Liquidity, Liquidity Risk and the Closed-End Fund Discount*

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ABSTRACT

This paper examines the liquidity and liquidity risk of closed-end mutual funds and of their portfolios and the relationship to closed end fund pricing. This paper tests two main hypotheses: closed-end fund discounts are in part related to liquidity differences between the closed-end fund and its underlying portfolio; closed-end fund discounts are related to differences in liquidity risk between closed-end funds and closed-end fund portfolios. The results of the study indicate that closed-end fund discounts increase (closed-end fund market prices are lower relative to net asset value) as the liquidity of the closed-end fund decreases relative to the liquidity of the underlying portfolio. Additionally, we find that the higher the liquidity risk of a closed-end fund relative to its underlying portfolio, the larger the closed-end fund discount (market price of the closed end fund is lower relative to its net asset value). The results are consistent with the closed-end fund discount including components for liquidity and liquidity risk.

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ABSTRACT

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1. Introduction

It is well known that closed-end funds (CEFs) typically trade at a discount to the net asset value (NAV) of their underlying portfolios (see Dimson & Minio-Paluello (2002)). This fact has been cited as strong evidence against market efficiency (see Lee, Shleifer, & Thaler (1990), Dimson & Minio-Paluello (2002), Malkiel (1977), Pontiff (1996)). In fact Lee, Shleifer, and Thaler (1991) claim "few problems in finance are as perplexing as the closed-end fund puzzle," because it seems to violate value additivity, one of the most basic tenets of finance; with CEFs, the whole sells at a discount to the sum of the parts.

The notion that a CEF is simply the sum of its parts may be simplistic, however. Within the bounds created by limits to arbitrage and the cost of opening up a CEF, there are many dimensions in which the characteristics of the CEF and its underlying portfolio can differ. In particular, since the CEF and its underlying securities trade independently, they can have different liquidities. In fact, Lee, Shleifer, and Thaler (1991) and Grullon and Wang (2001) provide evidence that CEFs are primarily held by non-institutional investors[1], while Dey and

[1] In the Lee, Shleifer, and Thaler (1991) sample, CEFs had average institutional ownership of 6.6% while the average institutional ownership of a random sample of the smallest 10% of NYSE stocks is 26.5% and 52.1% for a random sample from the largest 10% of NYSE stocks. Grullon and Wang (2001) report a mean (median) fraction of institutional ownership of CEFS of 6.8% (3.0%) and a mean (median) institutional ownership difference between the CEFs and CEF assets of 40.65% (43.33%).

Radhakrishna (2004) finds that increased institutional trading reduces the bid-ask spread. Furthermore, recent studies that examine liquidity and asset pricing have documented a positive relationship between liquidity and price.[2] This paper examines the extent to which the discount can be attributed to differences in liquidity between the CEF and the underlying assets.

Specifically, the paper examines the difference between the liquidity of the CEF and its underlying portfolio using a sample of 20 CEFs from the U.S. general equity CEF category in the Wall Street Journal and CEF historical portfolio data for the period 1/1/95 through 12/31/03. If liquidity is a factor in asset pricing then the CEF discount should be increasing in the illiquidity of the CEF relative to its portfolio illiquidity. Also, if liquidity is a priced state variable, then the CEF discount should increase as the liquidity risk of the CEF increases relative to the CEF portfolio. Therefore, there are two potential liquidity effects: static liquidity differences between the CEF and its portfolio, and liquidity risk differences between the CEF and its portfolio. Static liquidity is an average liquidity difference where liquidity risk is the risk that liquidity positively covaries with investor wealth. Archarya and Pedersen (2004) shows that both liquidity effects are important in explaining security returns. We therefore examine liquidity and liquidity risk and the relationship to CEF discounts by investigating the following relationships:

- Cross sectional and time series relationship between the liquidity differential (using the Amihud (2002) liquidity measurement) of the CEF portfolio/CEF and the CEF price/NAV differential
- Cross sectional and time series relationship between the CEF portfolio liquidity (using the Amihud (2002) liquidity measurement) and the CEF price/NAV differential

[2] See Eleswarapu (1997), Chalmers, Kadlec (1998), Brennan, Chorida, and Subrahmanyam (1998), Datar, Naik, and Radcliffe (1998), Amihud, Mendelson (1986), Lauterbach (1997), and Brennan, Subrahmanyam (1996)

- Cross sectional and time series relationship between the relative spread differential of the CEF portfolio/CEF and the CEF price /NAV differential
- Cross sectional relationship between the CEF/CEF portfolio liquidity risk difference and the CEF discount

A priori there is reason to suspect that liquidity may play a role in the CEF discount. Although the theoretical relationship between liquidity and price is ambiguous[3], most empirical studies document a positive relationship where price increases with higher liquidity (see Eleswarapu (1997), Chalmers, Kadlec (1998), Brennan, Chorida, and Subrahmanyam (1998), Datar, Naik, and Radcliffe (1998), Amihud, Mendelson (1986), Amihud, Mendelson and Lauterbach (1997), and Brennan, Subrahmanyam (1996)). In addition, Amihud (2002) finds that illiquidity has a greater effect on small stocks. CEFs are similar to small stocks in that both have low institutional ownership, and therefore may also have low liquidity. Lee, Shleifer, and Thaler (1991) claims that investor sentiment drives discounts, which is based on the relationship between small stock returns and CEF discounts. Based on the findings of Amihud (2002) this relationship may be related to liquidity rather than investor sentiment.

It is also possible that liquidity is a priced state variable. Chordia, Roll, and Subrahmanyam (2000) finds that spreads and depth co-move with market-wide and industry-wide liquidity even after controlling for volatility, volume, and price. Chordia, Roll, Subrahmanyam (2001) finds liquidity co-movements are induced by common factors such as market declines, interest rate movements, and macroeconomic announcements. Pastor and Stambaugh (2003), Sadka (2004), Jones (2004), Acharya and Pedersen (2004) all find that stocks

[3] Constantinides (1986) and Jones and Slezak (2000) show that while transaction costs have an impact on demand they have only a second order effect on asset prices, with transaction volume adjusting with costs. Vayanos (1998) also shows that transaction costs effect volume with little effect on price with prices actually increasing sometimes in illiquidity. Longstaff (2004) shows that risky assets can be more valuable in an illiquid market. In contrast, Amihud and Mendelson (1986) shows that the observed market gross return in equilibrium is an increasing and concave function of the relative spread.

that are more sensitive to marketwide liquidity fluctuations have higher expected returns. Lee, Shleifer, and Thaler (1991) finds evidence that discounts of different domestic CEFs tend to move together, which is consistent with the existence of a systematic component in CEF discounts potentially related to systematic movements in liquidity.

There is some academic evidence of a relationship between liquidity and the CEF discount. Jain, Xia, and Wu (2004) examines the liquidity of country CEFs and the liquidity of the home and host market of the CEF. They compare Amihud's illiquidity measure of the home and host country with the CEF illiquidity in order to detect a relationship between CEF discount and liquidity differentials. They find a strong relationship between the CEF discount and the CEF illiquidity, home country illiquidity, and of the host country illiquidity. While Jain, Xia, and Wu use actual Amihud CEF illiquidities, they use aggregates of the home market illiquidity to proxy for CEF portfolio illiquidity. Without knowing the correlation between the home market and the portfolio liquidity, the effect of the CEF and CEF portfolio liquidity difference on the discount cannot be determined as is done in our paper. Grullon and Wang (2001) examines CEF discounts and the relationship to CEF transaction costs and finds they are positively and significantly related, but does not consider portfolio liquidity. Pontiff (1996) examines CEF discounts in an arbitrage context and finds that CEF discounts increase in the arbitrage difficulty of the portfolio and the transaction costs of the CEF. Arbitrage difficulty is measured in terms of unhedgeable risk, not portfolio liquidity and therefore Pontiff does directly analyze liquidity differences. Although these papers provide evidence of a liquidity/CEF discount relationship, they do not specifically examine the liquidity differences between the portfolios and the CEFs, which is the focus of this paper.

