reduction than stocks with small embedded capital gains or losses.

While a capital gains tax cut increases stock return volatility, investors are not necessarily worse off. From investors' perspective, the expected investment opportunities or the risk and return trade-off are the key consideration for long-term investment decisions. A capital gains tax cut may also increase investors' after-tax stock return leading to better risk and return trade-off. In this case, investors may benefit from a capital gains tax cut. It is interesting to see the effect of a capital gains tax cut on the risk and return trade-off on stock investment. We leave this for future research.

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Table 1 Market and Industry Portfolios and Aggregate Control Variables

Panel A of this table provides summary statistics for the market, industry portfolio and aggregate control variables. Panel B provides univariate tests on the mean volatility change before and after TRA97 for the market and industry portfolios. $\bar{r}_{market}$ is the monthly average daily excess return of value-weighted CRSP stock index; σ_{market} is the monthly volatility of the excess return of the value-weighted CRSP stock index; VIX_t is the monthly implied volatility for the Standard & Poors index options at month *t*, $\bar{r}_{industry}$, is the monthly average daily excess return for the five industry portfolio as defined in Fama and French: consumer; manufacturing; high technology; heathcare and all others; $\sigma_{industry}$ is the monthly volatility for each of the five industry portfolios*; CAY* is the demeaned consumption-wealth ratio; *RREL* is the stochastically detrended risk free rate; and *GIP* is the growth rate of industrial production. The sample period covers January of 1993 to December of 2002. Note that both April and May of 1997 are excluded in the calculation of volatility mean in the univariate tests.

Panel A: Summary Statistics

Variable	***Mean***	***Median***	***Std***	***Min***	***Max***
Market Portfolio and Implied Volatility					
$\bar{r}_{market}$	0.01887	0.05250	0.22370	-0.81762	0.40600
σ_{market}	4.28393	3.72106	2.31162	1.14089	13.47769
VIX_t	5.92684	6.06362	1.99210	3.06862	12.78254
Industry Portfolios					
$\bar{r}_{consumer}$	0.03760	0.05174	0.19744	-0.66238	0.52261
$\bar{r}_{manufacturing}$	0.03235	0.04138	0.18795	-0.70867	0.58095
$\bar{r}_{hightech}$	0.04220	0.07952	0.39592	-1.30000	0.83739
$\bar{r}_{healthcare}$	0.05329	0.08731	0.22793	-0.61524	0.56191
$\bar{r}_{other}$	0.04477	0.07728	0.22639	-0.99524	0.61304
$\sigma_{consumer}$	4.20179	3.95541	2.01454	1.36115	11.09683
$\sigma_{manufacturing}$	3.47898	3.15529	1.71258	1.23093	11.20402
$\sigma_{hightech}$	6.87807	5.86460	3.80486	2.01788	18.76379
$\sigma_{healthcare}$	5.24268	4.73629	2.32152	1.67003	14.57388
σ_{other}	4.43622	3.93285	2.34291	1.22332	12.91087
Aggregate Controls					
CAY	0.00033	0.00116	0.02076	-0.04622	0.03312
RREL	-0.00757	-0.00887	0.07144	-0.20375	0.14783
GIP	0.00282	0.00314	0.00528	-0.00836	0.02163

Panel B: Univariate Tests for the mean volatility difference for market and industry portfolios

Mean volatility	*Pre-TRA97*	*Post-TRA97*	*Difference*	*p-value*
σ_{market}	2.7090	5.4723	2.7633	0.0001
VIX_t	4.1518	7.2857	3.1338	0.0001
$\sigma_{consumer}$	2.7161	5.3218	2.6057	0.0001
$\sigma_{manufacturing}$	2.2179	4.4336	2.2156	0.0001
$\sigma_{hightech}$	3.9430	9.1426	5.1995	0.0001
$\sigma_{healthcare}$	3.8496	6.2931	2.4435	0.0001
σ_{other}	2.6695	5.7755	3.1059	0.0001

