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Abstract

Based on an extensive sample of U.S. closed-end funds undergoing open-ending, we examine the behavior of discounts prior to the announcement till open-ending. Discounts are significantly reduced upon announcement of open-ending with price increase. Announcement period return is directly related to the pre-announcement discount, and other hypothesized characteristics of the fund and investor behavior. The role of investor sentiments as an explanator of discounts is weaker after announcement. We decompose the pre-announcement discount into structural and idiosyncratic parts, and report that there is a greater reduction of the idiosyncratcic part of the discount at announcement. Time series behavior of discounts lends support to investor confidence. We find that small amounts of discounts remain at the time of the open-ending.

Termination of closed end funds and behavior of their discounts

1. Introduction

We aim to examine the behavior of closed-end fund discounts before, during, and after the announcement of termination of such funds. A Closed-End Fund (CEF) is a simple form of corporation which invests in a portfolio of various assets. The shares of CEFs are traded in stock exchanges and are not redeemed or issued on demand. Details of the investment portfolio is publicly disclosed quarterly with SEC and the value of the portfolio on a per share basis (known as "net asset value," NAV) is computed daily and reported at least weekly in the financial press. In an efficient market with rational investors, the share price of a CEF should equal its NAV, yet CEFs are often found to trade at prices that deviate from their NAVs.

The deviation of CEF prices from the NAV - the discount[1], has long remained a puzzle. Gemmill and Thomas (2002) provide evidence that it is not unusual for CEFs to be trading at prices ranging from 5 percent above to 30 percent below their NAVs. Early studies (i.e. Malkiel, 1977; Brauer, 1984) hypothesize that the exchange-traded prices are different from the reported NAV because of hidden costs such as capital gain tax liability, illiquidity of the portfolio, and agency costs. Lee, Shleifer, and Thaler (1991) argue that such costs do not fluctuate much over short horizons while the CEF discounts fluctuate highly even on weekly interval; thus, the presence of hidden costs cannot provide sole explanation for the CEF discount.

More recent explanations for the CEF discount include investor sentiment hypothesis (Lee, Shleifer, and Thaler, 1991), costly arbitrage hypothesis (Pontiff, 1996; Gemmill and Thomas, 2002), signaling hypothesis (Johnson, Lin, and Song, 2006), and managerial ability compensation hypothesis (Ross, 2002; Berg and Stanton, 2007). Empirical tests of the first three hypotheses suggest specific variables that purport to explain the discounts.[2] These empirical tests in the literature focus on the level of CEF discounts in general. While some studies (i.e. Brauer, 1984;

[1] "Discount" is the difference between the exchange-traded price and the underlying per share value of the portfolio of the fund given by its net asset value (NAV). The discount is positive if the price exceeds the NAV.

[2] Direct empirical tests for the managerial ability compensation hypothesis have not been reported.

Brickley and Schallheim, 1985) document significant change in CEF discounts when the CEFs announce their intentions to terminate the fund, [3] there is no empirical examination of how the explanatory power of the hypotheses changes upon such announcement. Based on the arguments contained in the hypotheses, we believe that the relationship between the discount and the variables proposed by the theories are likely to change at the time of the announcement. Thus, one of the objectives of our study is to examine how the explanatory power of the discount hypotheses changes subsequent to the termination announcement.

1.1 Recent discount hypotheses applied to CEF termination announcement

The investor sentiment hypothesis proposes that the discount is a mechanism by which CEF holders are compensated for the risk of their inability to sell the funds at the NAV, as noise traders become more pessimistic when CEF owners want to sell. The liquidation date is usually announced shortly following the first termination announcement. If noise traders are pessimistic during the period between announcement and actual liquidation, the holders of the soon-to-be liquidated CEFs could simply wait for the liquidation event and achieve better price outcome.[4] Also, if the holders of the CEFs must sell immediately, they should be able to do so at prices close to NAV since the buyers are also aware of the impending liquidation event. Investors will bid up the price based on the knowledge that they will be soon paid an amount equal to the NAV less liquidation expenses. The noise trader risk should be greatly reduced upon the termination announcement, and consequently, the role of investor sentiments in the structure of CEF discounts should be greatly attenuated after the liquidation announcement.

The costly arbitrage hypothesis posits that CEF discount exists because arbitrageurs do not adequately perform their roles in the presence of high transaction costs. If the arbitrageurs or active shareholders want to purchase majority of the shares and liquidate the CEF, they will require high upfront investment. Additionally, resistance from entrenched managers (see Bradley, Brav,

[3] The term "open-ending" refers to any of the events that terminate a closed-end fund: liquidation of the fund, conversion to an open-end fund, or merger with an open-ended fund.

[4] This argument can also apply to open-ending of closed-end funds. Subsequent to the open-ending of the closed-end fund, the fund holders are able to redeem the funds at the NAV price at a time of their choosing.

Goldstein, and Jiang, 2007) will exacerbate the arbitrage costs as well as the probability of the failure of the strategy. These costs would discourage arbitrageurs from disciplining the market. In the presence of low costs, arbitrageurs may buy CEF shares and short sell the funds' portfolio. Lee et al (1991) argue that the dividend from the long position will entirely offset the dividend from the short position, enabling the investors to capture the discount as the arbitrage profit. However, because the CEF portfolio may not be easily replicable and the fund manager can change the structure of the portfolio composition by active trading, the arbitrageurs may be unable to mimic their short portfolio appropriately. And if the arbitrageurs must liquidate their short portfolio before the funds in their long portfolio are terminated, they are exposed to the risk that the discount may widen by the time they liquidate the portfolio. These costs of arbitrage may discourage arbitrageurs from disciplining the markets.

Subsequent to the termination announcement it is expected that the arbitrage costs would be somewhat mitigated leading to weaker explanatory power over the remaining discount. Subsequent to the announcement, arbitrageurs do not require large upfront investment or buy majority of the funds or convince shareholders to liquidate the funds. Further, they are unlikely to face resistance from entrenched managers. Third, since the holding period is relatively short, the arbitrage strategy is easier and less risky to undertake. In other words, arbitrage strategies are less costly and much easier to conduct; hence, the portion of discount due to costly arbitrage should be greatly reduced after the termination announcement.

The signaling hypothesis argues that CEF discount exists due to asymmetric information between fund managers and investors. CEFs that commit to pay high dividends send a signal to investors about their superior performance. Prior to the termination announcement, the holding period can be infinite and returns on investing in closed-end funds mainly rely on future performance of the funds. A good signal about future performance of the funds is therefore necessary. However, after termination announcement, the fund holding period becomes relatively short. The value of the CEF is less due to future performance of the funds, but more based on the current portfolio value. The signal assumes lower importance because investor will soon receive the liquidation value of the CEF portfolio.

Brauer (1984) and Brickley and Schallheim (1985) documents that CEF discounts significantly shrink when CEFs announce open-ending the funds. Most of the discount shrinkage is accounted by the adjustment of the fund price while the NAV of the funds is relatively unchanged. Both Brauer (1984) and Brickley and Schallheim (1985) focus on explaining cross-section variation of the CEF abnormal returns at termination announcements but they do not focus on the changes in theoretical links between the CEF discount and its theory-based explanatory variables. In this paper, we examine the relationship between CEF discount and its theory-based variables before and after termination announcement. We focus mainly on the three theories; the investor sentiment hypothesis, the costly arbitrage hypothesis, and the dividend signal hypothesis, because the proxy variables employed in the tests of the theories have been shown to have high degree of explanatory power.

Our paper contributes to existing literature from several perspectives. First, we update the results of abnormal returns on CEF termination announcement events. To our knowledge, the last study is by Brauer (1984) and Brickley and Schallheim (1985) both of which are more than two decades old and were based on relatively small samples of CEFs. Second, we examine the explanatory power of the three recent theories on CEF discounts. Third, we document potential changes in the relationship between the CEF discount and the three hypotheses and empirically compare the relation before and after termination announcements.

1.3 Summary of main findings

Our main findings, based on a large sample of 119 CEF termination announcements, are as follows. First, CEF discount shrinks by 6 percent, on average, from 12.32 percent on the week before to 6.23 percent during the week after the announcements. Seconds, we find significant abnormal returns to the stock on the termination announcement day and the following day. The cumulative average abnormal return for the two days is about 6.59 percent, indicating that the adjustment of share prices account entirely for the discount shrinkage. Third, the explanatory variables based on the investor sentiment, the dividend signaling hypothesis, the costly arbitrage argument, and the tax liability provide good explanatory power in the cross-section analysis of

discount prior to the termination announcement with a total R^2 of approximately 49% with the control variables accounting for approximately 25%.

Subsequent to the announcement, however, the explanatory power of these variables declines. The magnitude of the coefficients reduces roughly by half and becomes less statistically significant. Fourth, the abnormal returns are driven by the prevailing discount: - high discount funds provide higher abnormal returns. On average, every one percent in discount generates 0.47 percent in abnormal returns. Most of the discount-generated abnormal return comes from the portion of the discount that is unexplained by our theory-based explanatory variables. And lastly, the CEF discount becomes less correlated with aggregate discount after the termination announcement.

The remainder of the paper is organized as follows. In section 2, we discuss applicable literature on closed-end fund discounts. There is a large body of literature but we focus on some of the more relevant papers. We discuss the open-ending process and the data in section 3. We discuss the explanatory variables for discounts and their measurement in section 4. We present cross-sectional analysis of the discounts based on variables suggested in the recent literature in section 5. We present the regression based results and the time-series analysis of discounts in the same section. Section 6 provides concluding remarks.

