# A NAV a Day Keeps the Inefficiency Away? Fund Trading Strategies using Daily Values

J. Christopher Hughen*
Department of Finance
College of Business Administration
Bowling Green State University
Bowling Green, OH 43403
Phone: (419) 372-9341
Fax: (707) 281-2482
e-mail: chughen@cba.bgsu.edu

Prem G. Mathew
Department of Finance and Management Science
University of Saskatchewan
25 Campus Drive
Saskatoon, SK S7N 5A7
Phone: (306) 966-8427
Fax: (306) 966-2515
email: mathew@commerce.usask.ca

Kent P. Ragan
Department of Finance and General Business
Southwest Missouri State University
901 S. National Avenue
Springfield, MO 65804
Phone: (417) 836-5580
Fax: (417) 836-6224
e-mail: kentragan@smsu.edu

JEL Classification: G110; G140
Key Words: Closed-End Funds; Market Efficiency; Trading Strategies

*Corresponding author

# A NAV a Day Keeps the Inefficiency Away? Fund Trading Strategies using Daily Values


ABSTRACT

Previous research documents the value of closed-end fund trading rules based on the size of the weekly discount. The growing number of closed-end funds that provide daily net asset value data provides an opportunity to test the profitability of short-term fund trading strategies. We find that short-term trading strategies that purchase fund shares after large negative discount changes are profitable, on average, even when transaction costs are incorporated. However, strategies that short sell fund shares after large positive discount changes do not produce an average profit. The limited amount of trading in closed-end funds may make it difficult to achieve short-term profits from discount fluctuations.

## 1. Introduction

Individual investors are the primary owners of closed-end fund shares. These investors are frequently attracted to closed-end funds because shares in these investment companies trade at prices that are different from their net asset values, or NAVs.[1] Furthermore, the differences between the prices and values fluctuate significantly over time. Previous research shows that trading strategies designed to benefit from the mean reversion in closed-end fund discounts can yield excess returns.

Thompson (1978), Richards, Fraser and Groth (1980), and Anderson (1986) conduct the seminal research suggesting that portfolios of closed-end funds trading at large discounts earn abnormal returns. Later analyses show that such trading strategies can earn profits in excess of transaction costs (Cakici, Tessitore, and Usmen (2000); Anderson, Coleman and Born (2001)). Other studies document that returns can be improved by forming portfolios that require less frequent rebalancing or that own a higher percentage of larger discount funds (Cakici, Tessitore and Usmen (2002); Sias (1997)). All of the closed-end fund trading strategies analyzed in published research are based on weekly NAVs and are intended to profit from discount changes over long periods.

While mutual funds and unit investment trusts generally must disclose their NAV every business day, closed-end funds are exempt from this requirement because these funds are not obligated to repurchase their shares at NAV.[2] This is consistent with the intended use of the closed-end fund vehicle for investments in illiquid assets. Closed-end funds have historically released NAVs on a weekly basis.[3] However, many funds are voluntarily altering the frequency at which they disclose portfolio values, and some now release NAVs on a daily basis in the same manner as mutual funds.

The main goal of this paper is to examine whether daily NAV information can form the basis of a profitable short-term trading strategy. As individual investors own the majority of the outstanding closed-end fund shares, our analysis will reveal whether these investors should be following daily NAV fluctuations closely when trading these funds.[4] In other words, do fund prices reflect daily NAV changes within the bounds of transaction costs?

## 2. Literature Review

A number of studies examine the ability of investors to exploit closed-end fund discounts. In his seminal work, Thompson (1978) uses monthly return data and yearly discount data on 23 funds to evaluate returns from simple trading strategies. He finds that closed-end funds trading at a discount tend to outperform the market and concludes that the existence of profitable trading strategies could represent market inefficiencies. Malkiel and Firstenberg (1978) also offer support for the idea that closed-end funds discounts represent a market inefficiency. Richards, Fraser and Groth (1980) extend this research by using weekly price and distribution data to evaluate a number of trading rules and filter rules. These trading rules buy and sell funds based on specific discount levels, while filter rules determine when funds should be bought or sold using percentage changes in fund prices. They find that the trading rule strategies produce returns in excess of a buy-and-hold strategy and that purchasing at larger discounts provides greater returns. Their analysis of filter rules indicates that larger (smaller) filters generate substantial gains (losses). While examining the profitability of these strategies in other time periods, Anderson (1986) finds that strategies using specific buy and sell points provide higher returns than buy-and-hold strategies, but filter rules do not provide excess returns.

Recent research incorporates transaction costs into the analysis of fund trading strategies. Cakici, Tessitore and Usmen (2000) estimate these expenses using the product of the actual turnover and a transaction cost rate (0 - 4%). They find that accounting for transaction costs is crucial in evaluating the performance of strategies. Specifically, when transaction costs are low, long portfolios with deep discounts and frequent rebalancing outperform the benchmark whereas when transaction costs are moderate or high, short portfolios with high premiums and less frequent rebalancing provide the greatest returns. Anderson, Coleman and Born (2001) evaluate an extensive number of trading strategies by incorporating transaction costs, which are assumed to be between 1 and 3%. Their study reveals that with low transaction costs, narrow-span strategies provide the greatest returns, where the span is the difference between the buy and sell point of a particular strategy. However, when transaction costs are high, narrow-span strategies generate negative abnormal returns. The common result across these studies is that there appears to be mean reversion of CEF discounts.

Another line of research on trading strategies seeks to determine the optimal weights for a portfolio of closed-end funds. Earlier studies in this area use strategies that either equally weight or linearly discount weight the funds included in their portfolios. Sias (1997) evaluates non-linear methods of weighting, and Cakici, Tessitore and Usmen (2002) extend their previous analysis by using an endogenously determined weighting scheme.

In contrast to previous research that uses weekly NAV data, this study uses daily NAV data to provide insight into the short-term relation between prices and underlying values for closed-end funds. We first examine short-term fund returns following large discount changes. Then we investigate the profitability of the simplest short-term fund trading strategy: buy following a large negative discount change and sell short after a large positive discount change.

## 3. Data

The sample consists of 24 closed-end funds that release daily net asset values, and these funds are listed in Table 1. The date on which each fund begins providing daily NAVs is shown in the final column in the table. The sample period for each fund begins when the fund starts releasing daily NAVs and ends on April 25, 2003. The one exception is Bergstrom Capital Corporation. Stockholders of this fund approved a liquidating distribution in April 2003, and this fund's data are excluded from the sample after April 10, 2003. Only one fund in our sample (the Salomon Brothers Fund) was the target of a publicized attempt at open-ending. As the associated shareholder proposal was overwhelmingly defeated at the 2003 shareholder's meeting, our results are largely unaffected by open-endings.[5]

Since the funds in our sample voluntarily choose to provide daily NAVs when other funds provide only weekly NAVs, we are curious as to how the characteristics of the funds in our sample differ from the entire population of funds. Those in our sample may have portfolios that are relatively easy to value and less likely to contain illiquid securities. This relates to several papers that examine the determinants of closed-end fund discounts. Malkiel (1977) performs a cross-sectional regression analysis that shows the percentage of the portfolio invested in restricted stock is a statistically significant determinant of the fund's discount. However, Lee, Shleifer, and Thaler (1991) argue that illiquid stocks are not the main cause of discounts by pointing out that many funds invest in only liquid securities and still trade at substantial discounts. As many closed-end funds that invest in bonds and real estate still release daily NAVs, the liquidity of a fund's holdings is unlikely the primary driver behind the release of more frequent portfolio data.