Table 2 Summary Statistics for Constructed Portfolios

Panel A reports the monthly average of daily returns and monthly volatility for non-dividend paying, dividend-paying, low dividend yield, and high dividend yield portfolios constructed based on whether a firm pays dividends and the magnitude of dividend yield in the past year. We only include stocks with price changes (gains or losses) in the prior 18 months being less than 5 percent. $\bar{r}$ is the monthly average of daily return for month *t*. σ is the monthly volatility at month *t*. We use the subscript "*ND*" to represent the non-dividend paying portfolio, "*D*" for the dividend paying portfolio, "*LY*" for the low dividend yield portfolio (with dividend yield in the lower 50 percentile), and "*HY*" for the high dividend yield portfolio (with dividend yield in the upper 50 percentile), respectively. Panel B reports the monthly average of daily returns and monthly volatility for four quartile losses portfolios constructed based on a firm's stock price depreciation in the past 18 months up to month *t* in ascending order with portfolio 1 corresponding to the smallest embedded capital losses and portfolio 4 the largest embedded capital losses. Panel C reports the monthly average of daily returns and monthly volatility for four quartile gains portfolios constructed based on a firm's stock price appreciation in the past 18 months up to month *t* in ascending order with portfolio 1 corresponding to the smallest embedded capital gains and portfolio 4 the largest embedded capital gains. $\bar{r}_{\%t}$ represents the average daily return for month *t* for the quartile portfolios; $\sigma_{\%t}$, represents the monthly volatility of the quartile portfolios at month *t*. For both the gains and losses portfolios, we exclude dividend-paying stocks to mitigate possible confounding effect on stock return volatility from a firm's dividend distribution. The sample period covers January of 1993 to December of 2002.

Variable	***Mean***	***Median***	***Std***	***Min***	***Max***
			Panel A		
		Non-Dividend Paying vs. Dividend Paying Portfolios			
$\bar{r}_{ND}$	0.01020	0.00690	0.29672	-1.24217	1.01549
$\bar{r}_{D}$	0.03126	0.04418	0.17322	-0.50811	0.43754
σ_{ND}	5.89013	5.11680	2.51470	2.33783	16.10004
σ_{D}	3.49784	3.28363	1.36005	1.46585	8.02294
		Low Dividend Yield vs. High Dividend Yield Portfolios			
$\bar{r}_{LY}$	0.02438	0.03442	0.19979	-0.59497	0.54784
$\bar{r}_{HY}$	0.03713	0.04691	0.17608	-0.55451	0.47131
σ_{LY}	4.05311	3.87738	1.49104	1.63227	8.75432
σ_{HY}	3.51169	3.30966	1.34652	1.45658	8.37397

Panel B: Loss Portfolios (from the smallest losses to the largest losses)					
$\bar{r}_{25\%t}$	0.01382	0.04874	0.29515	-1.08488	0.73012
$\bar{r}_{50\%t}$	-0.01582	0.01873	0.37703	-1.40639	0.94808
$\bar{r}_{75\%t}$	0.02781	0.02734	0.40893	-1.26344	1.54829
$\bar{r}_{100\%t}$	0.04368	0.05614	0.55178	-1.93861	2.03547
$\sigma_{25\%t}$	5.75504	5.01138	2.34971	2.21929	14.06575
$\sigma_{50\%t}$	6.40039	5.29427	3.44350	1.65766	17.11815
$\sigma_{75\%t}$	7.14459	5.74115	3.67043	2.22324	17.40801
$\sigma_{100\%t}$	7.60548	5.95752	4.33132	2.85232	20.48670
Panel C: Gains Portfolios (from the smallest gains to the largest gains)					
$\bar{r}_{25\%t}$	0.00079	0.01519	0.29946	-0.99960	0.91874
$\bar{r}_{50\%t}$	0.02260	0.02076	0.28016	-0.93593	0.69403
$\bar{r}_{75\%t}$	0.04010	0.04708	0.29947	-0.97831	0.91414
$\bar{r}_{100\%t}$	0.07830	0.09727	0.41447	-1.80513	1.04318
$\sigma_{25\%t}$	5.44185	4.81950	2.25315	1.64414	11.62200
$\sigma_{50\%t}$	5.35551	4.57299	2.51103	1.62656	14.87364
$\sigma_{75\%t}$	6.00811	5.30272	2.48089	2.22233	14.54936
$\sigma_{100\%t}$	7.87081	7.03272	3.15716	3.52583	17.62147

Table 3 Summary Statistics for Portfolio Control Variables

This table reports the value-weighted monthly averages for the debt/asset ratio (*D/A*), turnover (*Turnover*), percentage bid-ask spread (*BidAskSpread*), and growth options (*GrowthOption*) for each portfolio constructed the same as in Table 2. Specifically, for each firm, *D/A* is the debt/asset ratio in the most recent quarter; turnover is monthly trading volume divided by outstanding shares in prior month; bid-ask spread is the average monthly percentage bid-ask spread for individual stocks in the past month, and growth option is analysts' forecast for firm's long-term operating income growth rate. The sample period covers January of 1993 to December of 2002.