2. Prior literature on CEF discounts

The time series evolution of the CEF discounts is a puzzling phenomenon. Lee et al. (1991) summarize that CEFs start out by being traded at premium of almost 10 percent at the time of their initial public offerings (Weiss, 1989; Peavy, 1990) and over a relatively short time span of 120 days the discount is of the order of 10 percent (Weiss, 1989). Furthermore, CEF discounts fluctuate widely over time and exhibit mean reverting pattern (Sharpe and Sosin, 1975). When CEFs announce liquidation or open-ending, the discount shrinks and continues to shrink thereafter (Brauer, 1984; Brickley and Schallheim, 1985).

Earlier studies have proposed three possible explanations for CEF discount: agency costs, capital gain tax liability, and illiquidity of the assets. The agency costs explanation argues that management fees do not correctly compensate for the service the fund management provides. The

management fee may be too high or too low compared to the realized fee charged, reflecting in discount or premium (see Lee et al. 1991; Bodurtha, Kim, and Lee, 1995; Berg and Stanton, 2007). Alternatively, the agency costs could be in forms of private benefit or perks extracted by entrenched managers (see Brauer, 1984; Barclay, Holderness and Pontiff, 1993). The capital gain tax liability explanation argues that capital gain tax liability is not included in calculation of NAV so NAV overstates its real net asset value.

There are two hypotheses that correspond to illiquidity of the fund assets (Lee et al. 1991). First, restricted stock hypothesis suggests that NAVs are overvalued because CEFs hold some restricted securities whose market values are lower than similar assets with no restriction. Second, block discount hypothesis suggests that NAVs are calculated using marginal share price; however, the proceeds from liquidating the funds may be smaller than NAVs because of the impact of the large trade. The tax liability and illiquidity of the assets arguments imply miscalculation of NAV. Malkiel (1977) finds these variables help explain cross-sectional variation in CEF discount.

The three explanations provide some explanatory power of CEF discount in cross-section analysis; however, CEF discounts also display high cross-sectional correlation and high degree of fluctuation over time. Lee et al. (1991) propose investor sentiment hypothesis to explain the time variation in CEF discounts. The investor sentiment hypothesis states that CEFs are mostly traded by small investors and the fluctuation in the sentiment of the small (noise) traders can lead to fluctuation in demand for and share price of CEFs. Because rational investors may not be able to resale CEF shares at the fundamental price if noise traders are pessimistic at the time to resale and because the sentiments are correlated among noise traders, the sentiment risk is systematic and must be compensated in terms of a discount.

Costly arbitrage is another reason for CEF discounts (see Bodurtha et al., 1995; Pontiff, 1996; and Gemmill and Thomas, 2002). In a complete market, discount cannot be persistent as arbitrage activities force price back to its intrinsic value. However, if arbitrage is costly, arbitrage profit can be too little to motivate arbitrageurs to act. And price can drift away from its fundamental. Gemmill and Thomas (2002) argue that costly arbitrage allows discount to wander in the range of -5

to 30 percent. Gemmill and Thomas (2002) and Pontiff (1996) report that funds that are more difficult to arbitrage tend to have larger discounts.

Johnson, Lin, and Song (2006) proposed that the CEF discount results from information asymmetry between fund managers and fund investors. They find the discount is related to the commitment to dividend payout, supporting a dividend signaling hypothesis. Ross (2002) and Berk and Stanton (2007) propose that the existence of the discount is to compensate for managerial ability. Bradley, Brav, Goldstein, and Jiang (2007) suggest that the CEF discount is endogenously related to the shareholder activism. Funds with large discount are more susceptible to activists who profit from buying and liquidating large-discount CEFs. However, the level of activism can be expected ex ante. The market prices reflecting the expectation lead to discount shrinkage. Wermers, Wu, and Zechner (2007) propose a similar argument that lagged discount representing poor fund performance helps predict the fund manager replacement and markets expectation of the replacement would lead to reduced fund discount.

Other related literature in the area of CEF discount shows that fund discount is negatively related to future return on the fund price, violating market efficiency hypothesis (Pontiff, 1995). Pontiff (1997) finds that monthly returns on fund price are about 64 percent more volatile than monthly returns on fund asset value, violating rational investor hypothesis. Khorana, Servaes, and Wedge (2007) find that fund performance is positively related to the percentage of ownership held by fund managers. Chan, Jain, and Xia (2008) report that discount of country funds is related to the differences between the illiquidity of markets that the fund invests in and the market in which the fund is traded.

We hypothesize that the cross-sectional difference in CEF discount due to sentiment risk and costly arbitrage become smaller and this is reflected in form of abnormal returns at the liquidation announcement. Lee et al. (1991) argue that fluctuation in noise traders' sentiment can affect demand for CEFs and their prices. Because sentiment risk can be correlated among noise traders, rational investors may not be able to sell CEFs at the fundamental price. Holding CEFs to wait for better price can be costly since the investors' opportunity costs are high and the sentiment risk can be persistent. Such a risk must be incorporated into the fund price.

The risk, however, is attenuated by the impending liquidation event as investors expect to unload the CEF shares at the NAV at the liquidation date. Costly arbitrage makes arbitraging activities less attractive, allowing CEFs to trade at price deviating from NAV. Arbitrage activities are costly requiring large investment to buy majority of shares for to enable fund liquidation and are further exacerbated in presence of management resistance (see Bradley et al., 2007). However, at the liquidation announcement, arbitrage costs are greatly reduced due to lower capital needs, lower probability of management resistance, and smaller transaction costs.

3. Data

3.1 The termination process

In a typical open-ending, the board of directors requests a proposal from the management. Once the board approves the restructuring proposal, shareholders vote is sought. Subsequent to the board's vote, a date for shareholders vote is established. The shareholder vote is typically scheduled one to three months following the board action. In case not enough shareholders votes are cast the date for shareholder vote is postponed. While news about the boards' vote is often released in news wire, it does not constitute a termination announcement which we define as one that follows shareholder vote. At that time, the terms and conditions of open-endings are often declared. Open-ending usually occurs in a period three to six months after tthe announcement.

Alternative to the management inititated proposal, the fund may announce that according to the fund's prospectus a shareholder vote on open-ending is triggered in the event that a sufficiently large discount exists for a specified time period. An example is provided in the following statement contained in the announcement by the Dessauer Global Equity Fund:

> *"…The Fund's prospectus provides that after 18 months from the date of the fund's initial public offering, the fund will automatically convert to an open-end investment company if its shares close at a market price that is at a 5% or greater discount to the net asset value of the fund on the last business day of any week and for each of the next 14 business days."* (LexisNexis Archives, Open-ending Announcement, January 6, 1999).

There are certain drawbacks to reorganizing the closed-end fund into an open-ended entity. The legal structure of closed-end funds provides a stable asset base. This enables the manager of

the closed-end fund to make longer-term investment decisions based on the fund's investment strategy without being unduly affected by the shareholders' buying or selling sentiments or activities, or being overly concerned about potential redemption considerations. Conversely, open-end funds tend to have a fluctuating asset base due to purchase and redemption requests by shareholders. Therefore, investor sentiment might affect the portfolio structure rather than the investment philosophy of the fund. Another disadvantage of converting into an open-end fund is that closed-end funds can add leverage to their portfolio whereas open-end funds do not have such opportunities. Furthermore, closed-end funds are better able to direct more investments into illiquid securities compared to open-ended mutuals.[5]

3.2 Descriptive sample statistics

A sample of 119 closed-end funds that announce terminating the fund during 1973 to 2006 period are hand-collected from Lexus/Nexus database. We also hand collect financial data (i.e. expense ratio, fund turnover ratio, unrealized appreciation, total asset value, etc.) from the fund's latest financial statement (N30D) prior to the announcement date from Edgar database. NAV data are collected Bloomberg system and if the data are not available, we obtain NAV data from the Wall Street Journal (WSJ). Share price and dividend payout data are collected from the Center for Research in Security Prices (CRSP) database.

We report the distribution of the sample in Table 1. Panel A shows the frequency distribution by year and Panel B reports frequency distribution by fund types. Out of the 119 funds, 23 funds were liquidated during 1973 to 1990 period, an average of about one fund per year. A larger number of CEFs were liquidated after 1990, particularly during the 1996 to 2000 period. About 58 percent of our sample is domestic funds and 47 percent is bond funds.

<< Insert Table 1 about here >>

3.3 CEF discount behavior preceding the open-ending announcement.

The NAV data are reported at different frequency. In the Bloomberg system, some funds report daily NAV while others report monthly NAV. In both Bloomberg and WSJ, some funds report

[5] Deli and Varma (2002) examine the choice of organizational form for investment funds and report that closed-end funds tend to hold less liquid securities and their security prices are less transparent than that of open-ended funds.

NAV on Friday while others report on Wednesday. To ensure that the discount is computed properly, we match the NAV with the share price from CRSP by date and calculate discount. Then, the discount is averaged over all observations available in a given week. Discount is defined as:

$$DISC_{i,t} = \ln\left(\frac{NAV_{i,t}}{Price_{i,t}}\right) x100 \quad (1)$$

We examine the behavior of funds' price, NAV, and discount over time by creating an artificial portfolio. We invest a hypothetical amount of $100 in each fund at the inception date, one year prior to announcement. The number of shares of each fund at the inception is used as the weight for subsequent NAV and value calculations of the portfolio. We plot the temporal behavior of portfolio price and NAV from one year before to one year after the announcement. The primary takeaway from this figure is the behavior of the discounts.

