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What Can "Nine-Eleven" Tell Us about Closed-end Fund Discounts and Investor Sentiment?

Timothy R. Burch*

University of Miami

Douglas R. Emery

University of Miami

Michael E. Fuerst

University of Miami

Abstract

We use the horrific events of September 11, 2001 ("nine-eleven") as a natural test of the hypothesis that closed-end mutual fund discounts from fund net asset values reflect small investor sentiment. Because nine-eleven was a sudden, unforeseen, and significantly negative and exogenous shock to the world, the capital markets, and investor sentiment, our test avoids many of the problems of extant studies. Discounts worsened dramatically following the event, and then recovered alongside the broader market. This finding is consistent with the hypothesis that discounts reflect the sentiment of small investors, who took their cues from the broader market's overall movement.

Keywords: investor sentiment, closed-end fund discounts

JEL Classification: G14

* *Corresponding author*: Department of Finance, 514 Jenkins, Coral Gables, FL 33124-6552; Phone: (305) 284-4362; Fax: (305) 284-4800; E-mail: tburch@miami.edu

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1. Introduction

We examine changes in the market values of closed-end mutual funds surrounding the horrific events of September 11, 2001 ("nine-eleven"). Our interest is in the idea that so-called "investor sentiment" plays a significant role in valuing financial securities. We test the hypothesis that closed-end mutual fund discounts from fund net asset values (NAVs) reflect investor sentiment. Because a closed-end fund trades independently of its NAV, and yet the NAV is the "theoretically correct" value of a share if the fund were liquidated (before transaction costs), such funds offer a natural laboratory for studying the behavior of capital markets.

Nine-eleven offers a natural experiment in investor sentiment. Unlike the ebb and flow of continuously evolving sentiment, nine-eleven was a sudden, unforeseen, significantly negative and exogenous shock to the world, the capital markets, and investor sentiment. The U.S. stock markets were closed for almost a week following nine-eleven. Investors' considerable nervousness about what would happen when the markets reopened, and continuing concerns over the economic aftermath even after their reopening, underscores just how unequivocally negative the shock of nine-eleven was. In short, the sheer magnitude of the event provides for a statistically powerful test.

Despite the possible impression that we are studying a single incident, our research actually comprises an event study with approximately 300 observations. A typical event study screens data around a common event (such as calling convertible bonds to force conversion) and aligns the observations in event time. Nine-eleven occurred across all of our observations at the same time in the same way. Thus, we avoid the need to screen data and realign observations in time to achieve comparability. We also avoid relying on a particular class of security returns, an asset-pricing model, and a comparative measure of investor sentiment.

To test whether discounts shifted around nine-eleven, we use Friday-to-Friday discounts on 391 closed-end mutual funds. We find that mean discounts change from 3.3% on Friday, September 7, 2001 to 7.7% on Friday, September 21, 2001, a statistically significant change based on a number of alternative test statistics. This finding is robust when we control for time series trends in the data.

We interpret the changes in discounts as significant evidence of an investor-sentiment component to closed-end fund discounts. We also find that over the ensuing month, discounts nearly return to their pre-nine-eleven levels, in conjunction with a stock market rebound. We believe that small-investor sentiment improved as the capital markets stabilized and investors realized that, although shocked, the economy would avoid disaster. However, there is no clearly defined "event" to which we can link a presumed sentiment improvement after nine-eleven. This renders our interpretation of changes in the ensuing month as more speculative, especially compared to our interpretation of the sharp change in discounts during the first trading week following nine-eleven.

2. Investor sentiment and closed-end fund discounts

Investor sentiment is particularly interesting because many people believe it plays a role in security pricing. For example, Federal Reserve Board Chairman Alan Greenspan warned investors in 1996 that "irrational exuberance" could be causing securities to trade above their fundamental values. Some studies conclude that investor sentiment can be used to forecast security returns. For example, Fisher and Statman (2000) use survey data to measure small investor sentiment and link it to the return on the S&P 500 Index. Lee, Shleifer, and Thaler (1991) argue that closed-end fund discounts reflect small-investor sentiment, which in turn affects the risk characteristics of stocks.[1] They conclude that closed-end fund discounts can be used to predict expected returns.

