JOURNAL OF FINANCIAL AND QUANTITATIVE ANALYSIS Vol. 48, No. 2, Apr. 2013, pp. 405–425

doi:10.1017/S0022109013000136

Why Do Closed-End Bond Funds Exist? An Additional Explanation for the Growth in Domestic Closed-End Bond Funds

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Abstract

This paper provides a new explanation for why closed-end bond funds coexist along with otherwise identical open-end bond funds. Closed-end bond funds offer investors the opportunity to leverage their fixed income investment at very low borrowing rates and are attractive to investors for this reason. We find that differences in leverage are reflected in the discount on closed-end bond funds in a manner consistent with the advantage of leverage.

I. Introduction

Closed-end bond funds are an important investment vehicle. According to the Investment Company Institute, as of the end of 2010 there were 2,286 long-term bond funds, of which 18% (420) were closed-end bond funds.

This paper provides a new explanation for the existence of closed-end bond funds. There is a large body of literature analyzing closed-end funds. Most of this literature focuses on the discount at which closed-end funds sell relative to their net asset value (NAV), but it does not explain why closed-end bond funds coexist with otherwise identical open-end bond funds. Explanations for the magnitude of the discount include the value and cost of management (Chay and Trzcinka (1999), Ross (2002)); agency costs (Malkiel (1977), Brennan and Jain (2007)); liquidity of investments and management fees (Cherkes, Sagi, and Stanton (2009)); tax liability associated with opening a fund (Malkiel (1977), Brennan and Jain (2007), and Brickley, Manaster, and Schallheim (1991)); fund

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distribution policy (Wang and Nanda (2006), Pontiff (1996)); price volatility (Pontiff (1997)); uncertainty relating to the size of the discount (Elton, Gruber, and Busse (1998)); and sentiment (Lee, Shleifer, and Thaler (1990), (1991)).

Cherkes et al. (2009) and Deli and Varma (2002) analyze why closed-end funds exist and offer, as the principal reason, that closed-end funds may hold less-liquid assets and maintain lower cash positions than open-end funds. We show that the provision of leverage is an important explanation for the coexistence of otherwise identical closed- and open-end bond funds. Both Deli and Varma and Cherkes et al. note that the provision of leverage affects the magnitude of the discount from NAV, but they do not take the additional step of arguing that the provision of leverage is a major reason for the existence of these funds.

Our paper examines the impact of leverage on i) return on total assets; ii) shareholder and NAV return; iii) shareholder and NAV risk (correlation and volatility); and iv) overall desirability of closed-end bond funds. We quantify the size of the impact of leverage on these variables using both accounting and market data, and we show that closed-end bond funds have a significant advantage over otherwise identical open-end bond funds, which cannot use leverage.

By investing in a closed-end bond fund, the investor enjoys the benefit of limited liability while at the same time the fund can borrow at lower rates than can the individual investor. The lower rates come about because closed-end bond funds borrow using instruments where payments are treated as dividends, which have favorable tax treatment. Furthermore, in the case of municipal closed-end bond funds, the payments on preferred stock are tax-free to the holders of these instruments. This results in municipal closed-end bond funds being able to borrow at rates below the federal funds rate and nonmunicipal closed-end bond funds being able to borrow at rates close to the federal funds rate.

To examine the extent to which we can attribute differential returns to the form of organization rather than managerial skill or security selection, we analyze a sample of closed-end bond funds for which we can identify open-end funds with the same objective, with the same portfolio manager, and sponsored by the same fund family. This matched sample represents the closed-end funds for which management is most likely to have thought about ways to exploit the opportunities provided by differences in organizational structure. While we employ a matched sample to examine differences in assets and liabilities between open- and closed-end funds, when we examine the effect of leverage on discounts, we use the population of all closed-end bond funds. The characteristics of the 2 samples are discussed in Section II.

In Section III, we examine differences in the characteristics of the assets held by the matched sample of open- and closed-end bond funds. We find negligible differences in the composition of assets and in the characteristics of the gross return on assets held. In Section IV, we examine the difference in liability structure. We find that closed-end funds almost always use leverage (often in the form of auction preferred stock) to raise large amounts of money to finance their investments, while open-end funds do not. We find that the use of leverage increases the attractiveness of the closed-end funds in our matched sample. In Section V, we study the theoretical impact of leverage on return, variance, and covariance, and then we examine the desirability of adding closed-end funds

to several diversified portfolios. Finally, in Section VI we study the impact of leverage on the closed-end fund discount using both cross-sectional and time-series analysis.

II. Sample

We examine 2 samples of closed-end bond funds for the period 1996–2006. The 1st sample is a sample of 54 funds (excluding single-state municipal funds) for which we can identify an open-end fund with the same portfolio manager, policy, and fund family as each of the closed-end funds.[1] These funds are distributed by 28 different fund families. Since each fund pair in the matched sample is managed by the same people, sold by the same fund family, and has the same objectives, these are the funds for which differences in characteristics should reflect management's attempt to take advantage of differences in organizational structure. The 2nd sample consists of all 332 closed-end bond funds (excluding single-state funds) contained in the data sources mentioned below. The data used in this study for closed-end funds were drawn from Lipper, Morningstar, Bloomberg, the Center for Research in Security Prices (CRSP) stock files, and closed-end fund annual reports. For open-end funds, we obtained data from the CRSP mutual fund database and Morningstar reports.

In Table 1, measures of size and leverage are presented for all fund years in our matched sample, and for those fund years when the closed-end funds employed leverage and those when they did not. The matched open-end funds have results recorded separately for levered and unlevered closed-end funds. The open-end funds did not use leverage, but the separate comparison was made to hold year affects the same, since leverage was more prevalent in later years.

TABLE 1

Sample Characteristics

Table 1 reports various characteristics of closed-end funds and a matched set of open-end funds. Net asset values are shown in millions of dollars; leverage is the amount of preferred stock and debt divided by total net assets, expressed as a percentage.

Fund Type	Fund Years	Gross Assets	Leverage
Panel A. All Funds			
Closed-End	389	517.1	35.29
Open-End	389	612.0	0
Panel B. Unlevered			
Closed-End	113	313.4	0
Open-End	113	544.4	0
Panel C. Levered			
Closed-End	276	575.2	51.25
Open-End	276	628.6	0

Note from Table 1 that closed-end bond funds employed leverage in 71% of the fund years in our sample. On average, closed-end bond funds held

[1] We exclude single-state municipal bond funds because of different tax rates across states.