Liquidity is also interesting in an organizational structure context. The CEF structure allows the portfolio manager to buy illiquid securities without the worry of large investor withdrawals. Deli and Varma (2002) empirically examine the choice of organizational structure of funds and find that CEFs do tend to hold less liquid securities than open-end funds (OEFs). This implies an interaction between portfolio liquidity and CEF liquidity. One would expect to find portfolios of CEFs to be less liquid than the CEF themselves since the CEF structure would allow liquid investment into less liquid securities. This also may imply an interaction between portfolio strategy and discount. Less liquid portfolios may be valued more by CEF investors since this organizational structure is more efficient for less liquid portfolios (see Fama and Jensen (1983a,b)[4] and Deli and Varma (2002)). CEFs with liquid portfolios are inefficient relative to OEFs since the costs of the CEF structure (such as higher agency costs[5]) will outweigh the benefits. On the other hand, since investors cannot withdraw funds from a CEF (therefore the manager is compensated the same regardless of effort[6]), agency costs may be the dominant problem with CEFs. Given that, the CEF manager must signal to the investors that the CEF will be managed with low agency costs. Berk and Stanton (2004) shows that a CEF can trade at a premium or discount, depending on the interaction between manager ability and costs. According to Deli and Varma (2002), CEFs offer economies when the potential for value creating discretionary trading is large. This is because a CEF manager does not need to trade out of positions for redemptions nor does the manager need to hold cash, which generates high opportunity costs when the assets have a high expected return. In order to signal low agency costs and high ability, the manager must make a credible commitment to a high performance

[4] Fama and Jensen argue that redeemable claims (OEFs) are not efficient when the underlying assets are illiquid.
[5] Barclay, Holderness, and Pontiff (1993) show that there is an agency cost component to the CEF discount. These agency costs are eliminated in the OEF structure.
[6] Investment advisors are only allowed to charge a flat asset fee to registered investment companies.

strategy and illiquid securities may inhibit that strategy. One such credible signal is a managed distribution plan, which requires portfolio liquidity to implement.[7]

The empirical results from this paper are as follows. Estimates from panel regressions show a significant relationship between the CEF/portfolio liquidity difference and the CEF discount (the CEF market price decreases relative to the NAV when the CEF is more illiquid than the portfolio). Also, a positive relationship was detected between the CEF portfolio liquidity and the CEF discount (the CEF market price increases relative to the NAV when the portfolio becomes more liquid), which is consistent with the credible performance signal hypothesis. Furthermore, consistent with the credible performance signal hypothesis, we found that the CEF trades at a higher price relative to NAV (usually a premium) when a CEF utilizes a managed distribution plan.[8] Since a managed distribution plan increases yield, this significance is closely related to Pontiff (1966), which examines the effect of dividend yield on fund discounts in the context of the process of arbitrage. However, Pontiff also finds that higher dividend payments reduce costs of doing arbitrage which reduces CEF discounts. The managed distribution plan, while increasing yields, also forces the manager to return capital to investors if annual performance is below 10%. Finally, using liquidity risk mimicking portfolios to estimate liquidity risk loadings of the CEF and its NAV, we find that in the cross section the CEF discount widens as the liquidity risk of the CEF increases relative to its portfolio liquidity risk.

The remainder of the paper is organized as follows: Section 2 covers data collection; Section 3 explains the methodologies employed, Section 4 reports the results of the empirical tests, and Section 5 summarizes the findings.

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[7] A managed distribution plan is a distribution policy that commits the manager to distribute a fixed percentage of a CEF's asset base per quarter or year. In effect, this distribution reduces assets of the CEF and the manager's compensation when performance is poor and is similar to the Jensen (1986) free cash flow model of agency cost reduction. Johnson, Lin, and Song (2004) show that risk adjusted returns are higher and discounts are lower for CEFs with a managed distribution plan.

[8] In the sample used for this paper, the CEFs that have a plan use a 2.5% quarterly asset distribution (except for one CEF which uses a 2.25% quarterly plan).

2. Data

Monthly CEF premiums/discounts and CEF market prices were obtained from the Thomson Wealth Management Investment View database[9] for the 760 CEFs and ETFs that trade in the U.S. Table 1 shows an analysis, broken down by CEF, ETF, and CEF categories, of the 3-year average discount, discount standard deviation, and mean expense ratios. It is interesting to note that all the exchange-traded funds (ETF) trade at or near NAV, which is related to the fact that they are not actively managed and charge lower fees than CEFs (and thus have lower agency costs) and allow for in-kind exchanges (which eliminates limits to arbitrage). The sample size is reduced to 37 by filtering out all ETFs and filtering out the CEFs that have less than 95% U.S. traded stock, cash, and U.S. government bonds. For this particular study, it is necessary that the portfolios consist mostly of U.S. traded stock, cash, and U.S. government bonds in order to compute the liquidities and spreads of the underlying portfolios.

Each CEF files a Certified Annual Shareholder Report of Registered Management Investment Companies (N-CFR) on the Electronic Data Gathering, Analysis, and Retrieval (EDGAR) system of the U.S. Securities and Exchange Commission (SEC) every three or six months, which includes complete portfolio composition data. EDGAR provides an electronic filing process for filers and filing agents submitting documents under the Securities Act of 1933, the Securities Exchange Act of 1934, the Public Utility Holding Company Act of 1935, the Trust Indenture Act of 1939, and the Investment Company Act of 1940. Detailed historical quarterly or semi-annual portfolio composition and CEF financial data was obtained for each CEF from the SEC EDGAR N-CFR filings for each of the 37 CEFs obtained from the Thomson database for the period 1/1/95 through 12/31/03. Portfolio holdings were matched to Center for Research

[9] This data base has, for each CEF and ETF since inception, a monthly time series file of NAV, discount, income, capital gain distributions, monthly/annual returns since inception, ticker, type, advisor, expense ratios, style analysis, rankings, monthly/annual standard deviation, alphas, betas, Sharpe ratios, Treynor ratios, fund location, cusip, and bond data.

in Security Prices (CRSP) and Trade and Quote (TAQ) identifiers in order to build intraday and daily quote/price/volume securities history files for the period 1/1/95-12/31/03 for each CEF and CEF portfolio. CEFs that have more than 10% of its portfolio invested in real estate, private equity, restricted stock, other unpriced securities, or had less than a 3 year history were deleted from the sample. The presence of these types of securities does not allow for an accurate spread or liquidity computation. After the application of these filters, the number of funds in the sample was reduced to 19 for the panel set and 20 for the 12/31/03 cross section. There are 361 fund-months in the Amihud (2002) illiquidity data set and 350 fund-months in the TAQ spread data set.[10] The TAQ set is smaller because one fund was not in the TAQ database.

For the unpriced securities in each CEF portfolio, an estimate was used for spread and illiquidity. The following assumptions were used for calculating spreads and liquidities:[11]

- CRSP and TAQ listed securities are assigned the calculated relative spread and Amihud (2002) illiquidity.
- Short-term holdings, and cash are assumed to be zero spread.
- Government bonds and government notes are assumed to be very liquid with an Amihud illiquidity of .01 and spread of .0001.
- Unlisted stocks, preferred stocks, and private equity are assumed to be the 90 percentile spread and illiquidity from the equal weighted TAQ or CRSP data base for appropriate time period. These stocks are not listed in the TAQ/CRSP data base and are therefore by their nature illiquid. Illiquidities and spreads of securities above the 90^{th} percentile are in many cases outliers. In order to minimize the effect of outliers, the 90^{th} percentile was

[10] There will be two data sets, one built from price volume data to calculate security illiquidity and one built from quote data to calcuate relative spreads.
[11] We used less liquid and more liquid assumptions for the bonds and options with similar results.

used. This also allows for a time series variation in liquidity that will be related to the systematic nature of liquidity movements.

- Corporate bonds are assumed to have a .2% relative spread and Amihud illiquidity value of 2. Chakravarty and Sarkar (1999) find that corporate spreads average approximately $.20 per $100 par value.
- Options are assumed to be the 90 percentile spread and illiquidity from the equal weighted TAQ or CRSP data base for appropriate time period as well. Options are in general less liquid than stocks and Mayhew, Sarin, Shastri (1999) show that option liquidity is related to stock liquidity.
- Portfolio illiquidity/spread is calculated by a portfolio capitalization weighted average of the Amihud liquidities or the portfolio capitalization weighted monthly average spread of each security

Filters were used on the TAQ data to filter out quotes outside of normal trading hours, offer prices less than bid prices, and offer prices too large relative to bid prices.

3. Methodology

3.1 Liquidity and the CEF Discount

Here we compare the liquidity of the CEF and its portfolio. We examine whether the difference in the two liquidities is correlated with the discount of the CEF from NAV. To measure the liquidity of both the CEF and its portfolio, we use two liquidity measures. The first is the measure developed in Amihud (2002). The second measure is the relative spread. The Amihud liquidity measure for a given day t is defined as that day's absolute return divided by the dollar trading volume for that day. This measure of liquidity gives the absolute percentage price change per dollar of trading volume, or the price impact of the order flow for that day.[12] The larger the price change per unit of volume, the more illiquid the security and the larger the Amihud measure. Amihud (2002) shows that this measure is correlated with price impact and fixed cost measures obtained from microstructure data.