Closed-end fund discounts have long been a puzzle because of the potential arbitrage opportunities they seem to offer. Numerous hypotheses have been proposed to explain the existence of discounts, but none have gained universal acceptance. Arguably, however, the small investor sentiment hypothesis in Lee, Shleifer, and Thaler (1991) is the most prominent and has led to the occasional use of discounts as a sentiment index. Whether discounts actually reflect sentiment, however, is open to question. A memorably acrimonious exchange of articles by Chen, Kan, and Miller (1993a, 1993b) and Chopra, Lee, Shleifer, and Thaler (1993a, 1993b) details an intense debate over the small investor sentiment hypothesis of Lee, Shleifer, and Thaler (1991). More recent studies also suggest a lack of consensus on whether discounts reflect sentiment (e.g., see Elton, Gruber, and Busse, 1998; Neal and Wheatley, 1998; and Swaminathan, 1996).[2]

Testing whether discounts reflect sentiment is certainly not straightforward. A major difficulty facing any test of investor sentiment is that investor sentiment is not directly observable. It has not been explicitly defined and therefore cannot be precisely measured. We can of course measure discounts and premiums on closed-end funds and observe changes over time. However, what causes such changes and what do those changes mean?

For example, the mean discount for all closed-end funds at the start of January 2001 was 8.9%. It declined over the first half of that year and was 3.3% at the end of June 2001. This apparently systematic decline in the discount is certainly significant at the "eyeball" level. Although some researchers would attribute this decline to a change in investor sentiment, such an attribution is questionable in the absence of an identifiable, conceptually sound reason, because other factors can affect discounts as well. For example, changes in market frictions can affect the

[1] These authors note that individual investors own more than 90% of the closed-end funds they examine, and that their trading—presumably influenced by waves of optimism and pessimism—affects the extent to which prices deviate from NAVs.

[2] Recent studies that focus on different aspects of closed-end funds include Akhigbe and Madura (2001), Khorana, Wahal, and Zenner (2002), and Rowe and Davidson (2000).

rates of return that investors require (and hence realized security returns), while simultaneously affecting the ability of arbitrageurs to trade away discounts. In short, without an event that clearly identifies a change in sentiment, conclusively linking discounts and sentiment by inferring sentiment shifts from discount movements is challenging, if not impossible.

Studies that investigate predicted links between closed-end fund discounts and security returns are also open to interpretation. Suppose the evidence supports a predicted link between discounts and returns. Although this evidence may be consistent with discounts reflecting sentiment, it may also be explained by other, possibly unknown, factors that affect both returns and discounts.

Conversely, evidence that fails to support a predicted relation between discounts and returns does not eliminate the possibility that sentiment may be an important contributor to discounts. First, there are many factors besides sentiment that can affect returns. Further, sentiment could be only one of several factors that affect discounts, and thus discounts may have a very noisy (or even convoluted) relation to sentiment. As a result, the failure to find a predicted link between discounts and returns might reflect only a lack of statistical power. Further, although a lack of evidence could imply that discounts have limited practical use in explaining the particular returns examined, this conclusion might not extend generally. It could be that discounts are useful predictors of returns for one or more alternative classes of securities. In other words, tests of sentiment based on a predicted relation between discounts and returns are by their nature joint tests of whether sentiment exists, and whether sentiment has significant ability to explain the particular class of security returns examined. The second part of the test might fail because of a lack of power, the particular choice of security returns, or the use of a misspecified asset-pricing model to measure returns on a risk-adjusted basis.

We believe our test avoids these interpretation problems. Conceptually, prior studies typically first identify movements in discounts, and then attempt to determine whether the evidence is consistent with such movements reflecting changes in sentiment. Our design differs in that it first identifies an event around which sentiment shifted, and then tests for a corresponding movement in discounts. In addition, we do not have to choose a particular class of future returns or specify an asset-pricing model. We also believe nine-eleven provides a statistically powerful test given its cataclysmic nature. Finally, investors were undoubtedly paying close attention to the potential economic fallout in the weeks that followed. Indeed, Klibanoff, Lamont, and Wizman (1998) show that closed-end investors pay more attention when there is important news.