84.5% of the total assets held by the matched open-end funds. This difference in total assets between closed- and open-end funds is sufficiently small such that scale economies should not be an impediment to the ability to manage the closed- or open-end bond funds.[2]

III. Differences in Portfolio Characteristics

To examine the characteristics of the assets in our matched sample, we first examine the differences in the characteristics of the securities held by matched pairs of open- and closed-end funds. Second, we compare the characteristics of return on total assets before fees. We use the 2nd measure because of the possibility that aggregate measures could miss differences in holdings that affect the return and the pattern of return.

A. Differences in Portfolio Composition

The first way to compare open- and closed-end bond funds is to look at the differences in composition of the assets held. These results are presented in Table 2.

TABLE 2

Comparison of Closed- and Open-End Funds

Table 2 reports the percentage of holdings in each asset category held by closed- and open-end funds. Both closed- and open-end funds have the same managers and objective and are issued by the same fund family. Statistical significance for each category was evaluated using a matched-pair *t*-test on the pair-by-pair differences between the open- and closed-end funds. * and ** indicate significance at the 0.05 and 0.01 levels, respectively.

Panel A. By Rating of Bonds Held

	Overall		Municipal		Nonmunicipal	
General Rating	Open-End	Closed-End	Open-End	Closed-End	Open-End	Closed-End
Investment grade	74.5%	71.7%	87.4%	82.9%	50.6%	50.9%
Noninvestment grade	20.0%	22.0%	5.8%	8.2%	46.3%	47.6%
Unrated	5.5%	6.3%	6.8%	8.9%	3.2%	1.4%

Panel B. By Maturity of Bonds Held

	Overall		Municipal		Nonmunicipal	
Maturity (years)	Open-End	Closed-End	Open-End	Closed-End	Open-End	Closed-End
1–5	10.9%*	15.7%*	5.0%*	10.9%*	20.4%	23.4%
6–10	28.8%	32.5%	13.4%	19.9%	53.7%	52.9%
11–20	27.6%**	20.1%**	39.5%**	26.7%**	8.4%	9.4%
21+	32.7%	31.8%	42.2%	42.5%	17.5%	14.3%
<10	39.7%	48.2%	18.4%	30.8%	74.1%	76.3%
>10	60.3%	51.9%	81.7%	69.2%	25.9%	23.7%

Panel C. By Type of Bonds Held

Asset Type	Open-End	Closed-End
Government bonds	15.9%	13.7%
Mortgages	9.7%	11.6%
Corporate	61.9%	64.2%
Foreign bonds	11.2%	8.2%
Stocks	0.5%	0.6%
Preferred	0.5%	1.3%
Convertibles	0.3%	0.4%

[2]The discount on closed-end bond funds (2.2% in our sample) is on average much smaller than that typically found for closed-end stock funds.

Panel A of Table 2 shows the breakdown of portfolios by investment grade, noninvestment grade, and unrated bonds. Higher-rated bonds are considered more liquid. (See Harris and Piwowar (2006) for municipal bonds and Edwards, Harris, and Piwowar (2007) for corporate bonds.) The percentages in each category are almost identical, and none of the differences were statistically significant at the 0.05 level using a matched-pair *t*-test.[3]

While quality is substantially the same, closed- and open-end funds could differ by the maturity of the assets they hold. Shorter-maturity assets are thought of as more liquid (see Fabozzi (2010), Harris and Piwowar (2006)). From Panel B of Table 2, we see that the percentage of assets held in the maturity range of 1–5 years is higher for closed-end funds than for open-end funds. In addition, open-end funds have a higher percentage in long-maturity bonds than do closed-end funds. There is no evidence that closed-end funds take less-liquid positions by holding long-maturity portfolios. In fact, the data are more consistent with closed-end funds being more liquid. The only differences that were statistically significant were that closed-end funds have more investment in the 1- to 5-year category, and open-end funds have more investment in the 10- to 20-year category.

Panel C of Table 2 shows the percentage of the portfolio that nonmunicipal open- and closed-end funds place in bonds of different types. Government debt is more liquid than corporate debt (Chakravarty and Sarkar (2003)). Differences in the percentage held of each type of security are exceedingly small. None of the differences were statistically significant at the 0.05 level.

Let us examine the impact of different cash positions in closed- and open-end funds. Closed-end funds have an advantage in that they can maintain a lower cash balance. However, for our matched sample, the difference in cash held is extremely small. The median ratio of cash to assets in our open-end sample was 2.3%, while in the closed-end sample it was 0.60%. This difference of 1.7% impacts return by less than 8 basis points (bp), computed by applying the return on total assets to the 1.7% difference in cash held.

B. Differences in Return Characteristics

The aggregate characteristics examined in the previous section may not capture all aspects of risk and liquidity. If open- and closed-end funds hold securities with the same risk and liquidity, we would expect, before any fees, that returns on total assets would be the same. However, if the closed-end fund held a less-liquid or a riskier portfolio, it would do so presumably to earn a higher return, and the closed-end funds should earn more on their assets before fees than the open-end funds. In addition, since closed-end funds need to hold less cash because they are not subject to redemptions, they should also earn a higher rate of return on total assets.

We define monthly return for an open-end fund before expenses as the return from the CRSP mutual fund database plus 1/12 of the annual expense ratio for the fund. Because of leverage, computing the return on total assets is more

[3]We also examine a breakdown by detailed rating categories and again found no difference in quality.

complicated for closed-end funds. The annual return on total assets for a closed-end fund is gross income (earnings before expenses and preferred dividends or interest) plus realized and unrealized capital gains and losses for any year, divided by average monthly total assets for that year. To make the returns comparable, the return on the matched open-end fund was computed over the fiscal year of the closed-end fund.

Returns on total assets for closed- and open-end funds before expenses are presented in Table 3. The returns are almost identical. On average, open-end funds have a return 5 bp higher per year. This is not a meaningful difference economically, nor is it statistically significant at the 0.05 level on the basis of a matched-pair *t*-test. When we disaggregate the funds into municipal and nonmunicipal funds, the results are similar. While there is no meaningful difference, the data show that, if anything, open-end funds earn a higher, not a lower, return on assets. This is inconsistent with closed-end funds investing in more illiquid or more risky higher-return assets or having to hold less cash.

TABLE 3

Comparison of Closed- and Open-End Funds by Annual Return on Assets

Table 3 reports return on total assets before expenses for a matched set of closed- and open-end funds. Both closed- and open-end funds have the same objective, are issued by the same fund family, and have the same manager. None of the differences are statistically significant at the 0.05 level.