Figure 1 suggests that the NAV and price tend to be stable and are highly correlated prior to the termination announcement. At announcement, the plot of NAV does not drop significantly price exhibits upward adjustment toward NAV. As sample funds are open-ended or liquidated they drop out of the artificial portfolio and the price and NAV series decline following the announcement as CEFs are open-ended or liquidated.

We show a plot of the average discount along with the 95 percent confidence interval Figure 2. The portfolio implicit in the average discount calculation contains one share of each fund in contrast to the artificial portfolio with varying weights in Figure 1. We note that there is a significant discount shrinkage from 12 percent at one week before the announcement to 6 percent at one week after the announcement (see also Table 4). We find that the level of discount tends to decline approximately three months prior to the announcement, possibly based on market's anticipation of the termination announcement.

Termination process was as quick as three days for some funds while it took more than one year for some funds. Eighty-eight funds were liquidated within 30 weeks. The discount during the first 20 weeks shows a slow downward trend with more fluctuations thereafter. Fluctuations may be due to less reliable statistics as more funds drop out. Secondly, some funds may experience higher NAV returns on their portfolio. Third, since the liquidation date is often not stated at the time of the

announcement, the fund managers may have incentives to prolong the liquidation date if favorrable conditions arise[6]. In the event of uncertainty regarding liquidation date, discount may begin to bounce back. Price and NAV after week 20 in shown Figures 1 suggest that NAV does show some small spikes in our series. We also find that for some weeks, share price drops at a faster pace than does NAV. In the next section, we conduct an empirical test for abnormal returns at the termination announcement using an event study approach.

<< Insert Figure 1 and Figure 2 about here >>

3.4 Share price response to announcement

To test if the termination announcements generate abnormal return on the CEF share price, we employ a standard event study approach. The open-ending announcement date is treated day zero in event time. We estimate the market model using price returns. The estimation period is from –250 to –21, and the market model is estimated with CRSP equally weighted index.[7] The abnormal returns, $AR_{i,t}$, is defined as the difference between the realized returns and the expected returns based on the estimated parameters from the market model:

$$AR_{i,t} = R_{i,t} - \left(\alpha_i + \beta_i R_{m,t}\right) \tag{2}$$

The average abnormal returns by different portfolios are computed across event dates. The cross-section average daily abnormal return is obtained by fund type and various sub-samples (not reported). The test statistic is a *z*-statistic. We also report a non-parametric test of signficance of abnormal returns based on the proportions of funds exhibiting positive returns.[8]

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[6] CEF managers may prolong liquidation date due to several reasons. To receive better price they may slowly sell their portfolio rather than conduct fire sales of their assets. Second, managers may delay liquidation to enhance management fee income. Third, managers may prolong the liquidation time if their portfolios perform well due to favorable market conditions following the announcement.

[7] Our results are robust when we employ the CRSP value weighted index. To the extent that the share of a closed-end fund responds to the broad market movement, irrespective of the nature of the fund, our use of the CRSP index is reasonable. Even though there is a possibility of an omitted index in the context of international funds and bonds funds by only using the CRSP index, Bodurtha, Kim, and Lee (1995) show that closed-end fund prices are correlated to the market where the funds are traded rather than the market where the funds' underlying assets are traded.

[8] The binomial *z*-statistic is: $z = (PPOS - \overline{p}) \Big/ \sqrt{[\overline{p} \cdot (1 - \overline{p})] / N}$, where $PPOS$ is the percentage of positive observations, $\overline{p}$ is the expected percentage positive (50%) under the null, and N is the sample size.

We report the average abnormal returns and their associated statistics in Table 2. We show a plot of the average abnormal returns against days relative to the termination announcement day in Figure 3. The average abnormal returns at termination announcement date and one day after are positive, respectively at 3.72 and 2.87 percent,.and are highly statistically significant. About 76 (66) percent of our sampled CEFs exhibit positive abnormal returns on the announcement day (the day after the announcement day). The cumulative average abnormal return on the two days is approximately 6.59 percent, which is about the size of the discount shrinkage documented in the previous section. This suggests that on average the adjustment of share price is responsible entirely to the shrinkage of discount and NAV does not adjust in response to the termination announcement. Our results are consistent with those of Brauer (1984) and Brickley and Schallheim (1985) where the sample sizes were substantially smaller respectively at 14 and 10 closed-end funds. We conclude that markets react to the termination announcements of our sampled closed-end funds.

<< Insert Table 2 about here >>

4. Variables that explain discounts

4.1 Explanatory variables

Earlier studies have focused on specific variables to explain cross-sectional variations in discounts. We incorporate all the useful variables from earlier studies in a regression of the pre-announcement discount. Subsequently, we examine the change in the coefficients between pre-announcement and post-announcement discounts.

As we presented earlier, investor sentiment is considered in the literature to have bearing on the discount. Aggregate discount is used as a proxy for investor sentiment. Following Lee et al. (1991), we compute weekly NAV-weighted average discount of all closed-end funds available on the Bloomberg system. Prior to 1990, there are only a few CEFs available on the Bloomberg system; consequently, the cross-sectional regressions do not employ data prior to 1990. All available CEFs are classified by types: foreign versus domestic and bond versus equity funds. We match the aggregated discount sorted by type, and week to our sample. The variable, *INVS*, is expected to be positively related to the level of discount.

Based on signaling hypothesis, Johnson et al. (2006) suggest dividend yield can be a good signal about superior future performance to investors. Also Pontiff (1996) argues high dividend payout helps lowering arbitrage costs. Thus, dividend yield is a proxy for the signaling hypothesis. The variable is named *SIGH*. We calculate dividend yield using the dividend payout during week -52 to week -2 preceding the announcement. The variable *SIGH* is expected to have a negative coefficient when regressed on discount.

Early studies have suggested agency costs as an explanation for the discount. High level of expense ratio is one manifestation of the agency problem. Recent literature (Ross, 2002) suggests a positive link between the variable and the discount. However, Berk and Stanton (2007) caution that the relation may not be easy to observe due to unobservable managerial ability. Gemmill and Thomas (2002) also report that expense ratio is positively related to discount. We obtain the fund's expense ratio (*EXPR*) and expect it to be positively related to discount.

High transaction costs are an impediment to successful arbitrage that could eliminate or reduce the size of the discount. Following Pontiff (1996), we use the inverse of share price as a proxy for transaction cost. The higher the transaction cost, the less likely arbitrageurs will be active. We expect inverse price capturing transaction costs, *TRNS*, to be positively related to discount.

Portfolio uniqueness is a measure of how difficult it is to replicate a CEF portfolio. An index fund, for example, is easily replicated by investors and is therefore unlikely to trade at significant discount. The more unique the fund is, the higher its discount is likely to be. The standard deviation of the regression residuals is proposed by Pontiff (1996) and Gemmill and Thomas (2002) as a proxy for uniqueness of CEF's portfolio. Based on the costly arbitrage argument, the more unique the portfolio, the more difficult it is to replicate the portfolio and hence arbitrage is more costly. Because discount is higher in the presence of arbitrage costs, the more unique a portfolio is the higher the discount. We regress the weekly NAV of each CEF on a set of broad indices, depending on the CEFs is domestic/foreign and bond/equity status. The estimation period is from week -53 to week -2, relative to the announcement week. The standard deviation of the regression residual provides the portfolio uniqueness measure, *PRTU*.

Asset illiquidity provides an indication of the possible lacks of quality of assets. Highly illiquid asset portfolios may have stale and unreliable NAVs. Early studies (i.e. Malkiel, 1977) suggest that discount is related the illiquidity of the portfolio. The higher the turnover ratio, the more liquid the portfolio is. Thus, we expect negative relation between this variable and DISC. The log turnover ratio of the fund portfolio is the measure of asset illiquidity, *ASTI*.

Trading illiquidity of the shares is associated with higher discounts. Chan et al. (2008) find that liquidity of the markets where the CEF shares are traded is related to CEF discount. Similar to Chan et al. (2008), we measure trading illiquidity using Amihud's (2002) measure. We denote the illiquidity measure, *TRDI*, and expect a positive relationship between this variable and discount.

Early studies have suggested that discount is a function of capital gain tax liability. Because the unrealized capital gain of a fund is a future tax liability to a new investor, he buys the fund at a discount from the NAV reflecting the future capital gain tax. Thus, the size of unrealized capital gain is positively related to the discount. The unrealized appreciation (divided by total asset value) is obtained from the financial statements and named as *TAXL*. We provide a brief summary of the explanatory variables in Table 3.

<< Insert Table 3 about here >>

Our explanatory variables are chosen based on the previous earlier literature and have theoretical bases as discussed above. In addition to these variables we also employ a number of control variables. Fund's total asset in log is named *SIZE*. Fund's *AGE* is the log of the age of the fund in the CRSP listing and possibly underestimates the actual age.

