THE JOURNAL OF FINANCE • VOL. LXI, NO. 1 • FEBRUARY 2006

Investor Tax Heterogeneity and Ex-Dividend Day Trading Volume

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ABSTRACT

We propose that ex-dividend day excess volume is motivated by tax heterogeneity among investors, and thus is increasing in investor tax heterogeneity. Institutional ownership is our measure of heterogeneity. Since investor heterogeneity is a concave function of institutional ownership, we hypothesize that ex-day volume is a concave function of institutional ownership. Cross-sectional tests support the tax-motivated trading hypothesis. Additional tests, using trade size and pension ownership as proxies for institutional trades, yield similar results. We contribute to the literature by considering the interaction between payout policy and ownership structure in explaining the cross-sectional variation in ex-day volume.

MICHAELY AND VILA (1995, 1996) DEMONSTRATE THAT INVESTORS with differing relative preferences for dividends versus capital gains will trade with each other around ex-dividend days. They argue that although dividend yield, which is used as a measure of the tax-disadvantaged portion of security returns for some investors, is a necessary condition for ex-day excess trading, it is not a sufficient condition. It must be accompanied by tax-induced investor heterogeneity, defined as the difference in relative tax rates on dividends and capital gains for different categories of investors. Even if the level of tax-disadvantaged dividend yield is very high, if most investors are in the same tax category, ex-day excess trading volume will be thin. Using an economy-wide measure of tax heterogeneity, Michaely and Vila (1996) provide empirical evidence that the ex-day excess trading volume is increasing in investor tax heterogeneity.[1]

In this paper, we examine the role of firm-level tax-induced investor heterogeneity in conjunction with the differential tax treatment of dividends and

*Dhaliwal is from the University of Arizona and the University of Auckland and Li is from the University of Notre Dame. We thank Ashiq Ali, Robert Battalio, Dan Collins, Merle Erickson, Michelle Hanlon, Roger Huang, Hang Li, Edward Maydew, Richard Mendenhall, Lil Mills, Kaye Newberry, Paul Schultz, Bill Schwartz, Jim Seida, Rob Stambaugh (the Editor), Bob Trezevant, Hong Xie, an anonymous referee, and seminar participants at the University of Arizona, University of Chicago, University of Iowa, University of Notre Dame, University of Rochester, University of Southern California, University of Waterloo, University of Western Ontario, Indiana University, Rice University, Tulane University, and Yale University for helpful comments. All errors are ours.

[1] Michaely and Vila (1996) find a positive relation between (1) the monthly economy-wide mean cumulative excess trading volume, calculated as the weighted average (weighted by market capitalization) of the cumulative excess trading volume for all securities with an ex-dividend day in that month; and (2) a cross-sectional tax rate dispersion variable computed using IRS and Federal Reserve data.

capital gains in explaining ex-day excess trading volume. We use dividend yield to proxy for the tax-disadvantaged portion of security returns for some investors, which reflects the extent of potential gains from exchanging tax burdens. We use the level of institutional ownership to proxy for firm-level tax-induced investor heterogeneity because the relative tax rates on dividends and capital gains are different for individual and institutional investors. As the level of institutional ownership increases, tax-induced investor heterogeneity first increases and then decreases. Since ex-day excess trading volume is a result of the interaction between a stock's payout policy and its ownership structure, we hypothesize that the positive volume effect of dividend yield is increasing in tax-induced investor heterogeneity, or more specifically, that it is a concave function of the level of institutional ownership.

Cross-sectional tests support our tax-motivated trading hypothesis, and the major results can be summarized as follows. (1) Excess trading volume around ex-dividend days increases in dividend yield, and this positive volume effect is a concave function of the level of institutional ownership. (2) We use trade size to proxy for the level of trading by institutional shareholders, and the results confirm those using institutional ownership; that is, we find that the volume effect of dividend yield is a concave function of the percentage of institutional trades. Additional analysis using pension ownership also supports the tax-motivated trading hypothesis. We find that most excess trading volume around ex-dividend days is the result of trading between the most tax-advantaged investors, pensions, and the most tax-disadvantaged investors, individuals. (3) As for tax regime changes, we find some support for the tax-motivated trading hypothesis around the Revenue Reconciliation Act of 1993 (RRA93), but not around the Taxpayer Relief Act of 1997 (TRA97).

In conclusion, this paper suggests that ex-day excess trading volume is tax related. We contribute to the literature by analyzing the interaction between dividend payout policy and tax-induced investor heterogeneity, as reflected in the level of institutional ownership and institutional trades, in explaining the cross-sectional variation in excess trading volume around ex-dividend days.

The paper proceeds as follows. In Section I, we formulate the tax-motivated trading hypothesis. Section II describes the data. Section III tests the hypotheses and discusses the empirical results. Section IV summarizes and concludes.

I. Theory and Hypothesis

A. Relative Value of Dividends versus Capital Gains and Excess Trading Activities—Intuition

For each investor, the relative value of dividends versus capital gains, that is, their marginal rate of substitution (α), is determined by their tax rates

$$\alpha = \frac{1 - t_d}{1 - t_g}, \tag{1}$$

where t_d and t_g are tax rates on dividends and capital gains, respectively. The variable α measures the value of $1.00 of dividends per dollar of capital gains.

Let us consider an example of how differences in relative preferences for dividends and capital gains can motivate trade. Assume two investors, one with $\alpha_1 = 1.5(t_{1,d} < t_{1,g})$ and the other with $\alpha_2 = 0.5(t_{2,d} > t_{2,g})$. To Investor 1, \$1.00 of dividends is worth \$1.50 of capital gains; to Investor 2, \$1.00 of dividends is worth \$0.50 of capital gains. Investor 1 prefers to receive income in the form of dividends, while Investor 2 prefers to receive income in the form of capital gains. Both benefit from trading with each other, thus motivating ex-day trade.[2] Note that it is the difference in the relative taxation of dividends and capital gains that matters, not the absolute levels of taxation. Even if both prefer dividends to capital gains, there is benefit in trading with each other as long as the two investors have different values of α.[3]

B. *Impact of Stock Ownership Structure on the Ex-Day Volume Effect of Dividend Yield*

We follow Michaely and Vila (1995) in our model of ex-dividend day trading activities. Ex-day excess trading volume is determined in the following manner:

$$V_e = \frac{1}{2} D \left\{ \sum_{i=1}^{N} \left| (\alpha_i - \bar{\alpha}) \big(K_i / \sigma_e^2 \big) \right| \right\}, \tag{2}$$

where D is the amount of dividend per share, K_i is the level of risk tolerance for investor i, α_i, is the tax-induced preference for dividends versus capital gains for investor i, $\bar{\alpha}$ is the average preference for dividends versus capital gains in the economy, weighted by investors' levels of risk tolerance K_i, σ_2^e is the total risk of a stock, and N is the total number of investors in the economy. Equation (2) indicates that trading volume is a positive function of the dividend and of the degree of tax-induced heterogeneity.[4] If there is no tax-induced investor heterogeneity, that is, if $\alpha_i = \bar{\alpha}$ for all i's, then there is no extra trading around ex-dividend days, even in the presence of tax-disadvantaged dividends (e.g., even if $\bar{\alpha} < 1$). Thus, one necessary condition for ex-day excess trading volume is the presence of tax-induced investor heterogeneity.

[2] This example is similar to Michaely and Vila (1995, p. 179). Lakonishok and Smidt (1986) make a similar argument. They state that in idealized markets with homogeneous investors, market adjustments require price changes but not necessarily transactions. Tax laws serve to partition investors into distinct categories that may result in tax-induced trading not necessarily accompanied by price change (p. 953).

[3] For example, let $\alpha_1 = 1.5$ and $\alpha_2 = 1.2$. Since Investor 1 has a greater preference for dividends than Investor 2, they will trade with each other, even though they both prefer dividends to capital gains.

[4] Frank and Jagannathan (1998) show that excess trading volume is generally negative and mostly insignificant during the 11-day period around ex-dividend days in Hong Kong, where neither dividends nor capital gains are taxed. Since there is no tax differential on dividends and capital gains, and thus all investors have the same relative valuation of dividends and capital gains, there is no excess trading around ex-dividend days. This result is consistent with the ex-day tax-motivated trading hypothesis.

In this study, we use the level of institutional ownership of common stocks to proxy for the degree of tax-induced investor heterogeneity, and we use dividend yield as a measure of the extent to which a stock's return is tax disadvantaged. We assume that there are two categories of investors, institutional and individual. For institutional investors, dividends are on average less tax disadvantaged relative to capital gains than for individual investors (Dhaliwal, Erickson, and Trezevant (1999), Allen, Bernardo, and Welch (2000), Ayers, Cloyd, and Robinson (2002), and Dhaliwal, Li, and Trezevant (2003)).[5] This means that on average, dividend income is worth relatively more, compared to capital gains income, to an institutional investor than it is to an individual investor: $\alpha_{institution} > \alpha_{individual}$. This being the case, around ex-dividend days, institutional investors may want to acquire stocks cum-dividend, sell stocks ex-dividend, or both, so as to capture dividends. Individual investors may want to sell stocks cum-dividend, acquire stocks ex-dividend, or both, so as to avoid dividends. This difference in preferences motivates an increase in trading volume around ex-dividend days.

Because we assume two basic categories of investors, equation (2) becomes

$$V_e = \frac{D}{2\sigma_e^2}\left\{n_1|\alpha_1 - \bar{\alpha}|K_1 + n_2|\alpha_2 - \bar{\alpha}|K_2\right\}, \tag{3}$$

where n_1 and n_2 are the numbers of investors who belong to Category 1 and 2, respectively, K_1 and K_2 are the levels of risk tolerance for Category 1 and 2 investors, α_1 and α_2 are the tax-induced preferences for dividends versus capital gains for investor Category 1 and 2, and $\bar{\alpha}$, the average preference for dividends versus capital gains, weighted by the level of risk tolerance of both categories of investors, is computed as

$$\bar{\alpha} = \frac{K_1 n_1 \alpha_1 + K_2 n_2 \alpha_2}{K_1 n_1 + K_2 n_2}. \tag{4}$$

Substituting equation (4) into equation (3), ex-day trading volume becomes

$$\begin{aligned} V_e &= \frac{D}{2\sigma_e^2}(K_1 + K_2)|\alpha_1 - \alpha_2|\frac{n_1 n_2}{K_1 n_1 + K_2 n_2} \\ &= \frac{D}{2\sigma_e^2}(K_1 + K_2)|\alpha_1 - \alpha_2|\frac{n_1(N - n_1)}{K_1 n_1 + K_2(N - n_1)}, \end{aligned} \tag{5}$$

where $N = n_1 + n_2$ is the total number of investors in the economy for the underlying stock. Equation (5) suggests that ex-day trading volume is determined by the interaction between the relative taxation of dividends and capital gains for Category 1 and 2 investors, $|\alpha_1 - \alpha_2|$, and the stock's ownership structure OS,

$$OS = \frac{n_1 n_2}{K_1 n_1 + K_2 n_2} = \frac{n_1(N - n_1)}{K_1 n_1 + K_2(N - n_1)}. \tag{6}$$

[5] Institutional investors include banks, insurance companies, mutual funds, college endowment funds, corporate investors, pension and retirement funds, broker dealers, and investment advisors.