Return on All Assets	Open-End	Closed-End	Difference
All funds	6.40%	6.35%	–0.05%
Municipal funds	6.05%	6.03%	–0.02%
Nonmunicipal funds	6.92%	6.83%	–0.09%

If the matched pairs of open- and closed-end funds hold similar assets, then their return streams should be highly correlated. The average correlation between each closed-end fund and its matched open-end fund for our sample is 0.924. Closed-end funds that are managed by the same managers and issued by the same firm have returns that are highly correlated; they are much more highly correlated than funds of the same type with different managers, where the average correlation is 0.80. Finally, we find that the standard deviation of returns on open-end funds is 4.63%, while for closed-end funds it is 5.56%. The *t*-ratio of the difference is 0.22, which is insignificant.

Based on mean returns, correlations, variances, and the characteristics of their respective portfolios, the portfolios of bonds held by our matched set of closed- and open-end bond funds are very closely aligned, and there is no evidence supporting differences in liquidity or risk.

IV. Differences in Liabilities

Since our matched set of open- and closed-end funds does not differ on the asset side, perhaps fund families differentiate between them on the liability side. The difference on the liability side of the balance sheet is notable: Almost all closed-end funds lever their assets through the use of debt or auction preferred stock. Open-end funds are restricted in their use of leverage and rarely use it. In

2006, all but 7 funds in our matched sample had leverage, and an even higher percentage of more recently created funds used leverage (in 2001–2004, 149 out of 150 new closed-end bond funds were levered). For those funds that used leverage, the amount of leverage was substantial, on average equal to about ½ of the assets under management at the time of the borrowing (see Table 1), and many levered to the legal limit. Borrowing was principally in the form of auction preferred stock. All but one municipal closed-end fund that levered used only this form of borrowing. The pattern is understandable, since the dividend on the auction preferred stock issued by municipal funds is tax-exempt to the holder, while interest on debt is not. For nonmunicipal closed-end bond funds, loans were the principal form of leveraging until 2003, when auction preferred stock became the more common form. The rates paid on auction preferred stock are reset at auction, usually every week or every month. Thus, closed-end bond funds borrow short term and, as shown in Table 2, invest long term.

Why should this help the investor? Could not the investor lever on a personal account and accomplish the same objective (see Modigliani and Miller (1958))? There are 4 possible explanations. First, closed-end municipal bond funds, which use preferred stock, borrow at extremely low rates, since preferred dividends to holders of these preferred shares are tax-free. An individual could not get this tax treatment for direct borrowing. Second, dividends on preferred stock issued by government or corporate bond funds are taxed to holders of those instruments as dividends, resulting in a borrowing rate lower than that on debt. Third, closed-end funds borrow at lower rates because of their size and because of the protection provided by the large amount of liquid assets behind each dollar of borrowing. Fourth, borrowing by the closed-end fund limits liability to the investor, whereas liability on personal accounts is not so limited. The 3rd and 4th reasons for lower borrowing costs should not affect these costs in perfect markets. However, friction in actual borrowing markets suggests that they have some impact.

The tax rules that make borrowing by closed-end funds attractive are unique to the United States. If taxes are important, then we should see much less use of closed-end bond funds in countries that do not offer these tax advantages. According to Morningstar, there are 4 other countries besides the United States with closed-end bond funds; the United Kingdom is the most prominent of these. Closed-end funds, in general, are more important in the United Kingdom than in the United States. U.K. closed-end funds represent, on aggregate, ¼ of the U.K. open-end fund industry; in the United States, closed-end funds represent a much smaller proportion of the market. Yet, in the United Kingdom there are only 14 closed-end bond funds out of 676 closed-end funds, while in the United States, the majority of closed-end funds are bond funds.[4] Australia, Chile, and India are the other 3 countries with large numbers of closed-end funds. According to Morningstar, in Australia there are 5 closed-end bond funds out of 55 closed-end funds, and Chile has 1 out of 76. The one country with a large number of closed-end bond funds is India. However, Indian closed-end funds are identical in structure

[4]While there may be other reasons for the absence of closed-end bond funds in the United Kingdom, the absence of the tax advantages found in the United States is surely important.

to open-end funds (see Anagol and Kim (2011)).[5] Thus, closed-end bond funds are important only in the U.S. market, which is consistent with their special tax treatment in the United States.

For leverage to serve as an explanation for the existence of closed-end funds, such leverage needs to be beneficial to the investor. A necessary condition for this is that borrowing increases returns to investors. This requires examining the cost of borrowing and the return to investors.

A. Costs of Borrowing

The total cost to an investor of the borrowing by a closed-end bond fund can include 2 components in addition to interest and preferred payments. First, the closed-end fund, using auction preferred stock, pays fees to brokers at frequent intervals for handling their issuance. Across all funds in all years, this averaged 33 bp per year per dollar of preferred issued. This cost is much higher for nonmunicipal bond funds, 48 bp compared to 29 bp for municipal bond funds. Second, when a closed-end fund introduces leverage, assets under management are increased. Since management fees are paid on assets under management, this increases the fees paid by the holders of the fund's shares. For example, assume the investor has \$100 invested, borrowing is \$50, and management fees are 1%. Then the management fee the investor pays in the levered fund is \$1.50/\$100 or 1.5%.

Total expenses included in the reported expense ratio consist of management fees and administrative costs. Potentially, administrative costs also change with assets under management. However, an examination of funds that issued debt or preferred after they were organized showed that the increase in expenses was approximately equal to the management fee. Thus, we approximate the change in expenses by the management fee.

Table 4 presents the total cost of leverage for both municipal bond funds and nonmunicipal bond funds. When auction preferred stock is used to lever, the borrowing costs consist of the preferred dividend, flotation expense, and the impact of the increased assets on the shareholder expense ratio. When loans are used to lever, borrowing costs have 2 components: interest cost and the impact of the increased assets on shareholder expenses. Several properties of the direct borrowing costs are worth noting. First, direct borrowing cost on the auction preferred stock for municipal bond funds on average is 70% of that for nonmunicipal bond funds, reflecting the tax advantage on auction preferred stock issued by municipal bond funds. Second, when interest costs and dividend-over-price of preferred stock for nonmunicipal bond funds are regressed on each other, the correlation is 0.96, indicating that their levels are highly correlated on average. Third, for nonmunicipal bond funds, the direct borrowing costs on loans are 63 bp more than the rate on auction preferred stocks. However, when flotation costs are taken into account, the difference in total borrowing costs between preferred and debt is reduced to 15 bp.

[5] Indian closed-end funds are not traded on exchanges, and as with open-end funds, investors can sell their stock to the company at NAV.

