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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. Our results remain robust to various ex-day price drop measures and different investor holding period lengths assumed.

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

1. Introduction

One of the most highlighted phenomena in trading behavior is the "disposition effect"; when an investor faces the decision to select among candidate stocks to sell off from his portfolio, he is more inclined to pick the ones with prior gains than those with prior losses since their purchase. Various empirical studies have exploited information from 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 that 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 either from the perspective of a behavioral bias resulting from prospect theory preferences (Kahneman and Tversky (1979)), irrational investor beliefs (Odean (1998)), or as a natural implication of optimal portfolio management (Lakonishok and Smidt (1986), and Harris (1988)).

Although most studies contribute as to whether and why the disposition effect exists, few papers address the question of whether it actually has an effect on stock prices. In Coval and Shumway' s (2005) words: *".....even 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. .....Namely, a key question raised is whether the biases that are evident in trading behavior impacts 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. Since the disposition effect refers to the selling decision of investors, the natural downward price adjustment to the dividend on the ex-dividend day renders it an accommodating setting to make accurate predictions on the direction of a contingent mispricing caused by the disposition effect. Furthermore, the lack of consensus as to what factors explain the cross-sectional variation of the ex-dividend day anomaly apparent in the standard ex-day literature, makes us suspect that the disposition effect could be one of them.

In order to ascertain whether the disposition effect can affect stock prices at the ex-dividend day, we opt for using market-wide daily stock data for two reasons. First, data on daily portfolio holdings and trades of the universe of participants in wide stock markets such as the NYSE and AMEX exchanges are not readily available.[1] Second, since market prices reflect the trade decisions of both rational and behaviorally biased investors, a possible divergence from fundamental prices induced by the trades of disposition effect-investors might be arbitraged away quickly by their rational counterparties. Whether arbitrage is effective in repressing any price perturbation caused by the disposition effect can only be depicted in equilibrium market prices. Of course, the use of market-wide data does not serve without a cost, as it requires quite a few assumptions and approximations crucial for the empirical analysis to be made. In particular, a proxy needs to be constructed from aggregate data to measure the accrued gain or loss to the average investor owning a particular stock at any time.[2] We do acknowledge that this imperfect measure absorbs a lot of noise unrelated to the testable hypotheses. However, we believe that this can only make us more optimistic as to whether a significant relationship found in support of our prediction is indeed truthful, as long as it proves to be robust. Jin (2006) consents to this rationale by stating that "*.....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*".

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 on the aggregate investor holding 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 on the ex-dividend day is conditional upon the prior positive or negative record of the stock price, as

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[1] There are few exceptions using comprehensive datasets of investor holdings and trades of all market participants for a long period of time, 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 be accrued to various investor holding durations.

predicted by the disposition effect. We find that stocks that have appreciated in the past have higher price drops on the ex-dividend day than stocks that have 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. 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 for different investor holding period lengths assumed. Our results are in alignment with the disposition effect that postulates that the downward price adjustment expected on the ex-day will be facilitated by willing sellers of winning stocks while it will be hindered by reluctant sellers of losing stocks.

What is more, 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 cross-sectional variation of the price drop on the ex-day. According to the "tax-dividend clientele" theory, suggested by Elton and Gruber (1970, 1984), there must be a positive relationship between the price drop ratio and the dividend yield of each stock that ought to reflect the income tax bracket of the marginal investor at the stock's ex-dividend day. In contrast, Kalay (1982, 1984) claims that, where the expected price drop on the ex-day is large enough, effective short-term arbitrage around the ex-day, will make the magnitude of the actual ex-day price drop be a function of the transaction cost born by the short-term trader. In this study, we find a significantly positive relationship between the ex-dividend day price drop ratio and the capital gains overhang, after having controlled for both the dividend yield and the transaction cost pertaining to each stock. We deduce that the capital gains overhang constitutes an alternative factor with sufficient explanatory power over the cross-sectional variation of the ex-day price reaction.

The remainder of the paper is organized as follows. Section 2 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 3 describes the data selection and the filters applied as well as the methodology used to compute the variables that are employed in the tests. Section 4 reports the empirical results that are driven by the influence of the disposition effect on the stock price behavior on the ex-dividend day. With Section 5, this study is bridged with the ex-dividend day literature and Section 6 concludes.

2. Review of the literature and development of the hypotheses

2.1. The disposition effect

The notion 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 put forward to explain it; in short, within the behavioral context, the disposition effect can be attributed either to prospect theory or to the regret versus pride sentiment or to an irrational belief of mean reversion by investors. On the other hand, 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 those of 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, a great deal of investors value equivalent - in terms of current fundamentals - stocks differently, on the basis of their past accrued gain or loss that are "book-kept" in separate mental accounts for each stock. Accrued gains or losses for 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 when it comes to losing stocks. This automatically renders investors prone to selling past winners in order to quickly cash-in their capital gains and holding losers with a low probability of turning out to be profitable after all in the future. Moreover, the steeper convex slope in the loss domain implies loss aversion that exacerbates their reluctance to realize capital losses already accrued.[3]

[3] In a recent paper, Barberis and Xiong (2009) run a simulation test on artificial stock trade data of 10,000 investors who are supposed to have prospect theory preferences and deduce that in certain occasions, prospect theory fails to predict to disposition effect. Specifically, when the expected annual stock return is high and the trading intervals within an one year horizon are few, the prospect theory

Another purely psychological explanation of the disposition effect is the pursuit of feeling pride by realizing gains and the avoidance of feeling regret by deferring losses as noted in Shefrin and Statman (1985). Odean (1998) suggested that an irrational mean reversion belief could serve as an alternative behavioral theory explanatory 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, a holder of a stock that has appreciated in the past might wrongly revise his expected return downward leading him to a sell decision. Similarly, if the stock has 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 in the literature have also proposed rational interpretations of the phenomenon 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, in order to restore diversification to their portfolios. Also, a descriptive comment made by Harris (1988) suggests that the reticence of investors to realize 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 then introduction of the concept of the disposition effect by Shefrin and Statman (1985), numerous researchers have provided support for the existence of such an empirically observed phenomenon among both retail and professional investors. For example, Odean (1998) analyzing the records of 10,000 trade accounts selected from a US nationwide discount brokerage house, demonstrated that retail investors have a strong preference for realizing winners rather than losers.[4] Other studies that

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.

