Auburn University
Department of Economics
Working Paper Series

Fear and Closed-End Fund Discounts

Seth Anderson[a], T. Randolph Beard[b], Hyeongwoo Kim[b]
and Liliana Stern[b]

[a]Tuskegee University, [b]Auburn University

AUWP 2012-07

*Corresponding author. E-mail: gmmkim@gmail.com

Fear and closed-end fund discounts

S. Anderson[a], T. R. Beard[b], H. Kim[c,*] and L. V. Stern[d]

October 2012

Abstract

Closed end fund (CEF) discounts have intrigued researchers for decades. Of the many explanations offered, the behavioural framework of Lee *et al.* (1991), which posits noise traders subject to sentiment, is the most discussed. In this article, we contribute some novel evidence to the evaluation of this theory by examining the role of implied market volatility (VIX, i.e., the "fear index") in fund discounts using a dynamic conditional correlation (DCC) approach. We find that VIX has almost no role in determining discounts except during periods of extreme market turbulence, providing strong but indirect evidence for the sentiment story.

JEL Classification: C32; G01; G12

Keywords: Closed-end fund, discount, investor sentiment, dynamic conditional correlation, multivariate GARCH

[a] *Department of Economics and Finance, Tuskegee University, Tuskegee, AL 3608, USA*
[b] *Department of Economics, Auburn University, Auburn, AL 36849, USA*
[c,] *Department of Economics, Auburn University, Auburn, AL 36849, USA*
[d] *Department of Economics, Auburn University, Auburn, AL 36849, USA*

I. Introduction

CEFs are companies which exist to hold a portfolio of financial assets. CEFs have publically traded shares and, because the market prices of the underlying assets owned by the funds are easily observed, CEF share prices have long interested researchers. With some notable exceptions, CEF shares sell at prices below their corresponding net asset values (NAVs). Such CEF "discounts" are anomalous and explanations include various market frictions (Pontiff, 1996), the structure of management contracts (Berk and Stanton, 2007), management fees (Ross, 2002), management ownership of fund shares (Barclay *et al.*, 1993), agency costs (Malkiel, 1977), and tax effects (Brickley *et al.*, 1991). The most discussed explanation of recent years arises from the behavioural story of Lee *et al.* (1991), which posits the existence of noise trading to explain discounts. This theory has triggered much debate, as have other claims that stock prices reflect sentiment (Chen *et al.*, 1993; Chopra *et al.*, 1993; Abraham *et al.*, 1993; Swaminathan, 1996; Simon and Wiggins, 2001; Doukas and Milonas, 2004; Baker and Wurgler, 2006, 2007).

The "sentiment" variables used in previous CEF discount analyses include such measures of small investor sentiment as mutual fund redemptions and small cap stock performance. In contrast, our strategy uses the VIX, which is certainly *not* an index of small investor behaviour. However, examining the relationship between VIX and CEF discounts in a dynamic setting provides a strong though indirect test of the sentiment hypothesis. Under normal conditions VIX should play little role in determining discounts because VIX is not a measure of small investor sentiment. However, during periods of very elevated market uncertainty, fear becomes contagious and VIX should be positively and strongly correlated with discounts. The recent financial meltdown in the US markets provides a perfect laboratory for testing this indirect but plausible linkage. This is the purpose of this article.

Unlike previous analyses, we use a DCC specification to examine the relationship between implied market volatility and the level of discounts. We adopt a single latent factor specification for the process generating discounts. The results of this estimation are then used to estimate DCCs and examine their evolution over the period 2004 to 2011, which includes the "meltdown" of 2008/09. We show that VIX, though largely uncorrelated with discounts in the earlier period, becomes strongly correlated during the period of turbulence. Further, our results show that use of techniques that imply time-invariant correlations can be quite misleading.

II. The Econometric Model

Let $d_{i,t}$ denote the log price minus the log NAV of CEF $i \in [1, N]$ at time $t \in [1, T]$. When $d_{i,t}$ is negative (positive), the fund trades at a discount (premium).

We assume that $d_{i,t}$ has the following single factor structure:

$$d_{i,t} = \lambda_i f_t + \zeta_{i,t} \quad (1)$$

where f_t is the *common* factor component of $d_{i,t}$ across all mutual funds $i \in [1, N]$ at time t. The parameter λ_i denotes the fund-specific factor loading to the common factor, f_t. Lastly, $\zeta_{i,t}$ is fund i's *idiosyncratic* component.

