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Short selling behavior when fundamentals are known: Evidence from NYSE closed-end funds

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ABSTRACT

The larger a closed-end fund's premium over its portfolio value, the more intensely it is sold short. However, the intensity of short selling affects neither the rate at which premia mean revert to fundamental values nor the rate of return on fund shares. Consequently, short selling does not appear to constrain the mispricings found among closed-end funds. However, closed-end fund factor loadings in Fama French (1992) regressions are consistent with fund portfolio risks, suggesting that some form of arbitrage is bringing fund prices into line with fundamentals—despite the apparent inability of short selling to limit closed-end fund mispricings.

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This paper explores the ability of short selling to limit asset mispricings by examining how short selling affects the discounts and premia of NYSE-traded closed-end funds. Examining closed-end funds is particularly enlightening because closed-end funds publish their portfolio values weekly, thereby giving market participants a public, frequent, and precise measure of fundamental value. This means that we can see how short selling intensity varies depending on whether or not funds are trading at prices above (premia) or below (discounts) their respective fundamental values, and whether or not short selling appears to limit the extent to which fund prices can exceed their fundamental values. This effort adds significantly to the extensive literature on the limits to arbitrage as well as to the more specialized literature which attempts to understand the behavior of closed-end fund discounts and premia.

My key finding is that while short selling does increase dramatically the more a fund is overpriced relative to its portfolio value, the intensity of short selling does not increase rate at which premia mean revert toward fundamental values. Short selling intensity as measured by short ratios also fails to Granger cause changes in fund discount and premium levels, and short ratios are not correlated with the rates of return to long (and, symmetrically, short) positions in closed-end funds once you take account of the discount or premium at which a fund is trading. That is, conditional on already knowing the degree to which a fund is over-priced, short selling intensity gives no further information about future returns.

The non-correlation between short ratios and discount and premium levels is also demonstrated when funds go IPO. Immediately after IPO, funds always start off trading at premia in order to pay off investment bankers (Weiss 1989). Initial short ratios are high and the initial premia fall down to substantial discounts over the first few months of trading, consistent with short selling causing decreases in premia (Weiss and Seyhun 1994). But at the same time premia are falling, so are short ratios. This matters greatly because I find that premia continue to fall long after short ratios have bottomed out at low levels—indicating that something besides short selling is causing premia to continue to fall.

Further evidence against short selling causing the dramatic decreases in premia that are observed after IPO is given by how rapidly short positions are covered. They are built up very high in the few weeks immediately following a fund's IPO—weeks during which investment bankers intervene to prevent the initial IPO premia from falling (Weiss-Hanley, Lee, and Seguin 1996). However, once this stabilization period ends and premia are free to begin their decline, short positions begin to be rapidly covered—meaning that short sellers are net buyers during the period when premia are falling. This, of course, is inconsistent with short selling causing the observed decreases in premia that occur once the stabilization period ends.

These results all suggest that short selling does not help to bring fund share prices into alignment with fund portfolio values. However, the factor loadings that result from Fama and French (1992) regressions suggest quite clearly that arbitrage in some form does appear to constrain closed-end fund pricing and ensure that closed-end fund returns are very sensibly aligned with both fund portfolio characteristics and fund institutional structures. For instance, if you run separate three-factor regressions for bond funds and stock funds, you find that betas on the market risk factor are, respectively, 0.81 for stock funds but only 0.24 for bond funds. This is consistent with the intuition that stock fund portfolios are more exposed to the market risk factor, and accords well with the fact that the betas for similar regressions run on the returns generated by the underlying fund portfolios show a beta of 0.61 for stock funds and 0.16 for bond funds. Thus, the differences in exposure to the market risk factor that are present in the funds' underlying portfolios are also reflected in the returns generated by the funds' shares.

On the other hand, the coefficients on the HML factor that captures the difference in returns between value stocks and growth stocks is almost identical for bond and stock funds, at 0.16 for stock funds and 0.17 for bond funds. This correctly reflects the fact that both bond and stock funds are equally forced to behave like value stocks due to a provision in the tax code that relieves funds from paying capital gains taxes if they pass at leat 90% of their capital gains through to shareholders in the form of dividends. As a result of this law, funds choose to pay out nearly all capital gains as dividends, in effect making closed-end funds pure value stocks with no growth potential whatsoever. Thus the equal factor loadings on HML for both bond and stock funds are consistent with the market being aware of this similarity between bond and stock funds and pricing them accordingly. This conclusion is further supported by the fact that the coefficients on HML are insignificant when you run regressions on the returns generated by the underlying fund portfolios. The HML factor loadings on fund returns are therefore not attributable to the risk exposure of the underlying portfolios.

Finally, the markets appear to take proper account of the differences between stock and bond funds in terms of their exposure to the SMB factor, which is the difference between the returns on small capitalization stocks and large capitalization stocks. If you run Fama and French regressions on the returns generated by underlying fund portfolios, you obtain a statistically significant coefficient estimate of 0.17 on SMB for stock funds but a statistically insignificant coefficient estimate of -0.001 for bond funds. These estimates clearly reflect the fact that bond fund portfolios have no reason to vary with SMB since they are full of bonds, while stock fund portfolios should, given that they are filled with stocks from both large and small firms. What is interesting, though, when considering whether arbitrage pressures constrain closed-end fund returns, is the fact that when similar regressions are run on the returns generated by fund shares, the coefficient on the SMB factor is a significant 0.21 for stock funds and an insignificant -0.001 for bond funds. Clearly, the returns on fund shares appear to correctly account for the differences between stock and bond funds in terms of their underlying portfolios' exposure to the SMB factor.

Consequently, it appears that despite the apparent ineffectiveness of short selling in correcting fund mispricings, the markets do manage to price closed-end funds so that they sensibly reflect their exposure to each of the three Fama French factors. This is surprising given the often very large deviations from fundamental valuations shown by closed-end funds as well as the fact that their rates of mean reversion to fundamentals levels are quite slow. However, to the extent that these results can be generalized to the pricing of ordinary operating company shares, these results give hope that even mispriced stocks may sensibly reflect risk factors even when arbitrage cannot continuously keep their share prices equal to fundamental values.

This paper proceeds as follows. Section I discusses closed-end funds and how they can be used to add to the existing short sales literature. Section II describes the closed-end fund data as well as the NYSE short sales data and explains the method used to combine them. Section III shows how short selling varies with discount and premium levels. Section IV shows that more intense short selling does not reduce fund premia. Section V shows that while more intense short selling does not affect fund returns, Fama French factor loadings do suggest that closed-end fund returns conform to portfolio risk factors and fund institutional characteristics. Section VI concludes.

I. Closed-end Funds and Short Selling

Closed-end funds trading in the USA report their net asset values, or NAVs, weekly. Each fund's NAV is simply the current market value of its portfolio less the value of its liabilities; it is the dollar value that would be distributed to fund shareholders if the fund were to liquidate immediately. Unlike mutual funds, closed-end funds do not redeem their own shares at par with NAV. Instead, closed-end fund shares trade on stock exchanges at whatever price the market will bear. The perplexing result of this non-redemption policy is that fund share prices only rarely equal per-share NAVs. Indeed, share prices often differ by very large amounts from NAVs—sometimes trading at significant premia relative to NAVs while at other times trading at large discounts.

These large deviations at least appear to be significant violations of the law of one price. But while a large literature reviewed by Dimson and Minio-Kozerski (1999a) explores whether rational or behavioral factors offer a better explanation for the existence and evolution of closed-end fund discounts and premia, their unique novelty for this paper is the fact that they provide a precise and objective measure by which we—and, crucially, market participants—can judge whether a closed-end fund's share price reflects over- or under-valuation relative to fundamentals. This is crucially important when studying short selling because short sellers presumably increase the size of their positions in line with their beliefs about the degree to which a company is over-valued.

By contrast, any analysis of short selling applied to ordinary operating companies suffers from the fact that independent measures of fundamental values are typically not available. The problem is best understood by comparing the large amount of short selling actually observed for such companies with the pointlessness of short selling in an efficient market. In an efficient market where prices constantly adjust to perfectly reflect all information about fundamental values, there is no chance for prices to exceed fundamental values—and, hence, no reason for arbitrageurs seeking mispricings to ever want to engage in short selling. But without independent measures of fundamental values, one cannot directly tell whether the large amount of short selling that is actually observed reflects a rational response to an inefficient market or an irrational response to efficient prices.

Many authors have, however, used short selling to indirectly test for market efficiency. The test consists of realizing that if markets are efficient and stock prices always reflect fundamental valuations, then variations in short selling intensity should not be correlated with future returns. This implication of market efficiency has been rejected by a large number of authors who find, instead, that when short selling intensity increases, subsequent returns decrease. This inverse relationship has been documented by Desai, Ramesh, Thiagarajan, and Balachandran (2002) for NASDAQ stocks, by Asquith and Meulbroek (1996) for NYSE and AMEX stocks, and by Seneca (1967) and Choie and Hwang (1994) for S&P 500 stocks.[1] These findings indicate not only that stocks are sometimes overvalued, but that when they are, rational arbitrageurs take advantage of the over-valuations by increasing their short positions.

[1] Further support is given by Figlewski and Webb (1981), Asquith and Meulbroek (1996), and Senchack and Starks (1993). However, for a strongly dissenting opinion derived from more extensive data, see Asquith, Pathak, and Ritter (2004).

But are short sellers just along for a mean reverting ride, or does short selling also help to keep asset prices in line with fundamentals? A parallel literature supports the second contention by showing that when short sales are restricted, you get high stock prices and low subsequent returns. The measure used by these papers to quantify the degree to which short sales are restricted is the "rebate rate," the interest rate (net of loan fees) paid by large share lenders to large share borrowers on the collateral that the borrowers must post with the lenders until their short positions are covered.

This rate is called the "rebate rate" because, in the normal situation in which shares for shorting are plentiful, the lenders cannot drive a hard bargain and, consequently, end up rebating to the borrowers most of the interest that the lenders earn by investing the borrower's collateral in the money market. But when shares for shorting are hard to come by, the lenders who do have shares available can get away with paying low or even negative rebate rates on borrower collateral. Geczy, Musto, and Reed (2002), Jones and Lamont (2002), and Lamont and Thaler (2003) all show that when rebates rates are low or negative, subsequent stock returns (to long positions) are abnormally low, consistent with the idea that when issues are hard to short, stock prices get too high.

Unfortunately, it is not possible to use rebate rates to determine the degree to which closed-end fund short selling is constrained because closed-end fund shares are almost never available in the institutional lending markets in which rebate rates are negotiated for the simple reason that the large institutional shareholders who lend shares in these markets do not typically own any closed-end fund shares. In fact, D'Avolio (2002) finds that the shares of 92.3% of all closed-end funds trading in the USA are completely unavailable at any time from April 2000 to September 2001 at the large institutional share lending house that he studies. This compares with an unavailability rate of 1.6% for S&P 500 companies, 53.9% for the smallest decile stocks in the CRSP universe, and 52.9% for CRSP stocks trading at under $5. Closed-end funds have by far the highest unavailability rate of all the stock categories studied by D'Avolio.

This means that if you want to short a closed-end fund, you have to ask your broker to borrow the shares from the account of a small investor.[2] But, unfortunately, rebate rates are not paid on these transactions, meaning that we cannot use rebate rates to give us an idea of the degree to which closed-end funds may be hard to short.[3] That being said, I find a large amount of short selling of closed-end funds so that, in general, there does not seem to be any blanket difficulty shorting closed-end funds. Furthermore, the intensity of short selling increases dramatically as funds move from trading at discounts to trading at premia, indicating that, as a general matter, short sellers are able to find more shares to short when they feel that funds are over valued.

Indeed, the high volume of short selling implies that the lack of rebate rate data is not an insuperable barrier to using closed-end funds to study the effects of short selling on mispricings. Rather, it only implies a change in tactics. Instead of investigating whether mispricings vary with short sales restrictions (as measured by rebate rates), we can see how short sales vary with the mispricings themselves (as measured by discounts and premia). Given the ready availability of NAV data, we have a direct and precise measure of the degree to which funds are mispriced at any time—something much better than having to use low ex post returns to argue that short-sales constricted companies had been ex ante overpriced. Thanks to the weekly reporting of discounts and premia, we have a direct, ex ante, and contemporaneous measure of over pricing.

However, this paper's tactic of studying short selling in a market in which you can get an independent and contemporaneous measure of fundamental value is not entirely novel. Ofek, Richardson, and Whitelaw (2002) very cleverly manage to apply this tactic by comparing the spot share prices of operating company stocks with implicit prices derived from applying put-call parity to the prices of options trading on those stocks. Doing so gives them a contemporaneous and independent measure

[2]Lee, Shleifer, and Thaler (1991) and Weiss (1989) report that US closed-end funds are owned almost exclusively by small investors. Thus small investors are the only good source for shortable shares.

[3]Typically, the small investors whose shares are being borrowed by brokers to lend to short sellers are not even made aware that there shares are being borrowed and lent out (a practice facilitated by the holding of most shares in street name.) As a result, no collateral is posted with them when the shares are borrowed. This precludes the possibility of any rebate rate payment.

of whether or not a stock is over or undervalued. Using this method, they find that the greater the short-sales restriction on a stock in the spot market (as measured by rebate rates), the more spot prices tend to exceed the implicit prices derived from put-call parity. This makes sense because while the short-sales restrictions presumably prevent negative sentiment from lowering prices in the spot market, negative sentiment can readily push down implicit prices in the options market because traders can, without restriction, write and hold any number of put options.

However, as pointed out by Flynn (2006), a potential drawback to their method of using implicit prices derived from put-call parity to stand for rational prices lies in the fact that their data often shows substantial gaps between spot prices and implicit prices even when stocks have normal rebate rates and do not, therefore, appear to be short-sales constrained. Since these gaps can be interpreted as being due to market segmentation, we face the problem that the traders in the spot market may have a different distribution of valuations from the traders in the options market, meaning that we cannot necessarily use the implicit prices derived from the options markets as a reliable estimates of the fundamental values that are being assumed by participants in the spot market when they consider whether and to what degree the spot price represents an over-pricing, and, thus, to what degree they may want to sell short.

Utilizing closed-end funds solves this problem in two ways. First, the weekly public availability of NAV data gives all market participants a common measure of fundamental value. Second, there are no options markets for closed-end fund shares. This means that closed-end fund investors cannot be segmented between spot and options markets and that, consequently, everyone who wishes to place a negative bet on the future direction of a closed-end fund's share price can do so only by shorting the fund's shares in the spot market.

