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A NEW LOOK AT DISCOUNT RETURNS: IMPLICATIONS FOR THE GLOBAL INVESTOR

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This paper examines risk–return characteristics of discount returns on portfolios of closed-end funds and how they might benefit investors. Discount return is defined as the percentage change in discounts over a period. This paper focuses on the distribution of discount returns conditioned on discount level rather than time. Discount returns characterized this way represent an income stream that has little correlation with other well-known asset class and style-based factors. This paper shows that by adding discount portfolios to a traditional asset allocation mix an investor can improve diversification and earn higher risk-adjusted returns.

- The Closed-End Fund ("CEF") Discount has been an enigma for researchers and professionals in finance for the longest time. Many authors have addressed the existence of the anomaly as defying the efficient market hypothesis and have given rational explanations for its persistence. For example, Lee *et al.* (1990, 1991) based on DeLong *et al.* (1990) introduced the investor sentiment theory which assumes that small investors are the dominant traders in the CEF market and trade irrationally based on market sentiment. This type of noise trading is unpredictable so any Price/NAV discrepancies cannot be arbitraged away. Rational investors will purchase CEFs only if they are compensated for this noise trading risk, hence a discount. This theory, however, is unable to explain the significant co-existence of premium funds along with discount funds. Ferguson and Leistikow (2001, 2004) countered this argument with their expected investment performance hypothesis which ties discounts to a fund's expected performance based on manager's abilities rather than market sentiment. Investors bid up the price of a fund because they believe that a manager's ability will persist in the future. The resulting

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premium may not last long as investors realize their limitations in evaluating the manager and question the reliability of the information they received. This volatility in investor's assessment of managerial ability and the mobility of fund managers among different funds result in volatile discounts/premiums. In the latter paper, Ferguson and Leistikow support their hypothesis with empirical tests. Wermers *et al.* (2008) also study the relationship among individual fund discounts, portfolio performance of a fund and managerial turnover. Their findings show that underperforming managers are replaced with new, better ones, and discounts closely correlate with investor perception of the talents of a manager and his survival outlook on the job. When a fund performs poorly due to its manager's inabilities, discounts widen, whereas the perception of good performance leads to discount narrowing.

For asset managers the existence and persistence of the discount have been fertile ground for various trading strategies. The benefits of CEF investing are also well documented in both academic and practitioner research (see, for example, Thompson, 1978; Cakici *et al.*, 2000, 2002; Dimson and Minio-Paluello, 2002). Based on these findings and others, investment management teams have successfully managed CEF portfolios since the early 1990s.[1] Performance in these strategies generally stem from two sources. First is the buying of closed-end funds when discounts are especially deep and selling those funds when they are less deep. Second is, in effect, buying the underlying assets at a discount and if the underlying assets do well the strategy does also. The former generates a discount return and the latter an NAV return, combined the total return on investment.

This paper focuses on discount returns on a broad set of closed-end funds. Discount return is the percentage change in discount from one point in time to the next. It is defined as follows:

$$\textit{discount return} = \frac{\Delta \textit{discount}}{1 + \textit{starting discount}}$$

The discount return captures the gains or losses from an investment in CEFs based on discount movements alone. By definition, it depends on the discount change but also on the discount level from which the change occurred. It varies directly with the magnitude of discount change and inversely to starting discount level. It is equivalent to the relative growth rates of price to NAV as shown in the Appendix.

A discount return on a CEF can be generated through a hedged position in CEF shares and an offsetting position in the securities held by the funds. Investing in the hedge represents an alternative approach to CEF investing with low correlation to the traditional asset returns. In this paper, we treat NAV returns as perfectly hedged, hence an investor holding the hedge does not earn the price or NAV return of the fund but instead earns the relative return between the two on a stand-alone basis.[2]

We will show that discount returns are an income stream with little correlation to other asset class returns and add further diversification benefits to the portfolios of global investors. In particular, we examine discount returns of portfolios grouped by discount level. Consequently, the mean, variance and covariance structure of these "discount" portfolios, grouped solely on their levels of discounts, are independent of time. This conditioning of returns on discount levels instead of time is a novel approach that has clear and unambiguous implications for investment decisions.

The paper looks at the relationship between discount levels and discount returns and then analyzes the correlations of discount movements with respect to each other and with other asset classes.

Finally, the diversification benefits of adding discount returns to the asset allocation mix of global investors are demonstrated.