The type of the fund is an important determinant of the level of discount. We classify funds as *FOREIGN*, a dummy variable that takes on a value of one, if the fund's assets are primarily foreign bonds or stocks. Country funds, global, and international funds belong to this type. Based on the asset type we employ two dummy variables, *EQUITY*, which takes a value of one if the fund is primarily invested in equity, and *DUAL* takes a value of one if the fund is dual-purpose fund (zero otherwise). We also employ the trading venue as a control. *NYSE* is a dummy variable taking a value of one if the fund is traded in New York stock exchanges (zero otherwise).

The discount series exhibits cycles. We try to capture the potential time-series differences by roughly dividing our sample by three periods. Correspondingly *D1998* is a dummy variable taking value of one if the fund is terminated prior to 1998 fund (zero otherwise). *D2003* is a dummy variable taking value of one if the fund is terminated after 1998 but prior to 2003 (zero otherwise).

4.2 Descriptive statistics

As mentioned earlier, a proxy for our investor sentiment is limited to post 1990. In addition, some variables from the financial statement are not available. This reduces our sample size to 102 funds. Descriptive statistics are reported in Table 4. In the first panel, we provide some pre-announcement statistics, followed by post-announcement results, and some general

In the first panel, we observe that the mean (median) fund discount on the week before announcement is 12.32 percent (10.98). It is larger than that of the aggregated discount by approximately 4 percent, which has a mean (median) of 8.72 percent (6.30). The standard deviations of the two discount series are similar. The larger mean fund discount suggests that the prevailing higher discount on the sampled funds is one reason for these funds to undertake open-ending or termination.

During the post-announcement week, as shown in Panel 2, the average (median) fund discount drops to 6.23 percent (5.36) whereas the aggregated discount in the post-announcement period is similar to the pre-period. The inverse share price and the dividend yield series in the pre- and post-announcement period exhibit similar mean and dispersion. It is notable that the dividend yield is approximately 7 percent for the funds. The CAR during the two day period for the sampled 102 funds is 6.46 percent and is of magnitude very similar to that of the whole sample of 119 funds. The median of 5.44 percent suggests that the CAR is not unduly influenced by extreme observations as the minimum and maximum of the distribution bear out.

The distributions of NAV Residual σ and ILLIQ are highly skewed. In our regressions, we take the log transformation of these variables. The expense ratio is less than 2 percent. Variables such as transaction costs, dividend yield, and unrealized gains contain some extreme values and, as hence, are winsorized for subsequent analysis.

<< Insert Table 4 about here >>

Because the structure of CEF discounts may differ by fund types, we classify our sampled funds into foreign/domestic and bond/equity. For each class, the mean of each variable is reported in Table 5. The two sample t-test for difference in means is reported in the last six columns of the Table. For example, "y" in row Fund Discount and column "2-1" indicates that the mean discount of domestic bond funds (1) is statistically different (at 5 percent confidence level) from the mean discount of foreign bond funds (2).

The discount of our sampled funds differs by fund types: domestic funds tend to have higher discount than foreign funds. The discount for domestic bond funds is unusually high, given the common knowledge that bond funds are less risky and traded at lower discount. We compare our fund discount to aggregate discount. We notice that the average discount of our sampled bond funds is about three times as large as the average aggregated discount of comparable bond funds in general. The discount for equity funds between the sample and the aggregate is more comparable. Thus, the notion that high discount funds are likely to be terminated is supported for bond funds but remains unclear in equity funds.

The average standard deviation of the NAV residual for equity funds is higher than that for bond funds, suggesting that portfolios of equity funds are more difficult to replicate and are riskier than those of bond funds. The average expense ratio for the domestic equity funds is higher than other groups. Equity funds also tend to have lower share price (higher Inverse Share Price) than domestic funds. Average dividend yield and illiquidity measure (ILLIQ) do not differ across groups.

<< Insert Table 5 about here >>

5. Regression results

5.1 Cross-sectional regression specification

Our cross-sectional estimation consists of three regressions. First, we estimate cross-sectional regression using discount prevailing at one week before the announcements. Second, we repeat the cross-sectional regression using the discount at one week post-announcement. Because most of the explanatory variables are slow changing and do not change within the two weeks time period, they are re-used in the second step regression, except that we re-compute the dividend

yield, inverse price, and aggregated discount for the post-announcement period. Finally, to obtain the difference of the coefficients in first and second steps, we pool the two regression datasets together and employ a dummy variable (indicating whether discount is before or after announcement) to interact with each of the explanatory variables. The regression standard errors are robust using White (1980)'s method. The regression results are summarized in Table 6.

$$DISC_i = \beta_0 + \beta_1 INVS_i + \beta_2 SIGH_i + \beta_3 EXPR_i + \beta_4 TRNS_i + \beta_5 PRTU_i + \beta_6 ASTI_i + \beta_7 TRDI_i + \beta_8 TAXL_i + \sum_j \gamma_j X_{i,j} + \varepsilon_i \quad (3)$$

Where $DISC_i$ is discount of the closed-end fund. *INVS* is the investor sentiment hypothesis variable captured by the aggregated discount. *SIGH* is the signaling hypothesis variable captured via the dividend yield. *EXPR* is the expense ratio variable that captures the agency cost. *TRNS* is the inverse of the trading price and captures the transaction cost hypothesis. *PRTU* is the portfolio uniqueness measure and captured by the NAV residual σ. *ASTI* is the portfolio level illiquidity captured by the turnover. *TRDI* is the trading illiquidity of the fund shares in the market. *TAXL* is the measure of unrealized gains as a percent of total assets and captures the potential tax liability. The series of *X* variables are the control variables and include; size, age of the fund, type of fund (equity/dual/bond) or foreign/domestic funds. The trading exchange variable is *NYSE* and there are three years of announcement dummy variables.

<< Insert Table 6 about here >>

5.2 Cross-sectional regression results

The cross-sectional regressions are presented in Table 6, in three panels. In Panel A, we show the results with discount at one week before the announcement as the dependent variable. Consistent with the predications in theory and as summarized in Table 3, all coefficients exhibit expected signs. The aggregate discount or investor sentiment hypothesis shows positive and highly significant coefficient, consistent with Lee et al. (1991) that CEF discount is highly correlated with the aggregated discount. The time variation in the systematic component of discount is captured by the aggregated discount variable.

Transaction cost has positive coefficient indicating that the higher the transaction costs the less likely that arbitrage will take place leading to higher discount. Signaling hypothesis based on

dividend yield exhibits negative coefficient significant at better than 5 percent level. Higher dividend payout provides a better signal about superior performance of the funds and, hence, the lower the discount. The portfolio uniqueness measure is positive and statistically significant at 10 percent level, supporting the hypothesis that the more unique the portfolio, the most costly it is to conduct arbitrage and the greater the level of discounts. The potential for tax liability captured in the unrealized appreciation variable is positive and weakly significant. We do not find expense ratio, turnover and illiquidity to be statistically significant. Among the control variables, only the dummy corresponding to equity type of funds is significant and negative.

The explanatory power, measured by the R^2, is quite high at 0.49. In a separate analysis, not reported, we find that the R^2 is about 0.25 with only control variables in the regression. This means, about 25 percent of the explanatory power comes from our focal variables, which is quite high. Investor sentiment, arbitrage, signaling, and capital gains tax liability hypotheses provide explanatory power for CEF discount, especially for closed-end funds announcing termination.

When we use post-announcement discount as the dependent variable, the results are somewhat different as shown in Panel B of Table 6. Most of the variables remain statistically significant but the coefficients are smaller roughly by half. Overall results suggest that risk structure of CEFs changes by the termination announcement. When we examine the difference between the coefficients as shown in Panel C, the differential response to the investor sentiment variable, i.e., aggregated discount, is positive and significant. That is, there is a substantially muted response to the aggregated discount in the post-announcement period. The CEF discount becomes less sensitive to these explanatory variables after the termination announcement.

5.3 Relationship between discounts and abnormal returns

It is natural to ask how much the discount is accounted for the abnormal returns observed in the previous section. To investigate this question, we calculate the cumulate abnormal return (CAR) over the two-day period and estimate the following regression.

$$CAR_i = \alpha_0 + \alpha_1 DISC_i^* + \alpha_2 DAYS_i + \sum_j \gamma_j X_{i,j} + \varepsilon_i \qquad (4)$$

Where $DISC_i$ is the discount observed one week prior to the announcement and CAR_i is the cumulative abnormal return at the announcement. To facilitate interpretation, we adjust discount by

$$DISC_i^* = \frac{DISC_i}{100 - DISC_i} \quad (5)$$

The idea is that for a fund that is traded at x percent discount, the required return to eliminate the discount is [x / (100-x)] percent. Thus, a fund trading at 20% discount needs to experience a 25% abnormal return to fully remove the discount, i.e. trade at par with the NAV. Thus, we would expect that the coefficient attached to $DISC^*$ should be 1 if the announcement fully removes the discount. To the extent that the discount is not immediately erased, the coefficient is a measure of the speed of adjustment of the discount.

We insert the days-to-open ending as a variable of interest. If the market expectation is of a very short liquidation process then the CAR is likely to be higher. The coefficient on open-ending days (log) is not statistically significant. The reason is that in most cases, CEFs announce only the termination event but do not specify the termination date. Markets cannot predict this ex ante and are unable to incorporate into prices. The control variables employed are similar to the earlier regressions reported.