In addition, it should be pointed out that because fund NAVs are revealed so often and are of such high precision as measures of fundamental value, the use of closed-end funds to measure the relationship between fundamentals and short selling intensity improves on the work of Dechow, Hutton, Muelbroek, and Sloan (2002), who show that short sellers position themselves in stocks with low ratios of fundamentals (such as earnings and book values) to market values and cover their positions as ratios mean-revert.

Finally, the extremely large and detailed NYSE short interest data set utilized in this paper allows me to greatly expand upon the work of Weiss and Seyhun (1994), who find, in a data set of 48 funds over the period 1981 through 1989, that short selling immediately after funds go IPO may be profitable. Unfortunately, the conclusions that can be drawn from their study are substantially limited by the fact that due to the short interest reporting rules in effect at the time, a fund would appear in their data set for a given month only if there were at least 250,000 shares shorted that month. By contrast, funds appear in my data set even if they have zero shares shorted. This makes an enormous difference given the fact that 94.8% of my monthly fund observations would be eliminated if you imposed the 250,000 share requirement.

II. Data

This paper combines closed-end fund data from the Fund Edge data service sold by Weisenberger/Thompson Financial with official New York Stock Exchange short sales data. Fund Edge is a real time data service marketed to professional investors. It provides them with extensive information on closed-end funds trading in the USA and Canada. Subscribers also receive historical data on fund prices, NAVs, and dividend payments going back to the inception of each fund. Prices are quoted at the daily frequency while NAVs are listed weekly.

However, Fund Edge suffers from survival bias because it only gives historical data on funds in existence and trading at the time of subscription. As a result, the version of Fund Edge examined here contains information on the 462 US and Canadian funds trading as of June 22, 2001. Of these 462 funds, the 388 that are listed on the NYSE are matched with the NYSE's monthly short interest data files. Only these funds are used in this paper.

The short interest data is generated as follows. Each month, in accordance with NYSE Rule 421, all NYSE broker dealers report the outstanding uncovered short positions of their clients. The NYSE sums these for each NYSE-traded stock to arrive at the total number of shares that each NYSE stock has been shorted. Normally, these calculations are made as of the 15th of each month, using that date as the T + 3 settlement date. Since the settlement date is three business days after the trade date, this implies that in a normal month, the NYSE short interest data reflects short positions as of the trade date three business days prior. However, if the 15th of the month falls on a weekend or holiday, then the preceding business day becomes the relevant settlement date, with the relevant trade date being three business days prior to that. As a result, the trade date can be as early as the 9th of the month (for example June 9, 1992) or as late as the 12th of the month (for the months in which both the 15th and the 12th are business days.)

Close attention must be paid to these monthly short-sale tabulation dates if you wish to make sensible matches of the NYSE short-sales data with the weekly NAV data available in Fund Edge. In particular, NAV data for each fund is by tradition provided once per week, with the calculation typically being made using Friday-closing prices to calculate the values of fund portfolios.[4] These NAVs are then combined with same-day closing prices to generate each fund's discount or premia, which is then published the following Monday morning in the Wall Street Journal.

This timing is important because, presumably, short sellers react to this weekly burst of information when deciding how many shares of each fund to short. I do my best to account for the effect of Monday morning releases of discount and premium information by paring each fund's monthly short interest position with the discount or premium that was released on the most recent prior Monday. For instance, for June of 1992, the trade date that was used by the NYSE to calculate short interest was Tuesday, June

[4] If Friday is a holiday, then NAVs are calculated using closing prices from the most recent previous business day.

9th. So, I pair that day's short interest numbers with each corresponding fund's discount or premium released on Monday, June 8th.

This date-pairing protocol gives short sellers two full trading days (all day Monday the 8th and all day Tuesday the 9th) to digest the new information and make any necessary changes to their short positions. And it should be noted that such Monday/Tuesday date pairings are the exception rather than the rule. For most months, the Monday morning publication of discounts and premia is paired with a Wednesday, Thursday, or Friday short-sale trade date. Thus, for most months, there are three or more days for short sellers to react to the most recent prior weekly release of discount and premium information.

For this paper, I only use data from January 1992 through May 2001. I do this because, in January 1992, the NYSE short-sales data sets begin to include ticker symbols that can be used to accurately match the NYSE data to the Fund Edge data.[5] For these months, I only utilize a given fund in a given month if the NYSE reports the number of its shares that have been shorted and if Fund Edge also reports both its NAV and price on the relevant date-pairing date. As illustrated by Figure 1, these data requirements imply that, for most months, the number of funds used in the data analysis is fewer than the total number of funds trading that month. In particular, the thin line in Figure 1 gives the number of Fund Edge NYSE funds that are past their inception dates for each month running from January 1992 through May 2001.[6] Consequently, this line gives the maximum number of funds that might possibly be included in the analyzed data each month. In comparison to these monthly maximums, the black dots give the number of funds for which there is short sales data each month.

[5]The NYSE short sales data starts in January 1988. But before January 1992, the files lack tickers, having, instead, unsystematic abbreviations of company names that are difficult to match with the tickers given by Fund Edge.

[6]NB: Because the Fund Edge data suffers from survival bias, this line does *not* give the total number of closed-end funds trading on the NYSE each month. Any funds that traded during this period but went out of business before June 22, 2001 are not included in my version of Fund Edge and are consequently excluded from my analysis. However, Bradley, Brav, Goldstein, and Jiang (2005) report that only 37 closed-end funds went out of business over the years 1992 through 2000 (by converting to open-end formats). Since this number is small compared to the total number of funds trading over this time, this paper's results are most likely robust with respect to survival bias.

As you can see, the number of funds actually included each month is substantially fewer than the maximum number possible each month for all of 1992 and most of 1993. But from then on, the number included each month is either nearly as large as the maximum possible number or even equal to the maximum possible number. In virtually all cases where the number actually included for a given month is less than the maximum possible number, the gap is caused by funds being missing from the NYSE short interest data files. This appears to be the result of poor coverage by the NYSE, something made apparent by studying the outlier point corresponding to December 1993. For the previous month, November 1993, you find that there are 313 funds for which there is both price and NAV data as well as short interest data. And for the next month, January 1994, there are 319 funds that have all the necessary data. But the number falls to only 255 for December 1993 because many funds listed both the prior month and the following month in the NYSE short interest data files are, inexplicably, not listed at all in the December 1993 file.

Unfortunately, this appears to be a general phenomenon, such that the divergence of the dots from the thin line during 1992 and 1993 is caused in virtually all cases by funds being missing from the NYSE short interest data files—intermittently for some funds, continuously for others.[7] In personal correspondence, NYSE data experts have not been able to explain why this happened during 1992 and 1993, nor why it appears to have stopped thereafter. Finally, please note that the small separation between the thin line and the dots from January 1994 through December 1999 as well as in the last few months of data for 2001 is also caused by funds being missing from the NYSE short interest data files, not because there was missing price or NAV data in the Fund Edge data files.

That being said, there is a great deal of short selling taking place in the data. To begin with, 378 of the 388 funds are shorted for at least one month.[8] And from those 378 funds there are 34,688 usable

[7] I say "virtually all cases" because, in a handful of instances, the divergence is due to missing price or NAV data in the Fund Edge data set.

[8] Of the 10 that are never shorted, nine went IPO in either January or March of 2001, most likely implying that there non-appearance in the NYSE short interest data files is due to an inclusion lag. An inclusion lag may also explain why the tenth fund, Pacholder High Yield Fund (ticker: PHF) is also missing from the NYSE short interest files. It was started in 1988 but only listed on the NYSE in June of 2000.

monthly observations where price, NAV, and outstanding uncovered short positions are all available. To put this in context, please note that the 388 funds are in business and reporting discounts and premia for 37,910 total fund months. So the 34,688 total months for which the necessary short interest data is also available mean that funds are shorted in the data set for 91.5% of the months that they are in business.

The 388 funds consist of 283 bond funds and 105 stock funds. The bond funds account for 24,849 of the useable observations, while the stock funds account for the other 9,839 usable observations. The 10 funds that are never shorted all happen to be bond funds.

This paper focuses on two variables, the "short ratio" and the discount or premium at which each fund trades. The short ratio for each fund each month is simply each fund's number of outstanding uncovered short positions on that month's trade date divided by its average daily trading volume over the course of the four weeks leading up to the trade date.[9]

I utilize the short ratio as my measure of short selling intensity for two reasons. First, the short ratio is the short interest statistic most widely reported in the financial press. Second, it has a simple interpretation as the number of days it would take short sellers to cover all of their uncovered short positions if they were to buy up all available trading volume—assuming that trading volume would continue at the average daily rate at which it had taken place over the prior month.

Please note that it is also possible to construct for each fund each month the ratio of outstanding uncovered short positions to shares outstanding using CRSP data on shares outstanding. But because this paper's results are unchanged whether I use this second ratio or the short ratio, I stick with the short ratio given its place as the standard metric for short selling intensity.

In this paper, discounts and premia are defined such that discounts are negative numbers. Let N_t be the net asset value (NAV) per share of a fund at time t. The NAV of a fund is simply its portfolio

[9] Since the NYSE short interest data files list both of the necessary numbers, I calculate the short ratios used in this paper solely from the data provided by the NYSE.

value less any liabilities the fund may have; it is the value that would be distributed to shareholders if the fund were to liquidate immediately. Let P_t be the fund's price per share at time t. The discount or premium at which a fund trades at time t is defined as $D_t = P_t/N_t - 1$. Values of $D_t < 0$ are called discounts, while values of $D_t > 0$ are referred to as premia. A fund having $D_t = 0$ is said to be trading at par. Furthermore, I will multiply D_t by 100 in this paper so that I can refer to discounts and premia in percentages.

III. The Relationship Between Short Ratios and Discount and Premium Levels

This section shows that increases in closed-end fund D_t levels are strongly associated with increases in short ratios.

A. The Time Series Relationship Between D_t and Short Ratios

Figure 2 plots the average monthly discount or premium, $\bar{D}_t$, and the average monthly short ratio for all funds for which complete data is available over the period January 1992 through May 2001. There is, to the eye, a substantial positive association between the two series that is confirmed by the regression output reported in Table I.

For instance, row (1) of Table I gives the results of regressing the $\bar{D}_t$ series shown in Figure 2 on the average monthly short ratio series shown in the same figure. The regression takes the form $AverageShortRatio_t = Constant + Slope * \bar{D}_t + \varepsilon_t$, where ε_t is the error term, which is modeled using an AR(1) process to account for serial correlation. The regression has an R-squared of 0.69 and a highly statistically significant slope coefficient of 0.06, indicating that each one percentage point increase in D_t leads to a 0.06 increase in the short ratio.

Rows (2) and (3) run similar regressions on the two sub-samples created by distinguishing between bond funds and stock funds.[10] Row (2) reports the results of regressing the bond fund $\bar{D}_t$ series on the average monthly short ratios of bond funds, while row (3) reports the results of regressing the stock fund $\bar{D}_t$ series on the average monthly short ratios of stock funds. Dividing the sample this way shows that the slope coefficient of 0.06 reported for the regression in row (1) that averages across all funds is half way between the statistically significant 0.04 slope coefficient estimated for bond funds and the highly statistically significant 0.08 slope coefficient estimated for stock funds. This difference in slope coefficients indicates that the average short ratio of stock funds is more sensitive to changes in average discount and premium levels than is the average short ratio of bond funds.

A comparison of the estimated constant and slope coefficients in rows (2) and (3) also indicates that stock funds are more intensely shorted than bond funds for any D_t level in excess of a discount of -54.5%. In particular, the estimated constants can be interpreted as the short ratios that prevail when funds are on average trading at par—i.e., when $\bar{D}_t = 0$. Consequently, the highly statistically significant estimated constants for stock funds and bond funds of, respectively, 3.69 and 1.51 indicate that, at par, short ratios for stock funds are more than double the short ratios for bond funds. This large gap can also be seen to be very highly statistically significant if you convert the t-statistics on the constants into standard errors and use them to perform t-tests. Even using the the larger standard error of 0.39 derived from the stock fund t-statistic, the 2.18 percentage point gap between the estimated constants of 3.69 and 1.51 is 5.53 standard errors wide and therefore extremely statistically significant.

B. Short Selling Intensity and the Distribution of Discounts and Premia

I believe that stock funds are more intensely shorted than bond funds at any given discount or premium level because stock funds and bond funds have exceedingly different discount and premium distribu-

[10]Bond funds outnumber stock funds, such that over the 113 months from January 1992 through May 2001, bond funds constitute between a low of 62.2% and a high of 75.2% of all funds trading in a given month.

tions. This can be seen by comparing the distribution of monthly bond fund D_t observations given by the relative frequency histogram in Figure 3 with the distribution of monthly stock fund D_t observations given by the relative frequency histogram in Figure 4.

The bond fund histogram of Figure 3 is created by placing the 24,849 monthly D_t observations across all bond funds over the period January 1992 through May 2001 into one-percent wide bins ranging from a discount of -50% to a premium of 50% and then dividing each bin's total by the overall total number of observations (24,849).[11] Figure 4 follows the same procedure for the 9,839 monthly stock fund D_t observations.[12]

Before concentrating on the many differences between the bond and stock fund distributions, please note their one major similarity. Simple visual inspection as well as the summary statistics presented in Table II show that for both distributions, the mean, mode, and median D_t levels are all negative. A large literature surveyed by Dimson and Minio-Kozerski (1999b) debates why closed-end funds trade on average at discounts (rather than at par), with the two dominate alternative hypotheses being that funds should trade on average at discounts in order to rationally capitalize out future fund expenses (Ross 2002) and that average discounts serve to compensate investors for bearing noise-trader risk (DeLong, Shleifer, Summers, and Waldmann 1990).[13]

The evidence presented in this paper cannot distinguish between these competing explanations for why funds trade on average at discounts. But it must be noted that funds *do* on average trade at

[11] The three bond fund premia observations that are greater than 50% are excluded from Figure 3. All observations (for both bond and stock funds) exceed the figure's left bound of -50%. The lowest bond fund discount is -23.1% while the largest bond fund premium is 61.17%.

