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Who Moves Markets in a Sudden Marketwide Crisis? Evidence from 9/11

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Abstract

We compare reactions in the prices and trading patterns of common stocks and closed-end funds (CEFs), securities with substantially different investor clienteles, to the Sept. 11, 2001 terrorist attacks. When the market reopened 6 days later, retail investors sold and there were sharp price declines, even in assets with net institutional buying. In the subsequent 2 weeks, price reversals were substantially security specific and thus not simply due to improved systematic sentiment. Consistent with microstructure theory, comparisons between CEFs and common stocks show the speed of these reversals depended significantly on the relative quality and availability of information about fundamental values.

I. Introduction

How do stock markets respond to a sudden crisis? A rich literature finds inefficient stock price reactions to ordinary news events such as corporate earnings announcements. But how does the stock market respond to sudden crises that pose the threat of significant financial loss? And how do retail and institutional investors interact in such crisis periods? It is surprising that little is known about this question because unanticipated, crisis events that adversely affect a cross section of assets (e.g., oil spills, powerful weather events, and major industrial accidents) occur frequently. And although less frequent, crisis periods in the broader stock market could have large implications because even well-diversified investors could experience significant wealth loss. Do retail investors, who may be less able to effectively measure and manage such downside risk, engage in panicked selling? To what extent does institutional trading act as a stabilizing force by providing liquidity? How important is the quality and accessibility of information in how asset prices are affected?

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In this article we use the setting of the terrorist attacks of Sept. 11, 2001 (hereafter 9/11) to study how investor clienteles interact and security prices react in a sudden, marketwide crisis, which we define as an abrupt period of adversity that brings the threat of significant wealth loss for stock market investors. Although empirically identifying such a crisis may often be arbitrary, 9/11 clearly qualifies.[1] Moreover, the choice of 9/11 is justified by an ex post, empirical method we offer as a potential way to identify such market crises.

To infer whether retail and institutional investors traded differently, we use microstructure trading measures such as trade size and the direction of trade initiation (i.e., buy vs. sell initiated, as indicated by the Lee and Ready (1991) trade signing algorithm) and compare trading patterns among securities well known to have different investor clienteles. In particular, retail investors play a more prominent role in trading closed-end funds (CEFs) (Weiss (1989), Lee, Shleifer, and Thaler (1991)) and small-cap stocks, whereas institutional investors dominate trading in large-cap stocks (Sias and Starks (1997)). Therefore, we analyze the trading and price patterns of these security classes separately to further infer differential investor responses. As we motivate later in this article, we limit the CEF sample to only those with portfolios consisting of fixed-income securities.

Our main findings are summarized as follows. During the first post-9/11 trading week, which started 6 calendar days after 9/11, the average fixed-income CEF we study had a cumulative price return loss that was more than 5% larger in absolute terms than the cumulative loss in its net asset value (NAV). The majority of dollar volume was sell initiated for CEFs and small-cap stocks, but buy initiated for large-cap stocks, and trades larger than $50,000 in large-cap stocks were more buy than sell initiated in every day of trading. Such institutional buying is consistent with Lipson and Puckett (2010), who find that pension plan sponsors and money managers trade opposite to extreme market movements. Despite net institutional buying during the first post-9/11 trading week, prices declined significantly across CEFs and all common stock deciles.[2]

Prices recovered during the second and third post-9/11 trading weeks, and cross-sectional regressions show that the size of a security's recovery was significantly related to the security's initial price decline. Interestingly, these security-specific reversals primarily occurred during the second week for CEFs but during the third week for common stocks. We speculate that the faster, security-specific recoveries in CEFs were due to regularly disclosed NAVs, which provide natural benchmarks for fundamental values. This potential explanation is consistent with classic models such as Grossman and Stiglitz (1980) in which a higher ratio of informed to uninformed investors improves price efficiency. The intuition in these models could be extended to predict that any departures from fundamentals

[1]The 9/11 event was highly salient, and news reports at the time stated that investors feared the terrorist attack would lead to a sharp decline in both the economy and stock prices. For example, see "Attacks Raise Fears of a Recession," by G. Ip and J. McKinnon (*The Wall Street Journal*, Sept. 12, 2001, Sec. A, p. 1).

[2]Kumar and Lee (2006) and Barber, Odean, and Zhu (2009) show that correlated retail trading can move prices during normal trading conditions To the extent that retail selling affected prices in the aftermath of 9/11, our results suggest that prices can move in the direction of retail trading during a crisis period even if very large, presumably institutional, trades are in the opposite direction.

following a news shock will be reversed faster in assets with more public information about fundamentals.

Although our research setting draws on a single event and is thus a case study in some respects, it is important to note that we study the reactions of more than 1,600 different securities in multiple asset classes. The simultaneity of the event across the securities eliminates the need to align in event time observations that actually occurred at different times and in different economic climates. In this sense, our study is a natural experiment that examines how asset prices react to a macroeconomic shock, similar to Pearce and Roley (1985) and Anderson, Bollerslev, Diebold, and Vega (2003). In the Internet Appendix (available at www.jfqa.org), we examine other marketwide crises and present suggestive evidence that our main findings extend to other periods in the market.

We find evidence of heavy retail investor selling in the crisis period set off by 9/11, similar to the "flight" response the psychology literature documents as a potential reaction to a threat. Institutions responded by providing liquidity and were net buyers, but prices nonetheless declined throughout the first trading week. The return patterns and trading statistics we document suggest that different segments of financial markets respond differently to the same marketwide news due to not only different risk characteristics but also heterogeneity in the relative proportion and trading of institutional and retail investors. Moreover, our results suggest that the quality and accessibility of information becomes particularly important during a crisis period, both in terms of how asset prices respond during the crisis and how quickly they recover as the crisis dissipates.

II. Related Literature

Our analysis of CEFs is related to Klibanoff, Lamont, and Wizman (1998), who document underreaction to new information in closed-end country funds (CEFs whose underlying assets are foreign). They attribute the underreaction to unsophisticated investors dominating the trading and note that CEFs, like small-cap stocks, have a clientele that is primarily small retail investors.[3] Papers that directly measure individual investor trading include Barber et al. (2009), Barber and Odean (2008), Hvidkjaer (2008), and Kumar and Lee (2006), all of whom show that correlated retail trading can move prices. Dennis and Strickland (2002) and Lipson and Puckett (2010), in turn, investigate how correlated trading by institutional investors affects prices on volatile market days (which include both gains and losses of more modest magnitude than what we examine). None of these studies investigate simultaneous differences in retail and institutional investor trading.

Among papers that investigate other aspects of 9/11, Epstein and Schneider (2008) argue that "ambiguity-averse" investors react more strongly to bad news than good news, and that 9/11 triggered "a learning process whereby market participants were trying to infer the possibility of a structural change to the U.S. economy from unfamiliar signals" (p. 219). The notion that a learning process took place is consistent with our finding that the market did not begin to reverse

[3]Supporting this characterization of CEFs' investor clientele, Weiss (1989) finds that institutions own only about 7% of this asset class, and Lee et al. (1991) find that CEFs have a relatively high proportion of trades smaller than $10,000.

the initial reaction until the second post-9/11 trading week. Burch, Emery, and Fuerst (2003) examine CEF prices across 9/11 and argue that broad small-investor sentiment played an important role in how their price-to-NAV discounts reacted to the event. Using survey data, Glaser and Weber (2005) report a relatively high expected return by individual investors around the weekend of Sept. 22–23, 2001, and Graham and Harvey (2003) report a relatively low expected market return by chief financial officers (CFOs) based on survey data gathered Sept. 12–14, 2001. Glaser and Weber conclude that their results do not coincide with those in Graham and Harvey, but as we discuss later, our findings appear to reconcile the two.

III. 9/11 as a Marketwide Crisis

We begin by reviewing briefly the climate and timing of the extraordinary market closures following 9/11. In the months prior, the U.S. economy had been showing signs of weakness, and the Standard & Poor's (S&P) 500 stock index had gradually declined more than 20% during the prior 4 months. Many feared the event would push both the economy and stock market into a steep decline.

The U.S. financial markets did not open the Tuesday morning of 9/11, and the equity markets remained closed until 6 days later on Monday, Sept. 17, 2001. On that day the S&P 500 stock index declined 4.9%, and continued to fall throughout the trading week to close 11.6% below its Sept. 10, 2001 level. The fixed-income markets were also affected, but only moderately. They were closed for only 2 days (Sept. 11 and 12), and Treasury yields actually declined, in part due to Federal Reserve interventions to inject liquidity and stimulate the economy. Although spreads on risky bonds did increase, by Monday, Sept. 17, the 10-year Baa corporate-to-Treasury spread was only about 50 basis points higher than before 9/11 (see Section 1 in the Internet Appendix for a graph).

It is perhaps obvious that 9/11 was perceived as a sudden marketwide financial crisis that could cause panicked selling, but how would other crisis periods be identified? We propose that crisis events satisfy three criteria. First, a crisis event should be abrupt, negative, and have sufficient economic magnitude so as to greatly increase investor attention and the perceived likelihood of sharp stock market decline. Second, investor expectations of market volatility should increase. Finally, the economic magnitude of the crisis and increase in expected volatility should stand out relative to recent market conditions.

For completeness, we offer an ex post empirical method of identifying sudden marketwide crisis periods using inspection of daily returns in the Dow Jones Industrial Average (DJIA) and the VXO index, a measure of expected volatility derived from trading in options on the S&P 100 stock index.[4,5] Our identification

[4]Including a volatility metric is important to distinguish a true crisis period from stock market days that are merely volatile, the focus in Dennis and Strickland (2002) and Lipson and Puckett (2010). These studies investigate volatile days in which the Center for Research in Security Prices (CRSP) value-weighted or equal-weighted market index rises or falls at least 2%. The criteria we propose differs in using an index more highly visible to investors (the DJIA), identifies only market losses instead of both gains and losses, requires a trading-day return with considerably larger magnitude, and requires a substantial increase in uncertainty. Our methodology also will not identify events that are largely intraday price declines and recoveries, such as the flash crash of May 2010.

[5]We use the VXO index because it is available back to 1986, whereas the VIX index (based on the S&P 500 stock index) is available only back to 1990.

strategy has an advantage over searching for negative news, for example, in that it is based on hard data as opposed to inferring severity and tone in a subjective way. Although implementation of our strategy is objective, specification of required levels of changes in the DJIA and VXO remains somewhat arbitrary. Also, our method will not identify a crisis event that did not actually result in a substantial trading-day decline in the DJIA or an increase in expected volatility from one market close to the next.

To be specific, we propose identifying a sudden crisis by requiring a trading day in which i) the DJIA closes down 5% or more from the prior day, ii) the DJIA's loss exceeds 5 times the standard deviation in daily DJIA returns during the prior year, and iii) the VXO return from the prior day is positive and exceeds 5 times its daily standard deviation during the prior year. These criteria identify the onset of a crisis period based on a subsequent sharp decline in the highly visible DJIA that is large relative to recent market conditions and accompanied by a large increase in perceived uncertainty as measured by the VXO. We should note that we do not require pinning down a specific piece of economic news that triggers the crisis. For example, "Black Monday" in Oct. 1987 marks the beginning of a crisis event according to our criteria, even though there is no single piece of news that offers a reason for the crash; the crisis period began with the crash itself. This prescription identifies a total of 5 sudden crisis periods during 1986–2012 (including Oct. 1987 and 9/11), and in the Internet Appendix, we present suggestive evidence that our major findings for 9/11 extend to the other identified marketwide crisis events.

IV. Data

Daily returns and market capitalization information for New York Stock Exchange (NYSE) common stocks and CEFs are from the CRSP, and intraday trading data are from the NYSE Trade and Quote (TAQ) database. The period we study begins June 1, 2001 and ends Dec. 31, 2001. For the common stock sample we exclude stocks without the necessary coverage in the CRSP and TAQ databases, and CEFs, real estate investment trusts, companies incorporated outside the United States, primes, scores, depositary receipts, certificates, shares of beneficial interest, and units. The result is a sample of 1,463 common stocks.

The CEF sample consists of NYSE-listed CEFs that are classified as fixed-income funds by Barron's, covered in CRSP and TAQ, and report NAVs on a daily basis from June 1, 2001 to Oct. 31, 2001. NAVs are from Thomson Reuters, and there are 199 funds with the required CRSP, TAQ, and NAV data. Our focus on fixed-income funds is motivated by their values depending primarily on interest rates and credit spreads. This means that, in addition to NAVs (which were updated and disclosed as usual, as we discuss in the Internet Appendix), investors could obtain information about fundamental values from interest rate movements and the fixed-income markets more broadly for 2 full trading days (Thursday and Friday, Sept. 13 and 14) before CEFs themselves began to trade on Monday, Sept. 17.

For each security (common stock and CEF), we construct the following variables:

i) MARKET_CAP (market capitalization) is based on Sept. 10, 2001 closing data.

ii) TRADE_SIZE is the mean dollar value of all trades during a given day.

iii) SHARE_PRICE is the closing trading price according to CRSP.

iv) EFFECTIVE_SPREAD is the mean of the effective spread for all trades during a given day, where the effective spread for a trade equals the bid–ask spread divided by the midpoint, and the midpoint is the sum of the bid and ask divided by 2.

v) TURNOVER is the number of shares traded in a given day, divided by the number of outstanding shares.

vi) PERCENTAGE_OF_BUYS is the dollar buy-initiated trades divided by the sum of the dollar buy- and sell-initiated trades during a given day, where the buy- and sell-initiated trades are identified by the Lee and Ready (1991) trade signing algorithm. For expositional simplicity, we often refer to buy- and sell-initiated trades as buys and sells.

vii) TRADE_SIZE_PROPORTION is the percentage (based on the number of trades) of all trades during a given day falling into 1 of 5 possible size categories (<\$5K, \$5K–\$10K, \$10K–\$20K, \$20K–\$50K, and >\$50K).