[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. Also, he concludes that if there is a mean reversion belief among investors, it is indeed irrational because portfolio profitability could have

exploit trade records to demonstrate that retail investors are indeed subject to the disposition effect while trading have been made by Grinblatt and Keloharju (2001) for Finland, Shapira and Venezia (2001) for the Israeli market, Dhar and Zhu (2006) for the US market, and Barber et al. (2007) for the Taiwan Stock Exchange. The validity of the disposition effect has also been examined for professional trading such as by Frino et al. (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 ones, in support of the disposition effect.

2.2. 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 drop by the exact amount of the cash dividend. Yet, 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 mainly 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” that 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 order for long-term investors to be indifferent between buying and selling the stock before or on the ex-day, the equilibrium price drop on the ex-day should reflect the net-of-tax value of the dividend that accounts for the difference between income tax rates imposed on dividends and capital tax rates imposed on

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been higher if investors refrained from hastening past gains realization and deferring past losses for too long. Therefore, it is more likely that there are behavioral causes for the disposition effect.

[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.

(long-term) capital gains. Given that dividends historically carried a tax disadvantage relative to capital gains for individual investors, they should price the dividend at a value that is less than the cash amount distributed by corporations and measured by the price drop on the ex-dividend day. The argument of Elton and Gruber (1970) 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 such as 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 et al. (2003), Elton et al. (2005), and Milonas et al. (2006).

Alternatively, the "short-term arbitrage and transaction cost theory" 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. On the other hand, 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 that is paid over a "round-trip" transaction. As a result, the discrepancy between the ex-day price drop and the dividend will be just 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 ("tick size" hypothesis) entails dividends that are inexact multiples of the tick size,[6] the ex-day price drop will be equal to the dividend amount rounded always downwards to the tick below. 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 will purchase the stock on the cum-day at the bid price and

[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.

subsequently sell it at the ask price on the ex-day. This trading behavior in the Hong Kong stock market where neither dividends nor capital gains are taxed can explain a price drop versus dividend discrepancy that is equal to the bid-ask bounce ("bid-ask bounce hypothesis"). Both microstructure hypotheses directly challenge the "tax hypothesis" as they have introduced explanations for the ex-day anomaly that are not related to taxes.[7]

2.3. Hypotheses

Although there has been sufficient evidence of the prevalence of the disposition effect in trading behavior, little empirical research has been done on its impact on asset pricing.[8] In this direction, Grinblatt and Han (2005) suggest that in a market where rational investors co-exist with (PT/MA)[9] 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 - reference price for disposition effect investors. As long as the absolute difference between the aggregate cost basis and the market price (called "capital gains overhang") is large, there will be underreaction 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 is updated closer to the market price that is, in turn, 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, hence, 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

[7] Nevertheless, Graham et al. (2003), and Jakob and Ma (2004) examine the effect of changes in price quotation and find no support for the microstructure explanations.

[8] Frazzini (2006), Grinblatt and Han (2005), and Coval and Shumway (2005) have directly addressed this issue.

[9] Grinblatt and Han (2005) presume that investors who are selling winning stocks faster than losing stocks are governed by a prospect theory (PT) value function that is S-shaped and mental accounting (MA) of accrued gains or losses.

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

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 evidence. Within this rationale, Frazzini (2006) exploits corporate earnings' announcements in order to test whether the disposition effect causes underreaction of the stock price 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 lock-in 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 take place for stocks with past accrued losses, sluggish selling by investors who are reluctant to realize their capital losses will reduce available supply that leads to a lower price decrease than expected. The underreaction to either 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 the post-event drift is larger when news and capital gains have the same sign and its magnitude is directly related to the amount of unrealized gains (losses) experienced by the holders of the stock on the announcement date.[11]

In the same vein with Frazzini (2006), we regard the ex-dividend day as an equivalent opportunity 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 fact, apart from the direction of the price, we are also privy of the magnitude

[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 made by Jin (2006). He finds that stocks that are mostly owned by institutional investors who care about the tax consequences of their trades (the author names them "tax-sensitive") and that have appreciated in the past, have a higher cumulative abnormal return over a 3-day span around the earnings announcement. He states that tax-sensitive investors, following an optimal tax strategy, postpone their sell trades with view to deferring the realization of the accrued gains. As a result, as they limit their supply for the stock around negative earnings surprises, an upward price pressure leads to inflated market prices.

of the expected fundamental adjustment for it must approximate the relative value of the dividend *vis-à-vis* capital gains. In addition, given that the ex-day constitutes an informationless event, no conjectures need to be made on the interpretation of any corporate signal by the market 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 drops on the ex-dividend day.

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

3. Data and methodology

3.1. Sample construction and filtering

We start 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 in order to eliminate a possible tick size effect (Bali and Hite (1998)), and minimize any bid-ask bounce effect (Frank and Jagannathan (1998)) or tax effect (Elton and Gruber (1970)) induced by the relative taxation of dividends versus capital gains. From the beginning of February 2001 both NYSE and AMEX were fully decimalized[13] while there has been just one main tax law amendment from early 2001 until late 2007, the "*2003 Jobs and Growth and Tax Relief Reconciliation Act*". This Tax Act, effective in

[12] We consider this point fairly important, as the disposition effect might be covered up 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.
[13] Graham et al. (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, starting on January 29, 2001.

May 2003, equated the tax rate on qualified dividends to the long-term capital gain tax rates which were reduced to 15%, at the medium and high income tax brackets.[14]

Our initial sample is comprised of 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 in order to increase the power of our tests. First, we exclude dividends going ex within 20 trading days after the previous ex-day of the same stock. Second, we exclude dividends with an announcement day within 4 trading days before their respective ex-day. Third, we exclude ex-days with confounding corporate events. Specifically, if a stock split, stock dividend, rights issue, bonus issue occurs within a [−4, +4] window around the ex-day, then, the ex-day is removed from the sample. Fourth, following Elton et al. (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 in order 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 a number of 27,037 usable observations (100% of our "clean" sample), as illustrated in Table 1.

