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Noise-trading, Costly Arbitrage, and Asset Prices: Evidence from US Closed-end Funds

Sean Masaki Flynn*

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ABSTRACT

The behavior of US closed-end funds is very different from that of the UK funds studied by Gemmill and Thomas (2002). There is no evidence that their discounts are constrained by arbitrage barriers, no evidence that higher expenses increase discounts and no evidence that replication risk increases discounts—but strong evidence that noise-trader risk is priced. The differences between US and UK funds may be due to the fact that small investors dominate US funds while institutional investors dominate UK funds, or because the sample selection method for the UK funds chooses only funds that are relatively easy to arbitrage.

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Responding to the invitation of Gemmill and Thomas (2002) in the final paragraph of their paper, I compare their results on UK closed-end funds with those of US closed-end funds. I find that the behavior of US funds is extremely different from the behavior shown by their sample of UK funds.

In both countries, closed-end funds operate as actively managed investment companies that do not redeem their own shares at par with portfolio values in the way that mutual funds do. Instead, the shares of closed-end funds trade on stock exchanges where supply and demand determine their prices. The upshot is that their per-share stock prices typically differ from their per-share portfolio values—quite often by large amounts.

The resulting discounts (underpricings) and premia (overpricings) have been intensely studied because they are cases where arbitrage pricing and the Law of One Price at least appear to be violated. Numerous papers reviewed by Dimson and Minio-Kozerski (1999) debate whether behavioral explanations or rational factors like fund expenses, mispriced portfolios, or outstanding tax liabilities can do a better job of explaining why fund market values deviate from fund portfolio values.

The purpose of Gemmill and Thomas (2002) is to add to the literature by testing competing rational and behavioral explanations using UK data. They focus on the ability of arbitrage to constrain discount and premium levels to be consistent with rational factors as well as whether the discounts and premia of the funds in their sample appear to be affected by the leading behavioral explanation for closed-end fund mispricings, noise-trader risk.

As explained by DeLong, Shleifer, Summers, and Waldmann (1990), noise-trader risk is the risk faced by rational traders that irrational “noise traders” may not only cause an asset to be mispriced, but may also, on an ongoing basis, cause any given mispricing to widen rather than narrow. Noise traders can do this because their trading actions are completely unpredictable and noisy. As such, the random trading of the noise traders confronts rational traders with a unique, non-diversifiable risk that deters them from fully and immediately rectifying the mispricings caused by the noise traders. The result

is that the noise traders can cause lingering mispricings in closed-end funds—sometimes generating discounts by driving fund share prices below portfolio values and at other times generating premia by bidding fund share prices above portfolio values.

However, the noise-trader model of DeLong, Shleifer, Summers, and Waldmann (1990) also makes an equilibrium prediction about the intensity of noise-trader risk and the price at which a fund will trade relative to its portfolio value. The model predicts that the higher the level of noise-trader risk that a fund experiences, the deeper on average will be the discount at which it trades, all other things being equal. The intuition is that a deeper average discount provides rational traders with a compensation for bearing noise-trader risk. The compensation comes in the form of a higher rate of return than they would get if they mimicked the fund's underlying portfolio by buying the portfolio's assets at their full market prices. By buying the rights to the same stream of future returns at a discount by buying fund shares at a discount, rational traders get a higher rate of return.

When Gemmill and Thomas (2002) test for the ability of arbitrage to constrain the magnitude of mispricings in their sample of UK funds and for the effects of noise-trader risk and fundamental factors on the discounts and premia of their sample of UK funds, they find the following. First, they find that arbitrage appears to successfully constrain discount and premium levels between an upper discount bound and a lower premium bound. Second, they find that discount and premium levels are affected by rational factors but not by noise-trader risk. I find diametrically opposite results for US funds.

First, the US data is inconsistent with the two arbitrage bounds that Gemmill and Thomas (2002) suggest constrain funds from trading at discounts of more than 30 percent or at premia of more than five percent. To begin with, nearly 16 percent of the 224,112 weekly discount and premium observations in the US data between 1985 and 2001 lie outside the two boundaries. In addition, the vast majority of the funds break the suggested boundaries. For instance, 87% of the 284 bond funds that were in business for more than five years and 93% of the 114 stock funds that were in business for more than five years break the five percent premium barrier at least once. Extreme violations of the bounds are

also not uncommon, with, for instance, 10% of the bond funds that were in business for more than five years and 28% of the stock funds that were in business for more than five years trading at more than a twenty percent premium at least once.

Furthermore, contrary to the implications of their underlying model of discounts and premia, the US distribution of discounts and premia is not asymmetric due to censoring, does not have a mode at par, does not show skewness toward discounts, and does not show low kurtosis due to the tails of the discount and premium distribution being censored. Rather, the US data shows no signs of censoring, has a mode discount at approximately the value consistent with capitalizing out future management fees, is skewed toward premia rather than discounts, and shows excess kurtosis rather than leptokurtosis.

It is also the case that the long-run average discounts or premia at which US funds trade are not consistent with fundamentals. Unlike UK funds, fund expenses (which should affect the present value of future fund disbursements) and a measure of the difficulty of replicating a given fund's portfolio (something very important when considering arbitraging against a mispriced fund) are both insignificantly related to long-run average discount and premium levels. In fact, the only variable that is consistently correlated with long-run average discount and premium levels in US funds is a measure of each fund's exposure to noise-trader risk. As predicted by DeLong, Shleifer, Summers, and Waldmann (1990), the higher the exposure to noise-trader risk, the deeper the discount. But, as with this paper's other findings, this relationship between noise-trader risk and discount levels is just the opposite of what Gemmill and Thomas (2002) find in their sample of UK funds.