Each of the funds in the sample meets two requirements. The first requirement is that the fund be classified as either a general equity fund or a specialized equity fund by *The Wall Street Journal*. The domestic equity funds are the focus of this analysis because previous studies conclude that the discounts on these funds fluctuate significantly. The second requirement is that the fund has at least one year of historical daily NAV data available through the Nasdaq Mutual Fund Quotation System (MFQS) as of April 25, 2003.

To be included in its Mutual Fund Quotation System, Nasdaq charges funds a one-time application fee of $325 and an annual fee of $400 for the News Media List or an annual fee of $275 for the Supplemental List. Data on funds in the News Media List are available on Nasdaq's Level I data feed service, and the NAVs of these funds may be included in national newspapers. Closed-end funds are required to have $60 million in assets to be included on this list, and they must keep at least $30 million in assets to remain on the list. Data for funds on the Supplemental List are only available via Nasdaq's Level I data feed service. To be included in the Supplemental List, funds need at least $10 million in assets or two full years of operations. The ticker symbol for the NAV of a closed-end fund is five letters, and it starts and ends with X. The middle three letters are typically similar to the ticker symbol for the fund shares.

The sample contains 30,797 daily observations. Historical NAVs come from CDA/Wiesenberger and MSN Money. Transaction prices and trading volume are from The Center for Research in Security Prices (CRSP) and Yahoo! Finance. A small number of the NAVs (36 NAVs, or 0.12% of the sample) are unavailable from MSN Money, Lycos Finance, or Yahoo! Finance. Assuming each missing NAV equals the last previously available NAV, none of the missing observations have discount changes that are 3% or more in absolute value.

Table 2 describes the trading activity in the funds during the sample period. The prices and NAVs show considerable cross-sectional variation. During the sample period, Bergstrom Capital Corporation has the highest NAV of $300.82, and the Blue Chip Value Fund has the lowest closing price ($3.88). Daily share volume ranges from 3,295,500 shares to 0, but half of the observations have volume between 12,600 and 84,300.

The median discount is around 9%, and the shares close at a price near or above the NAV in about 25% of the days in the sample. The daily change in the discount equals the discount for a particular day minus the discount for the previous trading day. A negative discount change indicates that the price has fallen relative to the NAV. This includes situations where a fund is trading at a discount and the price moves farther away from NAV, and situations where a fund is trading at a premium and the price moves closer to NAV. While the daily discount change is between 0.69% and -0.67% in half of the observations, the sample contains some surprisingly large discount changes.

**4. Results**

To examine whether daily NAV information can form the basis of a profitable short-term trading strategy, we first investigate how fund share prices react to large discount fluctuations. The $98^{th}$ and $2^{nd}$ percentiles for the discount changes are 2.94% and -2.94%, respectively. Thus, we classify a large discount change as one that is greater than 3% in absolute value. Next, we examine the trading after such changes.

*4.1. Returns after large discount changes*

Table 3 shows the mean returns on fund shares after discount changes (labeled D Δ) less than -3%. In our sample, there are 581 instances of such large negative discount changes. The average fund return on the day following a large negative change (day 1) is 0.37%. This is calculated as the percentage change from the opening price on day 1 to the closing price on day 1. The NAV information used to calculate a discount change is not available until after the market closes for trading. Therefore, the opening price is used to calculate the day 1 return to provide an accurate indication of the return that an investor could achieve after observing the discount change. With a p-value less than 0.01, the Student's t-test rejects the hypothesis that the return on day 1 equals 0%.

The mean share price returns are also provided for days 2 through 7, and these returns are calculated using the closing prices on the previous trading day. The returns for days 1 to 5 are all positive and statistically significant. The average return on these days is 0.30%. The positive trend in average fund prices ends after five trading days. While the mean return on day 6 is positive (0.04%), it is not statistically different from zero (p-value = 0.69 for a two-tailed test). Also, the mean return on day 7 is negative.

The market-adjusted return equals the return on the fund shares minus the return on the S&P 500 Index.[6] For discount changes less than -3%, the average difference between the fund return and market return is positive for the 6 days following the large discount change, but the mean is only significantly different from zero in 4 of these 6 days. Whether measured on a raw return or a market-adjusted return basis, closed-end funds prices exhibit mean reversion over the five trading days following large daily discount increases.

The average returns are also provided for the NAV following large discount changes. Out of the seven days following discount declines of more than 3%, the NAV has a positive and statistically significant return in three days (days 3 – 5). This contrasts with the findings of Pontiff (1995), who uses the monthly data from 1965 to 1985 to examine the relation between returns and discounts. He finds that the abnormal returns from funds trading at large discounts are generated from mean reversion in the discounts, not in the portfolio values. In examining this mean reversion, he concludes that about half of the discounts on 49 funds are nonstationary over a 25-month period. Pontiff further asserts that discounts may be nonstationary over the short-term even though they are stationary over the long-term. This provides further motivation for our study of whether trading strategies in closed-end funds, which have been found to be valuable over the long-run, can be profitable over the short-run.

One possible explanation is associated with investor psychology. As discount levels are often interpreted as a measure of market sentiment, a large discount change can be a signal of an extreme swing towards optimism or pessimism by investors that soon moderates to some extent. While the mean NAV return is positive and statistically significant for three days, the mean market-adjusted return is not positive and statistically significant in any of the seven days following a large negative discount change. This indicates that both the S&P 500 index and the fund portfolios are experiencing positive returns during the five trading days following these events.

To investigate whether the fund returns are even higher following larger discount changes, we examine the price reactions to discount changes less than -4% and -5%. The middle section of Table 3 provides statistics on the trading following discount changes of less than -4% (N = 232). The mean returns in the first five trading days are generally positive and statistically

significant. A comparison of changes less than -3% to those less than -4% reveals the average returns are higher in three of these five days for the discount declines of greater magnitude. The mean market-adjusted return is particularly large for day 1 (0.50%), and the means are positive and significant for days 1 and 4. While the mean NAV returns tend to be positive, only the return on day 3 is statistically significant. None of the market-adjusted NAV returns are significant.

For a discount change less than -5% (N=108), the mean returns are positive for the first six days but only one day has a statistically significant return (day 3 with a p-value = 0.02). None of the market-adjusted returns are statistically significant. In four of the first five trading days, the mean returns are lower for changes less than -5% than for those less than -4%. This indicates that the returns from pursuing a short-term trading strategy will not increase as the magnitude of the discount change that triggers trading increases.

Next, we examine large positive discount changes, and Table 4 provides statistics on fund prices after these events. Out of the first five trading days following a discount change exceeding 3%, the mean fund price return is negative in four days. However, the average return on day 1 (-0.36%) is the only return that is significantly different from zero (p-value < 0.01). The fund performance during this period is much worse when viewed on a relative basis. The mean market-adjusted price return is negative for all seven days following a large positive discount change, and the negative price change is statistically significant in three of the first four trading days. The mean NAV return does not exhibit statistically significant performance in the first three days following a large change, but the mean market-adjusted NAV return for day 1 (0.10%) is statistically significant. The data is consistent with short-term mean reversion in fund prices following a large positive discount change.

