The price impact of the disposition effect on the ex-dividend day of NYSE and AMEX common stocks

Efthymiou, Vassilis A. and Leledakis, George N.

Athens University of Economics and Business, Athens University of Economics and Business

8 February 2011

The Price Impact of the Disposition Effect on the Ex-Dividend Day of NYSE and AMEX Common Stocks

by

Vassilis A. Efthymiou
Department of Accounting and Finance
Athens University of Economics and Business
Greece

and

George N. Leledakis*
Department of Accounting and Finance
Athens University of Economics and Business
Greece

This version: April, 2011
First version: February, 2011

* Vassilis A. Efthymiou and George N. Leledakis are at the Athens University of Economics and Business. The paper has benefited from the comments of Efthimios Demirakos, Konstantinos Drakos, Athanasios Episcopos, Daniel Giamouridis, George Papaioannou, Leonidas Rompolis, Hersh Shefrin, Spyros Skouras, and Andrianos Tsekrekos. We would also like to thank John Doukas, Daniel Wolfenzon, and other seminar participants at the 2010 European Financial Management Association (EFMA) meetings, as well as workshop participants at the 2010 European Economics and Finance Society (EEFS) conference and the 2011 International Atlantic Economic (IAES) conference for helpful discussion and suggestions. All remaining errors and omissions are our own.

The Price Impact of the Disposition Effect on the Ex-Dividend Day of NYSE and AMEX Common Stocks

ABSTRACT

We empirically test whether the disposition effect, the inclination of investors to sell winning stocks more readily than losing stocks, has an asymmetrical impact on the price adjustment on the ex-dividend day. Using aggregate market data for a sample of ordinary taxable dividends of common stocks listed in NYSE and AMEX during the 2001-2008 period, we employ the capital gains overhang proxy to measure accrued gains or losses for individual stocks. We find that stocks with accrued gains have a higher market adjusted price drop than stocks with accrued losses on the ex-dividend day. Moreover, there is a significantly positive relationship between the ex-day price drop and the capital gains overhang. Both results are attributed to the disposition effect since active (limited) selling by holders of winning (losing) stocks will most likely speed up (restrain) the downward price adjustment on the ex-dividend day. We also contribute to the ex-dividend day literature, insofar as we propose a new factor, namely, the past accrued gain or loss, to explain the time-series variation of the ex-day price drop ratio for a particular stock that can be a winner or a loser at different times. Our results remain robust to various ex-day price drop measures, panel data models adjusting for both stock and time correlations, and different investor holding period lengths assumed.

Keywords: disposition effect, ex-dividend day, capital gains overhang
JEL classification: G12, G14, G35

One of the most important phenomena in trading behavior is the "disposition effect," that is, when an investor faces the decision to select among candidate stocks to sell from his portfolio, he is more inclined to pick the stocks that have experienced prior gains than those with prior losses since their purchase. Various empirical studies have exploited information from the trade accounts of individual and professional investors to confirm the existence of the disposition effect. In particular, they find that losing market positions are held longer than winning positions (Locke and Mann (2005), and Locke and Onayev (2005)), and the proportion of accrued gains that are realized is greater than the proportion of accrued losses that are realized in the average portfolio (Odean (1998), and Barber et al. (2007)). In addition, attempts have been made to propose possible causes of the disposition effect in terms of a behavioral bias resulting from prospect theory preferences (Kahneman and Tversky (1979)), irrational investor beliefs (Odean (1998)), or a natural implication of optimal portfolio management (Lakonishok and Smidt (1986), and Harris (1988)).

Although most studies explore whether and why the disposition effect exists, few papers address the question of whether it has an effect on stock prices. In Coval and Shumway' s (2005) words:

> [E]ven if biases can be identified in investor behavior, to demonstrate that this is more than just instances of noise trading, empirical tests must be positioned to identify a link between biases in individual trader behavior and overall prices (p. 2).

Namely, a key question is whether the biases that are evident in trading behavior impact prices. Following Grinblatt and Han (2005), and Frazzini (2006), we select a regular corporate event, namely, the deprivation of the right to the dividend on the ex-dividend day, to test whether the disposition effect matters for asset pricing. Compared to other corporate events, the choice of the ex-dividend day is considered advantageous due to three unique characteristics. First, because the disposition effect refers to investors' selling decisions, the natural downward price adjustment to the dividend on the ex-dividend day renders it an appropriate setting to make accurate predictions about the direction of contingent mispricing caused by the disposition effect. Second, given that no corporate information is conveyed on the ex-dividend day, we do not have to speculate on the direction of price changes that depend upon investors' interpretations of the content of the corporate release. Third, the magnitude of the expected ex-day price drop can be approximated by the dividend amount. From another perspective, the lack of consensus on the factors that explain the time-series variation of the price drop ratio (the stock price drop on the ex-dividend day divided by the dividend amount) that is apparent in the standard ex-day literature leads us to suspect that the disposition effect could be one such factor.

To ascertain whether the disposition effect can affect stock prices at the ex-dividend day, we use market-wide daily stock data for two reasons. First, data on the daily portfolio holdings and trades from the universe of participants in wide stock markets such as the NYSE and AMEX exchanges are not readily available.[1] Second, because market prices reflect the trade decisions of both rational and behaviorally biased investors, a possible divergence from the fundamental prices induced by the trades of disposition effect-investors might be arbitraged away quickly by their rational counterparts. Whether arbitrage is effective at repressing price perturbations caused by the disposition effect can only be depicted in equilibrium market prices. Of course, the use of market-wide data also entails a cost in that it requires a number of crucial assumptions and approximations to be included in the empirical analysis. In particular, a proxy must be constructed from aggregate data to measure the accrued gain or loss to the average investor who owns a particular stock at any time.[2] We acknowledge that this imperfect measure absorbs substantial noise that is unrelated to the testable hypotheses. However, we believe that this can only make us more optimistic about the veracity of a significant relationship found in support of our prediction, as long as it proves to be robust. Jin (2006) consents to this rationale by stating the following:

> The error introduced by the imprecise measurement of capital gains creates an attenuation bias toward 0 in the estimated coefficient on the impact of capital gains. If we find evidence of price pressure due to capital gains in the presence of the attenuation bias, the real magnitude of the price pressure is likely to be more significant (p. 1420).

---

[1] There are a few exceptions that have used comprehensive datasets of investor holdings and trades of all market participants over long time periods, such as Grinblatt and Keloharju (2001), and Barber et al. (2007).

[2] One of the most ambiguous inputs of the capital gain proxy measurement is the assumed average investor horizon over which capital gains or losses accrue. Naturally, investors buy and sell stocks at different times, and therefore, for a given price stock appreciation, different amounts of gain will accrue to different investor holding durations.

In the empirical analysis that follows, we use the "capital gains overhang" proxy, as computed by Grinblatt and Han (2005), to measure the gain or loss accrued by the aggregate investor who holds a particular stock and the price drop ratio proposed by the ex-dividend day literature to measure the market-adjusted ex-day price adjustment. In short, we test whether the magnitude of the expected price drop ratio on the ex-dividend day is conditional upon the prior positive or negative record of the stock price, as predicted by the disposition effect. We find that stocks that appreciated in the past have higher price drop ratios on the ex-dividend day than stocks that declined in value, implying a positive relationship between the capital gains overhang and the ex-dividend day price drop ratio that is found to be both statistically and economically significant. In fact, in the multivariate regression analysis that employs a pooled sample and, alternatively, two panel data models used to test the relationship between the price drop ratio and the capital gains overhang, the latter variable proves to be the only one with significant explanatory power across all specifications. The same conclusions are drawn when we substitute the ex-day abnormal return for the price drop ratio, when we employ alternative methodologies for the calculation of the ex-day normal return, when we use opening rather than closing ex-day prices, and when we assume different investor holding period lengths. Our results are in alignment with the disposition effect, which postulates that the expected downward price adjustment on the ex-day will be facilitated by willing sellers of winning stocks and hindered by reluctant sellers of losing stocks. Our results also contribute to the ex-dividend day literature, insofar as they propose a new factor, namely, the past accrued gain or loss, to explain the time-series variation of the price drop ratio on the ex-day for a particular stock that can be a winner or a loser at different times.

The remainder of the paper is organized as follows. Section I provides a review of the literature on both the disposition effect and the ex-dividend day, ending with the development of the hypotheses that will be empirically tested. Section II describes the data selection, the filters applied to the data, and the methodology used to compute the variables that are employed in the tests. Section III reports the empirical results that are driven by the influence of the disposition effect on the stock price behavior on the ex-dividend day. In Section IV, connections are made to the ex-dividend day literature, and Section V concludes the paper.

I. Review of the Literature and Development of the Hypotheses

A. The Disposition Effect

The concept of the disposition effect was introduced by Shefrin and Statman (1985) as the inclination of investors to "sell winners too early and ride losers too long." Several theories have been advanced to explain this effect; in short, in the behavioral context, the disposition effect has been attributed to prospect theory, to regret versus pride sentiment, and to an irrational belief of mean reversion by investors. Alternatively, those who posit rationality among investors state that the need for optimal portfolio rebalancing and transaction cost minimization could lead to investor decisions with the same characteristics as the disposition effect.

The most widely documented explanation of the disposition effect refers to investors that are subject to mental accounting (Thaler (1985)) and the postulates of prospect theory (Kahneman and Tversky (1979)). According to this explanation, many investors value equivalent - in terms of current fundamentals - stocks differently on the basis of their past accrued gains or losses, which are "book-kept" in separate mental accounts for each stock. The accrued gains or losses of a particular stock are evaluated with respect to a reference price that can be proxied by the average cost basis of the stock holdings. Prospect theory's assumed value function is S-shaped, implying that investors are risk averse with respect to winning stocks but risk takers with respect to losing stocks. This automatically renders investors prone to selling past winners to quickly realize their capital gains and to holding losers with a low probability of turning out to be profitable in the future. Moreover, the steeper convex slope in the loss domain implies a loss aversion that exacerbates their reluctance to realize capital losses already accrued.[3]

Another purely psychological explanation of the disposition effect is the pursuit of a feeling of pride from realizing gains and the avoidance of feeling regret by deferring losses, as noted

[3] In a recent paper, Barberis and Xiong (2009) run a simulation test on artificial stock trade data from 10,000 investors who are supposed to have prospect theory preferences and deduce that on certain occasions, prospect theory fails to predict a disposition effect. Specifically, when the expected annual stock return is high and the trading intervals within a one-year horizon are few, the prospect theory value function predicts that investors will have a greater propensity to sell a stock with a prior loss than one trading at a prior gain.

in Shefrin and Statman (1985). Odean (1998) suggested that an irrational mean reversion belief could serve as an alternative behavioral explanation of the disposition effect. He reasons that investors who fail to rationally update their expected returns for the stocks that they own might mistakenly believe that today's losers will soon outperform today's winners. In particular, the holder of a stock that appreciated in the past might wrongly revise his expected return downward, leading him to a sell decision. Similarly, if the stock depreciated in the past due to negative information about its long-term prospects, the investor might insist on keeping the stock within his portfolio because he fails to revise his expected return downwards accordingly.

Other authors have also proposed rational interpretations of the disposition effect. Lakonishok and Smidt (1986) argue that the disposition to sell winning stocks might be related to the rebalancing of portfolios held by imperfectly diversified investors. As a stock that has consistently appreciated in the past becomes over-weighted among overall stock holdings, investors will sell a portion of it to restore diversification to their portfolios. Also, a descriptive comment made by Harris (1988) suggests that the reticence of investors to sell losing stocks implied by the disposition effect can also be explained by the higher transaction cost per dollar of investment implicit in low-priced stocks that have been performing badly in the market.

Since the introduction of the concept by Shefrin and Statman (1985), numerous researchers have provided empirical support for the disposition effect among both retail and professional investors. For example, Odean (1998) analyzed the records of 10,000 trade accounts selected from a US nationwide discount brokerage house and demonstrated that retail investors have a strong preference for realizing winners rather than losers.[4] Additional studies which exploit trade records to demonstrate that retail investors are indeed subject to the disposition effect while trading in various markets, are those by Grinblatt and Keloharju (2001) for Finland, Shapira and Venezia (2001) for Israel, Dhar and Zhu (2006) for the US, and Barber et al.

[4] The author's results imply that the tendency to sell winners and hold losers is not motivated by either the higher transaction cost of losing stocks or portfolio rebalancing. In addition, he concludes that if there is a mean reversion belief among investors, it is irrational because portfolio profitability could have been higher if investors refrained from hastening the realization of past gains and deferring past losses for too long. Therefore, it is more likely that there are behavioral causes for the disposition effect.

(2007) for the Taiwan Stock Exchange. The validity of the disposition effect has also been examined for professional trading, as in the studies by Frino, Johnstone, and Zheng (2004) for professional futures traders, Garvey and Murphy (2004) for professional stock traders, Coval and Shumway (2005) for market makers in the Treasury Bond futures contract at the Chicago Board of Trade, and Locke and Mann (2005), and Locke and Onayev (2005) for floor traders in commodities traded on the Chicago Mercantile Exchange, among others. Overall, the authors conclude that professional traders close their profitable positions at a much faster rate than their losing positions, in line with the disposition effect.

B. Ex-Dividend Day

Miller and Modigliani (1961) propose that in an efficient market with no taxes and transaction costs, at the ex-dividend day, the price of the stock should theoretically decrease by the exact amount of the cash dividend. However, empirical research has shown that the price drops by less than the amount of the dividend. The "tax hypothesis," the "short term arbitrage and transaction cost hypothesis," and two market microstructure hypotheses, the "tick size hypothesis" and the "bid-ask bounce hypothesis," all attempt to explain the empirical inefficiency of the price drop on the ex-dividend day.[5] Elton and Gruber (1970) first introduced the "tax hypothesis," which posits that the drop in the stock price on the ex-dividend day is less than the amount of the dividend when ordinary income tax rates imposed on dividends exceed capital gains tax rates. In particular, they show that for long-term investors to be indifferent between trading the stock before and after the opening of the ex-day, the price drop ratio must equal $(1-\tau_d) / (1-\tau_g)$, where τ_d is the ordinary income tax rate applied to dividends and τ_g is the capital gains tax rate. Given that dividends historically carried a tax disadvantage relative to capital gains ($\tau_d > \tau_g$) for individual investors, they should price the dividend at a value that is less than the cash amount distributed by corporations, resulting in a price drop ratio of less than one on the ex-dividend day. The

[5] Notably, attributing the abnormal ex-dividend day returns to the differential tax treatment of capital gains and dividends is the most widely documented explanation in the literature.

argument of Elton and Gruber (1970) also implies that the effective tax rate on dividends for the marginal investor can be inferred on the ex-day. Evidence supporting the “tax hypothesis” is provided by several studies, including Poterba and Summers (1984), Barclay (1987), Robin (1991), Lamdin and Hiemstra (1993), Lasfer (1995), Koski (1996), Green and Rydqvist (1999), Bell and Jenkinson (2002), Graham, Michaely, and Roberts (2003), Elton, Gruber, and Blake (2005), and Milonas et al. (2006).