<u>Insert **Table 1** here</u>

3.2. 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

[14] The "*2005 Tax Increase Prevention and Reconciliation Act*" was effective on the 1st of January 2008 so that we expect this 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 this Tax Act, qualified dividends remained taxable at the long-term capital gain tax rates which were set to zero for income tax brackets less than 25%.

[15] After having eliminated ex-days that have multiple ordinary cash dividends and/or a return-of-capital distribution on the same date.

[16] Elton et al. (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 both before and after the ex-day central time point in order to avoid a total overlap with the estimation horizon used for the calculation of the capital gain overhang as described in section 3.5 below.

for the expected return on the ex-day that reflects the relative valuation of the dividend by the marginal investor:

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

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* as:

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

where α_i and β_i are estimated with the OLS market model over the estimation window of [(–130, –31) & (+31, +130)] days, where 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 weight 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:

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

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 skewness and kurtosis compared to PDR, as will be shown below.

3.3. 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% quantile of our PDR sample in order to limit the outliers' impact, following Graham et al. (2003). We also repeat the trimming separately for the AR^{ex} total sample so that both PDR and AR^{ex} testable distributions move closer to

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

being normal.[19] By excluding 1,351 outlier observations we end up with our final sample of 25,686 ex-days that will be used for the analysis that follows. Table 2 reports descriptive statistics for PDR/AR^{ex} before and after trimming, therefore, illustrating the marginal effect of outliers' elimination. The elimination of extreme outliers for the PDR sample has a tremendous normalizing effect as it reduces its standard deviation from 10.24 to 4.15 (−59%), skewness from 2.49 to −0.06 (−102%) and kurtosis from 168.65 to 5.65 (−97%), in approximation.[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), significantly less than the hypothesized value of unity and that the mean (median) AR^{ex} is 0.124% (0.097%), significantly more than the hypothesized value of zero (at the 1% level).

Insert **Table 2** here

3.4. Abnormal turnover

There are few event studies that measure the abnormal volume activity on the ex-day using the percentage deviation of the ex-day trade turnover from its mean turnover calculated over the estimation window for an individual stock (raw ATO). As Ajinkya and Jain (1989) document, this raw measure of abnormal trading volume for individual securities is highly non-normal while a natural log-transformation yields abnormal trading volume 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 a methodology that provides abnormal turnover estimates deviating the least from normality, as follows. Initially, we calculate the abnormal trading turnover on the ex-day of the PDR 2.5% trimmed sample using three alternative metrics; i) raw ATO that assumes that the mean turnover over the estimation period is representative of the normal stock turnover ii) natural log-

[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 regressions to follow where both are used as dependent variables alternatively.

[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.

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 methodologies and select the one that better satisfies the normality assumption.

According to Campbell and Wasley (1996), the abnormal trade 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:

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

where *n* is the number of all NYSE/AMEX listed stocks contained in our sample at a particular date *t* and TO_{it} is the natural log-transformed daily turnover for individual stock *i* as:[22]

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

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*. On the other hand, the Lynch and Mendenhall (1997) approach takes the ratio of the [log(1+$value of trading

[21] Following Campbell and Wasley (1996), we also obtain the α_i and β_i coefficients using a two-step estimated generalized least square procedure (EGLS) to control for possible autocorrelation present 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 a minor difference to our analysis given that 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 in order to remove the pronounced skewness and use the market model in order to compute the normal turnover on the ex-day. Their main difference is that while Kadapakkam (2000) adds a constant equal to 0.01, Campbell and Wasley (1996) add a constant equal to 0.000255 to the logarithmic turnover, in order to preclude taking the logarithm of zero trading volume on a given day.

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.

Table 3 reports descriptive statistics and the χ^2-statistic of the D'Agostino et al. (1990) normality test for the distribution of the ex-day ATO computed with the three alternative methodologies.

Insert **Table 3** 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 29 times higher kurtosis than the logarithmic ATO as per Lynch and Mendenhall (1997) (skewness = 2.41 and kurtosis = 17.61). Given that the ATO of Campbell and Wasley (1996) yields the lowest positive skewness, kurtosis and χ^2-statistic compared to the other two alternatives, we find it plausible to opt for the Campbell and Wasley (1996) methodology. Abnormal trading turnover combined with abnormal return will be used in the examination of the trading patterns before and after the ex-day as reported in the empirical results in Section 4.4.

3.5. The capital gains overhang proxy

In order to test the disposition effect hypothesis on the ex-day, we need to use an indicator that distinguishes among stocks with an accrued gain (winner) from stocks with an accrued loss (loser) just before the ex-day. Aggregate accrued gains or losses could be calculated with accuracy if we ideally knew the actual cost basis and holding period of all investors holding an individual stock at each point in time. Provided that we use market wide data as opposed to data extracted from trade records of all market participants, it is not feasible to estimate either element with precision. We attempt to tackle this by using the capital gains overhang that was introduced by Grinblatt and Han (2005). This proxies 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 on the cum-day (RP_i^T) using daily data as:[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 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 weights is a normalizing constant that makes all TO weights to past prices to 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 to 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. On the other hand, if TO were very low at the beginning of the investors' holding period but very high towards the ex-day, then, most likely, investors would use purchase prices proximate to the ex-day for their accrued gain or loss computation. 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 stock 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 alternatively seven different assumed holding periods in calendar time; T = 360, 250, 150, 90, 60, 30, 15 calendar days before the ex-day.

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[23] Grinblatt and Han (2005) consider this aggregate cost basis to proxy for the average reference price adopted by all investors holding a stock, whose risk aversion against trades 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 4** here

Table 4 reports Pearson correlations for the CGOH calculated at seven different calendar 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 that are presented in this paper are based on the assumption of a 90-calendar days long holding period, all other six calendar periods have also been used as a robustness test. Furthermore, Odean (1998) reports that the median holding period for stocks held by his sample of US discount broker investors is 84 trading days that approximates to 120 calendar days, not far from our adopted 90-calendar day holding horizon assumption.[25]

4. Empirical results

4.1. Difference of means and capital gains overhang quantile analysis

In order 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 days holding period and we calculate pooled arithmetic means and medians for each sample. In approximation, 58% of the ex-days refer to stocks with positive CGOH (winners) and 42% of the ex-days refer to stocks with negative CGOH (losers).