How do you explain the large differences between the US and UK data? One possibility has to do with the fact that very different groups of investors hold the majority of fund shares in the two countries. In the US, Lee, Shleifer, and Thaler (1991) point out that the overwhelming majority of shareholders are small investors. By contrast, Brown (1998) and Dimson and Marsh (1999) report that the large majority of UK shares are held by institutions like pension plans and insurance companies. In addition, while most closed-end fund IPOs are marketed to institutions in the UK, they are marketed

to retail investors in the US so that institutions dominate UK funds from their inceptions while small investors dominate US funds from their inceptions.

As argued by Lee, Shleifer, and Thaler (1991), this difference in shareholder composition may matter because small investors are more likely to be irrational noise traders than are large institutional shareholders who utilize the services of well trained professional asset managers. If so, then the differences between the US and UK data may be due to higher levels of noise trading in the US closed-end fund markets.

The primary piece of evidence in favor of this explanation is of course the regression results showing that noise-trader risk affects US funds but not UK funds. In addition, the larger number of possibly irrational, noise-trading small investors in the US may cause so much unpredictable price volatility that they deter arbitrageurs from pushing closed-end fund discounts and premia to be consistent with fundamentals. This would explain the two other differences between the US and UK data. First, less arbitrage pressure would explain why US funds so routinely and extremely violate the arbitrage barriers that Gemmill and Thomas (2002) argue apply to UK funds. Second, a smaller amount of arbitrage pressure would explain why the discounts and premia of US funds are not pushed to be consistent with rational factors like fund expenses and the difficulty of replicating a fund's portfolio.

Finally, the differences between the US and UK data may also be due to a sample selection bias in the UK data. Whereas the US data contains every fund trading in the US in 2001 and suffers only from survival bias, the UK funds that Gemmill and Thomas (2002) include in their sample were chosen specifically because they could be precisely matched with extremely similar mutual funds that were trading in the UK at the same time. Their selection process thereby includes only funds for which there are excellent hedge vehicles available in the financial markets. To the extent that this facilitates arbitrage against mispriced funds, we should expect the UK funds selected by Gemmill and Thomas (2002) to be better behaved than the US funds—which is what we find.

Section I describes the US data set and defines discounts and premia. Section II shows that the US funds routinely violate the arbitrage bounds that Gemmill and Thomas (2002) argue apply to UK funds. Section III applies the methodology of Gemmill and Thomas (2002) to US funds to test and reject the hypothesis that arbitrage pressures are strong enough to push fund prices to be consistent with rational factors like replication risk and dividend yield. Section IV discusses potential explanations for why US and UK funds behave so differently. Section V concludes.

I. Data and Definitions

In June of 2001, I purchased a subscription to the Fund Edge data set sold by Weisenberger/Thompson Financial. Fund Edge is used primarily by analysts for its real-time streaming data on fund portfolio values and share prices, which can be utilized to compute the discounts and premia at which closed-end funds trade. Fund Edge also contains historical time series of fund prices, net asset values, dividend payments, and other variables.

However, the way the data is sold, a subscriber only receives historical data for the funds currently in existence at the time of subscription. Consequently, my data set only contains historical time series on the 458 closed-end stock and bond funds that were trading in the US in June of 2001.¹ This implies, of course, that the data set suffers from survival bias. However, this is an improvement on the sample selection method used by Gemmill and Thomas (2002), which suffers from the fact that it contains both funds entering and exiting the sample during the middle of their sample period.

Their sample of 158 UK stock funds consists of all UK stock funds trading between 1991 and 1997 that can be perfectly matched to a stock mutual fund with an identical investment objective and for which there are at least two years of accounting data. As a result, the included funds do not necessarily span the entire 1991-1997 period which they examine. In particular, the sample contains 18 funds that exit the sample as well as 54 funds that enter the sample. While Gemmill and Thomas (2002)

do not say why these funds enter and exit the sample, the most likely reason for entrants is newly formed funds going through IPO, and the most likely reason for exits is funds either liquidating as they go out of business or converting themselves into mutual funds. Both present problems because the discounts and premia of newly formed funds as well as funds that are going out of business because they are liquidating or converting into mutual funds are known to behave very differently from those of seasoned funds that are expected to continue in business indefinitely.

For instance, new issues always begin trading at premia of about ten percent in order to pay off investment bankers—but these premia subsequently dissipate and the new funds usually fall over the next few months to trade at the small average discount typical of seasoned funds, as documented by Weiss (1989), Peavy (1990), and Levis and Thomas (1995). This movement from premia to discounts is predictable and not caused by changes in rational factors like fund expenses or dividend payout ratios. Consequently, including such observations may lead to incorrect conclusions about the relationship between rational factors and discount and premium levels.

During their final months, the 54 funds that go out of business will also show a bias because Brauer (1984) and Brickley and Schallheim (1985) demonstrates that as soon as a fund announces that it is either going to liquidate or convert to a mutual fund, its price immediately jumps to par with its portfolio value. This movement erases whatever discount or premium previously existed and since such announcements are often made several months in advance, such funds will come to trade at par with their portfolio values without there having been any accompanying change in rational factors. Including post-announcement observations in the data set will therefore lead to incorrect conclusions about the relationship between rational factors and discount and premium levels.