Alternatively, the “short-term arbitrage and transaction cost hypothesis” is based on the premise that marginal pricing on the ex-day is dominated by short-term arbitrageurs. Kalay (1982, 1984) argues that, if transaction costs are negligible, risk neutral arbitrageurs who have the same tax rate on short-term capital gains and dividends will eliminate any abnormal returns on the ex-dividend day that are generated due to the relative taxation of dividends. If transaction costs are non-zero, the price drop should fall within the range of the amount of the dividend plus or minus the transaction cost paid on a “round-trip” transaction. As a result, the discrepancy between the ex-day price drop and the dividend will be a reflection of the transaction cost of arbitrage rather than the effective tax rate on dividends implied for the marginal investor.

Within the microstructure explanatory framework, Bali and Hite (1998) argue that whenever price discreteness entails dividends that are inexact multiples of the tick size, the ex-day price drop will be equal to the dividend amount rounded down to the nearest tick below (the “tick size hypothesis”).[6] In addition, Frank and Jagannathan (1998) presume that long-term investors who “find dividends more of a nuisance” due to the cost of collecting and reinvesting dividends will want to either sell the dividend on the day before the ex-day (cum-day) or buy (or repurchase) the dividend on the ex-day. This “sell at cum-day versus buy at ex-day” order imbalance will be met by market makers who purchase the stock at the bid price on the cum-day and subsequently sell it at the ask price on the ex-day. In the Hong Kong stock market, where neither dividends nor capital gains are taxed, Frank and Jagannathan (1998) claim that this trading behavior can explain a price drop versus dividend

[6] Bali and Hite (1998) examine a period from July 2, 1962 until December 31, 1994 during which the tick size was equal to 12.5 cents.

discrepancy that is equal to the bid-ask bounce (the "bid-ask bounce hypothesis"). Both microstructure hypotheses directly challenge the "tax hypothesis" in that they introduce explanations for the ex-day anomaly that are not related to taxes.[7]

Whenever the price drop falls short of the dividend, abnormal positive total returns accrue to those who are eligible to receive the dividend. Eades, Hess, and Kim (1994), and Naranjo, Nimalendran, and Ryngaert (2000) explicitly investigated the time-series fluctuation of the ex-day abnormal returns over long periods. They argue that the factors that vary the attractiveness of dividend capturing over time generally determine the long-term time series of ex-day abnormal returns. Taken together, the results of these two papers show that dividend capturing becomes more intense when the dividend yield increases, the transaction costs of ex-day trading decrease, the amount of dividend that income corporate traders can exclude from taxable income increases, and the Treasury bill interest rates that serve as close substitutes for stock dividend yields decrease. Therefore, whenever dividend capture is attractive, this results in lower or even negative ex-day abnormal returns. Nevertheless, their inferences mainly relate to the highest dividend yield stocks, which are most likely to be subject to dividend capture trades around the ex-day.

C. Hypotheses

Although there has been sufficient evidence of the prevalence of the disposition effect in trading behavior, little empirical research has examined its impact on asset pricing.[8] In this direction, Grinblatt and Han (2005) suggest that in a market where rational investors co-exist with investors who are prone to the disposition effect, the equilibrium market price will be a weighted average of the fundamental value and the aggregate cost basis, which is the reference price for disposition effect investors.[9] As long as the absolute difference between the aggregate cost basis and the market price (called "capital gains overhang") is large,

[7] Nevertheless, Graham, Michaely, and Roberts (2003), and Jakob and Ma (2004) examine the effect of changes in price quotation and find no support for microstructure explanations.
[8] Coval and Shumway (2005), Grinblatt and Han (2005), and Frazzini (2006) have directly addressed this issue.
[9] Grinblatt and Han (2005) presume that investors who sell winning stocks faster than losing stocks are governed by an S-shaped prospect theory value function and mental accounting of accrued gains or losses.

investors prone to the disposition effect will underreact to prior news, rendering past winners undervalued and past losers overvalued. However, as disposition-free investors initiate trades to exploit the mispricing, the aggregate cost basis for a stock will update closer to the market price, that is, closer to the fundamental value. Thus, as gains and losses are realized via trading, the capital gains overhang diminishes, and the market price converges to the fundamental value. This dynamic effect leads to momentum in stock returns and stock return predictability.[10] From a similar perspective, the impact of the disposition effect can be effectively tested with market-wide data whenever we are aware that there will be a significant price reaction at a particular date and an *a priori* prediction can be made on the direction of the price change. If the disposition effect is prevalent among investors, it will either accelerate or hinder the predicted price movement, depending on its direction.

Corporate events constitute a plausible market setting to apply this principle. By changing the fundamental value of the stock, corporate events often initiate investor trading until the market price adjusts to the new perceived valuation. Whether the disposition effect has a destabilizing character in restoring equilibrium prices remains subject to empirical examination. Within this rationale, Frazzini (2006) exploits corporate earnings' announcements to test whether the disposition effect causes the stock price to underreact to the release of new information to the market. The author claims that whenever positive earnings surprises occur for stocks with past accrued gains, active selling by investors who are disposed to realize their capital gains will create excess supply that leads to a lower price increase than expected on the announcement day. Likewise, whenever negative earnings surprises occur for stocks with past accrued losses, sluggish selling by investors who are reluctant to realize their capital losses will reduce the available supply, which leads to a lower price decrease than expected. The underreaction to good or bad news on the earnings announcement day will be corrected in the days following the news release, generating the post-earnings announcement drift that has been widely reported in the finance literature. The author concludes that post-event drift is greater when the news and capital gains have the

[10] Using Fama-MacBeth's (1973) regressions, Grinblatt and Han (2005) find a significantly positive cross-sectional relationship between a stock's capital gains overhang and its future stock return. They explicitly suggest that the capital gains overhang, which accounts for both past price direction and trading turnover, is a superior predictor of future returns than raw past returns.

same sign and that its magnitude is directly related to the amount of unrealized gains (losses) experienced by the stockholders on the announcement date.[11]

Similar to Frazzini (2006), we regard the ex-dividend day as a favorable corporate event to empirically test whether the disposition effect plays an important role in asset pricing. On the ex-day, the price change is foreordained; the stock price will drop. In addition to the direction of the price, we are also aware of the magnitude of the expected fundamental adjustment because it must approximate the relative value of the dividend *vis-à-vis* capital gains. In the case of Frazzini (2006), the expected stock value at the close of the announcement day is equal to the previous close price plus or minus the change of the fundamental stock value, which is caused by the revision of investor expectations according to the earnings surprise. In our case, the expected stock value at the close of the ex-day will be equal to the cum-dividend day close price minus the dividend, adjusted for any tax preferences. In both cases, people trade intraday until the stock price at the close equals the aggregate expected value. In addition, given that the ex-day constitutes an informationless event, no conjecture must be made on the market's interpretation of corporate signals before predicting the impact of the disposition effect.[12] If the disposition effect is pervasive in the investor trading behavior, we expect holders of winning stocks to be more willing to sell than those of losing stocks on the ex-day. Therefore, assuming a downward-sloping demand curve, two testable predictions can be made with respect to the expected price impact of the disposition effect on the ex-day:

Hypothesis I: Excess (limited) supply for winning (losing) stocks will result in wider (smaller) price drop ratios on the ex-dividend day.

---

[11] Another study that examines whether the presence of accumulated capital gains can distort stock prices around large earnings surprises using market-wide data is that of Jin (2006). He finds that stocks that are mostly owned by institutional investors who care about the tax consequences of their trades (the author calls these investors "tax-sensitive") and whose stocks have appreciated in the past have a higher cumulative abnormal return during the 3-day span around the earnings announcement. He states that tax-sensitive investors, following an optimal tax strategy, postpone their sell trades to defer the realization of the accrued gains. As a result, because they limit their supply around earnings surprises for the stocks that they hold, an upward price pressure will lead to inflated market prices. Although his results contradict the implications of the disposition effect, they are confined to stocks with the highest concentration of tax-sensitive investors.

[12] We consider this point fairly important because the disposition effect might be hidden by the price impact of the divergence of opinions over the information that is conveyed in the market, as in the case of corporate announcements.

Hypothesis II: The higher the unrealized gain (loss) accrued on the stock, the larger (smaller) the ex-dividend day price drop ratio because the influence of the disposition effect on trading activity will be amplified.

Next, we empirically test the validity of these two hypotheses (Section III) and position the implications of our results in the ex-dividend day literature (Section IV).

II. Data and Methodology

A. Sample Construction and Filtering

We begin with the CRSP history of prices and dividends paid by stocks listed on NYSE and AMEX from February 1, 2001 until December 31, 2008. This includes all common stocks (CRSP codes: 10 and 11) that paid ordinary taxable cash dividends throughout the period. The beginning of the examined period was carefully selected to eliminate a possible tick size effect (Bali and Hite (1998)), and to minimize the bid-ask bounce effect (Frank and Jagannathan (1998)) and tax effect (Elton and Gruber (1970)).Beginning in February of 2001, both NYSE and AMEX were fully decimalized,[13] and only one main tax law amendment took effect between early 2001 and late 2007, the "*2003 Jobs and Growth and Tax Relief Reconciliation Act.*" This Tax Act, which went into effect in May of 2003, equated the tax rate on qualified dividends to the long-term capital gain tax rates, which were reduced to 15% for the medium and high income tax brackets.[14]

Our initial sample comprises 29,004 cash dividends that are fully taxable throughout the years 2001-2008.[15] Consistent with the prior ex-day literature, we apply several screening filters to our sample to increase the power of our tests. First, we exclude dividends that go ex

[13] Graham, Michaely, and Roberts (2003) show that bid-ask spreads and the quoted depth are significantly reduced due to the increasing fineness of the pricing grid in the decimal era, which began on January 29, 2001.
[14] The "*2005 Tax Increase Prevention and Reconciliation Act*" went into effect on January 1, 2008. Thus, we expect this amendment to have a minor influence on the eight-year average relative valuation of the dividend on the ex-day based on tax grounds. According to the Tax Act, qualified dividends remained taxable at the long-term capital gain tax rates, which were set to zero for taxable income brackets that refer to tax rates less than 25%.
[15] After eliminating ex-days with multiple ordinary cash dividends and/or a return-of-capital distribution on the same date.

within 20 trading days after the previous ex-day of the same stock. Second, we exclude dividends with an announcement day that is within four trading days before the respective ex-day. Third, we exclude ex-days with confounding corporate events. Specifically, if a stock split, stock dividend, rights issue, or bonus issue occurs within a [−4, +4] window around the ex-day, then the ex-day is removed from the sample. Fourth, following Elton, Gruber, and Blake (2005), we drop "penny dividends" that pay less than $0.01 to investors. Fifth, we exclude dividends of stocks that did not trade either on the cum-day or the ex-day. Sixth, we eliminate dividends that pertain to stocks with a cum-price of less than $5 to reduce extreme values and noise in the sample.[16] Seventh, we omit ex-days whose estimation period [(−130, −31) & (+31, +130)] has less than 60 observations.[17] In total, we filter out 1,967 ex-days (6.8% of the initial sample size of 29,004 ex-days), yielding 27,037 usable observations (100% of our "clean" sample), as illustrated in Table I.

Insert **Table I** here

B. Price Drop Ratio and Abnormal Return on the Ex-Day

We perform standard event-study methodology, where various statistics are estimated around the ex-dividend day. First, we calculate the Price Drop Ratio (PDR_i) adjusted for the expected return on the ex-day that reflects the relative valuation of the dividend by the marginal investor as follows:

$$PDR_i = \frac{P_i^{cum} - \left(\frac{P_i^{ex}}{1 + R_i^{norm}} \right)}{D_i} \qquad (1)$$

[16] Elton, Gruber, and Blake (2005) suggest that the bid-ask spread of low priced securities is sufficiently large relative to the dividend that it can generate substantial noise in the empirical results.

[17] We intentionally select an estimation period that contains trading days before and after the ex-day central time point to avoid a total overlap with the estimation horizon used to calculate the capital gain overhang as described in Section II.E below.

where P_i^{cum} is the closing price on the cum-day for stock i, P_i^{ex} is the closing price on the ex-day for stock i, D_i is the amount of the dividend for stock i, and R_i^{norm} is the ex-day expected return that accounts for both the market return and the beta risk of stock i given by

$$R_i^{norm} = \hat{\alpha}_i + \hat{\beta}_i R^{mkt} \qquad (2)$$

where α_i and β_i are estimated with the OLS market model over the estimation window of [(−130, −31) & (+31, +130)] days, and day "0" is the ex-dividend day. As a proxy for the market return (R^{mkt}), we use the percentage change of the daily value of the CRSP equal-weighted NYSE/AMEX index on the ex-day.[18] Second, we compute the Abnormal Return (AR_i^{ex}) that occurs on the ex-day, adjusted for the expected return, as follows:

$$AR_i^{ex} = \frac{P_i^{ex} - P_i^{cum} + D_i}{P_i^{cum}} - R_i^{norm} \qquad (3)$$

The AR^{ex} is an alternative measure of the ex-day anomaly that has a lower variance and is less susceptible to the statistical problems of skewnness and kurtosis compared to PDR, as will be shown below.

C. Outlier Control and Descriptive Statistics

Price drop ratios can be relatively extreme for firms with negligible dividend payouts and large price drops on the ex-dividend day or vice versa. Therefore, we trim the upper and lower 2.5% quantiles of our PDR sample to limit the impact of outliers following Graham, Michaely, and Roberts (2003). We also repeat the trimming separately for the AR^{ex} total sample so that both the PDR and AR^{ex} testable distributions move closer to normal.[19] After excluding 1,351 outlier observations, we have a final sample of 25,686 ex-days that will be used for the analysis that follows. Table II reports descriptive statistics for PDR/AR^{ex} before and after trimming, thereby illustrating the marginal effect of the elimination of outliers. This elimination has a tremendous normalizing effect for the PDR sample such that it reduces the

[18] Elton and Gruber (1970, footnote 10) suggest that an equal-weighted index is preferable to a value-weighted index for calculating the market movement on the ex-day.

[19] The PDR and AR^{ex} distributions do not share the same outliers. Performing separate trims on either PDR or AR^{ex} contributes to the robustness of the following regressions where each is used as an alternate dependent variable.

standard deviation of the sample from 10.24 to 4.15 (−59%), skewness from 2.49 to −0.06 (−102%), and kurtosis from 168.65 to 5.65 (−97%).[20] Likewise, for the AR^{ex} sample, the 2.5% trim reduces the standard deviation from 1.96% to 1.32% (−33%), skewness from 1.39 to 0.14 (−90%), and kurtosis from 63.15 to 3.33 (−95%). Furthermore, we confirm that for the 2.5% trimmed sample, the mean (median) PDR is 0.741 (0.832), which is significantly less than the hypothesized value of unity, and that the mean (median) AR^{ex} is 0.124% (0.097%), which is significantly higher than the hypothesized value of zero (at the 1% level).