Instead of investigating the dynamics of each fund, we focus on the movement of the common factor, f_t. For this purpose, we first estimate the common factor and the factor loadings via the principal component analysis after proper normalization.[1] Since $d_{i,t}$ is likely nonstationary, we employ Bai and Ng's (2004) method to obtain the estimate for Δf_t from the relation:

$$\Delta d_{i,t} = \lambda_i \Delta f_t + \Delta \zeta_{i,t} \tag{2}$$

which allows recovery of the common and idiosyncratic components by summation.

Once the common factor is identified, we investigate its DCCs with VIX. We are interested in how the discount changes during tranquil and turbulent periods, employing the US financial crisis as our target period. We use the DCC estimator (Engle, 2002) for multivariate generalized autoregressive conditional heteroskedasticity (MGARCH) models to estimate time-varying conditional correlations between f_t and VIX.[2]

III. Data and Empirical Results

Data

We use daily returns for 32 closed-end funds for the period May 7, 2004 through February 17, 2011. Our sample includes 16 bond and 16 stock CEFs. Our sample was selected from funds with complete daily price and NAV series available on Yahoo satisfying the additional criteria: (1) bond funds are selected from the Closed-End Fund Association's "General Bond" and

---

[1] Normalization is required because the principal component analysis is not scale-invariant.
[2] The DCC model is a generalization of the constant conditional correlation (CCC) estimator of Bollerslev (1990). We skip technical details for the DCC model to save space.

"Corporate Debt BBB Rated Funds" categories, while stock funds are selected from the "Core Funds" category; (2) only funds with assets exceeding $50 million (US) on May 7, 2004 are selected.[3]

Bond funds' portfolios include Treasury bonds, corporate bonds, foreign long-term debt, foreign US $-denominated bonds/notes, FNMA nonmortgage backed securities, FNA mortgage-backed securities, and other mortgages. Stock funds have portfolios allocated primarily to technology, industrials, health care, financials, consumer services, consumer goods, oil and gas, utilities, communications, and basic materials.

Empirical results

We first estimate the common factor component, f_t, of the CEF's discounts, $d_{i,t}$, as per Equation 1. To highlight its potential association with VIX, we changed the sign of the estimates, so that a positive sign on f_t implies the fund traded at a discount. Fig. 1 displays the series and suggests their inter-relations.

Fig. 2 presents estimated DCC and the CCC, where CCC fixes the correlation across the sample period. Inspection suggests the CCC formulation is mis-specified: the DCC series exhibits a structural break around late 2007, coincident with the US subprime mortgage market collapse.

First, we reject the CCC formulation in favour of the DCC with a 7% *p*-value. We note also that, prior to the US financial crisis, the correlation between the discount and VIX was virtually 0%, but it increased (in absolute value) dramatically in the post crisis period, reaching a

[3] Detailed information on individual funds is available upon request.

peak at around -0.5 in late 2008. Prior to the meltdown (Lehman failed on September 15, 2008), there is essentially no relationship between innovations in the discount and investors' perceptions of market volatility. Afterwards, however, this effect becomes quite strong. This result is precisely what one would expect if market perceptions of future volatility were correlated with small investors' sentiments *only* under conditions of financial "stress", during periods in which fear became contagious. The post-Lehman period would surely appear to qualify in this regard.

We also implement a subsample analysis with an alternative structural break date, since there is an apparent shift in the DCC in mid-July of 2007. In both subsamples, we cannot reject the null of CCC between CEF discounts and the VIX index.[4] We note that there is almost no correlation between discounts and investor sentiment during tranquil times, i.e., prior to mid-July 2007. There is a much stronger, and negative, correlation during the market meltdown.

Figs 1 and 2 about here

IV. Concluding Remarks

Using a sample of CEFs for the period 2004 to 2011, we find a strong relationship between discounts and VIX only after the market meltdown in 2007. This provides a new form of indirect evidence in favour of the sentiment theory of discounts: if VIX, which is not determined by small investor actions, explains the evolution of discounts during a particular identifiable period, then the sentiment hypothesis would require that this period be one in which small investor sentiment becomes correlated with VIX. Such is the post-Lehman period. Additionally,

---

[4] Engle's (2002) test for the CCC is accepted for the tranquil (5/11/2004 - 7/13/2007) and turbulent periods (7/16/2007 - 2/17/2011) with 0.7959 and 0.9184 *p*-values, respectively. All results are available upon request.

the results suggest that more attention be given to time variation in correlations regardless of the sentiment variables being used. Otherwise, misleading conclusions are possible. Since we found strong evidence of a structural break in the relationship between CEF discounts and a measure of investor sentiment around late 2007, this casts doubt on the accuracy of any earlier results obtained by applying CCC estimates of the relationship.