Equation (5) also suggests that excess trading volume is a function of the level of Category 1 (or 2) investors, that is, ownership structure. The first and second derivatives of equation (5) with respect to n_1 are

$$\frac{\partial V_e}{\partial n_1} = \frac{D}{2\sigma_e^2}(K_1 + K_2)|\alpha_1 - \alpha_2|\frac{K_2(N - n_1)^2 - K_1 n_1^2}{[K_1 n_1 + K_2(N - n_1)]^2}, \tag{7}$$

$$\frac{\partial^2 V_e}{\partial n_1^2} = -\frac{D}{\sigma_e^2}(K_1 + K_2)|\alpha_1 - \alpha_2|\frac{K_1 K_2 N^2}{[K_1 n_1 + K_2(N - n_1)]^3} < 0. \tag{7'}$$

This means that ex-day trading volume is a concave function of the level of Category 1 (or 2) investors. It first increases in the level of Category 1 (or 2) investors, reaches a peak, and then decreases. The reason for this pattern is that the level of tax-induced investor heterogeneity, a function of the stock ownership structure, first increases and then decreases in the level of Category 1 (or 2) investors.

C. Tax-Motivated Trading Hypothesis

The intuition for equation (5) is simple. When the level of institutional ownership is very low, the degree of tax-induced investor heterogeneity is low because most of the investors are homogeneous individual investors. Likewise, the degree of tax-induced investor heterogeneity is low when the level of institutional ownership is very high because most of the investors are homogeneous institutional investors. The highest degree of tax-induced investor heterogeneity occurs in between the two extremes. In testing the relation between ex-day excess trading volume and investor tax-induced heterogeneity, Michaely and Vila (1996) use an economy-wide measure of investor tax heterogeneity. They find a positive relation between investors' weighted average absolute deviation from the mean tax rate and the economy-wide excess trading volume around ex-dividend days. We use a stock-specific measure of investor tax-induced heterogeneity. Michaely and Vila (1996) argue that if clientele groups could be precisely identified, one could construct a firm-specific tax heterogeneity variable. However, there are no reliable data on the cross-sectional variation in tax rates and absolute risk aversion across holders of different stocks. Our firm-specific measure of tax-induced investor heterogeneity, the level of institutional ownership, is an imperfect but reasonable proxy.

Based on the above argument, we propose the following tax-motivated trading hypothesis for the cross-sectional relations among ex-day excess trading volume, dividend yield, and institutional ownership.

TAX-MOTIVATED TRADING HYPOTHESIS: *Trading volume rises around ex-dividend days and the positive volume effect of dividend yield is a concave function of the level of institutional ownership, a proxy for the magnitude of the tax-induced investor heterogeneity.*

This hypothesis relies on the implicit assumption that trade occurs mainly between existing investors of the stock. It is possible that traders who are not existing investors of the stock may trade in and out of the stock around the ex-dividend days, thus driving the trading volume. To examine this possibility, we also conduct analyses using a proxy for institutional trades based on trade size. The results suggest that our holding clientele-based proxy, level of institutional ownership, is correlated with our trading clientele-based proxy, the ratio of the number of large trades to the number of all trades, and that the effects of both proxies on ex-day volume are similar. For brevity, we focus our discussion on the effect of institutional ownership in this section. The argument for the effect of the trading clientele-based proxy is similar to that for the holding clientele-based proxy.

D. Controls for Risk and Transaction Costs of Trading

Michaely and Vila (1995, 1996) and Michaely, Vila, and Wang (1996) suggest that ex-day trading will cause investors to deviate from an otherwise optimal portfolio, thus increasing their risk exposure. This suggests that ex-day excess trading volume should be decreasing in risk. They argue that both systematic risk and idiosyncratic risk will dampen trading activities around ex-dividend days. In our study, we control for both systematic risk and idiosyncratic risk and we expect them to have a negative effect on ex-day trading volume.

Transaction costs are frictions to trade because they erode trading profits, thus dampening trading incentives. When transaction costs increase, each investor trades in fewer stocks and fewer investors trade (see Michaely and Vila (1995, 1996), Michaely et al. (1996)). This means that excess trading volume around ex-dividend days should be decreasing in the level of transaction costs. As in Karpoff and Walkling (1988) and Naranjo, Nimalendran, and Ryngaert (2000), we use the inverse of stock price as a measure of transaction costs. Both papers argue that a higher level of the inverse of stock price results in higher percentage brokerage costs and bid-ask spreads. In fact, Bhardwaj and Brooks (1992) find direct evidence that both bid-ask spreads and round-trip commissions are inversely related to share prices. Thus, excess trading volume around ex-dividend days is expected to be negatively related to the inverse of stock price. We also include size (market capitalization) in our analyses to determine whether size impacts ex-day excess volume.

II. Data Description and Variable Definitions

This study covers the 10-year period from 1989 to 1998. We focus on quarterly taxable cash dividend distributions (CRSP distribution code 1232). Most cash dividend distributions are quarterly distributions, and they represent predictable and committed dividend policies. We extract 60,194 such ex-day observations from the CRSP distribution file. We apply three screens to this data: (1) each ex-dividend day in the sample must not coincide with other distribution days; (2) each ex-day observation must have 91 days of daily trading volume, return, and market capitalization data centered on the ex-day; and (3) each ex-day observation must have data on the dollar value of dividends and cum-dividend stock price. After applying these three screens, 51,279 ex-day observations remain.

Further, each ex-day observation is required to have data on the level of institutional ownership. Beginning-of-the-year aggregate levels of institutional ownership are obtained from Compact Disclosure SEC. Institutional investors with more than \$100 million of equity under management must report their holdings to the SEC in quarterly 13f filings.[6] Institutional investors in this database include banks, insurance companies, mutual funds, college endowment funds, corporate investors, pension and retirement funds, broker dealers, and other investment advisors. The firm-specific aggregate level of institutional ownership is defined as the total number of shares held by institutional investors divided by the total number of shares outstanding.[7] After volume data are matched with institutional ownership data, we have 31,878 ex-day observations.

Dividend yield, *YIELD*, for each ex-day is computed as the dollar amount of dividends per share, *AMT*, divided by the cum-dividend stock price, P_{CUM}. To avoid the effect of outliers, we eliminate observations in the top 0.5 percentile of dividend yield.[8] This reduces the sample size to 31,719 ex-day observations.

We control for systematic and idiosyncratic risks, which are estimated from the CAPM, as in Michaely and Vila (1996). For all of our tests, the event period is defined as the 11-day period centered on the event day (days -5 to $+5$ relative to the ex-dividend day) and the nonevent period is defined as the 80-day period including days -45 to -6 and $+6$ to $+45$. To obtain an estimate of the CAPM beta, β, our measure of systematic risk for each ex-day observation, we regress individual stock returns on market returns from the 80-day nonevent period. Idiosyncratic risk is measured by the standard error of the CAPM residuals scaled by the standard error of the market returns during the nonevent period, $\sigma_\varepsilon/\sigma_M$.

To control for transaction costs, we use the inverse of the cum-dividend closing price, P_{CUM}, following Naranjo, Nimalendran, and Ryngaert (2000). We use

[6] However, a manager may omit holdings otherwise reportable if the manager holds, on the period end date, fewer than 10,000 shares (or less than \$200,000 principal amount in the case of convertible debt securities) and less than \$200,000 aggregate fair market value (and option holdings to purchase only such amounts).

[7] This aggregate level of institutional ownership is an imperfect measure of tax-induced investor heterogeneity. For example, this measure includes mutual funds that indirectly hold equity for fully taxable individuals, for whom dividends are tax disadvantaged. However, this may not pose too serious a problem in this paper for two reasons. (1) The proportion of mutual funds is relatively low and has been declining over time: Gompers and Metrick (2001) find that the proportion of mutual funds among all institutional investors has declined from 9.00% in 1980 to 6.90% in 1996. (2) If mutual funds behave like individual investors, their presence will make it more difficult to find results supporting the tax-motivated trading hypotheses. Three studies have used aggregate level of institutional ownership as a measure of tax-related ownership structure: Ayers, Cloyd, and Robinson (2002); Dhaliwal, Erickson, and Trezevant (1999); and Dahliwal, Li, and Trezevant (2003).

[8] These outliers are mainly due to small denominators—the cum-dividend prices are too small.

the average daily market capitalization of a stock during the 80-day nonevent period as the measure of firm size. It is computed as

$$ACAP_i = \frac{\sum_{t \in [-45,-6] \cup [6,45]} CAP_{it}}{80}, \tag{8}$$

where CAP_{it} is the daily market capitalization (in \$millions) for stock i on day t, and $ACAP_i$ is the mean daily market capitalization for stock i during the 80-day nonevent period.

The ex-day excess trading volume is estimated as follows. As in Michaely and Vila (1995, 1996), we use the mean daily trading volume during the 80-day nonevent period as our measure of normal daily trading volume,

$$NV_i = \frac{\sum_{t \in [-45,-6] \cup [6,45]} VOL_{it}}{80}, \tag{9}$$

where VOL_{it} is the daily trading volume for stock i on day t and NV_i is the normal daily trading volume for stock i. Excess trading volume, $EXVOL$, for a day during the event period is

$$EXVOL_{it} = \frac{EV_{it}}{NV_i} - 1 \quad t \in [-5, 5], \tag{10}$$

where EV_{it} is the daily trading volume for stock i on day t during the event period. Thus, $EXVOL_{it}$ is a normalized measure of event period excess daily trading volume.

The average daily excess trading volume for each ex-day observation, $EXVOL_i$, is computed as

$$EXVOL_i = \frac{\sum_{t \in [-5,5]} EV_{it}}{11 \times NV_i} - 1, \tag{11}$$

This measure of event period average daily excess trading volume for each ex-day observation is the dependent variable used in our cross-sectional tests.