A security-level metric for a given multiday period is defined as the trading statistic's median across trading days in the period. Log price returns are calculated on a close-of-trading-day to close-of-trading-day basis. For example, the return for Monday, Sept. 17, the first day of trading after 9/11, is from the Sept. 10 close to the Sept. 17 close. Consequently, the log price return for a security for day t, denoted RP_t, is

$$\mathrm{RP}_t = \ln(P_t + D_t) - \ln(P_{t-1}), \tag{1}$$

where P_t is the closing price on trading day t, D_t is the dividend on trading day t, and ln is the natural log operator. The log NAV return for a CEF for day t (denoted RN_t) is similarly defined, using NAVs in place of closing prices. Because NAVs are calculated using closing prices of the funds' assets, NAV returns provide a good benchmark for price returns (Klibanoff et al. (1998)). Therefore, when analyzing CEFs we sometimes include abnormal returns (AR_t), defined as the price return minus the NAV return ($\mathrm{AR}_t = \mathrm{RP}_t - \mathrm{RN}_t$).

V. Return Patterns and Investor Expectations

Table 1 shows cumulative returns over 6 periods for common stocks, CEFs, and the S&P 500 stock index. We report statistics by market-capitalization deciles, measured as of Sept. 10, 2001 (decile 1 denotes the smallest stocks and decile 10 denotes the largest). Cumulative returns from June 1 to Sept. 10 document the down market in the months before 9/11, and returns from Sept. 10 to Sept. 21 document a large price decline during the first post-9/11 trading week. There was a strong rebound in the subsequent trading week (Sept. 21–28) for all of the classes

of securities except stock decile 1. In the third week of trading (Sept. 28–Oct. 5), all security classes continued to recover except stock deciles 1 and 3.

TABLE 1

Log Price Returns

Means of cumulative log price returns during 6 periods before, across, and after 9/11, for 10 market-capitalization-based deciles of 1,463 NYSE-listed stocks, 199 fixed-income closed-end funds (CEFs), and the S&P 500 stock index. Decile partitions for common stocks (D1–D10) are based on market capitalizations as of Sept. 10, 2001.

	Time Period					
	6/1–9/10	9/10–9/21	9/21–9/28	9/28–10/5	9/10–10/5	10/5–12/31
D1	−21.89%	−16.69%	−2.11%	−1.53%	−20.33%	2.89%
D2	−9.82%	−19.14%	1.26%	1.72%	−16.17%	11.26%
D3	−8.29%	−21.02%	6.62%	−0.51%	−14.91%	15.57%
D4	−5.35%	−17.89%	6.46%	2.46%	−8.97%	14.17%
D5	−11.61%	−16.71%	5.79%	2.99%	−7.93%	13.60%
D6	−6.70%	−13.95%	5.87%	2.68%	−5.41%	15.18%
D7	−5.34%	−14.54%	6.55%	2.42%	−5.57%	12.63%
D8	−12.37%	−15.79%	6.14%	2.97%	−6.68%	12.16%
D9	−8.04%	−12.49%	6.13%	2.24%	−4.12%	6.43%
D10	−11.20%	−12.49%	6.81%	2.05%	−3.63%	3.88%
CEFs	4.38%	−7.80%	4.56%	1.50%	−1.74%	6.91%
S&P 500	−13.93%	−12.33%	7.49%	2.88%	−1.96%	7.16%

Note that cumulative returns for the broader period (Sept. 10–Oct. 5) are almost monotonic across the deciles, with small deciles experiencing more pronounced cumulative price declines than larger deciles following 9/11. Sias and Starks (1997) show that retail investors play a more significant role in small-cap stocks because of lower institutional trading. Hence, these return patterns are consistent with increasingly pronounced retail selling in small-cap stocks. Also contributing to the monotonicity across deciles is the more pronounced trading role institutions play in larger stocks. Evidence we present later implies that institutions as a group were net buyers even during the first post-9/11 trading week.

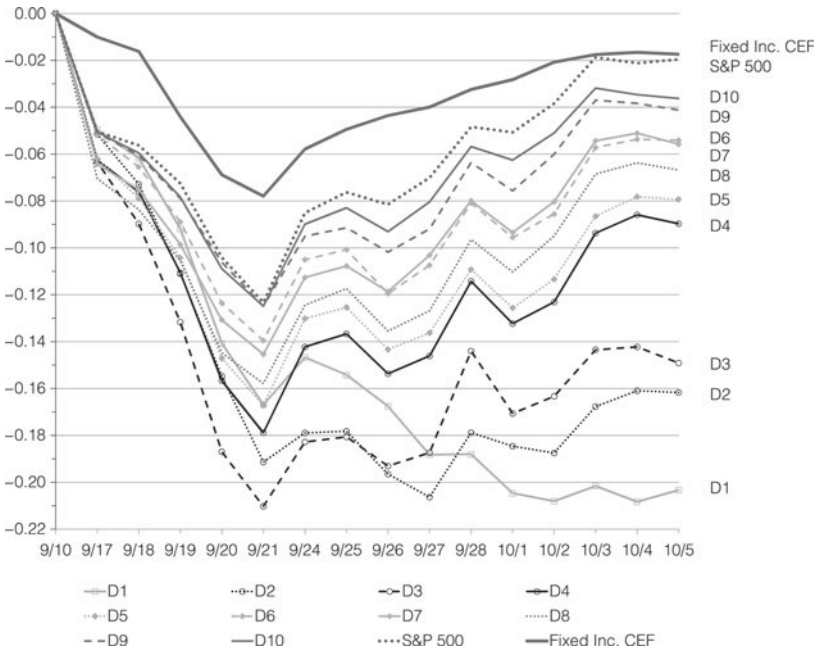
CEFs are not heavily traded by institutional investors (Weiss (1989), Lee et al. (1991)), and yet in this case they experienced smaller price declines (and subsequent recoveries) than large-cap stocks. One potential reason, of course, is that the funds we study are claims on baskets of fixed-income securities, whose values were much less affected by 9/11 compared to equities. Also, Bradley, Brav, Goldstein, and Jiang ((2010), p. 1) note that "closed-end funds constantly attract arbitrageurs" who trade to exploit differences between prices and NAVs. As discounts widened during the initial trading days after 9/11, arbitrage traders may have bought funds and helped mitigate price declines.

Figure 1 graphs cumulative price returns during the Sept. 17–Oct. 5 period. Every category shows a sharp price decline in the first 5 days of trading after 9/11, followed by a sharp recovery that begins on day 6 of trading (Sept. 24), and generally continues throughout days 7 through 15. The only exception is decile 1, which experiences a recovery on day 6 but then shows negative returns throughout the rest of the period. These plots are consistent with Table 1 and align with retail investors being net sellers after 9/11 and institutions being net buyers except in the smallest stocks.

FIGURE 1

Cumulative Price Returns around 9/11

Figure 1 plots cumulative log price returns for 10 market-capitalization-based deciles of 1,463 NYSE-listed stocks, the S&P 500 stock index, and 199 fixed-income closed-end funds from Sept. 10 through Oct. 5, 2001. Decile partitions for common stocks (D1–D10) are based on market capitalizations as of Sept. 10, 2001.



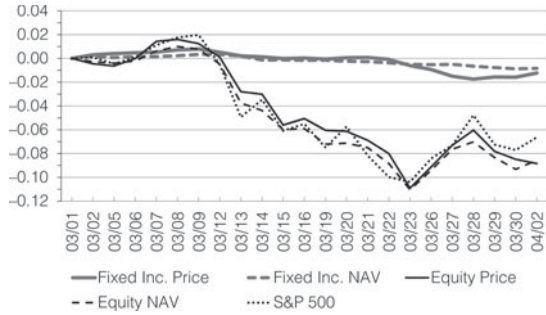
A. Benchmarking Return Patterns

Using NAV returns as a benchmark for CEF returns is common and is often the primary motivation for studying a wide variety of phenomena using CEFs (e.g., Dimson and Minio-Kozerski (1999), Gemmill and Thomas (2002), and Klibanoff et al. (1998)). Likewise, we examine how CEF prices move relative to NAVs. We begin with Figure 2, which plots Mar. 2001 cumulative price and NAV

FIGURE 2

Cumulative Price and NAV Returns during Mar. 2001 for CEFs and S&P 500 Stock Index

Figure 2 plots cumulative log price returns and cumulative log net asset value (NAV) returns during Mar. 2001 for 199 fixed-income closed-end funds (CEFs) and 59 equity CEFs, and cumulative price returns during Mar. 2001 for the S&P 500 stock index.



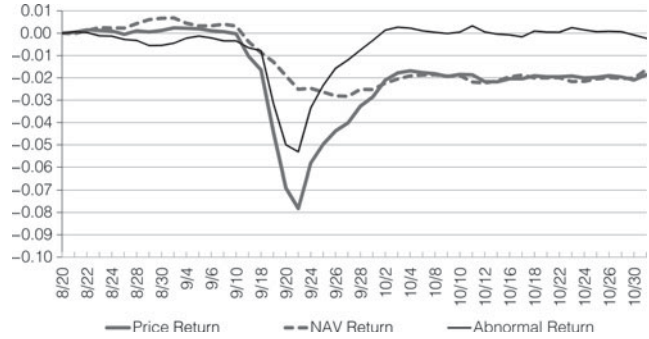
returns for our sample of fixed-income CEFs and a sample of 59 equity closed-end mutual funds (whose underlying assets are common stocks).[6] In addition, Figure 2 plots cumulative price returns for the S&P 500 stock index.

Figure 3 plots cumulative price and NAV returns, along with cumulative abnormal returns (CARs) (price returns minus NAV returns) for the CEFs from Aug. 20 to Oct. 31, 2001. Figure 3 shows that before 9/11, cumulative price returns closely track NAV returns, just as they do in Figure 2. Then, in the first week of trading following 9/11, cumulative price returns fall dramatically below cumulative NAV returns. Cumulative price returns begin to recover during the second week and then move back to roughly track cumulative NAV returns during the third week and beyond. The same pattern is, of course, also clearly visible in the CARs. In the Internet Appendix, we show that this pattern is not due to errors in NAVs.

FIGURE 3

Cumulative Price, NAV, and Abnormal Returns around 9/11 for Fixed-Income Closed-End Funds

Figure 3 plots cumulative log price returns, cumulative log net asset value (NAV) returns, and cumulative abnormal returns (log price returns minus log NAV returns) from Aug. 20, 2001 to Oct. 31, 2001 for 199 fixed-income closed-end funds.



After observing how fixed-income CEF prices sharply declined and recovered, both in isolation and relative to NAVs, it is worth revisiting Figure 1 to observe how strikingly similar the price return patterns for NYSE common stocks are to those of fixed-income CEFs. This similarity supports the idea that common stocks were also in turmoil, as their prices declined and recovered to varying degrees based on variation in the trading proportion of retail versus institutional investors as proxied by relative market capitalization. Below we discuss evidence that return-pattern differences among deciles are not explained by variation in market-risk exposures.

B. Changes in Investor Expectations

Graham and Harvey's (2003) survey of CFOs during Sept. 12–14, 2001 indicates lower forecasts of the 1-year equity premium compared to pre-9/11

[6]We select March because it is the month during Jan.–Aug. 2001 with the largest 5-day price decline in the S&P 500 stock index. Hence, it is especially useful for illustrating how CEF returns typically behave during short-term market declines.

forecasts, implying an expected fall in market prices. In a survey of individual investors over the weekend of Sept. 22–23, Glaser and Weber (2005) find expectations of higher returns compared to pre-9/11 expectations, which implies an expected increase in market prices. Glaser and Weber compare their findings with those in Graham and Harvey and conclude that these two results "do not coincide."

The return patterns we document appear consistent with both studies and suggest that the seeming inconsistency between the two surveys is due to the difference in their timing. The expectation during Sept. 12–14 in Graham and Harvey (2003) of an impending market decline was subsequently realized during the first post-9/11 week of Sept. 17–21, and similarly, the expectation during Sept. 22 and 23 that Glaser and Weber (2005) find, of an impending market increase, was also subsequently realized during the 2 weeks that followed. Therefore, the realized returns we document coincide extremely well with the expectations expressed in both surveys.

C. Other Sudden Marketwide Crises and Market-Risk Exposure

Although performing a complete analysis of other marketwide crisis events is beyond the scope of this article, the Internet Appendix provides an exploratory analysis of whether the return patterns we document for 9/11 are comparable to those of other crisis periods. To do so, we employ the identification method described earlier and identify 4 additional events for which we plot cumulative returns (the method also identifies 9/11). Overall, patterns for common stocks are similar to those for 9/11 in that price declines are larger, and recoveries are smaller, for small-cap stocks compared to large-cap stocks. Patterns are also similar for fixed-income CEFs, in that discounts widen and then eventually narrow.

We also show that return-pattern differences among deciles are not merely due to small- and large-cap stocks having different market-risk exposures. Specifically, we include graphs of CARs, where abnormal returns are defined relative to stock-specific market model-predicted returns. Differences in the patterns for small- and large-cap stocks are striking, with large-cap-stock CARs typically displaying very slight downward or upward drifts, but small-cap-stock CARs displaying significant negative drifts. We provide a similar graph for 9/11, which shows the same pattern. These plots make it clear that the raw return patterns we document are not explained by different exposures to market risk.

VI. Trading Statistics

We now report trading statistics for the periods before and after 9/11. These statistics provide additional insight into the composition of retail and institutional trading that coincide with the return patterns we observe.

A. Pre-9/11 Trading Statistics

To establish a baseline, we first examine the period from June 1 through Sept. 10, 2001. Panel A of Table 2 reports the medians of the various metrics defined in the data section for 11 groups of securities: 10 common stock deciles

TABLE 2

Pre-9/11 Summary Statistics

Summary statistics during the pre-9/11 period, June 1–Sept. 10, 2001, for 10 market-capitalization-based deciles of 1,463 NYSE-listed stocks and 199 fixed-income closed-end funds (CEFs). Decile partitions for common stocks (D1–D10) are based on market capitalizations as of Sept. 10, 2001. The reported statistics are medians of security-day observations, except for TRADE_SIZE distributions (Panel B), which are means.

