

# The Disposition Effect and Underreaction to News

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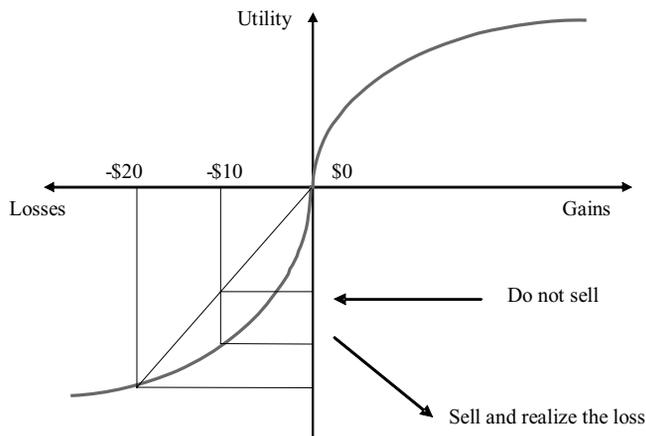
## ABSTRACT

This paper tests whether the “disposition effect,” that is the tendency of investors to ride losses and realize gains, induces “underreaction” to news, leading to return predictability. I use data on mutual fund holdings to construct a new measure of reference purchasing prices for individual stocks, and I show that post-announcement price drift is most severe whenever capital gains and the news event have the same sign. The magnitude of the drift depends on the capital gains (losses) experienced by the stock holders on the event date. An event-driven strategy based on this effect yields monthly alphas of over 200 basis points.

IN RECENT YEARS, MOUNTING EVIDENCE CHALLENGES the traditional view that securities are rationally priced to reflect publicly available information. Specifically, an extensive body of empirical literature reports that stock prices appear to drift after major corporate news announcements. While positive news is generally met with price appreciation, prices subsequent to the announcement often show positive abnormal drift; similarly, negative news generates negative market reaction around the event date, but often tends to be followed by a negative drift. As a result, some event-driven equity strategies based on market impact appear to earn significant returns in the subsequent weeks or even months.<sup>1</sup>

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<sup>1</sup>Events of this type include earnings announcements (Mendenhall (1991), Abarbanell and Bernard (1992)), stock splits (Grinblatt, Masulis, and Sheridan (1984), Desai and Prem (1997), Ikenberry, Gaeme, and Stice (1996)), tender offer and open market repurchases (Lakonishok and Vermaelen (1990), Ikenberry, Lakonishok, and Vermaelen (1995)), analysts' recommendations revisions (Groth et al. (1979), Bjerring, Lakonishok, and Vermaellen (1983), Elton, Grueber, and Gueltekin (1984), Womack (1996)), SEOs (Lougran and Ritter (1995), Teoh, Welch, and Wong (1998)), public announcements of insider trades (Seyhun (1986, 1988)), headline news (Chan (2003)), and R&D expenses increase (Eberhart, Maxwell, and Siddique (2004)).



**Figure 1. Prospect theory, mental accounting, and the disposition effect: Realize a loss.** Assume that an investor purchased one share at \$50 and the price is now \$40. Suppose that in the next month, the price could go either up \$10 or down \$10 (with equal probability). The investor must choose between selling the stock now and realizing a paper loss of \$10, or keeping the stock in his portfolio. This figure shows the utility gain (loss) of the two alternatives.

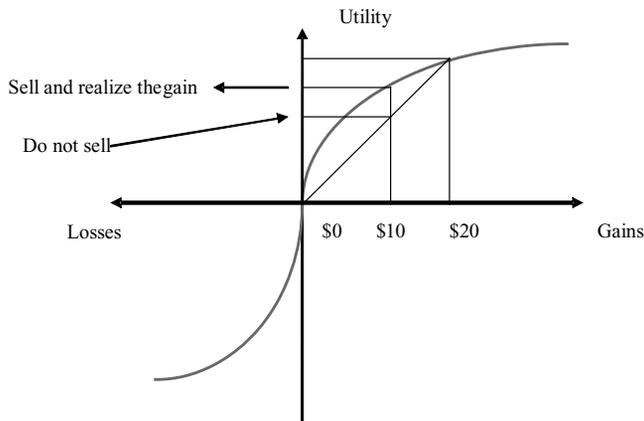
The interpretation of this evidence is still highly controversial, as no unified rational or irrational explanation has won general acceptance.<sup>2</sup> Nevertheless, there are some promising theoretical developments. Recent work by Barberis, Huang, and Santos (2002), Barberis, Huang, and Thaler (2003), and Grinblatt and Han (2005) integrates psychological evidence on typical attitudes to risk into models of equilibrium prices. These papers suggest that preferences specifications based on prospect theory and mental accounting can play an important role in explaining asset pricing dynamics and the cross-section of stock returns.<sup>3</sup>

A combination of prospect theory and mental accounting (PT-MA) tends to generate a “disposition effect,” that is, a tendency to sell securities that have gone up not down in value since purchase. For example, assume that an investor purchased one share at \$50 and the price is now \$40. Suppose that in the next month, the price could go either up \$10 or down \$10 (with equal probability). The investor must choose between selling the stock now and realizing a paper loss of \$10, or keeping the stock in his portfolio, in which case he has 50–50 odds of losing \$20 and breaking even. A risk-averse investor will sell the stock. An investor who is risk seeking on the loss domain, employing the purchase price as the base (or reference price) to compute gains and losses, will not sell the stock. This example is illustrated in Figure 1; the PT-MA investor prefers the chance of breaking even to the certain pain of experiencing a loss.

On the other hand, assume that the investor purchased one share at \$50 and the price is now \$60, again with a 50–50 chance of going up or down by \$10.

<sup>2</sup> See, for example, Fama (1998).

<sup>3</sup> See Kahneman and Tversky (1979), and Thaler (1985).



**Figure 2. Prospect theory, mental accounting, and the disposition effect: Realize a gain.** Assume that an investor purchased one share at \$50 and the price is now \$60. Suppose that in the next month the price could go either up \$10 or down \$10 (with equal probability). The investor must choose between selling the stock now and realizing a paper gain of \$10, or keeping the stock in his portfolio. This figure shows the utility gain (loss) of the two alternatives.

In this case, a PT-MA investor will prefer the immediate realization of the \$10 gain and he will sell the stock. This example is illustrated in Figure 2.

In this paper, I argue that the presence of a large subset of investors who display the disposition effect can generate stock price “underreaction” to news and, in turn, return predictability and post-announcement price drift. When a stock experiences good news and increases in value relative to the purchase price, these investors want to sell it to lock in the paper gain, which depresses its price (assuming a downward-sloping demand curve). From that lower base, subsequent returns will be higher. Therefore, good news tends to lead to high future returns. Similarly, when bad news is released into the market and the stock price goes down in value relative to the purchase price, disposition investors are reluctant to sell, absent a premium. In this case, any trading will occur at a temporarily inflated price, and from that higher base, subsequent returns will be lower. Hence, bad news tends to be followed by a negative price drift.

To test this hypothesis, I propose a way to compute the aggregate basis for individual stocks using data on actual stock holdings for a large class of investors, namely, mutual funds. I use a database of mutual funds holdings to construct a time series of reference prices for individual stocks. I use this measure to construct a test of stock price underreaction to public news generated by the presence of disposition managers. I test the hypothesis that the presence of disposition investors hampers the transmission of information when firm-specific information, such as an earnings announcement, is released, thereby inducing a predictable price drift. The drift depends on the news content (positive or negative) and the difference between the current and the reference price.

To test for event-driven return predictability, I first sort stocks into different classes according to the degree to which capital gains are likely to induce a sluggish response to corporate news. I then construct a long–short equity strategy. The central prediction is that exposure to a disposition proxy should forecast cross-sectional differences in subsequent returns of the test portfolios.

To better understand how investors who tend to ride losses and lock in paper gains can generate underreaction to news, consider the following example. Stock XYZ is trading at \$13 and its aggregate cost basis is equal to \$16; that is, most of the current holders acquired their shares at a price around \$16, and the stock is currently trading at a capital loss. At date  $t$ , bad news reveals a consensus valuation of only \$11.