1 Discount levels and returns

This study looks at all closed-end funds traded in the United States and in the United Kingdom, the two major regions for trading these securities. The data consists of monthly observations on all closed-end funds from July 1997 through December 2014. The source of the data is a proprietary database of closed-end funds maintained by Gramercy Funds Management. At each point in time the data consists of all funds that existed at the time, including funds that came into existence after the start of the period and those that dropped out sometime during the period of study.

Table 1 shows a total of 2,005 funds in the sample and tallies both newly created funds and funds that were delisted at some point over the period. There were 752 funds at the start of the study and 981 funds available at the end. There was a net change of 229 funds over the period with 1,172 newly created funds and 943 deletions. One qualitative aspect of the table is the fairly large movement of funds into and out of the industry. Hence, the make-up of the universe of funds constantly changes and available opportunities are not the same from one period to the next.

Table 1 Overview of funds.

Number of funds in sample: July 1997–December 2014

Funds	United States	United Kingdom	Combined
All funds	926	1,079	2,005
Jul-97	428	324	752
Funds added	456	716	1,172
Funds delisted	355	588	943
Dec-14	529	452	981
Net change	101	128	229

Table 1.1

Average annual discount statistics of funds in the sample

Year	Mean	Sigma	Skew	Kurt	Num
1997	−8.1	11.1	0.2	5.2	758
1998	−8.9	13.3	0.0	4.2	807
1999	−10.3	11.6	0.4	5.3	837
2000	−9.8	10.9	0.8	5.8	817
2001	−6.8	11.8	0.4	5.1	816
2002	−7.9	12.4	−0.5	5.0	823
2003	−6.6	10.4	−0.3	4.7	863
2004	−6.4	9.2	0.1	4.8	896
2005	−5.3	8.8	0.5	4.9	920
2006	−4.0	8.3	0.3	5.2	1,104
2007	−7.3	7.5	−0.2	5.6	1,159
2008	−12.7	12.9	−0.9	6.1	1,171
2009	−9.8	13.7	−1.0	6.3	1,117
2010	−6.6	11.5	−1.1	5.5	1,096
2011	−7.5	11.7	−1.0	5.5	1,093
2012	−6.1	12.8	−1.1	5.7	1,066
2013	−7.7	10.0	−0.6	6.7	1,028
2014	−7.4	9.3	−0.5	7.1	1,005
Average	−7.7	11.0	−0.2	5.5	965

Fund discount characteristics from year-to-year are shown in Table 1.1. For each year the table reports the average number of funds in the sample as well as the cross-sectional mean, standard deviation, skewness and kurtosis of the distribution of discounts. These numbers are averages over 12 monthly observations in each year and hence the number of funds count slightly differs from Table 1. Cross-sectional variability of discounts or discount spread (column labeled *Sigma*) is a measure of opportunities that are present at the time. One can capitalize on discount spread, for example, by buying CEFs with deepest discounts and selling CEFs with the narrowest discounts.

Volatility figures are also changing from year to year showing that some years present better opportunities than others. It is interesting to note that deepest discounts and highest volatilities were observed during and after the 2008 Crisis. In fact the crisis has created ample opportunities to gain from narrowing discounts in the subsequent years. Also note the increase in the number of funds prior to the 2008 financial crises largely due to new issuance of US bond funds to satisfy demand in the market.

2 The conditional distribution of discount returns

An important characteristic of discount changes is how they systematically vary across discount levels. A discount change from one point in time to the next is closely tied to the level from which the change occurred. Figure 1A plots average discount return against discount level. Each point represents the average monthly discount return grouped by beginning of month discount level. There is a downward bias from discounts of −30% through +10%. Average return pattern becomes less clear with discounts greater than +10% due to smaller number of funds in that range. Average monthly changes are 1.33% at the −25% level, 0.71% at −20% level and 0.37% at −15% discount level. On the other hand, average monthly returns are no longer positive after −10% levels. As expected, discount returns increase as the discount level deepens. A polynomial regression was fit to the data as well and the resulting line supports the relationship between discount levels and discount returns as described. The goodness of fit is high at $R^2 = 0.89$ and normalized sum of squared deviations (norm of residuals) is 2.65.