	Common Stock Deciles Partitioned by Market Capitalization										
Trading Statistic	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	CEFs
Panel A. Median Characteristics											
MARKET_CAP ($millions)	52	170	331	539	860	1,290	2,077	3,470	6,996	23,985	194
TRADE_SIZE ($)	3,218	6,576	9,360	12,236	16,772	19,667	25,844	30,987	39,243	67,951	11,835
SHARE_PRICE ($)	3.37	11.49	15.85	19.90	25.11	27.08	31.39	30.40	39.90	44.81	12.81
EFFECTIVE_SPREAD	2.27%	0.84%	0.57%	0.41%	0.30%	0.26%	0.20%	0.17%	0.14%	0.10%	0.46%
TURNOVER	0.063%	0.127%	0.175%	0.208%	0.294%	0.310%	0.345%	0.376%	0.327%	0.277%	0.077%
PERCENTAGE_OF_BUYS	44.56%	51.44%	53.30%	54.66%	55.46%	56.00%	55.87%	56.09%	55.30%	55.03%	49.45%
Panel B. Distribution of Trades by TRADE_SIZE											
TRADES < $5K	77.11%	65.98%	57.77%	49.85%	42.13%	37.05%	30.39%	26.64%	20.63%	12.07%	34.75%
TRADES $5K–$10K	12.44%	15.87%	18.04%	19.75%	19.69%	20.69%	19.39%	19.75%	20.56%	16.95%	23.31%
TRADES $10K–$20K	6.51%	9.77%	12.69%	14.90%	17.73%	18.73%	19.96%	19.56%	20.15%	18.42%	23.46%
TRADES $20K–$50K	3.08%	5.80%	7.84%	10.55%	13.52%	15.12%	18.43%	19.80%	22.04%	25.26%	15.31%
TRADES > $50K	0.85%	2.57%	3.66%	4.94%	6.93%	8.41%	11.83%	14.25%	16.62%	27.30%	3.17%
TRADES < $20K	96.06%	91.62%	88.49%	84.50%	79.55%	76.47%	69.73%	65.95%	61.34%	47.44%	81.52%
Panel C. PERCENTAGE_OF_BUYS ($BUYS/($BUYS + $SELLS)) among Lee and Ready (1991) Signed Trades Larger Than $50,000											
PERCENTAGE_OF_BUYS (>$50K)	46.37%	54.03%	56.29%	57.28%	57.17%	57.59%	56.57%	57.12%	56.10%	55.41%	41.34%

defined by market capitalization, and fixed-income CEFs. As can be seen, the patterns among the stock deciles are regular. For example, TRADE_SIZE, SHARE_PRICE, and EFFECTIVE_SPREAD change almost monotonically across the decile columns. TURNOVER increases to a maximum for decile 8 and then declines with deciles 9 and 10. Finally, the PERCENTAGE_OF_BUYS increases monotonically from a low of 44.56% in decile 1 to a high of 56.00% in decile 6, and then remains around 55%–56% for the remaining deciles.

The CEFs are similar to small-cap stocks with respect to TURNOVER and SHARE_PRICE. Average TURNOVER for the CEFs is 0.077%, which is only slightly larger than that of decile 1 (0.063%), and SHARE_PRICE for the CEFs is \$12.81, which is slightly larger than it is for decile 2 (\$11.49).[7] Interestingly, the CEFs have significantly lower values of EFFECTIVE_SPREAD than small-cap stocks (deciles 1 and 2), and hence trading costs are less than one might expect. It seems reasonable that this enhanced liquidity is due to the superior information environment that the funds offer because of regularly disclosed NAVs and underlying assets that are fixed-income securities. Such a superior information environment should presumably lower the costs and risks of providing liquidity.

Panel B of Table 2 reports the distribution of TRADE_SIZE. Again, the patterns among the deciles are regular. For example, the proportion of trades in the smallest dollar category (<\$5K) decreases monotonically from the smallest to the largest decile, whereas the proportion in the two largest dollar value categories (\$20K–\$50K and >\$50K) increases monotonically. The percentage of trades in the smallest TRADE_SIZE categories for CEFs is similar to that of stock deciles 6–7.

Lee and Radhakrishna (2000) and Malmendier and Shanthikumar (2007) use trades of \$20K or less to identify small investors and trades of more than \$50K to identify institutional investors. Barber et al. (2009) also infer trader identity from trade size but warn that in 2001, institutional investors began to use computers to break up trades and hence the number of small trades that actually originate from institutions began to increase. Hence, we rely more heavily on very large trades to compare CEFs with common stocks because it is reasonable to assume such trades continued to originate from institutional investors. Panel B of Table 2 shows the TRADE_SIZE_PROPORTION of large trades (>\$50K) for CEFs is between that of deciles 2 and 3, and hence closer to small-cap stocks. Therefore, although CEFs are not like small-cap stocks in their portions of very small trades, they are fairly similar to small-cap stocks in their lack of very large trades.

Panel C of Table 2 reports the median PERCENTAGE_OF_BUYS for trades larger than \$50K, as a measure of institutional trading. Based on this metric, there was net institutional buying in all classes except decile 1 and the CEFs during the pre-9/11 period. In the next section, we investigate the extent to which institutional investors continued to be net buyers after 9/11.

[7] It could be that CEFs deliberately maintain a relatively low share price to appeal to a small-investor shareholder base. See Fernando, Krishnamurthy, and Spindt (1999) for an analysis of share price management by open-end fund managers.

B. Post-9/11 Trading Statistics

In Table 3, we report summary statistics during 5 periods, which cover June 1, 2001 through Dec. 31, 2001. In the first row of each panel, we repeat the statistics for the pre-9/11 period to aid in making comparisons.

Panel A of Table 3 reports the median PERCENTAGE_OF_BUYS, as well as changes from pre-9/11 levels. In the week of Sept. 17–21, the PERCENTAGE_OF_BUYS (as well as its change, which is universally negative) increases almost monotonically from deciles 1 through 8 and remains at the level of decile 8 for deciles 9 and 10. Its level is smallest for decile 1 by a wide margin and second smallest for decile 2, also by a wide margin. Thus, during the first post-9/11 trading week, sell-initiated trades were especially dominant in small-cap stocks. To a lesser extent, deciles 3 and 4 also had more sells than buys. For deciles 5 through 10, however, there remained more buy-initiated trades than sell-initiated trades. In fact, in results not tabulated here (but available from the authors), there were more buys than sells in deciles 6 through 10 on each day during the first trading week. We also note that although the PERCENTAGE_OF_BUYS is smaller than in the pre-9/11 period, the decrease is much less for large-cap compared to small-cap stocks.

Selling also became pervasive in the CEFs: PERCENTAGE_OF_BUYS is 33.37% in the week of Sept. 17–21, slightly lower than for decile 1 and a relative drop of 33% from the pre-9/11 level. We conclude that there was a massive rush by retail investors to sell small-cap stocks and fixed-income CEFs but that there continued to be more buying than selling in mid- and large-cap stocks just as there was before the event. Among common stocks, these results are consistent with a relative flight to quality (for a parallel flight to quality in the banking system, see Caballero and Krishnamurthy (2008) and McAndrews and Potter (2002)).

Figure 1 shows that price returns rebounded during the second and third post-9/11 trading weeks. Thus, it is not surprising that PERCENTAGE_OF_BUYS is higher in all security classes during these 2 weeks (Sept. 24–Oct. 5), and that the swing was strongest in the CEFs and small-cap stocks. On average, net buying continued through the rest of the year as well (Oct. 8–Dec. 31), except for in decile 1 and the CEFs.

Panel B of Table 3 reports the PERCENTAGE_OF_BUYS based only on signed trades >$50K, which were those likely executed by institutional investors. For every security class, the PERCENTAGE_OF_BUYS is smaller in the week following 9/11 (Sept. 17–21) than beforehand. Strikingly, however, there remained net institutional buying in deciles 5 and larger.

The dramatic reduction in buy-signed trades for both CEFs and small-cap stocks (deciles 1 and 2), together with the small-investor base of these securities, provides additional evidence that retail traders engaged in heavy selling during the first trading week after 9/11. And the fact that the PERCENTAGE_OF_BUYS for mid- and large-cap stocks remained above 50% suggests that if retail investors also sold these stocks heavily, institutional investors must have bought them at least as heavily, on average. Consistent with this, trades $50K and larger indicate institutional net buying in these deciles. This is key because these buying and selling patterns, together with Figure 1, show that in an environment with heavy retail selling but institutional buying (at least in larger trades), prices moved lower.

TABLE 3

Post-9/11 Summary Statistics

Summary statistics during 5 periods between June 1 and Dec. 31, 2001 for 10 market-capitalization-based deciles of 1,463 NYSE-listed stocks and 199 fixed-income closed-end funds (CEFs). Decile partitions for common stocks (D1–D10) are based on market capitalizations as of Sept. 10, 2001. The reported statistics are medians of security-day observations in the period, except for TRADE_SIZE distributions (Panel B), which are means.

	Common Stock Deciles Partitioned by Market Capitalization										
Time Period	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	CEFs
Panel A. PERCENTAGE_OF_BUYS ($BUYS / ($BUYS + $SELLS)) among All Lee and Ready (1991) Signed Trades											
6/1–9/10	44.56%	51.44%	53.30%	54.66%	55.46%	56.00%	55.87%	56.09%	55.30%	55.03%	49.45%
9/17–9/21	33.65%	41.99%	47.24%	48.22%	50.98%	52.11%	53.37%	53.66%	53.31%	53.37%	33.37%
Change (from pre-9/11)	−24%	−18%	−11%	−12%	−8%	−7%	−4%	−4%	−4%	−3%	−33%
9/24–9/28	47.55%	51.71%	56.06%	56.68%	56.29%	56.81%	56.25%	56.84%	55.61%	56.36%	53.36%
Change (from pre-9/11)	7%	1%	5%	4%	1%	1%	1%	1%	1%	2%	8%
10/1–10/05	44.85%	52.05%	53.64%	56.62%	56.77%	57.15%	56.53%	57.58%	57.08%	57.56%	53.39%
Change (from pre-9/11)	1%	1%	1%	4%	2%	2%	1%	3%	3%	5%	8%
10/8–12/31	48.02%	51.51%	53.85%	55.85%	56.13%	56.48%	56.70%	56.70%	56.18%	55.86%	45.89%
Change (from pre-9/11)	8%	0%	1%	2%	1%	1%	1%	1%	2%	2%	−7%
Panel B. PERCENTAGE_OF_BUYS ($BUYS / ($BUYS + $SELLS)) among Lee and Ready (1991) Signed Trades Larger Than $50K											
6/1–9/10	46.37%	54.03%	56.29%	57.28%	57.17%	57.59%	56.57%	57.12%	56.10%	55.41%	41.34%
9/17–9/21	41.58%	43.96%	49.34%	46.38%	52.04%	54.78%	53.78%	54.38%	53.34%	53.33%	9.89%
Change (from pre-9/11)	−10%	−19%	−12%	−19%	−9%	−5%	−5%	−5%	−5%	−4%	−76%
9/24–9/28	60.67%	62.07%	59.62%	57.48%	56.30%	56.17%	56.07%	56.86%	56.48%	56.64%	59.84%
Change (from pre-9/11)	31%	15%	6%	0%	−2%	−2%	−1%	0%	1%	2%	45%
10/1–10/05	68.49%	56.66%	53.58%	59.08%	57.36%	58.25%	56.25%	58.71%	58.10%	58.13%	48.19%
Change (from pre-9/11)	48%	5%	−5%	3%	0%	1%	−1%	3%	4%	5%	17%
10/8–12/31	53.00%	56.61%	57.23%	57.54%	57.22%	57.39%	57.41%	57.99%	56.77%	56.46%	31.16%
Change (from pre-9/11)	14%	5%	2%	0%	0%	0%	1%	2%	1%	2%	−25%

(continued on next page)

TABLE 3 (continued)

Post-9/11 Summary Statistics

Time Period	Common Stock Deciles Partitioned by Market Capitalization										
	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	CEFs
Panel C. TRADE_SIZE ($)											
6/1–9/10	3,218	6,576	9,360	12,236	16,772	19,667	25,844	30,987	39,243	67,951	11,835
9/17–9/21	3,115	6,990	10,294	14,164	18,505	22,287	29,613	35,639	45,795	103,366	13,407
Change (from pre-9/11)	−3%	6%	10%	16%	10%	13%	15%	15%	17%	52%	13%
9/24–9/28	2,824	6,374	9,560	11,641	15,536	19,290	24,314	29,970	38,581	75,036	11,779
Change (from pre-9/11)	−12%	−3%	2%	−5%	−7%	−2%	−6%	−3%	−2%	10%	0%
10/1–10/05	2,518	5,720	8,167	10,181	14,292	16,660	22,806	26,935	35,964	64,083	11,587
Change (from pre-9/11)	−22%	−13%	−13%	−17%	−15%	−15%	−12%	−13%	−8%	−6%	−2%
10/8–12/31	2,729	5,217	7,736	9,960	12,923	15,844	21,478	25,326	33,362	59,301	11,456
Change (from pre-9/11)	−15%	−21%	−17%	−19%	−23%	−19%	−17%	−18%	−15%	−13%	−3%
Panel D. TURNOVER (shares traded/shares outstanding)											
6/1–9/10	0.063%	0.127%	0.175%	0.208%	0.294%	0.310%	0.345%	0.376%	0.327%	0.277%	0.077%
9/17–9/21	0.096%	0.185%	0.260%	0.322%	0.445%	0.477%	0.579%	0.693%	0.599%	0.600%	0.142%
Change (from pre-9/11)	52%	45%	49%	55%	51%	54%	68%	84%	83%	116%	86%
9/24–9/28	0.085%	0.196%	0.238%	0.281%	0.411%	0.465%	0.508%	0.568%	0.497%	0.453%	0.100%
Change (from pre-9/11)	35%	54%	36%	35%	40%	50%	47%	51%	52%	63%	30%
10/1–10/05	0.068%	0.144%	0.172%	0.239%	0.353%	0.377%	0.437%	0.525%	0.426%	0.386%	0.089%
Change (from pre-9/11)	8%	13%	−1%	15%	20%	22%	27%	39%	30%	39%	16%
10/8–12/31	0.082%	0.118%	0.177%	0.213%	0.282%	0.317%	0.352%	0.394%	0.352%	0.309%	0.086%
Change (from pre-9/11)	31%	−7%	2%	3%	−4%	2%	2%	5%	8%	12%	12%
Panel E. EFFECTIVE_SPREAD											
6/1–9/10	2.27%	0.84%	0.57%	0.41%	0.30%	0.26%	0.20%	0.17%	0.14%	0.10%	0.46%
9/17–9/21	3.47%	1.33%	0.88%	0.61%	0.43%	0.37%	0.29%	0.25%	0.19%	0.15%	0.82%
Change (from pre-9/11)	53%	59%	54%	51%	44%	43%	43%	41%	35%	49%	78%
9/24–9/28	3.51%	1.27%	0.80%	0.59%	0.41%	0.32%	0.26%	0.22%	0.17%	0.13%	0.70%
Change (from pre-9/11)	55%	51%	39%	45%	37%	26%	26%	24%	21%	29%	52%
10/1–10/05	3.46%	1.15%	0.72%	0.52%	0.38%	0.31%	0.24%	0.20%	0.16%	0.13%	0.63%
Change (from pre-9/11)	53%	38%	25%	27%	27%	21%	16%	16%	12%	29%	36%
10/8–12/31	2.62%	0.97%	0.60%	0.42%	0.30%	0.25%	0.20%	0.17%	0.13%	0.10%	0.54%
Change (from pre-9/11)	16%	16%	4%	2%	1%	−3%	−2%	−4%	−4%	0%	18%

Panel C of Table 3 reports TRADE_SIZE statistics. In most cases there is a modest increase in average TRADE_SIZE in the week following 9/11, but decile 10 increased from $67,951 to $103,366 (a relative increase of 52%). This does not seem to have been caused by one-sided trading aimed at liquidating large positions, because Panel B shows that the PERCENTAGE_OF_BUYS for trades larger than $50K fell only to 53.33% during this week, from 55.41% beforehand. Hence, any increase in sell-initiated trade size must have been offset by larger buy trades such that the majority of larger trades remained buy initiated.