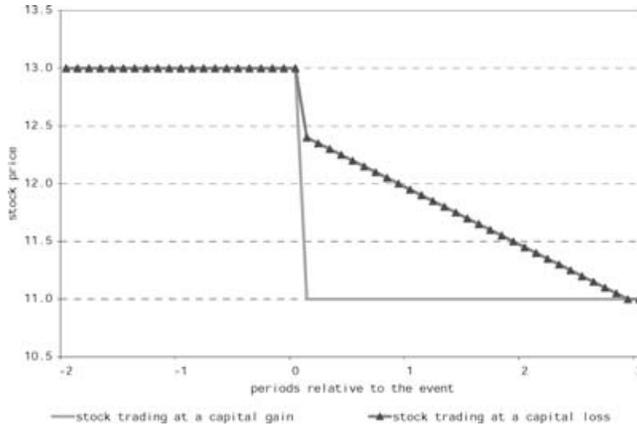
In the absence of frictions, the stock price should promptly adjust to \$11. However, if holders are reluctant to realize the paper loss, that is, they restrict the available supply, and if demand functions are not perfectly elastic, the stock price will only fall to a point between \$13 and \$11. Thus, trading initially takes place at a temporarily inflated price, as current holders are willing to sell only at a premium, but from this higher base subsequent returns tend to be lower, ultimately generating a negative post-event drift.

Now consider the same initial scenario, but let the initial aggregate cost basis be equal to \$5, so that the stock is initially trading at a large capital gain. When the bad news is revealed, no friction rations the supply of the stock since most of the current holders are engaged in active selling to lock in their paper gains. Indeed, in this alternative scenario, the active selling helps the market to promptly incorporate the bad news, and thus the stock price should speedily drop to the new fundamental value.

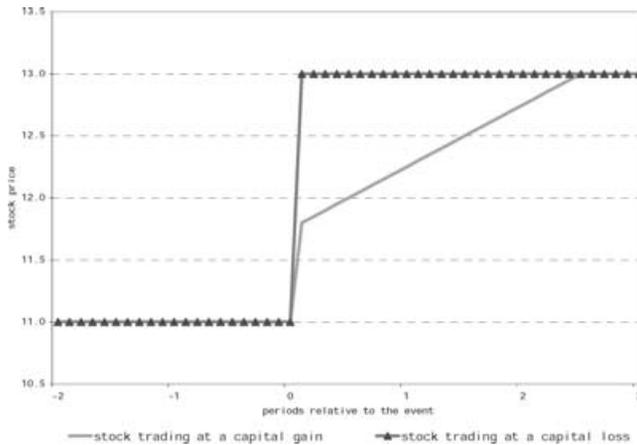
The reluctance to unload an asset that is trading at a capital loss hampers price discovery when negative news hits such a security; this results in post-event drift. Given that disposition investors ration the stock's supply, bad news travels slowly across assets trading at large capital losses; this generates (negative) post-event return predictability.

Since disposition investors are more likely to realize gains than losses, a similar argument can be made for good news stocks. When most of the current holders are trading at large paper gains, their active selling tends to create excess supply, which leads to a lower price impact, and thus generates underreaction to good news. If the stock is trading at a capital loss, the lower relative supply will generate a relatively higher price, and help the price adjustment to the new higher level. Good news travels slowly across assets trading at large capital gains, which generates (positive) post-event return predictability. This hypothetical example is illustrated in Figures 3 and 4, which report the impact of positive and negative news on stocks with unrealized gains and losses.

The new result is that once one sorts event stocks using the capital gains measure, post-event predictability is indeed most severe where the disposition effect predicts the largest underreaction. 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 stock holders on the event date.



**Figure 3. An example of stock price response to negative news.** This figure shows an example of a stock price response to negative news. The initial stock price is \$13. At date 0, public news reveals a fundamental value of \$11.



**Figure 4. An example of stock price response to positive news.** This figure shows an example of a stock price response to positive news. The initial stock price is \$11. At date 0, public news reveals a fundamental value of \$13.

I also document the extent of the disposition effect among mutual fund managers and show that it adversely affects returns. Loser funds tend to be as disposition prone as retail investors. The results confirm the intuition in Wermers (2003): Managers of underperforming funds appear reluctant to close their losing positions. Conversely, successful managers realize losses at higher rates than gains.

The rest of the article is organized as follows. Section I gives a brief introduction to the disposition effect. Section II defines the central variable, the capital gains overhang. I also document the extent of the disposition effect among fund managers. In Section III, I describe the hypothesis. In Section IV,

I report abnormal returns for the main test assets. Section V reports returns net of trading costs. Section VI concludes.

### I. The Disposition Effect

The disposition effect, introduced into the finance literature by Shefrin and Statman (1985), refers to the tendency of investors to ride losses and realize gains. This runs counter to sound tax planning. With the availability of account-level transaction data, the disposition effect has become a widely documented empirical regularity. Indeed, subsequent to the well-known paper by Odean (1998), several studies find that investors are reluctant to unload assets at a loss relative to the price at which they were purchased.

The available evidence shows that although greater investor sophistication is associated with less susceptibility to the disposition effect, professional traders are far from immune to it.<sup>4</sup> Locke and Mann (2000) analyze the trading behavior of professional futures traders and find that while all traders hold losers longer than winners, the least successful traders hold losers the longest, while the most successful traders hold losers for the shortest time. Coval and Shumway (2000) report evidence of loss aversion among professional market makers at the Chicago Board of Trade, with the most compelling evidence concentrated in morning loser traders. Shapira and Venezia (2001) find evidence of the disposition effect among professional investors in Israel, while results in Wermers (2003) show that managers of underperforming funds appear reluctant to sell their losing stocks, which is consistent with their being disposition prone.

### II. The Capital Gains Overhang

To construct a test of return predictability induced by the disposition effect, one must construct a measure of unrealized capital gains. Here, I use the time series of net purchases by mutual fund managers and their cost basis in a particular stock to compute a weighted average reference price. This measure is central to the empirical analysis in this paper since it allows one to summarize the dollar gains and losses experienced by the stock holders on a given date.

Previous research focuses exclusively on price momentum and on a measure of the cost basis based on trading volume.<sup>5</sup> I devise a measure of the cost basis based on portfolio holdings, and I analyze the transmission of information when firm-specific information is released in the form of public news.

I compute the reference price as

$$RP_t = \phi^{-1} \sum_{n=0}^t V_{t,t-n} P_{t-n}, \quad (1)$$

<sup>4</sup> See Odean (1999), Barber and Odean (2000, 2001, 2002), Grinblatt and Keloharju (2001), Brown et al. (2002), and Dhar and Zhou (2002).

<sup>5</sup> See Ferris, Haugen, and Makhija (1998), and Grinblatt and Han (2005).

where  $V_{t,t-n}$  is the number of shares purchased at date  $t - n$  that are still held by the original purchasers at date  $t$ ,  $\phi$  is a normalizing constant such that  $\phi = \sum_{n=0}^t V_{t,t-n}$ , and  $P_t$  is the stock price at the end of month  $t$ .

When a stock is purchased several times, and partially sold at different dates, I assume that investors use the purchase price as the base for computing gains and losses. When they trade, I assume that they use a cost-based mental accounting method (FIFO-first in, first out) to associate a quantity of shares in their portfolio to the corresponding reference price.<sup>6</sup>

For example, assume that an investor purchases 100 shares at date 0 for  $P_0 = \$20$  and an additional 100 shares at date 1 for  $P_1 = 23.3$ , and subsequently sells 120 shares at date 2 for  $P_2 = 22$ . Of the 120 shares sold, 100 units are assumed to be drawn from the shares acquired at date 0, which realize a gain, while the remaining 20 shares are sold at a loss. The total mental gain/loss will be  $(22 - 20) * 100 + (22 - 23.3) * 20$  and the “mental book” at the end of period 2 will be given by  $V_{2,0} = 0$  and  $V_{2,1} = 80$ .

The capital gains overhang is defined as the percentage deviation of the aggregate cost basis from the current price

$$g_t = \frac{P_t - RP_t}{P_t}. \quad (2)$$

Capital gains are meant to be the best estimate of the stock’s cost basis to the representative investor. The advantage of using holdings relies on the possibility of unambiguously identifying the fraction of shares purchased at a previous date that is still held by the original purchasers at the current date, thus taking into account shareholder heterogeneity in the anchor points.