[12] The 65 stock fund premia observations that are greater than 50% are excluded from Figure 4. As noted before, all observations (for both bond and stock funds) exceed the figure's left bound of -50%. The lowest stock fund discount is -41.1% while the largest stock fund premium is 138.97%

[13] DeLong, Shleifer, Summers, and Waldmann (1990) argue that due to market segmentation, irrational noise traders dominate the markets for closed-end fund shares but not the markets for the shares held by funds in their portfolios. As a result, if you were to buy those underlying shares directly, you would not be exposed to noise-trader induced volatility, whereas if you bought those shares indirectly by purchasing shares of the fund, you would. To make directly purchased and indirectly purchased shares equally attractive, closed-end funds must trade at discounts so that their effective rates of return are higher those generated by their underlying portfolios. This extra rate of return serves to compensate investors whose decision to buy closed-end fund shares exposes them to noise-trader induced volatility (i.e., "noise-trader risk").

discounts so that a rational short seller looking for arbitrage opportunities in closed-end funds would be sensible to consider a fund overvalued not when its D_t value exceeds par, but when it exceeds a value corresponding to the long-run average discount at which funds of its type trade. Indeed, such a sensibility can explain not only why the estimated constants for both bond and stock funds in rows (2) and (3) of Table I are positive, but also why the stock fund constant is larger than the bond fund constant.

To begin with, the fact that both constants are positive is consistent with short sellers believing that funds trading at par are over-valued. This is consistent with the fact that both distributions have negative means, modes, and medians. Short sellers who are aware that funds trade on average at discounts will consider funds trading at par to be overvalued and will consequently engage in substantial positive amounts of short selling in such situations—consistent with the positive estimated constants given in Table I.

The difference in short selling intensity at par between bond and stock funds is also easily explained if you assume that rational short sellers take into account how different the bond and stock fund distributions are. If you compare the summary statistics for the bond and stock fund distributions given in Table II, you can see that stock funds not only trade at much deeper average discounts than do bond funds, but they also have distributions that are much wider, much more highly skewed towards premia, and which possess much fatter tails.

These differences imply that arbitrageurs who are interested in short selling over-valued closed-end funds will have systematically different views about what a given fund's current D_t value implies about its being overvalued depending on whether the fund is a bond fund or a stock fund. Compare, for instance, a bond fund and a stock fund that are both trading at par (i.e., at $D_t = 0$.) For the bond fund, this represents a D_t value that is at the 67th percentile of the 24,898 bond fund D_t observation in the data set. By contrast, a stock fund trading at par is at the 74th percentile out of the 9,839 stock fund observations. Thus, conditional on its own distribution, the stock fund trading at par is more overvalued than the bond fund trading at par. It thus appears natural that stock funds trading at par show higher short ratios than do bond funds trading at par.

C. Short Selling Intensity as a Function of Discount and Premium Levels

My analysis so far has drawn conclusions by examining the relationship between short ratios and D_t levels over time. These conclusions—that D_t levels drive short ratios and that the intensity of short selling appears to be related to the difference between the current discount or premium level and the long-run average discount and premium level—receive additional support if you aggregate the data across time periods.

C.1. Short Ratios as a Function of D_t Levels

Figure 5 plots the average short ratios of bond funds and stock funds as a function of discount and premium levels. The thin line with dots plots out the average short ratios for stock funds while the thick line plots out the average short ratios for bond funds. The respective lines were created by sorting the 9,839 stock fund D_t observations and the 24,849 bond fund D_t observations into one-percent wide bins ranging from a discount of -50% to a premium of 50%.[14] The figure plots the average short ratios of the bond and stock funds falling into each bin.

As you can see, the differences between bond fund and stock fund short ratios that manifest themselves in the regressions given in Table I are even more starkly drawn when the data is aggregated over time in Figure 5. Most striking is the fact that for all D_t bins up to a premium of 15%, stock fund short ratios exceed bond fund short ratios. Note that these bins—all the bins from -50% to 17%—contain 94.1% of the stock fund observations and 97.6% of the bond fund observations, so that we can state

[14]There are 68 premia observations in excess of 50%. The short ratios associated with these observations are excluded from the figure.

clearly that except at the most extreme premium levels, stock funds are shorted more intensely than bond funds at any particular D_t level.

This behavior is of course consistent with the idea that short sellers take into account the respective distributions of stock and bond funds when deciding how intensely to short a fund trading at any given D_t level. Since stock funds trade on average at deeper discounts than do bond funds, an arbitrageur looking at a stock fund and a bond fund trading that are trading at the same D_t level will consider the stock fund to be more overvalued and will consequently short it more intensely.

More broadly speaking, the steady increase in short ratios as funds move to higher D_t levels represents one of this paper's most important findings. In a market in which fundamentals are public and in which it is also well known how the market has reacted in the past to those fundamentals in terms of converting information about fundamentals into prices, short sellers clearly increase their positions the more funds appear to be overvalued relative to the distribution of D_t values at which the market has previously priced fundamentals. The higher a fund's D_t level is compared to the distribution of D_t levels for funds of its type, the more intensely the fund is sold short.

This of course has important implications for the literature which discusses the limits to arbitrage and whether arbitrage can be relied upon to keep asset prices consistent with fundamentals. For advocates of arbitrage, Figure 5 offers both hopeful and cautionary information. The good news is that despite the fact that closed-end fund shares are almost never available at large institutional share lenders (D'Avolio 2002) and must be obtained by asking your broker to run a "locate" in order to borrow them out of the account of a small investor, and despite the fact that the proceeds derived from a short sale are impounded and not even paid any interest until the position is covered, there does seem to be a great deal of closed-end fund short selling. In addition, it does appear that despite the difficulties, short sellers pay close attention to the degree to which closed-end funds are mispriced and that they do manage to find enough shares by hook or by crook to increase their short positions the more a fund is over valued. This of course should tend to keep over-pricings from getting too big, consistent with the logic of Miller (1977) in which asset prices are lowered when short selling allows the valuations of pessimistic investors to affect asset prices.

Indeed, the behavior of closed-end funds in terms of short selling is very gratifying when you consider the likelihood that short sellers should have a much greater ability to constrain the prices of operating companies, given the fact that the shares of all other types of companies are much easier to borrow from institutional share lenders than are are the shares of closed-end funds (D'Avolio 2002). The likelihood that this is true is supported by Table III, in which the 351,547 short ratio observations in the NYSE short interest files over the period January 1992 through May 2001 are divided into three groups: closed-end funds, NYSE-traded S&P 500 companies, and all other listings.[15] The table gives the mean, median, and standard deviation of each group's short ratios.

While the mean short ratios for the other two groups are substantially larger than the mean short ratio for closed-end funds, the fact that short ratios for all three groups show high skewness means that it is better to compare the three groups using medians. When you do so, you see that the S&P 500 median short ratio of 3.62 is more than double the 1.23 median of the non-S&P 500, non-closed-end fund issues, and that that value is, in turn, nearly double the 0.62 median short ratio of closed-end funds. If short selling does help to keep asset prices in line with fundamentals, then these numbers should imply that the levels of mispricings in found in closed-end funds—as given by their D_t distributions—may in some way be taken as an upper bound on the levels of mispricings that one is likely to see for publicly traded companies. If short selling does help to contain mispricings, then the fact that it is more intense for other companies seems likely to indicate that their share prices will be kept more in line with fundamentals than are the share prices of closed-end funds.

On the other hand, the bad news about the limits to arbitrage conveyed by Figure 5 is that despite the fact that short selling does goes on in closed end funds and despite the fact that it increases substantially

[15]Not all S&P 500 companies trade on the NYSE. A month-by-month list of S&P 500 companies is derived from CRSP and used to identify those that do trade on the NYSE. It is used along with the 388 NYSE-traded closed-end funds to partition the data into three groups.

in intensity the more funds are overvalued, the width and skewness of the bond and stock fund D_t distributions—as visible to the naked eye in Figures 3 and 4 and as summarized in by the statistics in Table II—suggest that the amount of arbitrage pressure that is present and being applied by short sellers is not able to tightly constrain D_t levels.

This is especially true if you interpret the skewness toward premia of the D_t distributions of both bond and stock funds in Figures 3 and 4 as indicating that arbitrage activities that involve short selling are less effective at constraining prices from rising too high than are arbitrage activities that involve taking long positions in order to prevent prices from falling too low. That is, if you assume that irrational traders would be equally likely to cause overpricings as underpricings if they were left to their own devices and unconstrained by rational arbitrageurs, then the skewness of the D_t distributions towards premia would have to derive from the relative ineffectiveness of the observed levels of short selling at constraining irrational exuberance as compared to the ability of arbitrageurs taking long positions to constrain irrational pessimism. Given the relative ease of taking up long positions rather than short positions, this is perhaps not surprising. But it does indicate that even in a market where arbitrageurs are paying attention and in which they seem to have at least some ability to increase their short positions as funds become increasingly overvalued, the practical effectiveness of short positions in constraining overpricings appears to be weaker than the practical effectiveness of long positions in constraining underpricings.[16]

Finally, another piece of bad news when considering the apparent effects of arbitrage in closed-end funds and what their behavior implies about the limits to arbitrage for other stocks is the fact that ordinary operating companies do not have publicly available measures of fundamental value that are anywhere near as precise or as frequently updated as are closed-end fund NAVs. This is an important

[16]On the other hand, it may well be the case that irrational sentiment (DeLong, Shleifer, Summers, and Waldmann 1990) may be asymmetric and more likely to drive funds to extreme premia rather than extreme discounts. If so, then part of the skewness towards premia manifested by both Figures 3 and 4 may be due to the fact that arbitrageurs resisting overpricings may be having to fight a more difficult battle than arbitrageurs resiting underpricings. Whether or not this is true, the skewness towards premia still seems to indicate that short sellering cannot constrain upward mispricings as well as taking out long positions can constrain downward mispricings.

consideration given that fact that closed-end fund NAVs give investors a precise and commonly shared reference point around which to build their estimates of the proper prices at which funds should trade—and thus, also, of the degree to which funds are overvalued and, consequently, the proper intensity with which to short a fund.

By contrast, because no such commonly agreed upon measure of fundamental value is available for operating companies, it seems likely that there will be more disagreement among shareholders as to proper valuations. If so, this could lead to both more upward buying pressure as well as more downward selling pressure. And to the extent that the two pressures offset, we will be less able to interpret the larger amounts of short selling shown by non-closed-end funds in Table III and by D'Avolio (2002) as indicating that the higher levels of short selling pressure found in non-closed-end funds will keep their prices better aligned with fundamentals than the smaller levels of short selling pressure found in closed-end funds.

C.2. Regression Analysis of Short Selling Intensity

Table IV reports the results of running the same pooled regression specification on four different subsets of the 378 funds for which there are short ratio observations in the data set. Each regression is estimated using fund fixed effects and is of the form, $ShortRatio_t^i = C + \beta D_t^i + \gamma \bar{D}_t + \delta r_t + \varepsilon_t^i$, where C is the common constant (estimated along with the fund fixed effects), D_t^i is fund i's discount or premium at time t, $\bar{D}_t$ is the average discount or premium across all funds included in the regression in month t, and r_t is the yield on 1-year Treasury bonds in month t divided by 12 to get a monthly proxy for the risk-free interest rate. The regressions are run for the entire 113 month period from January 1992 through May 2001 and utilize and AR(3) process to account for serial correlation.

Column (1) presents the results of running the regression on the 273 bond funds in the data set, while column (2) presents the results for the 105 stock funds in the data set. Separate regressions for bond and stock funds seem warranted given the results presented in the previous sections of this paper. In addition, it also seems wise to see what happens when you exclude funds that went IPO during the period of analysis. This is prudent for two reasons. First, Weiss (1989) and Levis and Thomas (1995) show that that closed-end fund D_t levels behave unusually immediately after IPO: funds must begin trading at premia of about 8% in order to pay investment bankers for floating the new issues, but their premia typically fall very quickly to discounts in the following six months. Second, Weiss and Seyhun (1994) report that closed-end fund short selling is high immediately after IPOs but declines quickly thereafter. Since both these factors indicate that IPO funds may behave differently from seasoned funds, columns (1a) and (2a) provide a robustness check by excluding any fund that had its IPO during the January 1992 through May 2001 period. The regression involve, respectively, the 125 bond funds and 53 stock funds that are in business for the entire 113 month period.

The first thing to notice about the regression results presented in Table IV is that the estimated slope coefficients for the two bond fund regressions reported in columns (1) and (1a) are nearly identical and statistically indistinguishable for all variables, meaning that the inclusion of IPO funds in (1) does not seem to bias results. The same is true for stock funds, such that a comparison of the coefficient estimates in (2) and (2a) reveals that they are in all cases statistically indistinguishable if you convert the t-stats given in parentheses to standard errors and use them to perform t-tests on the differences between the pairs of coefficients. Because the results are statistically indistinguishable whether you include or exclude funds that went IPO during this period, I will, for simplicity, focus on comparing the results of the long-term funds in columns (1a) and (1b).

The most important result is that the slope coefficients on D_t^i are positive and statistically significant for both bond and stock funds, consistent with the behavior shown in Figure 5. Furthermore, the fact that the bond fund coefficient of 0.15 is much larger than the stock fund coefficient of 0.06 is also consistent with the bond fund line in Figure 5 being substantially steeper than the stock fund line. The fact that the stock fund common constant estimate of 4.05 is more than double the bond fund common constant estimate of 1.59 is also consistent with previous results and consistent with the intuition that because stock funds trade at deeper average discounts, they will typically manifest more short selling than bond funds at any particular discount or premium level.

The coefficient estimates on $\bar{D}_t$, however, only offer partial support for that contention. The highly statistically significant -0.12 coefficient on bond funds indicates that the higher the average discount, the smaller the short ratio on individual funds. This would make sense because—holding a fund's own discount or premium constant—the higher the average discount or premium, the less over-valued the fund's own discount or premium will be compared to other funds of its type. And if relative-overvaluation drives short ratios, this reduction in relative overvaluation should, as the negative coefficient indicates, lead to smaller short ratios.

The stock funds, however, do not appear to follow this behavior. The stock fund $\bar{D}_t$ coefficient of -0.002 is insignificantly different from zero, indicating that the average discount or premium on stock funds does not affect the intensity with which individual stock funds are shorted, holding their own D_t^i levels constant. One possible explanation for the different relationships shown by bond and stock funds relative to their respective $\bar{D}_t$ series is that stock funds are much less prone to move in unison than are bond funds, meaning that an increase in the stock fund $\bar{D}_t$ is more likely to be by happenstance, whereas an increase in the bond fund $\bar{D}_t$ series really means that the entire bond fund distribution has shifted right. This explanation is supported by the fact that the average monthly pairwise correlation among individual fund D_t^i series for the long-lived bond funds is 0.38, but only 0.28 for the long-lived stock funds.