Panel D of Table 3 shows, not surprisingly, that TURNOVER increased in all security classes following 9/11. Panel E reports statistics for EFFECTIVE_SPREAD. As with TURNOVER, EFFECTIVE_SPREAD is substantially larger for all security classes following 9/11. As one might expect, the largest increases were for the CEFs and deciles 1 and 2. The PERCENTAGE_OF_BUYS during the first post-9/11 trading week (see Panel A) indicate that selling pressure was heaviest in these securities, and so it is not surprising that liquidity providers demanded higher levels of compensation for providing liquidity.

In summary, trading patterns show that in the immediate aftermath of 9/11 there was more dollar selling than buying in CEFs and the smaller common stock deciles, and more dollar buying than selling in the larger deciles. This is consistent with retail selling and institutional buying. Given the respective investor bases of small- and large-cap stocks, such disparate trading behavior may explain the differences in return patterns we observe in Figure 1 for small- versus large-cap stocks, in which small-cap stocks had much larger price declines than large-cap stocks. It is also particularly interesting that large-cap stocks suffered significant price declines after 9/11 despite institutional buying as indicated by more dollar-weighted buys than sells, both overall and in trades $>$\$50K. This finding demonstrates that as a marketwide crisis unfolds, prices can move in the direction of correlated retail trading and against the direction implied by large, institutional trades.

VII. Pooled, Cross-Sectional Time-Series Regressions

We now proceed to cross-sectional regressions of weekly (Friday-to-Friday) returns, with three goals in mind. First, regressions will establish whether price declines and recoveries are statistically significant. Second, regression analysis allows us to control for the CEF leverage return effects documented in Elton, Gruber, Blake, and Shachar (2013), in which the use of leverage increases returns but also return volatility.[8] Finally, regression analysis allows us to document the extent to which price recoveries for both funds and common stocks are due to a general improvement in sentiment versus a reversal of security-specific price declines.

[8]We thank Christopher Blake for providing leverage data for the funds in the Elton et al. (2013) sample. We supplement these data by hand-collecting leverage as of the latest date before 9/11, obtained from financial statements on the U.S. Securities and Exchange Commission's Electronic Data Gathering, Analysis, and Retrieval (EDGAR) Web site (https://www.sec.gov/edgar.shtml).

A. Regressions of Pre-9/11 Returns

Our initial regressions provide benchmark results based on the 48-week period before 9/11, which identify weekly return autocorrelations (price momentum or reversal). All of our pooled, cross-sectional time-series models include unreported security-specific constants (i.e., fixed effects) and allow for autocorrelated and heteroskedastic error terms.[9] For all securities, we regress weekly (Friday-to-Friday) price returns on lagged price returns. For the CEFs, we also estimate the regression with abnormal returns in place of price returns.

The model we estimate and report in Table 4 is:

$$R_{i,t} = \alpha_i + \beta_1 R_{i,t-1} + \beta_2 R_{i,t-2} + \varepsilon_{i,t}, \tag{2}$$

where $R_{i,t}$ is the return for security i in week t, and α_i is a security-specific constant (fixed effects).

The first regression column of Table 4 shows a positive coefficient of 0.176 on $R_{i,t-1}$, which is significant both statistically and economically. This indicates a 1-week security-specific price momentum of 0.176% for every 1% return in the prior week. The coefficient on $R_{i,t-2}$ is insignificant. The second regression column repeats this regression but also includes LEVERAGE, defined as the sum of liabilities plus preferred stock divided by the sum of liabilities plus net assets. Cherkes, Sagi, and Stanton (2009) note that "CEFs make substantial use of leverage" (p. 261). We are unable to locate leverage information for 12 funds, and hence the sample of funds decreases from 199 to 187. Consistent with Elton et al. (2013), fund returns are positively correlated with LEVERAGE. However, the coefficient on $R_{i,t-1}$ is relatively unchanged in magnitude and statistical significance.

The third and fourth regression columns repeat the first two regressions using abnormal returns (log price returns minus log NAV returns) in place of price returns. The third regression shows that the CEF abnormal returns have insignificant 1-week momentum (coefficient for $R_{i,t-1} = 0.068$, p-value $= 0.069$), followed by significant 2-week reversal (coefficient for $R_{i,t-2} = -0.083$, p-value < 0.001). In column 4, LEVERAGE is insignificant and the coefficient for $R_{i,t-2}$ remains statistically significant with a slightly lower magnitude.

Table 4 also reports baseline regressions for the common stock deciles. On average, stock prices are significantly reversed with a 2-week lag as indicated by the negative and significant coefficients on $R_{i,t-2}$ for every decile. The coefficients on $R_{i,t-1}$, however, are mixed: 6 are insignificant, 2 are significant and positive, and 2 are significant and negative.

B. Regressions of Returns Before, Across, and After 9/11

We now turn to regressions that include a total of 54 weekly observations for each security: 48 pre-9/11 weekly return observations, the return across 9/11

[9]We estimate time-series, cross-sectional models using the Gauss–Newton method of Davidson and MacKinnon (1980) to allow for first-order autocorrelation among the residuals of each fund and obtain unbiased estimates of this correlation. In addition, we allow for heteroskedasticity among funds. The regression results for both the pre-9/11 sample that we discuss here and the sample that spans 9/11 that we discuss below are qualitatively similar if we use alternative techniques, including simple ordinary least squares both with and without fixed effects.

TABLE 4

Regressions Explaining Weekly Returns for 48 Pre-9/11 Trading Weeks

Pooled, cross-sectional time-series regressions for 10 market-capitalization-based deciles of 1,463 NYSE-listed stocks and 199 (187 when LEVERAGE is included) fixed-income closed-end funds (CEFs) that explain weekly Friday-to-Friday returns for the 48 return weeks immediately preceding 9/11. Decile partitions for common stocks (D1–D10) are based on market capitalizations as of Sept. 10, 2001. The main regression specification is $R_{i,t} = \alpha_i + \beta_1 R_{i,t-1} + \beta_2 R_{i,t-2} + e_{i,t}$, where $R_{i,t}$ is the cumulative log return for security i in week t, and α_i is a security-specific constant (i.e., fixed effects, the coefficients on which are not reported in the table for brevity). The second and fourth CEF regressions additionally include the regressor LEVERAGE, which is the CEF's leverage ratio measured at the latest available date before 9/11. Cumulative log price returns are used except for the CEF regressions with the dependent variable labeled abnormal, in which case the return is the cumulative log price return minus the cumulative log net asset value return. Error terms allow for both heteroskedasticity and first-order autocorrelation. The χ^2 p-value (shown below in parentheses) measures the joint significance of only the coefficients reported (it excludes the unreported fixed effects indicator variables). * and ** indicate statistical significance at the 5% and 1% levels, respectively.

					Common Stock Deciles Partitioned by Market Capitalization									
Sample:	CEFs	CEFs	CEFs	CEFs	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10
Dependent Var. Return Type:	Price	Price	Abnormal	Abnormal	Price	Price	Price	Price	Price	Price	Price	Price	Price	Price
$R_{i,t-1}$ (lagged return)	0.176**	0.171**	0.068	0.051	−0.034	0.184**	0.108*	−0.117*	−0.032	−0.051	−0.110*	0.011	−0.049	−0.028
	(<0.001)	(<0.001)	(0.069)	(0.199)	(0.474)	(<0.001)	(0.024)	(0.023)	(0.551)	(0.298)	(0.045)	(0.833)	(0.264)	(0.545)
$R_{i,t-2}$ (twice-lagged return)	−0.016	−0.009	−0.083**	−0.075**	−0.038**	−0.089**	−0.067**	−0.074**	−0.061**	−0.051**	−0.068**	−0.069**	−0.108**	−0.132**
	(0.348)	(0.613)	(<0.001)	(<0.001)	(0.004)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)
LEVERAGE		0.002*		−0.001										
		(0.036)		(0.314)										
Wald statistic	33.53**	40.04**	44.84**	39.30**	9.26**	25.91**	15.75**	26.51**	23.40**	16.46**	23.36**	28.72**	76.36**	116.97**
χ^2 p-value	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(0.010)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)

itself, and 5 post-9/11 weekly return observations. Note that the return across 9/11 spans 2 calendar weeks, Sept. 7–21, because of the market closure. Therefore, we allow for a distinct error term for the return across 9/11, which corrects for increased volatility due to the event itself and the greater than usual number of calendar days over this return's measurement period.

The model we estimate is:

$$
\begin{aligned}
(3) \qquad R_{i,t} \;=\; & \alpha_i + \lambda_0 E_t + \lambda_1 E_{t-1} + \beta_1(-E_{t-1}R_{i,t-1}) + \lambda_2 E_{t-2} \\
& + \beta_2(-E_{t-2}R_{i,t-2}) + \beta_3(1 - E_{t-1})R_{i,t-1} \\
& + \beta_4(1 - E_{t-2})R_{i,t-2} + \varepsilon_{i,t},
\end{aligned}
$$

where $R_{i,t}$ is the return for security i in week t, α_i is a security-specific constant (fixed effects), and E_t is an indicator variable equal to 1 if the weekly return $R_{i,t}$ spans 9/11 (the return over Friday, Sept. 7 to Friday, Sept. 21). Hence, λ_0 measures the systematic reaction to 9/11 (the first-week reaction), and λ_1 and λ_2 measure systematic recoveries in the second and third weeks, respectively. We also use the E_t indicators to partition how the current return (the left-hand-side variable) depends on lagged returns $R_{i,t-1}$ and $R_{i,t-2}$, based on whether the lagged returns span 9/11. Specifically, $R_{i,t-1}$ is partitioned into $E_{t-1}R_{i,t-1}$ and $(1 - E_{t-1})R_{i,t-1}$, and $R_{i,t-2}$ is partitioned into $E_{t-2}R_{i,t-2}$ and $(1 - E_{t-2})R_{i,t-2}$.

For our purposes, the key variables here are $E_{t-1}R_{i,t-1}$ and $E_{t-2}R_{i,t-2}$. Their coefficients, β_1 and β_2, measure the extent to which security-specific recoveries are directly tied to the initial security-specific price declines. Note that we perform simple transformations and actually use $(-E_{t-1}R_{i,t-1})$ and $(-E_{t-2}R_{i,t-2})$ in the specifications we estimate. By making these terms negative, positive values for β_1 and β_2 indicate recovery, or positive returns. This is because for a given security i, the return $R_{i,t-1}$ is negative when $E_{t-1} = 1$ due to the security's negative return reaction to 9/11, and similarly, $R_{i,t-2}$ is negative when $E_{t-2} = 1$. Section 4 in the Internet Appendix provides a numerical example of the coding scheme.

1. CEF Regressions

Table 5 presents the results. The coefficient E_t for the CEF price returns (first regression column) is -0.056, which is both economically and statistically significant ($p < 0.001$). This implies that the average first-week price reaction to 9/11 was -5.6%, which is smaller than the -7.8% mean return reported in Table 1. However, this regression controls for the momentum in the prior 2 weeks of returns by including the variables $(1 - E_{t-1})R_{i,t-1}$ and $(1 - E_{t-2})R_{i,t-2}$.

Table 1 reports a mean recovery return of 4.56% in the second week of trading. The regression shows that the systematic component of this return is statistically significant, but only 0.6% (the coefficient for $E_{t-1} = 0.006$, with p-value = 0.047). In marked contrast, the fund-specific component of this second-week recovery return is large: The coefficient on $(-E_{t-1}R_{i,t-1})$ is 0.409, implying that 40.9% of each fund's distinct initial price return decline over the first post-9/11 trading week was reversed during the second week. The systematic return in the third week is similar to that in the second week at 0.006, and the third week's fund-specific recovery component is insignificant.

TABLE 5

Regressions Explaining Weekly Returns for Before, Across, and After 9/11

Pooled, cross-sectional time-series regressions for 10 market-capitalization-based deciles of 1,463 NYSE-listed stocks and 199 (187 when LEVERAGE is included) fixed-income closed-end funds (CEFs) that explain weekly Friday-to-Friday returns over the 48 weeks immediately preceding 9/11, the return across 9/11, and 5 weekly returns after the 9/11 return week (54 total return-week observations). Decile partitions for common stocks (D1–D10) are based on market capitalizations as of Sept. 10, 2001. The main regression specification is $R_{i,t} = \alpha_i + \lambda_0 E_t + \lambda_1 E_{t-1} + \beta_1 (-E_{t-1}R_{i,t-1}) + \lambda_2 E_{t-2} + \beta_2 (-E_{t-2}R_{i,t-2}) + \beta_3 (1-E_{t-1})R_{i,t-1} + \beta_4(1-E_{t-2})R_{i,t-2} + e_{i,t}$, where $R_{i,t}$ is the cumulative log return for security i in week t, α_i is a security-specific constant (i.e., fixed effects, the coefficients on which are not reported in the table for brevity), and E_t is an indicator variable set to 1 if the return $R_{i,t}$ spans 9/11 (the return over 9/7–9/21). The second and fourth CEF regressions additionally include the regressors LEVERAGE and (E_t)LEVERAGE (an interaction term), where LEVERAGE is the CEF's leverage ratio measured at the latest available date before 9/11. The negative signs on $-E_{t-1}R_{i,t-1}$ and $-E_{t-2}R_{i,t-2}$ are so that positive coefficients indicate recoveries in the second and third return weeks following 9/11. Cumulative log price returns are used except for the CEF regressions with the dependent variable labeled abnormal, in which case the return is the cumulative log price return minus the cumulative log net asset value return. Heteroskedasticity is modeled between funds and within funds for event and nonevent weeks; in addition, first-order autocorrelation is permitted in the error terms of each fund, as well as a distinct error term across 9/11. The χ^2 p-value (shown below in parentheses) measures the joint significance of only the coefficients reported (it excludes the unreported fixed effects indicator variables). * and ** indicate statistical significance at the 5% and 1% levels, respectively.