For the 219 occurrences of a discount change greater than 4%, the mean share price returns and market-adjusted returns are similar to the returns for changes above 3% in terms of both magnitude and statistical significance. As shown in the bottom section of Table 4, the mean share price returns are even closer to 0% for the discount changes above 5% (N = 83). Furthermore, the data suggest that there is no meaningful trend in mean market-adjusted price returns, mean NAV returns, or mean market-adjusted NAV returns following changes above 5%. We conclude that that post-change returns do not increase in magnitude following larger daily discount changes.

*4.2. Large discount changes and discount levels*

Previous research indicates that the level of the discount is related to future closed-end fund returns (Thompson (1978); Richards, Fraser and Groth (1980); Anderson (1986); Pontiff (1995); Sias (1997)). Therefore, we examine fund returns after large discount changes at various discount levels.

Table 5 shows the results for large negative discount changes when the discount (labeled D) is less than -10%. A cutoff of -10% is used since this is approximately the median discount for the sample. For the 183 discount changes less than -3%, the mean fund returns in the first two trading days are quite large (0.81% for day 1 and 0.31% for day 2). Without the restriction on the discount level, the mean return for days 1 and 2 (as shown in Table 3) are 0.37% and 0.28%. The mean NAV return and mean market-adjusted NAV returns are not statistically significant in the first two days following a large negative discount change at a high discount level. This suggests the fund returns are emanating from mean reversion in the discount rather than from gains in the fund's portfolio value. The middle and lower sections of Table 5 show that the Day 1 returns for

discount changes below -4% and -5% are also surprisingly high. The mean fund return on day 1 is 1.27% (p-value = 0.03) for discount changes less than -4%, and 1.04% (p-value = 0.34) for discount changes less than -5%.

Table 6 provides the statistics for large positive discount changes when the discount is above -5%. The mean return for days 1, 2 and 3 are -0.57%, -0.37%, and -0.31%, respectively; these are all statistically significant at the 0.01 level. When there is no restriction on the discount level, the returns are lower for days 1 through 3 (-0.36%, -0.15%, and -0.10% as shown in the top of Table 4). For the 143 instances where the discount changes by more than 4% when the level is greater than -5% (shown in the middle section of Table 6), the mean return is the same as the Day 1 return for increases more than 3%, but the day 2 and 3 returns are lower (-0.50% and -0.39%, respectively). There are only 54 instances of a discount change of more than 5% when the discount is greater than -5%. The mean share price return for day 2 (-0.62%) is the only return that is statistically significant in the seven trading days following the discount change.

*4.3. Trading volume and discount changes*

In order to successfully implement a trading strategy based on large daily discount changes, the market for closed-end fund shares needs sufficient liquidity. One measure of liquidity is the daily dollar volume, which equals the number of shares traded times the closing price per share. Table 7 provides statistics on the dollar volume for the days around a large discount change.

The first section of the table shows the trading information for discount changes of less than -3%. The mean dollar volume for the day of the discount change is $1,000,800, and this average declines for each of the five days after the discount change. The first chance that an

investor has to trade on the discount change information is Day 1, which has a mean dollar volume of $813,600. However, the dollar volume on day 1 is less than $55,800 for 10% of the instances of large negative changes. This indicates that it would be difficult to implement trades of large size without adversely affecting the transaction price. Furthermore, in one instance of a large negative discount change, there is no trading volume on Day 1. For days 2 – 5, there are at least two instances of zero daily trading volume for each day.

The bottom section of Table 7 provides a description of the trading around large positive discount changes. In general, there is less trading around large positive discount changes than large negative discount changes. The mean dollar volume for day 0 is $912,700 and this declines to $776,800 for day 1, the day when traders could actually execute trades in response to the discount change. Out of the 576 large positive discount changes in our sample, there is at least one instance of zero trading volume on each of the five trading days following day 0. Again, the data on trading volume indicate that implementing a short-term trading strategy based on large discount changes would be challenging due to the lack of trading in some of the closed-end funds.

*4.4. Profitability analysis of short-term trading strategies*

If discounts exhibit short-term mean reversion, a successful trading strategy may be to purchase fund shares after a large negative discount change, which occurs when the share price falls relative to the NAV. Another possible profitable strategy is to short a fund after a large positive change in the discount. This occurs when the share price increases relative to NAV.

While Tables 3 – 6 show abnormal returns after large discount changes, they do not indicate whether these returns would exceed the transaction costs of implementing a trading

strategy to profit from daily discount changes. Therefore, we calculate the profit from buying fund shares after large negative discount changes and from short selling fund shares after large positive discount changes. Profits are computed assuming that a trader initiates a position at the opening price on day 1 and closes the position at the closing price on day 5. Positions are closed on day 5 because the mean share price returns are statistically significant out to day 5 in the top and middle sections of Table 3. Transaction costs include the bid-ask spread and a $10 commission charged when a position is initiated and closed. The initial trade has a value of $10,000.

Estimates of the spread for each fund are based on bid and ask quotes observed at 3:00 PM on January 15, 2003. The spread is expressed as a percentage of the ask price for long positions and a percentage of the bid price for short positions; the same relative bid-ask spread for each fund is used to compute the profit over the entire sample period. For long positions, the bid-ask spread has an average of 0.72% and ranges from 0.13% to 1.73%. For short positions, the mean is 0.73% and the range is from 0.13% to 1.76%. These estimates of the bid-ask spread likely underestimate the true cost of implementing a trading strategy based on short-term discount changes. Such changes will tend to occur around information events and shifts in sentiment. The specialist's costs may be impacted by higher inventory and asymmetric information cost, and this would likely result in a higher bid-ask spread.

Table 8 presents statistics on the profit generated by various strategies. The mean, median, $75^{th}$ percentile, and $25^{th}$ percentile of the returns are provided. The percentage of trades that are profitable is provided under the columns labeled % > 0. The p-value of the Student's t-test that the mean is zero is found under the columns labeled P>|t|.

The statistics in Panel A are estimated over the entire sample period. The first row describes the profit generated by buying shares after a discount change less than -3%. Only 48.7% of the 581 trades from this strategy are profitable. The median profit is -0.11% and the mean profit is 0.39%. The Student's t-test indicates the mean is statistically different from zero (p-value = 0.06). While the trading strategy generates an average profit, we would be hesitant to pursue this strategy because the majority of trades are unprofitable.

Rows 2 – 5 in Panel A examine whether the strategy of buying after a large discount change can be improved upon by using a different trigger. The second row describes a strategy of buying shares after a discount change less than -3% that occurs when the NAV increases by 1.5%. As the composition of a closed-end fund's portfolio is not exactly known, changes in the NAV, which is released after the market closes, can be unexpected. Is it more profitable to exploit negative discount changes driven by an increase in the NAV? The data indicates that it is only marginally more profitable since the mean return increases from 0.39% to 0.44%. We also consider a trading strategy based on large negative changes that occur at a discount of less than -10%. This is the most profitable strategy as the mean return over five trading days is 0.70%. Using larger discount change triggers of -4% and -5% (rows 4 and 5) produces average profits of 0.57% and 0.36%, respectively.