Apart from using the level of institutional ownership as a holding clientele-based measure of investor tax-induced heterogeneity, we also use a trading clientele-based measure of tax-induced heterogeneity. As discussed in more detail in Section III.A.2., a common proxy for institutional trades is large trades. We obtain trade data from the TAQ database. Since the TAQ database started in 1993, our sample is reduced to the 18,387 ex-day observations that occur between 1993 and 1998 and with data on trade size. For these observations, we obtain all trades between 9:30 am and 4:00 pm for every day during the 11-day event period around the ex-day. We then compute the ratio of the number of large trades to the number of all trades and average it over the 11-day event period in the following manner:

$$RATIO_i = \frac{\sum_{t\in[-5,5]} \frac{\#\ large\ trades_{it}}{\#\ all\ trades_{it}}}{11}, \tag{12}$$

where # *large trades*$_{it}$ is the number of large trades for stock i on day t relative to its ex-day and # *all trades*$_{it}$ is the number of all trades for stock i on day t relative to its ex-day. This *RATIO* variable is our proxy for trading clienteles around the ex-dividend days.

There are two available approaches to defining a large trade, namely, based on the number of shares traded and based on the dollar value of a trade. Lee and Radhakrishna (2000) argue that dollar-based cutoffs are conceptually superior to share-based cutoffs because they incorporate differences in stock prices, while share-based cutoffs ignore differences in stock prices. Based on this argument, we adopt dollar-based cutoffs to define large trades. We use three different cutoff levels of dollar-based trade size. Specifically, if the dollar value (based on closing price as in Lee and Radhakrishna (2000)) of a round lot trade is above \$15,000 (\$10,000 and \$5,000), we define the trade as a large trade.

III. Test Design and Empirical Results

A. Ex-Day Excess Trading Volume and Tax-Induced Investor Heterogeneity

A.1. Level of Institutional Ownership as a Holding Clientele-Based Measure of Heterogeneity

Using our full sample, we form quintiles based on the level of dividend yield and institutional ownership. This results in 25 portfolios. For each portfolio, we compute the mean excess trading volume, the dividend yield, and the level of institutional ownership. The results are shown in Table I. In general, within each institutional ownership quintile, excess trading volume increases as dividend yield increases. We compute chi-square statistics to test for the equality of mean excess trading volume, *EXVOL*, across dividend yield quintiles within each institutional ownership quintile. As shown in the bottom row of the table, in each of the five institutional ownership quintiles, the equality of excess trading volume across dividend yield quintiles is rejected. This result is consistent with the presence of tax-motivated trading around ex-dividend days. When the dividend yield is large, so that the potential tax benefit of exchanging dividends and capital gains among different investors is great, investors are more motivated to trade, thus creating a positive relation between dividend yield and excess trading volume. Also, Table I shows that in the highest dividend yield quintile, as the level of institutional ownership increases, excess trading volume first increases and then declines. This is consistent with the notion that as the level of institutional ownership increases, tax-induced investor heterogeneity first increases and then decreases, causing excess trading volume to peak and then decline. This supports our hypothesis that there is a concave relation between the volume effect of dividend yield and the level of institutional ownership.

Table I

Statistics for Event-Period Excess Trading Volume for Quintile Subsamples Based on Dividend Yield and Institutional Ownership

Ex-dividend dates and volume data are obtained from CRSP. For each ex-day observation, 91 days (days −45 to +45 relative to the ex-day) of daily trading volume are extracted. The 11-day period from day −5 to day 5 is defined as the event period, and the 80-day period including days −45 to −6 and days +6 to +45 is defined as the nonevent period. Average normal daily trading volume *NV* for each stock is the average daily trading volume for the nonevent period. The normalized excess volume during the event period for each ex-day observation is $EXVOL = EV/NV - 1$, where *EV* is the average event period daily trading volume for each ex-day observation. The full sample of 31,719 ex-day observations is used. *YIELD* is defined as the dollar amount of dividends paid on the ex-dividend day *AMT* divided by the cum-dividend stock price P_{CUM}. *INST* is the number of shares owned by institutional investors divided by the total number of shares outstanding. Data on institutional ownership are from SEC 13f filings obtained from Compact Disclosure SEC. The chi-square statistics test for the equality of the value of *EXVOL* across *YIELD* (*INST*) quintiles, within each *INST* (*YIELD*) quintile. It is computed as

$$\chi^2(5) = \sum_{s=1}^{5}\left[\frac{\overline{EXVOL_s} - \overline{EXVOL}}{S_s}\right]^2,$$

where $\overline{EXVOL_s}$ is the mean excess trading volume for Quintile s, S_s is its standard deviation, and $\overline{EXVOL}$ is the mean excess trading volume for the whole sample.

		INST Quintile 1			*INST* Quintile 2			*INST* Quintile 3			*INST* Quintile 4			*INST* Quintile 5			
	Variable	*N*	Mean	*SD*	*N*	Mean	*SD*	*N*	Mean	*SD*	*N*	Mean	*SD*	*N*	Mean	*SD*	χ^2 Test
YIELD	*YIELD*	1,219	0.0013	0.0009	1,024	0.0013	0.0009	1,136	0.0013	0.0009	1,155	0.0013	0.0009	1,812	0.0014	0.0008	
Quintile 1	*INST*	1,219	0.1226	0.0865	1,024	0.3450	0.0480	1,136	0.4806	0.0326	1,155	0.6008	0.0330	1,812	0.7642	0.0844	
	EXVOL	1,219	0.0661	0.7754	1,024	0.0398	0.7282	1,136	0.0391	0.6119	1,155	0.0109	0.5964	1,812	0.0406	1.1137	4.0986
YIELD	*YIELD*	1,129	0.0037	0.0006	1,179	0.0038	0.0006	1,274	0.0038	0.0006	1,279	0.0037	0.0006	1,479	0.0037	0.0006	
Quintile 2	*INST*	1,129	0.1382	0.0878	1,179	0.3485	0.0442	1,274	0.4810	0.0336	1,279	0.5956	0.0336	1,479	0.7465	0.0738	
	EXVOL	1,129	0.0357	0.8185	1,179	0.0431	0.6859	1,274	0.0405	0.5614	1,279	0.0106	0.4988	1,479	−0.0173	0.4794	13.0157
YIELD	*YIELD*	1,100	0.0057	0.0006	1,115	0.0057	0.0006	1,332	0.0058	0.0006	1,497	0.0058	0.0006	1,302	0.0057	0.0006	
Quintile 3	*INST*	1,100	0.1337	0.0867	1,115	0.3474	0.0449	1,332	0.4811	0.0353	1,497	0.5971	0.0321	1,302	0.7357	0.0697	
	EXVOL	1,100	0.0580	0.8339	1,115	0.0837	0.9610	1,332	0.0459	0.5898	1,497	−0.0027	0.4524	1,302	−0.0008	0.4717	21.1170
YIELD	*YIELD*	984	0.0082	0.0009	1,130	0.0082	0.0009	1,516	0.0083	0.0009	1,607	0.0082	0.0009	1,106	0.0082	0.0009	
Quintile 4	*INST*	984	0.1407	0.0860	1,130	0.3519	0.0441	1,516	0.4818	0.0356	1,607	0.5981	0.0319	1,106	0.7242	0.0620	
	EXVOL	984	0.0861	1.0377	1,130	0.0744	0.8111	1,516	0.0499	0.7091	1,607	0.0573	0.7255	1,106	0.0918	0.9399	2.4917
YIELD	*YIELD*	1,923	0.0156	0.0041	1,857	0.0153	0.0040	1,110	0.0141	0.0045	806	0.0134	0.0038	648	0.0127	0.0028	
Quintile 5	*INST*	1,923	0.1629	0.0698	1,857	0.3381	0.0468	1,110	0.4759	0.0353	806	0.5951	0.0326	648	0.7276	0.0653	
	EXVOL	1,923	0.4181	1.6852	1,857	0.6229	1.7329	1,110	0.2305	0.8910	806	0.2537	0.9505	648	0.1424	0.8750	143.0750
	χ^2 Test		119.1524			312.2981			48.4847			70.6948			41.2991		

Table II

Descriptive Statistics

Ex-dividend dates and volume data are obtained from CRSP. For each ex-day observation, 91 days (days −45 to +45 relative to the ex-day) of daily trading volume are extracted. The 11-day period from day −5 to day 5 is defined as the event period, and the 80-day period including days −45 to −6 and days +6 to +45 is defined as the nonevent period. Average normal daily trading volume *NV* for each stock is the average daily trading volume for the nonevent period. The normalized excess volume during the event period for each ex-day observation is $EXVOL = EV/NV - 1$, where *EV* is the average event period daily trading volume for each ex-day observation. Our measure of systematic risk, the CAPM β, is estimated by regressing nonevent period individual stock returns on nonevent period market returns. Idiosyncratic risk is measured by the standard error of the CAPM residuals scaled by the standard error of the market returns during the nonevent period, $\sigma_\varepsilon/\sigma_M$. *YIELD* is defined as the dollar amount of dividends paid on the ex-dividend day *AMT* divided by the cum-dividend stock price P_{CUM}. *INST* is the number of shares owned by institutional investors divided by the total number of shares outstanding. Data on institutional ownership are from SEC 13f filings obtained from Compact Disclosure SEC. The proxy for transaction costs is $1/P_{CUM}$, where P_{CUM} is the cum-day stock price. Average market capitalization *ACAP* is the average daily market capitalization during the nonevent period.

Variable	*N*	Mean	5th Ptcl	25th Pctl	50th Pctl	75th Pctl	95th Pctl
EXVOL	31,719	0.1118	−0.6134	−0.2957	−0.0512	0.2723	1.2696
β	31,719	0.6781	−0.0928	0.3213	0.6480	1.0189	1.6013
$\sigma_\varepsilon/\sigma_M$	31,719	2.7429	1.0703	1.6555	2.2814	3.1848	5.4193
$1/P_{CUM}$	31,719	0.0470	0.0137	0.0240	0.0357	0.0548	0.1194
ACAP	31,719	3.6382	0.0296	0.1862	0.7579	2.8058	14.9761
INST	31,719	0.4618	0.0700	0.3045	0.4800	0.6256	0.7837
YIELD	31,719	0.0067	0.0006	0.0032	0.0057	0.0090	0.0167

The regression analyses are designed to examine the interaction between dividend yield and institutional ownership while controlling for risk, transaction costs, and size. Table II presents descriptive statistics for the sample. The table indicates that although the mean excess volume is positive, the median excess volume is negative, suggesting that the distribution of excess volume is skewed.[9]

For the dependent and independent variables in our sample, excess trading volume is positively correlated with dividend yield ($\rho = 0.1574$, $p = 0.0001$), which is consistent with the tax-motivated trading hypothesis. The correlation between excess trading volume and institutional ownership is negative ($\rho = -0.0594$, $p = 0.0001$). Since the expected relation between these two variables is nonlinear, this simple correlation may not be meaningful. It is interesting to note that the correlation between dividend yield and the level of institutional ownership is negative ($\rho = -0.1931$, $p = 0.0001$), which suggests that the often hypothesized dividend tax clientele effect does not exist, at least within

[9] This result is also true for a subsample of observations with trades during the 11-day event period and for subsamples of observations with dividends per share greater than \$0.05 and \$0.10. When we focus on excess volume on the ex-day itself, we still observe the same pattern; that is, the distribution of excess volume is skewed.

dividend paying stocks. See Grinstein and Michaely (2003) for a formal analysis of dividend clienteles.