					Common Stock Deciles Partitioned by Market Capitalization									
Sample:	CEFs	CEFs	CEFs	CEFs	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10
Dependent Var. Return Type:	Price	Price	Abnormal	Abnormal	Price	Price	Price	Price	Price	Price	Price	Price	Price	Price
Panel A. First-Week Reaction to 9/11 (negative coefficients indicate negative return reaction)														
E_t (systematic reaction)	−0.056**	−0.060**	−0.042**	−0.048**	−0.117**	−0.141**	−0.150**	−0.143**	−0.144**	−0.132**	−0.136**	−0.135**	−0.118**	−0.111**
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)
Panel B. Second-Week Systematic and Security-Specific Reactions to 9/11 (positive coefficients indicate recovery)														
E_{t-1} (systematic reaction)	0.006*	0.005	0.005*	0.003	0.001	0.034**	0.066**	0.029**	0.042**	0.062**	0.054**	0.057**	0.043**	0.070**
	(0.047)	(0.154)	(0.033)	(0.236)	(0.928)	(0.002)	(<0.001)	(0.008)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)
$-E_{t-1}R_{i,t-1}$ (security-specific reaction)	0.409**	0.408**	0.557**	0.601**	0.015	−0.092	−0.008	0.159*	0.089	−0.067	0.041	−0.023	0.130	0.002
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(0.839)	(0.135)	(0.891)	(0.021)	(0.229)	(0.349)	(0.578)	(0.710)	(0.066)	(0.977)

(continued on next page)

TABLE 5 (continued)

Regressions Explaining Weekly Returns for Before, Across, and After 9/11

					Common Stock Deciles Partitioned by Market Capitalization									
Sample:	CEFs	CEFs	CEFs	CEFs	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10
Dependent Var. Return Type:	Price	Price	Abnormal	Abnormal	Price	Price	Price	Price	Price	Price	Price	Price	Price	Price
Panel C. Third-Week Systematic and Security-Specific Reactions to 9/11 (positive coefficients indicate recovery)														
E_{t-2} (systematic reaction)	0.006**	0.009**	−0.001	0.001	−0.031**	−0.010	−0.018*	0.001	−0.004	−0.006	−0.004	−0.009	0.001	−0.007
	(0.001)	(<0.001)	(0.755)	(0.708)	(0.001)	(0.253)	(0.038)	(0.852)	(0.644)	(0.470)	(0.596)	(0.227)	(0.858)	(0.308)
$-E_{t-2}R_{i,t-2}$ (security-specific reaction)	−0.014	−0.050	0.077*	0.064	0.143*	0.087	0.073	0.109*	0.133**	0.185**	0.138**	0.184**	0.115*	0.126**
	(0.644)	(0.107)	(0.036)	(0.103)	(0.017)	(0.063)	(0.053)	(0.014)	(0.009)	(<0.001)	(0.003)	(<0.001)	(0.023)	(0.010)
Panel D. Correlations with Non-9/11 Lagged Returns (positive coefficients indicate momentum; negative coefficients indicate reversals)														
$(1-E_{t-1})R_{i,t-1}$ (once-lagged return)	0.192**	0.170**	0.083*	0.055	−0.019	0.195**	0.064	−0.024	0.026	0.018	−0.029	0.120**	−0.008	0.088*
	(<0.001)	(<0.001)	(0.023)	(0.159)	(0.696)	(<0.001)	(0.169)	(0.620)	(0.618)	(0.696)	(0.581)	(0.008)	(0.858)	(0.031)
$(1-E_{t-2})R_{i,t-2}$ (twice-lagged return)	−0.047**	−0.035*	−0.095**	−0.086**	−0.031*	−0.094**	−0.060**	−0.055**	−0.055**	−0.048**	−0.050**	−0.079**	−0.103**	−0.132**
	(0.006)	(0.043)	(<0.001)	(<0.001)	(0.016)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)
Panel E. CEF Leverage														
LEVERAGE		0.002*		−0.001										
		(0.042)		(0.433)										
(E_t) LEVERAGE		−0.010		0.015										
		(0.298)		(0.129)										
Wald statistic	2,329.50**	2,523.60**	1,728.60**	1,747.50**	207.77**	459.91**	513.09**	688.67**	629.46**	584.76**	623.30**	685.60**	677.09**	703.50**
χ^2 *p*-value	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)

The second regression of Table 5 adds both LEVERAGE and LEVERAGE interacted with E_{t-1}, the 9/11 return indicator. As in the prior results using only pre-9/11 data, the coefficient for LEVERAGE is statistically significant with a coefficient of 0.002. The interaction term is insignificant. Importantly, the 9/11 coefficient of E_t is relatively unchanged with a coefficient of -0.060 and a p-value < 0.001, and the second-week security-specific recovery term of $(-E_{t-1}R_{i,t-1})$ is even less affected.

The regressions of CEF abnormal returns (third and fourth regressions) show fairly similar results for our main variables of interest. One difference is that the security-specific recovery coefficient for the third week $(-E_{t-2}R_{i,t-2})$ is also significant in the third regression of Table 5. This term is not quite significant in regression 4. Overall, regressions 3 and 4 show that abnormal returns after 9/11 were significantly reversed on a fund-specific basis, mostly during the second post-9/11 trading week.[10]

2. Common Stock Regressions

The right-most 10 columns in Table 5 show the regression results for the common stock deciles. As expected, the coefficients on E_t, which measure the average price return during the first post-9/11 trading week, are negative and significant for every decile group. In the second week, there is significant systematic marketwide recovery in all but decile 1, as coefficients on E_{t-1} are positive and significant. Except for decile 4, however, there is no significant evidence of security-specific recovery in the second week, as the coefficients for $(-E_{t-1}R_{i,t-1})$ are insignificant.

During the third week, there is no evidence of systematic recovery; none of the coefficients on E_{t-2} are positive and significant (although deciles 1 and 3 are negative and significant). Of note, however, stocks do show significant security-specific recoveries during the third week following 9/11: The coefficients on $(-E_{t-2}R_{i,t-2})$ are positive and significant for all deciles except 2 and 3. This implies that for the most part, common stocks, like fixed-income CEFs, experienced a security-specific reversal of the 9/11 price declines. The difference is that the security-specific reversals for common stocks occur during the third week following 9/11 instead of the second.

Comparing the CEF and common stock regressions, both statistically validate significant negative returns followed by both systematic and security-specific reversals during the second or third post-9/11 trading weeks. In addition, the regressions show that initial reactions were more severe for common stocks than for fixed-income CEFs. As noted previously, less severe first-week price declines and faster security-specific reversals in fixed-income CEFs than in common stocks support the intuition in classic models such as Grossman and Stiglitz (1980)

[10]We also construct a systematic sentiment factor that is, for each week, the cross-sectional mean of the difference between the fund price and NAV returns. Including this as a regressor in the CEF abnormal return regression results in a coefficient (p-value) on $(-E_{t-1}R_{i,t-1})$ of 0.472 (<0.001). In addition, we estimate a regression in which we include the sentiment factor times a fund-specific sentiment beta (estimated using pre-9/11 data). In this regression, the coefficient (p-value) on $(-E_{t-1}R_{i,t-1})$ is 0.311 (<0.001). Hence, the evidence of fund-specific recoveries is robust to these alternative ways of controlling for systematic sentiment.

in which greater numbers of informed traders make pricing more efficient. The availability of NAVs, and information from 2 full trading days in fixed-income securities before trading in CEFs resumed, implies that both retail investors and arbitrageurs should have been better informed about the fair values of fixed-income CEFs than those of common stocks.

VIII. Did Retail Investors Overreact?

To summarize, return plots and cross-sectional regressions show that prices of common stocks declined sharply during the first trading week (which started almost a week after 9/11) but then rebounded thereafter in most market-cap deciles. Fixed-income CEFs exhibited a similar pattern, even though their underlying fixed-income assets experienced a relatively modest decline as shown by NAV returns. Ownership patterns, as well as trading statistics, indicate that there was pronounced selling pressure by retail investors, whereas there was continued institutional buying. It appears that retail investors engaged in panicked selling, while institutional investors provided liquidity, albeit at higher cost as evidenced by lower transaction prices and increases in the average effective spread. One possible and perhaps controversial interpretation of this evidence is that retail investors overreacted, at least relative to the reactions of institutional traders. Below we briefly summarize arguments for and against an overreaction explanation.

For common stocks, the case for overreaction is primarily made on the basis of the short-term reversal pattern we observe. Two papers that interpret short-term reversals as overreaction are Tetlock (2011) and Huang, Nekrasov, and Teoh (2012). For the CEFs we study, which are known to be primarily traded by retail investors, additional evidence is that prices sharply declined and recovered relative to NAVs, which are commonly used as benchmarks for fundamental value. Finally, as the regression analysis shows, price recoveries were substantially security-specific reversals of initial post-9/11 returns. This is consistent with the notion that security-specific price recoveries reflect security-specific mispricing.

An argument against an overreaction explanation is that strong retail selling was due to a sharp increase in aversion to risk or ambiguity, because retail investors are relatively unsophisticated in their ability to measure and manage downside risk. Arguably the simplest reaction to a perceived threat of a significant wealth loss is to sell, even if it means accepting substantial price concessions to compensate liquidity providers, and Figure 1 suggests that in most asset classes liquidity providers were well compensated. We leave it to the reader's interpretation whether the rush to sell by retail investors should be viewed as overreaction.

IX. Conclusion

We exploit the 9/11 terrorist event to study the interaction between retail and institutional traders and how prices react during a marketwide crisis. In our analysis we benchmark price returns against NAV returns for fixed-income CEFs. When the market reopened 6 days after 9/11, retail investors sold and CEF prices declined substantially, even relative to NAVs, during the first week of trading. This was followed by security-specific reversals during the second and third weeks of

trading. NYSE common stocks experienced a similar, but even more dramatic, pattern during the same 3-week period. This return pattern holds even for large-cap stocks, despite evidence that institutions were net buyers in these stocks.

Our study extends the literature in at least two important respects. First, whereas prior studies examine trading by retail or institutional investors, we examine how both sets of investors trade simultaneously during a crisis period. We find that in an environment with heavy retail investor selling, prices can move opposite to the net trading direction of institutional investors. An open question is whether this finding extends to industry- or firm-specific crisis periods. It is possible that retail and institutional investors interact similarly in such crises, but it is also possible that many retail investors are sufficiently well diversified as not to respond to a narrower crisis with the same level of urgency.

Second, we find that prices reversed sooner in fixed-income CEFs than in common stocks, particularly those in the smallest capitalization deciles. Potentially this was due to fixed-income CEFs having a superior information environment through regularly disclosed NAVs and being claims on fixed-income securities. Such an explanation is consistent with predictions stemming from classic microstructure theory, wherein a greater proportion of informed traders should speed the movement of prices toward fundamental values. This explanation would also suggest that the quality and availability of information plays a particularly important role in the ability of asset prices to recover during a crisis period.

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ONLINE APPENDIX

Who moves markets in a sudden market-wide crisis?

1) Errors in closed-end fund net asset values

2) Market-model cumulative abnormal returns following nine-eleven

3) Other market-wide crisis events

4) Numerical illustration of data coding for Table 5 regressions

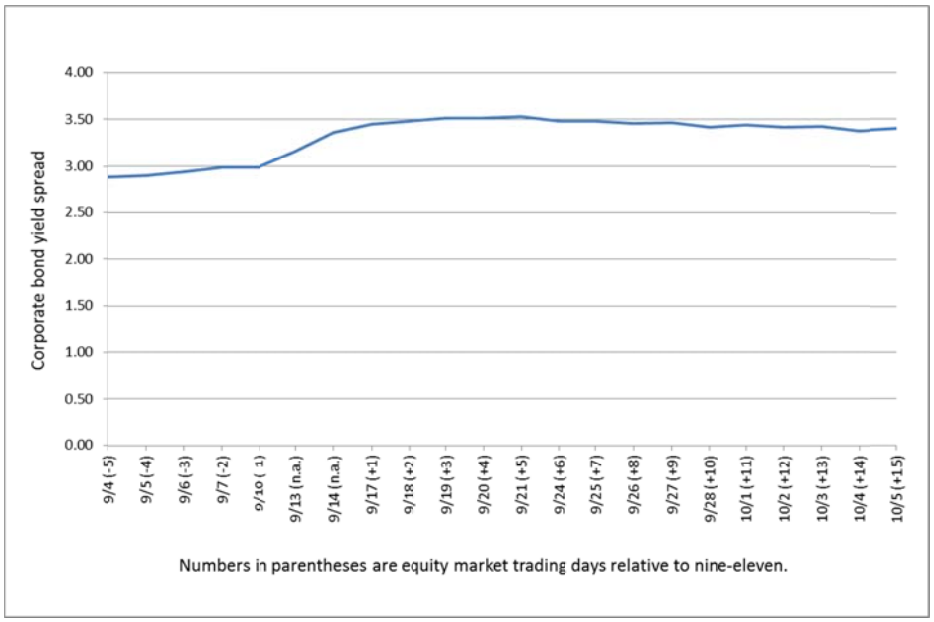
1 Errors in closed-end fund net asset values

We first consider whether the evidence is potentially explained by errors in reported NAVs. Suppose NAVs during the first week after nine-eleven (and on Friday, 9/21, in particular) were overstated because they were not updated after non-eleven due to the disrupted environment. If that were the case, negative abnormal returns could be due to errors in the NAVs. However, we find that only one fund has the same NAV both on the last trading day prior to nine-eleven and at the end of the first trading week (9/21) after nine-eleven. Thus, NAVs were updated during the first trading week following nine-eleven.