By contrast, the survival bias in the data set examined here works as a nice filter. Those funds that went through the process of being liquidated or converted into mutual funds have been eliminated. Furthermore, in the analysis summarized in Table I where I regress variables on long-run average discount and premium levels, the averages cover January 1991 to December 2000, thereby eliminating

the final six months of the data set and the possible inclusion of any discount and premium observations towards the end of the data set that might involve a situation in which a fund has announced that it will liquidate or convert into a mutual fund but has not yet done so. In addition, I utilize only funds that are in the data set for the entire January 1991 to December 2000 period. Taking a fund's average discount or premium over such a long period vitiates the possible bias caused by including discount and premium observations from the months immediately following a fund's IPO.

In this paper, I will only utilize Fund Edge data covering 1985-2001. I do this for three reasons. First, the bulk of the data lies in that time period because there was a huge increase in the number of funds starting in the late 1980's.² Second, the time series for older funds before 1985 are in some cases incomplete. Third, there may have been some sort of regime change prior to 1985 since during the sixties and seventies closed-end funds traded on average at much deeper discounts than they have since the early 1980's. It seems wise to avoid this possible complication.

In this paper, discounts will be defined as positive 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 value of its assets 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 . Consistent with Gemmill and Thomas (2002), the discount or premium at which a fund trades, D_t , is normally defined by the equation $D_t = N_t/P_t - 1$, but may also be defined in logs as $D_t = \log(N_t/P_t)$. In either case, values of $D_t > 0$ are called discounts, while values of $D_t < 0$ are referred to as premia. In this paper, I will multiply D_t by 100 and refer to discounts and premia in percentages.

II. Testing the Arbitrage Bounds Hypothesis on US data

Closed-end funds are mutual funds whose shares trade like common stock on major stock exchanges. Unlike the much more numerous open-end mutual funds that guarantee to redeem shares at par with

portfolio value, closed-end funds do not engage in redemptions. As a result, the only way for a current shareholder to cash out her shares is by selling them on the stock exchange at whatever price the market will carry.

It is typically the case, however, that a fund's price per share does not equal its net asset value per share. This is surprising because, management fees aside, purchasing the shares of a closed-end fund entitles the owner to the same stream of future payments as she could earn mimicking the fund's underlying portfolio. One would expect arbitrage pressures to either set the price of a fund's shares equal to its net asset value per share or to its net asset value per share less the capitalized value of expected future management fees (Ross 2002).

This is especially true given that there do not appear to be any substantial barriers to arbitrage among closed-end funds. For instance, their shares trade on major exchanges and many are very liquid. Transparency is also not an issue because closed-end funds publicly disclose their net asset values at least once per week. And Flynn (2004) finds very active short selling of NYSE funds trading at premia—a phenomenon inconsistent with substantial short-selling barriers.

Yet, despite the apparent ease with which arbitrage may be conducted, closed-end funds trade at large and lingering discounts and premia relative to their net asset values. This has spawned a substantial literature debating whether the distribution of discounts and premia can be explained rationally or is the result of irrational noise traders driving share prices away from fundamental values. See, for example, Boudreaux (1973), Zweig (1973), Thompson (1978), DeLong, Shleifer, Summers, and Waldmann (1990), Chen, Kan, and Miller (1993), Chopra, Lee, Shleifer, and Thaler (1993), Pontiff (1997), and Dimson and Marsh (1999).

The model constructed by Gemmill and Thomas (2002) (hereafter GT) can be viewed as one of many attempts to explain the observed distribution of discounts and premia and why funds trade on average at discounts rather than at par with their underlying portfolio values. GT "begin by assuming that

the discount is subject to fluctuations.” They do not attempt to explain the causes of those fluctuations. Rather, they assume that the price at which a fund trades and the value of its portfolio will each follow a log normal distribution with mean zero. Defining discounts and premia as $D_t = \log(N_t/P_t)$, this implies that the distribution of discounts and premia would also be log normal and centered on zero. GT parameterize this log normal distribution for discounts and premia by assuming that the underlying price and portfolio distributions each have a volatility of 25% and a correlation of 0.9. This implies that the log normal distribution would have a standard deviation of 11.2% as well as a mean of zero.

The authors next propose that the full log normal distribution will not be seen in its entirety in real-world data because it will be censored at both ends. The deepest discounts will be censored because of an arbitrage pressure having to do with the possibility that funds trading at deep discounts will be either liquidated or converted to mutual funds by angry shareholders. Similarly, most of the premia will be censored because of an arbitrage pressure having to do with the creation of new funds through IPOs, the new funds putting downward pressure on the share prices of existing funds, thereby preventing their premia from becoming very large.

I will discuss both of these arbitrage barriers below. But first, compare the actual distribution of the US data with the distribution predicted by the GT bounds. GT set their suggested upper bound at a discount of 30% and their suggested lower bound at premium of -5%. Applying these bounds to the assumed log normal distribution centered on zero and having a standard deviation of 11.2% produces Figure 1.

[Insert Figure 1 Approximately Here]

GT’s predicted distribution does not fit the US data. If we plot a relative frequency histogram of the 224,112 weekly D_t observations of the 458 US funds found in Fund Edge over the period January 1985 through May 2001, we get Figure 2. Figure 2 does not look like a log normal distribution of mean zero being censored. Rather, the distribution is centered on a mode discount of 6% and there is no

sign that the distribution suddenly comes up against an arbitrage barrier on either side.³ The tails are gently tapering and nearly 16% of the observations lie outside the bounds assumed by GT. These facts suggest that the GT bounds do not hold and that the distribution found in Fund Edge does not follow the truncated log normal distribution assumed by GT.