In the empirical analysis, I use mutual funds’ common stock holdings to compute capital gains and losses for individual stocks. While this assumes that mutual fund managers are a representative sample of the cross-section of shareholders, the approach is general and can be applied whenever holdings data are available for individual stocks.<sup>7</sup>

### A. Data Description

I obtain the data from several sources. Stock returns and accounting data between January 1980 and December 2002 are obtained from the CRSP/COMPUSTAT merged database. Quotes and trades are obtained from the New York Stock Exchange Trades and Quotations (TAQ) database; the TAQ

<sup>6</sup> Using reference prices constructed employing LIFO, HIFO, the last trading price, the last buying price, or averages of past buying and selling prices does not alter any of the main results.

<sup>7</sup> Clearly, we would like to use holdings of all the shareholders at a particular date, including retail investors. I repeat the analysis combining the mutual fund data (1980–2002) with individual investors’ holdings from a nationwide discount brokerage house (1991–1996). The results are unchanged as the size of mutual funds’ common stocks holdings tends to swamp the fraction of shares outstanding owned by retail investors. Since I only have access to retail investors’ holdings for a limited period of 5 years and they do not generate a noticeable difference in the analysis, I present results obtained using mutual fund holdings only.

data cover the period 1993 to 2002. Analysts' stock recommendations are taken from the Institutional Brokers Estimates System (I/B/E/S); the data cover the period 1993 to 2002.

Mutual fund holdings from January 1980 to December 2002 are obtained from the Thomson Financial CDA/Spectrum Mutual Funds database, which includes all registered mutual funds filing with the SEC plus 3,000 global funds. The data show holdings of individual funds collected via fund prospectuses and SEC N30D filings.<sup>8</sup>

The statutory requirement for reporting holdings is semiannual. However, about 60% of the funds file quarterly reports. The data include a report date (RDATE), which is the calendar day at which a snapshot of the portfolio is recorded, and a file date (FDATE), which is a vintage date assigned by Thomson. Neither of the two dates corresponds to the actual filing date with the SEC. Thomson always assigns file dates to the corresponding quarter-ends of the filings. Although reports may be made on any day, the last day of the quarter is the most common report day. In some cases, the report date is as much as 6 months prior to the file date, because fund managers have discretion about when to take their portfolio's snapshot, which can be filed at a subsequent date.

A typical fund-quarter-stock observation is as follows: as of March 30th, 1998, Fidelity Magellan owned 20,000 shares of IBM. Holdings are adjusted for stock splits and are assumed to be public information with a 30-day lag from the file date.<sup>9</sup> Holdings are merged with CRSP data and filtered to eliminate potential anomalies that are probably due to misreporting or errors in data collecting. Holdings are set to missing whenever

1. the number of shares in a fund portfolio exceeds the total amount of shares outstanding at a particular date;
2. the value of the fund's holding of a particular stock on a particular date is larger than the total asset value of the fund reported by CDA;
3. the asset has zero shares outstanding;
4. the total asset value of the fund reported by Thomson differs from the implied CRSP value by more than 100%.

After these filters are applied, the data contain end-of-quarter stock holdings for about 29,000 mutual funds between January 1980 and December 2003. The stock price at the report date is used as a proxy for the buying or selling price. Clearly, this is a noisy measure, since the actual transaction price is generally different from the price at the report date. Nevertheless, to the extent that stock prices are equally likely to increase or decrease after being purchased or sold

<sup>8</sup> Holdings are identified by CUSIP; they constitute most of the equities, but are not necessarily the entire equity holdings of the manager or fund. The potential exclusions include small holdings (typically under 10,000 shares or \$200,000), cases in which there may be confidentiality issues, reported holdings that cannot be matched to a master security file, and cases in which two or more managers share control (since the SEC requires only one manager in such a case to include the holdings information in their report).

<sup>9</sup> Currently, filings appear on the SEC EDGAR system on the next business day following a filing; however, information lags were probably longer at the beginning of the sample period.

**Table I**  
**The Capital Gains Overhang, Summary Statistics**

This table reports summary statistics for the capital gains overhang. The capital gains overhang is defined as the percentage deviation of the aggregate reference price from the current price  $g_t = (P_t - RP_t)/P_t$ . The reference price is defined as  $RP_t = \phi^{-1} \sum_{n=0}^t V_{t,t-n} P_{t-n}$ , where  $V_{t,t-n}$  is the number of shares at date  $t$  that are still held by the original  $t - n$  purchasers,  $\phi$  is a normalizing constant, and  $P_t$  is the stock price at the end of month  $t$ . Investors are assumed to use a FIFO criterion (first-in-first-out) to associate shares in their portfolio to the corresponding reference price. The table reports the value-weighted mean (VW, the weights are proportional to total market value at the end of the previous quarter), equally weighted mean (EW), standard deviation, skewness, and the first and fifth quintiles for selected years. % Stocks is the percentage of stocks in the CRSP database with a valid capital gains overhang, and % MV is the percentage of the total market value of stocks with a valid capital gains overhang.

Year	Mean		Median	St.Dev.	Skew	P20	P80	% Stocks	% MV
	VW	EW							
1985	0.08	-0.08	0.01	0.42	-2.55	-0.26	0.18	64.5	95.9
1990	0.03	-0.27	-0.11	0.55	-1.99	-0.54	0.10	62.2	96.9
1995	0.05	-0.07	0.03	0.44	-2.61	-0.24	0.20	83.6	82.0
2000	-0.14	-0.33	-0.14	0.67	-1.54	-0.72	0.16	73.8	88.6
1980-2002	0.03	-0.15	-0.01	0.52	-2.30	-0.36	0.18	72.7	84.4

by a mutual fund, I can see no reason to expect this measure to bias the results one way or the other.

### B. Cross-Sectional Determinants of the Capital Gains Overhang

Table I provides summary statistics of the capital gains overhang. In terms of market capitalization, on average 84.4% of CRSP stocks have valid capital gains over the period 1980 to 2002. The gap is filled by very small stocks due to the fact that mutual funds tend to avoid illiquid micro cap securities.

Table II reports coefficients from Fama and MacBeth (1973) regressions of unrealized gains by regressing them, cross-sectionally, on the stock's past short- and long-term returns, size, turnover, and some fund-related variables.

Model 1 shows the likelihood that winning (losing) stocks exhibit large unrealized capital gains (losses), with most of the effect coming from recent price movements. The size coefficient is also positive, perhaps reflecting the fact that large stocks have a different ownership structure, with investors tilted toward riding gains rather than realizing them, or reflecting liquidity issues.

In model 2, I add firm turnover in the past year (*TURN*) and an interaction term between turnover and returns as a control.<sup>10</sup> The results show that controlling for past returns, low volume winners tend to have larger capital gains, while high volume losers tend to experience smaller capital losses.

<sup>10</sup> The coefficients are allowed to be different for NASDAQ stocks since turnover numbers do not have the same interpretation in a dealer market.

**Table II**  
**The Capital Gains Overhang, Fama–MacBeth Regressions 1980–2002**

This table reports coefficients from Fama–MacBeth regressions of the capital gains overhang on a set of firm- and fund-specific regressors.  $R_{-12,1}$  is the prior-year stock return,  $R_{-36,-13}$  is the previous 2-year return,  $\log(mv_{-1})$  is the log of market capitalization at the end of the previous month,  $TURN$  is the average turnover in the previous 12 months,  $MF\_OWN$  is the percentage of shares outstanding owned by mutual funds, and  $HOLD\_RET$  is the average return in the previous 12 months of all funds holding the stocks. Funds' prior returns are weighted by the percentage of ownership in the stock.  $NASD$  is a NASDAQ dummy. Cross-sectional regressions are run every month and standard errors are adjusted for heteroskedasticity and autocorrelation using a Bartlett kernel. In model 4, the absolute value of the overhang variable is regressed on the absolute value of the full set of regressors.  $t$ -statistics are shown below the coefficient estimates and 5% statistical significance is indicated in bold. The  $\bar{R}^2$  is the average  $R^2$  from the cross-sectional regressions.