Another possibility is that, although reported NAVs were updated, some of the asset prices used in NAV calculations were stale. This could have resulted in valuation errors immediately after nine-eleven. For example, suppose the risk of default increased immediately following nine-eleven. If bond prices for NAV calculations were stale or matrix-priced based on a pre-nine-eleven risk assessment, they would have been too high (relative to true fundamentals) and caused overstated fixed-income NAVs.

The figure below plots the Baa-rated corporate bond yield spread (above the 10-year treasury yield) and shows that the default premium did increase following nine-eleven. However, the patterns of price and NAV returns are not consistent with NAVs being overstated because of increased default risk. As shown in the figure below, the default premium remains somewhat higher through 10/05. And yet, cumulative price returns recovered to the level of cumulative NAV returns instead of cumulative NAV returns converging to cumulative price returns (see Figure 3 in the paper). If bond prices were erroneously high and did not reflect the increased default premium at first, then as bond prices became increasingly accurate, cumulative NAV returns should have converged to cumulative price returns instead of vice versa.

Corporate Bond Yield Spreads

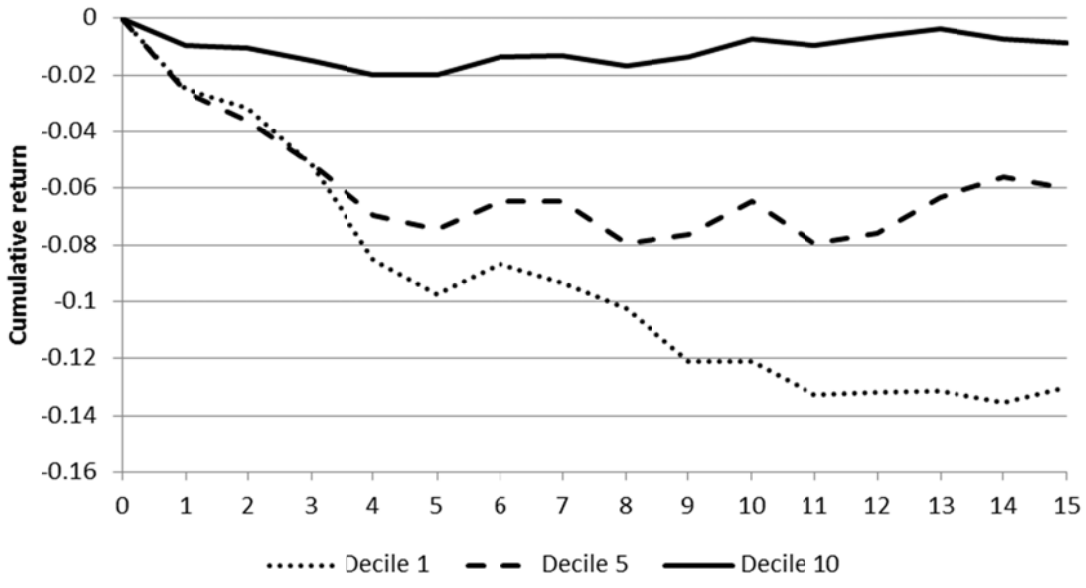


As an additional check, we spoke with multiple people responsible for the NAV calculations of a variety of CEFs. They assured us that prior to Friday, 9/21, accurate, updated secondary-market based prices were being used to calculate the NAVs of fixed-income CEFs. The evidence strongly supports the idea that NAVs for Friday 9/21 are appropriately updated and therefore not stale.

2 Market model cumulative abnormal returns following nine-eleven

To see how stock returns behaved after nine-eleven after controlling for market risk, below we plot cumulative abnormal returns relative to market model predicted returns. The market model's parameters are estimated on a stock-specific basis over trading days -125 to -5 and using the value-weighted CRSP return (including dividends) as the market proxy. We plot only deciles 1, 5, and 10 to show a less cluttered graph. The deciles not shown plot in between deciles 1 and 10, except during trading days 5 through 15 when decile 2 plots somewhat beneath decile 1. As represented by deciles 1 and 10 below, small-cap stocks experienced significantly more pronounced market-risk-adjusted price declines than large-cap stocks. Hence, the significantly worse returns experienced by smaller-cap stocks and plotted in Figure 1 in the paper are not explained by market risk exposure.

Cumulative abnormal returns relative to market model (Day 1 = Close on September 17, 2001)



3 Other market-wide crisis events

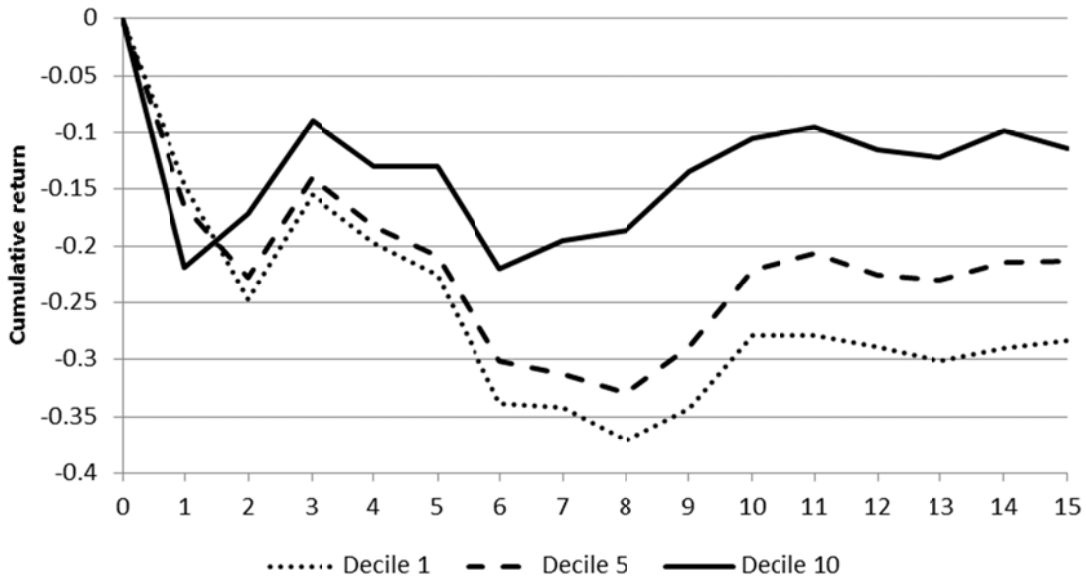
The methodology described in Section 3 of the paper identifies nine-eleven, as well as the following four market-wide crisis event days: (3.1) October 19, 1987, (3.2) October 13, 1989, (3.3) October 27, 1997, and (3.4) August 8, 2011. Below we provide three graphs for each that help the reader compare reactions in common stocks and fixed-income closed-end funds to those observed after nine-eleven. The first graph displays cumulative log returns for the average firm in NYSE deciles 1, 5, and 10, where the horizontal axis identifies trading days relative to the event day. The second graph displays cumulative abnormal returns for the deciles relative to a market model, where the market model's parameters are estimated on a stock-specific basis using the value-weighted CRSP return (including dividends) over trading days -125 to -5 relative to the event day. The third graph plots cumulative log price and net asset value (NAV) returns for fixed-income funds both before and after the event date.[1] We provide a short description of each event above its graphs. Following all twelve graphs, in section (3.5) we provide a brief discussion of commonalities and differences.

[1] NAVs for the October 19, 1987 event are from various issues of *The Wall Street Journal* and are available only weekly, so we plot the weekly return data points as well an interpolation of daily returns. Price returns are daily, from CRSP. NAV and price data for the October 13, 1989, October 17, 1997, and August 8, 2008 events are from Morningstar and include both surviving and defunct funds. For the October 13, 1989 event, almost no funds report daily NAVs and hence we again plot weekly NAV returns as well as interpolated return. The October 17, 1997 and August 8, 2008 events use funds reporting NAVs on a daily basis. The closed-end fund graph for September 17, 2001 event (the first trading day after nine-eleven) uses the data from Figure 3 in the paper, whose NAVs are from Thomson Reuters and prices are from CRSP.

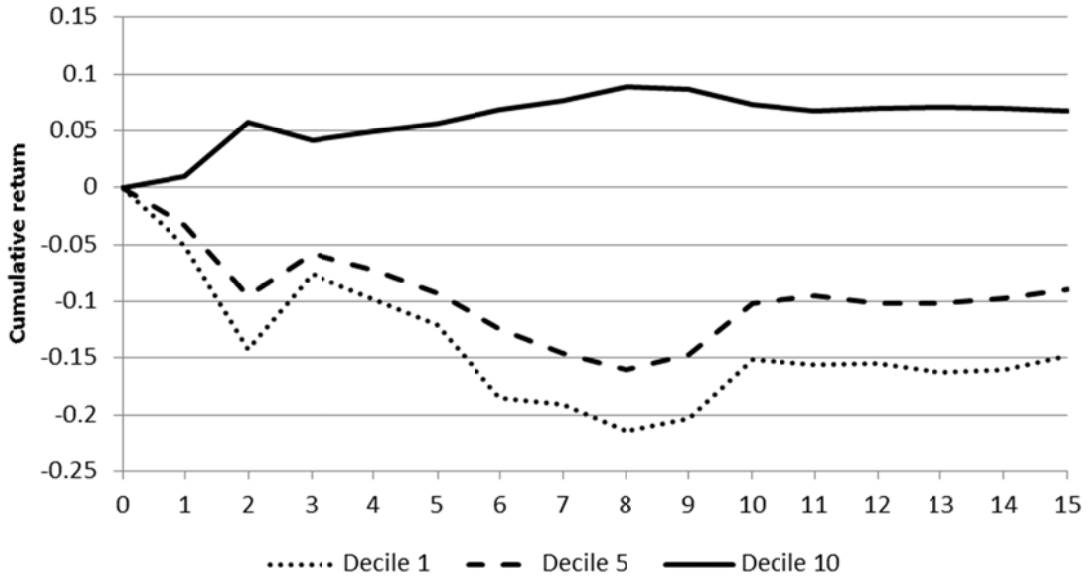
3.1 October 19, 1987 crisis event

On Friday, October 16, 1987, the DJIA closed down 9.5% from the prior Friday's close. The next day (Saturday 10/17/87), a front-page article in The New York Times reported "After the sharp selloff of recent days, these retail investors and mutual fund owners are wondering if the long, euphoric period is finally over. The nervousness of so many little investors, however, is not shared by market professionals." On Monday, Oct. 19, 1987, the DJIA dropped closed 22.6% from its close on Friday, 10/16, its largest ever one-day drop. The event came to be known as "Black Monday."

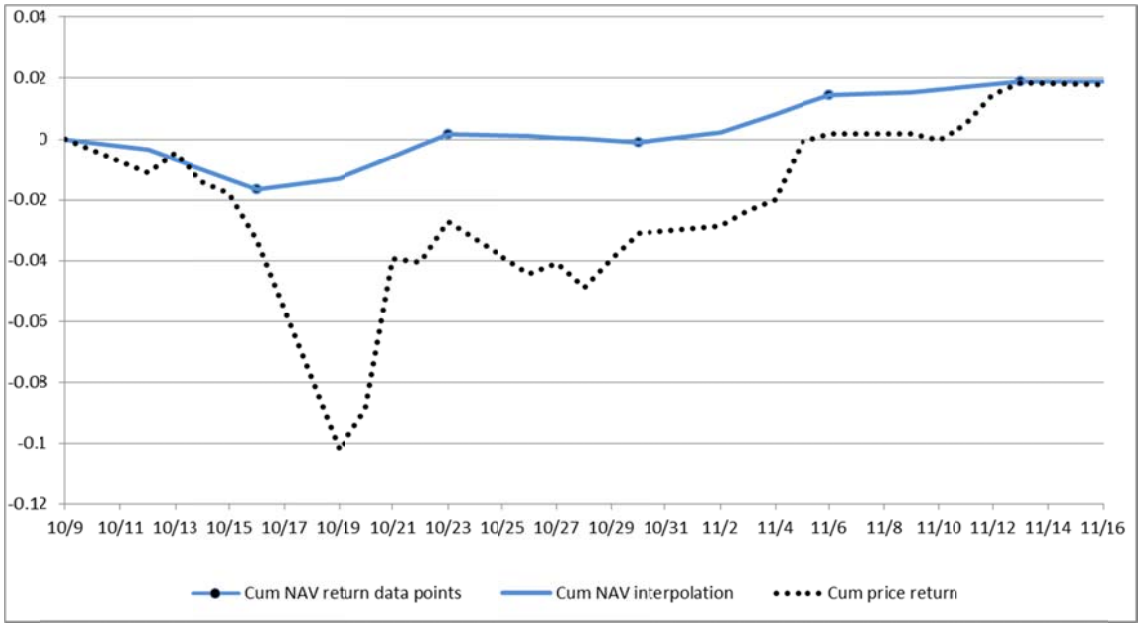
Cumulative log returns (Day 1 = Close on October 19, 1987)



Cumulative abnormal returns relative to market model (Day 1 = Close on October 19, 1987)



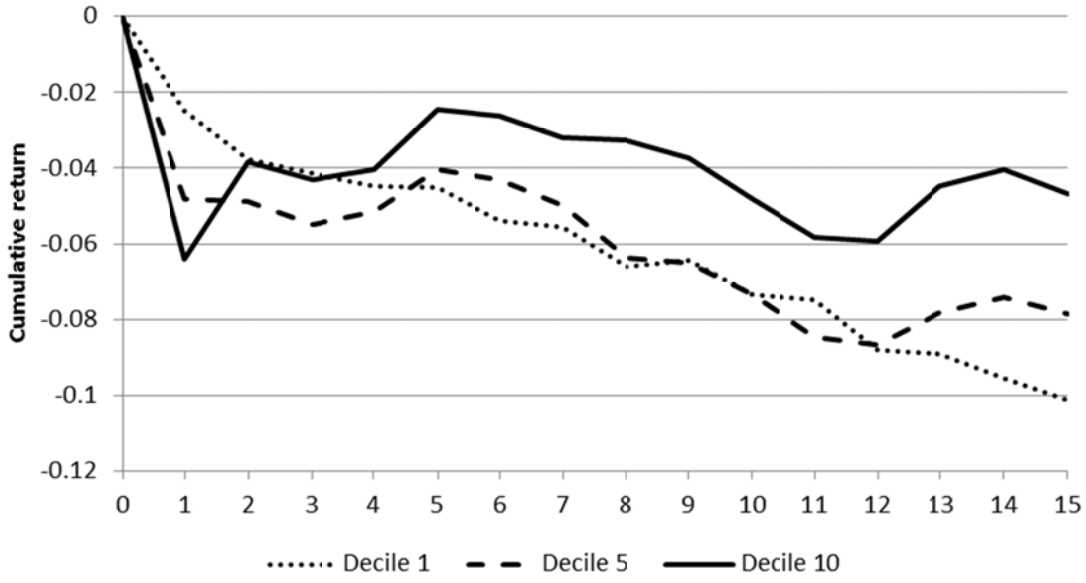
Fixed-income closed-end fund cumulative price and NAV returns