Rows 6 – 10 in Panel A describe the profitability of trading strategies that short closed-end fund shares after large positive changes in the discount. A negative number for the profitability of a short-selling strategy implies that it loses money. Row 6, which is labeled "D $\Delta$ > 3%," shows that shorting funds after discount changes of more than 3% does not generally produce gains; the mean and median profits after five trading days are -0.59% and -0.67%, respectively. Only 42.5% of these trades are profitable after reflecting transaction costs. A

strategy that goes short only after positive discount changes that are driven by NAV changes generates a smaller loss (mean profit = -0.12%), but 45.5% of the trades are still unprofitable. The only profitable strategy involving short selling that we uncovered is to only short funds that experience large discount increases when the discount is greater than -5%. This has a mean profit of 0.06% but it is not statistically different from 0%. The final two rows in the table show that even positive changes of larger magnitude do not deliver an average profit. We conclude that short-term strategies that attempt to profit from large positive discount changes are detrimental to your financial health.

There are two issues that are important to understanding why the market for fund shares does not quickly react to large positive discount changes. First, the short selling of closed-end funds is relatively difficult because the largest lenders of shares are custody banks that act as agents for institutional owners. Since institutional ownership of closed-end funds is low, borrowing shares may be a constraint that prevents investors from quickly pushing down prices after positive discount changes. In support of this argument, D'Avolio (2002) finds that 55% of the cross-sectional variation in the loan supply for short selling is explained by institutional ownership, which is concentrated in large stocks.

Another issue that helps to explain why fund prices do not quickly fall after large positive discount increases is that closed-end funds tend to trade at discounts. The essence of arbitrage is to buy at a low price and sell at a higher price. As it applies to this situation, investors may be reluctant to sell fund shares even after large positive discount changes as the shares still trade at prices below NAVs. As a test of this explanation, we examine the profitability of short selling fund shares after discount changes greater than 3% that occur when the fund trades at a premium. The mean profit after transaction costs is 0.04% in the 286 instances in our sample. While this

profit is miniscule, it exceeds the mean loss of 0.59% for shorting following all discount changes greater than 3%.

We next examine the robustness of our results. One possible concern about our study is that a fund enters our sample when it starts releasing daily NAVs. Since funds choose different dates on which to implement this policy, some funds have more observations in our sample than other funds. The funds with greater weights in the sample may be driving our findings. Another concern is whether the switch to pricing securities in decimals affects our results. The large daily discount fluctuations may be an artifact of fractional prices and the resulting higher bid-ask spreads.

To address these concerns, Panel B of Table 8 presents the profitability analysis for the period after the funds in our sample started trading in decimals.[7] Of the ten trading strategy triggers that are examined in Table 8, eight have a higher mean profit over the post-decimalization sample period than in the entire sample period. The data are not consistent with the change to decimal pricing lowering the general profitability of the trading strategies examined in this paper.

Furthermore, decimalization does not appear to have reduced the occurrence of large discount changes. For the entire sample, large discount changes occur in 3.76% of the observations. In the post-decimalization sample period, 4.17% of the observations have large discount changes. Therefore, large daily discount changes occurred more frequently in our sample period after decimalization had been fully implemented.

As a further check of the robustness of our results, we examine whether our findings are related to abnormal trading that follows initial public offerings (IPOs). Weiss (1989) finds that closed-end funds have an average market-adjusted return of -15.05% in the 120 trading

following an IPO. She also finds that funds generally trade at a premium soon after their offerings, but these funds trade at an average discount of -10.02% after 24 weeks following their IPOs. Peavy (1990) analyzes the 100 trading days following closed-end funds, and he also finds significant negative returns. Hanley, Lee and Seguin (1996) extend the initial research on this issue by documenting large transaction imbalances and underwriter stabilization in the first 100 days of trading after closed-end fund IPOs.

Our sample contains five funds with observations that are within 168 days of the fund's inception date as shown in the CDA/Wiesenberger database. We eliminated the observations within 168 days after the fund starts and conducted a profitability analysis identical to that shown in Table 8. For the 570 occurrences of a discount change less than -3% in the reduced sample, the mean profit generated from purchasing fund shares is 0.37%. This is similar to the mean profit of 0.39% in the full sample. For the 567 occurrences of a discount change greater than 3% in the reduced sample, the mean profit generated from short selling fund shares is -0.60%, which is slightly less than the mean profit of -0.59% for the full sample. As the profitability analysis results are not significantly changed by expunging the observations near the IPO, we conclude that the abnormal returns around fund IPOs are not causing our results.

## 5. Conclusions

The increasing availability of daily NAVs for closed-end funds provides an exciting opportunity for investors to track the prices of these funds relative to their underlying values. Our analysis indicates that fund shares provide positive market-adjusted returns after large negative daily discount changes. The mean daily return for the five trading days after a discount change less than -3% is 0.30%. The mean returns are even larger for large negative discount returns that

occur when the discount is below -10%. The mean return on the day after such a change is 0.81%. Also, fund shares experience negative market-adjusted returns after large positive discount changes when the discount is greater than -5%.

We examine the profitability of short-term fund trading strategies that buy shares after large negative discount changes and short shares after large positive discount changes. Even after accounting for transaction costs, the strategies that buy shares are profitable on average. In particular the strategy of purchasing funds after large negative discount changes when the discount is large generates an average profit of 0.70% over five trading days. However, the majority of trades are not profitable. The trading strategies that short funds following large discount increases generally do not provide profits on average. Our study finds that the lack of liquidity of closed-end funds is likely an impediment to implementing short-term trading strategies based on large discount changes.

While our study is not intended to encourage individual investors to engage in short-term trading strategies, our findings do suggest that frequent investors in closed-end funds pay attention to daily discount fluctuations. We provide evidence that prices may not immediately reflect daily NAV changes within the bounds of transaction costs. As large discount changes occur in 3.76% of the observations in our sample, the data suggest that the average fund will experience about 9.4 large discount changes per year. At the end of 2003, 130 closed-end equity funds were traded in the U.S. (Investment Company Institute (2004)), so one can expect about 1,222 large discount changes in these funds per year. As the average equity fund has about $400 million in assets, a 3% change in its value is equivalent to about $12 million. These large daily discount changes are of sufficient economic significance to be important to the individual investors that own the funds.

**Notes**

[1] The NAV equals the total market value of the securities in the fund's portfolio divided by the number of shares outstanding. When the fund price is less (more) than the NAV, the fund is trading at a discount (premium). The discount (if negative) or premium (if positive) equals the difference between the closing price and NAV divided by the NAV.

[2] For a description of this requirement, see SEC Rule 22c-1 (Pricing of Redeemable Securities for Distribution, Redemption and Repurchase) adopted under the Investment Company Act of 1940.

[3] SEC Rule 23c-3 (Repurchase Offers by Closed-End Companies) adopted under the Investment Company Act of 1940 outlines the conditions under which closed-end funds need to calculate NAVs on at least a weekly basis when repurchasing securities of which it is the issuer.

[4] While individual investors own most of the closed-end fund shares in the United States, this is not the case in all countries. Elroy and Minio-Kozerski (1999) state that closed-end funds in the United Kingdom are primarily owned by institutional investors.

[5] An open-ending occurs when a closed-end fund is converted to a mutual fund, which is required to accept buy and sell orders only at NAV. Brauer (1984) and Brickley and Schallheim (1985) find that open-ending announcements are not immediately reflected in the prices of closed-end funds. The abnormal returns associated with open-endings could potentially affect our results. We used LexisNexis to search for the name of each closed-end fund and "open-end" over our sample period. Only one related event was discovered. A proposal to open-end the

Salomon Brothers Fund was defeated by 77.3% of those shareholders voting in the 2003 shareholders meeting.