Insert **Table II** here

D. Abnormal turnover

Few event studies quantify the abnormal trading volume on the ex-day by measuring the percentage deviation of the ex-day turnover from its mean turnover calculated over the estimation window for an individual stock (raw ATO). As documented by Ajinkya and Jain (1989), this raw measure of abnormal trading volume for individual securities is highly non-normal, while a natural log-transformation yields abnormal turnover values that are approximately normally distributed, depending on the sample size. Given the excessive skewness and kurtosis inherent in raw ATO measures, we opt for an approach that provides abnormal turnover estimates that deviate least from normality as follows. Initially, we calculate the abnormal turnover on the ex-day of the PDR 2.5% trimmed sample using three alternative methodologies: i) raw ATO, which assumes that the mean turnover over the estimation period is representative of the normal stock turnover, ii) natural log-transformed ATO as described in Campbell and Wasley (1996), and iii) natural log-transformed ATO as described in Lynch and Mendenhall (1997). Then, we compare the three measures and select the one whose statistical distribution is regarded as closer to normal.

[20] Boyd and Jagannathan (1994) explicitly point out the severe kurtosis that can be generated by outliers in the PDR distribution and employ an averaging procedure to reduce the sensitivity of their regression estimates to outliers.

According to Campbell and Wasley (1996), the abnormal turnover for stock *i* at day *t* (ATO_{it}) is calculated by

$$ATO_{it} = TO_{it} - \left(\hat{\alpha}_i + \hat{\beta}_i TO_{mt}\right) \qquad (4)$$

where α_i and β_i coefficients are obtained via an ordinary least squares (OLS) regression of TO_{it} against TO_{mt} throughout the estimation window of [(−130, −31) & (+31, +130)] trade days.[21] TO_{mt} is the daily turnover for the market portfolio for a given day *t*, calculated as follows:

$$TO_{mt} = \frac{1}{n}\sum_{i=1}^{n} TO_{it} \qquad (5)$$

where *n* is the number of all NYSE/AMEX common stocks reported in CRSP at a particular date *t* and TO_{it} is the natural log-transformed daily turnover for an individual stock *i*, given as follows:[22]

$$TO_{it} = \log\left(100 * \left(\frac{V_{it}}{N_{it}}\right) + 0.000255\right) \qquad (6)$$

where V_{it} and N_{it} are the trading volume in shares and the number of outstanding stocks, respectively, for a single security *i* at day *t*. Alternatively, the Lynch and Mendenhall (1997) approach takes the ratio of the [log(1+$value of trading volume)/log(1+$value of outstanding stocks)] rather than the log of the ratio of (trading volume/No of outstanding stocks) to calculate the daily stock turnover.

---

[21] Following Campbell and Wasley (1996), we also obtain the α_i and β_i coefficients using a two-step estimated generalized least squares procedure (EGLS) to control for possible autocorrelation in the parameter estimation. First, we run the usual OLS market model regression. The estimated OLS residuals are then exploited to transform the original data and re-estimate α_i and β_i using the Yule-Walker AR(1) correction. The EGLS procedure makes only a minor difference to our results because the correlation between the OLS and the EGLS estimated ex-day ATO values is close to unity for the PDR 2.5% trimmed sample.

[22] The ATO of Campbell and Wasley (1996) is similar to the one computed in the ex-day event study of Kadapakkam (2000). Both papers use the logarithm of the stock turnover to remove the pronounced skewness and the market model to compute the normal turnover on the ex-day. Their main difference is that while Kadapakkam (2000) adds a constant of 0.01, Campbell and Wasley (1996) add a constant of 0.000255 to the logarithmic turnover to preclude taking the logarithm of zero trading volume on a given day.

Table III reports the descriptive statistics and the χ^2-statistic of the D'Agostino, Belanger, and D'Agostino (1990) normality test for the distribution of the ex-day ATO computed with the three alternative methodologies.

Insert **Table III** here

We observe that the percentage raw ATO has almost 90 times higher skewness (16.35) and 50 times higher kurtosis (451.73) than the logarithmic ATO as per Campbell and Wasley (1996) (skewness = 0.18 and kurtosis = 9.18). Likewise, it has almost 7 times higher skewness and 26 times higher kurtosis than the logarithmic ATO as per Lynch and Mendenhall (1997) (skewness = 2.41 and kurtosis = 17.61). Because the ATO of Campbell and Wasley (1996) yields the lowest positive skewness, kurtosis and χ^2-statistic compared to the two alternatives, we use the Campbell and Wasley (1996) measure. Daily abnormal turnover values combined with daily abnormal returns will be used in the assessment of the relevance of dividend motivated trading before and after the ex-day, as reported in the empirical results in Section III.D.

E. The Capital Gains Overhang Proxy

To test the disposition effect hypothesis on the ex-day, we need an indicator that distinguishes stocks with an accrued gain (winner) from stocks with an accrued loss (loser) just before the ex-day. Ideally, aggregate accrued gains or losses could be calculated accurately if we knew the actual cost basis and holding period of all investors holding an individual stock at each point in time. However, because we use market-wide data rather than data extracted from trade records of all market participants, it is not feasible to estimate either element with precision. We address this issue using the capital gains overhang that was introduced by Grinblatt and Han (2005) to proxy for the market wide gain/loss accrued on a particular stock using the time series of its past prices and the time series of concurrent and forward turnover values. In particular, for each ex-day t of stock i, we calculate the stock's aggregate cost basis, which is assumed to be the relevant reference price on the cum-day (RP_i^T), using daily data, as follows:[23]

$$RP_i^T = \frac{1}{\sum_{n=1}^{T} w_{t-n}} \sum_{n=1}^{T} w_{t-n} P_{t-n} \quad where \; w_{t-n} = \left[TO_{t-n} \prod_{\tau=1}^{n-1} \left(1 - TO_{t-n+\tau}\right) \right] \quad (7)$$

In essence, the aggregate cost basis is a turnover-weighted average of past prices, where P_{t-n} is the stock price (adjusted for stock distributions) n days before the ex-day, TO_{t-n} is the turnover n days before the ex-day, and $TO_{t-n+\tau}$ is the "forward-looking" turnover τ days after the t-n day point over an assumed holding period of T days.[24] The inverse of the sum of the weights is a normalizing constant that makes all TO weights of past prices sum to one. This measure can be interpreted as follows. If a stock had a high TO value T days before the ex-day but low TO during the trading days that follow, then we can assume that most investors that hold the stock just before the ex-day use distant purchase prices in their cost basis calculation. However, if the TO was very low at the beginning of the investors' holding period but very high just before the ex-day, then, investors would most likely use purchase prices proximate to the ex-day price to calculate their accrued gains or losses. Thus, the capital gains overhang (hereafter, "CGOH") of stock i for an assumed investor holding period of T days can be reasonably defined as the percentage deviation of the closing trade price from the aggregate cost basis proxy on the cum-day:

$$CGOH_i^T = \frac{P_i^{cum} - RP_i^T}{P_i^{cum}} * 100\% \qquad (8)$$

Given that it is impossible to infer the average holding period of all owners of a particular stock with precision from market data, we test the validity of the hypothesized relationship between the CGOH and the ex-day PDR/AR^{ex} using seven different assumed holding periods in calendar time: T = 360, 250, 150, 90, 60, 30, 15 calendar days before the ex-day.

[23] Grinblatt and Han (2005) consider this aggregate cost basis as a proxy for the average reference price adopted by all investors holding a stock, the risk aversion against trades of which reflects an S-shaped value function of accrued gains or losses that pertains to the inferences of prospect theory.

[24] Following Grinblatt and Han (2005), we calculate turnover as the stock trading volume divided by the number of outstanding shares.

Insert **Table IV** here

Table IV reports Pearson correlations for the CGOH calculated at seven different calendar-day holding periods for the PDR 2.5% trimmed sample. We note that the estimated correlations (ρ) are all significant at the 5% level and range from ρ (360, 250) = 0.98 for the longer horizons to ρ (360, 15) = 0.37 for those with the smallest overlap. Although the empirical results presented in this paper are based on the assumption of a 90-calendar-day holding period, all other calendar periods are also used as a robustness test. Furthermore, Odean (1998) reports that the median holding period for the stocks held by his sample of US discount broker investors is 84 trading days, or approximately 120 calendar days, which is close to our adopted 90-calendar-day holding horizon assumption.[25]

III. Empirical Results

A. Difference of Means and Capital Gains Overhang Quantile Analysis

To test Hypothesis I, we split the PDR/AR^{ex} 2.5% trimmed sample into losers and winners on the basis of the CGOH estimated over the 90-calendar-day holding period, and we calculate pooled arithmetic means and medians for each sample. Approximately 58% of the ex-days refer to stocks with positive CGOH (winners), and 42% refer to stocks with negative CGOH (losers).

Insert **Table V** here

Panel A of Table V shows that the mean PDR for winners is 0.887 (median = 0.928), which is significantly higher than the mean PDR = 0.539 for losers (median = 0.684) at the 1% level of significance (t-statistic = −6.62). Similarly, the mean AR^{ex} for winners is 0.071% (median = 0.046%), that is significantly lower than the mean AR^{ex} = 0.202% for losers (median = 0.184%) at the 1% level (t-statistic = 7.70). The difference between median values using the

[25] In the case of quarterly dividends, the 90-calendar-day horizon can be considered as non-arbitrary if we assume that all current owners of the stock decide to sell the stock around each quarterly ex-day. Given that a significant number of investors sell or buy the stock around the ex-day due to dividend capture or avoidance attitudes, it might be reasonable to assume that the aggregate cost basis is widely updated each quarter.

Wilcoxon rank-sum test remains statistically different from zero at the 1% level, providing strong evidence that the ex-day price drops more for winners than for losers on a market-adjusted basis. Hypothesis II can be tested by separately dividing each sample of losers and winners into three equally sized CGOH90 quantiles and calculating mean (median) PDR/AR^{ex} values for each of the resulting six quantiles. In panel B of Table V, we note that the mean (median) PDR increases monotonically from 0.431 (0.639) in the quantile with the highest accrued loss (−14.7%) to 1.008 (1.022) in the quantile with the highest accrued gain (9.8%). Similarly, in Panel C of Table V, the mean (median) AR^{ex} decreases monotonically from 0.250% (0.234%) in the quantile with the lowest CGOH (−13.5%) to 0.032% (0.003%) in the quantile with the highest CGOH (9.8%). Notably, in the biggest winner quantile, we cannot reject that the mean PDR is significantly different from one (t-statistic = 0.13), and the mean AR^{ex} is only marginally significantly different from zero at the 10% level (t-statistic = 1.65). As a robustness test, we replicated Table V for the other six (T = 360, 250, 150, 60, 30, 15 calendar days) CGOH estimation periods, and we deduced that the results remain qualitatively similar. In short, we find that the higher is the accrued gain on a stock before it goes ex, the higher (lower) the PDR (AR^{ex}) will be on the ex-day, in alignment with Hypothesis II.

B. Regression Analysis

Hypothesis II states that the higher the unrealized gain (loss), the larger (smaller) the ex-dividend day price drop ratio, which translates into an expected positive (negative) relationship between the PDR (AR^{ex}) and the CGOH. To perform a direct test on Hypothesis II, we regress the PDR/AR^{ex} of the 2.5% trimmed samples against CGOH and a group of other explanatory variables that have been consistently used in the ex-day literature to control for alternative tax, transaction cost, short-term arbitrage and microstructure effects on the ex-day. Accordingly, the regression equation takes the following form:

$$PDR_{it} / AR_{it}^{ex} = \alpha + \beta_1 CGOH_{it}^{T} + \beta_2 DY_{it} + \beta_3 MCap_{it} + \beta_4 TO_{it} + \beta_5 IVol_{it} + \beta_6 Tax03_{it} + \varepsilon_{it} \quad (9)$$

where $CGOH^T$ is the capital gains overhang of stock *i* for an assumed investor holding period of T = 90 calendar days before the ex-dividend day *t*. *DY* is the stock dividend yield equal to the dividend amount over the closing price on the cum-day. *MCap* is the mean stock relative size equal to the natural logarithm of the ratio of individual stock capitalization to the capitalization of the CRSP equal-weighted NYSE/AMEX index, averaged over the estimation window of [(−130, −31) & (+31, +130)] trade days. *TO* is the average stock turnover over the estimation window of [(−130, −31) & (+31, +130)] trade days.[26] *IVol* measures the idiosyncratic volatility as the ratio of the individual stock standard deviation to the standard deviation of the market portfolio returns over the estimation window of [(−130, −31) & (+31, +130)] trade days. Again, the market portfolio is represented by the CRSP equal-weighted NYSE/AMEX index. *Tax03* is a dummy variable that takes the value of one if the ex-day is located after May 22, 2003 when the 2003 Tax Act went into effect, and zero otherwise. The dividend yield has been consistently used in the ex-day literature as a proxy for dividend-tax clienteles, whereas the mean relative size, mean turnover and idiosyncratic volatility should capture liquidity, arbitrage and microstructure effects.[27]

We employ three different models to estimate equation 9: a pooled sample regression, a panel regression adjusting standard errors for clustering across both ex-days and stocks, and a fixed effects model that simultaneously controls for year and stock effects. Michaely and Vila (1995) suggest that PDR volatility is a function of the dividend yield and daily return volatility, which could generate severe heteroscedasticity in the estimation. Therefore, the Weighted Least Squares method (WLS) is utilized for the pooled PDR regression, where the weight is equal to the squared ratio of the dividend yield over the standard deviation of the stock returns over the estimation period,[28] whereas the Ordinary Least Squares (OLS) method is selected for the pooled AR^{ex} regression.[29] The U.S. ex-day literature has pointed out that severe clustering of observations on the same ex-dividend date could induce cross-sectional

[26] The daily turnover is computed by formula 6, Section II.D., as per Campbell and Wasley (1996).
[27] Michaely and Vila (1995), Kadapakkam (2000), and Zhang, Farrell, and Brown (2008) are examples of ex-day studies that employ some or all of these regressors.
[28] Following Zhang, Farrell, and Brown (2008).
[29] The t-statistics of the estimated OLS coefficients are computed with heteroscedasticity consistent standard errors, according to the White (1980) correction.

dependence in the PDR/AR^{ex} samples. This econometric problem is addressed using calendar time portfolios, whereby stocks that go ex-dividend on the same date are pooled together, and the portfolio mean PDR/AR^{ex} value is treated as a single observation (e.g., Barclay (1987), Kadapakkam (2000), and Naranjo, Nimalendran, and Ryngaert (2000)). We refrain from using the calendar time portfolios method to avoid grouping winning stocks together with losing stocks that share the same ex-day. This also allows us to avoid the drawback of weighting stocks within ex-day PDR/AR^{ex} portfolios with fewer observations more than portfolios with a larger number of observations. Thomson (2011) describes a panel data method for computing standard errors that are robust to correlation along both firm and time dimensions. He recommends its application when the regression errors and/or the regressors include evident time and firm components and when the number of firms is close to the number of time periods. Given that there are 1,943 ex-day clusters and 1,359 stock clusters in our PDR/AR^{ex} 2.5% trimmed samples, we calculate "double-clustered" standard errors, as per Thompson (2011) and Cameron, Gelbach, and Miller (2011).[30] Finally, we present the results of a fixed effects model that includes year and stock dummies in the specification of equation 9.[31]

<u>Insert **Table VI** here</u>

According to the results of the pooled WLS/OLS regressions in Table VI, the relationship between the PDR and the accrued gain/loss measured by CGOH is positive (coefficient = 1.8029), whereas the relationship between the AR^{ex} and the CGOH is negative (coefficient = −0.0083). Both results are significant at much less than the 1% level (t-statistic = 7.49 for PDR and t-statistic = −6.43 for AR^{ex}). In the PDR/AR^{ex} panel data regressions with clustered standard errors and fixed effects, the CGOH coefficients remain statistically significant at the 1% level with the predicted signs. The results also indicate weak evidence on the importance of alternative hypotheses on the ex-day. For example, the coefficient of the dividend yield is

[30] The programming code for this estimation can be found on Doug Miller's web page: (http://www.econ.ucdavis.edu/faculty/dlmiller/statafiles/).