Model No.	1	2	3	4
Dependent Variable	Capital Gains	Capital Gains	Capital Gains	Abs(Capital Gains)
$R_{-12,-1}$	<b>0.396</b> (10.87)	<b>0.553</b> (15.29)	<b>0.557</b> (15.25)	<b>0.273</b> (5.71)
$R_{-36,-13}$	<b>0.044</b> (4.27)	<b>0.068</b> (6.81)	<b>0.073</b> (7.90)	<b>0.012</b> (2.89)
$\log(mv_{-1})$	<b>0.064</b> (13.91)	<b>0.071</b> (13.44)	<b>0.069</b> (17.07)	<b>-0.072</b> (-14.96)
$TURN$		<b>-0.110</b> (-15.80)	<b>-0.127</b> (-12.68)	<b>0.106</b> (8.86)
$NASD * TURN$		<b>0.086</b> (3.87)	<b>0.073</b> (7.58)	<b>-0.062</b> (-7.22)
$R_{-12,1} * TURN$		<b>-0.124</b> (-11.40)	<b>-0.134</b> (-10.82)	<b>-0.099</b> (-5.35)
$MF\_OWN$			<b>0.452</b> (10.67)	<b>-0.290</b> (-8.87)
$HOLD\_RET$			<b>0.424</b> (8.14)	<b>-0.474</b> (-7.88)
$\bar{R}^2$	0.25	0.28	0.30	0.15

In model 3, I add to the regressors the percentage of shares owned by mutual funds ( $MF\_HOLD$ ) as well as the average return in the previous year of all the funds holding the stocks ( $HOLD\_RET$ ). If losing funds are reluctant to realize losses, we would expect stocks with a low  $HOLD\_RET$  to be trading at a loss. The results show that stocks mostly held by losing (winning) funds display larger losses (gains). High fund ownership stocks tend to trade at a gain, probably reflecting the fact that the average manager is less disposition prone compared to retail investors.

Finally, I regress the absolute value of capital gains on the absolute value of the full set of regressors. Stocks mostly held by mutual funds and by funds with large returns in the previous year tend to have reference prices that are closer to the current stock price. Large stocks also trade closer to reference prices. High turnover accompanied by large return realizations of either sign keeps the overhang closer to zero, although the coefficient on raw turnover is

**Table III**  
**Proportion of Gains Realized to the Aggregate Proportion of Losses Realized, Mutual Funds (1980–2002)**

This table compares the aggregate proportion of gains realized (*PGR*) to the aggregate proportion of losses realized (*PLR*). *PGR* (# of shares) is the number of realized gains divided by the number of realized gains plus the number of paper (unrealized) gains. *PLR* (# of shares) is the number of realized losses divided by the number of realized losses plus the number of paper (unrealized) losses. *PGR* (\$ value) is the dollar value of realized gains divided by the dollar value of realized gains plus the dollar value of paper (unrealized) gains. *PLR* (\$ value) is the dollar value of realized losses divided by the dollar value of realized losses plus the dollar value of paper (unrealized) losses. Realized gains, paper gains, realized losses, and paper losses are aggregates across funds from 1980 to 2002. *PGR* and *PLR* are reported for the full sample and across mutual funds ranked by the previous year's return. The *t*-statistics test the null hypothesis that the difference in proportions is equal to zero; 5% statistical significance is indicated in bold.

	Fund Return in the Previous Year (Quintiles)					All
	1 (Low)	2	3	4	5 (High)	
# of shares						
<i>PLR</i>	0.112	0.122	0.137	0.158	0.169	0.145
<i>PGR</i>	0.193	0.182	0.188	0.179	0.198	0.176
<i>PGR</i> – <i>PLR</i>	<b>0.081</b>	<b>0.060</b>	<b>0.051</b>	<b>0.021</b>	<b>0.029</b>	<b>0.031</b>
<i>t</i> -stat	(24.0)	(25.5)	(23.0)	(17.0)	(10.0)	(43.6)
\$ Value						
<i>PLR</i>	0.120	0.138	0.150	0.157	0.154	0.149
<i>PGR</i>	0.183	0.179	0.192	0.188	0.164	0.172
<i>PGR</i> – <i>PLR</i>	<b>0.063</b>	<b>0.041</b>	<b>0.042</b>	<b>0.031</b>	<b>0.010</b>	<b>0.023</b>
<i>t</i> -stat	(19.0)	(22.5)	(21.0)	(16.0)	(9.0)	(33.6)

positive, probably reflecting nonlinearities not captured by the linear specification. Finally, high momentum stocks tend to have large capital gains of either sign.

### *C. The Disposition Effect in Mutual Fund Managers*

Table III compares the aggregate proportion of gains realized (*PGR*) to the aggregate proportion of losses realized (*PLR*) for all the 29,812 mutual funds in the database, where *PGR* is realized gains divided by the sum of realized gains and paper (unrealized) gains, and *PLR* is realized losses divided by realized losses plus paper (unrealized) losses.

Each quarter a sale takes place between two report dates in a mutual fund portfolio, the current stock price is compared to the purchase price to determine whether the stock is trading at a gain or a loss. If the current price is above (below) the original purchase price, then the stock is counted as trading at a gain (loss). Managers are assumed to use the FIFO criterion in updating the reference price. At the beginning of each quarter, mutual funds are ranked by their previous year's return. *PGR* and *PLR* are reported both for the full

sample and across the performance-based quintiles. The  $t$ -statistics test the null hypothesis that the difference in proportions is equal to zero.

What emerges from Table III is a statistically strong ( $t$ -statistic = 44) tendency for mutual fund managers to sell a higher proportion of their winners than their losers. The magnitude of the aggregate difference ( $PGR - PLR$ ) is around 3%, which is smaller than the average 5% reported by Odean (1998) for retail investors, but still of the same order of magnitude. Computing  $PGR$  and  $PLR$  on a dollar basis delivers similar results.

What is striking is the amount of variation that can be observed across the performance-based quintiles. Loser funds show signs of a disposition effect, with magnitudes comparable to retail investors: loser funds are 1.7 times more likely to realize a paper gain than a paper loss, an 8% ( $t$ -statistic = 25.5) difference between  $PGR$  and  $PLR$ . This result confirms the evidence in Wermers (2003) that managers of underperforming funds appear reluctant to sell their losing stocks.

### III. Underreaction to Corporate News

I describe the main underreaction hypothesis and design a related investment rule to construct the test assets. The conjecture is that in the presence of disposition-prone investors, stock prices underreact to a specific set of news, and thereby generate post-event drift.

**HYPOTHESIS UR (UNDERREACTION):** When most of the current holders are facing a capital loss, stock prices underreact to negative news and in turn generate a negative post-announcement price drift. When most of the current holders are facing a capital gain, stock prices underreact to positive news and in turn generate a positive post-announcement price drift. Moreover, holding the news constant, the capital gains overhang forecasts post-event returns.

An interaction between the news content and capital gains generates return predictability. The example in the Introduction reveals the intuition behind this hypothesis: trading (or reluctance to trade) by disposition investors tends to hamper price discovery. Positive (negative) news travels slowly in stocks with large capital gains (losses) as disposition traders tend to dampen the transmission of information, thereby generating return continuation.

Hypothesis UR implies that a long–short strategy, in which a long position in good news stocks is offset by a short position in negative news stocks, should yield higher returns, the higher the spread in the capital gains overhang between the long and the short sides. Since stocks with large gains underreact more to good news and stocks with large losses underreact more to bad news, the difference in capital gains between the two positions of a long–short news strategy forecasts returns.

I refer to the maximum profits strategy as the *overhang spread*: A portfolio that is long good news stocks with the largest paper gains, and short bad news stocks with the largest paper losses has the largest capital gains spread between

the long and short sides. Similarly, I call the opposite extreme portfolio the *negative overhang spread*: A portfolio that is long good news stocks with the largest capital losses and short bad news stocks with the largest capital gains has the minimum (negative) gains spread between the long and short sides.