Panel A: Non-Dividend Paying Versus Dividend Paying Portfolios					
		Non-Div. Paying	***Div. Paying***	***Low-Yield***	***High-Yield***
D/A	Mean	0.49438	0.63701	0.59957	0.69139
	Std. Err.	0.12058	0.04944	0.06465	0.06344
Turnover	Mean	0.16114	0.06267	0.07065	0.05658
	Std. Err.	0.06776	0.01903	0.02456	0.01796
BidAskSpread	Mean	0.68149	0.30231	0.35103	0.28219
	Std. Err.	0.34838	0.12825	0.17513	0.10928
GrowthOption	Mean	14.44870	9.42230	12.16224	5.79097
	Std. Err.	3.62953	2.36977	2.29289	2.06081
Panel B: Losses Portfolios (from the smallest losses to the largest losses)					
		Port. 1 (25%)	***Port. 2 (50%)***	***Port. 3 (75%)***	***Port. 4 (100%)***
D/A	Mean	0.46038	0.46348	0.46072	0.47627
	Std. Err.	0.09478	0.10398	0.10487	0.09705
Turnover	Mean	0.19680	0.18439	0.16628	0.16331
	Std. Err.	0.06538	0.06443	0.06348	0.05540
BidAskSpread	Mean	1.32748	0.94552	0.81524	0.65151
	Std. Err.	0.70716	0.49334	0.48836	0.34826
GrowthOption	Mean	12.21200	13.85127	14.25049	14.57773
	Std. Err.	5.18375	3.96058	3.94605	3.50905
Panel C: Gains Portfolios (from the smallest gains to the largest gains)					
		Port. 1 (25%)	***Port. 2 (50%)***	***Port. 3 (75%)***	***Port. 4 (100%)***
D/A	Mean	0.49245	0.48671	0.42941	0.40496
	Std. Err.	0.08107	0.07477	0.08123	0.07702
Turnover	Mean	0.16669	0.15393	0.18222	0.24589
	Std. Err.	0.05371	0.05427	0.06568	0.05939
BidAskSpread	Mean	0.68417	0.96722	0.82086	0.48739
	Std. Err.	0.67612	0.98076	0.80893	0.30978
GrowthOption	Mean	15.36813	14.83292	17.98733	20.34189
	Std. Err.	3.40833	3.95367	4.55247	3.16656

Table 4 Market and Industry Regression Analysis

This table reports the regression results on the effect of TRA97 on the monthly volatility of the excess return of the value-weighted CRSP stock index (column 1), the implied volatility for the Standard & Poors index options (VIX, column 2), the return volatility of five industry portfolios including consumer (column 3), manufacturing (column 4), high tech (column 5), healthcare (column 6), and others (column 7) constructed using 4 digit SIC code. See table 1 for variable definitions. The sample period covers January of 1993 to December of 2002. *Post* is a dummy variable which takes value of 1 if the observation is after 6/1/1997 and 0 if it is before 3/31/1997. The numbers in parentheses are p-values. The p-value for dummy variable *post* is based on one-sided test.