[31] Jakob and Ma (2004), following Hayashi and Jagannathan (1990), adopt a panel data model that allows for fixed ex-dividend day effects only. To the best of our knowledge, our analysis is the first in the ex-dividend day literature to employ panel data techniques that simultaneously account for correlations along both time and firm dimensions.

significantly positive (at the 5% level) in the pooled WLS and the clustered standard errors regression of the PDR sample but becomes insignificant in the fixed effects model. Moreover, it is positively and significantly correlated with AR^{ex} across all three specifications. Larger stocks appear to have lower abnormal returns (implying higher ex-day price drops), but this result is only significant for the AR^{ex} sample. Likewise, more liquid stocks seem to have higher PDR (lower AR^{ex}) values, possibly due to short term trading on the ex-day, though this relationship does not significantly hold for the fixed effects model. The idiosyncratic volatility and the 2003 Tax Act dummy variables are overall insignificant across the six regressions. In brief, we find a significant positive (negative) relationship between the PDR (AR^{ex}) and the CGOH, which is the only explanatory variable that remains statistically significant (at the 1% level) across both PDR/AR^{ex} regressions and all three pooled and panel data model specifications.[32] The effect of the capital gains overhang on the ex-day is also economically significant. If a stock held by the aggregate investor depreciated by 5% over the assumed holding period of 90 days, its AR^{ex} will be 0.0415% higher (−0.0083 × −5%, based on the estimates of the OLS pooled regression) as compared to a stock with no gain or loss accrued on the cum-day. This is substantial if we take into account that this extra return is one-third of the mean AR^{ex} (0.124%) for the entire 2.5% trimmed sample.

Next, we show that both a long array of robustness tests (Section III.C) and empirical testing of whether abnormal trading pressure around the ex-day can be charged for the results presented so far (Section III.D) corroborate our disposition effect-driven hypotheses I and II.

[32] According to Frazzini (2006), the disposition effect that is prevalent among investors will cause underreaction to negative news for stocks with accrued capital losses, which, in turn, will generate a negative post-announcement price drift. Likewise, underreaction to positive news for stocks with accrued capital gains will generate a positive post-announcement price drift, implying that any mispricing on the event date will be corrected after the event. If this were true for the ex-dividend day, we would expect positive abnormal returns for winners and negative abnormal returns for losers after their ex-dividend dates. To identify any possible post ex-day drift effects, we calculate daily cumulative abnormal returns for a [0, +20] trade window starting from the ex-day "0" separately for winners and losers that are defined on the basis of the CGOH of 90 calendar days before the ex-day. In unreported results, we find that the already depreciated ex-day positive AR^{ex} for winners wears out completely and becomes a negative cumulative abnormal return, whereas the high ex-day positive AR^{ex} for losers seems to persist over the post ex-day [0, +20] window. Although these results do not support the existence of post ex-day price drifts, they do not challenge our predicted theory and conclusions drawn from the analysis on the actual ex-dividend day.

C. Robustness Tests

C.1. Opening Prices

In frictionless markets, the price adjustment due to the dividend on the ex-day should occur between the cum-day close and the ex-day open. Therefore, we repeat our analysis after replacing the closing ex-day price with the opening ex-day price to eliminate any noise associated with intra-day stock-specific volatility. Furthermore, following Graham, Michaely, and Roberts (2003), we adjust PDR/AR^{ex} for the overnight market movement by assuming that the overnight normal return is half of the full ex-day normal return computed with the market model estimation.[33] We replicate the tests on the difference of mean and median PDR/AR^{ex} between winners/losers and the calculation of the mean PDR/AR^{ex} per CGOH quantile (as reported in Table V for closing prices) using the alternative PDR/AR^{ex} computed with ex-day opening prices.[34]

Insert **Table VII** here

Panel A of Table VII shows that the mean PDR for winners is 0.836 (median = 0.860), which is significantly higher than the mean PDR = 0.651 for losers (median = 0.690) at the 1% level (t-statistic = −7.18 for the difference of means, and z-statistic = −9.46 for the difference of medians). Similarly, the mean AR^{ex} for winners is 0.104% (median = 0.075%), which is significantly lower than the mean AR^{ex} = 0.209% for losers (median = 0.179%) at the 1% level (t-statistic = 12.31 for the difference of means, and z-statistic = 12.25 for the difference of medians). Elton and Gruber (1970) and Elton, Gruber, and Blake (2005) refrain from using opening prices because all limit orders on the specialists' books on the ex-day opening are adjusted by the full amount of the dividend. They reason that this will bias the ex-day opening price downwards. Nevertheless, if we carefully compare Panel A from Table V with Panel A from Table VII, we can deduce that the PDR (AR^{ex}) values calculated with opening ex-day prices are very similar to those calculated with closing ex-day prices, if not lower

[33] We confirmed that using one-third of the full ex-day normal return as an alternative overnight market adjustment makes a minor difference to the reported results.

[34] The 2.5% trimmed sample size falls from 25,686 to 25,628 observations because CRSP did not provide opening prices for 58 ex-days.

(higher). For example, the mean PDR calculated with opening prices for the all-stocks sample is equal to 0.759 (median = 0.798), which is very close to the mean PDR = 0.741 (median = 0.832) calculated with closing prices. Moreover, the mean AR^{ex} calculated with opening prices is equal to 0.147% (median = 0.114%), which is higher than the mean AR^{ex} = 0.124% (median = 0.097%) calculated with closing prices; this finding contradicts Elton and Gruber's (1970) prediction.

According to Panel B of Table VII, the mean (median) PDR increases monotonically from 0.508 (0.552) in the quantile with the most negative CGOH to 0.861 (0.909) in the quantile with the most positive CGOH. Similarly, in Panel C, the mean (median) AR^{ex} decreases monotonically from 0.288% (0.289%) in the quantile with the highest accrued loss to 0.085% (0.042%) in the quantile with the highest accrued gain. For the highest CGOH quantile, we observe that the mean PDR calculated with closing prices, equal to 1.008 (Panel B of Table V), is higher than its respective value calculated with opening prices, which is equal to 0.861 (Panel B of Table VII). In non-tabulated results, we find that their difference is statistically significant at the 5% level using a two-tailed test (t-statistic = 2.00). This is in alignment with the disposition effect because the investors holding the biggest winners will get a chance to provide their entire excess supply of the stock after the opening of the ex-day, resulting in a price drop calculated with closing ex-day prices that slightly exceeds the dividend amount.

In addition, we repeat the estimation of the three regression models (pooled WLS/OLS regression, clustered standard errors, and fixed effects) depicted in Table VI with the alternative PDR/AR^{ex} measures that are computed with opening ex-day prices and report our results in Table VIII.

<u>Insert **Table VIII** here</u>

In the pooled WLS/OLS regressions, the coefficient of the CGOH is positive (0.7643) for the PDR sample and negative (–0.0074) for the AR^{ex} sample, and both of these coefficients are significant at much less than the 1% level (the t-statistic is equal to 6.51 for PDR and −11.35 for AR^{ex}). In the panel data regressions, the PDR (AR^{ex}) continues to be positively (negatively) related to the CGOH, and significance levels remain at 1%, except in the clustered standard errors estimation of the PDR sample, where the CGOH coefficient is significant at the 5% level.[35] Again, the significance of the coefficients of the control variables implies weak evidence for the power of the tax, transaction cost and microstructure hypotheses to explain the dispersion of PDR/AR^{ex}. The coefficient on dividend yield remains significantly positive for the AR^{ex} sample but becomes almost insignificant in the PDR sample. The only control variable that remains significant at the 1% level across five of the six regressions is the mean stock turnover, but the signs are reversed as compared to the regressions that use closing prices, implying that higher liquidity, in fact, hinders the overnight price adjustment to the dividend on the ex-day. In summary, both hypotheses I and II are confirmed with both closing and opening prices on the ex-day, enhancing the support for the predicted price impact of the disposition effect on the ex-day.

C.2. Alternative Methodologies and Capital Gains Overhang Windows

With a view to increasing the strength of our results, we deploy a set of alternative methodologies to measure the normal return on the ex-day that adjusts the PDR/AR^{ex} for the market movement.[36] Specifically, we use i) the mean-adjusted model, where the average individual stock return over the estimation window is used as the normal return on the ex-day; ii) the market-adjusted model, where the return of the CRSP equal-weighted NYSE/AMEX index on the ex-day is used as the normal return; iii) the three-factor Fama and French (1997) model; iv) the four-factor Carhart (1997) model[37]; and v) the market model as described in Section II.B while adopting the CRSP value-weighted NYSE/AMEX index as the market portfolio proxy. We simultaneously employ all seven different assumed holding periods for the $CGOH^T$ that are used alternatively, namely, T = 360, 250, 150, 90, 60, 30, 15

[35] The clustered standard errors estimation is conservative in that it simultaneously adjusts t-statistics for two-dimensional clustering and heteroscedasticity according to the White (1980) correction (for more technical details, see Thompson (2011), and Cameron, Gelbach, and Miller (2011). Therefore, the evident reduction of significance is somehow expected.

[36] Each PDR/AR^{ex} sample distribution that was derived with the alternative specifications was independently trimmed at the upper and lower 2.5 percentile.

[37] Fama and French's (1997) three factors and Carhart's (1997) momentum factor are extracted from Kenneth French's web site (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/).

calendar days before the ex-day.[38] Subsequently, we examine Hypothesis I by repeating the test of the difference in the mean and median PDR/AR^{ex} between winners and losers (Panel A of Table V), and Hypothesis II is tested by re-estimating equation 9 using the WLS (OLS) pooled regression for the PDR (AR^{ex}) sample (columns 2 and 5 of Table VI) with all alternative ex-day normal return specifications and assumed CGOH holding periods.

In total, we perform 84 tests of difference of means and medians between winners and losers (2 measures (PDR/AR^{ex}) of the ex-day adjustment × 7 CGOH holding periods × 6 different ex-day normal return specifications - counting the market model estimation of the ex-day normal return twice, once with the equal-weighted and again with the value-weighted NYSE/AMEX index). In unreported results, we find that in 79 of the 84 tests, the difference in the mean and median PDR/AR^{ex} between winners and losers is significant at the 1% level, in two tests it is significant at the 10% level, and in the remaining three tests, the insignificant differences pertain to the 15-calendar day holding period.[39] Similarly, we estimate 112 alternative regressions (84 as described above + 2 measures (PDR/AR^{ex}) of the ex-day adjustment × 7 CGOH holding periods × 2 panel data clustered standard errors and fixed effects models). Of the 112 regressions, the beta coefficient on the CGOH is significant at the 1% level in 110 estimations and significant at the 10% level for the remaining 2 cases (t-statistics range between 2.85 (−1.92) and 9.23 (−9.89) across all 112 PDR (AR^{ex}) estimated regressions). Overall, the results remain robust to the various ex-day normal return specifications, panel data econometric models and different holding period length assumptions.

D. Abnormal Trading Pressure Around the Ex-Day

Graham and Kumar (2006) investigate the dividend preferences of retail investors by inspecting the trading records of 77,995 US households taken from a major US discount brokerage house. They find significant evidence of abnormal trading and buy-sell order

[38] Naturally, if the results prove robust across all seven holding periods, we expect them to remain qualitatively similar for all other investor horizons between 360 and 15 calendar days before the ex-day.

[39] Assuming a two-tailed test on the difference of means.

imbalances around ex-days driven by age and income investor clienteles.[40] Naranjo, Nimalendran, and Ryngaert (2000) claim that systematic dividend capture by corporations that are taxed more heavily on capital gains than on dividends could extend price drops such that ex-day abnormal returns have a negative sign. If sizeable dividend capture (avoidance) trades take place a few days before the ex-day, they can generate significant upward (downward) pressure on the stock price until the cum-day and perhaps even a price reversal on the ex-day when initial buy (sell) positions are closed. This consideration might raise doubts about whether the empirical results presented thus far can be attributed to the disposition effect or are simply an artifact of upward or downward pressure by dividend-induced trades. For example, stocks that rise before the ex-day due to abnormal buying by investors who pursue the right to the dividend are expected to have a greater price drop because the prior upward pressure is reversed on the ex-day. In the same manner, investors who dislike the dividend will hasten to sell the stock prior to the ex-day, hence depreciating the stock until the cum-day and inducing a deflated price drop on the ex-day. If the majority of stocks with a positive CGOH on the cum-day exhibit excess short-term buying pressure and most stocks with a negative CGOH are subject to excess short-term selling pressure before the ex-day, then our disposition effect explanation will merely "mask" the price impact of the dividend-motivated trades of particular tax, income or age clienteles. In theory, dividend capture targeted toward winning stocks can be justified in the following two ways. Investor sentiment might make investors believe that stocks with positive momentum will quickly recover the price drop on the ex-dividend day. In addition, stocks that have already appreciated with deeply in-the-money call options are more likely to bear upward pressure before the ex-day because the call options are optimally exercised early by their holders (Roll (1977), and Kalay and Subrahmanyam (1984)).[41]

[40] Briefly, they find that old and low-income investors aggressively buy the stock prior to the ex-day to capture the dividend, while young investors prefer to wait until the ex-day to buy the stock, indicating a possible dividend aversion. Rantapuska (2008), examining the universe of trades in the Finnish market over an 8-year period, also concludes that there is evident abnormal buying or selling around the ex-day on the basis of relative dividend taxation at the investor level.

[41] Roll (1977), and Kalay and Subrahmanyam (1984) report that as the underlying stock price increases, that is, the call option becomes more deeply in-the-money, and as the dividend amount also increases and the duration until option maturity decreases, the probability of early exercise of American call options before the ex-day increases.

To examine whether the above concern is valid, we use the cumulative abnormal return over a window of 20 trading days ending on the cum-day to measure significant abnormal buying (selling) pressure for stocks with prior longer-term accrued gains (losses). Using the AR^{ex} 2.5% trimmed sample of ex-days, we separately divide winning (losing) stocks with a positive (negative) CGOH90 into three quantiles on the basis of the value of their [−20, −1] cumulative abnormal return ($CAR_{[-20, -1]}$). We consider the winners that belong to the top 3rd $CAR_{[-20, -1]}$ quantile as having abnormal buying pressure and those losers in the bottom 1st (most negative) $CAR_{[-20, -1]}$ quantile as having abnormal selling pressure prior to the ex-day.