TABLE 4

Cost of Levering (annual data)

Table 4 reports the cost of borrowing. For auction preferred stock, the direct costs are the preferred dividend over the amount of the preferred. Total costs include, in addition to direct costs, the costs of flotation plus the impact of borrowing on management fees. For loans, the direct cost is interest over loan principal. Total cost also includes the impact of the loans on management fees.

	Municipal Bond Funds			Nonmunicipal Bond Funds					
Calendar Year	Number with Preferred	Dividend Preferred	Total Cost	Number with Preferred	Dividend Preferred	Total Cost	Number with Loans	Interest Cost	Total Cost
1996	11	3.66%	4.61%	1	2.76%	3.47%	5	4.91%	5.45%
1997	11	3.39%	4.33%	1	4.62%	5.20%	6	5.89%	6.06%
1998	12	3.34%	4.25%	1	5.07%	5.65%	6	6.36%	6.93%
1999	16	3.21%	4.10%	1	5.39%	6.00%	7	5.97%	6.60%
2000	17	4.03%	5.01%	1	7.54%	8.22%	7	7.18%	7.83%
2001	18	3.31%	4.26%	3	5.82%	8.30%	7	6.07%	6.75%
2002	21	1.58%	2.50%	5	2.41%	4.13%	7	3.08%	3.83%
2003	26	1.08%	1.98%	7	1.35%	2.36%	7	1.68%	2.42%
2004	28	1.09%	1.99%	11	1.33%	2.34%	7	1.80%	2.53%
2005	29	2.26%	3.16%	11	2.70%	3.87%	7	3.33%	4.09%
2006	29	3.06%	4.18%	11	4.27%	5.49%	7	5.24%	6.01%

To better understand the total borrowing costs of closed-end funds, we regress closed-end total borrowing costs on a wide variety of short-term interest rates. The best fit is obtained with the federal funds rate ($R^2 > 0.90$). The total cost of leverage using auction preferred stock for municipal bond funds is below the federal funds rate. For nonmunicipal bond funds, the cost of leverage is slightly higher than the federal funds rate.

B. Benefits of Borrowing

Closed-end bond funds borrow short and invest long in hopes of increasing the return to investors. However, the increase in return depends on the return on long-maturity bonds relative to short-maturity bonds. We first examine whether closed-end funds on average earn more income for investors on the additional investment due to leverage. This is computed as the return on total assets pre-expenses, less the percentage borrowing costs; Table 5 presents the data. On average, the return earned on the assets financed using leverage is 2.64% higher than the total cost of borrowing for municipal bond funds and 2.39% higher for nonmunicipal bond funds. For municipal bond funds, income to investors is increased in 88.3% of fund years. This is statistically significant at the 0.01 level using a binomial test. For nonmunicipal bond funds, income to investors is increased in 70% of fund years, which is also significant at the 0.01 level.

In the Appendix, we use historical data to extend our analysis back in time, to see whether the extra return is unique to the period of this study. The results are consistent with those reported above. Extending the analysis back in time reinforces what we observed over the period of our study. In most years, and for most funds, leverage increases return to shareholders.

C. Leverage and Timing

It has been shown that the risk premium determines future expected returns at different maturities (see, e.g., Ludvigson and Ng (2009)). Furthermore, future

TABLE 5

Effect of Leverage on Returns (annual data)

Table 5 reports the net return (earnings less cost of financing) earned on assets financed with leverage. Return is pre-expenses and includes realized and unrealized gains and losses. Cost for preferred is computed as the sum of preferred dividends over the amount of preferred plus flotation expenses plus impact on the management fee. For loans, the cost is interest cost plus impact of loans on management fee. ** indicates significance at the 1% level. For marginal returns, significance is from 0. For numbers, significance is from equally likely.

Fund Type	No. of Obs.	% Return on Total Assets	Extra Return	Number Positive
Nonmunicipal	113	7.186	2.39**	77**
Municipal	214	6.071	2.64**	185**

expected returns and risk premiums are higher when the yield curve is steeper (see Campbell and Shiller (1991), Ludvigson and Ng (2009), Backus, Foresi, Mozumdar, and Wu (2001), Dai and Singleton (2002), and Duffee (2002)). Thus, a larger positive difference between long- and short-term rates implies a higher risk premium for longer maturities, a higher expected return for longer-maturing securities relative to short-term securities, and a greater advantage for leverage.

This would suggest that firms should use leverage strategically, increasing or decreasing it as the term premium changes; however, they do not do so. The amount of borrowing remains constant through decreases in the term premium. Possible explanations include the cost of liquidating part of the portfolio, difficulty in floating different amounts of auction preferred stock, or reluctance on the part of the manager to give up assets and associated fees.

While funds do not decrease the amount of leverage over time as the term spread changes, they do time their issuance of debt and preferred stock to reflect current spreads. To test this, we perform a probit analysis where the dependent variable took the value 1 if there is an issuance, and 0 if there is no issuance. The independent variable is the normalized yield spread.[6] The coefficient on the normalized yield spread is 0.17 (with a p-value less than 0.01). We also perform probit analysis separately for municipal bond funds and for nonmunicipal bond funds. The results are similar and statistically significant in both cases.

V. Leverage and Attractiveness to Stockholders

In Section IV, we show that there is a potential benefit to investors from levering, since leverage results in a higher return on NAVs. While higher return is a necessary condition for leverage to benefit investors, it is not sufficient. In this section, we examine characteristics of returns to equity investors to determine whether leverage is desirable. We first examine the characteristics of return (mean, variance, and correlation), and then we put these together to test whether leverage makes closed-end bond funds more attractive to investors. Before we examine the

[6]The yield spread for municipal bond funds was defined as the yield on a 20-year municipal bond (from Bloomberg) minus the federal funds rate, while the yield spread for nonmunicipal bonds was defined as the difference between the 10-year constant maturity Treasury yield and the federal funds rate. So that we could combine municipal bond funds and nonmunicipal bond funds, we normalized the yield spread for each type of bond by dividing by the mean spread. Thus, the independent variable is the proportion of normal spread that the current spread represents.

empirical estimates of return and risk, we model how these variables should be determined and then examine how closely the modeled values approach actual values. The effect of leverage on the return on NAV is defined as follows:

R_{TA} as the return on total assets before expenses,

E as the expense ratio on total assets as it would be in the absence of leverage,

R_{NAV} as the return on NAV,

L as leverage, defined as borrowing over shareholder equity (shareholder equity is total assets minus borrowing),

R_B as the cost of borrowing, including the effect of borrowing on expenses, and

R_D as $R_{TA} - R_B$ or the extra return earned on borrowed assets.