Variable	***Pred. sign***	***Market***	***Implied Volatility***	***Ind. 1 Consumer***	***Ind. 2 Manufact.***	***Ind. 3 High Tech.***	***Ind. 4 Healthcare***	***Ind. 5 Others***
		(1)	(2)	(3)	(4)	(5)	(6)	(7)
Post	+	**3.4191**	**2.7911**	**2.6805**	**2.4813**	**4.6006**	**2.2254**	**3.4045**
		(0.0015)	**(0.0002)**	**(0.0020)**	**(0.0019)**	**(0.0009)**	**(0.0243)**	**(0.0007)**
$\Delta\sigma_{t-1}$		0.0387	0.5357	-0.1562	-0.1608	-0.1510	-0.3224	-0.1889
		(0.7310)	(0.0005)	(0.2910)	(0.1226)	(0.4350)	(0.0295)	(0.2036)
$\Delta\sigma_{t-2}$		0.0531	-0.1337	-0.0028	-0.0118	-0.2537	-0.1744	0.1299
		(0.6112)	(0.3369)	(0.9831)	(0.9067)	(0.1826)	(0.1848)	(0.3749)
CAY_{t-1}		115.3346	84.4675	66.8269	48.5161	153.0678	46.8488	85.5904
		(0.0077)	(0.0013)	(0.0464)	(0.0813)	(0.0046)	(0.2525)	(0.0219)
CAY_{t-2}		-51.1667	-38.0116	-42.0771	-20.8615	-90.4914	-31.9903	-43.2338
		(0.1727)	(0.0967)	(0.1528)	(0.3845)	(0.0590)	(0.3760)	(0.1871)
$RREL_{t-1}$		0.2138	0.3312	2.9884	-1.1893	-1.6506	1.6298	0.4089
		(0.9636)	(0.9030)	(0.4271)	(0.6946)	(0.7847)	(0.7271)	(0.9192)
$RREL_{t-2}$		-3.8448	-1.7037	-2.2531	-0.2941	0.8714	-0.7863	0.5076
		(0.3868)	(0.5037)	(0.5199)	(0.9198)	(0.8786)	(0.8586)	(0.8939)
GIP_{t-1}		27.9338	19.2453	34.8339	32.7383	78.4214	39.6576	44.9269
		(0.5128)	(0.4414)	(0.2999)	(0.2421)	(0.1527)	(0.3510)	(0.2283)
GIP_{t-2}		28.3754	-32.5519	-8.9904	-0.5741	-14.7907	40.4535	-29.3466
		(0.5068)	(0.1986)	(0.7883)	(0.9835)	(0.7880)	(0.3438)	(0.4339)
$\bar{r}_{t-1}$		-3.1156	0.4414	-1.0620	-1.8512	0.4630	0.1931	-2.2531
		(0.0005)	(0.5063)	(0.3607)	(0.0456)	(0.8523)	(0.8444)	(0.0691)
$\bar{r}_{t-2}$		-0.8927	-0.3529	1.8115	0.4159	-4.2424	-2.3676	2.0130
		(0.3431)	(0.5302)	(0.2040)	(0.6592)	(0.1008)	(0.0348)	(0.1159)
$\bar{r}_{i(t-1)}$				-1.8530	-0.0530	-1.7900	-2.9208	-0.8635
				(0.1626)	(0.9608)	(0.1909)	(0.0057)	(0.4582)
$\bar{r}_{i(t-2)}$				-3.1844	-1.7619	1.3939	0.0382	-3.4770
				(0.0438)	(0.0935)	(0.3245)	(0.9717)	(0.0034)
$\Delta\sigma_{i(t-1)}$				0.2774	0.4401	0.3938	0.3368	0.2825
				(0.1276)	(0.0071)	(0.0112)	(0.0171)	(0.0761)
$\Delta\sigma_{i(t-2)}$				0.1369	0.0676	0.1656	0.3582	0.0240
				(0.4393)	(0.6933)	(0.2634)	(0.0053)	(0.8855)
N		116	116	116	116	116	116	116
Adj. R^2		0.4846	0.7576	0.5914	0.6184	0.7119	0.5204	0.6152

Table 5 Regression Analysis for Non-Div. Paying and Div. Paying Portfolios

This table reports the regression results on the effect of TRA97 on the monthly volatility of the excess return of the value-weighted portfolios formed based on whether a stock pays dividends and the magnitude of dividend yield in the prior year. To mitigate the effect of large embedded capital gains or losses on stock return volatility, we only include stocks with price changes in the past 18 months prior to current month to be less than 5 percent. See tables 1, 2 and 3 for variable definitions. The sample period covers January of 1993 to December of 2002. *Post* is a dummy variable which takes value of 1 if the observation is after 6/1/1997 and 0 if it is before 3/31/1997. The numbers in parentheses are p-values. The p-value for dummy variable *post* is based on one-sided test.