As noted in Acharya and Pedersen (2004), there are three problems with the Amihud illiquidity measure. First, the illiquidity measure is expressed in return per dollar volume. As a result, the Amihud illiquidity measure is not stationary under inflation when measured as the ratio of the daily absolute return to the dollar trading volume for the day. I correct for this by multiplying each monthly Amihud illiquidity measure by one plus the cumulative monthly CPI, with the January 1995 CPI value equal to zero.[13] Second, the illiquidity measure can have large outliers, which can distort the illiquidity estimate. For example, on days when there is public information released and low volume the illiquidity measure will assume an abnormally large value. Third, the Amihud illiquidity measure is not scaled to represent the cost of a trade. To correct for these problems, we use the Acharya and Pedersen (2004) illiquidity transformation, which normalizes the illiquidity measure and truncates outliers.

Using the daily Amihud illiquidity measure for each stock during a specific quarter, quarterly Amihud illiquidity measures are computed as the average of daily measures during that quarter. The Acharya and Pedersen (2004) illiquidity transformation is then applied to each quarterly Amihud illiquidity measurement. The CEF's quarterly portfolio illiquidity is calculated as the weighted average of the individual quarterly illiquidity measures for the securities in the CEF portfolio, with weights determined by the market value of each asset. The

[12] This follows Kyle's concept of illiquidity, which is the response of price to order flow, and Silber's (1975) measure of thinness
[13] Obtained from Economagic time series site. Series Title: Inflation in Consumer Prices: Percent: CPI-U.

CEF illiquidity is computed the same way as a single stock. The quarterly portfolio illiquidity and CEF illiquidity for each CEF at each quarter are then organized into a panel data set.[14]

We use this panel data set to test whether liquidity differences can explain (at least partially) the CEF discount. More specifically we test the following hypothesis:

Hypothesis 1: The CEF discount widens as the CEF becomes less liquid relative to the underlying portfolio.

Hypothesis 2: There is a relationship between portfolio liquidity and the CEF discount. If there is a positive relationship (the CEF discount increases as portfolio illiquidity increases), then CEF discounts are driven more by agency costs and manager performance. If there is a negative relationship (the CEF discount decreases as portfolio illiquidity increases), then discounts are driven more by organizational structure costs. As mentioned in the introduction, there are economies for CEFs when they purchase illiquid portfolios. Therefore a CEF should be more highly valued the more illiquid the portfolio as the economies will increase relative to the agency costs. However, this is countered by performance economies and the need for liquidity to achieve those performance economies. For the high performance manager a credible signal is needed in order to inform investors that the CEF is a performance type, which comes in the form of the managed distribution plan.[15]

The discount[16] d for CEF k at month t is measured as follows:

$d_{k,t} = P_{m,k,t}/P_{n,k,t} - 1$, where

$P_{m,k,t}$ = market price at end of month t of CEF k,

$P_{n,k,t}$ = NAV at end of month t of CEF k.

[14] The panel data set is unbalanced since it is possible for each CEF to have different quarterly reporting points and different time series lengths.
[15] The managed distribution plan also requires liquidity in order to have cash to distribute.
[16] The negative sign makes the discount larger as the CEF market price decreases relative to the NAV.

The Amihud illiquidity measure is computed each day for each CEF k and stock i in the sample and then the mean quarterly illiquidity is computed for each CEF k and stock i:

$$illiq_{k,t} = \frac{1}{D_{k,t}} \sum_{d=1}^{D_{k,t}} | R_{k,d,t} | / V_{k,d,t} \text{, and} \quad (1)$$

$$illiq_{i,t} = \frac{1}{D_{i,t}} \sum_{d=1}^{D_{i,t}} | R_{i,d,t} | / V_{i,d,t} \text{,} \quad (2)$$

where

$R_{k,d,t}$ ($R_{i,d,t}$) = return of CEF k (security i) for day d for quarter t,

$V_{k,d,t}$ ($V_{i,d,t}$) = dollar volume of CEF k (security i) for day d for quarter t,

$D_{k,,t}$ ($D_{i,,t}$) = # of days for which data is available for CEF k (security i) in quarter t.

Then, for $l = k$ *or* i, the normalized and truncated illiquidity $L_{l,t}$ is computed:

$$L_{k,t} = \min(.25 + .30 * illiq_{k,t} * I_t, 30) \text{, and} \quad (3)$$

$$L_{i,t} = \min(.25 + .30 * illiq_{i,t} * I_t, 30) \text{,} \quad (4)$$

where I_t = cumulative CPI adjustment for month t.

The CEF weighted portfolio spread is computed as follows:

$$PL_{k,t} = \sum_{i=1}^{N} L_{i,t}^{k} (PV_{i,t}^{k} / PV_{k,t}) \text{,} \quad (5)$$

where

$PL_{k,,t}$ = portfolio illiquidity of CEF k for month t,

$PV^{k}_{i,,t}$ = portfolio value for security i of CEF k for month t,

$PV_{k,t}$ = sum of all security portfolio values for CEF k in month t,

N = number of securities in CEF k.

The relationship between the CEF discount and the CEF/portfolio liquidity differential is examined using one-way fixed effects panel regression in the following regression equation:

$$d_{k,t} = \alpha_k + \delta_1 \Delta L_{k,t} + \delta_2 MD_{k,t} + \delta_3 d_{k,t-1} + \delta_4 d_{k,t-2} + \delta_5 d_{k,t-3} + \delta_6 d_{k,t-4} + u_{k,t}\,, \quad (6)$$

where

$d_{k,t}$ = % discount on CEF k at time t,

α_k = fixed effects for CEF k,

$\Delta L_{k,t} = PL_{k,t} - L_{k,t}$, which is the illiquidity difference between $CEF_{k,t}$ portfolio and $CEF_{k,t}$,

$MD_{k,t}$ = Managed distribution dummy for $CEF_{k,t}$,

$PL_{k,,t}$ = portfolio liquidity of CEF k for month t.

Note that when $\Delta L_{k,t} < 0$ the CEF is more illiquid than the underlying portfolio and when $\delta_1 > 0$ the CEF discount is larger (CEF market price is lower relative to NAV) as the CEF is more illiquid relative to its portfolio.

The relationship between the CEF discount and the CEF portfolio liquidity is examined using one-way fixed effects panel regression in the following regression equation:

$$d_{k,t} = \alpha_k + \varphi_1 PL_{k,t} + \varphi_2 MD_{k,t} + \varphi_3 d_{k,t-1} + \varphi_4 d_{k,t-2} + \varphi_5 d_{k,t-3} + \varphi_6 d_{k,t-4} + u_{k,t}\,. \quad (7)$$

The managed distribution dummy is included to control for agency costs. Autocorrelations are generally high for the discount so lags are included to control for autocorrelation. The lag lengths are determined by successively including fewer lags until the last lag is not significant.

A significantly positive estimate for δ_1 indicates that the CEF discount is larger (CEF market price decreases relative to NAV) as the CEF becomes more illiquid relative to the CEF portfolio. A significantly positive estimate for φ_1 indicates smaller discounts (CEF market price increases relative to the NAV) as the CEF portfolio becomes more illiquid, consistent with organizational structure costs dominating agency costs. On the other hand, a significantly negative estimate for φ_1 indicates a larger discount (CEF market price decreases relative to the NAV) as the CEF portfolio becomes more illiquid, which is consistent with increased portfolio liquidity allowing the manager to implement performance strategies, which implies that agency costs dominate organizational structure costs. A significantly positive estimate for δ_2 and φ_2 will indicate that the CEF market price decreases relative to NAV when there is no managed distribution plan, consistent with the presence of higher agency costs.

Next, the spread is used as a proxy for liquidity as a robustness check to the Amihud (2002) illiquidity results. Using the TAQ database, intraday quoted spreads are obtained for each CEF and CEF portfolio stock for each day of each month that ends with a N-CFR filing. The quoted spreads are transformed to relative spreads and then averaged to obtain a monthly average relative spread for each stock and CEF. For each portfolio the relative spreads of each stock are weighted by portfolio weights and then the weighted relative spreads are summed to obtain the portfolio relative spread. As was the case with the Amihud (2002) illiquidity data, the portfolio spreads and CEF spreads are arranged in an unbalanced panel data set to be used in a panel regression. The third hypothesis is as follows:

Hypothesis 3: The CEF market price decreases relative to the NAV as the CEF relative spread increases relative to the weighted relative spread of the underlying portfolio.