Then,

$$(1) \qquad \begin{aligned} R_{NAV} &= R_{TA} + (R_{TA} - R_B)\,L - E, \\ R_{NAV} &= R_{TA} + R_D L - E \end{aligned}$$

and expected return at a given leverage is

$$(2) \qquad \bar{R}_{NAV} = \bar{R}_{TA} + \bar{R}_D L - \bar{E}.$$

Assuming that both the expense ratio on total assets without borrowing and the leverage ratio are constant over time, the variance of the return on *NAV* is

$$(3) \qquad \sigma^2_{NAV} = \sigma^2_{TA} + 2L\,\mathrm{cov}(R_D R_{NAV}) + L^2\sigma^2_D,$$

where the subscripts on the variances correspond to the subscripts on the *R*s. The covariance between the return on NAV and any index, such as the Standard & Poor's (S&P) 500 index, is given by

$$(4) \qquad \mathrm{cov}(R_{NAV} R_I) = \mathrm{cov}(R_{TA} R_I) + L\,\mathrm{cov}(R_D R_I),$$

where R_I is the return on the index.

Finally, the percentage of variance (R^2) of NAV return explained by index I is given by

$$(5) \qquad R^2 = \left[\frac{\mathrm{cov}\,(R_{TA} R_I) + L\,\mathrm{cov}\,(R_D R_I)}{\left[\sigma^2_{TA} + 2L\,\mathrm{cov}\,(R_D R_{NAV}) + L^2\sigma^2_D\right]^{1/2} \sigma_I} \right]^2.$$

Graph A of Figure 1 shows the theoretical effect of leverage on expected return using equation (2), with values estimated in Section V.A. The intercept is $\bar{R}_{TA} - \bar{E}$ and the slope is $\bar{R}_D$. Note that at an average leverage ratio of 0.5125 (from Table 1), return on NAV increases by about 25% compared to the unlevered fund. As shown in Section V.A, this is almost identical to the values for expected return found in our sample.

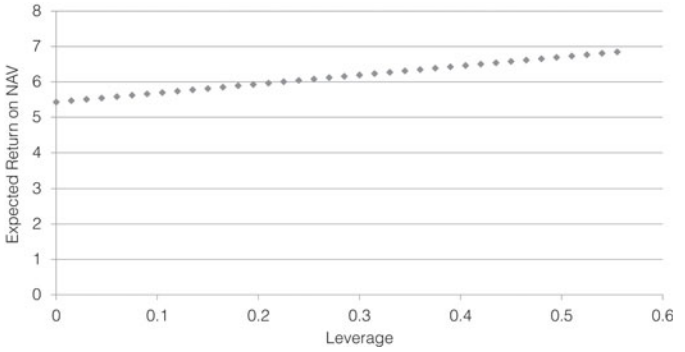
Graph B of Figure 1 shows what happens to the theoretical value of NAV variance (equation (3)) as a firm adds leverage. Using average values for the variance and covariance terms and using the 0.5125 leverage ratio from Table 1, the

FIGURE 1

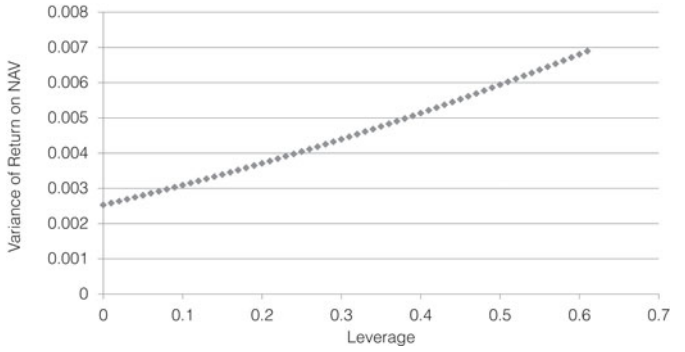
Leverage and the Expected Value and Variance of Return on NAVs

Graph A of Figure 1 shows the relationship between expected return on net asset values (NAVs) and leverage using equation (2) and the parameters found in this paper. Graph B shows the relationship between leverage and the variance of the return on NAVs computed using equation (3) and the parameters found in this paper.

Graph A. Effect of Leverage on the Expected Return on NAVs



Graph B. Effect of Leverage on the Variance of Return on NAVs



variance of return on NAV would increase by 87% and the standard deviation by 37%. Equation (3) is an approximation derived assuming that the leverage ratio and expense ratio are constant over time. The data show that these variables vary only slightly over time. Calculating the variance of NAV return for each fund and comparing it to the estimate given by equation (3) shows an average error of 13%, with the estimate almost always lower than the values found in our sample.

When we compare the numbers computed from equation (3) with the R^2s found in ours sample, the average difference is 13.5% with a bond index, 5.2% with the S&P 500 index, and 3.9% with an equal combination of the bond index and the stock index. Again, in almost all cases, R^2 computed from equation (3) underestimated the R^2 found in our sample. The effect on R^2 of leverage depends on the estimates of the various covariances and variances. In our sample, on average, and in 75% of the individual cases, R^2 declines with leverage. Using a binomial test, this is significant at the 0.01 level.

A. Return

For closed-end funds, investor return is dividend yield plus percentage change in price. Since it is useful to see what would happen if the discount did not change, we also compute the dividend yield plus percentage change in NAV. When we look at the return to shareholders in closed-end funds, we find that investors in levered funds earn a higher return than investors in unlevered funds: 8.40% compared to 7.01%. Since this could reflect differences in returns across years, a more relevant comparison is the difference in return from the matched open-end fund. The spread is 3.33% for levered funds compared to 1.24% for unlevered funds. This is partly attributable to shrinkage of the discount over time.

Since one cannot predict future discount changes, a more conservative comparison metric is return on NAV. Shareholders in levered closed-end funds have higher NAV returns than those in unlevered closed-end funds, 6.82% compared to 5.77%. Examining the spread over matched open-end funds, we find that the spread in NAV return is higher for levered funds (2.08% higher) than for unlevered funds. To see whether this difference is meaningful, we perform a test of the difference in spread assuming unequal variances. The *t*-value was 3.13, which is highly significant. Thus, levered funds earn a higher return to shareholders than do unlevered funds; this is so whether we use NAV return or shareholder return and whether we examine directly or relative to their matched open-end funds.