The coefficient of the discount is positive and highly statistically significant as shown in Panel A of Table 7. Because discount is at one week prior to the announcement while the abnormal returns are at the announcement, we can interpret this result as a causal effect. On average, every one percent of discount (at one week prior to the announcement) generates 0.47 percent of abnormal returns at the announcement date, holding other things unchanged. The result suggests that about 47 percent of CEF discount is due to uncertainty about open ending date. After the CEFs announce the termination policy, markets rebate a portion of the discount back in terms of abnormal return. Another 57 percent of the discount is not eliminated at the announcement period.

An alternative view of discount is that it has a structural component and an idiosyncratic component. Discount can be is decomposed into explained discount and unexplained discount. Systematic discount is the portion of discount that can be explained by the explanatory variables in the last section and unexplained discount is simple the residual from the above regression (using

discount at one week prior to the announcement as dependent variable). Based on the regression in Panel A, we estimate the systematic and the unsystematic discounts and transform each discount to an expected return using equation (5).

In the second specification, we decompose the closed-end fund discounts into two components - a systematic and an idiosyncratic component. The systematic component is the predictable part of discount based on the type of the fund, its trading pattern, liquidity, risk, age since inception, and similar variables. The idisyncratic part of discount is the difference between the observed discount and the predictable component of discount. The abnormal return response at the time of the announcement is related to the size of the discount as we have shown in Panel A – the larger the pre-announcement discount the higher the announcement period abnormal returns.

$$CAR_i = \alpha_0 + \alpha_1 PDISC_i^* + \alpha_2 RDISC_i^* + \alpha_3 DAYS_i + \sum_j \gamma_j X_{i,j} + \varepsilon_i \qquad (6)$$

In the regression specification, *PDISC** and *RDISC** are the predicated and the residual discount by CEF. We present evidence in Panel B that at the time of the announcement, the abnormal return responds to close the idiosyncratic discount rapidly with a coefficeint of 0.744. However, only a smaller part of the sytematic discount 0.398, is eliminated at that time. The remaining part of the systematic discount is subsequently eliminated or reduced by the date of open-ending. The difference between the two coefficients is 0.346 and the t-statistical is 3.76, statistically significance at 1 percent level.

<< Insert Table 7 about here >>

In summary, the regression results suggest the following. First, that discounts do respond to hypothesized variables in the predicted manner. Second, the reductions in the discounts post-announcement are largely due to the reduction in the residual part of the discount and less due to reductions in the predicted part. Third, post-announcement the relationships with the variables get weaker with the strongest drop in the investor sentiment, or aggregated discount, coefficient.

5.4 Time series behavior of discounts

Lee et al. (1991) argue that the risk from holding a CEF consists of two parts; the risk arising from fund's portfolio and noise trader risk. Noise trader risk is the risk that fund holders may not be

able to sell the fund at a reasonable price because noise trader becomes pessimistic. In addition, the noise trader risk is symmetric because sentiments of investors are correlated. As we argued earlier, the noise trader risk could decline with the termination announcement. In the last section, we show that the sensitivity of the discount declines after the announcement. In this section, we provide additional results to strengthen this conjecture.

We perform additional two tests. First, for each of our sampled fund, we run the following time-series regression.

$$DISC_{i,t} = \gamma_0 + \gamma_1 INVS_t + \gamma_2 INVS_t \cdot I_{i,t} + \sum_{j=1}^{10} \varphi_{i,j} DISC_{i,t-j} + u_i \quad (7)$$

Where $DISC_{i,t}$ is the discount of funds i[th] in week t; $INVS_t$ is the aggregate discount at time t for an appropriately type-matched aggregated portfolio; and $I_{i,t}$ is dummy variable taking value of one if t is at or after the announcement date. Because discount is persistent but stationary, we include 10 lagged discounts to account for potential autoregression. We run this regression for each of the sampled funds. The sample period is from one year before the announcement date to either one year after the announcement date or the termination date or the liquidation date if it is earlier. As we have discussed, for CEFs that prolong their termination event, the discounts could reverse to the pre-announcement level due to increased uncertainty about the termination date.

The null hypothesis is that sensitivity of the discount to aggregate discount does not change with the termination announcement. And the alternative hypothesis, broadly supported by the cross-sectional ergressions, is that the sensitivity declines after announcement.

$H_0 : \gamma_2 = 0$ versus $H_A : \gamma_2 < 0$

Based on one regression for each CEF, we summarize the behavior of the sample average of the coefficient in Table 8. Note that the termination announcement dates differ across funds, i.e., there is no clustering of the announcements. Hence, the cross-sectional correlation of the estimated coefficients is of little concern and the t-tests as reported are robust. However, we also report the non-parametric sign test and sign rank tests of the coefficients.

In our sample, the sensitivity of discount to the aggregate discount declines after termination announcement. The average γ_1 coefficient of the Investor sentiment variable, *INVS*, is 0.52 and it is

statistically significantly different from zero at one percent level. This provides an additional piece of evidence that the sampled fund discounts are responsive to the level of aggregate discount. Of greater interest is the γ_2 coefficient. The average γ_2 coefficient is -0.84 which is statistically significantly different from zero. This provides evidence suggesting that the sensitivity of the discount to aggregate discount declines subsequent to the termination announcement.

Additional insight can be provided by estimating the following cross-section regressions.

$$DISC_{i,t} = \delta_0 + \delta_1 INVS_t + v_i \quad (8)$$

For each week from [-52, 52], we run cross-section regression of 103 funds. We plot the δ_1 coefficient along with its 95 percent confidence interval in Figure 4. Prior to the termination announcements, the δ_1 coefficient is positive and is statistically significant. We observe a small downward slope, particularly following week -30. The δ_1 coefficient drops noticeably on the announcement day and becomes not statistically significant different from zero after 12 weeks. Overall results suggest that sensitivity of the discount to aggregate discount declines after the termination announcement.

<< Insert Figures 3 and 4 about here >>

6. Summary and conclusions

Closed-end fund discount has attracted considerable attention from practitioners and academic researchers. The discount appears to suggest the lack efficiencies in financial markets. Recently, researchers have sought to provide explanations relying on behavioral theory based notions such as investor sentiment index and others theoreies based on transaction costs and signalling hypothesis. We consider a number of recent hypotheses in addition to the previously related hypotheses such as tax liability and illiquid assets in our assesment of discount.

Existing evidence on open-ending of closed-end funds relies on two early studies with very small sample sizes of 14 firms. Using a sample of 119 U.S. CEFs open-ending announcements between 1973 and 2007, we document a significant average abnormal return of 6.59 percent during the announcement period. The average discounts of the closed-end funds in the sample is reduced

from a discount of 12.32 percent prior to the announcement to a discount of 6.23 percent following the termination announcement.

The behavior of the closed-end prices during the open-ending process provides us with critical additional insight into the closed-end fund discount puzzle. Cross-sectional analysis reveals that discount is related to the hypothesized variables in a predictable manner during the pre- and post-announcement periods. The strength of the relationship of the variables reduces in the post-announcement period with a signficant decline of the role of investor sentiment. The announcement return is positively related to the size of the discount. However, the greater part of the reduction in discount is due to idiosyncratic component compared to the systematic part. Time series analysis of discounts also supports the weakening role of investor sentiments subsequent to the announcement.

After the announcement, there remains a discount of 6.22%. Cross-sectional analysis reveals that this discount is larger for illiquid funds. Also, the volatility is negatively related to the post-announcement discount. If the volatility is inversely related to the reliability of the fund's NAV, then the smaller reaction could be due to greater uncertainty about the liquidation value of the fund.

Our subsequent research is going to focus on the role of price versus NPV in the gradual reduction of discounts. Second, we observe a discount of 2.30 percent in the week prior to the termination which deserves closer scrutiny. It might be attributable to either NAV errors or delays in shareholders receiving the liquidating distribution. Further research should address the value of the actual distribution to the closed-end fund investors to verify whether this final discount represents errors in the reported NAVs or whether there are other costs such as redemption fees tacked on to the closed-end fund shares that may provide an explanation of the discount.

References

Berk, Jonathan B. and Richard Stanton. (2007). Managerial Ability, Compensation, and the Closed-End Fund Discount. *Journal of Finance* 62(2), p. 529-56.

Bodurtha, James N., Dong-Soon Kim, and Charles M.C. Lee (1995). Closed-end Country Funds and U.S. Market Sentiment. *Review of Financial Studies* 8(3), p. 879-918.

Bradley, Michael, Alon Brav, Itay Goldstein, and Wei Jiang, (2007). Shareholder Activism and Price Dynamics: Evidence from Closed-End Funds. *Working paper*, Duke University.

Brauer, Gregory A. (1984). Open-Ending Closed-End Funds. *Journal of Financial Economics* 13, p.491-507.

Brickley, James A. and James S. Schallheim. (1985). Lifting the Lid on Closed-End Investment Companies: A Case of Abnormal Returns. *Journal of Financial and Quantitative Analysis* 20, p. 107-18.

Chan Justin S.P., Ravi Jain, and Yihong Xia. (2008). Market Segmentation, Liquidity Spillover, and Closed-End Country Fund Discounts. *Journal of Financial Markets*, p. 1-23.

Gemmill, Gordon, and Dylan C. Thomas. (2002). Noise Trading, Costly Arbitrage, and Asset Prices: Evidence from Closed-End Funds. *Journal of Finance* 62(6), p. 2571-94.