The mean monthly quoted spread is computed for each CEF k and stock i:

$$S_{k,t} = \frac{1}{Q}\sum_{q=1}^{Q}(A_{k,q,t} - B_{k,q,t}) / M_{k,q,t}\text{, and}$$

$$S_{i,t} = \frac{1}{Q}\sum_{q=1}^{Q}(A_{i,q,t} - B_{i,q,t}) / M_{i,q,t}\text{,}$$

where

Q = number of quotes in the month,

$A_{k,q,,t}$ ($A_{i,,q,,t}$) = quoted ask price for quote q of CEF k (security i) for month t ,

$B_{k,q,,t}$ ($B_{i,q,,t}$) = quoted bid price for quote q of CEF k (security i) for month t.

The CEF weighted portfolio spread is computed as follows:

$$PS_{k,t} = \sum_{i=1}^{I} S_{i,t}^{k} (PV_{i,t}^{k} / PV_{k,t}), \qquad (8)$$

where

$PS_{k,,t}$ = portfolio spread of CEF k for month t,

$PV^{k}_{i,,t}$ = portfolio value for security i of CEF k for month t,

$PV_{k,t}$ = sum of all security portfolio values for CEF k in month t.

Using one-way fixed effects panel regression, the relationship between the CEF discount and the CEF/portfolio spread differential will then be examined. The CEF discount is regressed

$$d_{k,t} = \alpha_k + \delta_1 \Delta S_{k,t} + \delta_2 MD_{k,t} + \delta_3 d_{k,t-1} + \delta_4 d_{k,t-2} + \delta_5 d_{k,t-3} + \delta_6 d_{k,t-4} + u_{k,t}, \qquad (9)$$

where $\Delta S_{k,t} = PS_{k,t} - S_{k,t}$, the spread difference between $CEF_{k,t}$ portfolio and $CEF_{k,t}$.
As before, lags of the dependent variable are included because of autocorrelation in the CEF discounts. The managed distribution dummy is included once again to control for the effects of agency costs.

A significantly positive estimate for δ_1 indicates that the CEF discount is smaller (CEF market price increases relative to NAV) as the CEF spread becomes smaller relative to the CEF portfolio spread. A significantly positive estimate for δ_2 will indicate that the CEF discount is larger (CEF market price decreases relative to NAV) when there is no managed distribution plan, consistent with the presence of higher agency costs.

The estimation of the above relationships combines time series and cross sectional data. The data consists of multiple cross sections of CEFs and a time series of CEF illiquidity, spread, and discount data covering the period 1/1/95 through 12/31/03. According to Judge, Griffiths, Hill, Lutkepohl, Lee (1985), the model used to estimate these relationships must adequately allow for differences in behavior across cross sectional units as well as differences in behavior over time for a given cross sectional unit. Additionally, the estimation procedure must be chosen and the method selected for testing the hypothesis about the parameters.

In general the panel data model can be written:

$$y_{i,t} = \sum_{k=1}^{K} X_{i,t,k}\beta_k + u_{i,t}, i = 1,\ldots,N; t = 1,\ldots,T$$

Where:

N is the number of cross sections

T is the length of the time series for each cross section

K is the number of independent variables.

Since the model does not explicitly specify all the explanatory variables that affect the dependant variable, the unobservable variables are summarized in the error term. A primary motivation for using panel data is to solve the omitted variables problem. This paper will use a model that contains a time constant unobserved effect, where the model assumes that the specification is dependant on the cross section to which the observation belongs. The unobserved effects are treated as random variables drawn from the population along with the observed explained and explanatory variables.

The model can be specified as a fixed effects or random effects model. The fixed effects model assumes that the error term is correlated with the independent variable, where the random effects model assumes that the error and the independent variable are not correlated. Since it is probable that the error (which includes the cross-sectional effect) and the independent variable are correlated, and the specification is dependent on the cross section, this paper will use the one way fixed effects specification, which has the form:

$u_{i,t} = v_i + \varepsilon_{i,t}$, where the v_i's are non-random.

3.2 Liquidity Risk

In this section we examine the market liquidity risk premium difference between CEFs and their underlying portfolios by studying the cross-section of all CEF and NAV returns in the Thomson Investment View database with a 10-year history.[17] Acharya and Pedersen (2004) identify a positive market liquidity premium, when they adopt Amihud's (2002) market liquidity measure. We will also use the Amihud (2001) market liquidity measure to examine if an illiquidity premium exists in a CEF relative to its NAV. Rather than measuring security illiquidity innovations directly such as Acharya and Pedersen (2004) and Pastor and Stambaugh (2004), we will create an illiquidity risk factor from zero-cost liquidity sorted decile portfolios, similar to the Wang (2004) illiquid minus liquid (*IML*) factor that is constructed from institutional order flow.

The *IML* risk factor is constructed using daily CRSP return data from the pre-sample period 10/1/96 – 9/30/01. The Amihud (2002) illiquidity measure (unadjusted) is computed each day for each stock that has volume in the CRSP index. This measure is averaged over each month for each stock during the pre-sample period to arrive at a monthly average illiquidity measure for each stock. Acharya and Pedersen (2004) shows that innovations in illiquidity are needed to compute liquidity betas and that illiquidity is persistent with an autocorrelation coefficient of .87 at the monthly frequency. Therefore we will focus on illiquidity innovation risk of the CEFs and their portfolios. Innovations are defined as the residual from an AR(2) specification of the Amihud (2002) illiquidity measure. Acharya and Pedersen (2004) and Pastor and Stambaugh (2003) use a similar AR(2) specification to compute liquidity innovations.

For each month t an Amihud illiquidity AR(2) model is estimated for each stock to obtain the residual. Stocks are then ranked by the average of the 12 residual lags and sorted into

[17] A ten year history is necessary to obtain a long enough times series to estimate liquidity loadings. There are 358 CEFs in this sample.

illiquidity-risk decile portfolios. 12 months of residual lags are used to control for the possible effects of seasonality.[18] The IML factor is the equal weighted average return[19] of portfolio 10 (high liquidity risk) minus the equal weighted average return of portfolio 1 (low liquidity risk). Table 6 shows the *IML* factors and their summary statistics.

Once the monthly *IML* factors are computed, the following time series regressions are estimated for the period 10/1/96 – 9/30/01 to obtain the factor loadings on the Fama-French 3 factors[20] and the *IML* factor:

$$R_{k,t} - R_{rf,t} = \alpha + \beta_k^m R_{m,t}^e + \beta_{k,t}^{HML} R_{HML}^e + \beta_{k,t}^{SMB} R_{SMB}^e + \beta_{k,t}^{IML} R_{IML}^e + u_{k,t} \ ,$$

$$R_{k,t}^{NAV} - R_{rf,t}^{NAV} = \alpha + \beta_{k,NAV}^m R_{m,t}^e + \beta_{k,NAV}^{HML} R_{HML,t}^e + \beta_{k,NAV}^{SMB} R_{SMB,t}^e + \beta_{k,NAV}^{IML} R_{IML,t}^e + u_{k,t} \ ,$$

where,

$R_{k,t}$ ($R_{k,t}^{NAV}$) = return for month *t* for CEF *k* (NAV of CEF *k*),

$R_{rf,t}$ ($R_{rf,t}^{NAV}$) = risk free rate for month *t* (NAV of CEF *k*),

$R_{m,t}^e$ = is the excess return on the market. It is calculated as the value-weight return on all NYSE, AMEX, and NASDAQ stocks (from CRSP) minus the one-month Treasury bill rate (from Ibbotson Associates),

R_{HML}^e = HML (High Minus Low) is the average return on the two value portfolios minus the average return on the two growth portfolios, includes all NYSE, AMEX, and NASDAQ stocks for which market equity data for December of t-1 and June of t, and (positive) book equity data for t-1, exist,

[18] Eleswarapu and Reinganum (1993) find evidence of seasonality in spreads.
[19] Amihud (2002) and Chordia, Roll, Subrahmanyam (2000) suggest equal weighted measures as a way of compensating for the overrepresentation of large liquid securities and the omission of illiquid assets such as certain bonds, real estate, and small OTC stocks in stock indexes relative to the "true" market portfolio.
[20] Fama-French factors and risk free rates obtained from WRDS database

R^e_{SMB} = SMB (Small Minus Big) is the average return on the three small portfolios minus the average return on the three big portfolios, includes all NYSE, AMEX, and NASDAQ stocks for which market equity data for December of t-1 and June of t, and (positive) book equity data for t-1, exists,

R^e_{IML} = equal weighted average return of illiquid minus liquid portfolios, includes all NYSE, AMEX, and NASDAQ stocks for which price and volume data exists.