I use an investment rule that exploits the *post-earnings announcement drift*. Labeled by Fama (1998) as “above suspicion,” the inability of stock prices to speedily impound earnings information is probably the most compelling evidence of underreaction in equity markets. An extensive literature, dating back to Ball and Brown (1968), suggests that investors underreact to the information content of earnings, and thereby generate return continuation, otherwise known as the post-earnings announcement drift anomaly (hereafter PEAD).<sup>11</sup> Jegadeesh, Chan, and Lakonishok (1996) analyze the profitability of rolling investment strategies based on the PEAD.

I use a rolling portfolio approach, following Jegadeesh and Titman (1993) and Fama (1998). The resulting overlapping returns can be interpreted as the returns of a trading strategy that in any given month  $t$  holds a series of portfolios selected in the current month as well as in the previous  $k$  months, where  $k$  is the holding period. At the beginning of each month, an independent sort is used to rank stocks on the basis of their most recent earnings surprises and the capital gains overhang at the end of the previous month. The ranked stocks are assigned to one of 25 quintile portfolios. All stocks are equally weighted within a given portfolio, and the overlapping portfolios are rebalanced every calendar month to maintain equal weights.<sup>12</sup>

Earnings surprises are measured using the market model cumulative abnormal returns around the most recent earnings announcement date.<sup>13</sup> This is a fairly clean measure of news since it does not rely on assumptions regarding the market expectation for earnings. A return-driven news sort is appropriate because it closely mimics the underreaction hypothesis at hand.

A caveat that arises when sorting stocks using capital gains is that it is likely for winning (losing) stocks to exhibit large gains (losses). Ideally, we would like the subsamples to contain stocks with similar characteristics, but a wide spread in capital gains. Therefore, I sort stocks using both the *capital gains overhang* and a *residual overhang*. The residuals are constructed from cross-sectional regressions of gains on past returns, size, and volume.<sup>14</sup>

The time series of returns of the rolling portfolios tracks the calendar month performance of a post-event strategy that is based entirely on observables. Such an investment rule should earn zero abnormal returns in an efficient market.

<sup>11</sup> See Joy, Litzenberger, and McEnally (1977); Rendleman, Jones, and Latane (1982); Foster, Olsen, and Shevlin (1984); Bernard and Thomas (1989, 1990); Affleck-Graves and Mendenhall (1992); Ball and Bartov (1996); and more recently, Collins and Hribar (2000) and Tarun and Shivakumar (2002).

<sup>12</sup> I use equal weights for comparison to the existing literature on earnings and price momentum. Value weighting delivers identical results.

<sup>13</sup> The daily abnormal returns are cumulated from the 2 days preceding to 1 day after the event date in order to account for the possibility of early or delayed reaction to the announcement caused by information leaking, pre-announcements, or a delayed response for less-frequently traded stocks.

<sup>14</sup> Specifically, the residuals are obtained using model 2 in Table II.

I compute abnormal returns from a time-series regression of the portfolio excess returns on contemporaneous Fama and French (1993) factors in calendar time.<sup>15</sup>

Positive abnormal returns following positive news indicate the presence of post-event drift, consistent with underreaction or a sluggish response to news. The opposite is true for negative news. Under Hypothesis UR, the overhang spread consistently earns higher returns than the negative overhang spread. *Ceteris paribus*, the wider the spread in capital gains between the long and the short sides, the larger the subsequent alpha.

Note that the disposition effect makes a scenario-specific prediction about the sign of the underreaction pattern. In particular, the underreaction is more severe whenever capital gains and the event have the same sign. Stocks for which most current holders are experiencing large paper losses severely underreact to negative news, as opposed to negative news stocks that are trading at large gains. The opposite is true for positive news stocks.

#### IV. Results

The focus of the analysis is on short-term underreaction. Since earnings news is released on a quarterly basis, I use a 3-month strategy as the benchmark portfolio when presenting the results.

I begin by reporting returns of the standard PEAD strategy. The last column in Table IV confirms that there is significant PEAD in the full sample. The baseline rolling strategy that is long the top 20% positive earnings news stocks and short the bottom 20% generates risk-adjusted returns of 1.242% per month ( $t$ -statistic = 10.78). Negative (positive) earnings momentum stocks display negative (positive) return continuation, and the effect is monotonic with increasing average returns as one moves from the bottom to the top quintile. Such values are comparable to those reported in previous studies of the PEAD.

Table V reports monthly alphas for the main test assets. Separating stocks according to their unrealized gains induces large differences in subsequent returns. The overhang spread, a strategy that holds a portfolio of top 20% positive news stocks with large paper gains (top 20% capital gains) for 3 months and offsets this position by shorting the bottom 20% negative news stocks with large paper losses (bottom 20% capital gains), delivers abnormal returns of 2.433% per month ( $t$ -statistic = 6.60).

The results support Hypothesis UR: bad (good) news travels slowly among stocks with large unrealized capital losses (gains), generating large subsequent returns for the overhang spread portfolio. Post-event returns of the negative overhang spread are not significantly different from zero. When negative news hits securities trading at large paper losses, it generates a severe post-event drift. Similarly, subsequent returns are large for positive news stocks trading at large gains. Conversely, prices quickly adjust when good (bad) news hits

<sup>15</sup>The monthly factors and the risk-free rate are from Ken French's website: <http://mba.tuck.dartmouth.edu/pages/faculty/ken.french>.

**Table IV**  
**Post-Earnings Announcement Drift, Monthly Alphas 1980–2002**

At the beginning of every calendar month, stocks are ranked in ascending order on the basis of their cumulative abnormal returns on the most recent earnings announcement date. The daily abnormal returns are cumulated from the 2 days preceding the event date to 1 day after. Stocks are assigned to one of five equally weighted quintile portfolios. This table includes all available stocks and reports Fama and French (1993) three-factor alphas. The dependent variable is the monthly excess return of the Treasury bill rate from the rolling strategy. The explanatory variables are the monthly returns from Fama and French (1993) mimicking portfolios. L/S is the alpha of a zero-cost portfolio that holds the top 20% good news stocks and sells short the bottom 20% bad news stocks. Alphas are in monthly percent, *t*-statistics are shown below the coefficient estimates, and 5% statistical significance is indicated in bold. "Rolling period" is the holding period of the rolling strategy, in months.

Rolling Period	Earnings News Quintile					L/S
	1 (Bad)	2	3	4	5 (Good)	
+1	<b>-0.558</b> (-2.69)	-0.253 (-1.84)	0.014 (0.11)	0.232 (1.82)	<b>0.595</b> (3.20)	<b>1.152</b> (8.17)
+2	<b>-0.512</b> (-2.07)	0.044 (0.32)	0.137 (1.04)	0.215 (1.75)	<b>0.657</b> (3.91)	<b>1.169</b> (7.11)
+3	<b>-0.624</b> (-3.22)	-0.070 (-0.68)	0.080 (0.80)	<b>0.221</b> (2.29)	<b>0.618</b> (4.45)	<b>1.242</b> (10.78)

securities trading at large paper losses (gains), and post-event abnormal returns are on average zero.

Using residual rather than raw overhang delivers similar results. The alpha of the overhang spread is 2.201% (*t*-statistic = 6.56), but it is not significantly different from zero for the negative overhang spread portfolio. The results show that even after controlling for past returns, high overhang stocks underreact to earnings news, which generates subsequent abnormal returns.

Table VI better illustrates the result by reporting returns for different overhang quintiles. In the table, portfolio #*j* is defined as a zero-cost portfolio that holds the top 20% good news stocks in the *j*<sup>th</sup> overhang quintile and sells short the bottom 20% bad news stocks in the (6 - *j*)<sup>th</sup> overhang quintile. Hence, portfolio #5 corresponds to the overhang spread, that is the strategy with the largest (positive) difference in the overhang between the long and short sides and portfolio #1 corresponds to the negative overhang spread, that is the strategy with the minimum (negative) difference in the overhang between the long and the short sides.

Indeed, the spread in capital gains between the long and the short sides forecasts future returns. The alpha declines monotonically across the quintile-based portfolios as the spread in capital gains goes from maximum (positive) in portfolio #5 to minimum (negative) in portfolio #1. The returns generated by the overhang spread are statistically different from the negative overhang spread (*t*-statistic = 3.64). The induced difference is economically large, being over 200 basis points per month. The alpha still declines from maximum to minimum, although sometimes not monotonically, for the 1- and 2-month rolling period.