Insert **Table IX** here

Table IX reports the daily abnormal return (AR), cumulative abnormal return (CAR), daily abnormal turnover (ATO) and cumulative abnormal turnover (CATO) for a window of 20 trading days before or after the ex-day for the winner and loser quantiles described above.[42] According to Panel A, which refers to winners, both daily ARs and ATOs in the [−20, −1] trading day window are significantly positive at the 1% level (except from the ATO on day "–20"). CAR starts from 0.51% 20 days before the ex-day and increases to 11.02% on the cum-day. Notably, CATO starts from 0.91% on day "–20" and continuously increases until the ex-day, when it reaches a value of 146.72%. After the ex-day, both AR and ATO abruptly decrease to lower levels than before the ex-day, although they remain positive for another 10-15 days. We deduce that for this particular sample, there is significant upward pressure prior to the ex-day, as indicated by both return and turnover measures.[43] Panel B illustrates an equivalent picture for the losers that are subject to the highest abnormal selling pressure prior to the ex-day. During the [−20, −1] trading day window, daily ARs are significantly negative, and daily ATOs are significantly positive within the [−15, −1] trading day window at the 1%

[42] Abnormal return before or after the ex-day is calculated as the percentage deviation of daily closing prices adjusted for market movement, estimated using the market model during the estimation period. The abnormal return on the ex-day (AR^{ex}) includes the dividend, as illustrated in Section II.B. Abnormal turnover is calculated according to the methodology of Campbell and Wasley (1996) described in Section II.D.

[43] Most ex-day papers that consider samples of stocks that are mostly subject to dividend capture select stocks that belong to the quantile with the highest dividend yield on the grounds that dividend capturing trades will be more profitable when dividends are large in magnitude relative to the stock price. Nevertheless, when we adopted this criterion, we found weak evidence of abnormal trading pressure prior to the ex-day; the [−20, −1] CAR was only 2.97%, and the [−20, −1] CATO was negative at −14.44%.

level. In particular, CAR starts from –0.63% on day "–20" and falls to −12.18% on the cum-day, while CATO starts from 5.86% 15 days before the ex-day and increases to 138.31% on the cum-day. After the ex-day, ARs remain negative but insignificant (except from day "+2" and day "+15"), whereas ATOs remain significantly positive at the 1% level for another 20 days after the ex-day.[44]

To test whether short-term abnormal trading prior to the ex-day is responsible for the differential AR^{ex} between winning and losing stocks, we compare the AR^{ex} of winning (losing) stocks that appear to have the highest upward (downward) pressure with the AR^{ex} of those with the lowest upward (downward) pressure prior to the ex-day.[45] In particular, we test the difference of the mean AR^{ex} between winners/losers in the highest (3rd) $CAR_{[-20, -1]}$ quantile and winners/losers in the lowest (1st) $CAR_{[-20, -1]}$ quantile. If the short-term abnormal trading theory was true, we would expect the sample of winners with the highest prior upward pressure to have a lower mean AR^{ex} than those with the lowest prior upward pressure. Likewise, the sample of losers with the highest prior downward pressure should have a higher mean AR^{ex} than those with the lowest prior downward pressure.

Insert **Table X** here

Table X reports two-tailed tests of the differences in the mean and median AR^{ex} between the highest and lowest abnormal trading pressure quantiles separately for winners and losers. We note that the mean AR^{ex} of the one-third of winners with the highest upward pressure prior to the ex-day is 0.135% and significantly higher than the mean AR^{ex} of the winners with the lowest upward pressure (0.002%) at the 1% level (t-statistic = 5.16). Moreover, the mean AR^{ex} of losers with the highest downward pressure (0.181%) is lower and not significantly different from the mean AR^{ex} of losers with the lowest downward pressure (0.231%) at the 10% level (t-statistic = −1.46). The same conclusions are drawn for the median values.

[44] We confirmed similar abnormal return and turnover trends when we considered the median rather than the mean values for the same analysis.

[45] In unreported results, we find that winners in the lowest $CAR_{[-20, -1]}$ quantile have significantly negative [–20, –1] ARs and [–20, –1] ATOs at the 1% level, confirming that no abnormal buying occurs in the sample prior to the ex-day. Similarly, losers in the highest $CAR_{[-20, -1]}$ quantile have significantly positive [–20, –1] ARs and insignificant [–20, –1] ATOs at the 10% level, indicating that no abnormal selling pressure is evident prior to the ex-day.

Because the latter results do not support the predictions implied by the short-term abnormal pressure theory, we cannot reject the argument that it is the disposition effect that drives the variability of the ex-day abnormal returns across stocks with accrued gains or losses.[46]

IV. Implications for the Ex-Dividend Day Literature

Although our motivation for this study stems from the need to identify whether widely observed "taints" of trading behavior such as the disposition effect matter for asset pricing, the empirical results presented here also have direct implications for the ex-dividend day research. Elton and Gruber (1970), Elton, Gruber, and Rentzler (1984), and Elton, Gruber, and Blake (2005) explicitly state that the marginal income tax rates of different tax clienteles can be inferred by the cross-sectional variation of the price drop on the ex-day. Because shareholders optimally select stocks whose dividend policy is catered to the tax-efficiency of their shareholdings, shareholders in high (low) income-tax brackets will invest in stocks with low (high) dividend yields. As a result, the magnitude of the price drop that implies the marginal income-tax status of each dividend clientele within a sample of ex-days will be positively correlated to the stock dividend yield.[47] Subsequently, Kalay (1982, 1984) challenged the inference of investor tax-brackets from the ex-day price behavior. He stated that if the transaction cost of round-trip trades is not substantial, short-term traders will engage in arbitrage until the difference between the dividend and the ex-day price drop equals the minimum transaction cost borne for trading the stock. As a result, where the discrepancy between the expected ex-day price drop and the dividend is reduced due to arbitrage, the PDR will merely reflect the level of transaction costs for which profitable arbitrage opportunities are not feasible.

---

[46] As a robustness test, we repeat the analysis in this section using the CGOH estimated over 360, 250, 150, 60 and 30 calendar days to distinguish between winners and losers and find the same qualitative results.

[47] As reported in the PDR regression results in Table VI, the beta coefficient of the dividend yield is significantly positive for the WLS and clustered standard errors estimations, which may lend support to the dividend clientele theory. However, the beta coefficient is insignificant in the fixed-effects model. Further, although one would expect the coefficient sign to be negative in the AR^{ex} regression, it remains significantly positive across all three estimations. We believe that these empirical findings do not support the dividend clientele argument.

While the above mentioned theories compete to explain the cross-sectional dispersion of the price drop on the ex-dividend day, little has been documented on the factors driving the time-series dispersion of the ex-day PDR. Eades, Hess, and Kim (1994), and Naranjo, Nimalendran, and Ryngaert (2000) examine the fluctuation of ex-day average abnormal returns for portfolios of stocks that are ranked on the basis of dividend yield. From a different angle, we focus on explaining the variability of PDR/AR^{ex} at the individual stock level on the grounds of our predicted disposition effect theory. Given that the same stock will be a winner at good times and a loser at bad times, we expect its ex-day price drop to vary over time on the basis of whether a gain or a loss has accrued on the stock at different points in time. Namely, for the same stock, we expect a significantly lower (higher) PDR (AR^{ex}) when its CGOH is negative compared to when its CGOH is positive, ceteris paribus. This can be easily inspected by testing the significance of the mean difference of PDR/AR^{ex} values that are paired as follows. First, we split the PDR/AR^{ex} of the 2.5% trimmed samples into winning and losing ex-days on the basis of the CGOH estimated over the 90-calendar day holding period. Second, we double-sort the ex-days in each winner/loser sample by their dividend amount and ex-dividend day. Third, for each individual stock, we successively match one ex-day from the "winner" sample with its closer ex-day from the "loser" sample, provided that an equal dividend amount is paid on both ex-days.[48] Fourth, we calculate the mean/median difference between the PDR/AR^{ex} value of the losing ex-day and its respective value of the winning ex-day across all created pairs. The final sample consists of 7,893 (7,874) differences of the PDR (AR^{ex}) paired values.[49] Implicitly, by comparing ex-days of the same stock, we control for liquidity, size, and idiosyncratic volatility, and by additionally requiring the same dividend amount on both ex-days, we control for the marginal effect that an investor clientele with particular dividend-tax preferences might have on the ex-day.

<u>Insert **Table XI** here</u>

[48] The median duration between the two paired ex-dividend dates is 182 calendar days (6.1 months) for the PDR and AR^{ex} samples.

[49] Naturally, the final pair count is less than the maximum possible number of ex-day pairs (10,752) due to cases where the same stock distributes a different dividend amount in good and bad times and cases where the number of winning ex-days is different from the number of losing ex-days for the same stock over the examined period.

Table XI reports that the mean (median) difference of PDR between paired losing and winning ex-days is equal to −0.286 (−0.222) and significant at the 1% level (t-statistic = −4.32 and z-statistic = −4.92 for the mean and median difference, respectively). Similarly, the mean (median) difference of AR^{ex} is equal to 0.097% (0.105%) and is significant at the 1% level (t-statistic = 4.58 and z-statistic = 4.77 for the mean and median difference, respectively). We conclude that the significant negative (positive) mean difference found for the PDR (AR^{ex}) paired observations provides clear evidence that the disposition effect contributes to the time-series variation of the ex-day relative valuation of the dividend for the individual stock.[50]

Above, we showed that the PDR for the same individual stock will vary over time on the basis of whether it is perceived as a winner or loser by holding investors. Is this enough to explain the temporal variation of the aggregate PDR over a long period? Chetty, Rosenberg, and Saez (2007) examine the long-term relationship between changes in tax rates and the ex-day price drop ratio. They graphically show that the time-series of the aggregate yearly PDR over the 1963-2004 period is so volatile that tax amendments alone cannot explain the large time-series PDR dispersion. Even after they add controls for other factors that may contribute to the average PDR volatility (such as firm assets, liabilities, earnings), the explanatory power does not increase for the PDR fluctuation. Based on their time-series analysis, they conclude the following:

> [T]he lack of monotonicity in the excess premiums suggests that it is impossible to explain the evolution of the premium with variables such as reductions in trading transaction costs, the elimination of discrete pricing rules, or the development of tax-sophisticated arbitrage techniques (p. 21).

Based on the evidence presented thus far, it is possible that the disposition effect also contributes to the time-series variation of the ex-day price drop of the aggregate sample.

[50] As a robustness test, we repeat these tests on the mean and median differences on paired PDR/AR^{ex} values while using all other CGOH horizons (T = 360, 250, 150, 60, 30 calendar days) to distinguish between winning and losing ex-days. In addition, we repeat the test for two subsamples with maximum duration between the two paired ex-dividend dates equal to 182 and 92 days (the median duration for the two subsamples equals 92 and 90 days, respectively). In all cases, we find that the mean/median differences remain statistically significant at the 1% level.

Specifically, we expect that the more winners (losers) are present within a quarter, the higher (lower) the average PDR will be in the market. To confirm whether the winner/loser effect is a primary factor that makes the aggregate PDR fluctuate substantially over time, we plot the time-series of the quarterly mean and median PDR separately for winners and losers (Figure 1).

Insert **Figure 1** here

Two observations are evident in Figure 1. First, the aggregate PDR of the winners' sample is higher than that of the losers' sample in 29 of the 32 quarters, which conforms to the disposition effect that is hypothesized in this paper. Second, we note that the PDR fluctuation is rather noisy for both winners and losers with no sign of the smoothing that would take place if the winner versus loser concentration constituted a determinant of the temporal variation of the aggregate PDR. Further, the two time-series seem to move in parallel throughout almost the entire period (the correlation coefficient between winners' PDR and losers' quarterly mean PDR = 0.65 and is significant at the 1% level), which implies that another set of systematic factors, unrelated to the disposition effect and common to both samples of winners and losers, drives the aggregate price drop ratio on the ex-dividend day within the time-series dimension. We view the search for these factors as a good starting point for future research in this area.

V. Conclusion

Since Shefrin and Statman (1985) introduced the notion of the disposition effect, a growing body of literature has examined whether and why the disposition effect is prevalent in the trading behavior of both individual and professional investors. However, little has been documented about whether this effect has a significant impact on stock prices, which is of primary importance in the finance literature. Inspired by the empirical study of Frazzini (2006), and Grinblatt and Han (2005), our paper adds to the literature by examining the degree to which the tendency to sell winners more readily than losers facilitates or hinders the downward price adjustment of the stock price on the ex-dividend day. We use the capital gains overhang proxy, as computed by Grinblatt and Han (2005), to measure the accrued gain or loss for individual stocks just before the ex-day based on market-wide data on stock prices and turnovers. Consistent with the disposition effect, we find that stocks with a positive capital gains overhang have a higher price drop ratio than stocks with a negative capital gains overhang on the ex-day. Moreover, the market-adjusted price drop ratio is positively related to the level of the capital gains overhang. We attribute our results to the fact that active (limited) selling by holders of winning (losing) stocks accelerates (restrains) the downward price adjustment on the ex-day. Overall, our results remain robust to numerous ex-day normal return specifications, panel data models adjusting for clusters along stock and time dimensions or fixed effects, different holding period length assumptions and the use of opening prices instead of closing prices on the ex-day. Lastly, we examine whether our empirical results are driven by evident buy-sell order imbalances prior to the ex-day that are unrelated to the disposition effect. We deduce that abnormal buying (selling) pressure for winners (losers) prior to the ex-day affects ex-day abnormal returns in the opposite direction of the disposition effect, providing no support for an alternative hypothesis. Furthermore, our results contribute to the ex-dividend day literature in that they nominate the disposition effect as a reason why the ex-dividend day price drop ratio might vary over time at the individual stock level. Specifically, we show that the price drop ratio referring to the same stock will be higher in good times than in bad times, in accordance with our hypothesis.

Our results have implications for the ongoing discussion about whether behavioral biases identified during trading are capable of influencing asset prices. We find that one of the most widely acknowledged biases, namely, the disposition effect, can create significant asymmetries in the valuation of common stocks on the ex-dividend day.

REFERENCES

Ajinkya, Bipin B., and Prem C. Jain, 1989, The behavior of daily stock market trading volume, *Journal of Accounting and Economics* 11, 331-359.

Bali, Rakesh, and Gailen L. Hite, 1998, Ex-dividend day stock price behavior: Discreteness or tax-induced clienteles? *Journal of Financial Economics* 47, 127-159.

Barber, Brad M., Yi-Tsung Lee, Yu-Jane Liu, and Terrance Odean, 2007, Is the aggregate investor reluctant to realise losses? Evidence from Taiwan, *European Financial Management* 13, 423-447.

Barberis, Nicholas, and Wei Xiong, 2009, What drives the disposition effect? An analysis of a long-standing preference-based explanation, *Journal of Finance* 64, 751-784.

Barclay, Michael J., 1987, Dividends, taxes and common stock prices: The ex-dividend day behavior of common stock prices before the income tax, *Journal of Financial Economics* 19, 31-44.

Bell, Leonie, and Tim Jenkinson, 2002, New evidence of the impact of dividend taxation and on the identity of the marginal investor, *Journal of Finance* 57, 1321-1346.

Boyd, John H., and Ravi Jagannathan, 1994, Ex-dividend price behavior of common stocks, *Review of Financial Studies* 7, 711-741.

Cameron, Colin, Jonah Gelbach, and Douglas Miller, 2011, Robust inference with multiway clustering, *Journal of Business and Economic Statistics* 29, 238-249.

Campbell, Cynthia J., and Charles E. Wasley, 1996, Measuring abnormal daily trading volume for samples of NYSE/ASE and NASDAQ securities using parametric and nonparametric test statistics, *Review of Quantitative Finance and Accounting* 6, 309-326.