3. Hypothesis and data

Our hypothesis explicitly assumes that small-investor sentiment shifted negatively in the aftermath of nine-eleven. Because a financial disaster did not ensue, we might wonder in retrospect whether the investment community was really all that

concerned about the economic fallout. However, we believe that investors were indeed greatly concerned. The economy had already been showing signs of weakness, and one of the *Wall Street Journal's* front-page headlines for September 12 was "Attacks Raise Fears of a Recession."[3]

The impact on the financial sector's infrastructure was so severe that the U.S. capital markets were almost immediately closed after the attacks. The markets remained closed for four consecutive weekdays, as investors anxiously waited to see how the market would respond once trading resumed. Furthermore, it was not clear *when* the equity markets would reopen. The *New York Times* headline for September 17, 2001 notes that investors were looking to the market during this time period for cues as to the economic effects of nine-eleven.[4]

Although stock prices did not drop precipitously, trading on the first day after the reopening hardly assuaged fears of declines in the economy and capital markets. Investors watched as the Dow Jones Industrial Average dropped 7.1%, and the S&P 500 Index dropped 4.9%. On Friday, September 21 (the day on which we measure the first post-nine-eleven discount), *New York Times* readers awoke to an article headline containing the phrase "Deepening Gloom Pushes S&P Index below 1,000 Mark."[5] By the end of the day, the index was 11.6% below its pre-nine-eleven level, and throughout the entire week there were warnings of possibly tough economic times ahead. It seems safe to assume that investors had become more pessimistic relative to their pre-nine-eleven attitudes.

For analytical purposes, we calculate the deviation of the fund's market price from the fund's NAV. For clarity, we then refer to all deviations as premiums, and let the algebraic sign indicate whether the deviation is a discount (a negative difference) or a premium (a positive difference). We define a fund's premium as:

$$Premium = \frac{Price}{NAV} - 1 \tag{1}$$

where *Price* refers to the fund's closing price per share in the secondary market, and *NAV* is the fund's net asset value per share.

The hypothesis we test is:

> *If closed-end fund premiums indicate small-investor sentiment, premiums should have experienced a decrease around the terrorist attacks of September 11, 2001.*

We use weekly premiums for 393 closed-end funds, which we obtain from Thomson Financial Inc.'s Wiesenberger division. We begin with closed-end funds

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[3] See G. Ip and J. McKinnon, "Attacks Raise Fears of a Recession," *Wall Street Journal*, September 12, 2001, p. A1.

[4] See R. Stevenson with J. Fuerbringer, "After the Attacks: The Economy: Nation Shifts Its Focus to Wall Street as a Major Test of Attack's Aftermaths," *New York Times*, September 17, 2001, p. A1.

[5] See A. Berenson, "A Nation Challenged: The Markets: Deepening Gloom Pushes S.&P. Index below 1,000 Mark," *New York Times*, September 21, 2001, p. C7.

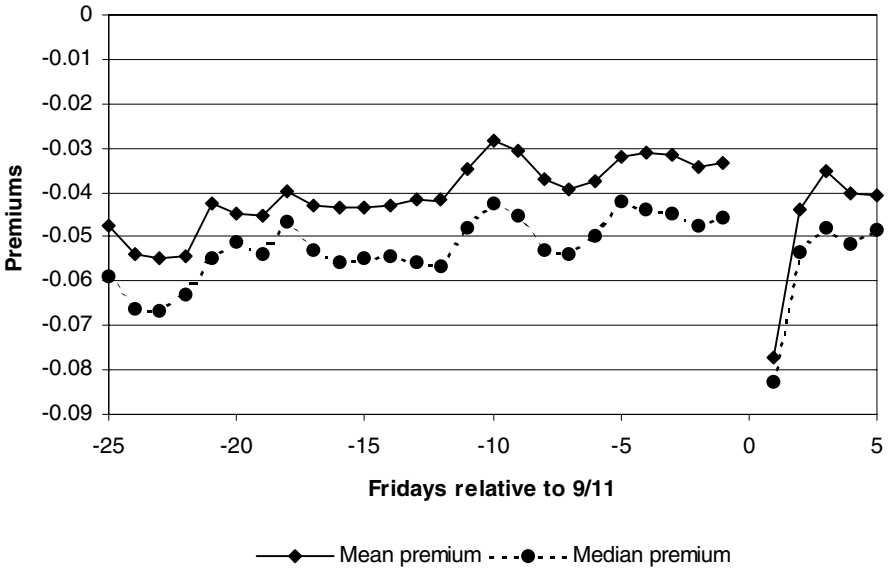

Figure 1

Premiums around nine-eleven

This graph plots mean and median Friday premiums for 391 closed-end funds around the terrorist attack of September 11, 2001. We define a fund's premium as *Premium* = *Price/NAV* – 1, where *Price* refers to the closing price per share in the secondary market. The first premium we plot (week –25) is for 3/23/01. Week −1 is 9/07/01 (the last Friday before the attack) and week +1 is 9/21/01 (the first trading Friday after the attack). We substitute Thursday, 4/12/01, for Friday, 4/13/01, because the market was closed 4/12/01 for Good Friday.