The results show that the bulk of the profitability of the PEAD is concentrated in high overhang stocks: Stocks with large unrealized capital gains tend to underreact to, and only to, positive earnings surprises, while negative overhang stocks underreact to, and only to, negative earnings news. This induces large differences between the returns of the overhang spread and negative overhang spread portfolios.

These results are consistent with Hypothesis UR: The post-event drift anomaly is related to investors' initial underreaction to news, either generated or amplified by the rate at which investors tend to realize gains and losses. The findings are consistent with an incomplete price discovery on the event date. This is not, however, the only plausible explanation for the results of Tables IV–VI. In particular, suppose that stocks experiencing extreme earnings news tend to be significantly exposed to a “news” factor that reflects systematic risk not captured by the Fama and French model. In this case, the returns of a PEAD strategy would be totally explained by a loading on a corresponding traded factor. I cannot rule out a risk-based explanation simply based on the results in Tables V and VI. Nevertheless, note that the cross-sectional variation in returns induced by the capital gains sort is large enough to make same-news strategies profitable. For example, looking at Table V, holding the bottom 20% *bad news* stocks with large paper gains for 3 months, and shorting the bottom 20% bad news with large paper losses generates an alpha of 97 basis points per month ( $t$ -statistic = 2.99). Since this portfolio includes only bad news stocks, it loads negatively on a news factor. Similar spreads can be constructed across different overhang quintiles and news stocks.

Table VII reports factors loadings for the 3-month rolling strategy. The portfolios have similar market and size exposure. High capital gains stocks of either

Table VII

### Three Factors Time-Series Regressions: Alphas and Factor Loadings

This table reports Fama and French (1993) three-factor loadings and alphas for the overhang spread and the negative overhang spread strategy. The dependent variable is the monthly excess return of the Treasury bill rate from the rolling strategy. The explanatory variables are the monthly returns from Fama and French (1993) mimicking portfolios. The holding period for the rolling strategy is 3 months. Alphas are in monthly percent,  $t$ -statistics are shown below the coefficient estimates, and 5% statistical significance is indicated in bold.

	Overhang Spread			Negative Overhang Spread		
	Bad News	Good News	L/S	Bad News	Good News	L/S
$\alpha(\%)$	<b>-1.129</b> (-3.51)	<b>1.304</b> (9.56)	<b>2.433</b> (6.60)	-0.245 (-1.61)	-0.152 (-0.57)	0.092 (0.28)
<i>MKT</i>	<b>1.216</b> (14.76)	<b>1.064</b> (30.47)	-0.152 (-1.61)	<b>1.038</b> (26.75)	<b>1.164</b> (16.91)	0.126 (1.49)
<i>SMB</i>	<b>1.002</b> (9.78)	<b>0.833</b> (19.18)	-0.169 (-1.44)	<b>0.772</b> (16.01)	<b>1.000</b> (11.69)	<b>0.228</b> (2.17)
<i>HML</i>	-0.011 (-0.09)	<b>-0.115</b> (-2.25)	-0.104 (-0.75)	-0.107 (-1.87)	0.150 (1.49)	<b>0.257</b> (2.07)
$R^2$	0.656	0.895	0.018	0.864	0.699	0.026

news type are slightly more concentrated on growth stocks. The intercepts of the overhang spread are particularly eye catching ( $-1.129\%$  and  $1.304\%$ ). These large alphas stem from the fact that the bad news portfolio has persistently low returns, even though it is tilted toward small stocks, which would tend to raise expected returns. The second portfolio has higher returns but a negative loading on *HML*, which, ceteris paribus, should decrease expected returns. None of the factor loadings is significant for the long–short overhang spread, which is consistent with returns being driven by underreaction to the initial news content, rather than reflecting systematic risk. Separating high overhang stocks has the effect of exacerbating the PEAD anomaly, since it allows for a substantial increase in returns with respect to a standard PEAD long–short strategy while maintaining a market-neutral risk profile.

## V. Liquidity, Size, and Trading Costs

Post-event price drift is consistent with a world in which firm-specific information diffuses only gradually across the investing public, and market participants only partially extrapolate information from prices. A priori, we would expect the drift to be most severe in stocks for which price discovery is likely to be sluggish, such as small stocks.<sup>16</sup>

In a recent paper, Lesmonda, Schill, and Zhouc (2004) argue that momentum strategies require frequent trading in disproportionately high cost securities, such that trading costs prevent profitable strategy execution.<sup>17</sup> Trading frictions associated with small or illiquid stocks may explain why the drift appears to persist, but they cannot explain why it arises in the first place. To realize the overhang spread returns, the relevant investor must fully open and close both the long and the short positions. Thus, the execution requires paying the full spread and incurring the commissions, fees, and costs associated with price impact on four trades.

Since trading costs vary according to firm size, I break the sample into size quintiles and compare the returns of the overhang strategy to the trading costs associated with executing these positions.<sup>18</sup> Since portfolios are equally weighted, round-trip trading costs are also equally weighted.

Trading costs estimates are as follows: For each stock in the TAQ database, I obtain trades and quotes for a randomly selected day in each calendar month and I compute the average direct effective spread and commission on that trading day. Monthly firm estimates are then computed using 12 monthly estimates obtained prior to inclusion in the portfolio. I use the standard approach to compute the effective spread as twice the absolute trading price deviation from the

<sup>16</sup> Hong, Lim, and Stein (2000) show that momentum profits are larger for stocks with low analyst coverage and for smaller stocks, once stocks in the lowest NYSE-size quintile are excluded from the sample. This result is consistent with underreaction caused by slow diffusion of information, as proxied by firm size or analyst coverage.

<sup>17</sup> Their analysis focuses on price, not earnings momentum.

<sup>18</sup> I use NYSE breakpoints.

bid-ask midpoint. I use a combination of price and tick tests to infer trade direction.<sup>19</sup> The trade is classified as buyer initiated or seller initiated, respectively, if the trade price is above or below the quote midpoint. If the trade occurred at the midpoint, then the effective spread is zero.

To compute commissions for each trade, I use a discount brokerage schedule from CIGNA financial services.<sup>20</sup> Since TAQ data are available only between 1993 and 2002, I assume that the average effective spread plus commissions in the latter part of the sample period is a reasonable estimate for the period 1980 to 1992.<sup>21</sup>

I set a minimum liquidity threshold by disallowing trading in stocks with a closing price below \$3 at the end of the previous month. This ensures that both the returns and the trading costs estimates are not contaminated by illiquid micro cap securities.

Table VIII reports results for the overhang spread portfolios across size quintiles. For each portfolio, I report the Fama–French alpha, the average turnover, the average trading cost, and the maximum trading cost. The latter is defined as the round-trip trading cost necessary to eliminate the abnormal return, given the portfolio turnover. The *t*-statistic tests the hypothesis that average trading costs exceed the maximum threshold. Last, I report the alpha net of trading costs and the average net semiannual buy-and-hold return. I use the actual monthly turnover to compute the time series of net returns.

The results strongly confirm the previous findings: Stock prices underreact to bad news when more current holders are facing a capital loss, and underreact to good news when more current holders are facing a capital gain. Abnormal returns of the overhang spread portfolios are statistically significant and economically large across all the size subsamples, and as conjectured, they tend to be larger for small stocks, for which information asymmetries are more likely to be pronounced.

<sup>19</sup> Lee and Ready (1991).

<sup>20</sup> This is the same schedule used by Lesmonda, Schill, and Zhouc (2004). The commission schedule is subject to a \$38 overriding minimum. Commissions are then as follows:

Dollar Volume (V)		Commissions
\$0	– 2,500	\$29+1.70% V
2,500.01	– 6,250	55+0.66% V
6,250.01	– 20,000	75+0.34% V
20,000.01	– 50,000	99+0.22% V
50,000.01	– 500,000	154+0.11% V
500,000	+	254+0.09% V

Since NASDAQ securities are reported in the TAQ database on a net basis, with commissions embedded into the reported trade price, the use of the commission schedule may overstate the true commission costs for those securities. The commissions are also high with respect to the rates available in the most recent part of the sample period.

<sup>21</sup> Lesmonda et al. (2004) provide evidence that this assumption is a fairly reasonable one.