To test for a nonlinear relation between the level of institutional ownership and the volume effect of dividend yield, we first analyze the following regression model in institutional ownership deciles,

$$EXVOL_i = \alpha_0 + \alpha_1\beta_i + \alpha_2\sigma_\varepsilon/\sigma_{Mi} + \alpha_3 1/P_{CUMi} + \alpha_4 ACAP_i + \alpha_5 YIELD_i + u_i. \tag{13}$$

We expect the coefficients on β and $\sigma_\varepsilon/\sigma_M$ to be negative, since excess trading around ex-dividend days will cause investors to deviate from their optimal portfolio holding, thereby forcing them to assume more risk. We also expect the coefficient on $1/P_{CUM}$ to be negative because transaction costs reduce trading gains. In this test based on institutional ownership deciles, we focus on the *YIELD* coefficient. Since *YIELD* is a measure of the potential tax gains from ex-day trading, we expect the coefficient on *YIELD* to be positive in all *INST* deciles. On the other hand, as the level of institutional ownership increases, the degree of tax-induced heterogeneity first increases and then decreases, and we expect that the coefficient on *YIELD* will follow the same concave pattern.

The results are shown in Table III. The coefficients on *YIELD* are positive for all the *INST* deciles and are significant for the first nine deciles. In Decile 3, the coefficient on *YIELD* peaks and then generally declines as the level of institutional ownership increases. This result is consistent with the tax-motivated trading (concavity) hypothesis. Figure 1 shows the coefficient on *YIELD* as a function of *INST* decile.

Next, we directly test for concavity in the relation between the level of institutional ownership and the volume effect of dividend yield by interacting *YIELD* with *INST* and $INST^2$. We utilize the following regression model for the whole sample,

$$EXVOL_i = \alpha_0 + \alpha_1\beta_i + \alpha_2\sigma_\varepsilon/\sigma_{Mi} + \alpha_3 1/P_{CUMi} + \alpha_4 ACAP_i + \alpha_5 INST_i + \alpha_6 INST_i^2 + \alpha_7 YIELD_i + \alpha_8 YIELD_i \cdot INST_i + \alpha_9 YIELD_i \cdot INST_i^2 + u_i. \tag{14}$$

We have argued that it is the interaction between dividends and tax-induced heterogeneity that creates excess trading volume. If the level of institutional ownership were a perfect measure of investor tax-induced heterogeneity, then we would expect the coefficient on $YIELD \cdot INST$ to be positive, the coefficient on $YIELD \cdot INST^2$ to be negative, and the coefficient on *YIELD* to be zero. However, because the aggregate level of institutional ownership is an imperfect measure, it does not completely capture investor tax-induced heterogeneity. Previous studies have found that dividend yield captures some of this heterogeneity as well as gains from trading. Therefore, we expect the coefficient on *YIELD* to be positive.

The results are shown in Table IV. The primary focus of this paper is the impact of institutional ownership on the volume effect of dividend yield. The coefficient on *YIELD* is significantly positive ($\alpha_7 = 18.0030, t = 3.01$). As expected, dividend yield appears to be capturing some variation in tax

Table III

Effect of Dividend Yield on Excess Trading Volume for Institutional Ownership Deciles

Ex-dividend dates and volume data are obtained from CRSP. For each ex-day observation, 91 days (days −45 to +45 relative to the ex-day) of daily trading volume are extracted. The 11-day period from day −5 to day 5 is defined as the event period, and the 80-day period including days −45 to −6 and days +6 to +45 is defined as the nonevent period. Average normal daily trading volume *NV* for each stock is the average daily trading volume for the nonevent period. The normalized excess volume during the event period for each ex-day observation is $EXVOL = EV/NV - 1$, where *EV* is the average event period daily trading volume for each ex-day observation. Our measure of systematic risk, the CAPM β, is estimated by regressing nonevent period individual stock returns on nonevent period market returns. Idiosyncratic risk is measured by the standard error of the CAPM residuals scaled by the standard error of the market returns during the nonevent period, $\sigma_\varepsilon/\sigma_M$. *YIELD* is defined as the dollar amount of dividends paid on the ex-dividend day *AMT* divided by the cum-dividend stock price P_{CUM}. *INST* is the number of shares owned by institutional investors divided by the total number of shares outstanding. Data on institutional ownership are from SEC 13f filings obtained from Compact Disclosure SEC. The proxy for transaction costs is $1/P_{CUM}$, where P_{CUM} is the cum-day stock price. Average market capitalization *ACAP* is the average daily market capitalization during the nonevent period. The regression model is

$$EXVOL_i = \alpha_0 + \alpha_1\beta_i + \alpha_2 IRISK_i + \alpha_3 1/P_{CUMi} + \alpha_4 ACAP_i + \alpha_5 YIELD_i + u_i.$$

The variance–covariance matrix is White's (1980) heteroskedasticity consistent matrix. The cell values are regression coefficients and t-values (in parentheses). ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Dividend	Decile 1	Decile 2	Decile 3	Decile 4	Decile 5	Decile 6	Decile 7	Decile 8	Decile 9	Decile 10
Intercept	0.0512	0.0036	0.0737	0.0000	0.1081	0.0025	−0.0225	−0.0249	0.0632	0.0790
	(1.28)	(0.09)	(1.44)	(0.00)	(2.23)**	(0.06)	(−0.53)	(−0.35)	(1.51)	(1.38)
β	−0.0555	−0.0500	−0.0704	−0.0370	−0.0410	−0.0060	−0.0086	0.0269	−0.0033	−0.0753
	(−1.67)*	(−1.87)*	(−1.92)*	(−0.80)	(−1.49)	(−0.28)	(−0.36)	(0.85)	(−0.15)	(−1.72)*
$\sigma_\varepsilon/\sigma_M$	−0.0012	−0.0061	−0.0407	−0.0098	−0.0424	−0.0131	−0.0267	−0.0345	−0.0420	−0.0104
	(−2.03)**	(−2.06)**	(−2.64)***	(−0.52)	(−3.48)***	(−1.35)	(−2.29)**	(−1.48)	(−2.21)**	(−0.64)
$1/P_{CUM}$	−0.1208	−0.6611	−1.6201	−1.2476	−0.4660	1.0493	0.2315	1.0861	1.3190	0.8307
	(−0.41)	(−1.80)*	(−2.45)**	(−1.91)*	(−0.78)	(1.34)	(0.44)	(1.10)	(0.85)	(1.41)
ACAP	−0.0009	−0.0003	0.0017	−0.0025	−0.0016	−0.0004	0.0001	−0.0015	−0.0011	−0.0016
	(−1.44)	(−0.66)	(0.73)	(−3.24)***	(−2.53)**	(−0.82)	(0.14)	(−1.75)*	(−0.76)	(−1.62)
YIELD	**16.3174**	**33.1958**	**48.3221**	**43.5871**	**22.0170**	**7.9598**	**22.5877**	**17.5602**	**8.6375**	**3.3159**
	(2.44)**	**(9.71)*****	**(10.07)*****	**(8.77)*****	**(4.79)*****	**(2.75)*****	**(4.54)*****	**(4.37)*****	**(2.29)****	**(0.67)**
Adj. R^2	0.0056	0.0328	0.0935	0.0358	0.0251	0.0074	0.0255	0.0134	0.0080	0.0016
No. of obs.	3,154	3,201	3,064	3,241	3,136	3,232	3,174	3,170	3,174	3,173

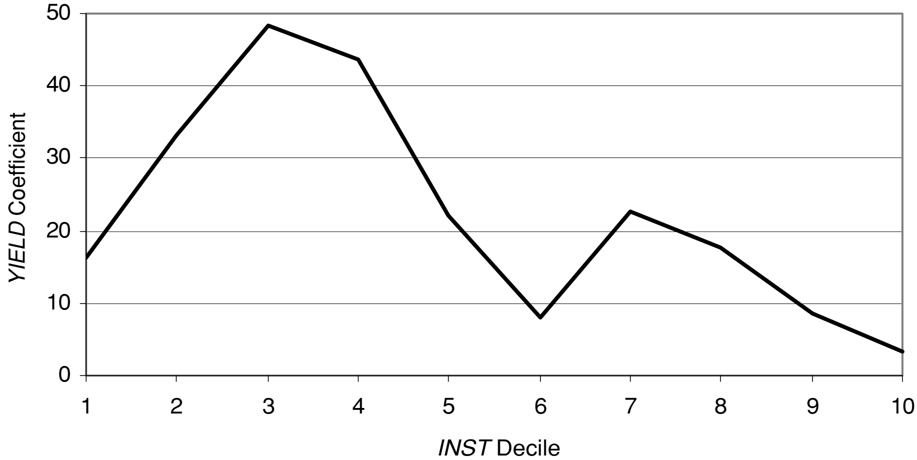


Figure 1. The regression coefficient on *YIELD* for the *INST* deciles. This figure is based on regression results reported in Table III. The regression model is

$$EXVOL_i = \alpha_0 + \alpha_1\beta_i + \alpha_2\sigma_\varepsilon/\sigma_{Mi} + \alpha_3 1/P_{CUMi} + \alpha_4 ACAP_i + \alpha_5 YIELD_i + u_i.$$