[6] We include the market-adjusted returns as a check for the robustness of main results. Our calculation of this return measure assumes a beta of 1. This may not be the case of all of the funds in our sample since some are sector and real estate funds. Sharpe and Sosin (1975) find closed-end fund shares have considerable variation in their betas.

[7] The NYSE completed its conversion to decimal pricing on January 29, 2001; all stocks on the Nasdaq and American Stock Exchange started trading in decimals on April 9, 2001. Therefore, our post-decimalization sample period starts on April 9, 2001 and ends on April 25, 2003.

**References**


Anderson, S. C., Coleman, B. J., & Born, J. A. (2001). A closer look at trading strategies for U.S. equity closed-end investment companies. *Financial Services Review*, 10 (1-4), 237-248.

Anderson, S. C. (1986). Closed-end funds versus market efficiency. *Journal of Portfolio Management*, 13 (1), 50-55.

Brauer, G. A. (1984). 'Open-ending' closed-end funds. *Journal of Financial Economics*, 13 (4) 491-507.

Brickley, J. A. & Schallheim, J. S. (1985). Lifting the lid on closed-end investment companies: A case of abnormal returns. *Journal of Financial and Quantitative Analysis*, 20 (1), 107-117.

Cakici, N., Tessitore, A., & Usmen, N. (2000). Closed-end equity funds: Betting on discounts and premiums. *Journal of Investing*, 9 (4), 83-92.

Cakici, N., Tessitore, A., and Usmen, N. (2002). Closed-end funds and turnover restrictions. *Financial Analysts Journal*, 58 (3), 74-81.

D'Avolio, G. (2002). The market for borrowing stock. *Journal of Financial Economics*, 66 (2), 271-306.

Elroy, D. & Minio-Kozerski, C. (1999). Closed-end funds: A survey. *Financial Markets, Institutions, and Instruments*, 8 (2), 1-41.

Hanley, K. W., Lee, C. M. C. & Seguin, P. J. (1996). The marketing of closed-end fund IPOs: Evidence from transactions data. *Journal of Financial Intermediation*, 5 (2), 127-159.

Investment Company Institute (2004). Closed-end fund assets, fourth quarter 2003. Available at: www.ici.org/stats/ce/index.html. Accessed April 2004.

Lee, C. M. C., Shleifer, A. & Thaler, R. H. (1991). Investor sentiment and the closed-end fund puzzle. *Journal of Finance*, 46 (1), 75-109.

Malkiel, B. G. (1977). The valuation of closed-end investment-company shares. *Journal of Finance*, 32 (3), 847-859.

Malkiel, B. G. & Firstenberg, P. (1978). A winning strategy for an efficient market. *Journal of Portfolio Management*, 4 (4), 20-25.

Peavy, J. W., III (1990). Returns on initial public offerings of closed-end funds. *Review of Financial Studies*, 3 (4), 695-708.

Pontiff, J. (1995). Closed-end fund premia and returns: Implications for financial market equilibrium. *Journal of Financial Economics*, 37 (3), 341-370.

Richards, R. M., Fraser, D. R. & Groth, J. C. (1980). Winning strategies for closed-end funds. *Journal of Portfolio Management*, 7 (1), 50-55.

Sias, R. W. (1997). Optimum trading strategies for closed-end funds. *Journal of Investing*, 6 (1), 54-61.

Sharpe, W. F. & Sosin, H. B. (1975). Closed-end investment companies in the United States. *Proceedings of the European Finance Association*, 37-63.

Thompson, R. (1978). The information of discounts and premiums on closed-end fund shares. *Journal of Financial Economics*, 6 (1), 151-186.

Weiss, K. (1989). The post-offering price performance of closed-end funds. *Financial Management*, 18 (3), 57-67.

Table 1
Sample Description

| Closed-End Fund | Fund Symbol | NAV Symbol | Start of Daily NAV Data |
|---|---|---|---|
| Adams Express Company | ADX | XADEX | 08/15/97 |
| Alliance All-Market Advantage Fund | AMO | XAMOX | 10/14/97 |
| Bergstrom Capital Corporation | BEM | XBEMX | 05/26/99 |
| Blue Chip Value Fund | BLU | XBLUX | 09/05/97 |
| Cohen & Steers Advantage Income Realty Fund | RLF | XRLFX | 06/12/01 |
| Cohen & Steers Quality Income Realty Fund | RQI | XRQIX | 03/12/02 |
| Cohen & Steers Total Return Realty Fund | RFI | XRFIX | 03/06/98 |
| Gabelli Equity Trust | GAB | XGABX | 07/11/97 |
| Gabelli Global Multimedia Trust | GGT | XGGTX | 07/11/97 |
| Gabelli Utility Trust | GUT | XGUTX | 07/12/99 |
| General American Investors | GAM | XGAMX | 10/04/96 |
| John Hancock Bank & Thrift Opportunity Fund | BTO | XBTOX | 12/01/94 |
| John Hancock Financial Trends | JHFT | XSTBX | 04/12/96 |
| Liberty All-Star Equity Fund | USA | XUSAX | 10/17/97 |
| Liberty All-Star Growth Fund | ASG | XASGX | 10/17/97 |
| Nuveen Real Estate Income Fund | JRS | XJRSX | 02/25/02 |
| Petroleum & Resources Corporation | PEO | XPEOX | 10/22/97 |
| Royce Focus Trust | FUND | XFUNX | 02/25/97 |
| Royce Micro-Cap Trust | OTCM | XOTCX | 10/11/96 |
| Royce Value Trust | RVT | XRVTX | 10/11/96 |
| Salomon Brothers Fund | SBF | XSBFX | 09/19/01 |
| Source Capital | SOR | XSORX | 12/12/97 |
| Tri-Continental Corporation | TY | XTYCX | 08/09/96 |
| Zweig Fund | ZF | XZFGX | 08/15/97 |

This table shows the 24 closed-end funds analyzed in this study. The Fund Symbol is the unique ticker symbol used for trading the shares in a particular fund. The NAV symbol is used to report the per share value of the fund's portfolio. The final column provides the date when each fund started releasing daily NAV data, and this also represents the date when the fund entered the sample for this study.

Table 2
Descriptive Statistics

| Variable | Maximum | 75th Percentile | 50th Percentile | 25th Percentile | Minimum | Standard Deviation |
|---|---|---|---|---|---|---|
| NAV | 300.82 | 28.26 | 13.99 | 10.30 | 4.22 | 34.654 |
| Price | 272 | 24.87 | 13.18 | 9.63 | 3.88 | 32.33 |
| Share Volume | 3,295,500 | 84,300 | 34,400 | 12,600 | 0 | 103,093 |
| Discount | 58.56% | 0.00% | -8.91% | -14.45% | -27.42% | 10.88% |
| Discount Change | 11.84% | 0.69% | 0.00% | -0.67% | -15.82% | 1.34% |
| Fund Price Change | 17.68% | 0.80% | 0.00% | -0.74% | -12.47% | 1.55% |
| NAV Change | 9.49% | 0.67% | 0.00% | -0.62% | -10.24% | 1.26% |

This table describes the trading and values of the 24 closed-end funds during the sample period. A discount is represented as a negative number when the price is less than the NAV.