from this source for the period of September 8, 2000 to October 31, 2001. Closing market prices come from *Bridge*, because Year 2001 data from the Center for Research in Security Prices (CRSP) were not available when we initiated our study. We focus on Friday premiums because approximately 19% of the final sample of funds only disclose NAVs on Fridays. Therefore, the last mean premium prior to nine-eleven is from September 7, and the first after nine-eleven is from September 21 (the stock markets remained closed on Friday, September 14). We eliminate two funds with missing premiums on the later date, leaving a sample of 391. For completeness, we also discuss the pattern in daily premiums for funds that report NAVs on a daily basis.

4. Empirical results

Figure 1 plots the sample's mean weekly premium from six months before nine-eleven through October 26, 2001. The mean premium rose from –4.8% on March 23

Table 1

Weekly premiums around nine-eleven

This table presents premiums and premium changes around nine-eleven. All dates are Fridays except 9/10/01, which is a Monday. *Premium* = *Price/NAV* – 1, where *Price* refers to the closing price per share in the secondary market. *Premium change* is the premium on the post-attack day (*Post 1*, *Post 2*, or *Post 3*) minus that on the pre-attack day (*Pre*). Definitions for the *t*-ratios are as follows: *t-ratio 1* is a standard *t*-test (the mean change divided by the sample standard deviation of those changes across all funds), *t-ratio 2* is the mean change divided by the sample standard deviation of mean changes over the prior year, where prior-year mean changes are over the same number of *trading* days as the change being examined, and *t-ratio 3* is similar to *t-ratio 2* but the prior-year mean changes are over the same number of *calendar* days as the change being examined. More detail on *t-ratio 2* and *t-ratio 3* is in the appendix.

Panel A: All funds (# obs. = 391)

	Pre (9/07/01)	Post 1 (9/21/01)	Post 2 (9/28/01)	Post 3 (10/05/01)
Premium				
Mean	−0.033	−0.077	−0.044	−0.035
Median	−0.046	−0.083	−0.055	−0.048
Premium change from 9/07/01				
Mean	–	−0.044	−0.010	−0.002
Median	–	−0.037	−0.011	−0.004
Std. deviation	–	0.048	0.028	0.033
t-ratio 1	–	−18.220***	−7.285***	−1.155
t-ratio 2	–	−7.053***	−0.924	−0.121
t-ratio 3	–	−3.931***	−0.643	−0.097

Panel B: Daily-NAV funds with different NAVs on 9/10/01 and 9/20/01 (# obs. = 310)

	Pre (9/10/01)	Post 1 (9/21/01)	Post 2 (9/28/01)	Post 3 (10/05/01)
Premium				
Mean	−0.034	−0.078	−0.044	−0.037
Median	−0.044	−0.084	−0.054	−0.048
Premium change from 9/10/01				
Mean	–	−0.044	−0.011	−0.003
Median	–	−0.038	−0.011	−0.006
Std. deviation	–	0.045	0.028	0.032
t-ratio 1	–	−17.212***	−6.632***	−1.830
t-ratio 2	–	−6.855***	−0.910	−0.199
t-ratio 3	–	−3.831***	−0.641	−0.159

*** Indicates statistical significance at the 0.01 level.

(week –25) to −3.5% on June 29 (week –11). It then fluctuated between –4% and –3% until dropping substantially across the week of nine-eleven.

Panel A of Table 1 reports the details of our statistical tests across nine-eleven. The mean premium on the last pre-nine-eleven Friday (September 7) was −3.3%,

and dropped to –7.7% on the first post-nine-eleven trading Friday (September 21, or "*Post 1*"), a change in the mean of −4.4%. A standard *t*-test, denoted *t-ratio 1*, shows that the change is significant ($t = -18.220$). However, this test does not take into account the volatility of mean premium changes from week to week.

A second test statistic, *t-ratio 2*, incorporates the variance in weekly changes of the mean premium over the year preceding nine-eleven. The statistic divides the mean premium change around nine-eleven, which is over the two consecutive trading Fridays of September 7 and 21, by the sample standard deviation of Friday-to-Friday mean premium changes during the period September 8, 2000 to September 7, 2001. More detail is provided in the Appendix. As Table 1 shows, *t-ratio 2* equals –7.053, which also shows that the mean change in mean premium around nine-eleven is significant.