Once the factor loadings are estimated, the 3-year average discount, manager alpha, and 12-month yield for each CEF is computed for the 3-year post sample period (10/1/01-9/30/04). The 3-year average discount is then used as the dependant variable in a cross sectional regression to test the following hypothesis:

Hypothesis 4: The CEF discount decreases (CEF price decreases relative to NAV) as the CEF liquidity loading increases relative to the NAV liquidity loading.

To see why this should hold, consider an APT return model where CEF and NAV returns are determined by Fama-French 3 factors and liquidity:

$$r_{cef,i} = \alpha + r_f + \beta^{m}_{cef,i} F_m + \beta^{size}_{cef,i} F_{size} + \beta^{btm}_{cef,i} F_{btm} + \beta^{liq}_{cef,i} F_{liq} + \varepsilon_{cef,i} \,,$$

$$r_{nav,i} = \alpha + r_f + \beta^{m}_{nav,i} F_m + \beta^{size}_{nav,i} F_{size} + \beta^{btm}_{nav,i} F_{btm} + \beta^{liq}_{nav,i} F_{liq} + \varepsilon_{nav,i} \,,$$

Where:

$r_{cef,i}$ ($r_{nav,i}$) = return on CEF *i* (NAV *i*),

r_f = risk free rate,

F_f = risk factor *f*, where *f* = market, size, book-to-market, or liquidity,

$\beta^{f}_{cef,i}$ ($\beta^{f}_{nav,i}$)= loading on risk factor *f* for CEF *i* (NAV *i*),

Taking expectations of both sides:

$$E(r_{cef,i} - r_f) = \gamma_m \beta^{m}_{cef,i} + \gamma_{size}\beta^{size}_{cef,i} + \gamma_{btm}\beta^{btm}_{cef,i} + \gamma_{liq}\beta^{liq}_{cef,i} + \varepsilon_{cef,i},$$

$$E(r_{nav,i} - r_f) = \gamma_m \beta^{m}_{nav,i} + \gamma_{size}\beta^{size}_{nav,i} + \gamma_{btm}\beta^{btm}_{nav,i} + \gamma_{liq}\beta^{liq}_{nav,i} + \varepsilon_{nav,i},$$

Where γ_f = risk premium for factor *f*.

Solving for the CEF discount *d* where $d_t^{cef,i} = (P_t^{cef,i} - P_t^{nav,i}) / P_t^{nav,i}$:

$$E[(P_{t+1}^{cef,i} - P_t^{cef,i}) / P_t^{cef,i})] = r_f + \gamma_m \beta^{m}_{cef,i} + \gamma_{size}\beta^{size}_{cef,i} + \gamma_{btm}\beta^{btm}_{cef,i} + \gamma_{liq}\beta^{liq}_{cef,i} + \varepsilon_{cef,i},$$

$$E[(P_{t+1}^{nav,i} - P_t^{nav,i}) / P_t^{nav,i})] = r_f + \gamma_m \beta^{m}_{nav,i} + \gamma_{size}\beta^{size}_{nav,i} + \gamma_{btm}\beta^{btm}_{nav,i} + \gamma_{liq}\beta^{liq}_{nav,i} + \varepsilon_{nav,i},$$

$$P_t^{cef,i} = E(P_{t+1}^{cef,i}) / 1 + r_f + \gamma_m \beta^{m}_{cef,i} + \gamma_{size}\beta^{size}_{cef,i} + \gamma_{btm}\beta^{btm}_{cef,i} + \gamma_{liq}\beta^{liq}_{cef,i} + \varepsilon_{cef,i},$$

$$P_t^{nav,i} = E(P_{t+1}^{nav,i}) / 1 + r_f + \gamma_m \beta^{m}_{nav,i} + \gamma_{size}\beta^{size}_{nav,i} + \gamma_{btm}\beta^{btm}_{nav,i} + \gamma_{liq}\beta^{liq}_{nav,i} + \varepsilon_{nav,i}.$$

Assuming that $E(P_{t+1}^{cef,i})$ and $E(P_{t+1}^{nav,i})$ converge in the future, then:

$$\frac{(P_t^{cef,i} - P_t^{nav,i})}{P_t^{nav,i}} = d_t^{cef,i} = \left(\frac{E(P_{t+1}^{i})}{P_t^{nav,i}}\right)[\omega_{cef,i} - \omega_{nav,i}],$$

$$d_t^{cef,i} = [E(r_{nav,i})](\omega^{dif}_{cef,i}), \tag{10}$$

where,

$$\omega_{cef,i} = (1 + r_f + \gamma_m \beta^{m}_{cef,i} + \gamma_{size}\beta^{size}_{cef,i} + \gamma_{btm}\beta^{btm}_{cef,i} + \gamma_{liq}\beta^{liq}_{cef,i} + \varepsilon_{cef,i})^{-1},$$

$$\omega_{nav,i} = (1 + r_f + \gamma_m \beta^{m}_{nav,i} + \gamma_{size}\beta^{size}_{nav,i} + \gamma_{btm}\beta^{btm}_{nav,i} + \gamma_{liq}\beta^{liq}_{nav,i} + \varepsilon_{nav,i})^{-1}.$$

Therefore the CEF discount consists of two terms: a performance term and a difference in risk discount term. The effect of liquidity risk (or any risk factor) is related to the relative change of CEF liquidity risk and NAV liquidity risk: as $\beta^{liq,dif}_{cef,i} = \beta^{liq}_{cef,i} - \beta^{liq}_{nav,i}$ increases, the risk discount difference $\omega_{cef,i} - \omega_{nav,i}$ decreases, which leads to a decrease in $d_t^{cef,i}$ (CEF market price decreases relative to NAV).

In addition to traditional risk factors affecting the CEF discount, equation 10 also indicates that the CEF discount increases (CEF market price increases relative to NAV) with manager performance. While at any time *t* the NAV of the CEF consists of a portfolio of stocks that are priced in the market, also priced at time *t* is the value that the manager adds or subtracts to the CEF, through either performance or lack thereof. Chay and Trzcinka (1999) shows that risk adjusted expected performance of the CEF NAV is related to CEF discounts. For our study, the manager alpha[21] for the period 10/1/01-9/30/04 is used as an estimate of the value the manager adds to the CEF. Finally, Pontiff (1996) and Lee and Moore (2004) show a negative relationship between yield and CEF discount. Consistent with the Jensen (1986) free cash flow hypothesis, the yield may be a manager signal of low agency costs and thus more manager value (or a least less of a manager discount).[22] The manager alpha and yield are therefore indicators of the value of the performance term in equation 10. Higher alphas and yields are indicate higher expected returns and lower expected agency costs. Therefore, the cross-sectional regression to be estimated at 9/30/01 is as follows:

$$d_k^{3Yr} = \alpha + \delta_1 \beta_k^{m,dif} + \delta_2 \beta_k^{hml,dif} + \delta_3 \beta_k^{smb,dif} + \delta_4 \beta_k^{iml,dif} + \delta_5 \alpha lpha_k + \delta_6 Y_k^{12mo} + u \qquad (11)$$

where,

d_k^{3Yr} = 3 year average discount of CEF *k*

$\beta_k^{m,dif}$ = difference between CEF *k* and NAV *k* Fama-French market factor loading

$\beta_k^{hml,dif}$ = difference between CEF *k* and NAV *k* Fama-French HML factor loading

[21] Alpha is the intercept from a CAPM regression of the CEF NAV excess return on the S&P 500 excess return.

[22] There is also a dividend-signaling hypothesis that suggests managers with private information will signal this private information using dividends. Under this hypothesis, CEF managers with information about performance would signal high performance with high dividends. See Allen and Michaely (2002).

$\beta_k^{smb,dif}$ = difference between CEF k and NAV k Fama-French SMB factor loading

$\beta_k^{iml,dif}$ = difference between CEF k and NAV k IML factor loading

$\alpha lpha_k$ = CEF manager alpha for 3 year period 10/1/01-9/30/04

Y_k^{12mo} =12 month yield on CEF k's NAV

4. Results

Results from Panel Regressions of Discount on Liquidity and Spread

Table 4 shows the results from the estimation of equation (6), Table 5 shows the results from the estimation of equation (7), and Table 6 shows the results from the estimation of equation (9). The coefficient δ_1 of the transformed Amihud illiquidity measure difference is positive and significant in equation (6) but not significant in equation (9) (coefficient of the spread difference). This indicates that the value of the CEF discount is increases as the CEF fund becomes more liquid relative to the CEF portfolio, when using Amihud's liquidity measure as the base measure of liquidity. The coefficient φ_1 of the transformed CEF portfolio Amihud illiquidity measure variable from equation (7) is negative and significant. This indicates that the CEF discount decreases (CEF market price declines relative to the NAV price) as the CEF portfolio becomes more illiquid. This result is consistent with the performance hypothesis where the manager can use liquidity to increase performance through selection and timing.