Table 3
Fund Returns after Large Negative Discount Changes

| Discount Change | | Day 1 | Day 2 | Day 3 | Day 4 | Day 5 | Day 6 | Day 7 |
|---|---|---|---|---|---|---|---|---|
| D Δ < -3% | Mean Share Price Return | 0.37% | 0.28% | 0.32% | 0.25% | 0.30% | 0.04% | -0.03% |
| N = 581 | | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.69 | 0.70 |
| | Mean Market-Adjusted Price Return | 0.25% | 0.28% | 0.03% | 0.17% | 0.20% | 0.02% | -0.06% |
| | | 0.02 | 0.00 | 0.73 | 0.04 | 0.02 | 0.83 | 0.49 |
| | Mean NAV Return | 0.08% | -0.01% | 0.21% | 0.14% | 0.14% | -0.02% | 0.01% |
| | | 0.32 | 0.86 | 0.00 | 0.04 | 0.04 | 0.81 | 0.82 |
| | Mean Market-Adjusted NAV Return | -0.05% | -0.01% | -0.08% | 0.06% | 0.04% | -0.04% | -0.01% |
| | | 0.32 | 0.79 | 0.06 | 0.19 | 0.29 | 0.39 | 0.82 |
| D Δ < -4% | Mean Share Price Return | 0.41% | 0.26% | 0.42% | 0.30% | 0.29% | 0.17% | -0.12% |
| N = 232 | | 0.04 | 0.13 | 0.01 | 0.04 | 0.06 | 0.28 | 0.41 |
| | Mean Market-Adjusted Price Return | 0.50% | 0.20% | -0.03% | 0.23% | 0.15% | 0.16% | -0.16% |
| | | 0.01 | 0.20 | 0.83 | 0.09 | 0.31 | 0.25 | 0.28 |
| | Mean NAV Return | -0.20% | 0.08% | 0.34% | 0.17% | 0.13% | 0.03% | 0.00% |
| | | 0.12 | 0.51 | 0.00 | 0.14 | 0.24 | 0.82 | 0.96 |
| | Mean Market-Adjusted NAV Return | -0.10% | 0.01% | -0.11% | 0.09% | -0.01% | 0.03% | -0.03% |
| | | 0.30 | 0.87 | 0.14 | 0.22 | 0.89 | 0.69 | 0.67 |
| D Δ < -5% | Mean Share Price Return | 0.36% | 0.19% | 0.65% | 0.19% | 0.10% | 0.22% | -0.16% |
| N = 108 | | 0.31 | 0.51 | 0.02 | 0.43 | 0.66 | 0.40 | 0.47 |
| | Mean Market-Adjusted Price Return | 0.23% | 0.03% | 0.11% | 0.25% | -0.13% | 0.20% | -0.06% |
| | | 0.46 | 0.89 | 0.66 | 0.23 | 0.53 | 0.38 | 0.80 |
| | Mean NAV Return | -0.13% | 0.13% | 0.44% | -0.01% | 0.17% | -0.06% | -0.08% |
| | | 0.51 | 0.47 | 0.01 | 0.95 | 0.32 | 0.76 | 0.64 |
| | Mean Market-Adjusted NAV Return | -0.25% | -0.03% | -0.10% | 0.05% | -0.06% | -0.08% | 0.02% |
| | | 0.09 | 0.73 | 0.35 | 0.69 | 0.54 | 0.36 | 0.88 |

This table summarizes the returns on fund shares after large negative changes in the discount (occurring on day 0). The share price return on day 1 equals the percentage difference between the opening and closing prices on that day. All other returns are calculated using the closing price from the previous trading day. Statistics are provided for changes of less than -3%, -4%, and -5%. The total number of changes in each category (N) is provided in the first column. The market-adjusted return is the fund share return minus the return on the S&P 500 index. The p-values, which are shown below the mean returns, are for a two-sided Student's t-test that the mean equals zero.

Table 4
Fund Returns after Large Positive Discount Changes

| Discount Change | | Day 1 | Day 2 | Day 3 | Day 4 | Day 5 | Day 6 | Day 7 |
|---|---|---|---|---|---|---|---|---|
| D Δ > 3% | Mean Share Price Return | -0.36% | -0.15% | -0.10% | 0.08% | -0.04% | 0.01% | 0.11% |
| N = 576 | | 0.00 | 0.14 | 0.27 | 0.40 | 0.69 | 0.94 | 0.20 |
| | Mean Market-Adjusted Price Return | -0.33% | -0.19% | -0.14% | -0.19% | -0.14% | -0.03% | -0.06% |
| | | 0.00 | 0.04 | 0.13 | 0.04 | 0.12 | 0.69 | 0.50 |
| | Mean NAV Return | 0.06% | 0.08% | 0.03% | 0.22% | 0.11% | -0.01% | 0.19% |
| | | 0.42 | 0.26 | 0.70 | 0.00 | 0.06 | 0.86 | 0.00 |
| | Mean Market-Adjusted NAV Return | 0.10% | 0.04% | -0.01% | -0.04% | 0.01% | -0.05% | 0.02% |
| | | 0.05 | 0.39 | 0.84 | 0.29 | 0.89 | 0.22 | 0.58 |
| D Δ > 4% | Mean Share Price Return | -0.37% | -0.28% | -0.19% | 0.21% | -0.08% | 0.15% | -0.01% |
| N = 219 | | 0.02 | 0.10 | 0.20 | 0.20 | 0.62 | 0.28 | 0.97 |
| | Mean Market-Adjusted Price Return | -0.34% | -0.18% | -0.41% | -0.27% | -0.26% | -0.01% | -0.08% |
| | | 0.04 | 0.27 | 0.01 | 0.09 | 0.12 | 0.95 | 0.54 |
| | Mean NAV Return | 0.14% | 0.01% | 0.09% | 0.38% | 0.15% | 0.08% | 0.10% |
| | | 0.31 | 0.95 | 0.43 | 0.00 | 0.13 | 0.47 | 0.35 |
| | Mean Market-Adjusted NAV Return | 0.17% | 0.11% | -0.14% | -0.10% | -0.03% | -0.08% | 0.02% |
| | | 0.06 | 0.17 | 0.06 | 0.15 | 0.67 | 0.27 | 0.75 |
| D Δ > 5% | Mean Share Price Return | -0.31% | -0.51% | 0.17% | 0.22% | -0.48% | -0.02% | -0.09% |
| N = 83 | | 0.26 | 0.10 | 0.54 | 0.48 | 0.13 | 0.93 | 0.74 |
| | Mean Market-Adjusted Price Return | -0.18% | -0.10% | -0.01% | -0.57% | -0.49% | -0.13% | -0.17% |
| | | 0.52 | 0.73 | 0.97 | 0.04 | 0.12 | 0.59 | 0.44 |
| | Mean NAV Return | 0.04% | -0.17% | -0.13% | 0.71% | -0.06% | -0.11% | 0.20% |
| | | 0.87 | 0.31 | 0.54 | 0.00 | 0.65 | 0.56 | 0.24 |
| | Mean Market-Adjusted NAV Return | 0.16% | 0.23% | -0.31% | -0.07% | -0.08% | -0.21% | 0.12% |
| | | 0.39 | 0.08 | 0.02 | 0.60 | 0.51 | 0.12 | 0.29 |

This table summarizes the returns on fund shares after large positive changes in the discount (occurring on day 0). The share price return on day 1 equals the percentage difference between the opening and closing prices on that day. All other returns are calculated using the closing price from the previous trading day. Statistics are provided for changes of greater than 3%, 4%, and 5%. The total number of changes in each category (N) is provided in the first column. The market-adjusted return is the fund share return minus the return on the S&P 500 index. The p-values, which are shown below the mean returns, are for a two-sided Student's t-test that the mean equals zero.