Another possible explanation has to do with the fact that the stock fund discount and premium distribution is so much less well constrained, so much wider, and so much more skewed than the bond fund discount distribution that a given percentage change in the average discount or premium across all stock funds is simply less meaningful than the same percentage change in the average discount or premium across all bond funds. It may be that the stark differences between the bond and stock fund distributions visible in Figures 3 and 4 mean that a distributional summary statistic like $\bar{D}_t$ is only meaningful for bond funds in terms of judging the degree to which a fund is over valued.

Finally, the fact that the estimated coefficients on r_t, the yield on 1-year US Treasury bonds, are insignificantly different from zero for both bond and stock funds indicates that short ratios seem to be, perhaps surprisingly, unaffected by interest rates. This is very interesting because a short seller is a borrower of stock, and as such must pay interest on her loan. While the loan is for shares of stock and must be repaid in shares of stock, the interest that must be paid on the loan is measured in dollars and must be paid on the cash generated from the sale of the borrowed shares.[17]

This cost is most likely unavoidable for the large majority of closed-end fund short sales transactions because the vast majority of closed-end funds are unavailable at the large share lending houses through which it is possible to negotiate rebate rates. If shares could be borrowed from the large lending houses, then the rebate rates paid to short sellers could help to make up for the interest payments due on the cash generated by short sales. But, the large majority of closed-end fund short selling appears to be done by borrowing shares directly from one's stock broker. This is costly for two reasons. First, the broker impounds the cash generated from selling the borrowed shares until the position is covered—meaning that one cannot take the cash and invest it at interest in order to make up for the interest payments due on the borrowed shares. Second, the broker does not pay rebate rates to the short seller despite the fact that he invests the cash that he has impounded. The result is that for the large majority of closed-end fund short selling, the interest costs on short sale stock loans must be paid in full by the short seller. This makes the insignificant coefficients on r_t rather surprising since you would expect the intensity of short selling to vary over time with interest rates and borrowing costs.

Indeed, this result contrasts sharply with Pontiff (1996), who finds evidence that interest rates do affect closed-end fund arbitrage activities. In a 1965-1985 sample of US closed-end funds, he finds

[17]Typically, the interest rate that they are charged is the broker's call rate, which varies with and is just slightly more than the short run, risk-free rate used in the regressions.

that the monthly average absolute discount or premium varies inversely with interest rates. That is, the width of the D_t distribution narrows when interest rates fall. This suggests that when the interest costs of arbitrage fall, arbitrage becomes more intense, thereby reducing the magnitude of both underpricings and overpricings in closed-end funds. It should be noted, however, that Flynn (2004) shows that the effect found by Pontiff (1996) disappears in post-1985 data. For the years 1985-2001, short run interest rates are uncorrelated with average absolute D_t values, a result that dovetails nicely with the coefficients on r_t being insignificantly different from zero in Table IV. Both pieces of evidence suggest that, at least for the more recent period examined here, short selling intensity is not strongly affected by the interest charged on short sales. Consequently, the results presented in Table IV imply that the major factor driving short selling intensity in closed-end funds is how much they appear to be overpriced relative to their NAVs. The next section investigates whether more intense short selling reduces overpricings.

IV. Does Short Selling Reduce D_t Levels?

Any test for the effect of short selling on closed-end fund D_t levels must take into account the fact that D_t levels tend to mean revert, as has been widely reported in the literature.

A. Short Ratios and D_t Mean Reversion Rates

Flynn (2005) shows for the same Fund Edge data examined here that the mean reversion of the D_t levels of US-traded closed-end funds since 1985 are well modeled by an AR(1) process. That is, D_t fits the process, $D_t = \bar{D} + \phi(D_{t-1} - \bar{D})$, where $\bar{D}$ is the long-run average discount or premium to which a fund's D_t series tends to mean revert and ϕ gives the fraction of the gap between the period $t-1$ discount or premium and the long run mean reverting average discount or premium that is closed by the next time period.

If you re-arrange this AR(1) equation, it can be turned into a form on which it is easy to run a regression: $D_t = (1-\phi)\bar{D} + \phi D_{t-1}$. If you run the regression $D_t = Constant + \phi D_{t-1} + \varepsilon_{t-1}$, where ε_{t-1} is the error term, then the estimated constant and the estimated ϕ can be used to back out the long-run mean reverting discount level, $\bar{D}$, because $Constant = (1-\phi)\bar{D}$. This is useful because you can compare this estimate for $\bar{D}$ to the known median value of the overall discount or premium distribution and use it as a simple check on the plausibility of the AR(1) process. Columns (1) and (2) of Table V present the results of running a pooled regression of this form on, respectively, the bond funds and the stock funds in the data set. Fund fixed effects are employed, as is an AR(1) process to capture serial correlation in the errors.

The two regressions each have very good fit, as indicated by both the very high R-squared statistics (of, respectively, 0.87 and 0.88) and by the large magnitude of the t-statistics on all of the estimated parameters. The estimated ϕ values for bond funds and stock funds of, respectively, 0.89 and 0.92, indicated that, on average, only about ten percent of the gap between a fund's D_t in a given month and the long-run mean reverting $\bar{D}$ level is erased by the next month. This slow rate of mean reversion is strong evidence that, for whatever reason, arbitrageurs do not (or cannot) quickly correct closed-end fund mispricings.

That being said, the estimated $\bar{D}$ levels to which D_t levels are estimated to mean revert are consistent with the central tendencies of fund distributions. In particular, the estimated $\bar{D}$ of -3.63% for bond funds given in the bottom row of column (1) is virtually identical to the -3.57% median bond fund D_t value reported in Table II. The same is true for stock funds, as indicated by the fact that the estimated $\bar{D}$ value of -8.12% for stock funds reported in the final row of column (2) is very close to the -8.83% median stock fund D_t value reported in Table II.

Columns (1a) and (2a) explore whether short ratios have any effect on how fund D_t values evolve over time by simply adding fund short ratios to the regressions run for bond funds and stock funds in, respectively, columns (1) and (2). These augmented regressions are of the form, $D_t = Constant +$

$\phi D_{t-1} + Shortratio_t + \varepsilon_{t-1}$. Before examining the results, it should be noted that, ceteris paribus, you would expect that if short selling had any effect on D_t levels, it would be an inverse effect, because more intense short selling would presumably decrease fund prices relative to NAVs, thereby reducing D_t levels. Consequently, we should be looking for negative coefficients on the short ratio variables introduced in columns (1a) and (2a).

What we find instead are positive coefficients. The 0.002 coefficient for the bond fund regression in column (1a) is insignificantly different from zero, while the 0.019 coefficient for the stock fund regression in column (2a) is just barely statistically significant at the 10% confidence level. However, since it is positive, rather than negative, it does not support the hypothesis that higher short ratios lead to lower D_t levels. In addition, it must be noted that the mean reversion ϕ estimates are completely unaffected by the introduction of fund short ratios, and that while the estimated constant terms do change, they lead to only small changes in $\bar{D}$ levels. For the bond funds, a comparison of the $\bar{D}$ levels in columns (1) and (1a) shows only a very small decrease from -3.63% to -3.70%, while a comparison of the stock fund $\bar{D}$ levels in columns (2) and (2a) shows a decrease from -8.12% to -9.69%. Consequently, it appears that accounting for fund short ratios has no effect on the rate of mean reversion of closed-end funds and at most a very small effect effect on the levels to which fund discounts and premia revert in the long run.

B. The Granger Causality Between Short Ratios and D_t

That short selling appears to have no meaningful effect effect on D_t levels is further re-enforced if you run fund-by-fund Granger (1969) causality tests on short ratios and D_t levels.

Table VI presents the results of running such tests on the 125 bond funds and 53 stock funds that were in business for the entire January 1992 through May 2001 period and for which there is complete data on D_t levels and short ratios. For each fund, a Granger causality test utilizing three lags of both variables is run to test two null hypotheses, N_1 and N_2. Null hypothesis N_1 is that D_t does not Granger cause the fund's short ratio. Null hypothesis N_2 is that the funds's short ratio does not Granger cause D_t.

Table VI shows how the probabilities under the two nulls are distributed for bond funds (in the top table) and stock funds (in the bottom table). The tables distribute the funds on the size of their F-statistic probabilities under the two nulls. Since smaller probabilities indicate rejection, the table sorts the funds on the basis of whether or not each fund's probabilities under each of the two nulls is greater or less than 0.05. For instance, if a bond fund has a probability under N_1 of 0.04 and a probability under N_2 of 0.06, it would be sorted into the lower-left bin in the upper (bond) table.

Consider the upper bond table first. The diagonal elements are both cases where it is impossible to make a strong case for the direction of Granger causality. For the two funds falling into the upper left bin, both N_1 and N_2 are rejected at the 5% level, meaning that it appears that for these two funds, D_t Granger causes short ratios *and* short ratios Granger cause D_t. Consequently, Granger causality appears to go both directions at once, which offers little support for the contention that causation goes from higher short ratios leading to lower discount levels. For the 92 funds falling into the bottom left bin, neither N_1 and N_2 are rejected at the 5% level, so that for these fund there does not appear to be Granger causality in either direction—something that is, again, inconsistent with higher short ratios leading to lower D_t levels.

The two off-diagonal bins represent cases where it appears to be possible to clearly assign the direction of Granger causality for particular funds. But because there are almost equal numbers in the two bins, it is impossible to argue persuasively for the direction of Granger causality for funds in general. On the one hand, there are 16 funds in the lower left bin, all cases where you can reject N_1 but not N_2, so that Granger causality would appear to go from D_t to short ratios but not vice versa. On the other hand, there are 15 funds in the upper right bin where you can reject N_2 but not N_1, so that Granger causality would appear to go from short ratios to D_t but not vice versa. But because there are equal numbers of funds in the two off-diagonal bins, one cannot make general case for Granger causality in either direction.

Matters are a bit different for the lower stock fund table. There, the lower-left, off-diagonal bin for which you can reject N_1 but not N_2 contains 14 funds while the upper-right, off-diagonal bin for which you can reject N_2 but not N_1 contains only 2 funds. This means that you are seven times more likely to find stock funds where Granger causality runs from D_t to short ratios than you are to find stock funds where Granger causality runs from short ratios to D_t levels. This behavior is inconsistent with there being a general tendency for higher short ratios to cause lower D_t levels.

As with the bond fund table, however, the large majority of the entries in the stock fund table lie in the bottom right bin where it is impossible to reject either null hypothesis. Consequently, I feel that when taken as a whole, the distribution of Granger causality probabilities indicates that short ratios and D_t levels are not strongly causally related in the Granger sense in either direction. This is consistent with the pooled time-series regression results presented in the last subsection in Table V.

C. Short Ratios and D_t Levels after Fund IPOs

Further evidence that short ratios do not drive D_t levels is found by examining the relationship between short ratios and D_t levels in the months following closed-end fund IPOs. But before turning to this evidence, it is good to review previous work on closed-end fund IPOs.

C.1. Previous Research on Closed-end Funds IPOs

Weiss (1989) and Peavy (1990) find that closed-end funds begin trading at 8% premia in order to pay investment bankers for the costs of making firm commitments to market fund shares. Both authors show that after IPO, fund D_t levels typically drop from these initial premia to discounts of around -8% within six months.

Weiss-Hanley, Lee, and Seguin (1996) show that there is, however, intense price stabilization by investment bankers in the weeks immediately following IPO. The investment bankers floating the funds place large "good until canceled" buy orders with specialists so that fund prices do not immediately fall. Once these are withdraw, typically after about 20 to 30 trading days, fund prices begin to fall and funds generally move from their initial IPO premia to the average discount levels typical of seasoned funds.

Weiss-Hanley, Lee, and Seguin (1996) also find that while there is very high trading volume during this period of price stabilization, nearly all of the transactions are seller initiated, with the ratio of sells to buys running as high as 70:1 on the first day of trading. This suggests that many initial owners of fund shares are eager to dispose of them as soon as possible during the stabilization period. This appears to be the case because many of the IPO shares are placed with clients of the investment banking houses who have no real interest in purchasing over-priced closed-end fund shares, but who accept their share allotments as an act of reciprocity in their on-going relationship with their investment banking firms. Given the fact that prices are stabilized at the 8% initial premium for about a month, these initial holders are not hurt by having purchased their shares at the initial premium of 8% since they can just turn around and sell their shares before prices drop. The more interesting thing, though, is that these initial holders appear to sell their shares to poorly informed small investors—the evidence for this being that the size of buyer-initiated transactions during the stabilization period is much smaller than the size of seller-initiated transactions. This reserve pool of apparently uninformed small investors is crucial, since it is only by selling shares to them that the funds can be brought to market at premia.

Weiss and Seyhun (1994) estimate the potential returns to short selling during the post-IPO period in a sample of 48 equity funds that went IPO between 1981 and 1989. They find that shorting their sample of closed-end funds immediately after their respective IPOs would have generated an average cumulative abnormal return of -26.51% over the first 150 trading days. This suggests extremely large potential returns to short selling fund IPOs if investors short at IPO and then hold onto their positions through the following 150 days. I present evidence, however, that short sellers cover their positions very quickly, so that few, if any, choose to realize the total possible returns. Instead, it appears that short sellers take out large initial positions as soon as short selling is possible, and then cover those positions as quickly as possible after stabilization ends and prices begin to fall. This is important because their rapid covering activities mean that short sellers are net buyers while D_t is falling. This is significant evidence that short selling does not cause D_t to fall during the immediate post-IPO period.

C.2. Short Ratios and D_t after IPOs

Figure 6 plots the average D_t levels and average short ratios of closed-end funds in the 18 months after their IPOs. The top figure plots the averages for the 148 bond fund IPOs that took place from January 1992 through September 1999, while the bottom figure plots the averages for the 41 stock fund IPOs that took place during that time period.[18]

Month 1 in each figure is the first month for which there is short selling data after each fund's IPO. Because there is typically a lag of several weeks between the time that a fund's shares first begin trading and the next following monthly trade date on which short positions are reported to the NYSE, fund D_t values typically have a few weeks during which they can evolve before the first monthly trade date that marks their initial appearance in the NYSE short interest data files. One result of this lag is that the average Month 1 D_t values shown in Figure 6 for both bond fund and stock fund IPOs are just above 5%. If data from the first weekly D_t listings immediately after the IPOs were used instead, the initial average premia would be higher, matching the 8% initial premia reported by Weiss (1989) and Peavy (1990). While such initial premia are available in Fund Edge, the fact that the NYSE only reports short positions monthly means that at the time the first short data is available, premia have already fallen several percentage points, on average—presumably because the period of price stabilization has ended. Due to this reporting delay, we cannot assess the relationship between short ratios and D_t levels in the

[18] I include only those IPOs happening up to September 1999 so that all of the included funds may have the full 18 post-IPO months over which to take averages of D_t levels and short ratios.

weeks immediately after IPO. That being said, the behavior of the two variables in the months that follow indicates strongly that short ratios do not drive D_t levels.