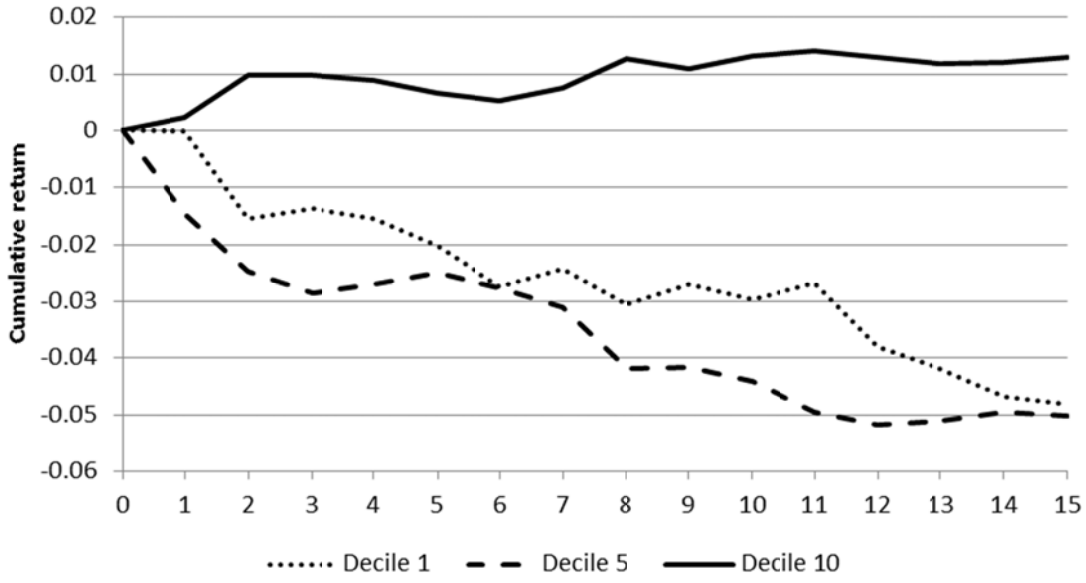
3.2 October 13, 1989 crisis event

On Friday, Oct. 13, 1989, the DJIA closed down 6.9% from the prior day's (10/12/87) close. Numerous articles recalled "Black Monday" in October 1987, and raised concerns about panicked selling by nervous small investors. For example, a front-page article in *The New York Times* ("Is It 1987 Again?") noted that "The market was suddenly swamped by customers wishing to sell, and except for a few firms, like Goldman, Sachs & Company, that stepped in…" Some articles cited experts who reassured people that the fundamentals of the market and economy were sound, and others noted the Federal Reserve was moving quickly to provide liquidity. On Monday (10/16/89), the DJIA rebounded and closed up 3.4%.

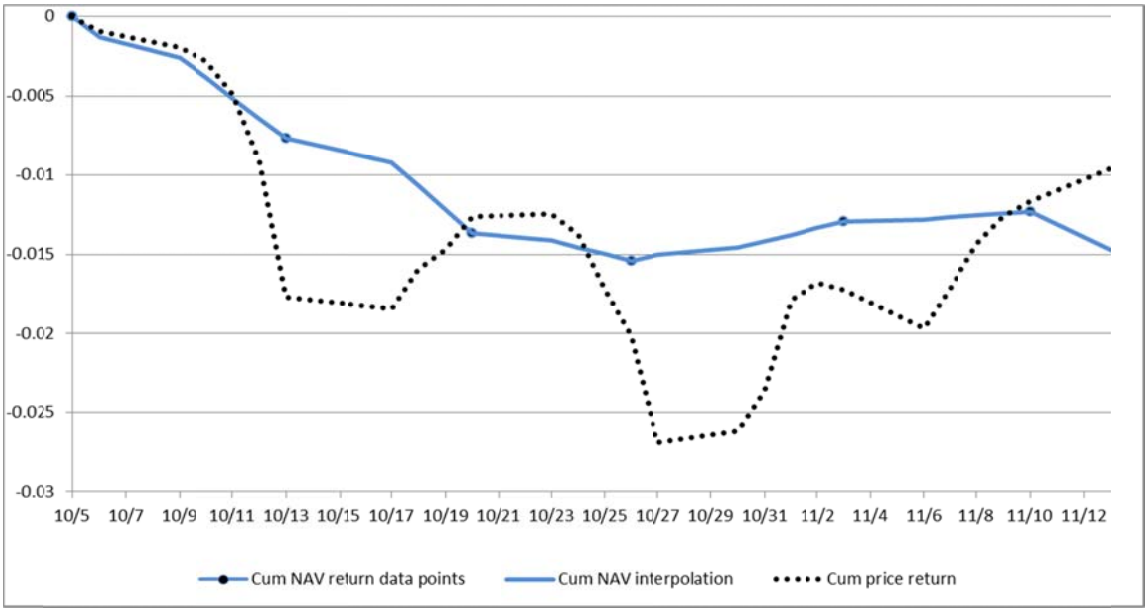
Cumulative log returns (Day 1 = Close on October 13, 1989)



Cumulative abnormal returns relative to market model (Day 1 = Close on October 13, 1989)



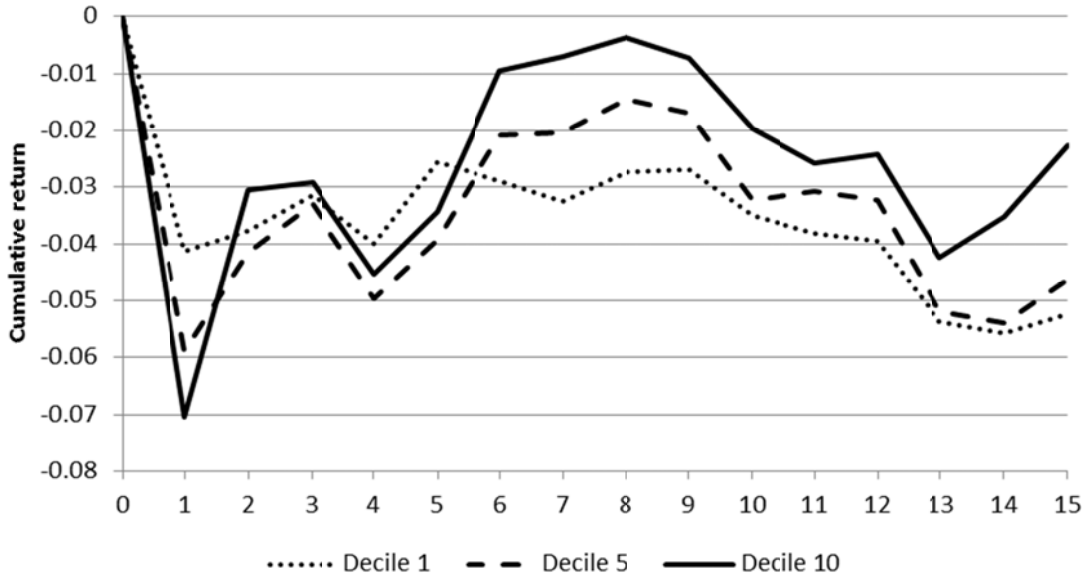
Fixed-income closed-end fund cumulative price and NAV returns



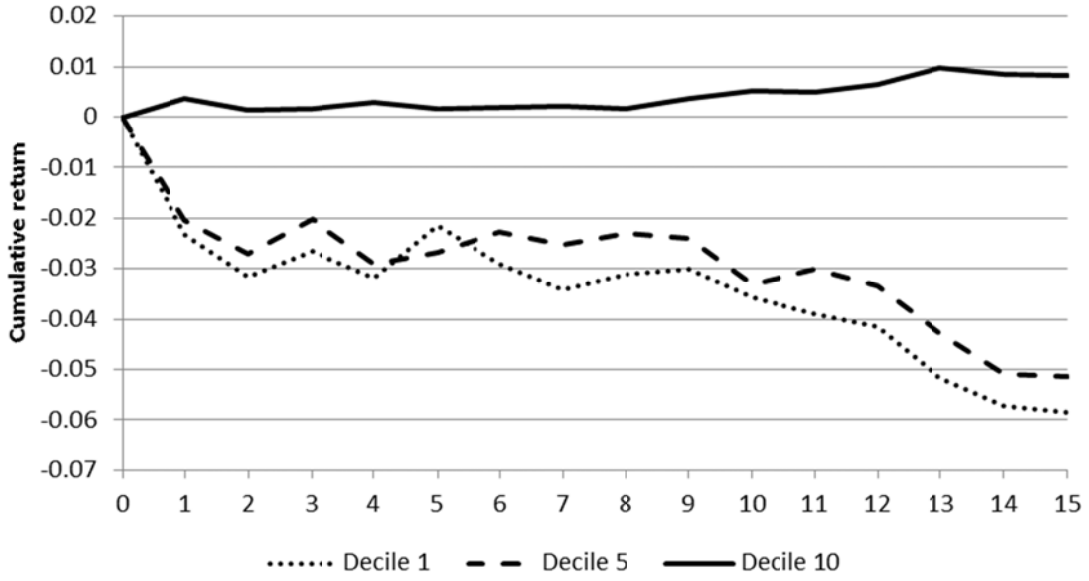
3.3 October 27, 1997 crisis event

On Friday, Oct. 24, 1997, a front-page article in *The New York Times* described an Asian crisis as starting with economic trouble in Thailand, growing over the subsequent months with tremendous currency turmoil across Asia, and "producing selloffs in nearly every stock market in the world" and resulting in the Hong Kong Market stock market falling 23 percent in one week. The article noted the DJIA was "down 2.3 percent, [which] was the mildest among major markets." On Monday, Oct. 27, 1997, however, the DJIA closed down 7.2% from its close the prior Friday (10/24/97). A different front-page *New York Times* article ("The Market Plunge: The Selloff") on Tuesday (10/28/1997) described the turmoil and stated "A worldwide plunge in stock prices erased more than 7 percent from the Dow Jones industrial average yesterday and forced the New York Stock Exchange to halt trading. The only other interruptions like this came after the wounding of President Ronald Reagan and the assassination of President John F. Kennedy."

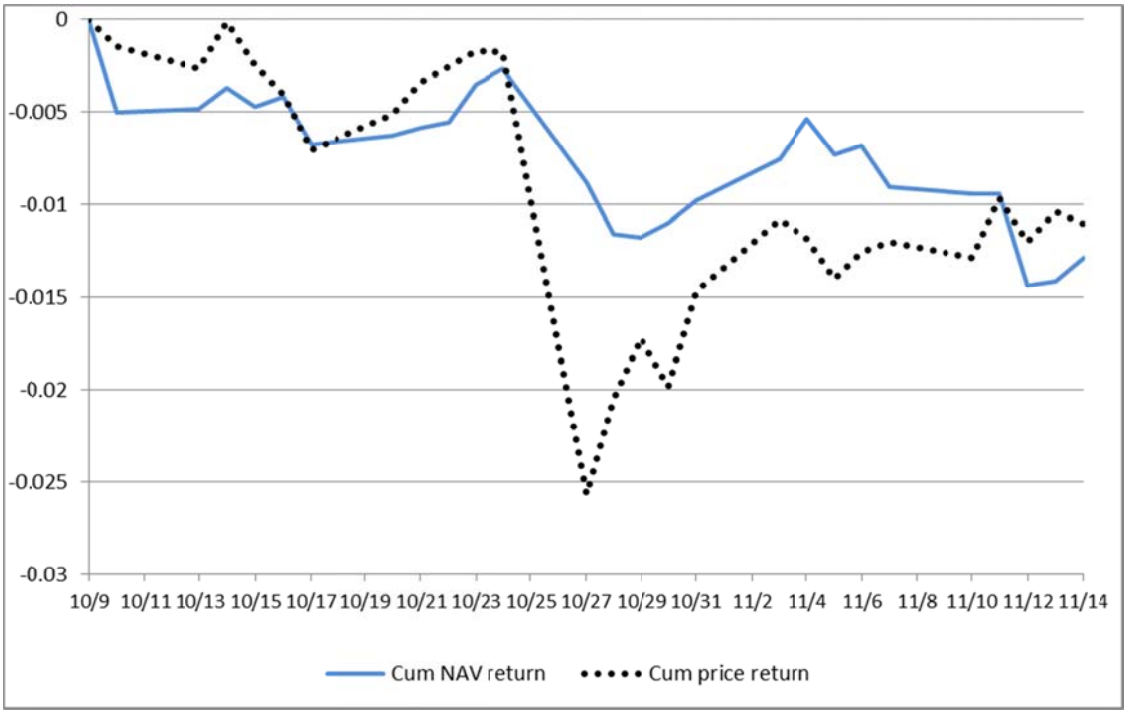
Cumulative log returns (Day 1 = Close on October 27, 1997)



Cumulative abnormal returns relative to market model (Day 1 = Close on October 27, 1997)