Ex-dividend dates and volume data are obtained from CRSP. For each ex-day observation, 91 days (days −45 to +45 relative to the ex-day) of daily trading volume are extracted. The 11-day period from day −5 to day 5 is defined as the event period, and the 80-day period including days −45 to −6 and days +6 to +45 is defined as the nonevent period. Average normal daily trading volume *NV* for each stock is the average daily trading volume for the nonevent period. The normalized excess volume during the event period for each ex-day observation is $EXVOL = EV/NV - 1$, where *EV* is the average event period daily trading volume for each ex-day observation. Our measure of systematic risk, the CAPM β, is estimated by regressing nonevent period individual stock returns on nonevent period market returns. Idiosyncratic risk is measured by the standard error of the CAPM residuals scaled by the standard error of the market returns during the nonevent period, $\sigma_\varepsilon/\sigma_M$. *YIELD* is defined as the dollar amount of dividends paid on the ex-dividend day *AMT* divided by the cum-dividend stock price P_{CUM}. *INST* is the number of shares owned by institutional investors divided by the total number of shares outstanding. Data on institutional ownership are from SEC 13f filings obtained from Compact Disclosure SEC. The proxy for transaction costs is $1/P_{CUM}$, where P_{CUM} is the cum-day stock price. Average market capitalization *ACAP* is the average daily market capitalization during the nonevent period.

heterogeneity and has a positive effect on excess volume. Thus, yield itself is related to the tax-motivated trading volume. This result is consistent with numerous previous studies, such as Michaely and Vila (1995, 1996) and Lakonishok and Vermaelen (1986). The coefficient on $YIELD \cdot INST$ is significantly positive ($\alpha_8 = 114.1877, t = 4.10$) and the coefficient on $YIELD \cdot INST^2$ is significantly negative ($\alpha_9 = -176.9474, t = -5.85$). This result is consistent with the effect of dividend yield on excess trading volume being a concave function of the level of institutional ownership, and it is therefore consistent with the tax-motivated trading hypothesis.[10]

[10] We also perform regression analyses for a subsample of stocks that are traded during the ex-day period, and based on subsamples of stocks with dividends per share greater than 5 cents and 10 cents. We obtain results that are qualitatively similar to those based on the full sample.

Table IV

Effect of Dividend Yield and Institutional Ownership on Excess Trading Volume Around Ex-Dividend Days

Ex-dividend dates and volume data are obtained from CRSP. For each ex-day observation, 91 days (days −45 to +45 relative to the ex-day) of daily trading volume are extracted. The 11-day period from day −5 to day 5 is defined as the event period, and the 80-day period including days −45 to −6 and days +6 to +45 is defined as the nonevent period. Average normal daily trading volume *NV* for each stock is the average daily trading volume for the nonevent period. The normalized excess volume during the event period for each ex-day observation is $EXVOL = EV/NV - 1$, where *EV* is the average event period daily trading volume for each ex-day observation. Our measure of systematic risk, the CAPM β, is estimated by regressing nonevent period individual stock returns on nonevent period market returns. Idiosyncratic risk is measured by the standard error of the CAPM residuals scaled by the standard error of the market returns during the nonevent period, $\sigma_\varepsilon/\sigma_M$. *YIELD* is defined as the dollar amount of dividends paid on the ex-dividend day *AMT* divided by the cum-dividend stock price P_{CUM}. *INST* is the number of shares owned by institutional investors divided by the total number of shares outstanding. Data on institutional ownership are from SEC 13f filings obtained from Compact Disclosure SEC. The proxy for transaction costs is $1/P_{CUM}$, where P_{CUM} is the cum-day stock price. Average market capitalization *ACAP* is the average daily market capitalization during the nonevent period. The regression model is

$$EXVOL_i = \alpha_0 + \alpha_1\beta_i + \alpha_2 IRISK_i + \alpha_3 1/P_{CUMi} + \alpha_4 ACAP_i + \alpha_5 INST_i + \alpha_6 INST_i^2$$
$$+ \alpha_7 YIELD_i + \alpha_8 YIELD_i \cdot INST_i + \alpha_9 YIELD_i \cdot INST_i^2 + u_i.$$

The variance–covariance matrix is White's (1980) heteroskedasticity consistent matrix. The cell values are regression coefficients and *t*-values (in parentheses). *** and ** indicate significance at the 1% and 5% levels, respectively.

Intercept	0.0692
	(2.03)**
β	−0.0261
	(−2.16)**
$\sigma_\varepsilon/\sigma_M$	−0.0031
	(−2.07)**
$1/P_{CUM}$	−0.5884
	(−3.66)***
ACAP	−0.0008
	(−3.28)***
INST	−0.6039
	(−4.14)***
$INST^2$	0.7622
	(4.94)***
YIELD	**18.0030**
	(3.01)* **
YIELD · INST	**114.1877**
	(4.10)* **
YIELD $\boldsymbol{\cdot INST^2}$	**−176.9474**
	(−5.85)* **
Adj. R^2	0.0301
No. of obs.	31,719

As for the control variables, the coefficient on β is negative and significant ($\alpha_1 = -0.0261, t = -2.16$), and the coefficient on $\sigma_\varepsilon/\sigma_M$ is also negative and significant ($\alpha_2 = -0.0031, t = -2.07$). These results are consistent with Michaely and Vila (1995, 1996) in that the ex-day excess trading volume is decreasing in both the systematic risk and the idiosyncratic risk. The coefficient on $1/P_{CUM}$ is negative and significant ($\alpha_3 = -0.5884, t = -3.66$), consistent with prior research, such as Lakonishok and Vermaelen (1986), Naranjo, Nimalendran, and Ryngaert (2000), and Koski and Scruggs (1998).[11] The coefficient on *ACAP* is negative and significant, suggesting that the ex-day trading effect is more pronounced for stocks with lower levels of market capitalization. The coefficient on *INST* is negative and significant and the coefficient on $INST^2$ is positive and significant.[12]

Based on Michaely and Vila's (1995) model assumptions, including exponential utility and normality, the volume-maximizing level of institutional ownership is a function of the relative risk tolerance of institutional and individual investors. If institutions are more risk tolerant than individuals (see Naranjo, Nimalendran, and Ryngaert (2000)), then the volume-maximizing level of institutional ownership should be less than 50%.[13] Based on the regression results for equation (14), shown in Table IV, the volume-maximizing level of institutional ownership is

$$INST^* = -\frac{114.1877 \times YIELD}{2 \times (-176.9474 YIELD)} = 0.3227 = 32.27\% < 50\%. \tag{15}$$

This volume-maximizing level of institutional ownership appears to be consistent with the univariate results in Table I, which shows that in the highest dividend yield quintile, the peak excess trading volume occurs when the level of institutional ownership is 33.81%.[14]

Figure 2 depicts the expected level of excess volume as a function of dividend yield and institutional ownership. It shows that at any dividend yield cross-section, excess volume first increases in the level of institutional ownership,

[11] For the subperiod from 1993 to 1998, when information on bid-ask spread is available, we replace $1/P_{CUM}$ with the event-period bid-ask spread and obtain qualitatively similar results.

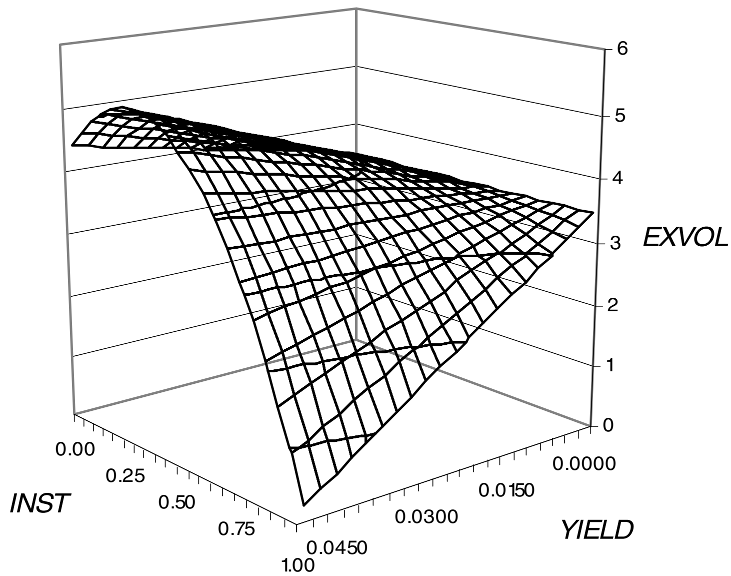
[12] This suggests that with the tax-induced investor heterogeneity effect controlled for, the level of institutional ownership has some dampening effect on the ex-day excess trading volume, and that this dampening effect declines when the level of institutional ownership increases. Since ownership structure enters the excess trading volume model in conjunction with dividend yield, we do not have an ex ante prediction for the effect of the level of institutional ownership in isolation.

[13] If $K_1 > K_2$, then the volume-maximizing level of Category 1 investor is

$$n^* = \frac{N\sqrt{K_2}}{\sqrt{K_1} + \sqrt{K_2}} < \frac{N}{2}.$$

Thus, if institutional investors are more risk tolerant than individual investors, then the volume-maximizing level of institutional ownership is less than 50%.

[14] We hasten to admit that while the exponential utility function strictly implies that K is a risk tolerance measure, different utility functions can result in a slightly different interpretation of K. For example, K can be interpreted as a relative wealth measure. Alternatively, institutional investors may simply have a higher propensity to trade, without regard to risk tolerance. We thank the referee for pointing this out to us.



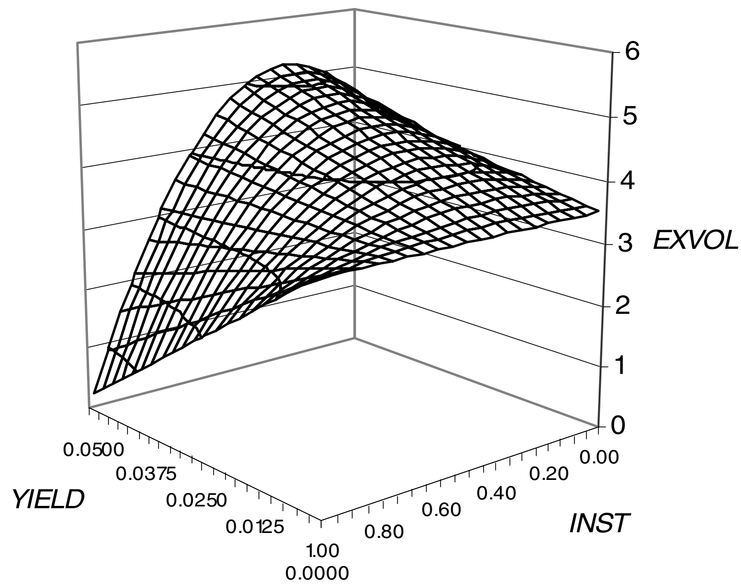
a. Frontal View

Figure 2. The expected effect of dividend yield and institutional ownership on excess trading volume around ex-dividend days. These figures are based on regression results for the full sample reported in Table IV. The regression model is

$$EXVOL_i = \alpha_0 + \alpha_1\beta_i + \alpha_2\sigma_\varepsilon/\sigma_{Mi} + \alpha_3 1/P_{CUMi} + \alpha_4 ACAP_i + \alpha_5 INST_i + \alpha_6 INST_i^2$$
$$+ \alpha_7 YIELD_i + \alpha_8 YIELD_i \cdot INST_i + \alpha_9 YIELD_i \cdot INST_i^2 + u_i.$$