[Insert Figure 2 Approximately Here]

However, it must be noted that GT's choice of upper and lower bounds along with their assumption that the discount distribution is mean zero with a standard deviation of 11.2% do imply that the censored distribution should have a mean discount of 5.87%, which is in fact very close to the empirical mode of about 6% found in Figure 2. However, the justifications given for the bounds as well as the assumption regarding the standard deviation of the log normal distribution are not strongly persuasive.

For instance, GT give two reasons why discounts should not exceed 30%. The first is that extremely deep discounts invite arbitrage activities that will tend to reduce discounts. Arbitrageurs will go long fund shares and short fund portfolios (or sufficiently similar hedge portfolios) in order to profit from the price divergence. GT contend that the price pressures that result from such arbitrage activities should keep discounts narrower than 30%. The second reason given by GT that discounts should never exceed 30% is that funds which trade at deep discounts are more likely to be liquidated or converted to open-end funds after a boardroom revolt by shareholders angry at the extremely deep discounts. However, the authors do not quantify the value at which either of these two pressures would become effectual. Both might be expected to increase in intensity gradually as discounts deepen, but the level at which they would become so strong as to deter even deeper discounts is not obvious. Thus the statement that the "discount can often reach 30% percent before the upper bound is reached" appears overly specific. In addition, GT state that the average D_t values of the 18 funds that leave their sample of 158 funds are not significantly different from those that continue in business (6.559% vs. 5.973%). This in itself

casts doubt on the idea that deep discounts are what lead funds to liquidate or convert to mutual fund formats.

As for the lower arbitrage bound at a premium of -5%, it is justified by the notion that if a fund were to trade at a large premium it would attract competition in the form of IPOs of similar closed-end funds. While it is true that Levis and Thomas (1995) and Lee, Shleifer, and Thaler (1991) find that there are more fund IPOs when the average discount across all funds decreases (i.e. when the average discount moves from, say, 15% to only 8%), there is no justification in the literature for the assumption that potential IPO activities imply a boundary for individual funds of “somewhere around” -5%.

This is especially true given that the evidence presented by Levis and Thomas (1995) and Lee, Shleifer, and Thaler (1991) has to do with IPOs increasing when average values of discounts across all funds decrease, not with whether or not the discount of any particular fund reaches the -5% premium boundary. Furthermore, the average values which appear to trigger increased IPOs are actually *discounts* of about 5% in the sample of Lee, Shleifer, and Thaler (1991) and of about 11.5% in Levis and Thomas (1995). Neither paper gives any suggestion about an arbitrage barrier for individual funds at a premium of -5%.

Indeed, there is substantial evidence that no such barrier exists. For instance, if competition for investor dollars meant that seasoned funds trading at large premia would engender IPOs of similar funds, then there should have been a plethora of IPOs of funds investing in Taiwan. That is because the original Taiwan Fund began trading in December 1986 at a -205% premia and stayed at more than a -50% premium for most of the next 18 months. That -205% premium was one of the largest seen among closed-end funds in the USA since the run up to the Crash of '29. However, the only other competitive fund to get started, the ROC Taiwan Fund, was not started until May of 1989—by which time the original Taiwan Fund was trading at par. Even worse for any theory that new funds should provide competition for existing funds is the subsequent behavior of the two funds. Six months after the new ROC Taiwan Fund began trading, the seasoned Taiwan Fund jumped to a -104% premium while

the new ROC Taiwan Fund fell to an 8% discount. And for most of the next 16 months, the seasoned Taiwan Fund traded at D_t values at least 20 percentage points more negative than those of the newer ROC Taiwan Fund.

The original Korea Fund also went to a very large premia of just over -150% in 1986 and continued to trade at more than a -30% premia for the next three years. Yet there were no new IPO's of funds investing in Korea until 1992 and 1993, when, respectively, the Korean Investment Fund and the Korean Equity Fund got started. Here, again, we see a large violation of the suggested -5% premium barrier without any sign of IPOs of similar funds.

While the suggested arbitrage boundaries are not consistent with the US data, the parameter values that GT assume when generating their log normal distribution for discounts are consistent with US values. They assume "a 25 percent annual volatility for both net asset value and price and a correlation [between them] of 0.90." The actual figures for the 458 funds in Fund Edge using monthly data over the period 1985-2001 are 22.9% and 29.8%, respectively, for the yearly volatilities of NAVs and share prices, and 0.895 for the correlation. Consequently, the poor fit that Figure 2 has with the predictions of Figure 1 cannot be due to incorrectly parameterizing the log normal distribution. Rather, it likely stems from the inapplicability of the log normal model and the given boundary assumptions to US funds.

The premium boundary assumption is particularly suspect. Of the 284 bond funds that, as of June 2001, had been in business at least 60 months, 87% of them had surpassed a -5% premium at least once. Even more extreme premia were quite common. 44% had exceeded a -10% premium at least once, 22% had exceeded a -15% premium at least once, and 10% had exceeded a -20% premium at least once. Of the 114 stock funds that had, as of June 2001, been in business at least 60 months, 93% had broken the -5% premium barrier at least once. 72% had exceeded a -10% premium at least once, 53% had exceeded a -15% premium at least once, and 38% had exceeded a -20% premium at least once. If a premium barrier exists for US funds, it is much less rigid than suggested by GT, or is at a much deeper premium.