Carhart, Mark M., 1997, On persistence in mutual fund performance, *Journal of Finance* 52, 57-82.

Chetty, Raj, Joseph Rosenberg, and Emmanuel Saez, 2007, The effects of taxes on market responses to dividend announcements and payments: What can we learn from the 2003 dividend tax cut? in Alan J. Auerbach, James R. Hines, Jr., and Joel Slemrod, ed.: *Taxing Corporate Income in the 21st Century* (Cambridge University Press).

Coval, Joshua D., and Tyler Shumway, 2005, Do behavioral biases affect prices? *Journal of Finance* 60, 1-34.

D'Agostino, Ralph B., Albert Belanger, and Ralph B. D'Agostino, Jr., 1990, A suggestion for using powerful and informative tests of normality, *American Statistician* 44, 316-321.

Dhar, Ravi, and Ning Zhu, 2006, Up close and personal: Investor sophistication and the disposition effect, *Management Science* 52, 726-740.

Eades, Kenneth M., Patrick J. Hess, and E. Han Kim, 1994, Time-series variation in dividend pricing, *Journal of Finance* 49, 1617-1638.

Elton, Edwin J., and Martin J. Gruber, 1970, Marginal stockholder tax rates and the clientele effect, *Review of Economics and Statistics* 52, 68-74.

Elton, Edwin J., Martin J. Gruber, and Christopher R. Blake, 2005, Marginal stockholder tax effects and ex-dividend-day price behavior: Evidence from taxable versus nontaxable closed-end funds, *Review of Economics and Statistics* 87, 579-586.

Elton, Edwin J., Martin J. Gruber, and Joel Rentzler, 1984, The ex-dividend day behavior of stock prices; A re-examination of the clientele effect: A comment, *Journal of Finance* 39, 551-556.

Fama, Eugene F., and Kenneth R. French, 1993, Common risk factors in the returns on stocks and bonds, *Journal of Financial Economics* 33, 3-56.

Fama, Eugene F., and James D. MacBeth, 1973, Risk, return and equilibrium: Empirical tests, *Journal of Political Economy* 81, 607-636.

Frank, Murray, and Ravi Jagannathan, 1998, Why do stock prices drop by less than the value of the dividend? Evidence from a country without taxes, *Journal of Financial Economics* 47, 161-188.

Frazzini, Andrea, 2006, The disposition effect and underreaction to news, *Journal of Finance* 61, 2017-2046.

Frino, Alex, David Johnstone, and Hui Zheng, 2004, The propensity for local traders in futures markets to ride losses: Evidence of irrational or rational behavior? *Journal of Banking and Finance* 28, 353-372.

Garvey, Ryan, and Anthony Murphy, 2004, Are professional traders too slow to realize their losses? *Financial Analysts Journal* 60, 35-43.

Graham, John R., and Alok Kumar, 2006, Do dividend clienteles exist? Evidence on dividend preferences of retail investors, *Journal of Finance* 61, 1305-1336.

Graham, John R., Roni Michaely, and Michael R. Roberts, 2003, Do price discreteness and transaction costs affect stock returns? Comparing ex-dividend pricing before and after decimalization, *Journal of Finance* 58, 2611-2635.

Green, Richard C., and Kristian Rydqvist, 1999, Ex-day behavior with dividend preference and limitations to short-term arbitrage: The case of Swedish lottery bonds, *Journal of Financial Economics* 53, 145-187.

Grinblatt, Mark, and Bing Han, 2005, Prospect theory, mental accounting, and momentum, *Journal of Financial Economics* 78, 311-339.

Grinblatt, Mark, and Matti Keloharju, 2001, What makes investors trade? *Journal of Finance* 56, 589-616.

Harris, Lawrence, 1988, Predicting contemporary volume with historic volume at differential price levels: Evidence supporting the disposition effect: Discussion, *Journal of Finance* 43, 698-699.

Hayashi, Fumio, and Ravi Jagannathan, 1990, Ex-day behavior of Japanese stock prices: New insights from new methodology, *Journal of the Japanese and International Economies* 4, 401-427.

Jakob, Keith, and Tongshu Ma, 2004, Tick size, NYSE rule 118, and ex-dividend day stock price behavior, *Journal of Financial Economics* 72, 605-625.

Jin, Li, 2006, Capital gain tax overhang and price pressure, *Journal of Finance* 61, 1399-1431.

Kadapakkam, Palani-Rajan, 2000, Reduction of constraints on arbitrage trading and market efficiency: An examination of ex-day returns in Hong Kong after introduction of electronic settlement, *Journal of Finance* 55, 2841-2861.

Kahneman, Daniel, and Amos Tversky, 1979, Prospect theory: An analysis of decision under risk, *Econometrica* 47, 263-291.

Kalay, Avner, 1982, The ex-dividend day behavior of stock prices: A re-examination of the clientele effect, *Journal of Finance* 37, 1059-1070.

Kalay, Avner, 1984, The ex-dividend day behavior of stock prices; A re-examination of the clientele effect: A reply, *Journal of Finance* 39, 557-561.

Kalay, Avner, and Marti G. Subrahmanyam, 1984, The ex-dividend day behavior of option prices, *Journal of Business* 57, 113-128.

Koski, Jennifer Lynch, 1996, A microstructure analysis of ex-dividend stock price behavior before and after the 1984 and 1986 tax reform acts, *Journal of Business* 69, 313-338.

Lakonishok, Josef, and Seymour Smidt, 1986, Volume for winners and losers: Taxation and other motives for stock trading, *Journal of Finance* 41, 951-974.

Lamdin, Douglas J., and Craig Hiemstra, 1993, Ex-dividend day share price behavior: Effects of the tax reform act of 1986, *Review of Economics and Statistics* 75, 778-783.

Lasfer, M. Ameziane, 1995, Ex-day behavior: Tax or short-term trading effects, *Journal of Finance* 50, 875-897.

Locke, Peter R., and Steven C Mann, 2005, Professional trader discipline and trade disposition, *Journal of Financial Economics* 76, 401-444.

Locke, Peter R., and Zhan Onayev, 2005, Trade duration: Information and trade disposition, *Financial Review* 40, 113-129.

Lynch, Anthony W., and Richard R. Mendenhall, 1997, New evidence on stock price effects associated with changes in the S&P 500 index, *Journal of Business* 70, 351-383.

Michaely, Roni, and Jean-Luc Vila, 1995, Investors' heterogeneity, prices, and volume around the ex-dividend day, *Journal of Financial and Quantitative Analysis* 30, 171-198.

Miller, Merton H., and Franco Modigliani, 1961, Dividend policy, growth, and the valuation of shares, Journal of Business 34, 411-433.

Milonas, Nikolaos T., Nickolaos G. Travlos, Jason Zezhong Xiao, and Cunkai Tan, 2006, The ex-dividend day stock price behavior in the Chinese stock market, *Pacific-Basin Finance Journal* 14, 155-174.

Naranjo, Andy, M. Nimalendran, and Mike Ryngaert, 2000, Time variation of ex-dividend day stock returns and corporate dividend capture: A reexamination, *Journal of Finance* 55, 2357-2372.

Odean, Terrance, 1998, Are investors reluctant to realize their losses? *Journal of Finance* 53, 1775-1798.

Poterba, James M., and Lawrence H. Summers, 1984, New evidence that taxes affect the valuation of dividends, *Journal of Finance* 39, 1397-1415.

Rantapuska, Elias, 2008, Ex-dividend day trading: Who, how, and why? Evidence from the Finnish market, *Journal of Financial Economics* 88, 355-374.

Robin, Ashok J., 1991, The impact of the 1986 tax reform act on ex-dividend day returns, *Financial Management* 20, 60-70.

Roll, Richard, 1977, An analytic valuation formula for unprotected American call options on stocks with known dividends, *Journal of Financial Economics* 5, 251-258.

Shapira, Zur, and Itzhak Venezia, 2001, Patterns of behavior of professionally managed and independent investors, *Journal of Banking and Finance* 25, 1573-1587.

Shefrin, Hersh, and Meir Statman, 1985, The disposition to sell winners too early and ride losers too long: Theory and evidence, *Journal of Finance* 40, 777-790.

Thaler, Richard, 1985, Mental accounting and consumer choice, *Marketing Science* 4, 199-214.

Thompson, Samuel B., 2011, Simple formulas for standard errors that cluster by both firm and time, *Journal of Financial Economics* 99, 1-10.

White, Halbert, 1980, A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity, *Econometrica* 48, 817-838.

Zhang, Yi, Kathleen A. Farrell, and Todd A. Brown, 2008, Ex-dividend day price and volume: The case of 2003 dividend tax cut, *National Tax Journal* 61, 105-127.

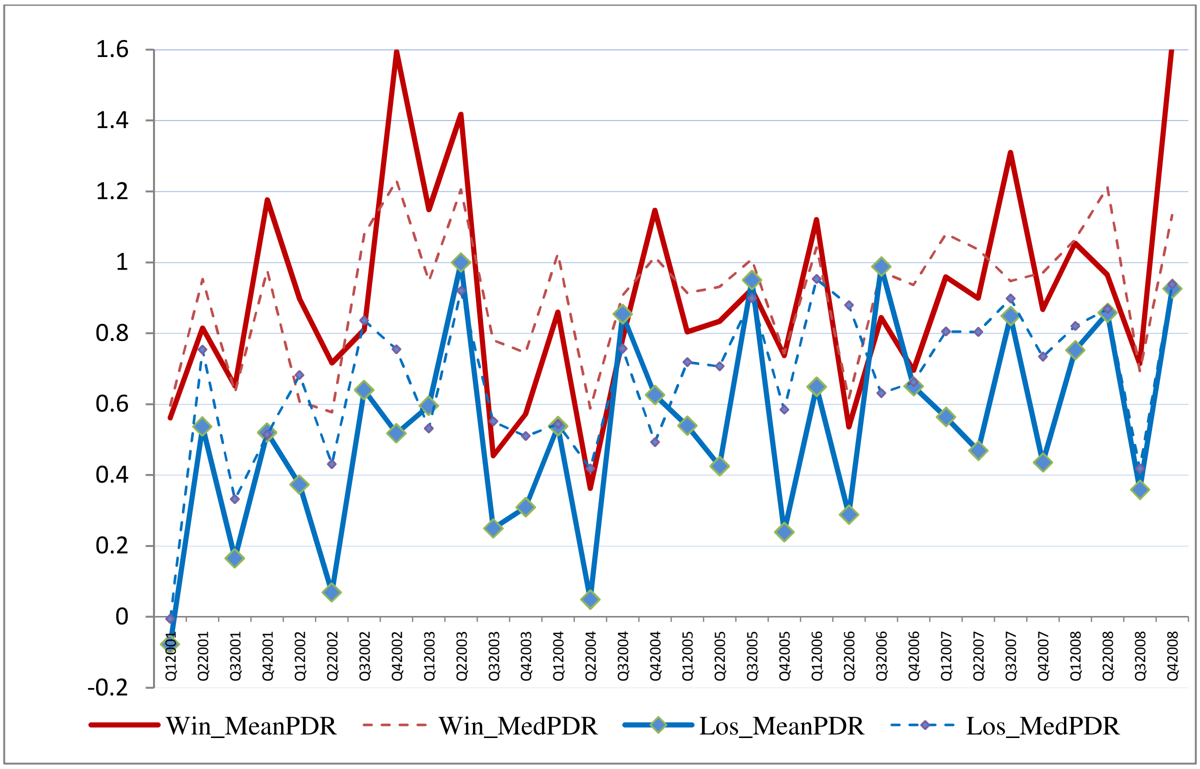

Figure 1. The time series of the average quarterly PDR separately for winners and losers; 2001-2008. This figure depicts the time series dispersion of the average PDR computed quarterly, separately for winners and losers. Winners are defined as those stocks with a positive CGOH while losers are those with a negative CGOH. Means and medians have been calculated for winners (*Win_MeanPDR* and *Win_MedPDR*) and losers (*Los_MeanPDR* and *Los_MedPDR*) for each quarter after trimming the top and bottom 2.5 percentiles of the initial PDR sample (final sample Obs = 25,628). The PDR is defined as $[(P^{cum} - (P^{ex}/(1 + R^{norm}))) / Div]$. P^{cum} is the closing price on the cum-dividend day, P^{ex} is the closing price on the ex-dividend day adjusted for market risk (R^{norm}) on that day and Div is the dividend amount. R^{norm} is the expected return on the ex-day calculated using the market model that is estimated over the [(−130, −31) & (+31, +130)] days window around the ex-day with the CRSP equal-weighted NYSE/AMEX index as the market proxy. The CGOH is defined as the percentage deviation of the closing trade price on the cum-day from the aggregate cost basis proxy over an assumed holding period of 90 calendar days that is computed as in Grinblatt and Han (2005) using daily price and turnover data, and described in Section II.E.

Table I
Filters of Sample Screening NYSE and AMEX Ex-Days of Ordinary Cash Dividends of Common Stocks for Years 2001-2008

The initial sample consists of the entire CRSP history of ordinary cash dividends paid by common stocks listed on NYSE and AMEX from February 1, 2001 until December 31, 2008. The initial sample size (29,004 obs.) is reduced by the removal of dividends going ex within 20 trading days after the previous ex-day of the same stock, dividends with an announcement day within 4 trading days before their respective ex-day, ex-days with confounding corporate events (stock split, stock dividend, rights issue, bonus issue) within a [–4, +4] window around the ex-day, "penny dividends" < $0.01, dividends whose stocks did not trade either on the ex-day or the cum-day, dividends whose stocks are priced at less than $5 on the cum-day, and finally, those dividends whose stocks were thinly traded over the estimation period [(–130, –31) & (+31, +130)]. The third column counts removed observations as a percentage of the initial sample size (29,004 obs.). In addition, in order to mitigate the outlier impact we trim separately the PDR and the AR^{ex} total distributions at the 2.5% upper and 2.5% lower tail.

Filters and Trimming applied to the ex-day sample (2001-2008)	Removed Obs	Removed %	Residual Obs
Ex-days for all ordinary cash dividends (2001-2008).			29,004
Exclude dividends going ex within 20 trading days after the previous ex-day of the same stock.	61	0.2%	28,943
Exclude dividends with an announcement day within 4 trading days before their respective ex-day [–4, –1].	394	1.4%	28,549
Exclude dividends with a corporate event within 4 trading days before or after their respective ex-day [–4, +4].	167	0.6%	28,382
Exclude all "penny dividends" < $0.01.	295	1.0%	28,087
Exclude ex-days with no trade on either the ex-day or the cum-day.	745	2.6%	27,342
Exclude ex-days with stock price < $5.0 on the cum-day.	302	1.0%	27,040
Exclude ex-days whose estimation period [(–130, –31) & (+31, +130)] has less than 60 observations.	3	0.0%	27,037
Trim the 2.5% upper tail and 2.5% lower tail of the ex-day Price Drop Ratio/Abnormal Return distribution of the total sample.	1,351		25,686

Table II

Descriptive Statistics of the Price Drop Ratio (PDR) and Abnormal Return (AR^{ex}) on the Ex-Day, for the Entire Sample and the 2.5% Trimmed Sample

This table presents summary statistics for the price drop ratio (PDR) and the abnormal return (AR^{ex}) on the ex-day, as well as t-tests on the theoretical values for PDR =1 and AR^{ex} =0. The second and fourth columns show statistics for the PDR and the AR^{ex} respectively, for the entire sample (100%). The third and fifth columns show statistics for the PDR and the AR^{ex} respectively, after trimming the top and bottom 2.5 percentiles (95%) separately for each measure. The PDR is defined as $[(P^{cum} - (P^{ex}/(1 + R^{norm}))) / Div]$ and the AR^{ex} is defined as $[((P^{ex} - P^{cum} + Div) / P^{cum}) - R^{norm}]$. P^{cum} is the closing price on the cum-dividend day, P^{ex} is the closing price on the ex-dividend day adjusted for market risk (R^{norm}) on that day and Div is the dividend amount. R^{norm} is the expected return on the ex-day calculated using the market model that is estimated over the [(−130, −31) & (+31, +130)] days window around the ex-day with the CRSP equal-weighted NYSE/AMEX index as the market proxy. The Wilcoxon signed-rank test is used for testing median values. *** denotes statistical significance at the 1% level, using a two-tailed test.