Variable	*Predicted sign*	*Non-div. Paying*	*Div. Paying*	*Low Yield*	*High Yield*
Post	+	**3.5223**	**2.3793**	**2.4559**	**2.0838**
		(0.0100)	**(0.0022)**	**(0.0009)**	**(0.0022)**
$\Delta\sigma_{t-1}$		-0.1314	-0.0826	-0.0622	0.0370
		(0.4603)	(0.3091)	(0.4776)	(0.6003)
$\Delta\sigma_{t-2}$		0.1709	-0.0187	0.0038	0.0725
		(0.2395)	(0.8070)	(0.9634)	(0.2583)
CAY_{t-1}		67.4915	33.1130	10.9371	11.7309
		(0.1850)	(0.1429)	(0.6674)	(0.5935)
CAY_{t-2}		-19.8621	7.4266	1.4367	23.7643
		(0.6639)	(0.7071)	(0.9481)	(0.2074)
$RREL_{t-1}$		-10.2174	-2.6214	-3.3185	-1.4068
		(0.0802)	(0.3267)	(0.2523)	(0.5657)
$RREL_{t-2}$		-2.0251	0.5928	2.8879	-0.2730
		(0.7274)	(0.8090)	(0.2888)	(0.9087)
GIP_{t-1}		17.0884	20.3628	3.9932	17.2549
		(0.7492)	(0.3800)	(0.8764)	(0.4320)
GIP_{t-2}		-42.3513	0.5677	-6.3079	-4.8673
		(0.4162)	(0.9800)	(0.8055)	(0.8227)
$\bar{r}_{t-1}$		-0.1894	-0.2888	0.0536	-0.9535
		(0.9016)	(0.6274)	(0.9330)	(0.0726)
$\bar{r}_{t-2}$		-1.7142	0.3846	0.2321	0.2619
		(0.3123)	(0.5393)	(0.7296)	(0.6252)
$\bar{r}_{i(t-1)}$		-2.5748	-1.4830	-2.0988	0.2438
		(0.0246)	(0.0338)	(0.0013)	(0.6932)
$\bar{r}_{i(t-2)}$		-0.1684	-1.2628	-1.0802	-1.5135
		(0.8831)	(0.0847)	(0.1024)	(0.0129)
$\Delta\sigma_{i(t-1)}$		0.0414	0.1790	0.1904	-0.0078
		(0.7869)	(0.1843)	(0.1369)	(0.9514)
$\Delta\sigma_{i(t-2)}$		-0.0754	0.0863	0.0925	-0.1888
		(0.5941)	(0.5346)	(0.4744)	(0.1520)
D/A		2.1049	2.1285	2.8289	3.3015
		(0.3587)	(0.4022)	(0.2316)	(0.1003)
Turnover		-4.8852	19.7777	19.8103	16.7280
		(0.2535)	(0.0103)	(0.0017)	(0.0645)
BidAskSpre		0.1563	0.8339	2.8690	-0.3265
		(0.8750)	(0.6531)	(0.0444)	(0.8331)
GrowthOpt		0.0564	-0.0286	-0.0275	0.0389
		(0.4835)	(0.6485)	(0.6222)	(0.5891)
N		116	116	116	116
Adj. R^2		0.4203	0.5919	0.5762	0.6394

Table 6 Regression Analysis for Loss Portfolios

This table reports the regression results on the effect of TRA97 on the monthly volatility of the excess return of the value-weighted portfolios formed based on the *price depreciation* in the past 18 months prior to current month. Only non-dividend paying stocks in the past year are included. Port. 1 corresponds to the lowest 25 percentile (smallest losses) while Port. 4 corresponds to the highest 25 percentile (largest losses), with Port. 2 and Port. 3 in between. See tables 1, 2 and 3 for variable definitions. The sample period covers January of 1993 to December of 2002. *Post* is a dummy variable which takes value of 1 if the observation is after 6/1/1997 and 0 if it is before 3/31/1997. The numbers in parentheses are p-values. The p-value for dummy variable *post* is based on one-sided test.