Reference

Abraham, A., Elan, D. and Marcus, A. J. (1998) Does sentiment explain closed-end discounts? Evidence from bond funds, *Financial Review*, **28**, 609-19.

Bai, J. and Ng, S. (2004) A PANIC attack on unit roots and cointegration, *Econometrica*, **72**, 1127-77.

Baker, M. and Wurgler, J. (2006) Investor sentiment and the cross-section of stock returns, *Journal of Finance*, **61**, 1645-80.

Baker, M. and Wurgler, J. (2007) Investor sentiment in the stock market, *Journal of Economic Perspectives*, **21**, 129-152.

Barclay, M. J., Holderness, C.G. and Pontiff, J. (1993) Private benefits from block ownership and discounts on closed-end funds, *Journal of Financial Economics*, **33**, 263-291.

Berk, J. B. and Stanton, R. (2007) Managerial ability, compensation, and the closed-end fund discount, *Journal of Finance*, **65**, 529-556.

Bollerslev, T. (1990) Modelling the coherence in short-run nominal exchange rates: a multivariate generalized ARCH model, *The Review of Economics and Statistics*, **72**, 498-05.

Brickley, J., Manaster, S. and Schallheim, J. (1991) The tax-timing option and the discounts on closed-end investment companies, *Journal of Business*, **64**, 287-312.

Chen, N. F., Kan, R. and Miller, M. H. (1993) Are the discounts on closed-end funds a sentiment index?, *Journal of Finance*, **48**, 795-800.

Doukas, J. A. and Milonas, N. T. (2004) Investor sentiment and the closed-end fund puzzle: out-of-sample evidence, *European Financial Management*, **10**, 235-266.

Engle, R. F. (2002) Dynamic conditional correlation: a simple class of multivariate generalized autoregressive conditional heteroskedasticity models, *Journal of Business & Economic Statistics*, **20**, 339-350.

Kumar, A. and Lee, C. M. (2006) Retail investor sentiment and return co-movements, *Journal of Finance*, **61**, 2451-86.

Lee, C. M., Shleifer, A. and Thaler, R. H. (1990) Anomalies: closed-end fund mutual funds, *Journal of Economic Perspectives*, **4**, 154-64.

Lee, C. M., Shleifer, A. and Thaler, R. H. (1991) Investor sentiment and the closed-end fund puzzle, *Journal of Finance*, **66**, 75-109.

Malkiel, B. G. (1977) The valuation of closed-end investment company shares, *Journal of Finance*, **32**, 847-59.

Nofsinger, J. and Sias, R. (1999) Herding and feedback trading by institutional and individual investors, *Journal of Finance*, **54**, 2263-95.

Pontiff, J. (1996) Costly arbitrage: evidence from closed-end funds, *Quarterly Journal of Economics*, **111**, 1135-1151.

Richards, R. M., Fraser, D. R. and Groth, J.C. (1979) Premiums, discounts, and the volatility of closed-end mutual funds, *The Financial Review*, **14**, 26-33.