Variable	PDR (Ho: PDR=1)		AR^{ex} (Ho: AR^{ex}=0)	
Distribution	100%	95%	100%	95%
Obs	27,037	25,686	27,037	25,686
Mean	0.783***	0.741***	0.134%***	0.124%***
Std Error	0.062	0.026	0.012%	0.008%
t-stat	-3.48	-9.97	11.25	15.13
Median	0.832***	0.832***	0.097%***	0.097%***
z-stat	-10.95	-11.84	12.78	13.72
Std. Dev.	10.244	4.154	1.955%	1.318%
Variance	104.939	17.260	0.038%	0.017%
Min	-277.107	-14.890	-33.670%	-3.529%
Max	373.260	16.834	63.547%	4.041%
Skewness	2.492	-0.063	1.388	0.137
Kurtosis	168.648	5.648	63.145	3.329

Table III

Descriptive Statistics for the Abnormal Turnover (ATO) on the Ex-Day for the PDR Sample

This table reports descriptive statistics for the abnormal turnover (ATO) on the ex-day for the PDR sample after trimming the top and bottom 2.5 percentiles, using three alternative methodologies. The second column reports the raw percentage ATO that is computed as the percentage deviation of stock turnover (TO) on the ex-day from the stock mean TO over the estimation window of [(−130, −31) & (+31, +130)] days around the ex-day where TO is defined as the simple ratio of (trading volume/No of outstanding stocks). The third column reports the log-transformed ATO as described in Campbell and Wasley (1996) who measure TO as the natural log of (the ratio of (100 × (trading volume/No of outstanding stocks)) + 0.000255) and ATO as the TO on the ex-day in excess of the normal stock TO estimated using the market model (OLS) over the estimation window of [(−130, −31) & (+31, +130)] days around the ex-day. The fourth column reports the natural log-transformed ATO as described in Lynch and Mendenhall (1997) who measure TO as the ratio of the [log(1+$value of trading volume)/log(1+$value of outstanding stocks)] and ATO as the TO on the ex-day in excess of the normal stock TO estimated using the market model (OLS) over the estimation window of [(−130, −31) & (+31, +130)] days around the ex-day. The market portfolio is defined as all NYSE/AMEX common stocks reported in CRSP at a particular date. The last row provides the χ^2 statistic of the D'Agostino, Belanger, and D'Agostino (1990) test that tests the null hypothesis of assumed normality based on the levels of skewness and kurtosis, in combination. *** denotes significance at the 1% level.

	Abnormal Turnover on the ex-day (ATO)		
Methodology	Raw %	Cambell and Wasley (96)	Lynch and Mendenhall (97)
Obs	25,686	25,686	25,686
Mean	0.1082	0.0189	0.0067
Median	-0.1265	-0.0053	0.0012
Std. Dev.	1.4897	0.6311	0.0436
Min	-0.9945	-4.5875	-0.2773
Max	64.2393	4.8286	0.5488
Skewness	16.353	0.183	2.408
Kurtosis	451.727	9.180	17.611
Normality (χ^2)	51,524***	3,436***	14,718***

Table IV

Pearson Correlations between Various Time Horizons of the Capital Gains Overhang (CGOH) for the PDR Sample

This table reports pairwise Pearson correlations for the capital gains overhang (CGOH) calculated at seven different calendar holding periods for the PDR sample after trimming the top and bottom 2.5 percentiles; T = 360, 250, 150, 90, 60, 30, 15 calendar days before the ex-day. The CGOH is defined as the percentage deviation of the closing trade price on the cum-day from the aggregate cost basis proxy, that is computed as in Grinblatt and Han (2005) using daily price and turnover data:

$$CGOH_i^T = \frac{P_i^{cum} - RP_i^T}{P_i^{cum}} * 100\%, \quad RP_i^T = \frac{1}{\sum_{n=1}^{T} w_{t-n}} \sum_{n=1}^{T} w_{t-n} P_{t-n}, \quad w_{t-n} = \left[TO_{t-n} \prod_{\tau=1}^{n-1} \left(1 - TO_{t-n+\tau}\right) \right]$$

P_{t-n} is the stock price n days before the ex-day, TO_{t-n} is the turnover n days before the ex-day and $TO_{t-n+\tau}$ is the "forward-looking" turnover τ days after the t-n day point. The inverse of the sum of the weights is a normalizing constant that makes all turnover weights to past prices sum to one. ** denotes significance at the 5% level.

T period	360	250	150	90	60	30	15
360	1						
250	0.982**	1					
150	0.918**	0.963**	1				
90	0.823**	0.875**	0.951**	1			
60	0.719**	0.771**	0.859**	0.954**	1		
30	0.526**	0.570**	0.654**	0.765**	0.876**	1	
15	0.374**	0.407**	0.470**	0.560**	0.669**	0.867**	1

Table V

Difference of Mean and Median PDR/AR^{ex} between Losers and Winners, and PDR/AR^{ex} Per CGOH Quantile

Panel A tests the significance of the difference of the mean and median PDR/AR^{ex} between stocks with a negative CGOH (losers) and stocks with a positive CGOH (winners). Panels B and C report the mean and median PDR/AR^{ex} per six CGOH quantiles as well as t-statistics from testing whether the mean PDR/AR^{ex} is equal to its hypothesized value (PDR=1 or AR^{ex}=0). Means and medians have been calculated after trimming the top and bottom 2.5 percentiles separately for the PDR/AR^{ex} samples. The PDR is defined as $[(P^{cum} - (P^{ex}/(1 + R^{norm}))) / Div]$ and the AR^{ex} is defined as $[((P^{ex} - P^{cum} + Div) / P^{cum}) - R^{norm}]$. P^{cum} is the closing price on the cum-dividend day, P^{ex} is the closing price on the ex-dividend day adjusted for market risk (R^{norm}) on that day and Div is the dividend amount. R^{norm} is the expected return on the ex-day calculated using the market model that is estimated over the [(−130, −31) & (+31, +130)] days window around the ex-day with the CRSP equal-weighted NYSE/AMEX index as the market proxy. The CGOH is defined as the percentage deviation of the closing trade price on the cum-day from the aggregate cost basis proxy over an assumed holding period of 90 calendar days that is computed as in Grinblatt and Han (2005) using daily price and turnover data, and described in Section II.E. The Wilcoxon rank-sum test is used for testing the difference of median values. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively, using a two-tailed test.

Panel A: Difference of mean and median PDR/AR^{ex} between losers and winners

	PDR			AR^{ex}		
Status (CGOH90)	Obs	Mean	Median	Obs	Mean	Median
Losers	10,752	0.539	0.684	10,570	0.202%	0.184%
Winners	14,934	0.887	0.928	15,116	0.071%	0.046%
Diff.		-0.348***	-0.244***		0.131%***	0.138%***
t-stat / z-stat		-6.62	-8.09		7.70	8.19
Total	25,686	0.741	0.832	25,686	0.124%	0.097%

Panel B: PDR per CGOH90 Quantile

	Losers			Winners			
Quantile	3	2	1	1	2	3	
CGOH90	-14.7%	-4.4%	-1.2%	1.5%	4.5%	9.8%	Total
Median	0.639	0.709	0.702	0.880	0.918	1.022	0.832
Mean	0.431***	0.584***	0.602***	0.775***	0.878**	1.008	0.741***
t-stat	-7.34	-6.08	-6.35	-4.26	-2.22	0.13	-9.97
Obs	3,584	3,584	3,584	4,978	4,978	4,978	25,686

Panel C: AR^{ex} per CGOH90 Quantile

	Losers			Winners			
Quantile	3	2	1	1	2	3	
CGOH90	-13.5%	-4.3%	-1.2%	1.5%	4.6%	9.8%	Total
Median	0.234%	0.166%	0.157%	0.072%	0.056%	0.003%	0.097%
Mean	0.250%***	0.188%***	0.166%***	0.105%***	0.074%***	0.032%*	0.124%***
t-stat	9.17	8.35	8.20	6.26	4.42	1.65	15.13
Obs	3,523	3,523	3,524	5,039	5,039	5,038	25,686

Table VI

Relationship between PDR/AR^{ex} and CGOH

This table reports the estimated coefficients and their t-statistics of the regressions of PDR/AR^{ex} of the 2.5% trimmed samples against CGOH and a group of control variables as:

PDR_{it} / $AR_{it}^{ex} = \alpha + \beta_1 CGOH_{it} + \beta_2 DY_{it} + \beta_3 MCap_{it} + \beta_4 TO_{it} + \beta_5 IVol_{it} + \beta_6 Tax03_{it} + \varepsilon_{it}$

where CGOH is the capital gains overhang of stock *i* for an assumed investor holding period of T = 90 calendar days before the ex-dividend day *t*. DY is the dividend yield equal to the dividend amount over the closing price on the cum-day. MCap is the mean stock relative size equal to the average natural log (individual stock capitalization to market capitalization) over the estimation window. TO is the average stock turnover over the estimation window. IVol measures the idiosyncratic volatility as the ratio of (individual stock standard deviation to market standard deviation) of daily returns over the estimation window. Tax03 is a dummy variable that takes the value of 1 if the ex-day is located after the May 22, 2003 Tax Act and 0 otherwise. Both PDR and AR^{ex} are computed using closing prices on the ex-day and the expected ex-day return is estimated with the market model. The estimation window is [(−130, −31) & (+31, +130)] trade days around the ex-day and the CRSP equal-weighted NYSE/AMEX index is employed as a proxy for the market portfolio. The CGOH is defined as the percentage deviation of the closing trade price on the cum-day from the aggregate cost basis proxy over an assumed holding period of 90 calendar days that is computed as in Grinblatt and Han (2005) using daily price and turnover data, and described in Section II.E. The Weighted Least Squares method (WLS) is utilized for the PDR pooled regression with the weight being equal to the squared ratio of (DY to stock return standard deviation). The AR^{ex} pooled regression estimated with the Ordinary Least Squares (OLS) method reports t-statistics corrected for heteroscedasticity (White (1980)). The Clustered SE-method refers to standard errors adjusted for both ex-day and stock clusters, as per Thompson (2011), and Cameron, Gelbach, and Miller (2011). The Fixed Effects estimation includes year and stock dummies to the regression equation above. The number in parentheses below the coefficient is the t-statistic. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively, using a two-tailed test.

	PDR			AR^{ex}		
Var./Model	WLS	Clustered SE	Fixed Effects	OLS	Clustered SE	Fixed Effects
Intercept	1.1558***	0.9830***	1.4438*	-0.0016***	-0.0016***	-0.0044*
	(10.34)	(6.08)	(1.82)	(-3.35)	(-2.84)	(-1.74)
CGOH90	1.8029***	2.0335***	2.1089***	-0.0083***	-0.0083***	-0.0084***
	(7.49)	(5.42)	(6.81)	(-6.43)	(-5.63)	(-7.85)
DY	1.4637**	3.5508***	-0.9106	0.0217**	0.0217**	0.0450***
	(2.03)	(3.33)	(-0.29)	(2.34)	(2.36)	(4.30)
MCap	0.0169	-0.0012	0.1097	-0.0002***	-0.0002***	-0.0007**
	(1.31)	(-0.07)	(1.21)	(-4.17)	(-3.64)	(-2.39)
TO	0.0789***	0.0931**	-0.0948	-0.0004***	-0.0004***	-0.0001
	(2.86)	(2.19)	(-1.08)	(-3.11)	(-2.80)	(-0.25)
IVol	-0.0668***	-0.0600*	-0.0109	0.0002*	0.0002	0.0000
	(-2.85)	(-1.72)	(-0.26)	(1.65)	(1.51)	(-0.32)
Tax03	-0.0256	-0.0558	-0.4536***	0.0000	0.0000	0.0010***
	(-0.53)	(-0.76)	(-2.94)	(0.07)	(0.06)	(2.05)
Adj. R^2	0.003	0.002	0.014	0.005	0.005	0.018
F-stat	13.56	9.02	4.88	17.44	17.44	8.13
Obs	25,686	25,686	25,686	25,686	25,686	25,686

Table VII

Difference of Mean and Median PDR/AR^{ex} between Losers and Winners, and PDR/AR^{ex} per CGOH Quantile, Using Opening Prices on the Ex-Day

Both PDR and AR^{ex} are computed as described in Graham, Michaely, and Roberts (2003) using opening prices on the ex-day. Panel A tests the significance of the difference of the mean and median PDR/AR^{ex} between stocks with a negative CGOH (losers) and stocks with a positive CGOH (winners). Panels B and C report the mean and median PDR/AR^{ex} per six CGOH quantiles as well as t-statistics from testing whether the mean PDR/AR^{ex} is equal to its hypothesized value (PDR=1 or AR^{ex}=0). Means and medians have been calculated after trimming the top and bottom 2.5 percentiles separately for the PDR/AR^{ex} samples. The PDR is defined as $[(P^{cum} - (P^{ex}/(1 + 0.5R^{norm}))) / Div]$ and the AR^{ex} is defined as $[((P^{ex} - P^{cum} + Div) / P^{cum}) - 0.5R^{norm}]$. P^{cum} is the closing price on the cum-dividend day, P^{ex} is the opening price on the ex-dividend day adjusted for overnight market risk ($0.5R^{norm}$) and Div is the dividend amount. R^{norm} is the expected return on the ex-day calculated using the market model that is estimated over the [(−130, −31) & (+31, +130)] days window around the ex-day with the CRSP equal-weighted NYSE/AMEX index as the market proxy. The CGOH is defined as the percentage deviation of the closing trade price on the cum-day from the aggregate cost basis proxy over an assumed holding period of 90 calendar days that is computed as in Grinblatt and Han (2005) using daily price and turnover data, and described in Section II.E. The Wilcoxon rank-sum test is used for testing the difference of median values. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively, using a two-tailed test.