Variable	*Predicted sign*	*Port. 1 (25%)*	*Port. 2 (50%)*	*Port. 3 (75%)*	*Port. 4 (100%)*
Post	+	**1.9614**	**3.5086**	**4.4904**	**5.3150**
		(0.0768)	**(0.0090)**	**(0.0029)**	**(0.0018)**
$\Delta\sigma_{t-1}$		-0.0215	-0.5100	-0.1475	-0.1820
		(0.8649)	(0.0010)	(0.4048)	(0.3492)
$\Delta\sigma_{t-2}$		0.0760	-0.0409	-0.2119	-0.1749
		(0.4923)	(0.7881)	(0.2029)	(0.3230)
CAY_{t-1}		87.4000	37.2706	108.5597	53.1664
		(0.0360)	(0.4432)	(0.0385)	(0.3683)
CAY_{t-2}		-38.4170	-5.3041	-16.7903	0.6491
		(0.2988)	(0.9036)	(0.7096)	(0.9899)
$RREL_{t-1}$		2.6236	2.5397	1.4744	-5.4556
		(0.5527)	(0.6338)	(0.7976)	(0.4147)
$RREL_{t-2}$		-9.2668	-1.7047	0.6039	2.5570
		(0.0336)	(0.7372)	(0.9130)	(0.6943)
GIP_{t-1}		24.4335	17.0052	63.1476	-16.8313
		(0.5405)	(0.7264)	(0.2658)	(0.7681)
GIP_{t-2}		7.8334	7.8724	-6.1322	-20.0431
		(0.8527)	(0.8704)	(0.9119)	(0.7239)
$\bar{r}_{t-1}$		-2.4045	-4.5191	-1.9934	-2.7819
		(0.0708)	(0.0017)	(0.2537)	(0.0954)
$\bar{r}_{t-2}$		-1.4868	-3.0005	-2.2783	-0.9519
		(0.2865)	(0.0365)	(0.2011)	(0.5669)
$\bar{r}_{i(t-1)}$		0.0548	-0.1600	-0.7516	-0.5809
		(0.9533)	(0.8356)	(0.4321)	(0.3917)
$\bar{r}_{i(t-2)}$		0.4894	0.6433	-0.0476	-0.2103
		(0.5915)	(0.4173)	(0.9593)	(0.7462)
$\Delta\sigma_{i(t-1)}$		0.0625	0.2526	0.1868	0.1208
		(0.6421)	(0.0769)	(0.2388)	(0.4161)
$\Delta\sigma_{i(t-2)}$		0.05138	0.2125	0.3925	0.2515
		(0.6815)	(0.1217)	(0.0058)	(0.0673)
D/A		4.2600	-1.9928	2.0223	11.6458
		(0.1458)	(0.5009)	(0.4948)	(0.0129)
Turnover		7.2251	6.9077	4.4808	-2.7749
		(0.0864)	(0.1325)	(0.4156)	(0.6583)
BidAskSpread		-2.3335	-0.7652	0.3252	-0.1930
		(0.0490)	(0.3738)	(0.7364)	(0.8553)
GrowthOption		0.0018	-0.0729	0.0280	0.2128
		(0.9807)	(0.3374)	(0.7716)	(0.0285)
N		116	116	116	116
Adj. R^2		0.5768	0.7336	0.7082	0.7527

Table 7 Regression Analysis for Gains Portfolios

This table reports the regression results on the effect of TRA97 on the monthly volatility of the excess return of the value-weighted portfolios formed based on the *price appreciation* in the past 18 months prior to current month. Only non-dividend paying stocks in the past year are included. Port. 1 corresponds to the lowest 25 percentile (smallest gains) while Port. 4 corresponds to the highest 25 percentile (largest gains), with Port. 2 and Port. 3 in between. See tables 1, 2 and 3 for variable definitions. The sample period covers January of 1993 to December of 2002. *Post* is a dummy variable which takes value of 1 if the observation is after 6/1/1997 and 0 if it is before 3/31/1997. The numbers in parentheses are p-values. The p-value for dummy variable *post* is based on one-sided test.