This is most obvious in the top figure showing the averages for bond fund IPOs. The average short ratio for the first three months is high, and peaks in the third month at 3.83 before beginning to fall down to 0.87 in month six. During this time, the average D_t level is falling continuously. And it continues to fall all the way through month 18 despite the fact that short ratios remain below 0.87 for months 6-18. Consequently, it is obvious that at least for months 6-18, short ratios cannot be what is causing D_t levels to continue to fall. Furthermore, the relationship between the two variables during months 4-6 is also inconsistent with short selling causing the observed declines in D_t during those months. For months 1-3, average short ratios do rise slightly, while D_t falls, consistent with a possible causal relationship. But since average short ratios begin to fall in Month 4, it must be the case that from Month 4 onward, short sellers become net buyers of fund shares, thereby putting upward pressure on D_t levels. This is inconsistent with short selling causing the observed continuing fall in D_t levels.

The behavior of the two variables in the lower graph dealing with stock fund IPOs is even more inconsistent with short selling causing D_t levels to fall. That is because short ratios peak in Month 1 before falling precipitously thereafter. This means that from Month 1 onward, short sellers are net buyers of fund shares, putting upward pressure on D_t levels. This is, of course, inconsistent with short selling causing the rapid decline of stock fund D_t levels that is actually observed.

But why do short sellers cover so quickly and unwind so many positions when D_t levels typically have further to fall? It may be their way of making a safe profit. They establish short positions during the stabilization period and its immediate aftermath when prices are kept artificially high, and then cover their positions extremely rapidly as the stabilization is removed and prices are likely to fall. Under this interpretation, the rapid fall of short ratios immediately after funds go IPO represents short sellers making a quick killing by covering their positions as soon as prices fall even a little. Indeed, they do not seem to be very interested in holding on for awhile and helping to drive the fund's share price all the way down to the sort of discount that would be consistent with funds of its type. Rather, they take advantage of the small, poorly informed investors in the market by selling their shorted shares to those investors at the high prices available during the stabilization period. Once the stabilization period ends and prices begin to fall, they rapidly cover and walk away with a quick killing.[19]

Indeed, the rapidity at which they cover is staggering. From Month 1 to Month 2, the average stock fund short ratio falls from 7.69 down to only 2.93 (while the average D_t falls from 5.17 down to 0.33.) But the true fall in short selling intensity is even greater than the fall in the short ratio suggests because trading volume (which is the denominator term in the short ratio) also falls precipitously, from an average of 89,302 shares in Month 1 down to only 42,644 shares in Month 2. If you take account of this and look directly at the average number of outstanding shorts, you find that it falls from 141,790 in Month 1 to only 49,497 in Month 2. Such rapid covering of short positions when the average D_t level will fall a further six percentage points on average by Month 7 does not look like short sellers trying to drive closed-end fund prices down. Rather, as stated before, it is more consistent with them taking out large short positions as soon as they are able to after IPO and then covering extremely quickly as prices begin to drop.

The rapid covering of short positions also puts into a very different light the finding by Weiss and Seyhun (1994) that closed-end funds in the first 150 trading days after IPO show a cumulative abnormal return of -26.51%. While this suggests a very large profit potential for short sellers who are willing to hold on for the entire 150-day period, the fact that short ratios fall precipitously in just the first few calendar months of trading suggests strongly that such a long term strategy (if 150 days can be called long term) is not what most short sellers are interested in. Rather, they appear to want to cover their positions quickly despite the fact that D_t has a long way yet to fall—meaning that they do not appear

[19]Rapid covering is also advantageous because there is always the possibility that D_t may rise. By covering quickly, IPO short sellers wash their hands of this risk.

to take advantage of a large fraction of the cumulative abnormal return that Weiss and Seyhun (1994) document.[20]

C.3. Comparing the Short Ratios and D_t Levels of IPOs with Those of Seasoned Funds

I have argued that the short selling behavior seen in closed-end funds after their IPOs has to do with an expected fall in D_t levels that is unique to the IPO situation. This hypothesis is given further support by setting up a comparison group of seasoned funds and seeing how differently their short ratios and D_t levels behave compared to those of IPO funds. Figure 7 looks at how average D_t levels and short ratios evolve over the 18 month after the D_t levels of seasoned funds happen to fall between a premium of 4% and a premium of 7%. This range—4% to 7%—is used because it produces average Month 1 premia nearly identical to the Month 1 premia after IPOs shown in Figure 6. As such, the evolution of the short ratios and average D_t levels of seasoned funds in Figure 7 can be directly compared with the behavior of those variables for IPO funds in Figure 6.

The top figure of Figure 7 includes the averages for the 351 cases where bond fund D_t levels fall within the given bounds, while the bottom figure shows the averages for the 147 cases where stock fund D_t values fall within the the given bounds. To make sure that independent events are being analyzed, a fund cannot be included multiple times simultaneously just because its D_t repeatedly enters the 4% to 7% bounds. Rather, once it initially hits the limits, it cannot be included again until 18 months have passed.[21] And for both figures, only cases where the limit is hit between January 1992 and September 1999 are included, so that there are a full 18 months of data for all of the included cases.

[20] This may be due to a form of risk aversion. While D_t levels do on average fall after IPO, they sometimes rise, and even when they do fall, they do not necessarily fall monotonically. Consequently, short sellers may feel it is best to cover quickly, lock in profits, and then invest their gains in other investments that better suit their preferred risk profiles going forward. See DeLong, Shleifer, Summers, and Waldmann (1990) for a discussion of noise-trader risk and how irrational traders may cause D_t levels to fluctuate unpredictably.

[21] For instance, if a fund's D_t value falls within the limits in March 1994, then the fund's monthly D_t and short ratio would be included for that month and the next 17 months as part of the respective Month 1 through Month 18 averages. But if at any time during that 18-month period the fund's D_t were to re-enter the limits, the fund would not be counted again. The full 18 months must expire before the fund can possibly be included again in the Month 1 through Month 18 averages.

The striking thing about both the bond fund figure and the stock fund figure is that D_t levels slowly mean revert over the entire 18 month period while short ratios remain unchanged. This suggests that the level of the sort ratio in closed-end funds is not causing the observed mean reversion in D_t levels. Furthermore, a comparison of the behavior of IPO funds in Figure 6 with seasoned funds in Figure 7 suggests that the converse—that short ratios are driven by D_t levels—does not hold either. That's because, when you make the comparison, you see that the much higher Month 1 short ratios shown by funds undergoing IPOs cannot just be caused by the fact that funds at IPO trade at premia. If trading at a premia by itself were enough to encourage short sellers, then we should see equal amounts of Month 1 short selling in both seasoned funds and IPO funds. Instead, what seems to be happening is that the short ratios of Month 1 IPO funds are much higher than the short ratios of Month 1 seasoned funds because the Month 1 premia associated with IPOs are *sui generis*, in that they are very likely to dissipate very quickly.

In fact, they appear to be a perfect example of the logic of Miller (1977), where a market price can remain too high as long as investors with more pessimistic evaluations are excluded. This is the case with funds at IPO. The small investors willing to buy during the stabilization period include only those willing to pay the 8% IPO premium. Once stabilization ends, the price is set not only by these high-valuation investors but by a larger group that includes investors with lower valuations. This means that prices are very likely to fall once stabilization ends. It appears that short sellers anticipate this price decline and take out very large initial short positions which they quickly cover as prices begin to fall. Consequently, it appears that IPO short selling is driven by the anticipated fall in D_t that will come from opening up trading to people with lower valuations rather than the fact that IPO funds happen to trade at a Month 1 premia of about 5%. Indeed, the irrelevance of the Month 1 premia as the driving force behind short ratios is made clear by the behavior of seasoned funds in Figure 7. They, too, have Month 1 premia of about 5%, but their short ratios remain perfectly flat for the next 18 months—a pattern completely different from that of IPO funds.

Miller (1977) can also explain the short ratio behavior found in seasoned funds and why it differs so greatly from the short ratio behavior of IPO funds. Because there is no price stabilization for seasoned funds, their market prices already reflect the full range of valuations placed upon them by all market participants. As such, the D_t of a seasoned fund cannot be expected to suddenly and predictably drop, as can the D_t of an IPO fund once stabilization ends. Rather, a seasoned fund's D_t represents a rough balance between high and low valuations, no matter how high or low D_t itself happens to be. As a result, short sellers do not react the same way when a seasoned fund is trading at a premia of 5% as they do when an IPO fund is trading at such a premia, since only the IPO fund offers the possibility of a rapid decline in D_t as the opinions of pessimistic investors come to affect share prices after stabilization ends.

A final set of comparisons between Figures 6 and 7 reiterates that idea that short selling around IPOs is different from short selling for seasoned funds as well as the more general point that short ratios are not strongly driven by changes in D_t levels. To see this, compare the long-run average short ratios of bond and stock IPOs in Figure 6 during, say, Months 8 through 18, with the long-run average short ratios of seasoned funds throughout all the months in Figure 7.

After the initial high short ratios associated with IPO have passed in Figure 6, the average short ratio of IPO bond funds falls down to the 0.70 to 0.80 range and averages 0.66 after month 7, while the average short ratio of IPO stock funds falls down to the 1.0 to 1.2 range and averages 1.07 after month 7. These average short ratios for post-IPO funds are much lower than those for seasoned funds. The average short ratio for seasoned bond funds never falls below 1.51 for any of the 18 months and averages 1.74 over the 18 months. And the average short ratio for seasoned stock funds never falls below 3.49 and averages 3.75 over the 18 months. Consequently, the average short ratios for seasoned funds throughout the 18-month period are more than double those of IPO funds after the high short ratios of their initial post-IPO months have passed. This gives further evidence that IPO short selling is *sui generis*.

But it also confirms the idea that short selling and D_t levels have no strong causal relationship. If they did have a strong causal relationship, then the much higher short ratios manifested by seasoned funds would drive down the D_t levels of seasoned funds at least as far as IPO short selling drives down the D_t levels of IPO funds. But the D_t behavior in Figures 6 and 7 contradicts this. While the average D_t for IPO bond funds falls from about 5% in month 1 down to about -5% in month 18, the average D_t for seasoned funds falls only from about 5% down to about 1%, despite the much higher short ratios manifested by seasoned stock funds for months 8 to 18. The same is true for stock funds. The average D_t of IPO stock funds falls sharply from about 5% in month 1 down to about -5% in month 6, and stays at about -5% through month 18. This is very different from seasoned funds, where the average D_t begins at 5% and gradually falls to only -1% in month 18—despite the fact that seasoned stock fund short ratios are more than double those of IPO funds from months 8 to 18.

Once again, this can be explained by Miller (1977). If you consider the short selling seen for seasoned funds as the market expression of the traders with the most negative opinions about those funds, but at the same time also recognize that their negative opinions are being balanced by the positive opinions of others, then it is not surprising that the high short ratios of seasoned funds are not able to move D_t. The negative opinion embodied by these high short ratios is being balanced by the positive opinion of other investors. It seems that unless one group or the other is to suddenly tip the balance and upset this equilibrium of opposing opinions, D_t will not be moved, no matter how high short ratios are in such an equilibrium. The fact that average D_t values slowly decline as time passes suggests that opinion may be tipping not because of more intense pressure by short sellers (of which there is no evidence since short ratios are unchanged), but because of less intense pressure by those with positive opinions.

V. Does Short Selling Affect Closed-end Fund Returns?

Previous sections have demonstrated that fund short ratios do not appear to constrain D_t levels. This section explores whether short ratios affect the rates of return on closed-end funds. To keep matters simple and the results easily comparable with normal studies of returns (which are concerned with long positions), I will examine how short ratios affect the returns to long positions in closed-end funds, the idea being that the returns to short positions are, transactions costs aside, simply the negative of the returns to long positions.

A. Long Returns by D_t Level

The rationality of shorting deeply discounted funds depends on whether or not it is sensible to expect the price of a deeply discounted fund to fall so that a short position would be profitable. Figure 8 shows that, on average, such an expectation is not sensible—and that, indeed, you should only expect the short selling of funds trading at large premia to have any reasonable hope of turning a profit. Figure 8 plots the average one-year return to long positions in bond and stock funds as a function of their initial D_t levels. More specifically, every monthly observation from January 1992 through May 2000 is placed into a one-percent wide bin on the basis of its D_t that month. I then calculate one-year returns when reinvesting all dividends back at closing prices on dividend payment dates and use these one-year market returns to construct average market returns for, respectively, the bond funds and stock funds falling into each one-percent wide bin.[22] These returns are plotted separately for bond and stock funds.

There is a clear negative relationship between long position returns and D_t levels. This is caused by D_t mean reversion. For funds trading at deep discounts, D_t levels rise over time, meaning that prices rise relative to NAVs, so that the returns on fund shares exceed the returns generated by fund portfolios.

[22] I test other reinvestment dates including announcement dates, ex dates, the days after them, and both the first Fridays and first Mondays after announcement dates, ex dates, and payment dates (so that the reinvestments would line up with, respectively, the days NAVs are calculated and the days that the WSJ publishes those calculations.) None of these variations make any substantial difference.

Contrariwise, for funds trading at large premia, D_t levels tend to fall over time, so that fund share prices fall relative to NAVs. This means that for such funds, the return on fund shares is lower than the return generated by fund portfolios. It can even be negative, as is clear for both the bond and stock returns on the right side of the figure where funds are trading at substantial premia.