Although the results indicate no relationship between spread and discount, there are significant results using the Amihud illiquidity measure. The results using the Amihud illiquidity measure are consistent with the findings of Amihud and Mendelson (1986), Eleswarapu (1997), Chalmers, Kadlec (1998), and Brennan, Subrahmanyam (1996) where price is lower for more illiquid securities. The coefficient δ_2 is positive and significant in both panel regressions indicating that the CEF discount becomes larger (market price lower than NAV) when there is no managed distribution plan.

The managed distribution result is consistent with the results of Johnson, Lin, and Song (2004) where they show that CEFs with a managed distribution plan have higher risk adjusted returns and lower discounts. Investors' expectations are for CEFs to attract bad managers since good managers will form OEFs where good performance attracts more inflows, which increases the manager's compensation. The managed distribution plan acts as a credible signal[23] that the manager is good since bad performance will result in the managed distribution returning capital and depleting the assets of the CEF, which lowers the compensation of the manager. It takes time for the managed distribution plan to erase the discount, possibly reflecting a period of credibility establishment for the manager. It would be interesting to see what would happen if a manager canceled the managed distribution plan. If the plan is a credible signal, then cancellation should result in an immediate discount since the credibility of the manager is reduced.

This in fact has recently happened in the Zweig Fund (ZF). In July 2003, the ZF board cancelled the managed distribution plan and adopted a variable distribution policy in an effort to reduce the potential for certain taxes on distributions to shareholders. ZF discount increased from -.54% at the end of 6/03 to -9.65% at the end of 7/03 to -13.47% at the end of 8/03 and stayed between 11.61% and 15.85% until 7/04 (-14.92%). The ZF board then announced on 8/11/04 that it would reinstate its managed distribution plan of 2.5% per quarter beginning 9/30/04. From June 1987 until July 2003, the fund had a 10% managed distribution policy and during the period of the managed distribution, the Zweig Fund averaged a premium of 2.71%. After the announcement eliminating the managed distribution plan, the fund averaged a discount

[23] See Allen and Michaely (2002) and Johnson, Lin, and Song (2004).

of -13.72%. As of 9/29/04 the discount is -7.81%. While this is only one fund, the pattern is consistent with the market interpreting the managed distribution plan as a management commitment to achieving high performance through applied managed skill (lower agency costs). The manager must perform better than the distribution amount in order not to deplete assets. If the CEF cancels the plan, credibility is lost and the CEF will return to discount status. It is also interesting that investors will typically reinvest their money back into the fund through managed distribution automatic reinvestment plans. Just having the option to keep the cash coupled with the credible signal of the manager seems to be enough to increase the market price of the CEF relative to the NAV. This is not consistent with the behavioral explanation of investors blindly buying yield and bidding up CEFs with higher yields. The ZF CEF continued to have a high yield after the managed distribution plan was cancelled and market price still dropped to a large discount.

It is somewhat troublesome, but explainable, that the spread coefficient was not significant in the panel regression. Chalmers and Kadlec (1998) point out that an individual's required return on a stock will equal his required return in the absence of a bid-ask spread, plus the percentage bid-ask spread amortized over the individual's expected holding period, or the amortized spread. They point out that is important to take into account the length of the holding period that spreads are amortized when examining the relationship between asset prices and liquidity. If stocks with similar spreads trade with different frequencies, the magnitude of the effective spread is not a sufficient proxy for liquidity. Therefore the longer the holding period for CEFs relative to the underlying portfolios, the less likely raw spreads are a priced factor. This is a testable hypothesis since data is available to estimate holding periods for stocks and CEFs. Chen and Kan (1996) and Brennan and Subrahmanyam (1996) find an insignificant relation between spreads and returns while Eleswarapu and Reinganum (1993) find that the relation between stock returns and bid/ask spreads is significant only in the month of January. Furthermore, if holding periods are longer for CEFs, then the Chalmers and Kadlec amortized effective spread measure should be used in the CEF spread/discount analysis in a future study. Finally, as Silber (1975) points out, raw spread measures do not account for depth or thinness. Silber argues that price variability, not spread, is a better indicator of liquidity. Therefore the Amihud illiquidity measure contains additional liquidity information that the spread does not and the absence of this information could corrupt the accuracy of the spread/discount panel regression.

<u>Results from Liquidity Risk Analysis</u>

Table 8 shows the results from the estimation of equation (10). Table 9 shows a breakdown of the discount, yield, and alpha by whether the CEF is stock or bond. Table 10 shows the pairwise correlations between the regressor variables from equation (10). Stock CEFs tend to have higher alphas, lower yields, and larger discounts. Pairwise correlation indicates that there is not much collinearity between the regressor variables.

The differences in liquidity risk and market risk between the CEF and NAV as well as manager alpha, and yield are all significant at the 95% confidence level. The liquidity risk difference coefficient is negative and significant, which means as the CEF loading on the IML factor increases relative to the NAV IML loading, the discount decreases (CEF price decreases relative to NAV and discount becomes more negative). The market risk difference coefficient is also negative and significant, which means as the CEF loading on the market factor increases relative to the NAV loading, the discount decreases (CEF price decreases relative to NAV). The coefficients on the Fama-French SMB and HML differences are not significant, which is not consistent with the small stock effect noted in Lee, Shleifer, and Thaler (1991). The coefficient of the manager alpha is positive and significant, indicating that as manager excess performance increases the CEF market price increases relative to the NAV. Finally, the coefficient of yield is significant and positive, indicating that as the yield increases, the CEF market price increases relative to the NAV.

The IML difference coefficient value is consistent with Archarya and Pedersen (2004) and Pastor and Stambaugh (2003) where liquidity is a priced risk factor for security returns. What is unique in this case is that the CEF and the CEF-NAV consist of the same bundle of assets yet they trade separately with separate ownership structures and risks. The manager alpha significance offers some insight on an additional factor that exists in the CEF over and above the NAV bundle: the manager's future security selection and timing. A common mistake is to view the NAV and the CEF market price difference as a violation of the law of one price. This type of analysis fails to take into to account that the NAV represents only a static value of a bundle of assets at a point in time while the CEF market price represents the value of those assets, the value of the microstructure differences between the CEF and the NAV, and the value of the expected added value of the manager. Chay and Trzcinka (1999) shows that risk adjusted expected performance of the CEF NAV is related to CEF discounts, but only for stock CEFs. Our results indicate that risk adjusted expected performance is significant for all CEFs when additionally controlling for liquidity risk and yield.

4. Summary and Conclusions

We have presented empirical evidence to support the following conclusions:

- Liquidity, liquidity risk, manager performance, and agency costs help explain in part why a CEF trades at a different price than its NAV

- Established a relationship between firm's asset and market price liquidity and liquidity risk differences and firm's market price through CEF laboratory
- Established that there are rational factors in CEF/NAV pricing difference
- Established an empirical link with CEF theoretical existence liquidity literature

Evidence has been presented that the CEF puzzle can be partially viewed as the result of ownership structure difference induced risk differences, managerial performance expectations, and agency costs. A CEF and its portfolio are not identical assets with respect to composition or microstructure and therefore the CEF market price is not just the sum of the weighted portfolio asset prices. Agency costs and liquidity differences create a unique CEF asset that is related to its asset bundle, but not identical.