Table 5
Fund Returns after Large Negative Discount Changes that Occur When the Discount is Large

| Discount Change | | Day 1 | Day 2 | Day 3 | Day 4 | Day 5 | Day 6 | Day 7 |
|---|---|---|---|---|---|---|---|---|
| DΔ < -3% | Mean Share Price Return | 0.81% | 0.31% | 0.23% | 0.32% | 0.43% | -0.19% | 0.01% |
| & D < -10% | | 0.00 | 0.09 | 0.23 | 0.04 | 0.02 | 0.29 | 0.96 |
| N = 183 | Mean Market-Adjusted Price Return | 0.50% | 0.31% | -0.02% | 0.07% | 0.36% | -0.22% | 0.05% |
| | | 0.04 | 0.05 | 0.90 | 0.63 | 0.04 | 0.22 | 0.76 |
| | Mean NAV Return | 0.08% | -0.02% | 0.26% | 0.22% | 0.13% | -0.11% | 0.06% |
| | | 0.53 | 0.86 | 0.03 | 0.04 | 0.26 | 0.31 | 0.54 |
| | Mean Market-Adjusted NAV Return | -0.23% | -0.02% | 0.02% | -0.03% | 0.06% | -0.14% | 0.10% |
| | | 0.02 | 0.79 | 0.85 | 0.72 | 0.43 | 0.08 | 0.20 |
| D Δ < -4% | Mean Share Price Return | 1.27% | 0.54% | -0.27% | 0.35% | 0.43% | -0.42% | -0.39% |
| & D < -10% | | 0.03 | 0.15 | 0.45 | 0.17 | 0.18 | 0.23 | 0.26 |
| N = 61 | Mean Market-Adjusted Price Return | 1.19% | 0.62% | -0.34% | 0.02% | 0.48% | -0.39% | -0.33% |
| | | 0.02 | 0.07 | 0.31 | 0.94 | 0.14 | 0.24 | 0.29 |
| | Mean NAV Return | -0.28% | -0.08% | 0.17% | 0.26% | -0.13% | -0.30% | -0.02% |
| | | 0.25 | 0.67 | 0.48 | 0.23 | 0.50 | 0.13 | 0.90 |
| | Mean Market-Adjusted NAV Return | -0.36% | 0.00% | 0.10% | -0.07% | -0.07% | -0.28% | 0.03% |
| | | 0.12 | 0.97 | 0.55 | 0.70 | 0.64 | 0.03 | 0.83 |
| D Δ < -5% | Mean Share Price Return | 1.04% | 0.06% | -0.14% | 0.38% | 0.35% | -0.78% | 0.03% |
| & D < -10% | | 0.34 | 0.92 | 0.80 | 0.37 | 0.41 | 0.16 | 0.94 |
| N = 29 | Mean Market-Adjusted Price Return | 0.97% | 0.39% | -0.23% | 0.15% | 0.25% | -0.65% | 0.10% |
| | | 0.30 | 0.44 | 0.66 | 0.72 | 0.54 | 0.19 | 0.81 |
| | Mean NAV Return | -0.32% | -0.19% | 0.34% | 0.02% | -0.13% | -0.49% | -0.01% |
| | | 0.37 | 0.50 | 0.35 | 0.96 | 0.67 | 0.11 | 0.98 |
| | Mean Market-Adjusted NAV Return | -0.39% | 0.14% | 0.26% | -0.21% | -0.23% | -0.36% | 0.05% |
| | | 0.31 | 0.41 | 0.24 | 0.47 | 0.35 | 0.05 | 0.84 |

This table summarizes the returns on fund shares after large negative changes in the discount (occurring on day 0) when the discount is less than -10%. The share price return on day 1 equals the percentage difference between the opening and closing prices on that day. All other returns are calculated using the closing price from the previous trading day. Statistics are provided for changes less than -3%, -4%, and -5%. The total number of changes in each category (N) is provided in the first column. The market-adjusted return is the fund share return minus the return on the S&P 500 index. The p-values, which are shown below the mean returns, are for a two-sided Student's t-test that the mean equals zero.

Table 6
Fund Returns after Large Positive Discount Changes that Occur When the Discount is Small

| Discount Change | | Day 1 | Day 2 | Day 3 | Day 4 | Day 5 | Day 6 | Day 7 |
|---|---|---|---|---|---|---|---|---|
| D Δ > 3% | Mean Share Price Return | -0.57% | -0.37% | -0.31% | 0.01% | 0.14% | 0.15% | 0.21% |
| & D > -5% | | 0.00 | 0.00 | 0.00 | 0.93 | 0.22 | 0.13 | 0.05 |
| N = 351 | Mean Market-Adjusted Price Return | -0.57% | -0.31% | -0.27% | -0.28% | -0.04% | 0.02% | 0.01% |
| | | 0.00 | 0.01 | 0.01 | 0.01 | 0.73 | 0.81 | 0.95 |
| | Mean NAV Return | 0.11% | 0.00% | -0.03% | 0.26% | 0.19% | 0.08% | 0.21% |
| | | 0.28 | 0.96 | 0.72 | 0.00 | 0.02 | 0.32 | 0.02 |
| | Mean Market-Adjusted NAV Return | 0.11% | 0.07% | 0.00% | -0.04% | 0.02% | -0.04% | 0.00% |
| | | 0.08 | 0.22 | 0.93 | 0.50 | 0.73 | 0.48 | 0.93 |
| D Δ > 4% | Mean Share Price Return | -0.57% | -0.50% | -0.39% | 0.10% | 0.22% | 0.36% | 0.05% |
| & D > -5% | | 0.00 | 0.02 | 0.03 | 0.59 | 0.25 | 0.02 | 0.73 |
| N = 143 | Mean Market-Adjusted Price Return | -0.49% | -0.40% | -0.54% | -0.46% | 0.03% | 0.07% | -0.09% |
| | | 0.02 | 0.03 | 0.00 | 0.01 | 0.86 | 0.68 | 0.57 |
| | Mean NAV Return | 0.18% | -0.02% | 0.12% | 0.46% | 0.14% | 0.25% | 0.09% |
| | | 0.31 | 0.89 | 0.45 | 0.00 | 0.27 | 0.07 | 0.50 |
| | Mean Market-Adjusted NAV Return | 0.26% | 0.08% | -0.03% | -0.10% | -0.05% | -0.04% | -0.05% |
| | | 0.02 | 0.41 | 0.69 | 0.28 | 0.57 | 0.61 | 0.60 |
| D Δ > 5% | Mean Share Price Return | -0.24% | -0.62% | -0.02% | 0.04% | -0.03% | 0.28% | 0.12% |
| & D > -5% | | 0.46 | 0.09 | 0.95 | 0.91 | 0.94 | 0.32 | 0.68 |
| N = 54 | Mean Market-Adjusted Price Return | -0.19% | -0.31% | -0.05% | -0.85% | 0.12% | -0.02% | -0.13% |
| | | 0.56 | 0.33 | 0.89 | 0.01 | 0.72 | 0.94 | 0.62 |
| | Mean NAV Return | 0.36% | 0.00% | -0.18% | 0.90% | -0.24% | 0.23% | 0.36% |
| | | 0.29 | 0.99 | 0.49 | 0.00 | 0.19 | 0.26 | 0.12 |
| | Mean Market-Adjusted NAV Return | 0.41% | 0.32% | -0.21% | 0.01% | -0.10% | -0.07% | 0.10% |
| | | 0.09 | 0.08 | 0.13 | 0.94 | 0.46 | 0.61 | 0.49 |

This table summarizes the returns on fund shares after large positive changes in the discount (occurring on day 0) when the discount is greater than -5%. The share price return on day 1 equals the percentage difference between the opening and closing prices on that day. All other returns are calculated using the closing price from the previous trading day. Statistics are provided for changes greater than 3%, 4%, and 5%. The total number of changes in each category (N) is provided in the first column. The market-adjusted return is the fund share return minus the return on the S&P 500 index. The p-values, which are shown below the mean returns, are for a two-sided Student's t-test that the mean equals zero.