Volatility of discount returns is shown in Figure 1B. Standard deviations are plotted on the y-axis grouped by discount levels on the x-axis as in Table 1A. Again there is a pattern in the plot. The figure is linear and downward sloping from discount levels of −30% through −10% which shows a steeper decline in discount return volatility as discounts become less. We observe that along with the higher returns with deeper discounts we also see increases in standard deviations as well. In other words, the distribution of discount returns grouped by discount levels has higher means *and* volatility as one moves from 0% discount to wider discount levels. R^2 for the regression is 0.93.

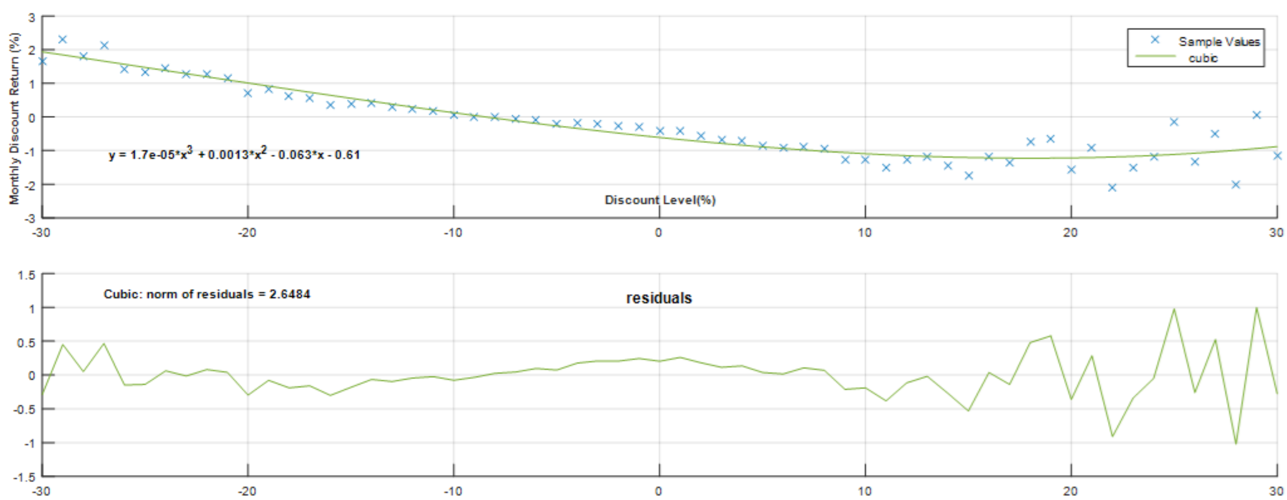


Figure 1A Conditional Average Return.

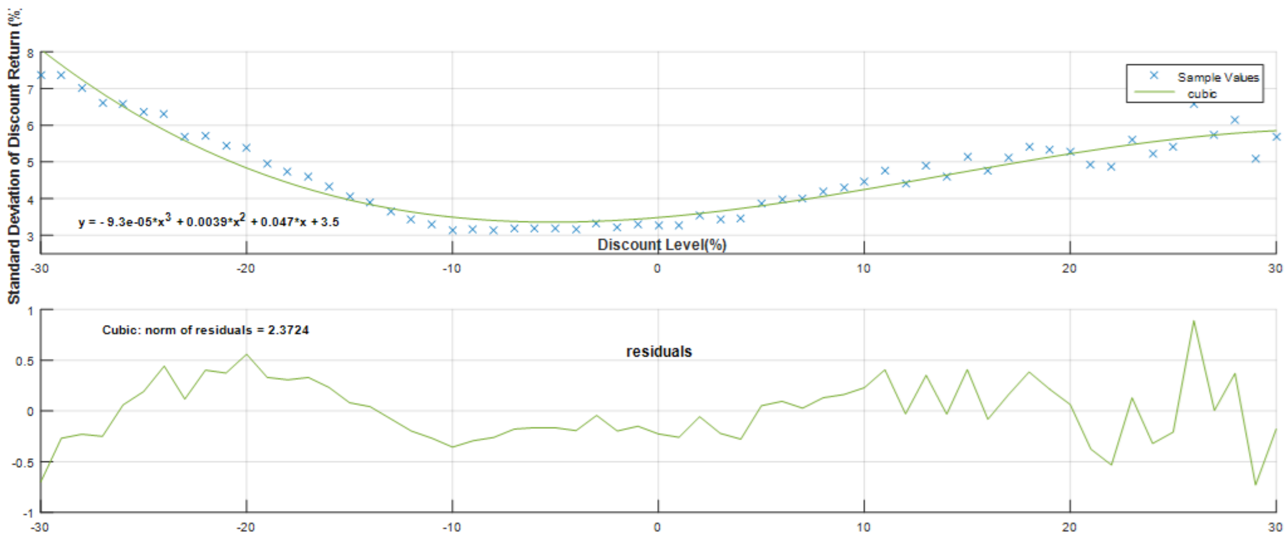


Figure 1B Conditional Standard Deviation of Return.