The discount and premium barriers also imply that the discount distribution should be platykurtic (because the tails should be chopped off) and skewed toward discounts (because more of the left tail than the right tail would be chopped off). In fact, just the opposite is true in the US data. The distribution is leptokurtic and skewed toward premia rather than discounts. For the 224,112 weekly discount and premia observations in Fund Edge between 1985 and 2001, the skewness and kurtosis for the entire sample are, respectively, -2.00 and 20.96. Skewness toward premia and leptokurtosis remain even if we exclude the 761 most extreme observations. These are the ones that are not included in Figure 2 because they were in the extreme tails of the distribution, with either premia of less than -50% or discounts greater than 50%.⁴ Excluding the 761 outliers, the skewness and kurtosis decline dramatically to, respectively, -0.42 and 5.07. But these values still contradict the predictions of skewness toward discounts and platykurtosis implied by the GT arbitrage barriers.

The same pattern emerges if we look not only at the aggregate discount and premium distribution, but at the individual distributions of each of the 284 bond funds and 114 stock funds which were in business for at least 60 months. For each individual fund, we can calculate the mean D_t and the standard deviation of D_t as well as the skewness and kurtosis of the fund's D_t observations. After we have done this for all funds, we can average across, respectively, the bond funds and the stock funds. For the bond funds, we find that the average mean D_t is 3.35%, with an average standard deviation of 5.59%, an average skewness of -0.13, and an average kurtosis of 3.21. For the stock funds, we find that the average mean D_t is 7.53%, with an average standard deviation of 10.68%, an average skewness of -0.70, and an average kurtosis of 4.23. From these statistics, we see that both bond and stock funds are skewed toward premia rather than discounts, and that both are leptokurtic, with stock funds being highly leptokurtic.

To summarize, this section has given ample evidence that the arbitrage boundaries suggested by GT in their paper on UK funds are routinely violated by US funds. Moreover, the gentle taper of both

tails of the discount distribution of Figure 2 appears inconsistent with discounts or premia suddenly coming up against arbitrage barriers of any sort at any point.

III. Do Arbitrage Pressures Align US Funds with Fundamentals?

This section applies GT's regression methodology to test whether or not long-run average D_t levels are consistent with fundamentals. If so, this could be taken as evidence that rational arbitrageurs effectively constrain discount levels to be consistent with fundamentals.

GT provide evidence in favor of this hypothesis by examining 158 UK closed-end stock funds that trade for at least two years during the period 1991 to 1997. For each fund, they calculate the fund's average discount or premium over the length of time for which they have data and then regress it on a constant, the average expense ratio of the fund over its length of operation, a measure of the fund's noise-trader risk over those years, the log of the fund's age at the end of those years, a measure of the difficulty of mimicking the fund's portfolio over those years, the fund's average dividend yield over those years, and the log of the fund's average market capitalization over those years. The measure of a fund's exposure to noise-trader risk is how highly correlated the fund's own D_t series is with the series that gives the average discount or premium across all funds. For bond funds, these are betas when regressing a fund's own discount or premium against the average across all bond funds, and for stock funds, these are the betas when regressing a fund's own series against the average across all stock funds. The variable that captures the difficulty of mimicking a fund's portfolio is the log of the residual standard error obtained by regressing a fund's monthly NAV returns on large market indices.

When this regression is run on their UK data, they find that five of the six variables are significant at the one-percent level, and that the sixth, the log of market capitalization, is significant at the five-percent level. This regression result is presented in the first column of Table IV of Gemmill and Thomas (2002) and is reproduced here as the first column of Table I. The regression is estimated using weighted least

squares, with the volatility of each fund's D_t series being used as the weighting variable. This procedure gives the regression a very robust weighted R -squared of 0.52, and an un-weighted R -squared of 0.34.

[Insert Table I Approximately Here]

Besides being highly statistically significant, each of the variables has the expected sign, except for the measure of noise-trader risk. The positive coefficient on the average expense ratio makes sense because higher fund expenses should be capitalized out by rational investors, thereby increasing D_t levels. The positive coefficient on the log of fund age is consistent with the work of Weiss (1989), and Levis and Thomas (1995), who find evidence that funds begin trading at their IPOs at ten percent premia which subsequently evaporate over the next six months as the funds mature and move toward discounts. The positive coefficient on replication risk is consistent with the idea that the harder a fund is to replicate, the more averse arbitrageurs will be to betting against deep discounts by going long the fund and short an imperfect hedge portfolio (that is, the lower is the replication risk, the more strongly GT expect their discount arbitrage bound to hold). The negative coefficient on the dividend yield is consistent with the idea that higher dividends should cause smaller D_t levels because higher dividends reduce the amount of fund capital that will in the future be taken away from shareholders in the form of management fees. The negative coefficient on the log of market capitalization is expected by GT because they believe that larger funds enjoy a liquidity premium because they can be traded rapidly and with low bid-ask spreads, and because there may be economies of scale in fund management such that larger funds have lower expense ratios. Finally, GT interpret the negative coefficient on the noise-trader risk variable as evidence against the Lee, Shleifer, and Thaler (1991) hypothesis that noise-trader risk is a priced risk because if it were a priced risk, then one would expect higher levels of noise-trader risk to be associated with larger rather than smaller D_t values.

Columns (2) and (3) of Table I give, respectively, the results of running the same specification on the US closed-end stock funds and US closed-end bond funds found in Fund Edge. Because Fund Edge

does not provide back data on fund fees and expenses, these were gathered by hand from fund annual reports. Because complete data could not be obtained for all funds, and because the averages were taken over only those funds that were in business for the entire ten year period running from January 1991 to December 2000, only 69 stock funds could be included in the stock fund regression reported in column (2), and only 123 bond funds could be included in the bond fund regression reported in column (3). It should be noted, though, that because each of the US funds is in the sample for the entire ten-year period, the US sample is much more stable than the UK sample, which has 18 entrants and 54 exits out of 158 total funds during its 1991-1997 period. As a result, the US sample should give a better sense of how funds behave under the normal situation of being seasoned offerings that are expected to continue operating for the foreseeable future.