Panel A: Ex-day opening prices; difference of mean and median PDR/AR^{ex} between losers and winners

	PDR			AR^{ex}		
Status	Obs	Mean	Median	Obs	Mean	Median
Losers	10,702	0.651	0.690	10,501	0.209%	0.179%
Winners	14,926	0.836	0.860	15,127	0.104%	0.075%
Diff.		-0.184***	-0.170***		0.105%***	0.104%**
t-stat / z-stat		-7.18	-9.46		12.31	12.25
Total	25,628	0.759	0.798	25,628	0.147%	0.114%

Panel B: Ex-day opening prices; PDR per CGOH90 Quantile

	Losers			Winners			
Quantile	3	2	1	1	2	3	
CGOH90	-14.7%	-4.4%	-1.2%	1.5%	4.6%	9.8%	Total
Median	0.552	0.720	0.776	0.819	0.870	0.909	0.798
Mean	0.508***	0.685***	0.760***	0.803***	0.843***	0.861***	0.759**
t-stat	-12.47	-9.44	-7.81	-7.83	-5.86	-4.47	-19.21
Obs	3,567	3,567	3,568	4,976	4,975	4,975	25,628

Panel C: Ex-day opening prices; AR^{ex} per CGOH90 Quantile

	Losers			Winners			
Quantile	3	2	1	1	2	3	
CGOH90	-13.3%	-4.3%	-1.2%	1.5%	4.6%	9.9%	Total
Median	0.289%	0.157%	0.128%	0.106%	0.073%	0.042%	0.114%
Mean	0.288%***	0.186%***	0.153%***	0.126%***	0.101%***	0.085%***	0.147%**
t-stat	21.43	16.46	14.54	14.80	11.97	9.14	35.77
Obs	3,500	3,500	3,501	5,043	5,042	5,042	25,628

Table VIII

Relationship between PDR/AR^{ex} and CGOH, Using Opening Prices on the Ex-Day

Both PDR and AR^{ex} are computed as described in Graham, Michaely, and Roberts (2003) using opening prices on the ex-day. This table reports the estimated coefficients and their t-statistics of the regressions of PDR/AR^{ex} of the 2.5% trimmed samples against CGOH and a group of control variables as:

PDR_{it} / $AR_{it}^{ex} = \alpha + \beta_1 CGOH_{it} + \beta_2 DY_{it} + \beta_3 MCap_{it} + \beta_4 TO_{it} + \beta_5 IVol_{it} + \beta_6 Tax03_{it} + \varepsilon_{it}$

where CGOH is the capital gains overhang of stock *i* for an assumed investor holding period of T = 90 calendar days before the ex-dividend day *t*. DY is the dividend yield equal to the dividend amount over the closing price on the cum-day. MCap is the mean stock relative size equal to the average natural log (individual stock capitalization to market capitalization) over the estimation window. TO is the average stock turnover over the estimation window. IVol measures the idiosyncratic volatility as the ratio of (individual stock standard deviation to market standard deviation) of daily returns over the estimation window. Tax03 is a dummy variable that takes the value of 1 if the ex-day is located after the May 22, 2003 Tax Act and 0 otherwise. Both PDR and AR^{ex} are computed using opening prices on the ex-day and adjusted for one half of the expected overnight return that is estimated with the market model. The estimation window is [(−130, −31) & (+31, +130)] trade days around the ex-day and the CRSP equal-weighted NYSE/AMEX index is employed as a proxy for the market portfolio. The CGOH is defined as the percentage deviation of the closing trade price on the cum-day from the aggregate cost basis proxy over an assumed holding period of 90 calendar days that is computed as in Grinblatt and Han (2005) using daily price and turnover data, and described in Section II.E. The Weighted Least Squares method (WLS) is utilized for the PDR pooled regression with the weight being equal to the squared ratio of (DY to stock return standard deviation). The AR^{ex} pooled regression estimated with the Ordinary Least Squares (OLS) method reports t-statistics corrected for heteroscedasticity (White (1980)). The Clustered SE-method refers to standard errors adjusted for both ex-day and stock clusters, as per Thompson (2011), and Cameron, Gelbach, and Miller (2011). The Fixed Effects estimation includes year and stock dummies to the regression equation above. The number in parentheses below the coefficient is the t-statistic. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively, using a two-tailed test.

	PDR			AR^{ex}		
Var./Model	WLS	Clustered SE	Fixed Effects	OLS	Clustered SE	Fixed
Intercept	0.7098***	0.6054***	0.2161	0.0014***	0.0014***	-0.0010
	(12.96)	(6.56)	(0.56)	(5.68)	(3.77)	(-0.79)
CGOH90	0.7643***	0.8362**	0.6496***	-0.0074***	-0.0074***	-0.0059***
	(6.51)	(1.96)	(4.32)	(-11.35)	(-7.01)	(-10.87)
DY	0.6544*	-0.1133	1.4206	0.0362***	0.0362***	0.0148***
	(1.86)	(-0.18)	(0.92)	(3.66)	(3.63)	(2.81)
MCap	-0.0050	-0.0178*	-0.0749*	0.0000	0.0000	-0.0002
	(-0.79)	(-1.80)	(-1.69)	(-1.23)	(-0.88)	(-1.60)
TO	-0.0637***	-0.0653**	-0.0340	0.0003***	0.0003***	0.0003**
	(-4.72)	(-2.45)	(-0.80)	(4.83)	(2.74)	(2.53)
IVol	-0.0248**	-0.0260	-0.0657***	-0.0001	-0.0001	0.0002***
	(-2.16)	(-1.12)	(-3.21)	(-1.55)	(-0.97)	(3.71)
Tax03	-0.0103	0.0038	0.1799**	0.0001	0.0001	-0.0011***
	(-0.43)	(0.06)	(2.40)	(0.94)	(0.38)	(-4.63)
Adj. R^2	0.004	0.003	0.012	0.014	0.014	0.043
F-stat	16.96	10.59	7.11	30.55	30.55	33.23
Obs	25,628	25,628	25,628	25,628	25,628	25,628

Table IX
Abnormal Trading Pressure around the Ex-Day

Using the AR^{ex} 2.5% trimmed sample of ex-days, we separately split winning/losing stocks, with a positive/negative CGOH over a 90-calendar day window, into three quantiles on the basis of the value of their [−20, −1] cumulative abnormal return ($CAR_{[-20, -1]}$). Winners in the highest $CAR_{[-20, -1]}$ quantile are assumed to bear the highest abnormal buying pressure and losers in the lowest $CAR_{[-20, -1]}$ quantile are assumed to bear the highest abnormal selling pressure before the ex-day. Panel A reports daily and cumulative abnormal returns (AR and CAR), and daily and cumulative abnormal turnovers (ATO and CATO), for a window of [−20, +20] trading days around the ex-day of winners with the highest upward pressure prior the ex-day. Panel B reports daily and cumulative abnormal returns (AR and CAR), and daily and cumulative abnormal turnovers (ATO and CATO), for a window of [−20, +20] trading days around the ex-day of losers with the highest downward pressure prior the ex-day. Abnormal return before or after the ex-day is calculated as the percentage deviation of daily closing prices adjusted for the market movement using the market model that is estimated over the [(−130, −31) & (+31, +130)] days window around the ex-day with the CRSP equal-weighted NYSE/AMEX index as the market proxy. The abnormal return on the ex-day (AR^{ex}) includes the dividend as illustrated in Section II.B. Abnormal turnover is calculated according to the Campbell and Wasley (1996) methodology described in Section II.D. T-statistics test whether daily or cumulative AR or ATO is significantly different to zero on each day. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively, using a two-tailed test.

Panel A: Winners in the top $CAR_{[-20, -1]}$ quantile (Obs. 5,038)

	AR		CAR		ATO		CATO	
Day	mean	t-stat	mean	t-stat	mean	t-stat	mean	t-stat
-20	0.51%***	16.51	0.51%***	16.51	0.91%	0.97	0.91%	0.97
-15	0.54%***	17.62	3.18%***	43.56	3.37%***	3.62	14.69%***	4.00
-10	0.59%***	18.27	6.06%***	68.53	8.74%***	9.24	49.38%	8.36
-5	0.56%***	16.80	8.87%***	94.54	11.28%***	12.44	102.06%***	13.06
-4	0.47%***	13.96	9.35%***	99.08	10.46%***	11.29	112.52%***	13.81
-3	0.55%***	17.06	9.89%***	105.02	10.90%***	12.06	123.43%***	14.55
-2	0.55%***	17.17	10.45%***	111.08	11.46%***	12.89	134.89%***	15.29
-1	0.57%***	19.59	11.02%***	117.79	11.83%***	13.05	146.72%***	15.96
Ex-Div	0.14%***	6.92	11.16%***	116.86	6.19%***	7.10	152.91%***	15.97
+1	0.01%	0.24	11.16%***	112.98	3.46%***	3.98	156.37%***	15.76
+2	0.02%	0.93	11.19%***	108.31	3.26%***	3.69	159.92%***	15.55
+3	0.07%***	2.68	11.26%***	105.11	2.72%***	3.08	162.81%***	15.25
+4	0.07%***	2.51	11.33%***	102.91	1.95%**	2.21	164.85%***	14.91
+5	0.03%	1.31	11.36%***	99.63	1.89%**	2.06	166.74%***	14.57
+10	0.06%**	1.97	11.51%***	88.86	1.07%	1.21	175.38%***	13.22
+15	0.00%	-0.09	11.73%***	80.67	-0.12%	-0.13	177.07%***	11.86
+20	0.04%	1.52	11.92%***	73.90	-1.46%	-1.58	171.97%***	10.43

Panel B: Losers in the bottom $CAR_{[-20, -1]}$ quantile (Obs. 3,524)								
	AR		CAR		ATO		CATO	
Day	mean	t-stat	mean	t-stat	mean	t-stat	mean	t-stat
-20	-0.63%***	-15.84	-0.63%***	-15.84	-1.60%	-1.44	-1.60%	-1.44
-15	-0.68%***	-16.51	-3.52%***	-41.04	4.06%***	3.42	5.86%	1.36
-10	-0.68%***	-16.86	-6.67%***	-63.72	8.71%***	7.38	39.02%***	5.59
-5	-0.64%***	-15.33	-9.85%***	-87.91	12.21%***	10.78	94.70%***	10.08
-4	-0.62%***	-15.77	-10.47%***	-91.52	10.36%***	8.95	105.07%***	10.65
-3	-0.59%***	-15.69	-11.06%***	-97.26	10.43%***	9.15	115.49%***	11.22
-2	-0.58%***	-16.21	-11.64%***	-103.12	11.29%***	10.29	126.79%***	11.82
-1	-0.55%***	-14.47	-12.18%***	-109.92	11.52%***	10.22	138.31%***	12.38
Ex-Div	0.18%***	7.27	-12.00%***	-105.90	8.92%***	8.44	147.23%***	12.73
+1	-0.01%	-0.14	-12.00%***	-101.45	6.66%***	6.22	153.99%***	12.86
+2	-0.13%***	-3.43	-12.12%***	-95.84	7.82%***	7.22	162.38%***	13.12
+3	-0.01%	-0.21	-12.12%***	-91.78	6.30%***	6.17	169.18%***	13.23
+4	-0.01%	-0.34	-12.14%***	-88.68	5.64%***	5.16	174.82%***	13.19
+5	-0.01%	-0.29	-12.14%***	-86.79	6.98%***	6.51	181.79%***	13.28
+10	-0.03%	-0.71	-12.33%***	-74.74	4.69%***	4.20	210.83%***	13.41
+15	-0.09%**	-2.42	-12.53%***	-67.52	4.03%***	3.67	235.37%***	13.31
+20	-0.06%	-1.45	-12.87%***	-62.43	3.31%***	3.03	257.27%***	13.23

Table X

Difference of Mean and Median AR^{ex} between Highest and Lowest Abnormal Trading Pressure, Separately for Winners and Losers

Using the AR^{ex} 2.5% trimmed sample of ex-days, we separately split winning/losing stocks, with a positive/negative CGOH over a 90-calendar day window, into three quantiles on the basis of the value of their [−20, −1] cumulative abnormal return ($CAR_{[-20, -1]}$). Winners in the highest (lowest) $CAR_{[-20, -1]}$ quantile are assumed to bear the highest (lowest) abnormal buying pressure. In the same manner, losers in the lowest (highest) $CAR_{[-20, -1]}$ quantile are assumed to bear the highest (lowest) abnormal selling pressure before the ex-day. The left part of the table reports tests on the difference of mean and median AR^{ex} between the highest and lowest abnormal buying pressure samples of winners. The right part of the table reports tests on the difference of mean and median AR^{ex} between the highest and lowest abnormal selling pressure samples of losers. The AR^{ex} is defined as $[((P^{ex} - P^{cum} + Div) / P^{cum}) - R^{norm}]$. P^{cum} is the closing price on the cum-dividend day, P^{ex} is the closing price on the ex-dividend day adjusted for market risk (R^{norm}) on that day and Div is the dividend amount. R^{norm} is the expected return on the ex-day calculated using the market model that is estimated over the [(−130, −31) & (+31, +130)] days window around the ex-day with the CRSP equal-weighted NYSE/AMEX index as the market proxy. The Wilcoxon rank-sum test is used for testing the difference of median values. ***, and * denote statistical significance at the 1%, and 10% level, respectively, using a two-tailed test.

Winners(CGOH90)	Obs	Mean	Median	Losers (CGOH90)	Obs	Mean	Median
Highest $CAR_{[-20, -1]}$	5,038	0.135%	0.114%	Lowest $CAR_{[-20, -1]}$	3,524	0.181%	0.176%
Lowest $CAR_{[-20, -1]}$	5,039	0.002%	-0.018%	Highest $CAR_{[-20, -1]}$	3,523	0.231%	0.228%
Diff.		0.133%***	0.132%***	Diff.		-0.050%	-0.052%*
t-stat/z-stat		5.16	5.10	t-stat/z-stat		-1.46	-1.76

Table XI

Mean and Median Difference of PDR/AR^{ex} between Losing and Winning Ex-Dividend Days

This table reports the significance of the mean and median difference of paired values of PDR/AR^{ex}, where each pair refers to one ex-dividend day with a negative CGOH (loser) and another ex-dividend day with a positive CGOH (winner) of the same stock. Losing and winning ex-days of the same stock are paired on the basis of equal dividend amount and time proximity. The ex-days have been matched after trimming the top and bottom 2.5 percentiles of the initial PDR/AR^{ex} samples. The PDR is defined as $[(P^{cum} - (P^{ex}/(1 + R^{norm}))) / Div]$ and the AR^{ex} is defined as $[((P^{ex} - P^{cum} + Div) / P^{cum}) - R^{norm}]$. P^{cum} is the closing price on the cum-dividend day, P^{ex} is the closing price on the ex-dividend day adjusted for market risk (R^{norm}) on that day and Div is the dividend amount. R^{norm} is the expected return on the ex-day calculated using the market model that is estimated over the [(−130, −31) & (+31, +130)] days window around the ex-day with the CRSP equal-weighted NYSE/AMEX index as the market proxy. The Wilcoxon signed-rank test is used for testing the median difference of the PDR/AR^{ex} paired values. *** denotes statistical significance at the 1% level, using a two-tailed test.

	Loser(PDR) - Winner(PDR)		Loser(AR^{ex}) - Winner(AR^{ex})	
	Mean	Median	Mean	Median
Paired ex-days diff.	-0.286***	-0.222***	0.097%***	0.105%***
t-stat/z-stat	-4.32	-4.92	4.58	4.77
Obs	7,893	7,893	7,874	7,874