Insert **Table 5** here

Panel A of Table 5 shows that the mean PDR for winners is 0.887 (median = 0.928) that is significantly higher than the mean PDR = 0.539 for losers (median = 0.684), at the 1% level (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 Wilcoxon rank-sum test remains statistically different from

[25] In the case of quarterly dividends, the 90 calendar days 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 because of dividend capture or avoidance attitudes, it might be reasonable to assume that the aggregate cost basis is widely updated every quarter.

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 dividing each sample of losers and winners separately into three equally sized CGOH90 quantiles and calculating mean (median) PDR/AR^{ex} values for each one of the resulting six quantiles. In panel B of Table 5, 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 5, 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 5 for all other six (T = 360, 250, 150, 60, 30, 15 calendar days) CGOH estimation periods and we deduced that results remain qualitatively the same. In short, we find that the higher 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.

4.2. Regression analysis

Hypothesis II states that the higher the unrealized gain (loss), the larger (smaller) the ex-dividend day price drop. This translates into an expected positive (negative) relationship between the PDR (AR^{ex}) and the CGOH, for the whole sample, as well as separately for winners or losers. Therefore, 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 in order to control for alternative tax, transaction cost, short-term arbitrage and microstructure effects on the ex-day. Accordingly, the pooled regression equation takes the form:

$$PDR_i \,/\, AR_i^{ex} = \alpha + \beta_1 CGOH_i^T + \beta_2 DY_i + \beta_3 MCap_i + \beta_4 TO_i + \beta_5 IVol_i + \beta_6 Tax03_i + \varepsilon_i$$

where $CGOH_i^T$ is the capital gains overhang of stock i for an assumed investor holding period of T = 90 calendar days. DY_i is the stock dividend yield equal to the dividend amount over the closing price on the cum-day. $MCap_i$ is the mean stock relative size equal to the natural logarithm of the ratio of individual stock capitalization to market capitalization, averaged out over the estimation window of [(−130, −31) & (+31, +130)] trade days. TO_i is the average stock turnover over the estimation window of [(−130, −31) & (+31, +130)] trade days.[26] $IVol_i$ measures the idiosyncratic volatility as the ratio of (individual stock standard deviation to market standard deviation) of daily returns over the estimation window of [(−130, −31) & (+31, +130)] trade days. $Tax03_i$ is a dummy variable that takes the value of 1 if the ex-day is located after May 22, 2003 when the 2003 Tax Act was made effective, and 0 otherwise. We use the market capitalization and standard deviation of the returns of the CRSP equal weight NYSE/AMEX index, that constitutes a proxy for the market portfolio. 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 any liquidity, arbitrage and microstructure effects.[27] Michaely and Vila (1995) suggest that PDR volatility is a function of the dividend yield and daily return volatility that could possibly generate severe heteroscedasticity in the estimation. Therefore, the weighted least squares method (WLS) is utilized for the PDR regression with the weight being equal to the squared ratio of the dividend yield over the standard deviation of the stock returns over the estimation period whereas the ordinary least squares (OLS) method is selected for the AR^{ex} regression.[28, 29]

<u>Insert **Table 6** here</u>

According to Table 6, for the sample including both winners and losers, the relationship between the PDR and the accrued gain/loss measured by CGOH is positive (coefficient = 1.803) whereas the relationship between the AR^{ex} and the CGOH is negative (coefficient = −0.008). Both results are significant at a level much less than 1% (t-statistic = 7.49 for PDR and t-statistic = −6.43 for AR^{ex}). The signs remain the same when we repeat the PDR/AR^{ex} regressions separately for losers or

[26] The daily turnover is computed by formula 7, section 3.4., as per Campbell and Wasley (1996).
[27] Michaely and Vila (1995), Kadapakkam (2000) and Zhang et al. (2008) are a sample of ex-day studies that employ some or all of these regressors.
[28] Following Zhang et al. (2008).
[29] The t-statistics of the estimated OLS coefficients are computed with heteroscedasticity consistent standard errors, according to the White (1980) correction.

winners, although significance is reduced to 1% for winners (t-statistic = 3.77 for PDR and t-statistic = −3.11 for AR^{ex}) and to 5%-10% for losers (t-statistic = 2.55 for PDR and t-statistic = −1.78 for AR^{ex}). The substantial reduction in significance that occurs when the winners/losers are separately tested is somehow expected because the differential price drop on the ex-day between stocks with a high past gain and a high past loss due to the disposition effect, will be mostly evident when both are included in the regression. Results also indicate that there is weak evidence on the importance of alternative hypotheses on the ex-day. For example, the dividend yield remains positively related with both PDR and AR^{ex} but only significant at the 5% level in the all-stocks sample, and the 2003 Tax Act dummy variable is overall insignificant across the six regressions. Larger and more liquid stocks appear to have lower abnormal returns (higher price drops) that can be attributed to short term trading on the ex-day but this result cannot be considered as strong as the positive (negative) relationship between the PDR (AR^{ex}) and the CGOH.[30] Overall, we find a significant positive (negative) relationship between the PDR (AR^{ex}) and the CGOH, that is especially pronounced when winning and losing stocks are tested together.[31] The effect of the capital gains overhang on the ex-day is also largely economically significant. If a stock held by the aggregate investor has depreciated by 5% over the assumed holding period of 90 days, its AR^{ex} will be higher by 0.041% (−0.008 × −5%), compared to a stock with no gain or loss accrued on the cum-day. This is quite substantial if we take into account the fact that this extra return is one third of the mean AR^{ex} (0.124%), for the 2.5% trimmed sample.

Next, we show that both a long array of robustness tests (section 4.3.), and empirical testing of whether abnormal trading pressure around the ex-day can be charged for the results presented so far (section 4.4.), corroborate our disposition effect-driven hypotheses I & II.