In closing, note that the return on levered closed-end funds is very close to the number implied by equation (2) and the numbers shown in Tables 1 and 5. The average return on total assets from Table 5 is 6.456 computed as ($7.186 \times 113/327 + 6.071 \times 214/327$). The average extra return for municipals and nonmunicipals on assets financed by leverage computed in the same way is 2.55. The expense ratio on levered firms in the absence of leverage is 1.03.[7] Finally, the average leverage ratio as shown in Table 1 is 0.5125. Using equation (2), our estimate of the effect of leverage on expected return on NAV is $6.46 + 0.5125 \times 2.55 - 1.03 = 6.74$. This is very close to the 6.82 we report above.

B. Risk Considerations

The attractiveness of closed-end funds compared to open-end funds depends on the risk characteristics of the return stream as well as the expected return. The standard deviation of stockholder return for closed-end funds is 3.40% (for levered funds it is 3.51%, and for unlevered funds it is 2.71%). The corresponding numbers for open-end funds are 1.24% when matched with levered closed-end funds and 1.19% when matched with unlevered closed-end funds. Stockholder returns on closed-end funds are more volatile than returns on open-end funds, and levered funds are 30% more volatile than unlevered funds. The other aspect affecting risk is correlation with other asset categories likely to be held.

[7] Since the expense ratio is reported on stockholder assets, to get the expense ratio without leverage we take this expense ratio and eliminate the effect of leverage by taking the levered expense ratio 1.29% and subtracting the marginal effect of leverage on the expense ratio (0.51) times the leverage ratio.

Table 6 presents the correlation coefficient between alternative definitions of returns for both leveraged and unleveraged bond funds with a bond index, a stock index, and a portfolio consisting of equal investment in each index.[8] In closed-end funds returns are computed as both the return on NAV and the return to stockholders in the fund. For open-end funds the NAV return and stockholder return are identical. The return on open-end funds is more highly correlated with each of the indexes than is the shareholder return on closed-end bond funds. The correlation of shareholder return with these indexes is much lower than the correlation of NAV return. The movement in discounts of closed-end funds increases standard deviation but lowers the correlation with a bond index, a stock index, and a combination of the two. There is no system difference between levered and unlevered funds.

TABLE 6

Correlation between Monthly Returns and Various Indexes

Table 6 reports the average correlation across all funds of each of 3 return measures on each of 3 indexes. The return measures are the return an investor would receive from holding a closed-end bond fund, the return a closed-end bond fund earned on NAV, and the return an investor would earn on a set of matched open-end bond funds. The bond index is Barclays Government-Credit Index for corporate and government bond funds and Barclay's 10-year Municipal Bond Index for municipal bond funds. The stock index is the S&P 500 index. The bond and stock index is an equally weighted mixture of the two.

	Levered			Unlevered		
Index	Shareholder Return	NAV Return	Open-End	Shareholder Return	NAV Return	Open-End
Bond index	0.506	0.744	0.811	0.464	0.781	0.820
Stock index	0.138	0.268	0.279	0.138	0.202	0.207
Bond and stock index	0.531	0.789	0.854	0.485	0.814	0.861

C. Overall Desirability

We have seen that for closed-end funds, over the period of this study, investors have a higher mean return, a higher variance, and a lower correlation with the stock and bond markets. The net effect of these differences can be studied using standard mean-variance analysis. If an investor were to choose among an unlevered closed-end fund, a levered closed-end fund, and an open-end fund, which fund would be the most desirable to add to a diversified portfolio of bonds, stocks, or a mixture of the two? The criteria for inclusion of a new asset N to a stock or bond portfolio P is[9]

$$\frac{\bar{R}_N - R_F}{\sigma_N \rho_{NP}} \geq \frac{\bar{R}_P - R_F}{\sigma_P}, \tag{6}$$

[8]The S&P 500 index is used for the stock index, while for bonds either Barclay's government-credit index or Barclay's 10-year municipal bond index is used, depending on the type of fund being examined.

[9]This formula follows from standard 1st-order conditions (see Elton, Gruber, and Rentzler (1987) for a derivation). For municipal bond funds, bond portfolio P is the Barclays Capital 10-year Municipal Bond Index; for nonmunicipal bond funds, bond portfolio P is the Barclays Capital Government/Credit Bond Index; for both municipal and nonmunicipal bond funds, stock portfolio P is the S&P 500 index. R_F was set at the 30-day T-bill rate over the period and had an average value of 3.76.

where

i) $\bar{R}$ is expected return;

ii) σ is standard deviation;

iii) R_F is the riskless rate;

iv) subscript P refers to 1 of 3 indexes: a stock index, a bond index, or a portfolio consisting of 50% stock and 50% bonds;

v) subscript N is for the new asset; and

vi) ρ_{NP} is the correlation coefficient between N and P.

In examining the desirability of adding a new fund to an existing portfolio, the value of the right-hand side of equation (6) is computed using the existing portfolio and is not affected by what fund is being added. Thus, the most likely to be added is the fund with the largest value of $\bar{R}_N - R_F/\sigma_N\rho_{NP}$.

We use the actual values for mean investor returns over the 30-day T-bill rate, correlations, and standard deviations to compute the left-hand side of equation (6). When we examine levered closed-end funds, we find that more than 80% of these funds have a higher ratio than their matched open-end funds, whether we consider adding the fund to a stock portfolio, a bond portfolio, or a portfolio consisting of 50% stocks and 50% bonds. Using a binomial test, this percentage is statistically significantly different from what we would expect by chance at the 1% level. When we examine unlevered closed-end bond funds, we find that slightly less than ½ (the number we would expect by chance) outperform their open-end matched sample. Both are dominated by levered closed-end bond funds. An investor holding a stock portfolio, a bond portfolio, or a portfolio of 50% stocks and 50% bonds would want to add a levered closed-end bond fund rather than an open-end fund or an unlevered closed-end fund. Leverage makes the closed-end funds more desirable.

VI. Evidence that Shareholders Value Leverage

If leverage is desirable, then evidence of its desirability should be seen in closed-end fund discounts. In this section, we analyze the effect of leverage on the discount cross-sectionally and over time, using data on all 332 closed-end bond funds.[10]

A. Cross-Sectional Determinants

In the preceding sections, we provided some evidence that the investor is better off with leverage. We provide further evidence on this issue by examining whether the price an investor will pay for a dollar of NAVs is a function of leverage.

[10]This section is not intended to explore all possible explanations for the existence of discounts, but simply to demonstrate the importance of leverage.