Although the premium change around nine-eleven crosses two consecutive trading Fridays, it actually crosses three calendar Fridays, which is a two-week calendar-time period. Therefore, it could be more appropriate to use the pre-nine-eleven sample variance for premium changes over two-week periods, for example, if price and NAV processes continue to evolve over trading halts. As outlined in the Appendix, a third testing statistic, *t-ratio 3*, is constructed using two-week periods. It equals −3.931, again showing that the –4.4% change in the mean premium across nine-eleven is significant. These tests show that premiums experienced a statistically significant drop across nine-eleven, which is consistent with a substantial negative shift in small-investor sentiment.

Over the ensuing weeks, the general economic outlook improved, and the financial markets recovered much of their first-week loss. By the close of market on Friday, September 28, the S&P 500 was down only 4.7% from its pre-nine-eleven level, having bounced back from being down 11.6% one week earlier. The next week it continued to rise, and by Friday, October 5, it was down only 1.9% from its pre-nine-eleven level. Therefore, although the outlook for some sectors of the economy seemed grim (e.g., the travel sector), the collective expectation of future economic conditions (as indicated by the major stock indexes) was much less negative than it had been during the first week of trading after nine-eleven. Some felt that the nine-eleven-induced drop in the market had actually led to a buying opportunity.[6]

As the market's collective expectations of future economic conditions improved, it seems likely that small-investor sentiment also improved. Figure 1 shows that the pattern in closed-end fund premiums is consistent with this notion. Premiums also rebounded to nearly their pre-nine-eleven levels over the same time period.

In Panel A of Table 1, we see that the mean premium change from the pre-nine-eleven level to September 28 is only –1.0%. Although the standard *t*-test statistic (*t-ratio 1*) for this change is significant, *t-ratio 2* and *t-ratio 3* are not significant. The

[6] The front page of *Barron's* on Monday, September 24, read, "It's time to buy stocks. And not just because its patriotic. A reliable indicator now shows that stocks are a better bargain for long-term investors than at any time in the past five years. Are you ready to put some of your cash to work?"

lack of statistical significance of *t-ratio 2* and *t-ratio 3* highlights the importance of incorporating the extent to which large mean premium changes are generally common.

By Friday, October 5, the mean premium ("*Post 3*") had almost fully recovered. The mean change from September 7 to October 5 is only –0.2%.

4.1. Robustness to stale NAVs

Given the disruption nine-eleven caused in the financial sector, it is possible that the sharp decline in premiums immediately following the event is the result of stale NAVs. To clarify this argument, if, due to personnel or infrastructure problems, a particular fund was unable to report an updated NAV for Friday, September 21, then agencies compiling closed-end fund NAVs may have reported the pre-nine-eleven NAV because the fund either reported this NAV or did not report one at all. (NAVs are occasionally reported as "missing," which suggests that it is not standard practice to report stale NAVs. However, it is possible that standard practice was not followed in the immediate aftermath of nine-eleven.) The market price of the particular fund might have been lower on September 21 to correctly reflect a lower market value of assets in the fund, but the NAV would have been artificially high because it was stale. As a result, the measured premium would have dropped incorrectly.

It is also possible that some of the decline in the mean premium results from investors not having access to updated NAVs. In Panel A, 73 of the 391 funds report their NAVs only on Fridays. Lacking the regular information update, investors in these funds may have feared that the NAV drop in the initial days of trading after nine-eleven was much larger than it actually was, causing them to push the market price lower than they would have had they been able to observe a daily updated NAV. This sequence of events would not necessarily invalidate our conclusions because it can be argued that investors can approximate the fund's value without relying on a reported NAV. Nevertheless, a lack of observable NAVs could somewhat alter the interpretation of the sharp premium decline.

To assess the extent to which our results might be affected by stale NAVs, Panel B of Table 1 repeats the analysis, now using a subset of the 318 funds that disclose daily NAVs. In constructing this subset, we eliminate eight funds whose NAV on Thursday, September 20 equaled that of the last available pre-nine-eleven NAV (on *Monday, September 10* since these funds have daily NAVs). This leaves 310 funds for which investors would have had access to an updated, post-nine-eleven NAV before Friday, September 21 trading (our *Post 1* date). Hence, by construction, this sample does not contain funds with stale NAVs.