[30] For the all-stocks sample, the t-statistics for mean market capitalization and turnover are equal to 1.31 and 2.86, respectively, for the PDR regression, and equal to −4.17 and −3.11 for the AR^{ex} regression.

[31] As a robustness test, we repeat the PDR (WLS) and AR^{ex} (OLS) regressions using all other alternative holding periods for the CGOH estimation; T = 360, 250, 150, 60, 30, 15 calendar days before the ex-day. We find that the CGOH coefficient remains significant at the 1% level.

4.3. Robustness tests

4.3.1. 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 in order to eliminate any noise associated with intra-day stock-specific volatility. Furthermore, following Graham et al. (2003), we adjust PDR/AR^{ex} for the overnight market movement, by assuming that the overnight normal return is one half of the full ex-day normal return used previously.[32] We replicate the tests on the difference of mean and median PDR/AR^{ex} between winners/losers and the calculation of mean PDR/AR^{ex} per CGOH quantile (as reported in Table 5 for closing prices), using the alternative PDR/AR^{ex} computed with ex-day opening prices.[33]

Insert **Table 7** here

Panel A of Table 7 shows that the mean PDR for winners is 0.836 (median = 0.860) that 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%) that 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 et al. (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 render the mean absolute price drop from cum-day close to ex-day open a biased (upwards) estimate of the equilibrium price drop. Nevertheless, if we compare carefully panel A from Table 5 with panel A from Table 7 we can deduce that the PDR/AR^{ex} values calculated with opening ex-day prices are very similar to the ones calculated with closing ex-day prices if not lower. For example, the mean

[32] 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.

[33] 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 despite the fact that there was positive trading volume on these days.

PDR calculated, for the all-stocks sample, with opening prices is equal to 0.759 (median = 0.798) that 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%) that is higher than the mean AR^{ex} = 0.124% (median = 0.097%) calculated with closing prices, hence, standing against Elton and Gruber's (1970) prediction.

According to panel B of Table 7, 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. By focusing our attention to the highest CGOH quantile, we observe that the mean PDR calculated with closing prices, equal to 1.008 (panel B of Table 5), is higher than its respective value calculated with opening prices that is equal to 0.861 (panel B of Table 7). In non-tabulated results, we find that their difference is statistically significant at the 5% level, using a two-tail test (t-statistic = 2.00). This is in alignment with the disposition effect, since the investors holding the biggest winners will get a chance to provide the full scope of their excess supply for the stock after the ex-day's opening, resulting in a price drop slightly in excess of the dividend amount.

We repeat all regressions depicted in Table 6 with the alternative PDR/AR^{ex} measures that are computed with opening ex-day prices and report our results in Table 8.

<u>Insert **Table 8** here</u>

In the sample including both winners and losers, the coefficient of the CGOH is positive (0.764) for the PDR regression and negative (–0.007) for the AR^{ex} regression both being significant at a level much less than 1% (t-statistic is equal to 6.51 for PDR and −11.35 for AR^{ex}). When winners and losers are treated separately, significance falls close to 1% except from the PDR regression for the stocks with accrued losses where it is insignificant.[34] Again, the significance on the coefficients of the control

[34] As already discussed, this is expected because the variation of the price drop on the ex-day as a function of the CGOH will be better identified when both winners and losers are included in the regression.

variables implies weak evidence for the power of the tax, transaction cost and microstructure hypotheses to explain the dispersion of the PDR/AR^{ex}. The only variable that remains significant at the 1% level across all six regressions is the mean stock turnover but with the signs reversed compared to the regressions using closing prices, implying that higher liquidity in fact, hinders the overnight price adjustment to the dividend on the ex-day. Briefly, both hypotheses I & II are confirmed with both closing and opening prices on the ex-day, hence, enhancing the support for the predicted price impact of the disposition effect on the ex-day.

4.3.2. Alternative methodologies and capital gains overhang windows

With view to increasing the strength of our results we deploy a set of alternative methodologies in the way we measure the expected return on the ex-day that adjusts the PDR/AR^{ex} for the market movement.[35] 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 weight NYSE/AMEX index on the ex-day is used as the normal return, iii) the expected return based on the 3-factor Fama and French (1993) model, and iv) the market model as described in Section 3.2 while adopting the CRSP value weight NYSE/AMEX index as the market portfolio proxy. In addition, we repeat both PDR and AR^{ex} regressions with OLS while adjusting t-statistics for ex-dividend day clustering.[36] At the same time, we employ all seven different assumed holding periods for the $CGOH^T$ that are used alternatively; T = 360, 250, 150, 90, 60, 30, 15 calendar days before the ex-day.[37] Subsequently, we repeat the test of difference of mean and median PDR/AR^{ex} between winners and losers (Hypothesis I, panel A of Table 5) and the PDR/AR^{ex} regressions for the sample including ex-day stocks with both accrued gains or losses, as described above (Hypothesis II, columns 2 and 5 of Table 6).[38]

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

[36] Standard errors were adjusted for 1,943 clusters (ex-days), as per Williams (2000).

[37] Naturally, if results prove to be robust across all seven different holding periods, we expect them to remain qualitatively the same for every other single investor horizon between 360 and 15 calendar day, before the ex-day.

[38] Namely, using the WLS method for the PDR regression and the OLS method for the AR^{ex} regression corrected for heteroscedasticity (White (1980)).

In total, we performed 56 tests of difference of means and medians between winners and losers (4 different normal return specifications × 7 CGOH holding periods × 2 measures (PDR/AR^{ex}) of the ex-day adjustment), and 70 regressions (56 regressions as described above + cluster adjusted OLS regression for 7 CGOH holding periods × 2 measures (PDR/AR^{ex}) of the ex-day adjustment). In unreported results, we find that in 50 out of the 56 tests, the difference of mean and median PDR/AR^{ex} between winners and losers was significant at the 1% level while only in 2 cases was it insignificant at the 10% level, both pertaining to the 15-calendar day holding period.[39] Similarly, out of the 70 regressions that were estimated, the beta coefficient on the CGOH was significant at the 1% level in 68 estimations while it was significant at the 10% level for the remaining two cases (t-statistics range between 2.85 (−1.92) and 8.91 (−7.85) across all 70 PDR (AR^{ex}) estimated regressions). Overall, the results remain robust to the various ex-day normal return specifications and different holding period length assumptions employed.