But because portfolio returns are on average positive (averaging 11.06% per year for stock funds and 6.87% per year for bond funds), it takes a lot of downward mean reversion for funds trading at premia to be able to produce total returns that are negative. Indeed, with the exception of the stock fund outlier at the -40% to -39% bin (which contains only 3 observations), average one-year returns to long positions in closed-end funds are positive for all bins for which $D_t < 6\%$ for stock funds and $D_t < 18\%$ for bond funds. What's more, for bins for which $D_t > 6\%$, it is not even the case that long positions in stock funds are consistently negative. For about half the bins, they are, on average, positive. Consequently, a short seller with a one-year horizon would have to think hard about the potential returns to short selling closed-end funds. To the extent that the returns to short positions are simply the negative of the returns to long positions, only bond funds selling at substantial premia show returns that would, on average, reward short sellers.

These dismal profit prospects are darkened further by Pontiff (1996), who points out that short selling closed-end funds is very costly. Besides the bid-ask spread and brokers fees, the fact that closed-end fund short sellers almost always have to borrow shares directly from their brokers means that they will not receive rebate rates, and will therefore have to bear the full cost of interest payments on their short sale borrowing. Consequently, simply using the negative of the long-position returns plotted in Figure 8 will tend to overestimate the average returns available to short sellers at given D_t levels. Actual returns would be lower.

B. Fama French Regressions on Fund Returns when Accounting for D_t and Short Ratios

This subsection analyzes the returns to short selling and how they are affected by D_t levels, short ratios, and other variables.

B.1. Short Ratios and Fama French Returns

Table VII presents the results of augmenting Fama and French (1992) three-factor regressions run on the monthly returns to long positions in closed-end funds with data on individual fund D_t levels and short ratios. Column (1) presents the results for the 273 bond funds for which there is complete data over the January 1992 through May 2001 period, while column (2) presents the results for the 94 stock funds for which there is complete data over the same period. Each pooled regression takes the form $r_t^i - r_t = \alpha + \beta(r_t^M - r_t^f) + \gamma HML_t + \delta SMB_t + \theta D_t^i + \lambda Shortratio_t^i + \varepsilon_t^i$, where r_t^i is firm i's return in month t, r_t is the yield on 1-year Treasury bonds at month t divided by 12 to give a proxy for the monthly risk-free rate, $r_t^M - r_t^f$ is the excess return on the market portfolio at time t, HML_t is the return to value stocks less the return to growth stocks at time t, SMB_t is the return to small capitalization stocks less the return to large capitalization stocks at time t, D_t^i is the discount or premium on fund i at time t, and $Shortratio_t^i$ is fund i's short ratio at time t. The data for $r_t^M - r_t^f$, HML, and SMB were taken from Kenneth French's web site.

The two regressions show that while D_t levels have strong effects on monthly excess returns, short ratios do not. Each one percentage point increase in D_t lowers monthly excess returns by a highly statistically significant -0.16 percentage point among bond funds and a strongly statistically significant -0.09 percentage points among stock funds. By contrast, a unit increase in the short ratio is associated with a statistically insignificant 0.02 percentage point increase in monthly excess returns among bond funds and a statistically insignificant 0.001 percentage point increase in monthly excess returns among stock funds. Because these effects are near zero, it appears that, conditional on already knowing a fund's

D_t level, the intensity with which it is sold short is uncorrelated with excess returns. Consequently, the regression results in Table VII offer further evidence that short selling does not appear to constrain mispricings in closed-end funds.[23]

B.2. The Reasonableness of Closed-end Fund Factor Loadings

The fact that short ratios are insignificant in the Fama French regressions might lead one to conclude that closed-end fund prices and returns are undisciplined by arbitrage and are therefore unlikely to be sensibly correlated with the common risk factors. A review of the estimated Fama French regression coefficients in columns (1) and (2), however, suggests otherwise. In fact, they appear to be very sensibly aligned with both fund portfolio characteristics and fund institutional structures.

Consider first the fact that stock funds have a highly statistically significant estimated beta of 0.81 while bond funds possess a highly statistically significant estimated beta of only 0.24. This large difference makes sense when you consider that stock fund portfolios are much more correlated with the market risk factor than are bond fund portfolios. In fact, if you run pooled Fama French regressions on the monthly returns generated by fund portfolios (rather than the returns generated by long positions in fund shares), you get betas of 0.61 for stock funds and 0.16 for bond funds. Consequently, the beta loadings of closed-end funds appear to be consistent with the market sensibly taking account of how much their underlying portfolios are exposed to systematic risk.[24]

The coefficient estimates on HML and SMB are also easily explained in terms of the nature of closed-end funds and the differences between bond and stock fund portfolios. For instance, the strongly

[23]Similar results obtain if you run the regressions on just those funds in business for the entire 1992-2001 time period. Thus the results are robust to the the unique behavior of funds in the months after they go IPO.

[24]It is interesting to note, though, that the betas of both bond and stock funds are higher than the betas of their underlying portfolios. This makes it appear as if the markets price closed-end fund shares as though the very act of bundling together a collection of assets into a portfolio exposes you to more systematic risk than is manifested by the portfolio constituents themselves. This is an interesting topic for further research, since it appears that the market is acting as if the act of bundling itself reduces the risk-reducing benefits of diversification. It is as though the bundle is thought of as being more risky than the underlying portfolio. *E pluribus unum*.

positive and statistically significant HML coefficients for both stock funds and bond funds can be reasonably explained as having to do with closed-end fund investors viewing all types of closed-end funds as dividend producing value stocks.

This is true because HML is the return on value stocks less the return on growth stocks. The positive and statistically significant HML coefficients on bond and stock funds of, respectively, 0.17 and 0.16, therefore indicate that as the difference between value stock returns and growth stock returns increases, so do the returns on closed-end funds. This makes sense given the fact that closed-end funds are often marketed to investors for their dividend generating power and that, in fact, tax considerations force most closed-end funds to behave as value stocks.

They behave as value stocks because US tax law relieves closed-end funds from paying corporate taxes on capital gains if the funds pass on to their shareholders at least 90% of the capital gains accrued in a given year.[25] In response, the vast majority of funds choose to pay out virtually 100% of their capital gains as dividends—stock funds on a quarterly basis, bond funds on a monthly basis. Some capital gains are retained to cover management fees and fund expenses, but once these are paid for, the net effect is that NAVs are static over time. This means that closed-end funds have no growth stock potential whatsoever and that they are, in effect, pure value stocks. Consequently, it is not surprising that closed-end fund returns vary positively with HML.

Furthermore, the fact that bond funds and stock funds react to this quirk in the tax law in exactly the same way can also explain why the HML coefficients are nearly identical in regressions (1) and (2). The identically high capital gains payout rates for both types of funds mean that are equally value-ish. It therefore makes sense that their excess returns vary almost equally with HML. This contention is given further support by running Fama French regressions on the monthly returns generated by fund portfolios. Neither bond fund nor stock fund portfolio returns are significantly related to HML. Thus, the relationship found between HML and the returns on long positions in fund shares must be

[25] The tax liability passes on to fund shareholders. See Dimson and Minio-Kozerski (1999b).

due entirely to the structures of the funds themselves rather than to the behavior of their underlying portfolios. The relevant structural factor appears to be their high dividend payout rates and, as with systematic risk, the markets appear to take this structural factor sensibly into account when pricing closed-end funds.

The large difference between stock and bond funds in their reaction to SMB also appears to be sensible. Bond funds show a statistically insignificant -0.001 coefficient on SMB while stock funds show a statistically significant 0.21 coefficient. Since SMB is the return to small capitalization stocks less the return to large capitalization stocks, this means that stock fund returns, but not bond fund returns, increase with the size of the returns gap between small and large capitalization stocks. The difference between bond and stock funds in their reaction to SMB appears to be caused by the fact that bond and stock funds have, obviously, very different portfolio holdings. If you run Fama French regressions on the monthly returns generated by fund portfolios, you find that SMB is positively and significantly related to the excess portfolio returns of stock funds but not bond funds.[26] That is, stock fund portfolios behave like small capitalization stocks while bond fund portfolios do not. Given the fact that portfolio returns affect share returns, it is not surprising that SMB ends up affecting the returns to stock fund shares but not bond fund shares.

The sensible coefficients for the Fama French factors suggest that sufficient arbitrage pressures may be in place in the closed-end fund markets such that closed-end fund returns relate reasonably to common risk factors. The fact that they do should temper any worries raised by this paper's repeated findings that arbitrage in the form of short selling does not appear to affect D_t levels. Regardless of the effectiveness of short selling, closed-end fund returns do vary sensibly with the standard risk factors.

[26]The estimated coefficient on SMB is -0.001 with at t-stat of -0.13 for bond funds but 0.17 with a t-stat of 2.41 for stock funds.

VI. Conclusion

In the closed-end fund markets where fundamental values are well known thanks to weekly updates about net asset values, there is no evidence that short selling reduces the magnitude of fund mispricings. While it is true that short ratios do rise the more a fund is overpriced relative to its net asset value, higher short ratios do not increase the rate at which share prices revert to fundamental values, do not affect the subsequent returns on fund shares, and do not Granger cause changes in discount and premium levels.

In addition, the observed behavior of short selling around fund IPOs is also inconsistent with short selling reducing fund mispricings. Short sellers build up large positions during the month or so after IPO during which investment bankers stabilize fund prices so that they do not fall from the 8% premium at which funds are sold at IPO. Once this stabilization period ends, the premium begins to fall. But this cannot be due to the effects of short selling since short sellers rapidly cover their positions once the stabilization period ends and prices begin to fall. With short ratios falling as short sellers buy shares to cover, the concurrent fall in premia must be caused by something other than short selling.

The most likely explanation has to do with the fact that only those investors with very high valuations are willing to buy at the 8% premium that is maintained during the stabilization period. Once the stabilization period is over, investors with lower valuations also enter the market and premia fall. Short sellers appear to anticipate this. They establish large short positions while prices are being kept artificially high during the stabilization period and then cover their positions as the stabilization is removed and prices begin to fall. That is, causation runs from the expected fall in premia leading to the establishment of high short ratios rather than from high short ratios leading to a fall in premia.

Each of the proceeding results is consistent with the hypothesis that short selling is ineffective at constraining closed-end fund mispricings. It is therefore somewhat surprising that closed-end fund prices do sensibly reflect fundamental risk factors when you run Fama French regressions. Despite the apparent ineffectiveness of short selling in reducing fund mispricings, the markets still apparently manage to keep closed-end fund returns properly varying with fundamental risk factors.

Indeed, the estimated coefficients on all three Fama French factors appear to properly reflect either the risk exposures of underlying fund portfolios or the payout characteristics of the funds themselves. For instance, the market risk factor coefficients of 0.81 for stock fund returns and 0.24 for bond fund returns sensibly reflect the fact that the market risk factor coefficients on their underlying portfolio returns are, respectively, 0.61 and 0.16.

Similarly, the estimated coefficients on the SMB factor of 0.21 for stock funds and -0.001 for bond funds properly reflect the fact that the estimated coefficients on the SMB factor for the returns on the underlying portfolios are, respectively, 0.17 and -0.001. These numbers also make good sense since SMB is the difference in returns between small and large capitalization stocks. The stock funds show a positive association with this factor since their portfolios contains stocks, while the bond funds show no association with this factor since their portfolios contain bonds.

Finally, the fact that both bond and stock funds have nearly identical estimated coefficients on HML is also consistent with the markets rationally varying closed-end fund returns. The identical coefficients make sense because both bond funds and stock funds choose to pay out nearly all of their capital gains in the form of dividends in order to avoid paying capital gains taxes. This shared policy, however, means that net asset values are nearly constant over time, unable to grow because capital gains are paid out to avoid taxes. This implies that all closed-end funds—whether bond funds or stock funds—are pure value stocks, with no growth stock characteristics. It therefore makes perfect sense that the estimated coefficients on HML—which measures the difference in the returns paid out by growth stocks less the returns paid out by value stocks—are positive and nearly equivalent for both stock and bond funds at, respectively, 0.16 and 0.17.

Further evidence in support of this institutional explanation for these estimated coefficient values is provided by the fact that the factor loadings on HML are statistically insignificantly different from zero when you run Fama French regressions on underlying portfolio returns. The HML factor loadings expressed by closed-end fund share returns are therefore independent of the behavior of their underlying portfolios.

The fact that the factor loadings on each of the Fama French factors vary sensibly with either the riskiness of underlying portfolios or with the payout characteristics of closed-end funds as institutions clearly suggests that the markets somehow manage to ensure that closed-end fund returns are rational. Furthermore, this appears to be the case despite the fact that funds often trade at large discounts and premia to their net asset values, and despite the apparent inability of short selling to reduce such mispricings. The generalizability of these results beyond closed-end funds is not clear, but because the funds studied here trade on the NYSE in the same way as ordinary operating companies, the temptation is hard to resist. So, to the extent that these results generalize, it would appear that stock returns can vary rationally with fundamental risk factors even if the stocks are often substantially mispriced with respect to fundamental valuations. If this is indeed true and generalizable, it suggests that stock prices can be incorrect in levels while varying correctly in differences. Further research is obviously needed to test this very intriguing possibility.

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Table I
Time Series Regressions of Discount and Premium Levels (D_t) on Short Ratios

The four regressions are of the form $ShortRatio_t = Constant + Slope * D_t + \varepsilon_t$, where an AR(1) process is used to correct for serially correlated errors. Regressions (1) to (3) report, respectively, the results of regressing monthly average D_t levels on monthly average short ratios for (1) all funds operating each month, (2) all bond funds operating each month, and (3) all stock funds operating each month. The regressions were estimated using OLS, with the standard errors computed using the method of Newey and West (1987), who provide a covariance matrix that is consistent under both heteroskedasticity and autocorrelation. The numbers in parentheses are t-statistics.

	Data Subset	**Constant**	**Slope**	**AR(1)**	**R-sq**	**DW**
(1)	All Funds	2.11	0.06	0.75	0.69	1.97
		(14.10)	(3.03)	(13.95)		
(2)	Bond Funds	1.51	0.04	0.74	0.53	1.98
		(13.11)	(2.01)	(9.97)		
(3)	Stock Funds	3.69	0.08	0.79	0.77	2.28
		(9.36)	(2.90)	(13.59)		

Table II
Summary Statistics for Discount and Premium (D_t) Distributions

	Mean	**Median**	**Mode**	**SD**	**Skewness**	**Kurtosis***	**Observations**
Stock Funds	-6.74	-8.83	-19	14.43	1.95	12.74	9,839
Bond Funds	-2.95	-3.57	-4	7.87	0.75	4.79	24,849
All Funds	-4.03	-4.52	-4	10.31	1.45	13.79	34,688

*This is unadjusted kurtosis, not the version that subtracts 3 because the kurtosis of a normal distribution is 3.