The results of the US regressions in columns (2) and (3) are very different from those of the UK regression column (1). Whereas all six independent variables were significant for GT's UK data, only two variables each are significant for US stock and bond funds. For the stock funds, the noise risk variable and the log of fund age are significant at the five percent level, while for the bond funds, the noise risk variable and the dividend yield are significant at the one percent level.

Notably, the only variable that is significant in all three regressions is the noise risk variable. However, while it is negative for GT's UK data, it is positive for the US data. Consequently, GT's decision to "reject very clearly the view of Lee, Shleifer, and Thaler (1991) that noise-trader risk is a priced factor which causes a discount" is not supported by the US data. Rather, noise-trader risk is the only tested factor that is priced into *both* bond and stock funds in the US data.

The results of columns (2) and (3) also cast doubt on the robustness of GT's conclusion that arbitrage pressures are strong enough to consistently align long-run average D_t levels with fundamentals. Not a single variable has the same sign and significance for both columns (2) and (3) as it does for column (1). While arbitrage pressures may be present and potent in GT's sample of UK stock funds, those pressures appear not to generalize to the US data, and also do not seem to generalize to bond

funds as opposed to stock funds. The expense ratio, replication risk, and market capitalization are all insignificant in columns (2) and (3). Worse yet for the generalizability of the UK results, the signs of the coefficients are different in columns (2) and (3). As for the other two independent variables, fund age is of the right sign for both US bond and stock funds in columns (2) and (3), but is only significant for stock funds. And whereas the coefficient on dividend yield is significant and of the expected negative sign in column (3) for bond funds, it is of the wrong sign and insignificant for stock funds in column (2).

To summarize, none of the GT regression results for UK stock funds generalize with any significance to both US bond and stock funds. This casts significant doubt on the contention that arbitrage pressures cause D_t values to move toward levels consistent with fundamentals like fund expense ratios and trading costs. The insignificance of the replication risk variable for both stock and bond funds in the US also casts doubt on whether the ease of replicating a fund's portfolio in any way affects arbitrage activities in closed-end funds. And the positive and statistically significant coefficients on noise-trader risk directly contradict GT's contention that noise-trader risk is not a priced factor in closed-end funds.

IV. Why do US and UK Funds Behave Differently?

US and UK funds behave very differently. In this section, I consider two possible explanations for why they behave differently, sample selection bias in the UK sample and differences between the two countries in terms of the fraction of fund shareholders who are individual investors rather than institutional investors.

A. Can sample selection explain the differences?

GT get their sample of 158 UK funds by selecting from a much larger population of closed-end funds only stock funds whose investment objectives can be matched exactly with those from a set of mutual funds.⁵ Can either of these two criteria—using only stock funds and using only funds which have matching mutual funds—account for the differences between US and UK funds?

First, consider the fact that I have been careful to separate my sample of US funds into stock and bond funds throughout this paper so that you can directly compare the results from US stock funds with the results from the UK stock funds used by GT. In all cases, US stock funds behave differently from UK stock funds. In particular, if you compare columns (1) and (2) of Table I, you can see that only a single independent variable—the log of fund age—is both significant and of the same sign for both UK and US stock funds. Furthermore, US stock funds routinely and often extremely violate the two arbitrage bounds that GT argue apply to their sample of UK stock funds.

Second, without a larger sample of UK funds, it is not possible to know with certainty whether any biases were introduced by selecting only closed-end funds whose investment objectives could be perfectly matched with those of mutual funds. But since GT focus on the strength of arbitrage in closed-end funds, I think it important to consider the possibility that their sample selection process may select funds for which arbitrage is more intense than it is for the average fund.

The problem is that closed-end fund arbitrage activities may be more intense for closed-end funds that can be exactly paired with mutual funds having identical investment objectives. For instance, consider a closed-end fund that is over-priced and trading at a premium. An arbitrageur might want to short the fund, hoping that the fund's price will fall down towards its net asset value. But she knows that there are two risks involved in this strategy. First, even if the fund's net asset value remains unchanged, the fund's premium might increase rather than decrease, thereby driving up the price of the fund's

shares and hurting her short position. Second, while she is waiting for the premium to decrease, the price of the fund's shares might increase because the value of its portfolio increases.

The first risk is unavoidable. But the second risk can be hedged if there is a matching mutual fund in which the arbitrageur can take a long position. If the portfolios of the closed-end fund and the matching mutual fund rise together, then the money she loses on her short position in the closed-end fund can be made up for by gains on the long position in the mutual fund. Indeed, to the extent that the mutual fund's portfolio and the closed-end fund's portfolio move in unison, hedging in this manner can totally eliminate the risk that stems from the closed-end fund's share price moving because of changes in its portfolio value.

If the ability to hedge this risk is attractive to arbitrageurs, then GT's sample will likely feature more intense arbitrage and consequently show discounts and premia that deviate less wildly from fundamental values and which are more consistent with rational factors like fund expenses and dividend yields than those of the UK funds that their method excludes. In the same way, since the US data contains all closed-end funds trading in the USA in 2001 and does not limit itself to funds for which there are perfectly matching mutual funds, the US data should show behavior much less consistent with strong arbitrage than does the UK sample—which is in fact the case. And, to the extent that strong arbitrage reduces the effects of noise trading, the sample selection bias that GT's method may entail could also explain why the proxy for noise-trader risk is priced into US funds but not into their sample of UK funds.