Table 1: Simple Statistics for CEF and ETF Discounts

As of 9/30/04 Type Fund	3-Year Avg Discount	Standard Deviation	Mean % Expense Ratio
All CEF	-2.994%	8.107%	1.132%
All ETF	0.049%	0.163%	0.428%
CEF Categories:			
Corporate - High Yield	9.060%	1.646%	
Corporate - Investment Grade	-4.783%	0.980%	
Emerging Market Equity	-9.867%	1.677%	
Emerging Market Income	1.247%	1.773%	
Equity Income	-0.795%	1.259%	
General Bd - Investment Grade	-5.506%	1.191%	
General Mortgage	0.535%	1.449%	
Global Equity	-12.328%	1.797%	
Global Income	-0.748%	1.325%	
Government Bond	-2.005%	1.247%	
Growth - Domestic	-7.444%	1.691%	
Growth & Income	-0.461%	1.292%	
Loan Participation	-0.632%	1.500%	
Multi-Sector Bond	-5.009%	1.043%	
Municipal	-3.355%	1.169%	
Non-US Equity	-10.600%	1.689%	
Sector	1.668%	1.273%	

Table 2: Sample CEF 9/30/04 Asset Allocation

Fund Name	Symbol	% Stock	% Bond	% Prefer	% Convert	% Cash
Adams Express Company	ADX	92.1	0	0	0	7.9
Alliance All-Market Advantage Fd	AMO	96.1	0	0	0	3.9
Liberty All-Star Growth Fund	ASG	98.6	0	0	0	0
Blue Chip Value Fund	BLU	99.9	0	0	0	0.1
Boulder Total Return Fund	BTF	93.3	0	0	0	6.7
Central Securities	CET	88.8	0	0	0	11.2
Cornerstone Strategic Value Fund	CLM	96.3	0	0	0	3.7
Cornerstone Total Return Fund[24]	CRF	98.4	0	0	0	1.6
Engex	EGX	100	0	0	0	0
Royce Focus Trust	FUND	75.9	0	0	0	24.1
First Trust Value Line Dividend[25]	FVD	100	0	0	0	0
First Trust Value Line 100 Fund[26]	FVL	100	0	0	0	0
Gabelli Equity Trust	GAB	89.1	0.2	2	0	6.3
General American Investors	GAM	88.1	0	0	0.9	11
NAIC Growth Fund	GRF	81.8	0	0	0	19.2
Royce Micro-Cap Trust	RMT	84.8	0	0	0	15.2
Royce Value Trust	RVT	82.7	0	0	0	17.3
Salomon Brothers Fund	SBF	99.4	0	0	0	0.6
Tri-Continental Corporation	TY	100	0	0	0	0
Liberty All-Star Equity Fund	USA	98.6	0	0	0.1	0
S&P Protected Equity	PEFX	98.1	0	0	0	1.9
Progressive Fund	PGF	99.52	0	0	0	0.48

[24] Dropped from panel data set because of too short a history
[25] Dropped from panel data set because of too short a history
[26] Dropped from panel data set because of too short a history

Table 3: Sample CEFs Mean Discount, Spread, and Liquidity

Fund	FREQ	Mean Discount	Mean ΔS	Mean ΔL	MD_k
ADX	32	-14.76%	-0.006	0.047	0
AMO	17	-2.58%	0.006	0.312	1
ASG	26	-9.42%	-0.013	-0.004	1
BLU	18	0.65%	-0.014	-0.006	1
BTF	7	-13.28%	-0.028	-0.008	0
CET	17	-9.54%	-0.009	0.156	0
CLM	10	-3.83%	-0.032	-1.541	1
CRF	3	7.84%	-0.019	-0.173	1
EGX	8	-2.10%	-0.069	-13.380	0
FUND	15	-14.30%	-0.007	-0.546	0
FVD	1	-5.85%	-0.041	0.000	0
FVL	2	5.40%	-0.015	-1.238	0
GAB	34	4.22%	0.004	0.168	1
GAM	33	-10.08%	-0.003	0.077	0
GRF	10	-4.03%	N/A	-12.469	0
PEFX	8	-8.21%	0.019	-1.019	0
PGF	6	0.90%	-0.031	-1.699	1
RMT	18	-12.02%	0.014	0.394	1
RVT	18	-9.60%	0.008	0.263	1
SBF	17	-8.54%	-0.010	0.064	0
TY	35	-15.90%	-0.007	0.059	0
USA	28	-4.52%	-0.005	0.014	1
Total		-5.89%	-0.012	-1.388	

	CEFs with no MD	CEFs with MD
FREQ	234	129
Mean Disc	-0.111	-0.012
Mean ΔS	0.008	0.006
Mean ΔL	-1.092	0.003
Mean Port Liq	0.355	0.336
Mean Fund Liq	1.447	0.333
Mean Port Spd	0.016	0.016
Mean Fund Spd	0.024	0.022

Mean Discount=average discount for CEF over entire sample period, or history of CEF, whichever is less.
Mean ΔL=average Amihud illiquidity difference for CEF over entire sample period, or history of CEF, whichever is less.
Mean ΔS=average relative spread difference for CEF over entire sample period, or history of CEF, whichever is less.
MD_k=managed distribution dummy. 1=CEF has managed distribution plan, 0=CEF does not have plan.
FREQ=# of time series observations

Table 4: Panel Regression of CEF Discount on Liquidity Difference

This table presents regression results of the CEF discount on CEF/portfolio liquidity difference, managed distribution dummy, and lagged discounts:

$$d_{k,t} = \alpha_k + \delta_1 \Delta L_{k,t} + \delta_2 MD_{k,t} + \delta_3 d_{k,t-1} + \delta_4 d_{k,t-2} + \delta_5 d_{k,t-3} + \delta_6 d_{k,t-4} + u_{k,t}$$

$\boldsymbol{d_{k,t}}$ = % discount on CEF k at time t,
$\boldsymbol{\Delta L_{k,t}}$ = $PL_{k,t}$-$L_{k,t}$, which is the liquidity difference between $CEF_{k,t}$ portfolio and $CEF_{k,t}$
$\boldsymbol{MD_{k,t}}$ = Managed distribution dummy for $CEF_{k,t}$
Period of estimation: 1/1/95 through 12/31/03

Estimation Method	Fixed Effects	
Number of Cross Sections	19	
Time Series Length	35	
R-Square	0.77	
F Test for No Fixed Effects	F Value	Pr > F
	4.70	<.0001

Parameter Estimates

Variable	Estimate	Standard Error	t Value	Pr > |t|
$d_{k,t-1}$	0.545	0.070	7.810	<.0001
$d_{k,t-2}$	-0.038	0.082	-0.460	0.643
$d_{k,t-3}$	0.018	0.080	0.230	0.820
$d_{k,t-4}$	0.108	0.070	1.540	0.125
$\Delta L_{k,t}$	0.029	0.005	5.470	<.0001
$MD_{k,t}$	0.047	0.019	2.540	0.012

Table 5: Panel Regression of CEF Discount on Portfolio Liquidity

This table presents regression results of the CEF discount on CEF portfolio liquidity, managed distribution dummy, and lagged discounts:

$$d_{k,t} = \alpha_k + \varphi_1 PL_{k,t} + \varphi_2 MD_{k,t} + \varphi_3 d_{k,t-1} + \varphi_4 d_{k,t-2} + \varphi_5 d_{k,t-3} + \varphi_6 d_{k,t-4} + u_{k,t}$$

$d_{k,t}$ = % discount on CEF *k* at time *t*
$PL_{k,,t}$ = portfolio liquidity of CEF *k* for month *t*
$MD_{k,t}$ = Managed distribution dummy for $CEF_{k,t}$
Period of estimation: 1/1/95 through 12/31/03

Estimation Method	Fixed Effects	
Number of Cross Sections	19	
Time Series Length	35	
R-Square	0.75	
F Test for No Fixed Effects	F Value	Pr > F
	3.14	<.0001

Parameter Estimates

Variable	Estimate	Standard Error	t Value	Pr > |t|
$d_{k,t-1}$	0.528	0.073	7.210	<.0001
$d_{k,t-2}$	0.014	0.085	0.170	0.869
$d_{k,t-3}$	-0.060	0.083	-0.730	0.465
$d_{k,t-4}$	0.148	0.074	2.000	0.047
$PL_{k,t}$	-0.079	0.037	-2.120	0.035
$MD_{k,t}$	0.051	0.020	2.630	0.009

Table 6: Panel Regression of CEF Discount on Spread Difference

This table presents regression results of the CEF discount on CEF/portfolio spread difference, managed distribution dummy, and lagged discounts:

$$d_{k,t} = \alpha_k + \delta_1 \Delta S_{k,t} + \delta_2 MD_{k,t} + \delta_3 d_{k,t-1} + \delta_4 d_{k,t-2} + \delta_5 d_{k,t-3} + \delta_6 d_{k,t-4} + u_{k,t}$$

$\boldsymbol{d_{k,t}}$ = % discount on CEF k at time t,
$\boldsymbol{\Delta S_{k,t}}$ = $PS_{k,t}$-$S_{k,t}$, which is the spread difference between $CEF_{k,t}$ portfolio and $CEF_{k,t}$
$\boldsymbol{MD_{k,t}}$ = Managed distribution dummy for $CEF_{k,t}$
Period of estimation: 1/1/95 through 12/31/03

Estimation Method	Fixed Effects	
Number of Cross Sections	18	
Time Series Length	35	
R-Square	0.7585	
F Test for No Fixed Effects	F Value	Pr > F
	3.02	<.0001

Parameter Estimates

Variable	Estimate	Standard Error	t Value	Pr > |t|
$d_{k,t-1}$	0.502	0.075	6.700	<.0001
$d_{k,t-2}$	0.056	0.086	0.650	0.517
$d_{k,t-3}$	-0.070	0.084	-0.840	0.403
$d_{k,t-4}$	0.183	0.073	2.510	0.013
$\Delta S_{k,t}$	0.240	0.200	1.200	0.232
$MD_{k,t}$	0.052	0.020	2.680	0.008

Table 7: IML Portfolio Factors

IML=return on decile portfolio that has high illiquidity risk minus return on decile portfolio that has low illiquidity risk. Illiquidity risk is calculated by averaging the residuals from a monthly Amihud illiquidity AR(2) autoregression for the lagged 12 months for each stock in the CRSP index. High valued residuals represent high illiquidity risk.