Table III
Short Ratio Statistics for Three Groups of NYSE-traded Stocks, January 1992 through May 2001

	Average Short Ratio	Median Short Ratio	Std. Deviation Short Ratio	Number In Data Set
S&P 500	5.38	3.62	5.88	50,831
Non-S&P 500, Non-Fund	5.92	1.23	124.26*	266,028
Closed-end Funds	1.93	0.62	4.82	34,688

*The standard deviation drops to just 9.62 if you exclude the 600 observations where short ratios exceed 131.50, which is the largest short ratio observed on an NYSE-traded S&P 500 company over this time period; for the remaining 265,428 observations, the average is 4.57 and the median is 1.22. The reason the standard deviation is so high for the entire group is because the data set lists very small volumes for some observations. For instance, the largest short ratio of 55,156 results for Laidlaw One Inc. (ticker symbol UXL) in September 1999 because the data set lists 496,400 shares shorted that month but an average daily volume of only 9 shares. If you exclude the 1% of observations containing the largest short ratios, then the largest remaining short ratio among the 263,367 remaining observations is 53.06, with the average for these observations being 4.01, the median 1.19, and the standard deviation 7.12.

Table IV
Pooled Regressions of Individual Fund D_t Levels, Average Discount Levels, and One-Year Treasury Rates on Individual Fund Short Ratios

This table presents the results of running pooled regressions to explore the determinants of fund short ratios. The same regression is run on four different groups of funds. Column (1) presents the results of running the regression on all 273 bond funds in the data set. Column (2) presents the results of running the regression on the 105 stock funds in the data set. And columns (1a) and (2a) present the results of running the regression on, respectively, the 125 bond funds and 53 stock funds in the data set that were in business for the entire 113 month period from January 1992 through May 2001. The regressions are run using fund fixed effects and are of the form $ShortRatio_t^i = C + \beta D_t^i + \gamma \bar{D}_t + \delta r_t + \varepsilon_t^i$, where C is the common constant (estimated along with the fund fixed effects which are not reported), D_t^i is fund i's discount or premium at time t, $\bar{D}_t$ is the average discount or premium across all funds included in the regression in month t, and r_t is the yield on 1-year Treasury bonds in month t. Note that $\bar{D}_t$ is the monthly average discount or premium of only those funds included in a given regression, e.g. all stock funds as in column (2), or only long-lived bond funds as in column (3). The coefficients β, γ, and δ are common to all funds and time periods and all four regressions are estimated over the full 113 month period running from January 1992 through May 2001. An AR(3) specification is used to account for serial correlation and the t-statistics presented in parentheses are calculated using White (1980) standard errors.

	(1)	(2)	(1a)	(2a)
Independent Variable	All Bond Funds	All Stock Funds	Long-term Bond Funds	Long-term Stock Funds
C	1.60 (3.46)	2.91 (2.99)	1.59 (3.00)	4.05 (3.22)
D_t	0.14 (19.09)	0.06 (5.74)	0.15 (15.46)	0.06 (4.42)
$\bar{D}_t$	-0.11 (-6.47)	-0.02 (-0.49)	-0.12 (-5.35)	-0.002 (-0.05)
r_t	-0.43 (-0.40)	0.93 (0.37)	-0.38 (-0.30)	0.69 (0.21)
R-sq	0.69	0.79	0.75	0.80
DW	1.92	2.02	1.97	2.02
Funds	273	105	125	53
Obs.	24,147	8,608	12,163	5,320

Table V
Pooled Regressions Exploring Whether Fund Short Ratios Affect the Average Rate at which Discounts and Premia Mean Revert

This table presents pooled regressions that explore whether the rate of mean reversion of discounts and premia is affected by short ratios. The regressions are run separately using fund fixed effects for bond and stock funds and both with and without including short ratios. Columns (1) and (2) presents the results for, respectively, all bond funds and all stock funds when not including short ratios. Columns (1a) and (2a) present the results for, respectively, all bond funds and all stock funds when including short ratios. The equation run in columns (1) and (2) is of the form, $D^i_{t+1} = C + \phi D^i_t + \varepsilon^i_t$, where C is the common estimated constant (the individual fund fixed effects are not reported), D^i_{t+1} is fund i's discount or premium at time $t+1$, and ε^i_t is the error term. The equation run in columns (1a) and (2a) simply adds in individual fund short ratios: $D^i_{t+1} = C + \phi D^i_t + Shortratio^i_t + \varepsilon^i_t$. All equations are run using an AR(1) process to account for serial correlation and the t-statistics presented in parentheses are calculated using White (1980) standard errors.

	(1)	(1a)	(2)	(2a)
Independent Variable	Bond Funds	Bond Funds	Stock Funds	Stock Funds
C	-0.39 (-3.88)	-0.41 (-3.76)	-.64 (-3.32)	-0.82 (-3.94)
D_t	0.89 (69.51)	0.89 (65.53)	0.92 (81.49)	0.92 (69.82)
$ShortRatio_t$		0.002 (0.22)		0.019 (1.76)*
R-sq	0.87	0.87	0.88	0.87
DW	2.01	2.01	2.04	2.04
Funds	283	273	105	95
Obs	26,780	25,207	10,541	8,963
Estimated ϕ	0.89	0.89	0.92	0.92
Implied $\bar{D}$	-3.63	-3.70	-8.12	-9.69

Table VI
Granger Causality Test Results for Bond and Stock Funds

To assess whether discount levels, D_t, caused increased short selling in closed-end funds, Granger (1969) causality tests with three monthly lags are run for the 53 stock funds and 125 bond funds funds that were in business for the entire 113 months from January 1992 through May 2001. The two Granger null hypotheses are denoted N_1 and N_2. N_1 is the null hypothesis that a fund's D_t does not Granger cause its short ratio. N_2 is the null hypothesis that a fund's short ratio does not Granger cause its D_t. Both nulls are tested for each fund, with the probability under the null computed in each case. Smaller probabilities mean that we would be more confident rejecting a given null. The tables below report separately for bond funds and stock funds how the probabilities under the null are distributed across funds. I place a fund into one of four bins based upon whether or not its N_1 and N_2 probabilities under the nulls are greater than or less than 5%.

Long-lived Bond Funds

	$N_1 < 0.05$	$N_1 \geq 0.05$
$N_2 < 0.05$	2	15
$N_2 \geq 0.05$	16	92

Long-lived Stock Funds

	$N_1 < 0.05$	$N_1 \geq 0.05$
$N_2 < 0.05$	7	2
$N_2 \geq 0.05$	14	30

Table VII
Pooled Regressions on Monthly Fund Excess Returns using the Fama French Factors as well as Fund Short Ratios and D_t Levels

This table presents the results of monthly pooled regressions exploring what factors explain the monthly excess returns to long positions in closed-end fund shares. Separate regressions are run for bond funds in column (1) and stock funds in column (2). Each regression takes the form $r_t^i - r_t = \alpha + \beta(r_t^M - r_t^f) + \gamma HML_t + \delta SMB_t + \theta D_t^i + \lambda Shortratio_t^i + \varepsilon_t^i$, where r_t^i is firm i's return in month t, r_t is the yield on 1-year Treasury bonds at month t divided by 12 to give a proxy for the monthly risk-free rate, $r_t^M - r_t^f$ is the excess return on the market portfolio at time t, HML_t is the return to value stocks less the return to growth stocks at time t, SMB_t is the return to small capitalization stocks less the return to large capitalization stocks at time t, D_t^i is the discount or premium on fund i at time t, and $Shortratio_t^i$ is fund i's short ratio at time t. Values for the three Fama and French (1992) variables (the excess return on the market portfolio, HML, and SMB) were obtained from Kenneth French's website. The t-statistics presented in parentheses are calculated using White (1980) standard errors.

	(1)	(2)
Independent Variable	Bond Funds	Stock Funds
α	-0.60	-1.09
	(-3.43)	(-2.30)
$r^M - r^f$	0.24	0.81
	(5.67)	(7.31)
HML_t	0.17	0.16
	(3.54)	(2.23)
SMB_t	-0.001	0.21
	(-0.03)	(2.38)
D_t	-0.16	-0.09
	(-6.13)	(-3.23)
$ShortRatio_t$	0.02	0.001
	(1.29)	(0.07)
R-sq	0.14	0.17
DW	2.05	2.16
Funds	273	94
Obs	25,489	9,000

Figure 1. Plot from January 1992 to May of 2001 of the total number of NYSE-traded closed-end funds listed by Fund Edge that are trading each month as well as the number for which there is complete price, NAV, and short sales data each month.

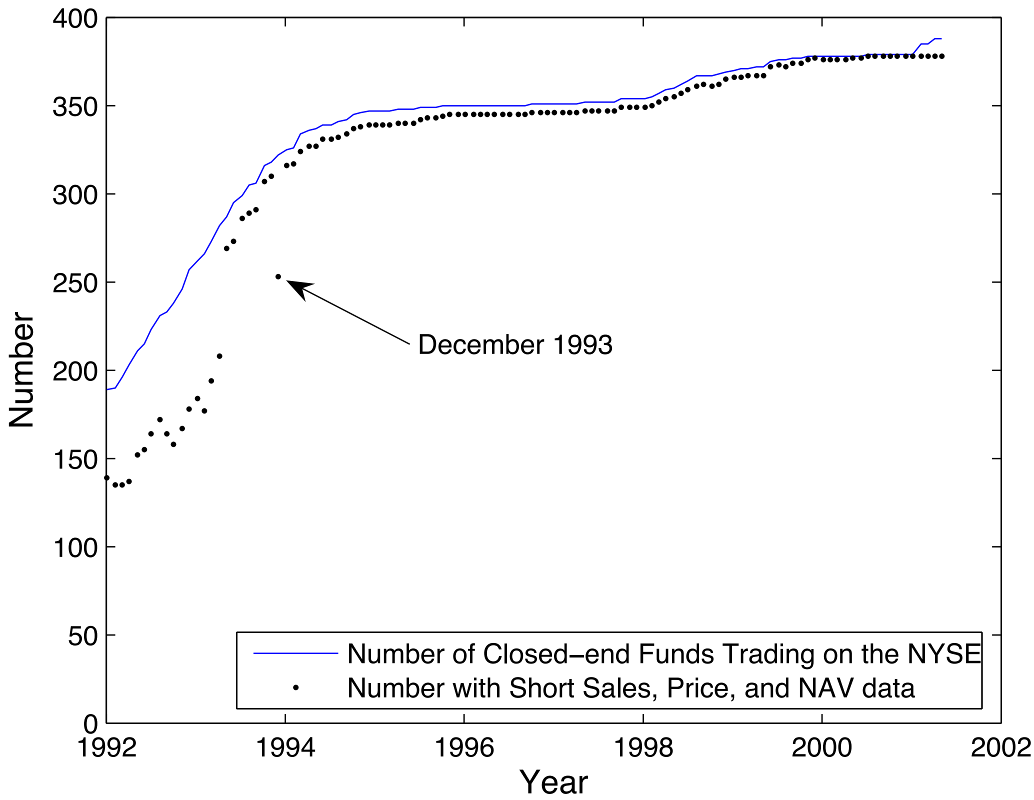


Figure 2. Average monthly closed-end fund premium or discount level (D_t) and average monthly short ratio for all funds for which there is complete D_t and short ratio data each month over the period January 1992 through May 2001.

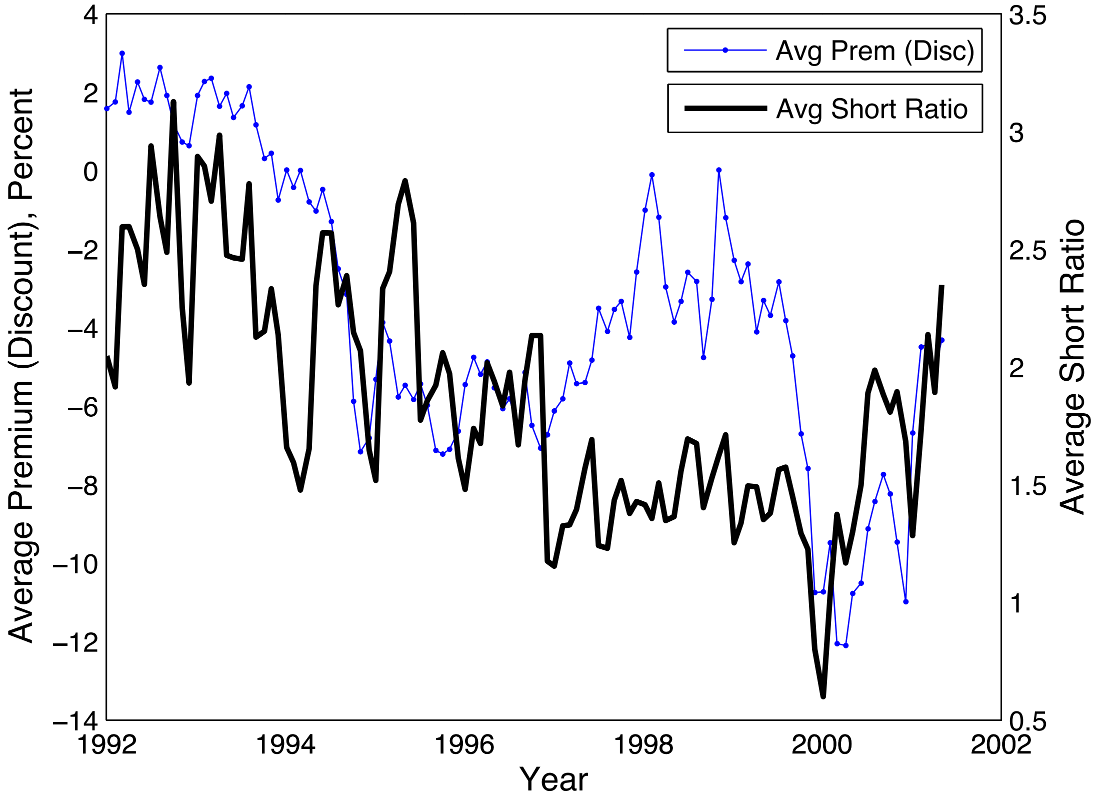


Figure 3. Relative frequency histogram of 24,898 monthly D_t observations on bond funds over the period January 1992 to May 2001.