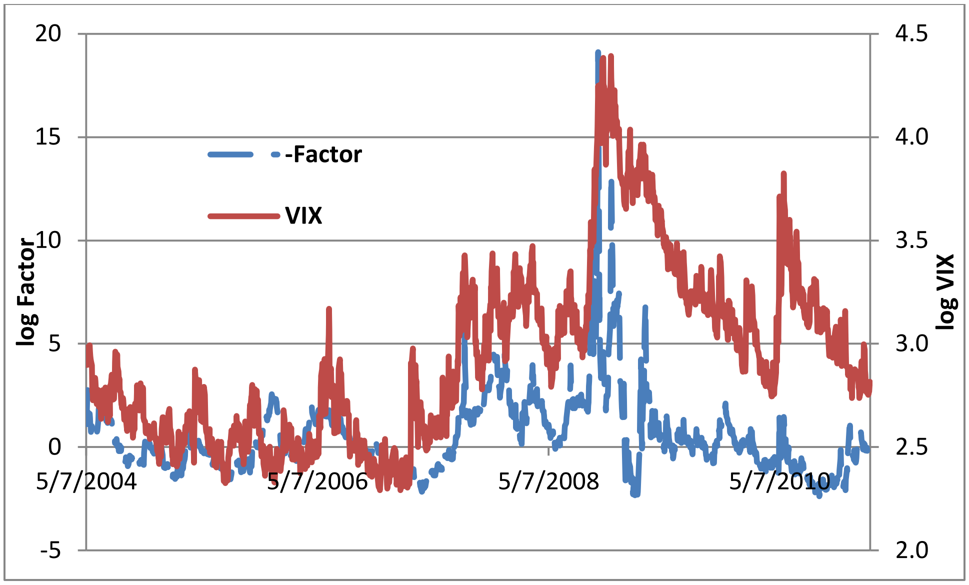
Ross, S. A. (2002) Neoclassical finance, alternative finance, and the closed end fund puzzle, *European Financial Management*, **8**, 129-137.

Simon, D. and Wiggins, R. A. (2001) S&P futures returns and contrary sentiment indicators, *Journal of Futures Markets*, **21**, 447-462.

Swaminathan, B. (1996) Time-varying expected small firm returns and closed-end fund discounts, *Review of Financial Studies*, **9**, 845-87.

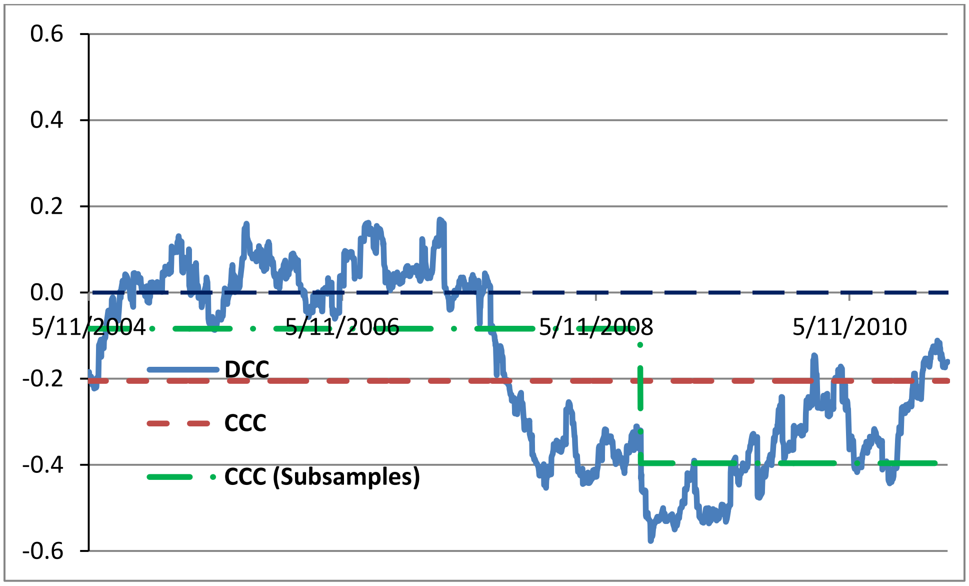
Whaley, R. (2000) The investor fear gauge, *Journal of Portfolio Management*, **26**.

Fig. 1. Common factor discount and the VIX



Notes: The common factor is obtained by the principal component analysis for the 32 closed-end mutual fund data, the log price minus the log NAV. The common factor is multiplied by -1, which equals the log discount.

Fig. 2. Conditional correlations between f_t and VIX



Notes: The common factor is obtained by the principal component analysis for the 32 closed-end mutual fund data. Observations are daily and span May 7, 2004 to February 17, 2011. DCC denotes the dynamic conditional correlation proposed by Engle (2002), and CCC is the constant conditional correlation of Bollerslev (1990). The estimated conditional correlation from the BEKK model (Engle and Kroner, 1995) is similar to the DCC and omitted from the graph. Engle's (2002) test for the CCC is rejected at the 10% significance level (p-value = 0.0733). The CCC estimates with two subsamples using the Lehman bankruptcy date (September 15, 2008) as the break are -0.0836 and -0.3957 for the pre- and the post-Lehman periods, respectively.