Johnson, Shane A., Ji-Chai Lin, and Kyojik Roy Song. (2006). Dividend policy, signaling, and discounts on closed-end funds. *Journal of Financial Economics* 81, p. 539-62.

Khorana, Ajay, Henri Servaes, and Lei Wedge. (2007). Portfolio Manager Ownership and Fund Performance. *Journal of Financial Economics* 85, p.179-204.

Lee, Charles M.C., Andrei Shleifer, and Richard H. Thaler. (1991). Investor Sentiment and the Closed-End Fund Puzzle 46(1), p.75-109.

Malkiel, Burton G. (1977). The valuation of Closed-End Investment Company Shares. *Journal of Finance* 32, p.847-859.

Peavy, John W. (1990). Returns on Initial Public Offerings of Closed-End Funds. *Review of Financial Studies* 3, p.695-708.

Pontiff, Jeffrey (1995). Closed-End Fund Premia and Returns: Implications for Financial Market Equilibrium. *Journal of Financial Economics* 37(3), p.341-70.

---. (1996). Costly Arbitrage: Evidence From Closed-End Funds. *Quarterly Journal of Economics* 111(4), p. 1135-51.

---. (1997). Excess Volatility and Closed-End Funds. *American Economic Review* 87(1), p. 155-69.

Ross, Stephen A. (2002). Neoclassical Finance, Alternative Finance and the Closed End Fund Puzzle. *European Financial Management* 8(2), p.129-37.

Sharpe, William F. and Howard B. Sosin. (1975). Closed-End Investment Companies in the United States: Risk and Return, in B. Jacquillat, ed.: European Finance Association 1974 Proceeding, North Holland, Amsterdam p. 37-63.

Weiss, Kathleen. (1989). The Post-Offering Price Performance of Closed-End Funds. *Financial Management*, p. 57-67.

Wermers, Russ, Youchang Wu, and Josef Zechner. (2007). Portfolio Performance, Discount Dynamics, and the Turnover of Closed-End Fund Managers. Working paper, University of Maryland.

Table 1
Distribution of the sample of 119 Closed Ended Funds that announced open-ending in the period from 1973 to 2007.

Panel A: Frequency distribution of open-ending announcement by year.

Year	Frequency
1973 – 1980	7
1981 – 1985	6
1986 – 1990	8
1991 – 1995	15
1996 – 2000	44
2001 – 2007	37
Total	119

Panel B: Frequency distribution by fund types

	Domestic	Foreign	Total
Bond	40(34%)	4(3%)	44(37%)
Equity	28(24%)	47(39%)	75(63%)
Total	68(58%)	51(42%)	119(100%)

Table 2

Average abnormal returns (AAR) for the sample of closed-end funds with the open-ending announcement as event date (day 0). We estimate coefficients from a market model estimated over the period [-251,-21] with the equally-weighted CRSP index returns as market returns. We show the abnormal portfolio return, *z*-statistics, percentage of positive and negative observations, and binomial *z*-statistics for positive abnormal returns in Panel A. We present the cumulative average abnormal returns (CAR) and the corresponding *z*-statistics in Panel B. ***, **, * denote significance levels of 1%, 5% and 10%, respectively.

Panel A

Event time	AAR (%)	*z*-statistic	Percent Positive	Binomial *z*-statistic
-10	-0.02%	-0.29	43	-1.49
-9	0.02%	-0.23	47	-0.56
-8	0.07%	0.68	47	-0.65
-7	0.00%	-0.75	49	-0.19
-6	0.18%	1.09	50	-0.09
-5	-0.01%	-0.11	42	-1.76
-4	-0.21%	-1.24	36	-3.08***
-3	0.13%	1.15	46	-0.85
-2	-0.15%	-0.53	41	-1.94**
-1	0.01%	0.06	49	-0.19
0	3.72%	37.77***	76	5.71***
1	2.87%	23.61***	66	3.42***
2	-0.08%	-0.77	43	-1.57
3	0.01%	0.35	46	-0.94
4	-0.02%	-0.75	45	-1.12
5	0.12%	0.77	50	0.00
6	0.02%	-0.15	45	-1.03
7	0.13%	0.52	47	-0.66
8	-0.13%	-0.62	45	-1.13
9	-0.07%	-0.89	45	-1.12
10	0.04%	0.29	56	1.32

Panel B

Event window	CAR (%)	*z*-statistic	
(-10, -1)	0.00%	-0.05	
(0, 1)	6.59%	43.38	***
(2, 10)	0.04%	-0.44	

Table 3
We summarize below some of explanatory variables used in closed-end fund discount studies. We present references to earlier studies, how the variables are measured, and the expected sign of the coefficient when the variables are regressed against discount. In the regression there are other control variables such as size, age, time period, bond or equity fund, foreign or domestic type fund.

Variable name	Proxy for	Reference Study	How the variable is measured	sign
INVS	Investor sentiment	Lee et al (1991)	Aggregate of NAV-weighted discount of all close-ended funds each week.	+
SIGH	Signaling hypothesis	Johnson, Ling, Seng (2006)	Dividend yield is a predictor of future performance.	-
EXPR	Agency problem	Berk and Stanton (2007)	Expense Ratio (%) of the fund.	+
TRNS	Transaction costs	Pontiff (1996)	1/price	+
PRTU	Portfolio Uniqueness	Gemmill and Thomas (2002)	Standard deviation of the regression residual of the NAV time series of a fund against a corresponding broad index.	+
ASTI	Asset Illiquidity	Lee et al. (1991)	Log(portfolio turnover ratio)	-
TRDI	Trading illiquidity	Chan et al (2008)	Illiquidity measure as defined in Amihud (2002)	+
TAXL	Tax liability		Unrealized appreciation as a percent of total assets	+

Table 4

We present the descriptive statistics of the explanatory variables below. Data is available for 102 closed-end funds. Pre-announcement refers to the week before the announcement and post-announcement is the week after the announcement. Fund discount is *DISC*. Average of the matched aggregated discount is a measure of the investor sentiment (*INV*). *TRNS* is the inverse of the share price. CAR refers to the two-day CAR over the -1 to 0 period. *PRTU* is the portfolio uniqueness measure obtained as the standard deviation of regression residuals of each fund's NAV against appropriate benchmark indices. There are 47 foreign funds, 57 equity funds, and 14 dual funds. Eighty-two funds trade on NYSE. There are 28 cases pre-1998 and 55 cases between 1998 and 2003.

Variables	N	Mean	Median	St.Dev	Min	Max
Panel A Pre-announcement						
Fund Discount	102	12.32	10.98	6.63	1.60	37.84
Aggregate Discount	102	8.72	6.30	6.98	-1.43	26.06
Inverse Share Price[b]	102	0.11	0.10	0.06	0.01	0.30
Dividend Yield[b]	102	6.94	6.54	4.69	0.00	20.00
Panel B Post-announcement						
Fund Discount	102	6.23	5.36	4.33	-1.51	22.90
Aggregate Discount	102	8.53	6.40	6.62	-1.32	25.65
Inverse Share Price[b]	102	0.11	0.10	0.06	0.01	0.30
Dividend Yield[b]	102	6.86	6.11	4.77	0.00	20.00
Panel C General						
CAR	102	6.46	5.44	5.49	-5.47	32.12
NAV residual σ	102	1.94	1.22	1.95	0.26	12.04
Expense Ratio	102	1.49	1.33	0.69	0.45	3.53
Asset Turnover (log)	102	3.44	3.73	1.45	-3.22	6.44
Trading Illiquidity	102	0.03	0.01	0.08	0.00	0.68
Unrealized Gains as % of total assets[a]	102	3.84	2.39	18.54	-38.00	38.00
Total Assets (log)	102	4.68	4.51	1.00	2.06	6.75
Listing Age in CRSP (log)	102	2.08	2.14	0.75	0.69	3.61
Number of Days to termination (log)	102	4.85	5.01	0.83	1.10	6.10

[a] Winsorized at 5 and 95 percentile
[b] Winsorized at 95 percentile

Table 5
Descriptive statistics by fund types: foreign/domestic and bond/equity. The last six columns contain test for difference in two means. For example, column "2-1" compare average domestic bond (1) to average foreign bond. "y" indicates statistical significance at 5 percent level based on two-sample t-tests. All variables except CAR and LN_OPEN_DAYS are measured one week before the termination announcements.

	Bond		Equity							
Variable	**Domestic (1)**	**Foreign (2)**	**Domestic (3)**	**Foreign (4)**	**2-1**	**3-1**	**3-2**	**4-1**	**4-2**	**4-3**
CAR	8.66	5.62	7.47	5.23						
Fund Discount	17.12	9.59	14.94	10.79	y		y	y		
Aggregate Discount	6.43	3.05	14.05	9.15	y	y	y		y	y
NAV residual σ	1.35	0.84	2.95	2.16		y	y		y	
Expense Ratio	1.12	1.21	1.88	1.21		y	y			y
Asset Turnover (log)										
Trading Illiquidity	0.10	0.02	0.02	0.08						
Inverse Share Price	0.14	0.12	0.11	0.09		y		y	y	
Dividend Yield	6.31	7.51	6.16	6.53						
Unrealized Gains as % of total assets	-1.42	-1.17	5.64	13.46				y	y	
Total Assets (log)										
Listing Age in CRSP (log)										
Number of Days to termination (log)	5.05	4.73	4.99	4.71						
Observations	4	40	43	15						

Table 6
Regression results. The dependent variable is the CEF discount. The first and second regressions are estimated separately. The "Difference" column is estimated by pooling data before and after the announcement together and using a dummy variable to interact with each of the explanatory variables. INVS captures investor sentiment by using the aggregate discount measure. SIGH captures the signaling hypothesis using dividend yields. EXPR captures the agency cost hypothesis by using expense ratios. TRNS is a proxy for transaction costs using the inverse of share price. PRTU captures the portfolio uniqueness hypothesis by using the NAV residual σ. ASTI is the asset illiquidity captured by portfolio turnover, and TRDI is the trading illiquidity captured by Amihud's (2002) measure. The unrealized capital gains are captured by the TAXL variable. The t-statistics are calculated using heteroscedasticity-robust standard error (White, 1980). ***, **, and * indicate statistical significance at 1, 5, and 10 percent level, respectively.