4.4. 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 imbalances around ex-days driven by age and income investor clienteles.[40] Naranjo et al. (2000), claim that systematic dividend capture by corporations that are taxed more heavily on capital gains than on dividends could extend price drops so wide that ex-day abnormal returns turn out with 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 to the stock price until the cum-day and perhaps a price reversal on the ex-day when initial buy (sell) positions are closed. This consideration might raise doubts about whether our

[39] Assuming a two-tail test on the difference of means.
[40] Briefly, they find that old and low income investor aggressively buy the stock prior the ex-day in order to capture the dividend while young investors prefer to wait until the ex-day before they 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 the relative dividend taxation at the investor level.

empirical results so far can be attributed to the disposition effect, given that these results could simply constitute an artifact of upward or downward pressure by dividend-induced trades. For example, stocks that are rising before the ex-day due to abnormal buying by investors who pursue the right to the dividend are expected to have a larger price drop as 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 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 those subject to excess short-term selling pressure prior the ex-day, then, our disposition effect explanation will merely "mask" the price impact of dividend-motivated trades of particular tax, income or age clienteles. In theory, dividend capture targeted to winning stocks can be justified in the following two ways. Investor sentiment might make investors believe that stocks on an positive momentum might quickly recover the price drop on the ex-dividend day. Also, already appreciated stocks with deeply in-the-money call options are more likely to bear upward pressure before the ex-day, as the call options are optimally exercised early by their holders (Roll (1977), and Kalay and Subrahmanyam (1984)).[41]

In order to examine whether the above concern is valid or not, 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 split 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 those 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.

[41] As demonstrated by Roll (1977), and Kalay and Subrahmanyam (1984), the higher the underlying stock price, namely, the more deeply in-the-money the call option, the larger the dividend amount, and the shorter the duration until option maturity, the higher the probability of early exercise of American call options before the ex-day.

<u>Insert **Table 9** here</u>

Table 9 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 day before or after the ex-day for the winner and loser quantiles described above.[42] According to panel A that refers to winners, both daily ARs and ATOs in the [−20, −1] trading day window are significantly positive at the 1% level. CAR starts from 0.51% 20 days before the ex-day and rises 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 an 146.72% value. After the ex-day, both AR and ATO abruptly fall to lower levels than the ones prior 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 the ex-day as indicated by both return and turnover measures.[43] Panel B illustrates an equivalent picture for losers. 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% level. Particularly, CAR starts from –0.63% on day "−20" and falls further to −12.18% on the cum-day while CATO starts from 5.86%, 15 days before the ex-day and moves upwards to 138.31% on the cum-day. After the ex-day, ARs remain negative but insignificant at the 10% level (except from day "+2") whereas ATOs remain significantly positive at the 1% level for another 10-15 days after the ex-day.[44] Again, we conclude that abnormal selling pressure prior to the ex-day is evident for this group of losers.

In order to test whether short-term abnormal trading prior the ex-day is responsible for the differential AR^{ex} between winning and losing stocks, we compare the AR^{ex} of

[42] 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 estimated during the estimation period. The abnormal return on the ex-day (AR^{ex}) includes the dividend, as illustrated in Section 3.2. Abnormal turnover is calculated according to the Campbell and Wasley (1996) methodology described in Section 3.4.

[43] Most ex-day papers that seek to consider samples of stocks that are mostly subject to dividend capture, select stocks belonging to the highest dividend yield quantile 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 criteria we found weak evidence for abnormal trading pressure prior the ex-day; the [–20, –1] CAR was only 2.97% and the [–20, –1] CATO was negative, equal to −14.44%.

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

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 the ex-day.[45] In particular, we test the difference of the mean AR^{ex} between winners/losers in the highest (3^{rd}) $CAR_{[-20, -1]}$ quantile and winners/losers in the lowest (1^{st}) $CAR_{[-20, -1]}$ quantile. Were the short-term abnormal trading theory to be true, we should 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 10** here

Table 10 reports two-tail tests of the difference of 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 the ex-day is 0.135% is 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 but not significantly different to 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 when looking at the median values. Since the latter results do not support the above mentioned predictions implied by the short-term abnormal pressure theory, we cannot reject the argument that it is the investors' disposition effect that drives the variability of the ex-day abnormal returns across stocks with accrued gains or losses.[46]

[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 this sample prior 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 the ex-day.

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

5. 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 can also fill long-lived gaps evident in the ex-dividend day research. Elton and Gruber (1970), Elton et al. (1984), and Elton et al. (2005) who associate the ex-day price drop with the relative taxation of dividends ("*tax hypothesis*") make two solid statements. First, they argue that the price drop on the ex-day is less than the dividend amount because capital gains tax rates are less than ordinary income tax rates for the marginal investor. Second, marginal income tax rates of different tax clienteles can be inferred by the cross sectional variation of the price drop on the ex-day. In particular, they show that for long-term investors to be indifferent between trading the stock before and trading the stock after the opening of the ex-day, it must be that; PDR = $(1-\tau_d) / (1-\tau_g)$ where τ_d is the ordinary income tax rate applied to dividends and τ_g is the capital gains tax rate.[47] As long as a particular shareholder group facing $\tau_d > \tau_g$ is identified as the marginal investor on the ex-day of a specific stock, the PDR for this stock will be < 1. According to Elton and Gruber (1970), their results support the notion of dividend clienteles; shareholders select stocks whose dividend policy is catering for the tax-efficiency of their shareholdings. Namely, shareholders in high (low) income tax brackets will seek to invest in stocks with low (high) dividend yields. As a result, the magnitude of the ex-day price drop in a sample of dividends that implies the marginal income tax status of each dividend clientele will be positively correlated to the stock dividend yield.[48] Subsequently, Kalay (1982, 1984) challenged the possibility of

[47] Since the τ_g must be the effective capital gains tax rate that decreases with the amount of capital losses accumulated, one might mechanically hasten to give a simple tax-based explanation of the positive relationship between PDR and the capital gains overhang that is herein attributed to the disposition effect, stated as: "The higher the accrued loss on a stock, the lower the τ_g in the denominator of the formula, hence the lower the PDR-ratio". We claim that such a surmise should be taken with caution, given that the capital gains overhang that measures the accrued loss refers to a single stock, while the effective τ_g in the PDR formula refers to the net capital gain of a portfolio of stocks held by the taxable investor. What is more, if there are more than one investors sharing the stock price setting on the ex-dividend day, the τ_g will reflect the average effective capital gain tax rate of different investors with either winning or losing positions in the equities market. Therefore, we claim that it is impossible to establish a valid direct link between the accrued gain/loss of an individual stock and the investor-wide effective capital gains tax rate.