We also checked with numerous individual closed-end funds and were told that updated daily NAVs were available as normal during the first trading week. These NAVs are available at a one-day lag either through the funds' website or over the phone (and usually both). In addition, the Closed-End Fund Association website (http://www.closed-endfunds.com) provides costless access to these daily NAVs. Thus, we are confident our daily NAVs were indeed available during trading

hours on Friday, September 21; that is, the data we have was not "backfilled" after the fact. We also repeated this exercise using Wednesday, September 19 as the date on which to check for a NAV that differed from that on September 10, and found similar results.

Finally, we change the "*Pre*" day to Monday, September 10 because these funds report NAVs daily. The post-nine-eleven dates remain the same. The results are similar to those reported in Panel A. Notably, the premium change immediately following nine-eleven remains significantly negative. Therefore, we conclude that the results are not driven by a lack of updated NAVs.

4.2. Robustness to time series trends

Another concern is that a trend in the data might be driving the decline in premiums. As Figure 1 shows, premiums follow a sine-like curve pattern before nine-eleven. Visual inspection does not suggest that the continuation of this pattern could easily explain the severity of the decline around nine-eleven. Nevertheless, we use forecast models to estimate the mean premiums in both Panels A and B based on Friday-to-Friday trading days. Augmented Dickey-Fuller tests confirm that the series of premiums is stationary. Standard Box-Jenkins techniques, in conjunction with the Akaike Information and Schwartz Bayesian Criteria, argue strongly for an autoregressive model with two lags.

If we compare the actual premiums on Friday, September 21 with the forecasted values, we find that the actual value is far more negative than predicted. For both panels, the null hypothesis that the observed mean premium on September 21 equals the forecast value is rejected (although not reported in the table, the t-statistic = –8.277 for the Panel A test, and −7.790 for the Panel B test).

5. Discussion

We believe discount changes across nine-eleven and their subsequent recovery result from changes in investor sentiment. As previously noted, conventional wisdom after nine-eleven was that many investors were looking to the broader market for clues about what lasting effects nine-eleven and its aftermath would have on the economy. Figure 2 plots the "*Relative S&P 500*" and mean premiums on a daily basis for the 310 sample funds that reported their NAVs on a daily basis. We define *Relative S&P 500* as the closing index level divided by the level on Monday, September 10 (the last pre-nine-eleven index level), minus one. (It was common during this time for commentators and investors to note how far the market had dropped from its pre-nine-eleven level.) We use *Relative S&P 500* as the holding period return on the index from September 10 to the day being plotted. As Figure 2 shows, premiums and the market index follow the same general pattern over the weeks following nine-eleven. They drop for a few days, hitting a low on September 21, and then show a fairly steady increase back to the pre-nine-eleven level.

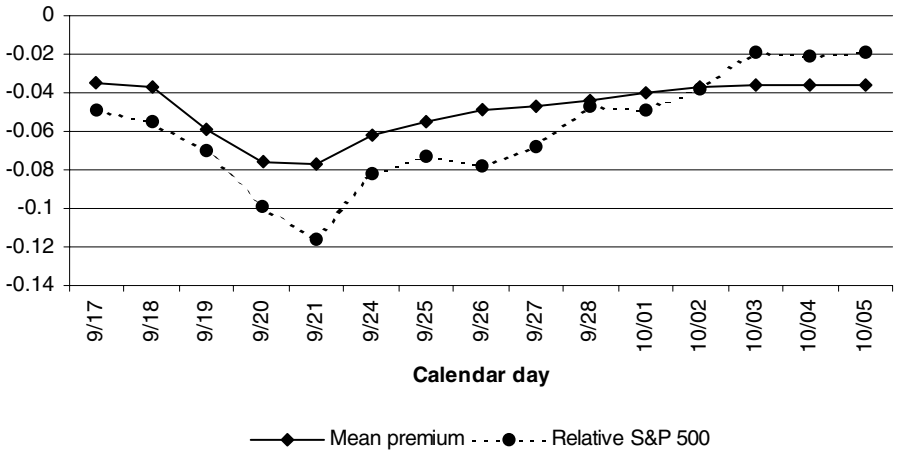

Figure 2

Relative S&P 500 index and mean daily premiums after nine-eleven

This graph plots the *Relative S&P 500* and the mean premium for 310 closed-end funds that disclose NAVs daily. *Relative S&P 500* is the index's value on each day divided by the index value on Monday, September 10, 2001, minus 1.