Ex-dividend dates and volume data are obtained from CRSP. For each ex-day observation, 91 days (days -45 to $+45$ relative to the ex-day) of daily trading volume are extracted. The 11-day period from day -5 to day 5 is defined as the event period, and the 80-day period including days -45 to -6 and days $+6$ to $+45$ is defined as the nonevent period. Average normal daily trading volume *NV* for each stock is the average daily trading volume for the nonevent period. The normalized excess volume during the event period for each ex-day observation is $EXVOL = EV/NV - 1$, where *EV* is the average event period daily trading volume for each ex-day observation. Our measure of systematic risk, the CAPM β, is estimated by regressing nonevent period individual stock returns on nonevent period market returns. Idiosyncratic risk is measured by the standard error of the CAPM residuals scaled by the standard error of the market returns during the nonevent period, $\sigma_\varepsilon/\sigma_M$. *YIELD* is defined as the dollar amount of dividends paid on the ex-dividend day *AMT* divided by the cum-dividend stock price P_{CUM}. *INST* is the number of shares owned by institutional investors divided by the total number of shares outstanding. Data on institutional ownership are from SEC 13f filings obtained from Compact Disclosure SEC. The proxy for transaction costs is $1/P_{CUM}$, where P_{CUM} is the cum-day stock price. Average market capitalization *ACAP* is the average daily market capitalization during the nonevent period.

reaches a peak at a level of institutional ownership less than 50%, and then declines as the level of institutional ownership increases further. This result suggests that excess volume is a concave function of the level of institutional ownership, thus supporting the tax-motivated trading hypothesis.



b. A 90-Degree Clockwise Rotation

Figure 2 —*Continued.*

A.2. Large Trade Ratio as a Trading Clientele-Based Measure of Heterogeneity

The above analyses use the level of institutional ownership to proxy for the magnitude of tax-induced investor heterogeneity. While the level of institutional ownership is a good and simple proxy for holding clienteles, it is not clear whether it is also a good proxy for ex-day trading clienteles. In this subsection, we use another proxy that directly tracks trades, rather than holdings. A common proxy for institutional trades is large trades. For example, Cready (1988), Cready and Mynatt (1991), Lee (1992), Lee and Radhakrishna (2000), Bhattacharya (2001), and Koski and Michaely (2000), among many others, use trade size to infer trader identity.[15] These studies suggest that large trades are usually executed by institutional investors and that small trades are usually executed by individual investors. This being the case, we use the ratio of the number of large trades to the number of all trades as a proxy for trading clienteles, that is, institutional trades versus individual trades, around the ex-dividend days. When this ratio is low, tax-induced heterogeneity in trading clienteles is low because most of the trades are executed by individuals, and ex-day trading volume should be relatively low. When this ratio increases, the possible trading interaction between institutional and individual investors in-

[15] Koski and Michaely (2000) is especially relevant to our study, since they examine the information effect of large trades in the ex-dividend setting.

creases and thus the tax-induced heterogeneity increases, and ex-day volume should increase. When this ratio is very high, tax-induced heterogeneity in trading clienteles declines because most of the trades are executed by institutions, and ex-day volume should decline. Thus, we predict that the ex-day volume effect of dividend yield should be a concave function of the ratio of the number of large trades to the number of all trades.

As discussed in Section II, we use three dollar-based trade size cutoffs to define large trades. The three ratio measures are all highly correlated with the level of institutional ownership. The correlation coefficients are 0.4605, 0.4379, and 0.3903 for the ratio based on the \$15,000, \$10,000, and \$5,000 cutoffs, respectively. The correlation between the large trade ratio and the level of institutional ownership appears to be increasing in the cutoff level of dollar-based trade size. This pattern is consistent with institutional investors executing relatively large trades and with individual investors executing relatively small trades. These correlation coefficients suggest that the two investor tax-induced heterogeneity proxies based on trading clienteles and holding clienteles are correlated, and that the level of institutional ownership is a reasonably good proxy for ex-day tax-induced heterogeneity. We suspect that there is a built-in correlation between trade size and excess volume, since if there are more large trades, volume is likely to be higher. To control for this potential effect and to determine the effect of the large trade ratio on volume, we include *RATIO* as a separate independent variable in the following regression analysis:

$$EXVOL_i = \alpha_0 + \alpha_1\beta_i + \alpha_2\sigma_\varepsilon/\sigma_{Mi} + \alpha_3 1/P_{CUMi} + \alpha_4 ACAP_i + \alpha_5 RATIO_i + \alpha_6 YIELD_i + \alpha_7 YIELD_i \cdot RATIO_i + \alpha_8 YIELD_i \cdot RATIO_i^2 + u_i. \quad (16)$$

Since we have argued that excess volume is a concave function of the large trade ratio, we expect the coefficients on *YIELD* and *YIELD* · *RATIO* to be positive and the coefficient on *YIELD* · *RATIO*^{2} to be negative.

The regression results are shown in Table V. For all three measures of the large trade ratio, the coefficient on *YIELD* · *RATIO* is positive and significant ($\alpha_7 = 92.3416, t = 4.11; \alpha_7 = 107.6596, t = 3.84$; and, $\alpha_7 = 156.3247, t = 5.16$ for \$15,000, \$10,000, and \$5,000 cutoffs, respectively). The coefficient on *YIELD* · *RATIO*^{2} is negative and significant ($\alpha_8 = -140.1174, t = -4.28; \alpha_8 = -122.7061, t = -3.49$; and, $\alpha_8 = -123.3579, t = -4.36$ for \$15,000, \$10,000, and \$5,000 cutoffs, respectively). These results corroborate those based on the level of institutional ownership and add further support for the tax-motivated trading hypothesis. The coefficient on *RATIO* is positive and significant for \$15,000 and \$10,000 cutoffs, which indicates that there is some built-in correlation between large trades and ex-day trading volume.

B. Role of Pensions

The results reported thus far are based on the implicit assumption that institutional investors are homogeneous with respect to their tax attributes. In reality, the tax attributes of different types of institutional investors are different.

Table V

Trade Size and Excess Trading Volume Around Ex-Dividend Days

Ex-dividend dates and volume data are obtained from CRSP. For each ex-day observation, 91 days (days −45 to +45 relative to the ex-day) of daily trading volume are extracted. The 11-day period from day −5 to day 5 is defined as the event period, and the 80-day period including days −45 to −6 and days +6 to +45 is defined as the nonevent period. Average normal daily trading volume *NV* for each stock is the average daily trading volume for the nonevent period. The normalized excess volume during the event period for each ex-day observation is $EXVOL = EV/NV - 1$, where *EV* is the average event period daily trading volume for each ex-day observation. Our measure of systematic risk, the CAPM β, is estimated by regressing nonevent period individual stock returns on nonevent period market returns. Idiosyncratic risk is measured by the standard error of the CAPM residuals scaled by the standard error of the market returns during the nonevent period, $\sigma_\varepsilon/\sigma_M$. *YIELD* is defined as the dollar amount of dividends paid on the ex-dividend day *AMT* divided by the cum-dividend stock price P_{CUM}. The proxy for transaction costs is $1/P_{CUM}$, where P_{CUM} is the cum-day stock price. Average market capitalization *ACAP* is the average daily market capitalization during the nonevent period. Trade data is from the TAQ database. For every day during the 11-day event period, we obtain all trades between 9:30 am and 4:00 pm. *RATIO* is the average of the ratio of the number of large trades to the number of all trades during the 11-day event period. We use three measures of *RATIO* based on \$15,000, \$10,000, and \$5,000 dollar value cutoffs for large trades. The numbers below the correlation coefficients are p-values. The regression model is

$$EXVOL_i = \alpha_0 + \alpha_1\beta_i + \alpha_2\sigma_\varepsilon/\sigma_{Mi} + \alpha_3 1/P_{CUMi} + \alpha_4 ACAP_i + \alpha_5 RATIO_i + \alpha_6 YIELD_i + \alpha_7 YIELD_i \cdot RATIO_i + \alpha_8 YIELD_i \cdot RATIO_i^2 + u_i.$$

The variance–covariance matrix is White's (1980) heteroskedasticity consistent matrix. The cell values are regression coefficients and t-values (in parentheses). ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Levels of Dollar Value Cutoffs		
	\$15,000	\$10,000	\$5,000
Intercept	−0.1854	−0.1958	−0.1822
	(−4.57)***	(−3.92)***	(−2.44)**
β	−0.0205	−0.0195	−0.0184
	(−1.60)*	(−1.57)	(−1.53)
$\sigma_\varepsilon/\sigma_M$	−0.0025	−0.0024	−0.0023
	(−1.65)*	(−1.64)*	(−1.63)*
$1/P_{CUM}$	0.3874	0.4470	0.3502
	(1.63)	(1.79)*	(1.36)
ACAP	−0.0007	−0.0006	−0.0003
	(−2.89)***	(−2.54)**	(−1.04)
RATIO	0.2520	0.2099	0.1389
	(2.59)***	(2.25)**	(1.35)
YIELD	**20.8818**	**12.1026**	**−14.3290**
	(3.93)*	**(1.80)***	**(−1.47)**
YIELD · RATIO	**92.3416**	**107.6596**	**156.3247**
	(4.11)*	**(3.84)***	**(5.16)***
YIELD · RATIO²	**−140.1174**	**−122.7061**	**−123.3579**
	(−4.28)*	**(−3.49)***	**(−4.36)***
Adj. R^2	0.0324	0.0322	0.0323
No. of obs.	18,387	18,387	18,387

Pensions are more likely to enjoy favorable tax treatment than other institutional investors. Therefore, it is useful to examine the role played by pensions while controlling for the level of other institutional investors.