Panel A of Table 7 presents the results of regressing (cross-sectionally) the ratio of price to NAV on leverage and other variables that might affect the discount for all government and corporate closed-end bond funds. The Fama-MacBeth (1973) procedure is used to estimate betas and their significance. Each month, a cross-sectional regression is estimated. The average values for the regression coefficients across all months, the *t*-values computed using the time-series standard deviation, and the average cross-sectional adjusted R^2 using the Newey-West (1987) adjustment with lag 3 are reported.

TABLE 7

The Effect of Leverage on the Discount

Panel A of Table 7 reports the results of using a Fama-MacBeth (1973) procedure (monthly) to estimate the effect of leverage, dividend yield, past return, turnover, and log volume on the discount (*t*-values are in parentheses). The results are for all government and corporate closed-end funds (sample 2) for the years 1996–2006. All estimates are computed using the Newey-West (1987) correction with lag 3. Panel B presents the results of a regression of market price over NAV across all closed-end funds (sample 2) for levered bond funds minus the same ratio for unlevered bond funds against the yield spread between long and short bonds across all closed-end funds (sample 2). For municipals, the spread is calculated as the difference between the yield to maturity on a 20-year municipal (from Bloomberg) and the federal funds rate. For nonmunicipals, the spread is calculated as the difference between 10-year constant maturity Treasury yield and the federal funds rate. All estimates are computed using the Newey-West correction with lag 12. When age or ln TNA (log of total net assets) is added to the cross-sectional regression, the coefficients on these variables are close to 0 and not significant at even the 10% level. The leverage variable remains significant at the 1% level with a *t*-value well above 7. ** and * indicate significance at the 1% and 5% levels, respectively.

Panel A. Relationship of Price to NAV to Determining Variables (cross-sectional)

Leverage	Lagged Return	Dividend Yield	Expense Ratio	Turnover	Ln Volume	R^2
0.1805**						0.24
(13.60)						
0.1113**	0.0068*	1.1045**				0.35
(7.86)	(2.22)	(2.80)				
0.146**	0.0070*	0.038	0.056**			0.54
(7.79)	(2.22)	(0.08)	(5.19)			
0.104**	0.0081*	0.125	0.040**	0.000	0.004	0.52
(7.84)	(2.23)	(0.22)	(5.49)	(1.33)	(1.73)	

Panel B. Differences in Price to NAV between Levered and Unlevered Funds as a Function of Yield-to-Maturity Spread (weekly data)

Fund Type	No. of Obs.	R^2	Slope	*t*-Value
Nonmunicipal bond funds	1,001	0.124	0.0061	3.48
Municipal bond funds	970	0.220	0.0058	5.80

When the ratio of price to NAV is regressed against the leverage variable, the coefficient is positive, large, and statistically significant at the 0.01 level, and the average cross-sectional adjusted R^2 is 0.24. Leverage explains a great deal of the difference in discounts across funds.

Investigators have introduced other variables to explain discounts cross-sectionally. We introduce these variables as control variables to determine whether leverage remains an important influence in explaining the discount.

We initially add 2 variables to the cross-sectional regression to determine whether they increase the ability to explain discounts and to see whether leverage continues to be important when these 2 variables are introduced. The 1st variable is dividend yield. Dividends may be valued by holders of closed-end funds. Since funds must pay out 95% of interest and capital gains, dividend yield reflects current earnings. In addition, many funds attempt to pay a constant dividend with occasional special dividends so that dividend yield also serves as a

proxy for expected long-run earnings. Dividend yield is examined by Gemmill and Thomas (2002), (2004), Lee and Moore (2003), and Wang and Nanda (2006). All these investigators find that the discount decreased with higher dividend yield, though Gemmill and Thomas (2002), (2004) found mixed results. The 2nd variable we analyze is past returns. There is ample evidence in the literature that investors chase return (e.g., Chevalier and Ellison (1999)), which could drive up the stock price of closed-end funds, causing firms with higher past returns to sell at a smaller discount. Both of these variables are correlated with leverage, since the use of leverage increases earnings and thus dividends and returns. Lagged return is measured using the average monthly return over the previous 3 months. Dividend yield is measured as annual dividend divided by the price at the beginning of the year.[11]

The results from running the additional regressions are presented in Panel A of Table 7. The leverage coefficient maintains its positive sign and is statistically significant at the 0.01 level. The dividend yield coefficient is positive and statistically significant at the 0.01 level, which is consistent with the studies cited previously, and the coefficient on past returns is positive and statistically significant at the 0.05 level or better. The average adjusted R^2 on the monthly cross-sectional regressions is 0.35. These 3 variables go a long way toward explaining the cross-sectional variation in the discount on closed-end bond funds.[12] Leverage remains an economically and statistically significant variable when dividend yield and past returns are introduced.

Several other variables have been suggested as affecting the size of the discount on closed-end funds. These include expense ratio, size, liquidity, age, and turnover.

The impact of the expense ratio on the discount was studied by Gemmill and Thomas (2002), (2004), Wang and Nanda (2006), and Barclay, Holderness, and Pontiff (1993). The evidence concerning the effect of expense ratio on discounts is mixed. Gemmill and Thomas (2002) find that the discount increases with higher expenses, Wang and Nanda (2006) find the discount increases but the results were not significant, and Barclay et al. find that they sometimes increase and sometimes decrease.

Size is examined by Wang and Nanda (2006), Barclay et al. (1993), and Gemmill and Thomas (2002), (2004). While Gemmill and Thomas (2002), (2004) find that the discount increases with size, the other two studies cited previously find that it sometimes increases and sometimes decreases, but the results were not statistically significant. The use of size is justified by some authors as a proxy for liquidity. We obtain data on trading volume, which is a better measure for liquidity. We measure liquidity as the log of trading volume, and we focus on this as our liquidity measure.

[11] The effect of dividend yield was also studied, by formulating the yield as dividends divided by NAV. The results are consistent with those reported later. The definition employed above is consistent with that used in previous studies.

[12] The analysis described above was repeated for closed-end municipal bond funds. The cross-sectional variation in leverage was so small (almost all municipal funds are levered and all by the same amount) across municipal bond funds that its impact on leverage could not be observed in the cross-sectional study.

Gemmill and Thomas (2002), (2004) examine age and find that it sometimes increases and sometimes decreases the discount, but its influence is not significant. Turnover is examined by Barclay et al. (1993), who find no significant relationship between the size of the discount and turnover.[13]

We examine the impact of each of these variables. As shown in Panel A of Table 7, when the expense ratio is added to the equation (making a 4-variable regression), the size of the regression coefficient on leverage is virtually unchanged, as is the *t*-value associated with the coefficient. The expense ratio enters with a sign opposite to that found in Gemmill and Thomas (2002), (2004). Theory would suggest that funds that have higher expense ratios are less desirable. Why do we get a sign different from other authors? As we pointed out previously, leverage increases the expense ratio because expenses are a function of total assets while expense ratios are computed on NAVs. The average expense ratio for unlevered funds was 0.825, while for levered funds it was 1.43. Expense ratios are strongly correlated (coefficient of 0.518) with leverage. Other authors studying expenses do not encounter this issue, since they study closed-end stock funds, which rarely employ leverage. While expense ratios are important, their introduction leaves the significance of leverage virtually unchanged.