B. Individual Investors versus Institutional Investors

The great difference between US and UK funds in terms of their shareholder composition offers another possible explanation for why their discounts and premia behave so differently. As noted by Lee, Shleifer, and Thaler (1991), small investors dominate the share holding and trading of closed-end funds

in the USA. By contrast, Brown (1998) and Dimson and Minio-Kozerski (1999) demonstrate that institutional investors like pension funds and insurance companies dominate the closed-end fund markets in the UK. Indeed, the differences between the two markets begin even before funds begin trading since IPOs of US funds are marketed to small investors while IPOs of UK funds are sold to institutional investors.

If institutional investors are more rational and less prone to noise trading than small investors, the difference in shareholder composition between the US and the UK may explain the differences found in this paper in how their discounts and premia behave. Most directly, the difference in shareholder composition could explain why noise-trader risk is priced only for US closed-end funds. In addition, a higher level of noise trading due to a higher proportion of small investors would presumably tend to disassociate fund D_t levels from fundamentals. This would explain why the discounts and premia of US funds in Table I do not vary significantly with the tested fundamental factors while those of UK funds do. And a higher level of noise-trader-induced volatility would also help to deter arbitrage activity and explain why only US funds appear to violate the two arbitrage bounds that GT argue successfully constrain the discounts and premia of UK funds.

V. Conclusion

The behavior of US closed-end funds is extremely different from the behavior of the UK stock funds examined by Gemmill and Thomas (2002). The differences between them call into question the generalizability of the conclusion that arbitrage barriers constrain the magnitudes of discounts and premia, as well as the conclusion that arbitrage pressures align the discounts and premia of different funds to reflect differences between the funds in terms of rational factors like expense ratios and dividend payout rates.

To begin with, US closed-end funds routinely and often extremely violate the thirty percent discount barrier and the five percent premium barrier that Gemmill and Thomas (2002) believe constrain closed-end fund discount and premium levels. Since these barriers are supposed to be enforced by arbitrage activities that prevent discounts and premia from exceeding either of the barriers, the fact that US funds violate the barriers calls into question the ability of arbitrage to constrain discounts and premia in the US.

Further doubts about the ability of arbitrage to constrain discounts and premia come from cross-sectional regressions of the long-run average discount and premium levels of US funds on their respective exposures to five rational factors—the expense ratio, the log of fund ages, replication risk, dividend yield, and fund size—as well as a proxy for noise-trader risk. Whereas the UK data show statistically significant coefficients of the expected signs for all of the rational factors and a statistically significant positive coefficient on the proxy for noise-trader risk, the US data show that the only statistically significant variable that affects both bond and stock funds is the proxy for noise-trader risk—but that it has a negative sign, contrary the positive sign generated by the UK data. In addition, none of the five rational factors is significant for both US bond and stock funds, and only one each is significant for either bond or stock funds—the log of fund age for stock funds and the dividend yield for bond funds.

These results are inconsistent with arbitrage pressures being strong enough to align the discount and premium levels of US funds with fundamentals. And the fact that increases in exposure to noise-trader risk lead to deeper discounts for both US stock and bond funds also suggests that noise-trader risk does affect closed-end fund prices—at least in the US.

That being said, what could possibly explain the differences between the UK funds studied by Gemmill and Thomas (2002) and the US funds studied here? One possibility has to do with the fact that the closed-end fund markets in the US are dominated by individual investors while the closed-end fund markets in the UK are dominated by institutional investors. To the extent that individual investors are more irrational and more prone to noise trading than are institutional investors, the differences

between the two markets in terms of shareholder composition could explain not only why noise-trader risk appears to affect only US funds but also why the discounts and premia of US funds are poorly aligned with rational factors while the discounts and premia of UK funds are very well aligned with rational factors.

An alternative possibility is that the sample chosen by Gemmill and Thomas (2002) is biased because they restrict their sample to include only those closed-end funds which they are able to match with mutual funds having identical investment strategies. To the extent that this provides perfect hedges for arbitrage activities undertaken against mispriced closed-end funds, their sample may contain only funds which face unusually high levels of arbitrage. If so, this would explain why the discounts and premia of the funds in their sample obey the authors' two suggested arbitrage bounds, why the discounts and premia in their sample are well aligned with rational factors, and even why noise-trader risk is not priced into the funds in their sample. Simply put, arbitrage may be so strong in these funds as to keep their discounts and premia well aligned with fundamentals despite the actions of noise traders.

By contrast, the sample of US funds contains every fund trading in 2001 and so is not biased towards including only those funds for which there exist perfectly matching mutual funds. As a result, it contains many funds for which arbitrage may be substantially more difficult than it is for the funds in the UK sample. That would explain why noise-trader risk is priced into the US funds but not into the sample of UK funds, why US funds violate the arbitrage bounds that appear to constrain the sample of UK funds, and why US funds are not well aligned with rational factors while the funds in the UK sample are.

Further research is obviously needed. To determine whether sample selection bias or some fundamental difference between US and UK funds drives the differences in behavior found in this paper, it might be useful to see how the UK funds excluded by the sample selection procedure used by Gemmill and Thomas (2002) actually behave. If the excluded UK funds behave like the US funds examined here, then a moderately strong case might be made for the deterrent effects of noise-trader risk on arbi-

trage activities. If, however, the excluded UK funds behave like the included UK funds, then it would seem likely that there is some fundamental difference between US and UK funds, perhaps driven by the difference in shareholder composition between the two countries or perhaps by some institutional difference between the two countries.