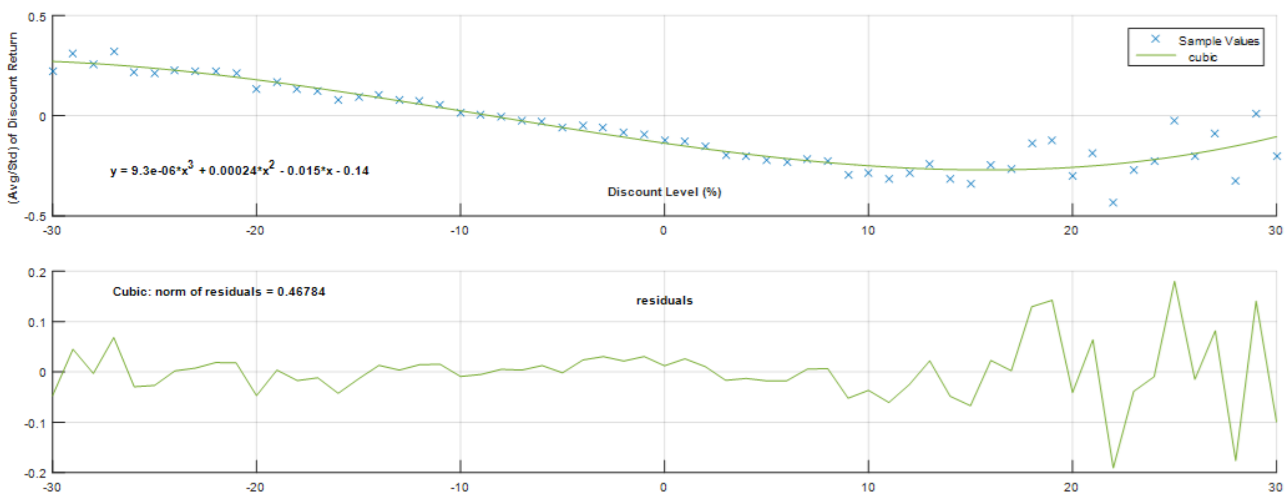


Figure 1C Conditional Sharpe Ratio.

Finally, Figure 1C displays the ratio of average return to standard deviation of return, i.e. risk-adjusted returns, grouped by discount levels (conditional Sharpe Ratio). Once again we see a linear downward plot from a −30% discount through a −10% discount. Note that risk-adjusted returns are 0.21 at −25% discount level, 0.13 at −20%, and 0.09 at −15% and zero at approximately −8% discount. It is interesting to note that although both average returns and spreads of discount returns (their volatility) move up as discounts deepen, the risk–return trade-off improves substantially to benefit the investor. R^2 of the regression is 0.94, and there is a very low sum of squared deviations that equal 0.47.

We next consider how these returns co-vary and might fit into a more traditional asset class allocation.

3 Discount returns of portfolios

Table 2 summarizes monthly returns on seven "discount portfolios" we constructed. They are equally weighted portfolios of CEFs sorted by

Table 2

Monthly returns grouped by discount: July 1997–December 2014

Discount level	Mean	Sigma	Mean/sigma
(−35 to −25)	1.44	2.36	0.61
(−25 to −15)	0.71	1.31	0.54
(−15 to −5)	0.08	1.03	0.08
(−5 to +5)	−0.36	1.17	−0.31
(+5 to +15)	−1.02	1.46	−0.69
(+15 to +25)	−1.23	2.18	−0.57
(+25 to +35)	−0.90	4.12	−0.22

discount levels. The portfolios were constructed as follows; at the beginning of every month funds were sorted by their discount levels and placed into bins. We created seven non-overlapping bins of 10% intervals, beginning at −35% discount level and ending at +35%. We equally weighted funds within each bin and calculated the discount returns of these portfolios over the subsequent month. At the beginning of the next month, we similarly sorted funds into bins once again, constructed equally weighted portfolios and computed the subsequent monthly discount returns. The process was continued over the entire sample period.