The other variables discussed above are added as additional control variables to the 4-variable regression discussed immediately above. None are statistically significant, nor did they impact the leverage variable. The 2 additional control variables that are most significant, turnover and log of volume, are added to the 4-variable cross-sectional regression, and the results are given in Panel A of Table 7. Consistent with the literature, neither variable is statistically significant, nor do they change the statistical significance of the leverage variable. Leverage is an important variable in explaining the cross section of discounts and retains its significance when all other variables used by other authors to explain the discount are also included.

B. Time-Series Determinants

We argue that leverage is especially valuable when the term premium is high. If investors care about leverage, prices should reflect this advantage by increasing the price to NAV of funds that use leverage when the term premium is high. In Panel B of Table 7, we present results of a regression of weekly values for price divided by NAV for levered bond funds, minus the same ratio for unlevered bond funds on the long-term bond rate minus the short-term rate for all funds in our larger sample. Note that by examining the difference of price divided by NAV for levered minus nonlevered funds, we are studying the effect of leverage on discounts, not the time-series overall level of discounts. We correct the standard errors with the Newey-West (1987) adjustment using a lag of 12 weeks.[14]

[13]One other variable, future performance, was examined by Chay and Trzcinka (1999). These authors found that while this factor was significantly related to the size of the discount for stock funds, it was not related to the discount for bond funds. Also, Starks, Yong, and Zheng (2006) find evidence of tax-loss selling in January, which could affect discounts, but they do not examine this directly.

[14]We tried different lags from 3 to 12 for the Newey-West (1987) adjustment. The results are highly significant for all lags.

The results are clear. For municipal bond funds as well as for corporate and government bond funds, the slope is positive and statistically significant at better than the 0.01 level.

Cherkes et al. (2009), Deli and Varma (2002), and others argue that liquidity may affect the time-series discount. To determine whether this affects our results, we add 2 different liquidity measures. First, we add the Fama-French (1992) "small minus big" variable, since small-cap stocks are less liquid than large-cap stocks. Second, we add the Pastor and Stambaugh (2003) liquidity measures to our basic regression. The addition of either measure of liquidity results in a slight increase in the regression coefficient and the *t*-value of the term premium variable, while keeping the sign unchanged. The Fama-French size variable is insignificant for both municipal and nonmunicipal funds. The Pastor and Stambaugh variables are significant for nonmunicipal funds but insignificant for municipal funds. Once again, we find strong evidence that the use of leverage and the impact of the shape of the yield curve on the advantage of leverage are recognized and rewarded in the pricing of closed-end bond funds.

VII. Conclusions

This paper examines why closed-end bond funds exist alongside open-end funds from the same family, with the same objective, and managed by the same manager. The principal reason presented in the literature for the existence of closed-end funds is that they are able to invest in less-liquid parts of the market. It is evident that there are more closed-end funds in less-liquid markets. However, if one compares open- and closed-end bond funds that operate in the same segment of the capital markets, one gains added insight into the advantages of closed-end funds. Surprisingly, in a matched sample of closed- and open-end funds where policy, manager, and fund family are held constant, there is no evidence of risk or liquidity differences in the assets held or the return earned on the assets. What is different is that almost all closed-end bond funds borrow, whereas open-end funds do not. This borrowing is short-term, while investment is long-term. We show that borrowing using preferred stock is tax advantaged and leads to advantageous borrowing rates for all closed-end funds, and particularly for municipal closed-end bond funds. We find that closed-end funds do not decrease their borrowing as the term premium decreases, but they do time issuances to coincide with a high term premium. Because they do not decrease their borrowing, the return they earn on NAVs is directly related to the relative return on long- and short-term bonds.

We show that leverage increases NAV returns and returns to stockholders in most years and decreases the correlation of returns with security market indexes, but it also increases the variability of return. The net effect of these three influences leads to investors being better off. We demonstrate this in two ways. First, using mean-variance analysis, levered closed-end bond funds are more likely to enter a bond portfolio, stock portfolio, or combined portfolio of stocks and bonds than are unlevered closed-end bond funds or matched open-end funds. Second, if leverage has value, investors should pay more for a dollar of NAVs (smaller discount) in levered funds than in unlevered funds. Indeed, they do. Leverage

explains much of the cross-sectional and time-series variation in closed-end bond fund discounts.

Appendix. Further Evidence on the Profitability of Levering

To examine whether our results are typical, we perform the following experiment. Since open- and closed-end funds have similar returns pre-expenses, and since we can access a long return history for open-end funds, we compute yearly returns pre-expenses for all open-end funds that have returns sometime between 1988 and the start of our sample, 1995. We begin in 1988 because that is the 1st year in which a closed-end bond fund borrowed. To proxy for borrowing costs, we use the regression relationship (estimated using data from 1996–2006) of each of the total borrowing rates with the federal funds rate and historical actual federal funds rates. To determine whether borrowing would have increased the returns on NAVs over this earlier period, we compare the returns on the open-end funds (pre-expenses) with the cost of borrowing implied by the regression relationship. For the years 1988–1995, we have 1,101 fund-years for municipal bond funds and 2,185 fund-years for nonmunicipal bond funds. For municipal bond funds, the return earned on assets averages between 4.40% and 4.54% higher than borrowing costs, while for nonmunicipal bond funds the increase in return on assets averages between 2.34% and 2.74% higher than borrowing costs, depending on the source of financing and the estimate of marginal expenses. For municipal bond funds, about 84% of the fund-years have returns that are above borrowing costs, and for nonmunicipal bond funds, more than 68% of the time returns exceed borrowing costs. These numbers are very similar to what we find over our sample period.[15]

All these numbers are highly statistically significant, whether we test difference from 0 for differential return or perform a binomial test on the number positive.

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[15]There is some growth in the number of municipal bond funds over these years, and substantial growth in the number of nonmunicipal bond funds. However, the number of funds that had returns less than borrowing cost on assets was greater at the end of the simulation period. Thus, if we were to compute the return differential each year and weight each year equally, we would obtain a higher number.

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