Although both NAVs and fund market prices are often positively correlated with the market (i.e., they have positive betas), we have no explanation other than investor sentiment for why *premiums* should follow the market so closely. Klibanoff, Lamont, and Wizman (1998) report that prices track NAVs more closely after salient news events. Based on this finding, we would expect prices to track NAVs more closely, rather than less closely, following nine-eleven. Therefore, we believe sentiment is the most plausible explanation, especially since investors were reportedly looking to the broader market for guidance. Nevertheless, the conclusion that investor sentiment caused the premium recovery is subject to greater challenge than is the conclusion that sentiment caused the premium drop across nine-eleven, because the "event" to which we can tie the presumed improvement in investor sentiment is not as sharply defined as the event of nine-eleven.

The movement of mean premiums following the event, particularly considering that they did not bottom out until a few days after trading had resumed, provides supporting evidence for our interpretations. The stock market has long been interpreted as a barometer of collective expectations of future economic conditions. The pattern we observe is consistent with at least some investors initially remaining calm and letting the market guide their sentiment and valuations of closed-end funds. As the market's performance in the first few days began to signal an economic decline, premiums declined as well. Later, they recovered along with the recovery of the broader market.

We also note that other factors have been proposed for explaining discounts, but we believe they are unlikely to explain the patterns we see. These explanations often include tax effects, illiquidity of fund holdings, managerial performance and agency problems, costs to arbitrage, market segmentation, and excessive turnover within the fund's assets. (See Dimson and Minio-Kozerski, 1999, for a review of this literature.) It is hard to believe such factors would have been impacted in such a way as to cause the discount patterns across nine-eleven.

For those factors that might have been impacted, the effect should have been greatest on the first trading day after nine-eleven, not at the end of the trading week. For instance, the illiquidity argument says that NAVs are overstated because funds' illiquid holdings cannot actually be sold for the market prices on which NAVs are based. However, closed-end fund holdings would likely have been most illiquid during the market closure and immediately on the market's open, rather than on the Friday of the first trading week.

Another argument could be that a lack of liquidity in the funds' shares (as opposed to the liquidity of the funds' assets) caused prices to drop and induced the change in discounts. One measure of liquidity is a stock's turnover, which is the day's number of shares traded divided by the number of shares outstanding. During the five trading days immediately before nine-eleven, mean turnover for our sample funds was 0.222%. During the five trading days immediately after nine-eleven, mean turnover for our sample funds was 0.391%. The *t*-statistic is 6.21 for a difference-of-means test between these two, which is significant at the 1% level. Although this does not preclude the possibility that even more investors wanted to trade than did trade, the increase in turnover clearly indicates that many investors were willing to provide liquidity and buy fund shares. Even if there had been an overwhelming number of investors rushing to sell quickly at any price—outstripping the number willing to provide liquidity—we would argue this is significant evidence of pessimism and negative investor sentiment.

Grullon and Wang (2001) present an argument based on an information differential among investors. They offer a theoretical model in which closed-end fund discounts can occur if the quality of private information that investors have on the underlying asset is better than that of investors in the fund's shares. Their premise is that closed-end fund investors tend to be relatively uninformed compared to investors in the fund's underlying assets. If investors in the underlying assets became better informed than closed-end fund investors about the effects of nine-eleven on firm values during the market closure, the Grullon and Wang model argues that such an increase in the information differential would lead to wider discounts. However, it seems most likely that any such information differential would have been at its greatest just before the stock markets reopened on September 17. The "disconnect" between prices and NAVs should therefore also have been at its maximum at this time. Instead, the largest divergence between prices and NAVs occurs later in that week, after any information differential would presumably have begun to dissipate.

Another possible argument holds that arbitrageurs routinely trade away changes in discounts, and that this activity usually causes price changes to mimic NAV changes. To the extent such arbitrage activity does exist, it must be risky arbitrage, because discounts often vary substantially over time from more than a 20% discount to more than a 10% premium. Still, there may be risky arbitrage activity that, under normal circumstances, causes price changes to closely parallel changes in NAVs. If this is the case, the disruption in the stock market due to nine-eleven surely would have increased the risk to such arbitrage activity. Arbitrageurs, observing price changes that seemed excessively inconsistent with NAV changes, could have withdrawn because of the perceived increased risk. However, such a scenario rests on the trading behavior of closed-end fund investors. A shock to sentiment caused closed-end fund prices to decline sharply relative to NAVs, which in turn increased the perceived risk of engaging in such arbitrage activity.