Variable	***Predicted sign***	***Port. 1 (25%)***	***Port. 2 (50%)***	***Port. 3 (75%)***	***Port. 4 (100%)***
Post	+	**0.2327**	**1.8842**	**2.6144**	**2.9880**
		(0.4231)	**(0.0692)**	**(0.0307)**	**(0.0372)**
$\Delta\sigma_{t-1}$		-0.0478	-0.4071	-0.1829	0.0248
		(0.7371)	(0.0276)	(0.1734)	(0.8826)
$\Delta\sigma_{t-2}$		0.2971	-0.1308	-0.1793	-0.1511
		(0.0236)	(0.4579)	(0.1865)	(0.3614)
CAY_{t-1}		-3.2094	80.4859	80.5510	129.7198
		(0.9437)	(0.0787)	(0.0601)	(0.0287)
CAY_{t-2}		-40.0160	-41.9612	-12.9075	-98.6577
		(0.3073)	(0.3031)	(0.7316)	(0.0493)
$RREL_{t-1}$		6.8164	-1.2616	-6.6588	0.3739
		(0.1504)	(0.8089)	(0.1750)	(0.9531)
$RREL_{t-2}$		-0.3551	4.2320	4.4710	3.7384
		(0.9376)	(0.3744)	(0.3344)	(0.5699)
GIP_{t-1}		34.2335	107.3920	64.2933	95.9465
		(0.4473)	(0.0248)	(0.1569)	(0.0961)
GIP_{t-2}		-20.2960	15.0404	10.2523	43.9944
		(0.6539)	(0.7514)	(0.8239)	(0.4443)
$\bar{r}_{t-1}$		-3.1162	0.0051	-1.3253	-0.2397
		(0.0172)	(0.9973)	(0.2884)	(0.8877)
$\bar{r}_{t-2}$		-0.0055	-0.2381	-1.0834	-3.4329
		(0.9968)	(0.8811)	(0.3887)	(0.0572)
$\bar{r}_{i(t-1)}$		1.1018	-0.7857	-0.1380	-0.5225
		(0.2427)	(0.4784)	(0.8919)	(0.5811)
$\bar{r}_{i(t-2)}$		-1.2009	-1.3667	-0.2585	1.6424
		(0.2294)	(0.2178)	(0.7992)	(0.0981)
$\Delta\sigma_{i(t-1)}$		0.1857	0.5988	0.2880	0.2045
		(0.2530)	(0.0009)	(0.0745)	(0.2064)
$\Delta\sigma_{i(t-2)}$		-0.1061	0.0371	0.2244	0.2180
		(0.4201)	(0.8361)	(0.1263)	(0.1086)
D/A		-0.6402	5.7902	-0.8243	-11.3047
		(0.8438)	(0.1092)	(0.8528)	(0.1882)
Turnover		3.9834	14.1990	6.0544	6.2618
		(0.3767)	(0.0112)	(0.0946)	(0.3908)
BidAskSpread		0.0035	0.1799	-0.0109	0.8256
		(0.9907)	(0.5097)	(0.9704)	(0.5600)
GrowthOption		0.0125	0.0190	-0.0095	0.1189
		(0.8981)	(0.8065)	(0.9212)	(0.5725)
N		116	116	116	116
Adj. R^2		0.4653	0.5189	0.5767	0.5583

Table 8 Hypothesis Tests of Cross-Sectional Volatility Increases for Different Portfolios

This table reports the test results of volatility increase for different portfolios. *Post* is a dummy variable which takes value of 1 if the observation is after 6/1/1997 and 0 if it is before 3/31/1997. *HVP* is a dummy variable which takes value of 0 if the observation is in a benchmark portfolio and 1 if it is in an alternative portfolio. The last column reports the probability of a one-sided test on a positive coefficient for $Post \times HVP$. The sample period covers January of 1993 to December of 2002.

Variable	Predicted sign	Estimate	Std. Error	t-statistic	Prob $\beta > 0$
Panel A: Non-dividend paying Vs. dividend-paying portfolios					
PostxHVP	+	1.6792	1.2776	1.31	0.0953
Panel B: Non-dividend paying Vs. high dividend yield (upper 50%) portfolios					
PostxHVP	+	1.7850	1.2314	1.45	0.0745
Panel C: Large embedded loss (upper 25%) Vs. small embedded loss (lower 25%) portfolios					
PostxHVP	+	3.2829	1.8116	1.81	0.0358
Panel D: Large embedded gain (upper 25%) Vs. small embedded gain (lower 25%) portfolios					
PostxHVP	+	1.4124	1.5399	0.92	0.1802