Dropping low-priced stocks increases the magnitude of the drift, due to the fact that micro cap stocks tend to exhibit reversals induced by supply shocks. None of the alphas of the negative overhang spread portfolios (not reported) is significantly different from zero.

Furthermore, the trading costs associated with these positions do not prevent profitable strategy execution. The baseline overhang spread portfolio delivers net monthly alphas of 0.885% and 1.062% depending on the holding period of the underlying rolling strategy. On a net basis, returns are higher for the 6-month strategy,<sup>22</sup> as the lower turnover more than compensates the reduction in returns with respect to the 3-month strategy. The 6-month overhang strategy delivers semiannual buy-and-hold returns between 1.7% and 6%, which is a significant achievement given the fact that these are zero-beta returns. Taking small stocks into account has two conflicting effects on the net alpha: On the one hand, the price discovery is more sluggish; on the other hand, the transaction costs are higher.<sup>23</sup> This explains why the highest net returns are found for midsize stocks.

An extensive battery of additional robustness tests is reported in the Appendix. All the results tell a consistent story, namely, signed overhang predicts subsequent returns. The post-event drift is larger when the news and the capital gains overhang have the same sign: Bad (good) news travels slowly among negative (positive) overhang stocks, generating post-event return predictability.

## VI. Conclusion

This paper suggests that the disposition effect can induce underreaction to news, leading to return predictability and post-announcement price drift. The price pattern depends on both the information content of the news and the investor's reference price relative to the current price. In particular, bad news travels slowly among stocks trading at large capital losses, in turn leading to a negative price drift; similarly, good news travels slowly among stocks trading at large capital gains, in turn leading to a positive price drift. This paper provides a test of this hypothesis.

I propose a new method to compute a measure of the aggregate basis for individual stocks that relies on holdings data. I use a database of mutual funds holdings to construct a measure of reference prices for individual stocks. I then use the gain (loss) to construct a test of stock price underreaction to news.

The calendar-time rolling method used in the portfolio approach allows for a straightforward test and controls for cross-correlation among event stocks, which tends to invalidate inference in event studies performed in event time. The focus here is on short-term underreaction. Hence, the asset pricing model misspecification problem, typical of long-term event studies, is less likely to be an issue. The methodology also allows for an interpretation of the testing

<sup>22</sup> This implies fully opening and closing both the long and the short positions every two quarters.

<sup>23</sup> In the lowest-size quintile, the net abnormal return of the 3-month portfolio is equal to zero due to the large trading costs and the high turnover of this portfolio.

procedure as an executable investment strategy whose risk profile and performance can be assessed using simple time-series regressions.

The results show that because investors initially underreact to news announcements, stocks with large unrealized capital gains have higher subsequent returns, thereby generating a predictable price drift.

The post-event predictability is most severe where the disposition effect predicts the largest underreaction. Post-event drift is larger when the news and the overhang have the same sign, and the magnitude of the post-earnings announcement drift is directly related to the amount of unrealized capital gains (losses) experienced by the stock holders at the event date.

Stocks with large unrealized capital gains underreact to, and only to, positive news, while stocks with large unrealized capital losses underreact to, and only to, negative news. These findings are consistent with a world in which trading frictions, captured by the capital gains overhang, impede a speedy transmission of information to stock prices via price impact.

Capital gains will predict returns under alternative hypotheses that do not rely on the disposition effect. Suppose that the overhang is simply a measure of the holding period of the stock holders, that is, some stocks have "loyal" holders who sell very rarely. Since, on average, stock prices increase over time, stocks with loyal holders will have large unrealized gains. Since loyal holders are slow to react to signals, it may take a while for the market to incorporate good news, thereby generating post-event drift.

Another alternative hypothesis is that because some stocks have low turnover and are generally illiquid, they have loyal holders. Since lower than average turnover and positive historical returns means high overhang stocks, overhang will be negatively correlated with turnover and positively correlated with size. This is consistent with the empirical findings reported in Subsection B. Small and illiquid stocks react less to good news since they react less to any news, as they do not trade often. In this world, residual overhang will be a better predictor of returns than raw overhang.

Finally, since reference prices are share weighted, there is the possibility that capital gains capture disagreement about a stock. In the presence of short sale constraints, stocks with greater disagreement have lower expected returns.<sup>24</sup>

Although it is possible that the capital gains overhang captures liquidity-related factors, none of the hypotheses above can explain the asymmetry in the price response to news: Return predictability is most severe when capital gains and the event have the same sign. Stocks with large unrealized gains underreact to good news, and to good news only, and stocks with large unrealized losses only underreact to negative news. Overhang is not just a proxy for liquidity since the response is in one direction for positive news, and a different direction for negative news.

This asymmetric pattern is consistent with the disposition effect because the latter predicts signed order flows as a function of the difference between the current and the reference prices. When facing a capital loss, disposition

<sup>24</sup> Miller (1977).

investors are reluctant to realize the loss, thereby generating underreaction to negative news. Similarly, their active selling prevents a stock price from rising immediately to its new level on positive news announcements. As a result, post-event risk-adjusted returns can be achieved by using a sort on the capital gains overhang, suggesting that such a variable predicts the gradual market response to new information.

## Appendix

### *A. Mutual Fund Ownership and Index Funds*

Capital gains are meant to be the best estimate of the stock's cost basis to the representative investor. Since reference prices are constructed using mutual fund holdings, it is plausible for this measure to be more relevant for stocks mostly held by mutual funds, and less relevant for stocks mostly held by retail investors. I address this issue by splitting the sample into stocks with high and low mutual fund ownership, where ownership is defined as the percentage of shares held by mutual funds. I use the median ownership at the end of the previous month as the breakpoint. The results in Table A1 show that separating stocks by mutual fund ownership has little effect on the magnitude of the overhang spread. The difference in returns between the overhang and the negative overhang spreads is large and significant for both groups of stocks.

This result is consistent with the cross-section of mutual fund managers' capital gains being a good approximation of the cross-section of gains experienced by all shareholders. To further test this hypothesis, I run an additional robustness test. Suppose, we can identify a subset of managers that, a priori, are known not to be prone to the disposition effect. The cross-section of gains and losses for this subset of managers should not provide any information to identify stocks that will underreact to news.<sup>25</sup> Such a class is easy to identify, namely, index funds. Index funds and exchange traded funds (ETFs) cannot be prone to the disposition effect since their holdings are driven by the index composition. Therefore, I compute the capital gains overhang using only holdings of index funds and ETFs, and I construct the two main test assets. If the presence of disposition managers is driving the results in Tables V and VI, then, restricting the sample to index funds only, we should not be able to detect a difference in returns between the overhang spread and the negative overhang spread. Rather, we should observe a mean news effect (i.e., the standard univariate PEAD, bad (good) news stocks should have lower (higher) subsequent returns), but the second sort on capital gains should be close to a sort on pure noise. The evidence in Table A1 confirms this intuition. Separating stocks using index funds' capital gains does not generate systematic differences in returns. The overhang spread and the negative overhang spread earn similar risk-adjusted returns, close to 60 basis point per month.

<sup>25</sup> I would like to thank Toby Moskowitz for suggesting this test.

**Table A1**  
**Robustness Checks**

This table reports Fama and French (1993) three-factor alphas for the three-month overhang spread and the negative overhang spread. Panels A and B report results for subsamples based on mutual funds ownership. The breakpoint is the median ownership at the end of the previous month. Panel C reports results for capital gains constructed using index funds and ETFs only. Panels D and E report results for a turnover-based overhang. The fraction number of shares purchased at date  $t - n$  still held by the original purchasers at date  $t$  is computed as  $V_{t,t-n} = TO_{t-n} \cdot \prod_{\tau=0}^{n-1} (1 - TO_{t-n+\tau})$ , where  $TO_t$  is turnover in month  $t$ . Panel F reports characteristics-adjusted returns using a single control firm matched on size, book-to-market, and price momentum. Panel G reports results for portfolios constructed using standardized unexpected earnings (SUE) as measure of earnings news.  $SUE = (e - e_{-4})/\sigma$ , where  $e$  is the most recent quarterly earnings per share as of month  $t$ ,  $e_{t-4}$  is the earnings per share four quarters before month  $t$ , and  $\sigma$  is the standard deviation of unexpected earnings  $e_t - e_{t-4}$  over the preceding eight quarters. Panel H reports results for strategies constructed using analysts' recommendations revisions. The news variable is the event-day return around the most recent date on which a change in analysts' recommendations occurred. Alphas are in monthly percent,  $t$ -statistics are shown below the coefficient estimates, and 5% statistical significance is indicated in bold.