[48] As reported in the PDR regression results in Table 6, the beta coefficient of the dividend yield is positive (1.464) and statistically significant at the 5% level (t-statistic = 2.03) for the all stocks 2.5% trimmed sample, in support of the dividend clientele theory. On the other hand, although one would

inference of the 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 born for trading the stock ("*short term arbitrage and transaction cost hypothesis*"). As a result, where the discrepancy between the expected ex-day price drop and the dividend is snipped off due to arbitrage, the PDR will merely reflect the actual level of transaction costs for which profitable arbitrage opportunities are not feasible.

Both above mentioned theories compete to explain the cross-sectional dispersion of the PDR in ex-dividend day samples; Elton and Gruber (1970) attribute the PDR cross-sectional variation to the differing income tax brackets of various dividend clienteles, while Kalay (1982) expects it to be a function of the liquidity, the bid-ask spread and the risk involved in short-term trading around the ex-dividend days of the sample. This paper contributes to the ex-dividend day literature by introducing the disposition effect as another factor that makes PDR and AR^{ex} vary across stocks on the basis of their accrued gain or loss. In particular, as postulated in hypothesis II and supported by our empirical results, the higher the unrealized gain (loss) accrued on the stock, the larger (smaller) the expected stock price drop on the ex-dividend day. Graham et al. (2003) investigate whether any of the ex-day traditional hypotheses can be reinforced by the results from analyzing the ex-day price and volume reactions to the reduction in price discreteness and bid-ask spreads that occurred as the pricing grid got finer until fully decimalized in NYSE from 1996 until 2001. Their results do not support any of the microstructure predictions, notwithstanding, they are deemed consistent with the tax explanation. However, their very last concluding remark is that "*..it is also possible that ex-day pricing patterns are caused by a phenomenon that has not yet been identified in the financial economics literature*". We feel that our empirical analysis constitutes one step forward in addressing the suggestion of this statement.

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expect the coefficient sign to turn negative in the AR^{ex} regression, it remains significantly positive (coefficient = 0.022 with t-statistic = 2.34). We view this empirical finding as not in accord with the dividend clientele argument.

6. Conclusion

Since Shefrin and Statman (1985) introduced the notion of the disposition effect, there has been a growing literature about whether and why the disposition effect is prevalent on the trading behavior of both individual and professional investors. However, little has been documented about whether it has a significant impact on stock prices which is what matters most to the finance literature. Inspired from 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 than stocks with a negative capital gains overhang on the ex-day. Moreover, the market adjusted price drop 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 speeds up (restrains) the downward price adjustment on the ex-day. Overall, our results remain robust to numerous ex-day normal return specifications, different holding period length assumptions and the use of opening prices in replacement of closing prices on the ex-day. Lastly, we examine whether our empirical results are driven by evident buy-sell order imbalances prior the ex-day that are unrelated to the disposition effect. We deduce that abnormal buying (selling) pressure for winners (losers) prior the ex-day affects ex-day abnormal returns in the opposite direction of what the disposition effect predicts, hence, providing no support for an alternative hypothesis.

If there are traders with negligible transaction costs who simultaneously trade close to the ex-day of high (positive) CGOH and low (negative) CGOH stocks with equal dividend payments and market risk, might be able to extract stock-pair arbitrage profits. Namely, they could short-sell stocks on the highest CGOH quantile and buy stocks on the lowest CGOH quantile on the cum-day, and subsequently close these positions on the ex-day. The equal dividends on these two roundtrip trades net out and traders will only be taxed for their arbitrage capital gain. Hence, based on the median

PDR values of Panel B in Table 5, they would gain $1.022 from the short position on the average biggest winner and lose $0.639 from the long position on the average biggest loser, for an assumed dividend payment of $1, resulting in a profit of $0.383 before taxes and transaction costs. In addition, they could minimize the overall market risk exposure by executing these trades overnight, from cum-day close to ex-day open and still earn a similar amount of arbitrage profit equal to $0.357, according to the median PDR values of Panel B in Table 7 that uses ex-day opening prices.

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.

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Table 1
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 2
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 weight 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 3
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 [ln(1+$value of trading volume)/ln(1+$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 listed stocks contained in our sample at a particular date. The last row provides the χ^2 statistic of the D'Agostino et al. (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 4
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:

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

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" TO τ days after the t-n day point. The inverse of the sum of weights is a normalizing constant that makes all TO weights to past prices to 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 5
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 two ex-day measures are equal to their hypothesized values (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 weight 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 3.5. 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 6
Relationship between PDR/AR^{ex} and CGOH for the whole sample and separately for winners or losers.