Table 7
Descriptive Statistics on Dollar Volume (in $1,000s) around Large Discount Changes

| | Day -2 | Day -1 | Day 0 | Day 1 | Day 2 | Day 3 | Day 4 | Day 5 |
|---|---|---|---|---|---|---|---|---|
| Discount Change < -3% | | | | | | | | |
| 90th Percentile | 1,788.5 | 1,639.1 | 2,464.0 | 2,023.1 | 1,732.4 | 1,646.5 | 1,608.2 | 1,476.7 |
| 75th Percentile | 762.0 | 760.2 | 995.3 | 862.9 | 744.9 | 762.9 | 669.7 | 673.5 |
| Mean | 756.7 | 755.3 | 1,000.8 | 813.6 | 733.0 | 655.7 | 645.9 | 636.4 |
| 50th Percentile | 283.5 | 291.2 | 395.7 | 324.5 | 294.5 | 268.2 | 275.6 | 258.2 |
| 25th Percentile | 131.0 | 146.9 | 171.9 | 147.3 | 139.0 | 131.0 | 130.1 | 127.1 |
| 10th Percentile | 54.5 | 65.0 | 66.1 | 55.8 | 60.0 | 53.7 | 47.0 | 56.0 |
| # of Days Volume = 0 | 5 | 5 | 0 | 1 | 4 | 2 | 2 | 3 |
| | | | | | | | | |
| Discount Change > 3% | | | | | | | | |
| 90th Percentile | 1,645.3 | 1,661.0 | 2,091.0 | 1,781.3 | 1,482.3 | 1,582.7 | 1,572.1 | 1,406.6 |
| 75th Percentile | 650.8 | 711.3 | 930.6 | 765.0 | 656.9 | 642.6 | 655.1 | 667.1 |
| Mean | 649.2 | 704.5 | 912.7 | 776.8 | 681.9 | 653.0 | 647.1 | 616.9 |
| 50th Percentile | 269.7 | 270.7 | 340.3 | 283.8 | 262.5 | 265.5 | 265.7 | 261.7 |
| 25th Percentile | 138.2 | 125.8 | 163.4 | 145.4 | 126.0 | 129.0 | 116.5 | 122.5 |
| 10th Percentile | 60.5 | 50.9 | 72.9 | 58.6 | 52.3 | 49.2 | 52.9 | 60.5 |
| # of Days Volume = 0 | 5 | 3 | 0 | 1 | 2 | 1 | 1 | 2 |

This table provides descriptive statistics on dollar volume around large positive and negative discount changes. The dollar volume for each day (shown in thousands of dollars) equals the number of shares traded times the closing price.

Table 8
Profitability Analysis Reflecting Transaction Costs

| Trigger for Trading Strategy | N | % > 0 | 75th Percentile | 25th Percentile | Median | Mean | P>\|t\| |
|---|---|---|---|---|---|---|---|
| Panel A: Entire Sample Period | | | | | | | |
| D Δ < -3% | 581 | 48.7% | 2.50% | -2.47% | -0.11% | 0.39% | 0.06 |
| D Δ < -3% & NAV Δ > 1.5% | 182 | 49.5% | 2.32% | -2.07% | -0.09% | 0.44% | 0.15 |
| D Δ < -3% & D < -10% | 183 | 48.1% | 2.70% | -2.92% | -0.43% | 0.70% | 0.09 |
| D Δ < -4% | 232 | 47.8% | 2.69% | -2.75% | -0.09% | 0.57% | 0.11 |
| D Δ < -5% | 108 | 49.1% | 3.90% | -3.50% | -0.07% | 0.36% | 0.56 |
| D Δ > 3% | 576 | 42.5% | 1.74% | -3.05% | -0.67% | -0.59% | 0.00 |
| D Δ > 3% & NAV Δ < -1.5% | 191 | 45.5% | 2.43% | -2.92% | -0.33% | -0.12% | 0.68 |
| D Δ > 3% & D ≥-5% | 351 | 45.9% | 2.29% | -2.29% | -0.24% | 0.06% | 0.81 |
| D Δ > 4% | 219 | 41.6% | 2.16% | -3.16% | -0.77% | -0.48% | 0.12 |
| D Δ > 5% | 83 | 51.8% | 2.80% | -3.15% | 0.19% | -0.19% | 0.73 |
| Panel B: Post-Decimalization Sample Period | | | | | | | |
| D Δ < -3% | 255 | 50.6% | 3.12% | -2.59% | 0.03% | 0.57% | 0.09 |
| D Δ < -3% & NAV Δ > 1.5% | 82 | 51.2% | 3.12% | -2.43% | 0.08% | 0.70% | 0.17 |
| D Δ < -3% & D < -10% | 35 | 42.9% | 4.00% | -3.45% | -1.28% | 0.55% | 0.60 |
| D Δ < -4% | 108 | 47.2% | 3.08% | -2.90% | -0.09% | 0.69% | 0.18 |
| D Δ < -5% | 55 | 52.7% | 5.17% | -3.09% | 0.59% | 1.05% | 0.20 |
| D Δ > 3% | 232 | 43.1% | 2.23% | -2.82% | -0.44% | -0.15% | 0.63 |
| D Δ > 3% & NAV Δ < -1.5% | 84 | 46.4% | 3.47% | -2.40% | -0.21% | 0.44% | 0.42 |
| D Δ > 3% & D ≥-5% | 186 | 45.2% | 2.43% | -2.12% | -0.24% | 0.14% | 0.69 |
| D Δ > 4% | 91 | 41.8% | 2.43% | -3.15% | -0.52% | -0.29% | 0.55 |
| D Δ > 5% | 34 | 52.9% | 1.71% | -3.15% | 0.10% | -0.22% | 0.82 |

This table presents statistics on the profit generated by short-term trading strategies. The first five rows of each panel describe the profitability of strategies that buy fund shares after large negative discount changes and sell the shares after five trading days. The final five rows of each panel describe the profitability of strategies that short the fund shares after large positive discount changes and cover the short position after five trading days. The first column in the table describes the discount change that initiates the strategy. Transaction costs include the bid-ask spread and a $10 commission charged when a position is initiated and closed. The initial trade has a value of $10,000. The mean, median, 75$^{th}$ percentile, and 25$^{th}$ percentile of the returns are provided. The percentage of trades that are profitable is provided under the columns labeled % > 0. The p-value of a two-tailed Student's t-test that the mean is zero is found under the columns labeled P>|t|. The post-decimalization sample period starts at April 9, 2001 and ends on April 25, 2003.