Although it is easy to believe that small-investor sentiment would have followed the lead of the broader market during this time period, our interpretation does not mean that other factors played no role in the changes in discounts after nine-eleven. Further, we do not mean to imply that other factors do not play a role, perhaps even a significant one, in discounts. Our point is that it is difficult to conclude that, compared to changes in small-investor sentiment, any of these alternative factors were the dominant force in explaining the changes in discounts during this time period.

6. Conclusion

Many people have observed patterns in mean closed-end fund discounts and have concluded that changes in the discounts are due to changes in small-investor sentiment. Unfortunately, investor sentiment has no precise definition and cannot be directly observed. Further, there are numerous other factors that may affect discounts. Current research has not reached consensus on this issue because it has relied on joint tests that discounts contain sentiment and that sentiment predicts security returns. Relations between returns and nonsentiment factors that may affect discounts can lead to a false conclusion that discounts reflect sentiment. Conversely, even if discounts do reflect sentiment, such tests can fail because of a lack of power, the particular choice of security returns, or the asset-pricing model used to control for risk.

The events of nine-eleven allow us to avoid the joint-test problem of linking discounts to particular security returns, and then inferring a sentiment component. Nine-eleven caused a pronounced negative shift in sentiment and thus allows for a powerful test of whether discounts are affected by investor sentiment. What does nine-eleven tell us about closed-end fund discounts and investor sentiment? We document a substantial deepening of discounts in the aftermath of the terrorist attacks of September 11, 2001. We conclude that these results are consistent with, and therefore provide supporting evidence for, the idea that closed-end mutual fund discounts do indeed contain a sentiment component. As capital markets stabilized in the month after the event, discounts recovered to their pre-nine-eleven levels. Both the sudden

changes in discounts and the recovery of discounts follow the broader market's performance over this period, and suggest that small investors' sentiment was linked to the market's evolving assessment of nine-eleven's economic impact.

Appendix

Construction of alternative test statistics

Friday premium availability around nine-eleven for our sample is as follows:

Date	Day label in Table 1	Trading Friday relative to nine-eleven	Calendar Friday relative to nine-eleven	Premium availability
9/09/00		−53	−53	✓
:		:	:	:
7/06/01		−10	−10	✓
7/13/01		−9	−9	✓
7/20/01		−8	−8	✓
7/27/01		−7	−7	✓
8/03/01		−6	−6	✓
8/10/01		−5	−5	✓
8/17/01		−4	−4	✓
8/24/01		−3	−3	✓
8/31/01		−2	−2	✓
9/07/01	Pre	−1	−1	✓
9/14/01		(no trade)	+1	× (market closed)
9/21/01	Post 1	+1	+2	✓
9/28/01	Post 2	+2	+3	✓
10/05/01	Post 3	+3	+4	✓

t-ratio 2 and t-ratio 3 for the mean premium change from Pre to Post 1

This change is over two consecutive trading Fridays (week –1 to +1). For the pre-nine-eleven sample standard deviation used in *t-ratio 2* (which we construct so that pre-nine-eleven changes have the same number of trading days as the change being tested), we construct the following mean premium changes: (week –2 to –1), (–3 to –2), (–4 to –3), etc. We then calculate the sample standard deviation of those pre-nine-eleven mean changes. We then divide the mean *Pre* to *Post 1* change by the pre-nine-eleven sample standard deviation. For *t-ratio 3*, we construct the pre-nine-eleven changes to match on the number of calendar Fridays. Because the change around nine-eleven is from calendar Friday –1 to +2, we construct the following mean premium changes: (week –3 to –1), (–5 to –3), (–7 to –3), etc. The rest of the construction follows that of *t-ratio 2*.

t-ratio 2 and t-ratio 3 for the mean premium change from Pre to Post 2

This change is over three consecutive trading Fridays (week –1 to +2). For the pre-nine-eleven sample standard deviation used in *t-ratio 2*, we construct the following mean premium changes: (Friday –3 to –1), (–5 to –3), (–7 to –5), etc. We then calculate the sample standard deviation of those pre-nine-eleven mean changes. For *t-ratio 3*, the change around nine-eleven is from calendar Friday –1 to +3. We construct the following mean premium changes: (day –4 to –1), (–7 to –4), (–7 to –10), etc. The rest of the construction follows that of *t-ratio 2*.

We construct the statistics for testing the significance of *Pre* to *Post 3* in the same way.

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