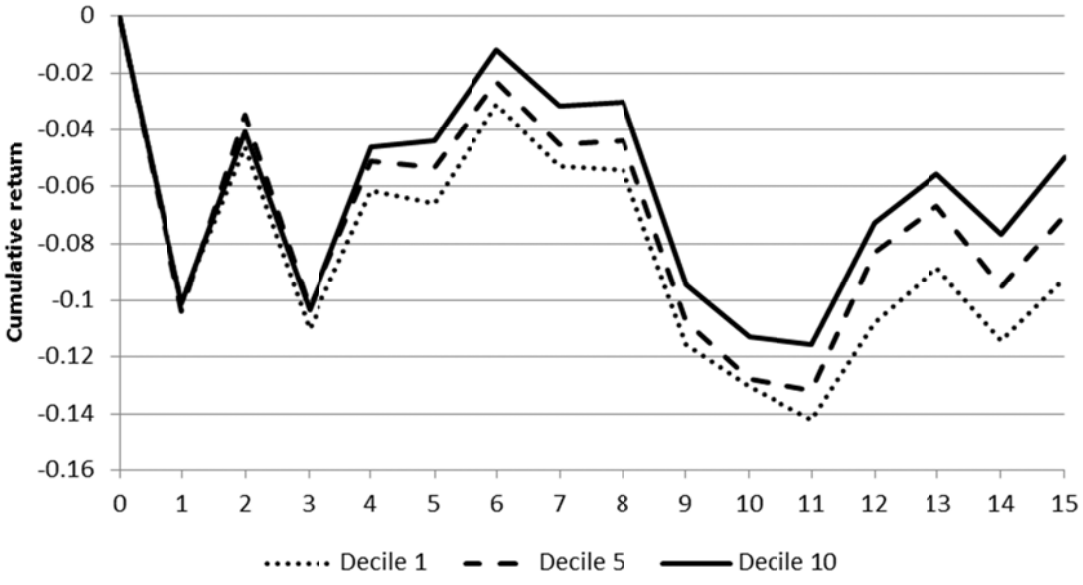
Fixed-income closed-end fund cumulative price and NAV returns



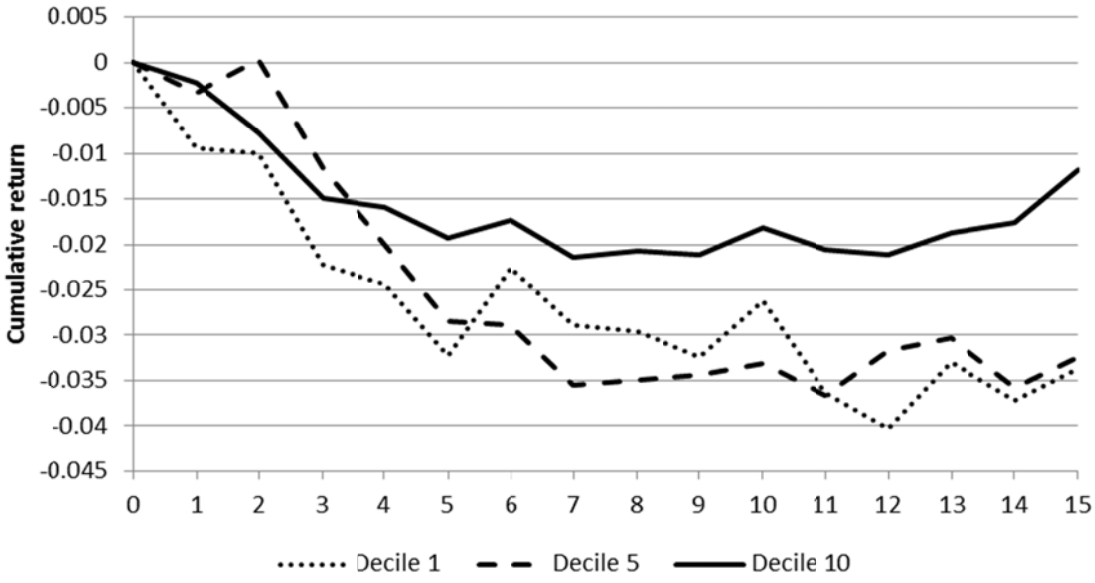
3.4 August 8, 2011 crisis event

On Thursday, Aug. 4, 2011, the DJIA closed down 4.3% from the previous day's close. The next day, a front-page *New York Times* article ("Stocks in Worst Tumble in 2 Years Amid Global Worry") started "What began as a weak day in the stock markets ended in the worst rout in more than two years, as investors dumped stocks amid anxiety that both Europe and the United States were failing to fix deepening economic problems. With a steep decline of around 5 percent in the United States on Thursday, stocks have now fallen nearly 11 percent in two weeks. Markets have been plunging as investors sought safer havens for their money—including Treasury bonds, which some had been avoiding during the debate over extending the nation's debt ceiling. Sparking the drop was an unsuccessful effort by the European Central Bank to reassure the markets, which instead ended up spooking investors." On Monday, Aug. 8, 2011, the DJIA closed down 5.5% from its the Friday (8/5/11) close.

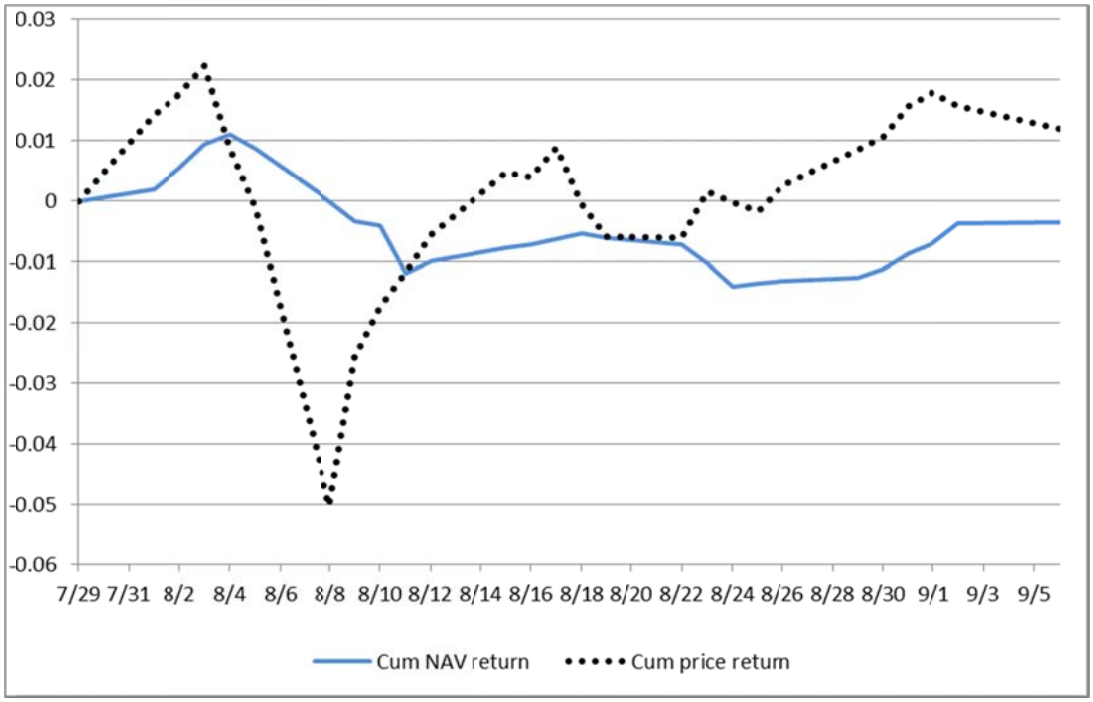
Cumulative log returns (Day 1 = Close on August 8, 2011)



Cumulative abnormal returns relative to market model (Day 1 = Close on August 8, 2011)



Fixed-income closed-end fund cumulative price and NAV returns



3.5 Discussion

As discussed extensively in the paper, the premise underlying our separately examining return patterns for stock deciles and closed-end funds is that retail investors, as prior literature documents, tend to play a relatively more prominent trading and ownership role in small stocks and closed-end funds than do institutional investors. If retail investors are more prone to engage in panicked selling during a market crisis period than institutional investors, then compared to large-cap stocks (decile 10), we would expect to see small-cap stocks (decile 1) suffer more significant price declines as the crisis unfolds and show smaller recoveries as the crisis abates. Generally, this is what the return patterns reveal, and this holds even more strongly once we control for market-risk by plotting cumulative abnormal returns relative to a market model.

Arguably the most dramatic market crisis of the four is October 19, 1987 ("Black Monday"), when the Dow Jones Industrial Average plummeted over 22% in a single day. As with the first trading day after nine-eleven, there is little difference in the first-day price decline between deciles 1 and 10. As shown, however, eventually price declines in decile 1 become more pronounced than in decile 10. The other three crisis periods seem less dramatic than October 1987 and nine-eleven, at least in the overall market reaction. For these events the eventual differences in price declines for deciles 1 and 10 are less pronounced.

Differences in price declines for deciles 1 and 10 are more significant once we control for market risk by plotting cumulative abnormal returns (CARs) relative to market model predicted returns. As the second graphs for each of the four events and the corresponding graph for nine-eleven (in Section 2 above) show, the plots for decile 10 exhibit only a modest decline, if any, whereas those for decile 1 show steady, sharper price declines. Thus, controlling for market risk shows that investor reaction in small stocks is more negative than in large stocks for all of the events.

Lastly, we also include plots of fixed-income price and NAV returns (the third graph for each event). Note that these plots begin several days before the event day that identifies the crisis. All four graphs show a pattern of price declines that were more severe than NAV declines (widening discounts), followed by price recoveries. A seeming difference with the 1989 crisis is that prices sharply decline relative to NAVs and recover twice during approximately a one-month period. This crisis period was prolonged with continued

volatility and a second occurrence: After the Friday (10/13/89) decline and Monday (10/16/89) rebound in the DJIA, the DJIA experienced exceptionally high volume for the week and closed almost 4.7% higher on Friday (10/20/89) along with a similar rebound in CEF prices. However, the DJIA experienced exceptionally high volatility on the following Monday (10/24/89), and a front-page article on Tuesday (10/25/89) titled "Dow Ends 3.69 Lower In Wild Day" contained the following description: "The stock market fluctuated wildly yesterday on heavy volume…. The early plunge, with investors' emotions still fragile after the 190-point tumble on Oct. 13, spurred speculation that the market had not returned to normal and prompted wide-spread selling." This market volatility and uncertainty apparently touched off a second decline in fixed-income CEF prices over the 10/24-10/27 period as the DJIA fell 2.35% over the same period.

4 Numerical illustration of data coding for Table 5 regressions

To illustrate the codings and coefficient sign interpretations, consider the simple example in the table that follows in which a security has a negative 10% return over the nine-eleven trading week (which is week 49 in the regression data). Note that the left-hand side variable is R_t, and that R_{t-1} and R_{t-2} are not included on the right-hand side on their own—they are only shown to clarify how the interaction-term variables are coded. For the week-49 observation, the non-zero regressor variables are coded as $E_t = 1$, $(1\text{-}E_{t-1})R_{i,t-1} = 3\%$, and $(1\text{-}E_{t-2})R_{i,t-2} = 1\%$. Because E_t is coded zero for all other weeks, the estimated coefficient for E_t in the cross-sectional regression will measure the average nine-eleven return that is not explained by the prior two lagged returns.

R_t = return (either price return or abnormal return) for week t. $E_t = 1$ if week t's return includes nine-eleven.

	Trading week	Friday-to-Friday return week period	Dep Var.	(These are not included as stand-alone regressors)		Regressor variables included in Table 5 regressions						
			R_t	R_{t-1}	R_{t-2}	E_t	E_{t-1}	E_{t-2}	$(-E_{t-1}R_{t-1})$	$(-E_{t-2}R_{t-2})$	$(1-E_{t-1})R_{t-1}$	$(1-E_{t-2})R_{t-2}$
	46	8/17 - 8/24	-3%	-1%	-2%	0	0	0	0%	0%	-1%	-2%
	47	8/24 - 8/31	1%	-3%	-1%	0	0	0	0%	0%	-3%	-1%
	48	8/31 - 9/7	3%	1%	-3%	0	0	0	0%	0%	1%	-3%
9/11 week	49	9/7 - 9/21	**-10%**	3%	1%	1	0	0	0%	0%	3%	1%
	50	9/21 - 9/28	7%	**-10%**	3%	0	1	0	**10%**	0%	0%	3%
	51	9/28 - 10/5	8%	7%	**-10%**	0	0	1	0%	**10%**	7%	0%
	52	10/5 - 10/12	2%	8%	7%	0	0	0	0%	0%	8%	7%
	53	10/12 - 10/19	1%	2%	8%	0	0	0	0%	0%	2%	8%
	54	10/19 - 10/26	0%	1%	2%	0	0	0	0%	0%	1%	2%

For the first recovery return week (which is week 50, the second week of trading after nine-eleven), the security experiences a positive return of $R_t = 7\%$. Our goal is to determine how much of the 7% recovery return is systematic across all securities in the regression, and how much is tied to a security-specific reversal of the security's prior-week return of -10%. The non-zero regressors for this observation (t = 50) are $E_{t-1} = 1$, $(\text{-}E_{t-1}R_{i,t-1}) = 10\%$, and $(1\text{-}E_{t-2})R_{i,t-2} = 3\%$. Note that E_{t-1} is zero in all other weeks. The coefficient estimated for E_{t-1} thus measures the recovery return that is common across all securities in the regression, and the

coefficient on ($-E_{t-1}R_{i,t-1}$) measures the extent to which the recovery returns are directly proportional to the security-specific initial return reactions to nine-eleven. Note also that recoveries (positive returns) are indicated by positive coefficients on these two variables. For example, given that $E_{t-1} = 1$ for t = 50, a coefficient of 0.05 on E_{t-1} would imply that 5% out of this security's 7% return in the $t = 50$ recovery week, or 71.4% (5/7), is due to a systematic recovery shared by all securities in the regression. And given that ($-E_{t-1}R_{i,t-1}$) = 10% for the $t = 50$ recovery week, a coefficient of 0.15 on ($-E_{t-1}R_{i,t-1}$) would imply that another 1.5% (which is 0.15 x 10%) out of the 7% recovery return, or 21.4% (1.5/7), is directly tied to this specific security's 10% loss during the nine-eleven trading week of $t = 49$.

The interpretations are similar for E_{t-2} and ($-E_{t-2}R_{i,t-2}$). For week $t = 51$ (the second week of recovery), $E_{t-2} = 1$ implying that the coefficient on E_{t-2} measures the second-week recovery common across all securities, and the coefficient on ($-E_{t-2}R_{i,t-2}$) measures the portion of the second-week recovery that is directly linked to the security's initial nine-eleven return reaction.