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VI. Notes

¹Of the 458 funds, 389 were listed on the NYSE, 61 on the AMEX, seven on the NASDAQ, and one—the NAIC Growth Fund—on the Mid-west Exchange. 124 were stock funds and 334 were bond funds. Fund Edge also contains data on four Canadian funds traded on the Toronto exchange, but these are excluded from this paper's analysis.

²Fewer than 30 funds were listed in the Wall Street Journal in 1985.

³Ross (2002) predicts that funds should rationally trade at a discount of about 7% if you capitalize out future fund expenses. Consequently, Figure 2 looks like D_t values being distributed around that rational discount level.

⁴Most of these 761 outliers lie in the left tail. The most extreme discount was 66.5% while the most extreme premium was the Taiwan Fund's -205.4%.

⁵They do this because they are interested in testing the hypothesis that capital flows to mutual funds are correlated with movements in closed-end fund D_t levels.

Table I
Comparison of UK and US Results from Cross-Sectional Regressions to Explain Which Factors Explain Discount and Premium Levels

The table reports cross-sectional regressions run on long-run average closed-end fund discount and premium levels. The first column reproduces column (1) of Table IV of Gemmill and Thomas (2002), which reports the results of a cross sectional regression run on UK-traded closed-end stock funds over the period 1991-1997. The second and third columns report the results of running the same specification on, respectively, stock and bond funds traded in the USA over the period 1991-2000. The independent variable is the long-run average discount or premium level, D_t , for each fund. The expense ratio is the long-run average of annual expenses divided by net asset value. The individual fund noise beta is the individual fund sensitivity to the average discount of the funds in the sample. The replication risk is the residual error from a regression of net asset value returns on large market indices. Numbers in parentheses are t-values. The symbol * denotes significance at the five percent level and ** denotes significance at the 1 percent level.

Dependent Variables	GT's UK Stock Fund Avg. Discs (1)	Fund Edge Stock Fund Avg. Discs (2)	Fund Edge Bond Fund Avg. Discs (3)
Independent Variables			
Constant	+0.049 (0.81)	+0.172 (0.48)	-0.187 (-1.67)
Expense Ratio	+2.992** (2.98)	+2.627 (1.01)	-0.085 (-1.31)
Noise Risk Beta	-0.029** (5.03)	+0.020* (2.58)	+0.031** (3.91)
Log of Age	+0.040** (8.77)	+0.064* (2.06)	+0.018 (1.21)
Replication Risk	+0.087** (4.16)	-0.020 (-0.77)	+0.0129 (0.92)
Dividend Yield	-0.0073** (-3.60)	+0.0059 (1.61)	-0.0071** (-2.52)
Log of Size	-0.011* (-2.11)	-0.019 (-1.05)	+0.009 (1.81)
R-sq (weighted)	0.52	0.06	0.42
R-sq (unweighted)	0.34	-0.29	0.29
Weighting Variable	Volatility of Discount	Volatility of Discount	Volatility of Discount
Number of funds	158	69	123

Figure 1. Censored Log Normal Distribution of Discounts and Premia Assumed by Gemmill and Thomas (2002).

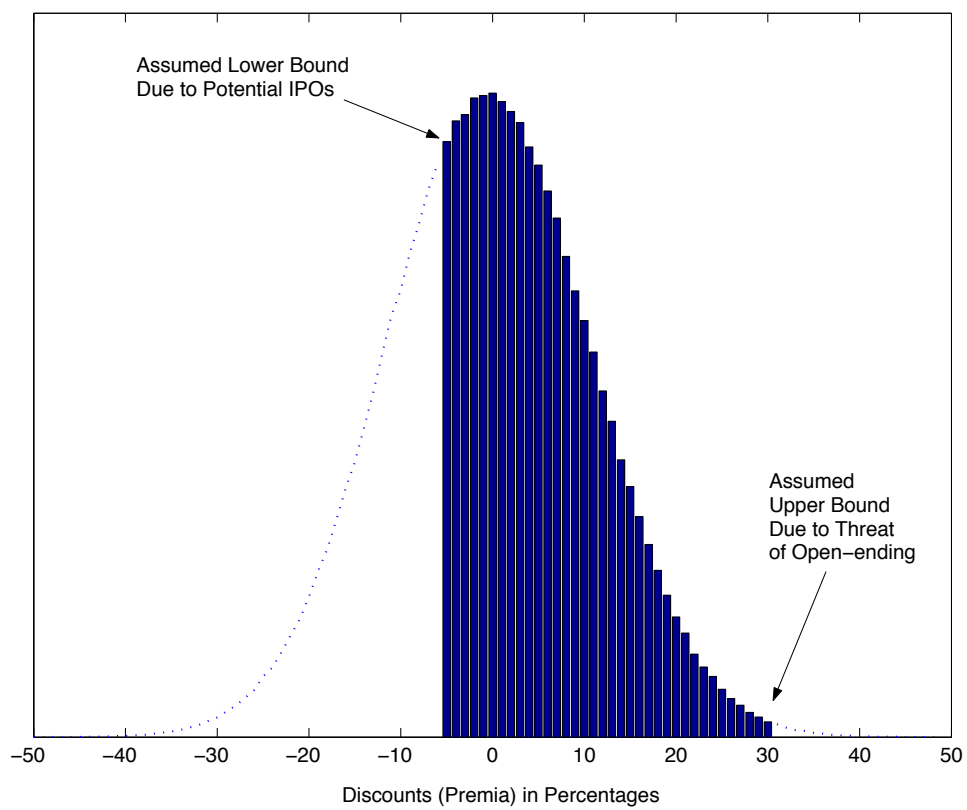


Figure 2. Distribution of Weekly Discounts and Premia of US Closed-end Funds, 1985-2001.