The above table provides the risk–return statistics from these seven portfolios of closed-end funds. Based on the information in the table an investor would have gained 1.44% per month (17.28% per year) by holding a portfolio of closed-end funds with discounts in the range −35% to −25% percent. Similarly, an investor would have lost 0.90% per month (10.80% per year) by holding a portfolio of closed-end funds trading in the +25% to +35% percent discount range. These are sizable return patterns that have existed for a very long period of time. Moving to the second group (−25 to −15), a discount return of 0.71% on average per month against a standard deviation of 1.31% per month over an extended period of time is quite robust as would be the case in holding a portfolio of funds with discounts within the range (−15% to −5%).

These portfolios were constructed without turnover constraints and without transactions costs. Practical portfolio management would seek an optimal balance between the expected return on discounts, correlation of discounts with other assets and trading costs due to turnover. An indication of turnover and transaction costs on these portfolios is presented in Table 2.1. Average turnover (TOV) for each portfolio group is listed in the first column of the table. It is largest when discounts are deepest but also at precisely when these portfolios return the highest. Transaction costs (TC) are computed based on two

Table 2.1

Monthly turnover and transaction costs: July 1997 –December 2014

Discount level	Mean (TOV)	Sigma (TOV)	Mean (TC@10 bps)	Mean (TC@25b ps)
(−35 to −25)	0.46	0.14	0.09	0.23
(−25 to −15)	0.33	0.09	0.07	0.17
(−15 to −5)	0.22	0.08	0.04	0.11
(−5 to +5)	0.27	0.10	0.05	0.14
(+5 to +15)	0.44	0.11	0.09	0.22
(+15 to +25)	0.55	0.16	0.11	0.27
(+25 to + 35)	0.61	0.28	0.12	0.31

Table 3

Correlation of discount returns across portfolios: July 1997–December 2014

Discount Level	(−35 to −25)	(−25 to −15)	(−15 to −5)	(−5 to +5)	(+5 to 15)	(+15 to +25)	(+25 to +35)
(−35 to −25)	1.00	0.531	0.291	0.202	0.133	0.071	0.084
(−25 to −15)		1.00	0.659	0.423	0.305	0.203	0.249
(−15 to −5)			1.00	0.823	0.617	0.514	0.438
(−5 to +5)				1.00	0.773	0.581	0.452
(+5 to +15)					1.00	0.624	0.507
(+15 to +25)						1.00	0.459
(+25 to +35)							1.00

assumptions, one with 10 basis points per dollar turnover and another with 25 basis points. TC figures in columns three and four are computed as 2 × TOV × TC per dollar. When these costs are deducted from the returns in Table 2, we still see significant returns to the first two portfolios. Only the third is substantially degraded at 25 basis points. These findings show that the average return of the deep discount portfolios is positive and profitable even with unconstrained turnover.

Table 3 shows correlations among the seven equally weighted portfolios described above. Some interesting facts emerge.

As we move from left to right in Table 3 the correlations decrease most of the time. The return streams among the portfolios behave differently the larger the distance between discount ranges. For example, the correlation between bins (−35 to −25) and (−25 to −15) is 0.531; however, between (−35 to −25) and (−5 to +5), the correlation drops to 0.202.

We now turn to diversification benefits of these portfolios of CEFs and how their discount returns would fit into traditional asset allocation framework.

4 Gains from diversification and investment results

In addition to offering attractive returns on their own, these discount portfolios fit well into a broader portfolio construction scheme. To see this, we turn to the diversification gains from