		Overhang Spread			Negative Overhang Spread		
		Bad News	Good News	L/S	Bad News	Good News	L/S
A	Low mutual fund ownership	<b>-1.098</b> (-2.95)	<b>1.337</b> (8.16)	<b>2.435</b> (6.28)	-0.284 (0.03)	0.010 (-1.59)	0.275 (0.85)
B	High mutual fund ownership	<b>-1.083</b> (-3.88)	<b>1.202</b> (8.33)	<b>2.284</b> (6.49)	-0.083 (-0.87)	-0.222 (-0.55)	-0.140 (-0.42)
C	Only index funds	<b>-0.293</b> (-2.43)	0.348 (1.45)	<b>0.641</b> (2.70)	<b>-0.285</b> (-2.56)	<b>0.313</b> (1.99)	<b>0.599</b> (2.81)
D	Turnover-based gains, 1963-1979	<b>-1.014</b> (-2.61)	<b>1.533</b> (5.48)	<b>2.547</b> (5.01)	0.202 (0.58)	0.213 (0.69)	0.012 (0.03)
E	Turnover-based gains, 1980-2003	<b>-0.559</b> (-2.36)	<b>1.361</b> (7.40)	<b>1.920</b> (4.79)	-0.141 (0.93)	0.299 (-0.75)	0.440 (1.67)
F	Characteristics matched returns	<b>-0.920</b> (-4.30)	<b>0.931</b> (3.32)	<b>1.851</b> (5.60)	0.011 (0.90)	-0.014 (-0.04)	-0.025 (-0.04)
G	Standardized unexpected earnings	<b>-0.672</b> (-2.52)	<b>1.066</b> (8.28)	<b>1.738</b> (5.26)	-0.049 (0.99)	0.278 (-0.27)	0.339 (0.97)
H	Analysts' revisions	<b>-1.568</b> (-2.07)	<b>1.193</b> (3.43)	<b>2.761</b> (2.84)	0.159 (-0.95)	-0.652 (0.53)	-0.811 (-1.01)

### B. Out-of-Sample Evidence

Using holdings limits analysis to the period 1980 to 2002, for which mutual fund data are available, and relies on the assumption that mutual fund managers are a random sample of the population of shareholders. I repeat the analysis by splitting the sample into the two subperiods, 1962 to 1979 and 1980 to 2002, and I use the turnover-based measure of overhang proposed by Grinblatt and Han (2005). The number of shares purchased at date  $t - n$  that are still held by the original purchasers at date  $t$  is computed as

$$\hat{V}_{t,t-n} = TO_{t-n} \left[ \prod_{\tau=1}^{n-1} (1 - TO_{t-n+\tau}) \right], \quad (\text{A1})$$

where  $TO_t$  is turnover in month  $t$ . The reference price is estimated as before using

$$RP_t = \phi^{-1} \sum_{n=0}^t \hat{V}_{t,t-n} P_{t-n}. \quad (\text{A2})$$

This measure has the following interpretation. If a stock had high turnover a year ago, but volume has been very low ever since, then most of the current holders probably bought the stock a year ago, so we can use the past year's price as a proxy for the purchase price. Similarly, if a stock had high turnover in the past month, most investors probably bought it recently, so we can use last month's average or closing price as a proxy for the purchase price. More precisely, suppose that turnover ratios correspond to trading probabilities. Then  $\hat{V}_{t,t-n}$  is equal to the probability that a share is traded at date  $t - n$  and never traded again up to date  $t$ . Hence,  $\hat{V}_{t,t-n}$  is equal to the probability that the reference price is equal to the price at  $t - n$ . Averaging over all possible reference prices gives the estimated cost basis for the market. Results in Table A1 are consistent with the previous findings: Stocks with large unrealized gains (losses) severely underreact to positive (negative) news. Not surprisingly, in the overlapping period 1980 to 2002, abnormal returns are lower and more volatile (lower  $t$ -statistic) with respect to the holdings measure. Using holdings allows one to directly measure, for each stock, the typical capital gain or loss for an investor in that stock. Hence, we expect this proxy to provide a more efficient estimator of aggregate capital gains than volume.

### *C. Characteristics-Adjusted Returns*

Daniel and Titman (1998a, 1998b) suggest that characteristics can be better predictors of future returns than factor loadings. I follow Barber and Lyon (1997) and measure abnormal returns comparing the return of event stocks to that of a single control stock. First, using conditional sorts and NYSE breakpoints, all stocks in the sample are assigned to one of 125 ( $5 \times 5 \times 5$ ) characteristics portfolios based on size, book to market (B/M), and returns in previous 12 months. To find a match for a given sample stock, all the non-event stocks in the same characteristics portfolio are ranked based on the difference between the sample stock and the matching stock on each characteristic. Ranks are summed across the different characteristics, and the lowest rank is selected as the matching stock. The match is maintained until the next event or the delisting date. If a match becomes unavailable at a given point, either because of delisting or because it has an earnings announcement, then from that point forward, it is replaced by the second-lowest-ranked stock. This procedure ensures that there is no look-ahead bias. I subtract the size-, B/M-, and momentum-matched returns from stock returns and then calculate calendar-time rolling returns as before. Results in Table A1 confirm that even after controlling for past returns, security prices tend to underreact to public news and

the magnitude of such post-event drift is indeed predictable by the signed overhang. The overhang spread portfolio consistently earns higher risk-adjusted returns than the negative overhang spread portfolio.

#### *D. Standardized Unexpected Earnings*

Using returns around the most recent event day provides a clean and easy way to measure earnings surprises since it does not require a model for expected earnings. Nevertheless, it may also have some drawbacks. Event-day returns only capture changes over a window of a few days of the market's view about earnings. On the other hand, an accounting-based measure of earnings news incorporates information up to the last quarter, and hence should reflect earnings surprises over a longer period. Jegadeesh et al. (1996) show that different measures of earnings surprises may have low correlation, suggesting that different surprise definitions may capture different aspects of the market's expectation of earnings releases. I use standardized unexpected earnings defined as  $sue_t = (e_t - e_{t-4})/\sigma$ , where  $e_t$  is the most recent quarterly earnings per share as of month  $t$ ,  $e_{t-4}$  is the earnings per share four quarters before month  $t$ , and  $\sigma$  is the standard deviation of unexpected earnings ( $e_t - e_{t-4}$ ) over the preceding eight quarters. The results in Table A1 are strikingly similar to the previous findings: Bad (good) news travels slowly among negative (positive) overhang stocks, thereby generating post-event return predictability. The lower magnitude of the drift may be due to the fact that strategies based on accounting surprises and market impact exploit market underreaction to separate pieces of information embedded in different news proxies.

#### *E. Analysts' Stock Recommendation Revisions*

The underreaction hypothesis is not specific to earnings announcements but can be applied to any situation in which firm specific information is released. I use an additional long-short strategy that mimics the most recent changes in analysts' stock recommendations. Analysts' recommendation revisions have been found to have predictive power for future stock returns.<sup>26</sup> In particular, upgraded stocks outperform downgraded stocks, implying that stock prices do not adjust immediately to a recommendation revision. Brokers' and analysts' recommendations are from the I/B/E/S database. The Recommendations Detail file contains analysts' ratings for a particular company: Each recommendation is assigned a numeric value and mapped to one of the I/B/E/S standard ratings from 1 (strong buy) to 5 (sell). I use the I/B/E/S rating code to compute changes in recommendations for each analyst following a particular stock, since the most recent recorded value. Analysts' revisions' event days are defined as the trading days on which at least one revision occurs. The data run from January 1993 to December 2002. The news proxy is the market model cumulative abnormal returns around the most recent revision date. Results in Table A1 confirm the

<sup>26</sup> See Womack (1996) and more recently Jegadeesh et al. (2004).

previous findings: The overhang spread portfolio displays price drift following analysts' recommendation changes.

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