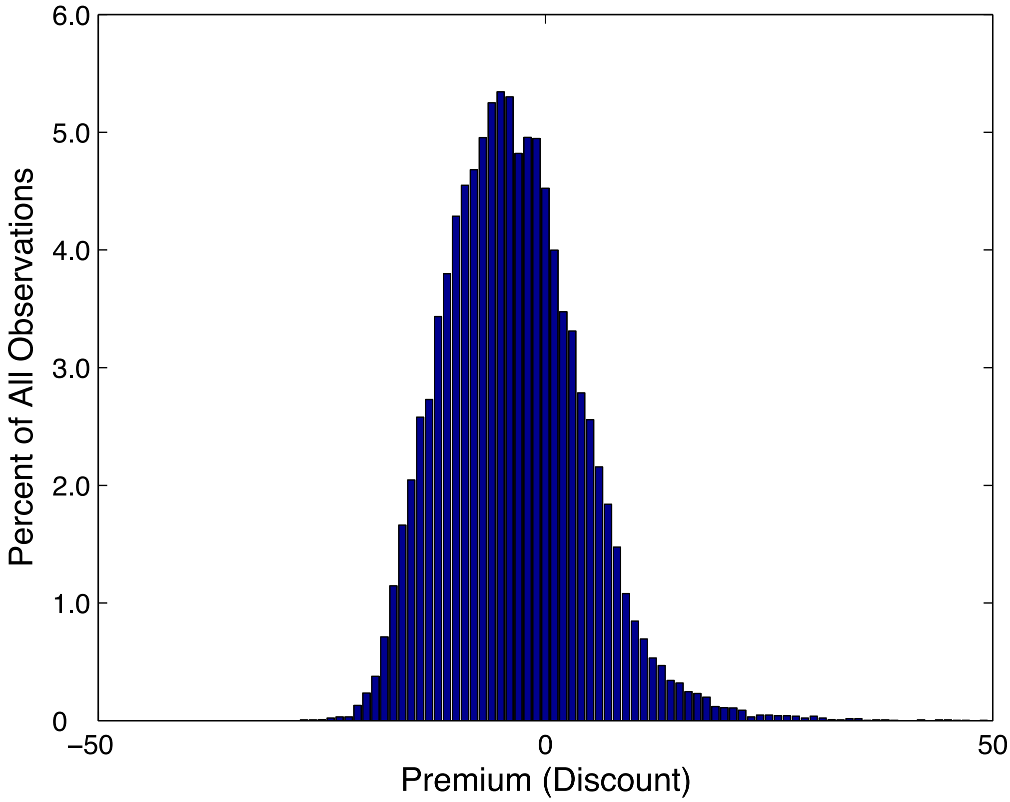


Figure 4. Relative frequency histogram of 9,839 monthly D_t observations on stock funds over the period January 1992 to May 2001.

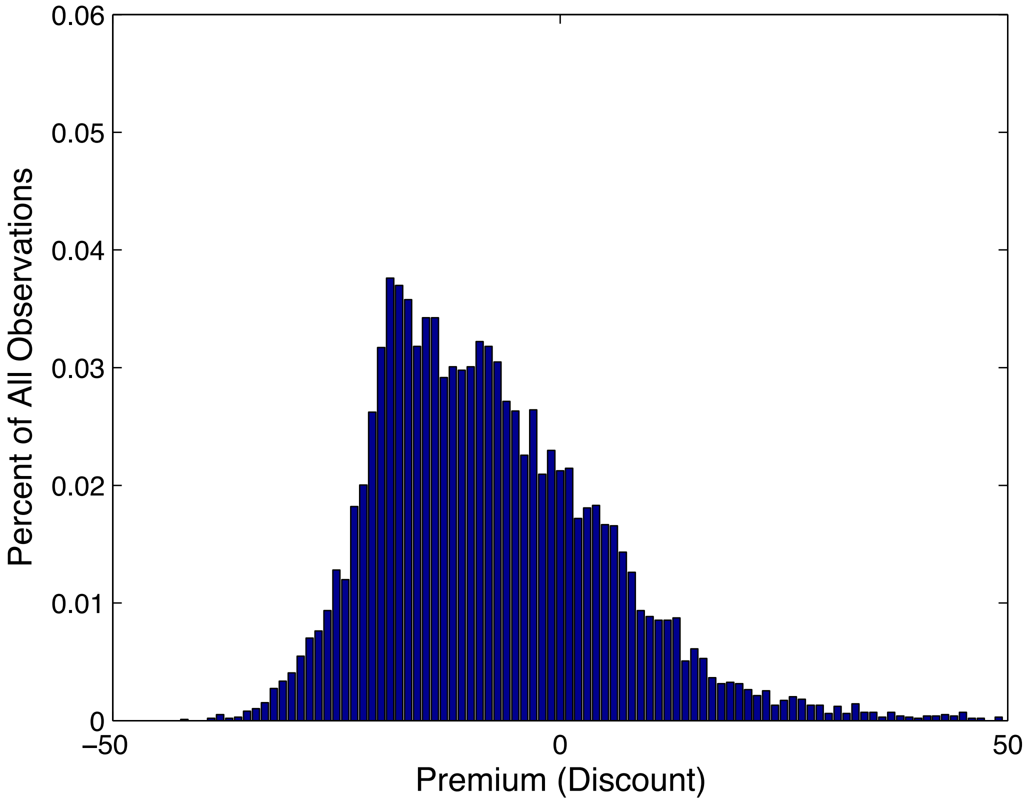


Figure 5. Average stock fund and bond fund short ratios by premium or discount level, D_t.

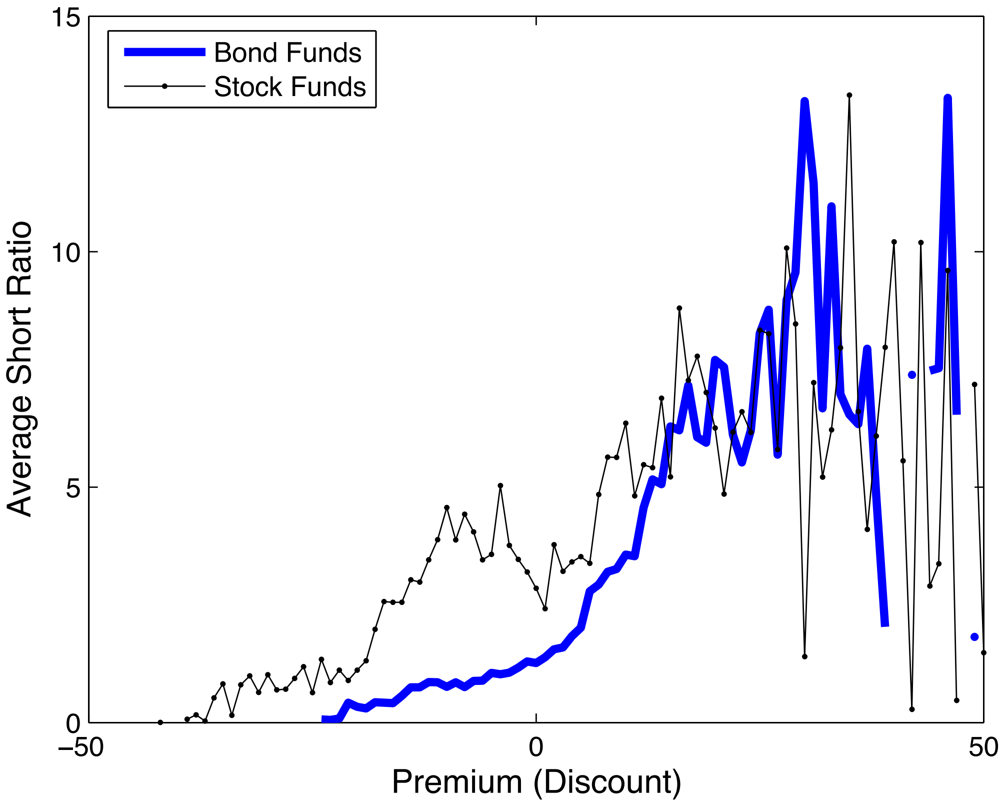


Figure 6. Average monthly D_t levels and average monthly short ratios during the 18 months after IPO for 148 bond fund IPOs and 41 stock fund IPOs taking place between January 1992 and September 1999.

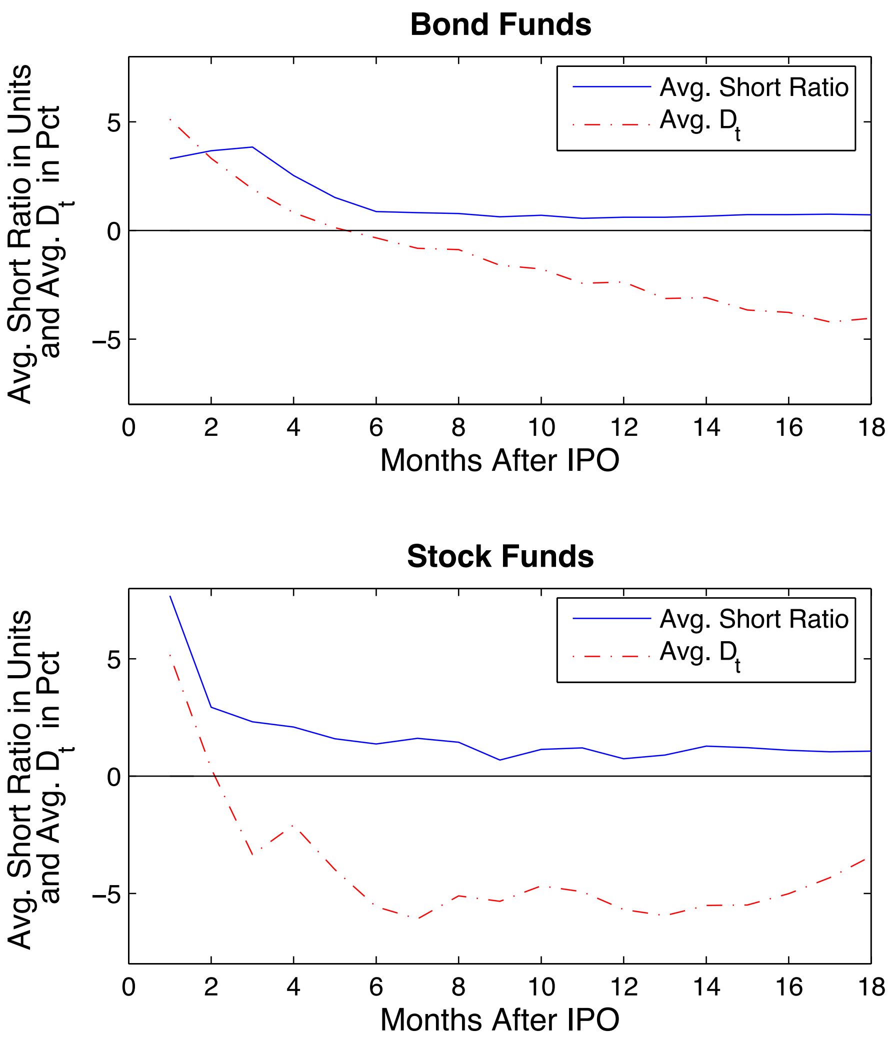
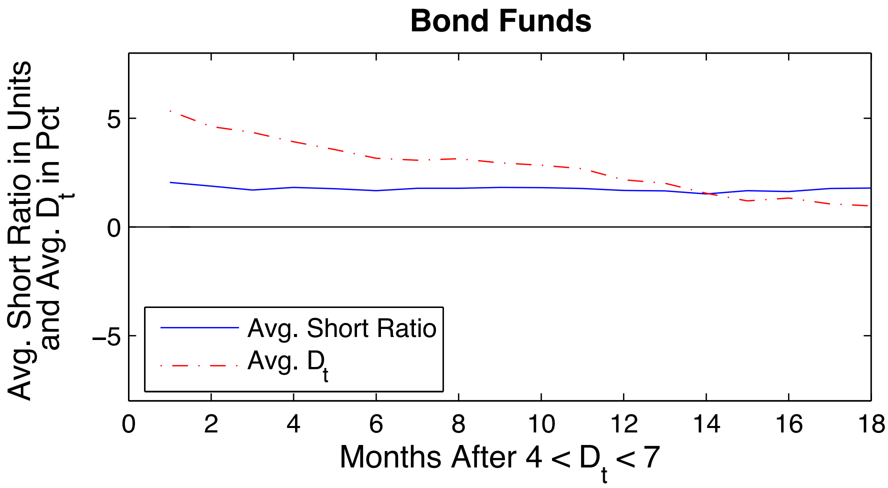


Figure 7. Separate graphs for bond funds and stock funds showing the average monthly D_t levels and average monthly short ratios over the 18 months following an instance where a fund's $4 < D_t < 7$. 351 cases were used to construct the bond averages while 147 cases were used to construct the stock averages.



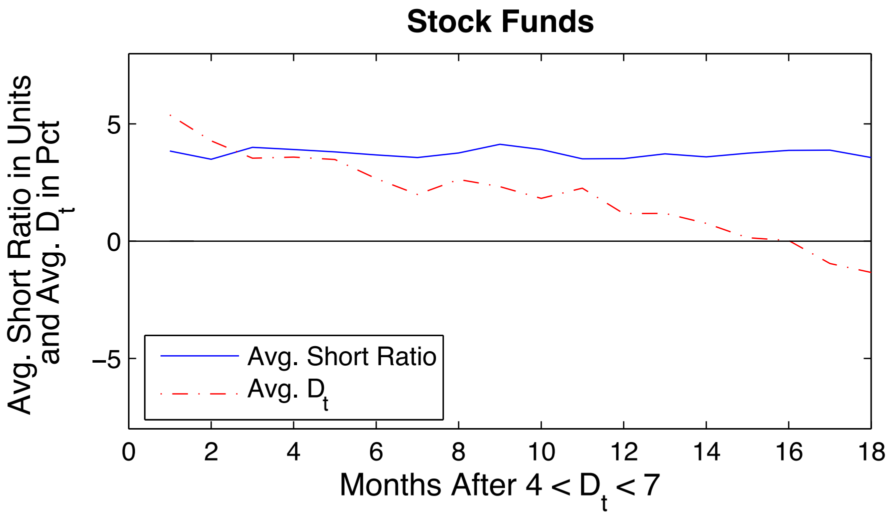


Figure 8. Average 1-year returns (including dividend reinvestment) to long positions in bond and stock funds, sorted by initial premium or discount level, D_t.