	Panel A		**Panel B**		**Panel C**	
Variables	**One Week before announcements**		**One Week after announcements**		**Difference**	
	Coefficient	*t*-statistic	Coefficient	*t*-statistic	**Coefficient**	***t*-statistic**
CONSTANT	0.576	(0.12)	-1.223	(-0.31)	1.799	(0.24)
INVS	0.597	(4.92)***	0.295	(3.00)***	0.302	(1.94)*
SIGH	-0.277	(-2.07)**	-0.184	(-2.27)**	-0.092	(-0.59)
EXPR	0.118	(0.12)	0.130	(0.25)	-0.012	(-0.01)
TRNS	35.184	(2.47)**	20.408	(1.55)	14.776	(0.76)
PRTU	1.478	(1.66)*	0.890	(1.74)*	0.588	(0.57)
ASTI	0.334	(0.95)	0.178	(0.72)	0.156	(0.36)
TRDI	0.459	(0.78)	1.310	(1.91)*	-0.851	(-0.94)
TAXL	0.057	(1.67)*	0.022	(0.91)	0.035	(0.85)
<u>Control variables</u>						
SIZE	0.577	(0.55)	1.946	(2.31)**	-1.369	(-1.01)
AGE	1.260	(1.51)	-0.060	(-0.08)	1.320	(1.20)
FOREIGN	1.119	(0.70)	0.535	(0.44)	0.584	(0.29)
EQUITY	-5.172	(-3.70)***	-2.532	(-1.66)*	-2.641	(-1.28)
DUAL	1.567	(0.71)	-0.205	(-0.15)	1.771	(0.68)
NYSE	0.874	(0.53)	-0.201	(-0.16)	1.075	(0.52)
D1998	1.595	(1.14)	0.334	(0.42)	1.262	(0.78)
D2003	0.529	(0.44)	1.720	(1.76)*	-1.191	(-0.77)
N	102		102			
R^2	0.491		0.384			

Table 7

Regression results. The dependent variable is the cumulative abnormal return (CAR) measure at the termination announcement (event window [0,1]). All explanatory variables are measure at one week before the announcement. $DISC^{EXP}$ and $DISC^{UNEXP}$ are, respectively, the explained portion and unexplained portions of discount, calculated by using regression results in Table 6. In the second specification, DISC are transformed by $DISC_i^* = \frac{DISC_i}{100 - DISC_i}$. TRDI is the trading illiquidity measure. Days-to-open is the log of the number of days to open-ending or liquidation. The t-statistics are calculated using heteroscedasticity-robust standard error (White, 1980). ***, **, and * indicate statistical significance at 1, 5, and 10 percent level, respectively.

Variables	**Panel A**		**Panel B**	
	Coefficient	***t*-statistic**	**Coefficient**	***t*-statistic**
CONSTANT	2.803	(1.28)	3.815	(1.79)*
DISC*	0.473	(6.47)***		
$DISC^{EXP}$			0.398	(3.78)***
$DISC^{UNEXP}$			0.744	(9.74)***
TRDI	-0.431	(-1.24)	-0.386	(-1.19)
Days-to-Open	0.186	(0.43)	0.130	(0.28)
Control Variables				
SIZE	-0.838	(-2.14)**	-1.027	(-2.67)***
AGE	0.087	(0.16)	0.271	(0.55)
FOREIGN	-0.529	(-0.72)	-0.020	(-0.03)
EQUITY	-0.951	(-1.24)	-0.885	(-1.16)
DUAL	0.658	(0.72)	0.609	(0.65)
NYSE	0.347	(0.39)	0.851	(0.95)
D1998	0.448	(0.74)	0.361	(0.61)
D2003	-2.938	(-3.05)***	-2.394	(-2.58)**
N	102		102	
R^2	0.663		0.679	

The difference (t-value) between $DISC^{EXP}$ and $DISC^{UNEXP}$ is 0.346 (3.76)***

Table 8
Distributions of the discount sensitivity measures, regression coefficients of discount on aggregate discount defined as follows.

$$DISC_{i,t} = \gamma_0 + \gamma_1 INVS_t + \gamma_2 INVS_t \cdot I_{i,t} + \sum_{j=1}^{10} \varphi_{i,j} DISC_{i,t-j} + u_i$$

For each of the sampled closed-end funds, the regression model is estimated using data from 52 weeks (plus 10 weeks for autoregressive terms) before the announcement date to either 52 weeks after the announcement date or termination date. The parametric t-test and two non-parametric Sign test and Sign Rank test are reported to test hypothesis $H_A : \gamma_2 < 0$.

Statistics	γ_1		γ_2	
N	103		103	
Mean	0.52		-0.84	
Median	0.50		-0.76	
Standard Deviation	0.64		1.28	
Min	-1.96		-8.25	
Max	2.12		3.54	
t-test (p-value)	8.18	(<0.0001)	-6.69	(<0.0001)
Sign test (p-value)	37.5	(<0.0001)	-39.5	(<0.0001)
Sign Rank test (p-value)	2066	(<0.0001)	-2102	(<0.0001)

Figure 1
Time series behavior of the price and NAV of a hypothetical portfolio for the period from one year before to one year after the termination announcement. The portfolio is created one year before the announcement with equal ($100) dollar investment in each sample fund. Based on the price of the inception date, the number of shares of each fund is fixed. These weights are applied in subsequent periods to obtain the price and NAV of the portfolio. Liquidation amounts are not reinvested in the portfolio.

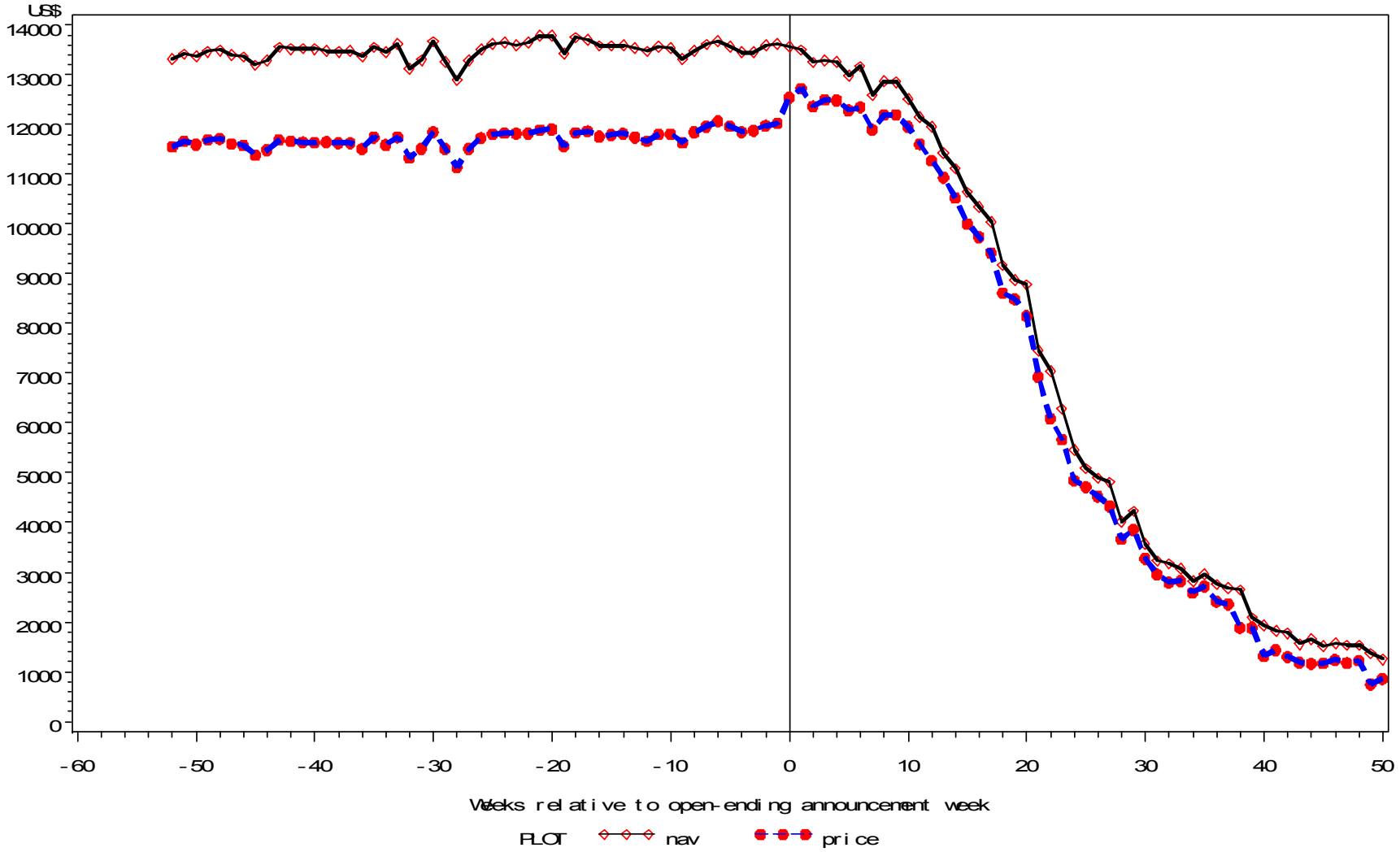

Figure 2
Average discount (along with its 95 percent confidence interval bound) from one year before to one year after the termination announcement