Month	IML	Cumulative Ret of $1
Oct-96	0.093078	1.093078
Nov-96	0.054133	1.152249
Dec-96	0.071035	1.234099
Jan-97	0.020434	1.259316
Feb-97	0.065842	1.342232
Mar-97	0.055703	1.416999
Apr-97	0.066605	1.511378
May-97	0.071762	1.619838
Jun-97	0.055966	1.710493
Jul-97	0.106998	1.893512
Aug-97	0.059965	2.007057
Sep-97	0.070397	2.148347
Oct-97	0.087269	2.335832
Nov-97	0.041033	2.431678
Dec-97	0.072661	2.608366
Jan-98	0.049435	2.73731
Feb-98	0.059559	2.900341
Mar-98	0.073511	3.113548
Apr-98	0.069161	3.328884
May-98	0.065676	3.547513
Jun-98	0.068939	3.792076
Jul-98	0.073624	4.071264
Aug-98	0.027692	4.184008
Sep-98	0.079222	4.515475
Oct-98	0.064142	4.805106
Nov-98	0.107069	5.319583
Dec-98	0.078901	5.739301
Jan-99	0.155665	6.63271
Feb-99	0.039674	6.895854
Mar-99	0.043201	7.193761
Apr-99	0.091655	7.853108
May-99	0.049029	8.238137
Jun-99	0.030372	8.488347
Jul-99	0.048961	8.903948
Aug-99	0.042641	9.283624

Sep-99	0.028795	9.550943
Oct-99	0.028295	9.821191
Nov-99	0.057141	10.38238
Dec-99	0.054914	10.95252
Jan-00	0.086721	11.90233
Feb-00	0.061868	12.6387
Mar-00	0.034326	13.07254
Apr-00	0.109918	14.50944
May-00	0.07775	15.63756
Jun-00	0.022771	15.99364
Jul-00	0.062653	16.99568
Aug-00	0.019083	17.32001
Sep-00	0.067345	18.48642
Oct-00	0.079393	19.95411
Nov-00	0.139978	22.74724
Dec-00	0.091414	24.82666
Jan-01	-0.09246	22.53114
Feb-01	0.091198	24.58593
Mar-01	0.076488	26.46647
Apr-01	0.004174	26.57695
May-01	0.066578	28.3464
Jun-01	0.04354	29.58062
Jul-01	0.070568	31.66806
Aug-01	0.063491	33.67869
Sep-01	0.015919	34.21482
Avg Monthly Return	6.12%	
Avg Annual Return	102.69%	

Table 8: Cross-Sectional Regression of Discount on Risk Factor Differences and Performance Proxies

This table presents the cross sectional regression results of the 3-year average CEF discount for each CEF on the Fama-French 3-factor beta differences, the liquidity risk beta difference, manager 3-year alpha, and CEF yield measured over the last 12 months:

$$d_k^{3Yr} = \alpha + \delta_1\beta_k^{m,dif} + \delta_2\beta_k^{hml,dif} + \delta_3\beta_k^{smb,dif} + \delta_4\beta_k^{iml,dif} + \delta_5 \alpha lpha_k + \delta_6 Y_k^{12mo} + u$$

d_k^{3Yr} = 3 year average discount of CEF *k* measured from 10/1/01-9/30/04

$\beta_k^{m,dif}$ = difference between CEF *k* and NAV *k* Fama-French market factor loading

$\beta_k^{hml,dif}$ = difference between CEF *k* and NAV *k* Fama-French HML factor loading

$\beta_k^{smb,dif}$ = difference between CEF *k* and NAV *k* Fama-French SMB factor loading

$\beta_k^{iml,dif}$ = difference between CEF *k* and NAV *k* IML factor loading

$\alpha lpha_k$ = CEF manager alpha for 3 year period 10/1/01-9/30/04

Y_k^{12mo} =12 month yield on CEF *k*'s NAV through 9/30/04

R-Square	0.29			
Variable	Estimate	St. Error	t Value	Pr > |t|
Intercept	-12.789	0.997	-12.830	<.0001
$\beta_k^{m,dif}$	-6.132	2.855	-2.150	0.032
$\beta_k^{hml,dif}$	3.706	3.181	1.170	0.245
$\beta_k^{smb,dif}$	-3.121	3.681	-0.850	0.397
$\beta_k^{liq,dif}$	-6.447	2.352	-2.740	0.006
$\alpha lpha_k$	0.138	0.051	2.700	0.007
Y_k^{12mo}	1.382	0.148	9.370	<.0001

Table 9: Simple Statistics for Discounts, Yield, and Alpha, by CEF Type

This table shows the mean 3-year average discount, yield, and manager alpha for all the CEFs in the sample categorized by stock CEF or bond CEF. Yield is the 12 month dividend paid by the CEF divided by the NAV and manager alpha is the intercept from a CAPM regression of the CEF NAV excess return on the S&P 500 excess return.

Stock CEFs

Variable	N	Mean	Std Dev	Minimum	Maximum
d_k^{3Yr}	99	-6.45	10.26	-36.50	33.96
Y_k^{12mo}	99	3.48	3.54	0.00	12.50
$\alpha lpha_k$	99	8.14	9.67	-11.48	32.89

Bond CEFs

Variable	N	Mean	Std Dev	Minimum	Maximum
d_k^{3Yr}	259	-2.58	6.12	-11.76	23.81
Y_k^{12mo}	259	6.70	1.37	0.11	11.18
$\alpha lpha_k$	259	1.44	4.55	-11.38	21.24

Table 10: Pairwise Correlations of Regression Variables

Simple Statistics

Variable	N	Mean	Std Dev	Sum	Minimum	Maximum
d_k^{3Yr}	358	-3.652	7.676	-1307.000	-36.500	33.960
$\beta_k^{m,dif}$	358	0.088	0.145	31.458	-0.518	0.745
$\beta_k^{hml,dif}$	358	0.112	0.159	39.916	-0.883	0.810
$\beta_k^{smb,dif}$	358	0.060	0.114	21.439	-0.693	1.151
$\beta_k^{liq,dif}$	358	-0.149	0.157	-53.323	-0.621	0.600
$\alpha lpha_k$	358	3.290	7.047	1178.000	-11.480	32.890
Y_k^{12mo}	358	5.812	2.623	2081.000	0.000	12.500

Pearson Correlation Coefficients, N = 358, Prob > |r| under H0: Rho=0

	d_k^{3Yr}	$\beta_k^{m,dif}$	$\beta_k^{hml,dif}$	$\beta_k^{smb,dif}$	$\beta_k^{liq,dif}$	$\alpha lpha_k$	Y_k^{12mo}
d_k^{3Yr}	1	-0.140	0.134	0.023	-0.253	-0.030	0.507
		0.008	0.011	0.662	<.0001	0.572	<.0001
$\beta_k^{m,dif}$	-0.140	1	0.473	0.163	0.031	0.071	-0.122
	0.008		<.0001	0.002	0.555	0.182	0.021
$\beta_k^{hml,dif}$	0.134	0.473	1	0.551	-0.206	-0.032	0.242
	0.011	<.0001		<.0001	<.0001	0.541	<.0001
$\beta_k^{smb,dif}$	0.023	0.163	0.551	1	-0.070	0.014	0.075
	0.662	0.002	<.0001		0.184	0.797	0.159
$\beta_k^{liq,dif}$	-0.253	0.031	-0.206	-0.070	1	0.220	-0.281
	<.0001	0.555	<.0001	0.184		<.0001	<.0001
$\alpha lpha_k$	-0.030	0.071	-0.032	0.014	0.220	1	-0.247
	0.572	0.182	0.541	0.797	<.0001		<.0001
Y_k^{12mo}	0.507	-0.122	0.242	0.075	-0.281	-0.247	1
	<.0001	0.021	<.0001	0.159	<.0001	<.0001	

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