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

PDR_i / $AR_i^{ex} = \alpha + \beta_1 CGOH_i + \beta_2 DY_i + \beta_3 MCap_i + \beta_4 TO_i + \beta_5 IVol_i + \beta_5 Tax03_i + \varepsilon_i$

where $CGOH_i$ is the capital gains overhang of stock i for an assumed investor holding period of 90 calendar days. DY_i is the dividend yield equal to the dividend amount over the closing price on the cum-day. $MCap_i$ is the mean stock relative size equal to the average natural log (individual stock capitalization to market capitalization) over the estimation window. TO_i is the average stock turnover over the estimation window. $IVol_i$ measures the idiosyncratic volatility as the ratio of (individual stock standard deviation to market standard deviation) of daily returns over the estimation window. $Tax03_i$ 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. The weighted least squares method (WLS) is utilized for the PDR regression with the weight being equal to the squared ratio of (DY to stock return standard deviation over the estimation window). The AR^{ex} regression estimated with the ordinary least squares (OLS) method reports t-statistics corrected for heteroscedasticity (White (1980)). Both PDR and AR^{ex} are computed as described in Section 3.2 using closing prices on the ex-day. The estimation window is [(−130, −31) & (+31, +130)] trade days around the ex-day and the CRSP equal weight 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 3.5. The number in parentheses below the coefficient is the t-statistic. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

	PDR (WLS)			AR^{ex} (OLS)		
Var./Sample	All stocks	Winners	Losers	All stocks	Winners	Losers
Intercept	1.1558***	1.4277***	0.7530***	-0.0016***	-0.0028***	0.0002
	(10.34)	(9.74)	(4.33)	(-3.35)	(-4.64)	(0.28)
CGOH90	1.8029***	2.7793***	0.9355**	-0.0083***	-0.0095***	-0.0042*
	(7.49)	(3.77)	(2.55)	(-6.43)	(-3.11)	(-1.78)
DY	1.4637**	1.0858	1.7502*	0.0217**	0.0191	0.0243*
	(2.03)	(0.98)	(1.82)	(2.34)	(1.45)	(1.91)
Mcap	0.0169	0.0361**	-0.0011	-0.0002***	-0.0003***	-0.0001
	(1.31)	(2.14)	(-0.05)	(-4.17)	(-4.52)	(-1.55)
TO	0.0789***	0.0967***	0.0401	-0.0004***	-0.0004***	-0.0002
	(2.86)	(2.65)	(0.94)	(-3.11)	(-2.73)	(-1.33)
IVol	-0.0668***	-0.0810**	-0.0639*	0.0002*	0.0003*	0.0001
	(-2.85)	(-2.51)	(-1.79)	(1.65)	(1.86)	(0.59)
Tax03	-0.0256	-0.1143**	0.1051	0.0000	0.0003	-0.0003
	(-0.53)	(-1.83)	(1.35)	(0.07)	(1.01)	(-1.05)
Adj. R^2	0.003	0.002	0.001	0.005	0.005	0.002
F-stat	13.56	6.62	2.93	17.44	10.74	3.17
Obs	25,686	14,934	10,752	25,686	15,116	10,570

Table 7
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 et al. (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 two ex-day measures are equal to their hypothesized values (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 weight 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 3.5. 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 8
Relationship between PDR/AR^{ex} and CGOH for the whole sample and separately for winners or losers, using opening prices on the ex-day.

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

PDR_i / $AR_i^{ex} = \alpha + \beta_1 CGOH_i + \beta_2 DY_i + \beta_3 MCap_i + \beta_4 TO_i + \beta_5 IVol_i + \beta_5 Tax03_i + \varepsilon_i$

where $CGOH_i$ is the capital gains overhang of stock i for an assumed investor holding period of 90 calendar days. DY_i is the dividend yield equal to the dividend amount over the closing price on the cum-day. $MCap_i$ is the mean stock relative size equal to the average natural log (individual stock capitalization to market capitalization) over the estimation window. TO_i is the average stock turnover over the estimation window. $IVol_i$ measures the idiosyncratic volatility as the ratio of (individual stock standard deviation to market standard deviation) of daily returns over the estimation window. $Tax03_i$ 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. The weighted least squares method (WLS) is utilized for the PDR regression with the weight being equal to the squared ratio of (DY to stock return standard deviation over the estimation window). The AR^{ex} regression estimated with the ordinary least squares (OLS) method reports t-statistics corrected for heteroscedasticity (White (1980)). Both PDR and AR^{ex} are computed as described in Section 3.2 using opening prices on the ex-day. The estimation window is [(–130, –31) & (+31, +130)] trade days around the ex-day and the CRSP equal weight 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 3.5. The number in parentheses below the coefficient is the t-statistic. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

	PDR (WLS)			AR^{ex} (OLS)		
Var./Sample	All stocks	Winners	Losers	All stocks	Winners	Losers
Intercept	0.7098***	0.8297***	0.5151***	0.0014***	0.0007**	0.0022***
	(12.96)	(11.77)	(5.91)	(5.68)	(2.34)	(5.61)
CGOH90	0.7643***	1.0929***	0.1173	-0.0074***	-0.0042***	-0.0072***
	(6.51)	(3.09)	(0.64)	(-11.35)	(-2.90)	(-5.40)
DY	0.6544*	0.5634	0.7595	0.0362***	0.0401***	0.0332**
	(1.86)	(1.06)	(1.59)	(3.66)	(2.92)	(2.44)
Mcap	-0.0050	0.0095	-0.0218**	0.0000	-0.0001**	0.0000
	(-0.79)	(1.18)	(-2.15)	(-1.23)	(-2.36)	(0.94)
TO	-0.0637***	-0.0647***	-0.0694***	0.0003***	0.0003***	0.0002**
	(-4.72)	(-3.70)	(-3.25)	(4.83)	(4.18)	(2.43)
IVol	-0.0248**	-0.0156	-0.0427**	-0.0001	-0.0001	-0.0001
	(-2.16)	(-1.00)	(-2.39)	(-1.55)	(-1.53)	(-1.10)
Tax03	-0.0103	-0.0137	-0.0085	0.0001	0.0002	0.0001
	(-0.43)	(-0.46)	(-0.22)	(0.94)	(1.35)	(0.31)
Adj. R^2	0.004	0.002	0.003	0.014	0.006	0.010
F-stat	16.96	4.65	6.91	30.55	7.23	8.53
Obs	25,628	14,926	10,702	25,628	15,127	10,501

Table 9
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 weight NYSE/AMEX index as the market proxy. The abnormal return on the ex-day (AR^{ex}) includes the dividend as illustrated in Section 3.2. Abnormal turnover is calculated according to the Campbell and Wasley (1996) methodology described in Section 3.4. 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.

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 10
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 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-tail 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