Table 9 Regression Analysis for Non-Dividend Paying and Dividend Paying Portfolios with Low and High Individual Ownership

This table reports the regression results on the effect of TRA97 on the monthly volatility of the excess return of the value-weighted portfolios formed based on a stock's dividend distribution in the prior year and the detrended individual ownership in the most recent past quarter. Stocks with detrended individual ownership in the lower 50 percentile are included in the low individual ownership portfolios (Low IND) and stocks with detrended individual ownership is the upper 50 percentile are included in the high individual ownership portfolios (High IND). The price change in the past 18 months prior to current month is restricted to less than 5 percent. See tables 1, 2 and 3 for variable definitions. The sample period covers January of 1993 to December of 2002. *Post* is a dummy variable which takes value of 1 if the observation is after 6/1/1997 and 0 if it is before 3/31/1997. The numbers in parentheses are p-values. The p-value for dummy variable *post* is based on one-sided test.

Variable	***Pred. sign***	***Non-dividend Low IND Port.***	***Non-dividend High IND Port.***	***Dividend Paying Low IND Port.***	***Dividend Paying High IND Port.***
Post	+	**3.5738**	**3.4441**	**2.4025**	**1.1626**
		(0.0160)	**(0.0115)**	**(0.0016)**	**(0.0866)**
$\Delta\sigma_{t-1}$		0.1626	-0.1538	-0.0655	-0.0364
		(0.3927)	(0.3794)	(0.4108)	(0.6821)
$\Delta\sigma_{t-2}$		0.2718	0.0576	0.0070	-0.1287
		(0.1256)	(0.7026)	(0.9232)	(0.1243)
CAY_{t-1}		-55.8186	125.4675	11.4571	31.1088
		(0.3741)	(0.0244)	(0.6457)	(0.2341)
CAY_{t-2}		56.7347	-82.8267	25.7895	-16.9123
		(0.2956)	(0.0736)	(0.2412)	(0.4631)
$RREL_{t-1}$		-1.0530	-8.4380	2.1211	-2.4277
		(0.8847)	(0.1636)	(0.4869)	(0.4533)
$RREL_{t-2}$		-8.9961	8.4445	-1.7579	3.7932
		(0.1946)	(0.1426)	(0.5254)	(0.1900)
GIP_{t-1}		-20.7078	17.1346	21.9431	21.8712
		(0.7420)	(0.7577)	(0.3816)	(0.4192)
GIP_{t-2}		-69.2185	-39.5227	1.4295	-9.9903
		(0.2590)	(0.4672)	(0.9540)	(0.7035)
$\bar{r}_{t-1}$		-1.6689	1.9454	0.0378	-0.3453
		(0.3030)	(0.2082)	(0.9518)	(0.5780)
$\bar{r}_{t-2}$		1.6299	-2.1314	0.7435	-1.0056
		(0.3568)	(0.2073)	(0.2648)	(0.1420)
$\bar{r}_{i(t-1)}$		-1.6150	-2.4964	-1.3701	-1.0533
		(0.1419)	(0.0254)	(0.0771)	(0.0960)
$\bar{r}_{i(t-2)}$		-1.7414	-0.7898	-1.5827	-0.2061
		(0.1226)	(0.4354)	(0.0405)	(0.7614)
$\Delta\sigma_{i(t-1)}$		-0.1442	0.3572	-0.0361	0.2852
		(0.3567)	(0.0335)	(0.7714)	(0.0502)
$\Delta\sigma_{i(t-2)}$		-0.1273	-0.2333	0.0006	0.2380
		(0.3625)	(0.0778)	(0.9957)	(0.0822)
D/A		0.6390	3.1685	0.7684	3.1184
		(0.8015)	(0.0758)	(0.6813)	(0.1343)

Turnover	-4.3566	-4.5058	30.6713	2.2925
	(0.2480)	(0.1656)	(0.0016)	(0.7217)
BidAskSpread	0.4141	0.4713	0.8159	-1.6953
	(0.5798)	(0.5285)	(0.5523)	(0.3398)
GrowthOption	0.0272	-0.0205	-0.0424	0.0343
	(0.6720)	(0.7231)	(0.3787)	(0.5707)
N	116	116	116	116
Adj. R^2	0.2627	0.4787	0.5477	0.5653