Table 4

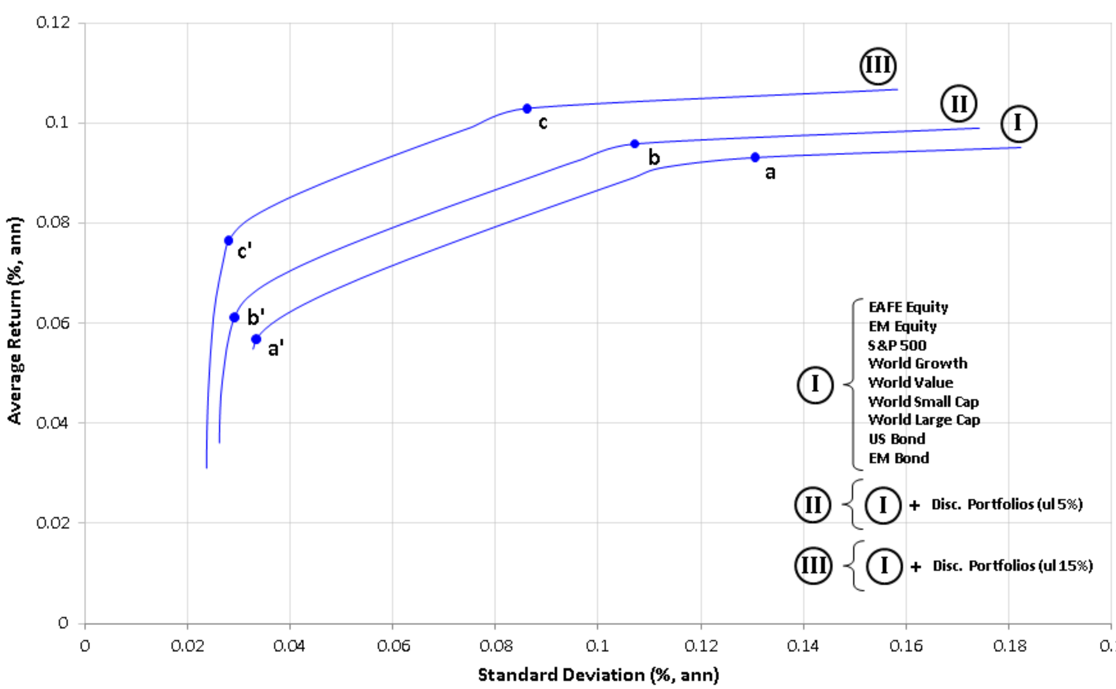
Correlation of discount returns of portfolios with assets and styles: July 1997–December 2014

Discount level	ACWI	EM equity	S&P	EAFE	US bonds	EM bonds	Global growth	Global value	Global large cap	Global small cap
(−35 to −25)	0.214	0.191	0.176	0.238	−0.006	0.167	0.176	0.228	0.200	0.238
(−25 to −15)	0.194	0.259	0.160	0.203	−0.135	0.226	0.142	0.216	0.181	0.241
(−15 to −5)	0.146	0.227	0.135	0.122	0.005	0.250	0.112	0.153	0.131	0.214
(−5 to +5)	0.152	0.203	0.150	0.131	0.101	0.285	0.117	0.169	0.141	0.192
(+5 to +15)	0.069	0.073	0.096	0.039	−0.032	0.126	0.047	0.089	0.060	0.088
(+15 to +25)	0.114	0.099	0.149	0.070	0.053	0.188	0.070	0.158	0.098	0.166
(+25 to +35)	0.046	0.066	0.061	0.021	0.062	0.243	0.036	0.053	0.042	0.092

including these portfolios in the overall mix of assets. In a portfolio context the correlation of discount returns with other asset classes are even more important than their individual risk measures, i.e. their standard deviations. Table 4 shows the correlations between the discount returns on these seven portfolios and traditional asset class and style-based returns over the sample period.

The table shows attractively low, sometimes even negative, correlations between discount portfolio returns and other asset class returns. The highest value is 0.259 between the second portfolio (−25 to −15) and EM Equity and the lowest is −0.032 between the fifth portfolio (+5 to +15) and US bonds. These correlations stand out as very low and appealing in portfolio construction. Especially note the low and sometimes negative correlation with US bonds which will play a significant role in sample optimal portfolios that follow.

In the next figure, we plot three ex-post efficient frontiers. These curves were produced by first taking 101 equally spaced horizontal slices of the expected return axis beginning at the minimum variance portfolio and ending at the maximum expected return portfolio. For each expected return we constructed a mean–variance efficient portfolio and plotted its mean and standard deviation in the chart. The 101 mean–standard deviation pairs were then connected with a line in the figure. All portfolios shown in the subsequent figures and tables, however, are appropriate selections from the discrete points. In particular, the curve labeled Roman numeral I consists of nine assets and styles including Equities (US, developed ex-US and emerging markets), Styles (Growth, Value, Large Cap, Small Cap) and Fixed Income (US and emerging markets). Curves labeled II and III consist of all assets in I plus the seven discount portfolios. The optimizations use upper limits of 5% (Efficient Frontier II), and



Points labeled a, b and c maximize geometric returns and a', b' and c' are tangency portfolios.