We divide all investors into three groups: individual investors (*IND*), pensions (*PEN*), and nonpension institutions (*NONPEN*) using institutional type information from CDA/Spectrum. Three trade types are possible: Pensions may trade with individuals; nonpension institutions may trade with individuals; and, pensions may trade with nonpensions. We perform the following regression to test for the presence of each type of trade:

$$\begin{aligned} EXVOL_i = {} & \alpha_0 + \alpha_1\beta_i + \alpha_2\sigma_\varepsilon/\sigma_{Mi} + \alpha_3 1/P_{CUMi} + \alpha_4 ACAP_i + \alpha_5 YIELD_i \\ & + \alpha_6 YIELD_i \cdot PEN_i \cdot IND_i + \alpha_7 YIELD_i \cdot NONPEN_i \cdot IND_i \\ & + \alpha_8 YIELD_i \cdot NONPEN_i \cdot PEN_i + u_i. \end{aligned} \tag{17}$$

We have interaction terms for *YIELD* with each of the possible trade types. These terms test for their combined impact on the volume effect of dividend yield. The interaction terms are analogous to the $YIELD \cdot INST$ and $YIELD \cdot INST^2$ terms in our previous analysis using aggregate institutional ownership in equation (14). In equation (14), we consider only two types of investors, institutions (*INST*) and individuals (*IND*). Tax-induced heterogeneity can be expressed as $INST \cdot IND$. Since $IND = 1 - INST$, we have $INST \cdot (1 - INST)$ as an expression for tax-induced heterogeneity, and thus we have both $YIELD \cdot INST$ and $YIELD \cdot INST^2$ in equation (14).

Since pensions are most likely to enjoy favorable tax treatment on dividends and individuals are most likely to have a tax penalty on dividends, these two groups are mostly likely to trade with each other. We expect the coefficient on $YIELD \cdot PEN \cdot IND$ to be positive. Because nonpension institutions may also trade with individuals but not as much as pensions, we expect the coefficient on $YIELD \cdot NONPEN \cdot IND$ to be positive but lower in magnitude than that on $YIELD \cdot PEN \cdot IND$. To the extent that nonpension institutions enjoy less favorable tax treatment, they may also trade with pensions, but we expect this type of trading to be even less significant. The coefficient on $YIELD \cdot NONPEN \cdot PEN$ should be close to zero.

Table VI presents the results. As predicted, the coefficient on $YIELD \cdot PEN \cdot IND$ is positive and significant ($\alpha_6 = 295.7323, t = 3.87$), supporting the tax-motivated trading hypothesis. On the other hand, the coefficient on $YIELD \cdot NONPEN \cdot IND$ is insignificant and the coefficient on $YIELD \cdot NONPEN \cdot PEN$ is negative and significant. These results suggest that most of the trading is between the most tax-favored investors (pensions) and the most tax-disadvantaged investors (individuals), which is consistent with the presence of tax-motivated trading around ex-dividend days.

C. Effect of Tax Regime Changes

Given the argument presented in this study and in related literature, tax regime changes should have an impact on ex-day excess trading volume because

Table VI

Pensions, Nonpensions, Individual Investors, and Excess Trading Volume Around Ex-Dividend Days

Ex-dividend dates and volume data are obtained from CRSP. For each ex-day observation, 91 days (days −45 to +45 relative to the ex-day) of daily trading volume are extracted. The 11-day period from day −5 to day 5 is defined as the event period, and the 80-day period including days −45 to −6 and days +6 to +45 is defined as the nonevent period. Average normal daily trading volume *NV* for each stock is the average daily trading volume for the nonevent period. The normalized excess volume during the event period for each ex-day observation is $EXVOL = EV/NV - 1$, where *EV* is the average event period daily trading volume for each ex-day observation. Our measure of systematic risk, the CAPM β, is estimated by regressing nonevent period individual stock returns on nonevent period market returns. Idiosyncratic risk is measured by the standard error of the CAPM residuals scaled by the standard error of the market returns during the nonevent period, $\sigma_\varepsilon/\sigma_M$. *YIELD* is defined as the dollar amount of dividends paid on the ex-dividend day *AMT* divided by the cum-dividend stock price P_{CUM}. *INST* is the number of shares owned by institutional investors divided by the total number of shares outstanding. *PEN* is pension ownership, *NONPEN* is nonpension institutional ownership, and *IND* is individual ownership. Data on institutional ownership are from SEC 13f filings obtained from Compact Disclosure SEC. The proxy for transaction costs is $1/P_{CUM}$, where P_{CUM} is the cum-day stock price. Average market capitalization *ACAP* is the average daily market capitalization during the nonevent period. The regression model is

$$EXVOL_i = \alpha_0 + \alpha_1\beta_i + \alpha_2\sigma_\varepsilon/\sigma_{Mi} + \alpha_3 1/P_{CUMi} + \alpha_4 ACAP_i + \alpha_5 YIELD_i + \alpha_6 YIELD_i \cdot PEN_i \cdot IND_i + \alpha_7 YIELD_i \cdot NONPEN_i \cdot IND_i + \alpha_8 YIELD_i \cdot NONPEN_i \cdot PEN_i + u_i.$$

The variance–covariance matrix is White's (1980) heteroskedasticity consistent matrix. The cell values are regression coefficients and *t*-values (in parentheses). *** and ** indicate significance at the 1% and 5% levels, respectively.

Intercept	−0.0225
	(−1.26)
B	−0.0286
	(−2.21)**
$\sigma_\varepsilon/\sigma_M$	−0.0033
	(−2.05)**
$1/P_{CUM}$	−0.5297
	(−3.35)***
ACAP	−0.0009
	(−3.80)***
YIELD	**29.2937**
	(6.87)***
YIELD · PEN · IND	**295.7323**
	(3.87)***
YIELD · NONPEN · IND	**−0.6474**
	(−0.04)
YIELD · NONPEN · PEN	**−333.6672**
	(−4.46)***
Adj. R^2	0.0272
No. of obs.	31,719

they cause changes in the relative taxation of dividends and capital gains among different categories of investors. The period covered in this study, 1989–1998, spans three tax regimes: the Tax Reform Act of 1986 (TRA86), the Revenue Reconciliation Act of 1993 (RRA93), and the Taxpayer Relief Act of 1997 (TRA97). During the TRA86 regime, the tax rates on dividends and capital gains were equal for individual investors. In 1993, the Clinton administration increased individual investors' maximum ordinary income tax rate from 31% to 39.6%. This regime change increased the difference between individual and institutional investors' relative valuations of capital gains versus dividends. Thus, we expect higher ex-day excess trading volume in the RRA93 regime than in the TRA86 regime. In 1997, the individual investors' capital gains tax rate was reduced from 28% to 20%. This change further increased the difference between individual and institutional investors' relative valuations of capital gains versus dividends. Thus, we expect higher ex-day excess trading volume in the TRA97 regime than in the RRA93 regime.

We find that dividend yield decreases from 0.0081 in the TRA86 regime to 0.0066 in the RRA93 regime to 0.0051 in the TRA97 regime. Firms may have adjusted their dividend policies in response to the tax regime changes—they may have decreased their dividend yield when dividends become relatively more tax disadvantaged. Firms may have paid lower dividends over time (Fama and French (2001)). Alternatively, dividend yield may have declined due to rising stock prices (Fama and French (2001) and Grullon and Michaely (2002)). At the same time, the level of institutional ownership increases from 0.4392 in the TRA86 regime to 0.4699 in the RRA93 regime to 0.4801 in the TRA97 regime. During the same period, excess volume decreases from 0.1474 in the TRA86 regime to 0.1167 in the RRA93 regime and further decreases to 0.0555 in the TRA97 regime. A chi-square test shows that this decrease in excess trading volume across the tax regimes is significant. These results indicate that it is necessary to control for dividend yield and institutional ownership in order to isolate the effect of tax regime changes.

To isolate the effect of tax regime changes, we run two separate regressions, one to compare TRA86 (1989–1992) with RRA93 (1993–1996) and the other to compare RRA93 (1993–1996) with TRA97 (1997–1998). To compare ex-day volume in TRA86 and RRA93, we create an indicator variable $T93$ that equals one if the ex-day observation falls in the RRA93 regime and zero otherwise. We also include interaction terms for $T93$ with $YIELD$, $YIELD \cdot INST$, and $YIELD \cdot INST^2$. The regression model is

$$\begin{aligned} EXVOL_i = {} & \alpha_0 + \alpha_1 T93_i + \alpha_2 \beta_i + \alpha_3 \sigma_\varepsilon / \sigma_{Mi} + \alpha_4 1/P_{CUMi} + \alpha_5 ACAP_i + \alpha_6 INST_i \\ & + \alpha_7 INST_i^2 + \alpha_8 YIELD_i + \alpha_9 YIELD_i \cdot T93_i + \alpha_{10} YIELD_i \cdot INST_i \\ & + \alpha_{11} YIELD_i \cdot INST_i \cdot T93_i + \alpha_{12} YIELD_i \cdot INST_i^2 \\ & + \alpha_{13} YIELD_i \cdot INST_i^2 \cdot T93_i + u_i. \end{aligned} \tag{18}$$

The results are shown in Table VII, Panel A. The coefficient on $YIELD$ is insignificantly positive ($\alpha_8 = 6.8401, t = 1.06$). The insignificant coefficient on

Table VII
Effect of Tax Regime Changes

Ex-dividend dates and volume data are obtained from CRSP. For each ex-day observation, 91 days (days −45 to +45 relative to the ex-day) of daily trading volume are extracted. The 11-day period from day −5 to day 5 is defined as the event period, and the 80-day period including days −45 to −6 and days +6 to +45 is defined as the nonevent period. Average normal daily trading volume *NV* for each stock is the average daily trading volume for the nonevent period. The normalized excess volume during the event period for each ex-day observation is $EXVOL = EV/NV - 1$, where *EV* is the average event period daily trading volume for each ex-day observation. Our measure of systematic risk, the CAPM β, is estimated by regressing nonevent period individual stock returns on nonevent period market returns. Idiosyncratic risk is measured by the standard error of the CAPM residuals scaled by the standard error of the market returns during the nonevent period, $\sigma_\varepsilon/\sigma_M$. *YIELD* is defined as the dollar amount of dividends paid on the ex-dividend day *AMT* divided by the cum-dividend stock price P_{CUM}. *INST* is the number of shares owned by institutional investors divided by the total number of shares outstanding. Data on institutional ownership are from SEC 13f filings obtained from Compact Disclosure SEC. The proxy for transaction costs is $1/P_{CUM}$, where P_{CUM} is the cum-day stock price. Average market capitalization *ACAP* is the average daily market capitalization during the nonevent period. To test for the effect of the tax regime change during the 1989 to 1996 period, we use an indicator variable *T*93 that equals one if the ex-day observation falls in the RRA93 regime and zero otherwise. *T*93 is combined with other variables to form the following interaction terms: $YIELD \cdot T93$, $YIELD \cdot INST \cdot T93$, and $YIELD \cdot INST^2 \cdot T93$. The regression model is

$$\begin{aligned} EXVOL_i = {} & \alpha_0 + \alpha_1 T93_i + \alpha_2\beta_i + \alpha_3 IRISK_i + \alpha_4 1/P_{CUMi} + \alpha_5 ACAP_i + \alpha_6 INST_i + \alpha_7 INST_i^2 \\ & + \alpha_8 YIELD_i + \alpha_9 YIELD_i \cdot T93_i + \alpha_{10} YIELD_i \cdot INST_i + \alpha_{11} YIELD_i \cdot INST_i \cdot T93_i \\ & + \alpha_{12} YIELD_i \cdot INST_i^2 + \alpha_{13} YIELD_i \cdot INST_i^2 \cdot T93_i + u_i. \end{aligned}$$