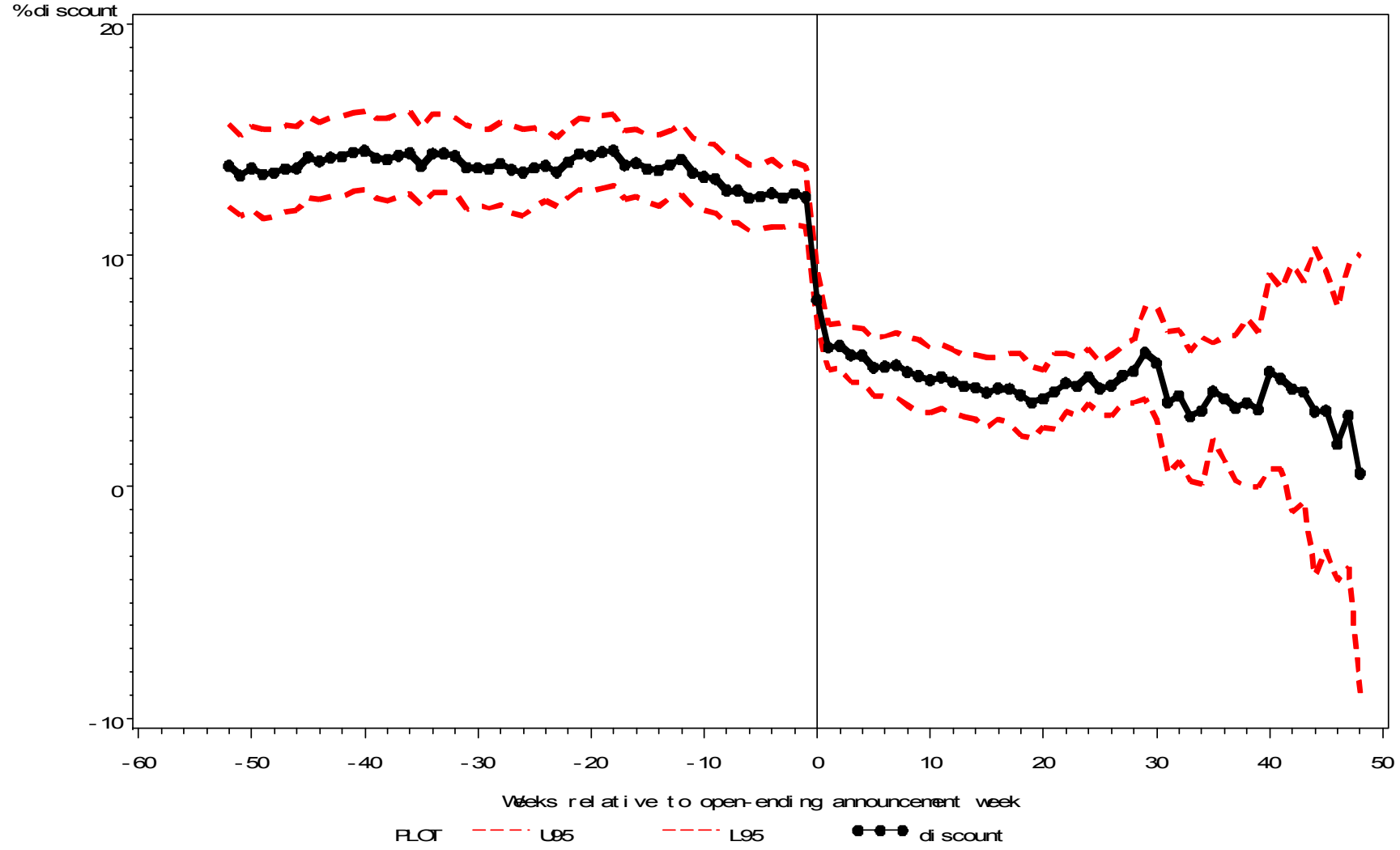

Figure 3
Average abnormal returns (AAR) on the sampled CEFs during open-ending announcements. The open-ending announcement date is set equal to zero. The abnormal returns are the differences between realized returns and expected returns. The expected returns are calculated using a market model using equally-weighted CRSP index returns as market returns. The parameters are estimated over the estimation period [-251,-21].

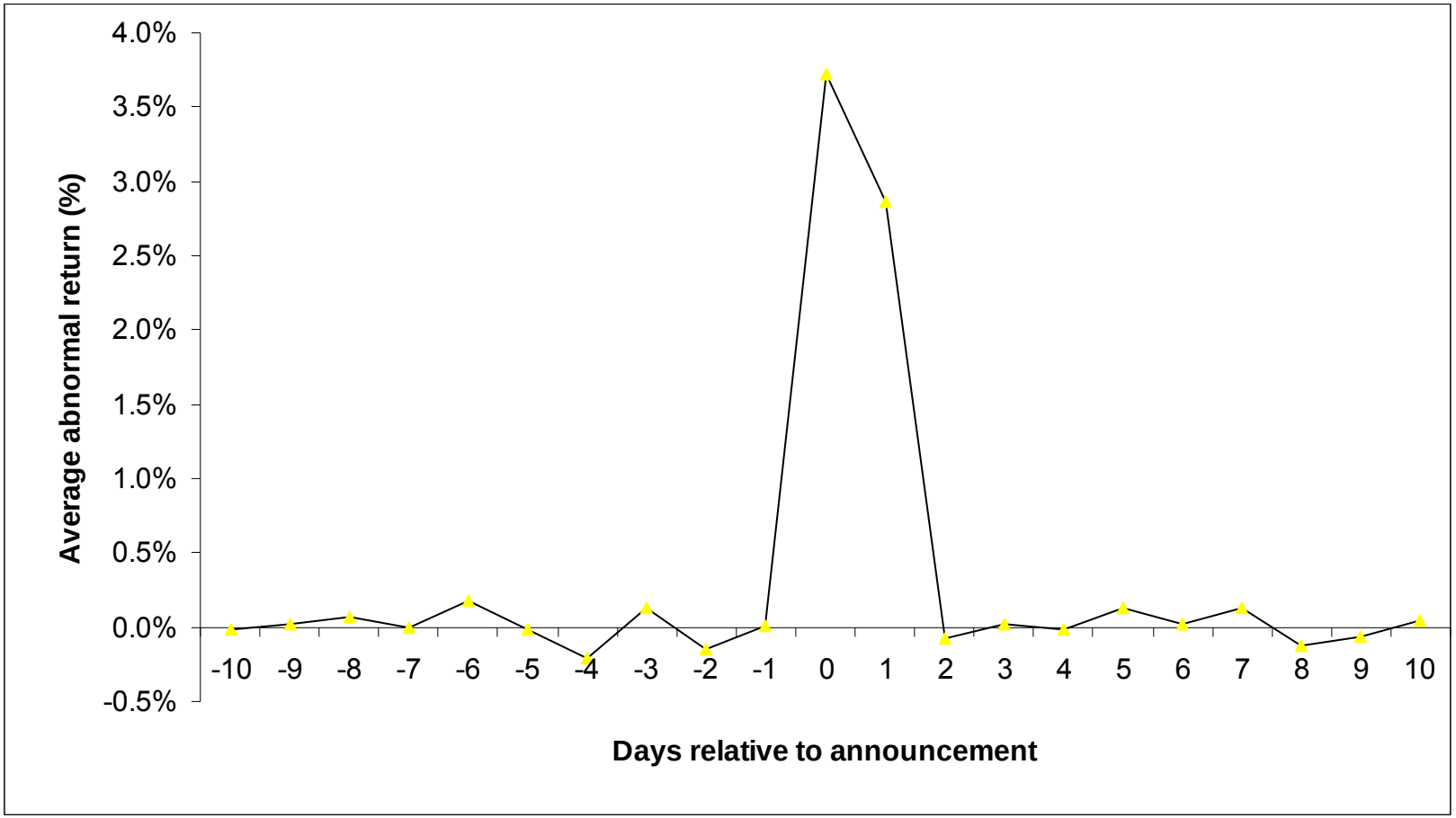

Figure 4

Plot of sensitivity of discount to the aggregate discount. The regression model is estimated weekly using cross-section data of 103 closed-end funds. The 95 percent confidence bound is plotted along with the coefficient. The sensitivity is measured by δ_1 coefficient in the following regression: $DISC_{i,t} = \delta_0 + \delta_1 AGG\_DISC_t + v_i$