Likewise, to test for the effect of the tax regime change during the 1993 to 1998 period, we use an indicator variable *T*97 that equals one if the ex-day observation falls in the TRA97 regime and zero otherwise. *T*97 is combined with other variables to form the following interaction terms: $YIELD \cdot T97$, $YIELD \cdot INST \cdot T97$, and $YIELD \cdot INST^2 \cdot T97$. The regression model is

$$\begin{aligned} EXVOL_i = {} & \alpha_0 + \alpha_1 T97_i + \alpha_2\beta_i + \alpha_3 IRISK_i + \alpha_4 1/P_{CUMi} + \alpha_5 ACAP_i + \alpha_6 INST_i + \alpha_7 INST_i^2 \\ & + \alpha_8 YIELD_i + \alpha_9 YIELD_i \cdot T97_i + \alpha_{10} YIELD_i \cdot INST_i + \alpha_{11} YIELD_i \cdot INST_i \cdot T97_i \\ & + \alpha_{12} YIELD_i \cdot INST_i^2 + \alpha_{13} YIELD_i \cdot INST_i^2 \cdot T97_i + u_i. \end{aligned}$$

The variance–covariance matrix is White's (1980) heteroskedasticity consistent matrix. The cell values are regression coefficients and *t*-values (in parentheses). ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Panel A: RRA93 Regime Change (1989–1996)		Panel B: TRA97 Regime Change (1993–1998)	
Intercept	0.1301	Intercept	−0.0157
	(3.03)***		(−0.30)
*T*93	−0.0222	*T*97	0.0189
	(−0.99)		(0.81)
β	−0.0287	β	−0.0178
	(−1.97)**		(−1.51)
$\sigma_\varepsilon/\sigma_M$	−0.0034	$\sigma_\varepsilon/\sigma_M$	−0.0023
	(−1.92)*		(−1.68)*
$1/P_{CUM}$	−0.6075	1/*PCUM*	−0.4465
	(−3.12)***		(−2.35)**
ACAP	−0.0016	*ACAP*	−0.0006
	(−2.97)***		(−2.49)**

(*continued*)

Table VII—*Continued*

Panel A: RRA93 Regime Change (1989–1996)		Panel B: TRA97 Regime Change (1993–1998)	
INST	−0.8698	*INST*	−0.3460
	(−4.59)***		(−1.67)*
INST ^{2}	1.0722	*INST* ^{2}	0.5322
	(4.82)***		(2.61)***
YIELD	**6.8401**	***YIELD***	**36.7987**
	(1.06)		**(4.61)*** **
YIELD · T93	**19.6925**	***YIELD · T97***	**−15.3279**
	(2.48) **		**(−1.08)**
YIELD · INST	**158.7261**	***YIELD · INST***	**51.9381**
	(4.85)* **		**(1.40)**
YIELD · INST · T93	**−52.8160**	***YIELD · INST · T97***	**20.2542**
	(−1.35)		**(0.37)**
YIELD · INST ^{2}	**−220.1355**	***YIELD · INST*** ^{2}	**−125.8064**
	(−5.68)* **		**(−3.17)*** **
YIELD · INST ^{2} ***· T93***	**37.9478**	***YIELD · INST*** ^{2} ***· T97***	**−7.0507**
	(0.85)		**(−0.13)**
Adj. R^2	0.0316	Adj. R^2	0.0290
No. of obs.	23,668		20,698

YIELD may be due to the fact that during the TRA86 regime, tax rates on dividends and capital gains were equal. The coefficient on $YIELD \cdot T93$ is significantly positive ($\alpha_9 = 19.6925, t = 2.48$), indicating that an increase in dividend tax rate increases the effect of dividend yield on excess trading volume. This result is consistent with Michaely and Vila (1995), who find that ex-day excess trading volume is higher pre-TRA86 than post-TRA86.[16]

When the tax regime change has been controlled for, the concave relation between the level of institutional ownership and the volume effect of dividend yield is still present. The coefficient on $YIELD \cdot INST$ is significantly positive ($\alpha_{10} = 158.7261, t = 4.85$) and the coefficient on $YIELD \cdot INST^2$ is significantly negative ($\alpha_{12} = -220.1355, t = -5.68$). On the other hand, the coefficients on $YIELD \cdot INST \cdot T93$ and $YIELD \cdot INST^2 \cdot T93$ are both insignificant ($\alpha_{11} = -52.8160, t = -1.35; \alpha_{13} = 37.9478, t = 0.85$), suggesting that the RRA93 tax regime change does not alter the shape of this concave relation, but does move it upward.

When we compare ex-day volume in the RRA93 and TRA97 regimes using a regression model similar to equation (18), our results do not support the tax-motivated trading hypothesis (see Table VII, Panel B). Thus, we find

[16] This result is also consistent with Kato and Loewenstein (1995), who show that excess volume around ex-dividend days declines after the 1988 tax reform in Japan. After the reform, individuals were taxed on capital gains for the first time and trading by corporations in other firms' stocks for dividend capture purposes was restricted and made more costly. Kato and Loewenstein attribute the decline in volume in part to the tax reasons.

partial support for the tax-motivated trading hypothesis concerning tax regime changes.[17,18]

D. Sensitivity Analyses

D.1. Impact of Outlying and Influential Observations

Given the construction of ex-day excess volume, outliers may have a significant impact on the results. We apply Belsley, Kuh, and Welsch's (1980) procedures to check for the impact of outliers and influential observations, and we find that the results are not impacted by outlying or influential observations.[19]

D.2. Normality of Excess Volume Distribution

Our measure of excess volume, *EXVOL*, is not normally distributed. A normal distribution has a skewness statistic of 0 and kurtosis statistic of 3. In contrast, *EXVOL* has a skewness statistic of 12.4669 and a kurtosis statistic of 351.5009. However, *EXVOL* is similar to measures used in the literature, for example, Michaely and Vila (1995, 1996), and enables a comparison of our results with those of prior studies. To obtain a closer approximation to the normal distribution, we perform a logarithmic transformation on ex-day excess volume, $LEXVOL = \log(1 + EXVOL)$, for observations with $EXVOL > -1$. Note that *LEXVOL* has a skewness statistic of -0.3338 and a kurtosis statistic of 4.3736. It is much closer to being normally distributed. When we replace *EXVOL* with *LEXVOL* in equation (14), we obtain qualitatively similar regression results.[20]

D.3. Economic Significance

Based on the results in Table IV for the full sample, we estimate the excess trading volume that is due to the interaction between the dividend yield and the

[17] There are two possible reasons for not finding support for the tax-motivated trading hypothesis around the Taxpayer Relief Act of 1997. The first one is that the required asset holding period to qualify for the long-term capital gains rates increased from 12 to 18 months. See Code Section 302. An increase in the holding period increases the risk involved in dividend-related trading, and this has a negative effect on excess trading volume. The second reason is related to rules on dividend-received deduction for corporations. Before TRA97, no dividend-received deduction was available for stock held by a corporation for 45 days or less. After TRA97, no dividend-received deduction was available for stock held for 45 days or less during the 90-day period beginning on the date 45 days before the ex-dividend date of the stock. See Code Section 246(c). This means that after TRA97, dividend-related trading for corporations is further restricted, which has a dampening effect on ex-day trading volume. While a decrease in the individual investor capital gains tax rate should increase ex-day trading volume, the changes in rules regarding holding period requirements and dividend-received deduction should decrease it, and as a consequence of these opposing influences, the net change in ex-day excess volume may be insignificant.

[18] We also perform regression analyses for a subsample of stocks that are traded during the ex-day period, and based on subsamples of stocks with dividends per share greater than 5 cents and 10 cents. We obtain results that are qualitatively similar to those based on the full sample.

[19] We use the general cutoff levels suggested in Belsley, Kuh, and Welsch (1980) for the two procedures.

[20] Results are available from the authors upon request.

level of institutional ownership. With a dividend yield of 1% and institutional ownership of 10%, 30%, and 50%, excess trading volume is 27.65%, 36.33%, and 30.86%, respectively.[21] These levels of excess volume are all economically significant and they are consistent, with excess volume being a concave function of the level of institutional ownership. Also see Figure 2 for evidence of economic significance.

IV. Summary and Conclusion

In this study, we examine the effect of the interaction between dividend yield and institutional ownership on excess trading volume around ex-dividend days. Dividend yield proxies for the tax-disadvantaged portion of stock returns for some investors, and the level of institutional ownership proxies for the degree of tax-induced investor heterogeneity. We hypothesize that the positive effect of dividend yield on ex-day excess trading volume is a concave function of the level of institutional ownership.

Cross-sectional test results support the tax-motivated trading hypothesis. Ex-day excess trading volume is increasing in dividend yield and this positive relation between dividend yield and excess trading volume is a concave function of the level of institutional ownership, consistent with a tax-induced investor heterogeneity argument. Additional tests using transaction data and pension ownership add further support to this argument. Partial support for the hypothesis is found around tax regime changes.

In conclusion, this paper demonstrates that tax-motivated trading activity is a cause of excess trading volume around ex-dividend days. An important contribution of the paper is the consideration of stock ownership structure in explaining the cross-sectional variation in excess trading volume around ex-dividend days. Ownership structure affects excess trading volume by influencing the degree of tax-induced investor heterogeneity.

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[21] $YIELD = 0.01, INST = 0.1 : 18.0030 \times 0.01 + 114.1877 \times 0.01 \times 0.1 - 176.9474 \times 0.01 \times 0.1^2 = 0.2765; YIELD = 0.01, INST = 0.3 : 18.0030 \times 0.01 + 114.1877 \times 0.01 \times 0.3 - 176.9474 \times 0.01 \times 0.3^2 = 0.3633; YIELD = 0.01, INST = 0.5 : 18.0030 \times 0.01 + 114.1877 \times 0.01 \times 0.5 - 176.9474 \times 0.01 \times 0.5^2 = 0.3086.$

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