Figure 2 Addition of Discount Portfolios to Global Asset Allocation.

Table 5 Discount Portfolios and Risk Statistics

	EAFE equity	EM equity	S&P 500	World growth	World value	World small cap	World large cap	US bond	EM bond	Disc.Port (−35,−25)	Disc.Port (−25,−15)	Disc.Port (−15,−5)	Disc.Port (−5,+5)	Disc.Port (+5,+15)	Disc.Port (+15,+25)	Disc.Port (+25,+35)
Portfolio Weights: Portfolios a, b and c																
Ⓘ Portfolio a	—	—	—	—	—	46.2%	—	—	53.8%	—	—	—	—	—	—	—
Ⓘ Portfolio b	—	—	—	—	—	19.6%	—	—	70.4%	5.0%	5.0%	—	—	—	—	—
Ⓘ Portfolio c	—	—	—	—	—	9.6%	—	—	60.4%	15.0%	15.0%	—	—	—	—	—

Risk and Return: Portfolios a, b and c

	Arith.Ret.	Std.Dev.	Sharpe Ratio
Ⓘ Portfolio a	9.3%	13.1%	0.71
Ⓘ Portfolio b	9.6%	10.7%	0.89
Ⓘ Portfolio c	10.3%	8.6%	1.20

	EAFE equity	EM equity	S&P 500	World growth	World value	World small cap	World large cap	US bond	EM bond	Disc.Port (−35,−25)	Disc.Port (−25,−15)	Disc.Port (−15,−5)	Disc.Port (−5,+5)	Disc.Port (+5,+15)	Disc.Port (+15,+25)	Disc.Port (+25,+35)
Portfolio Weights: Portfolios a′, b′ and c′																
Ⓘ Portfolio a′	—	—	0.9%	—	—	5.2%	—	93.9%	—	—	—	—	—	—	—	—
Ⓘ Portfolio b′	—	—	1.1%	—	—	3.3%	—	80.6%	—	5.0%	5.0%	5.0%	—	—	—	—
Ⓘ Portfolio c′	—	—	2.1%	—	—	—	—	66.7%	—	15.0%	15.0%	1.2%	—	—	—	—

Risk and Return: Portfolios a′, b′ and c′

	Arith.Ret.	Std.Dev.	Sharpe Ratio
Ⓘ Portfolio a′	5.7%	3.3%	1.70
Ⓘ Portfolio b′	6.1%	2.9%	2.10
Ⓘ Portfolio c′	7.6%	2.8%	2.73

All portfolios assume non-negative weight and discount portfolios have upper limits of 5% and 15%

15% (Efficient Frontier III) on each of the seven portfolios, with all other assets left unconstrained. Additional constraints on the optimizations would produce portfolios with a larger number of assets. The figure shows the dramatic improvement that discount portfolios bring to the asset allocation opportunities. The frontiers unambiguously shift north and west when these discount portfolios are added to the existing investment set.

Figure 2 provides details on the efficient frontiers that result from adding discount portfolios to other asset classes. Points a, b and c refer to mean–variance portfolios with maximum expected growth rates. Points labeled a′, b′ and c′ have maximum Sharpe ratios. Assuming zero risk-free rates, a portfolio has maximum Sharpe Ratio if its mean and standard deviation maximize $\frac{E}{\sigma}$. They are the tangency portfolios in the figure, providing the best risk–return tradeoffs for all investors, and if further levered by the investor can provide even higher returns.[3]

Table 5 provides portfolio weights and some risk statistics of these portfolio picks.

Looking at the growth optimal portfolios, a, b and c, we see that the addition of discount portfolios, specifically the ones with the deepest discounts ((−35, −25) & (−25, −15)), replaces a large portion of world Small Cap. The addition of discount portfolios also increases the weightings to EM bonds that already have large weightings in all growth optimal portfolios. The risk-adjusted returns improve by increasing exposure to the discount portfolios. Sharpe ratios increase from 0.71 to 0.89 and finally to 1.20. The absolute returns on the tangency portfolios increase from 9.3% to 9.6% and eventually to 10.3% per year.

The tangency portfolios a′, b′ and c′ have more asset classes than the growth optimal portfolios as they include more US equity. In contrast, the addition of discount portfolios reduces the very high exposure to US bonds from 93.9% down to 66.7%, and there is no exposure to EM bonds in

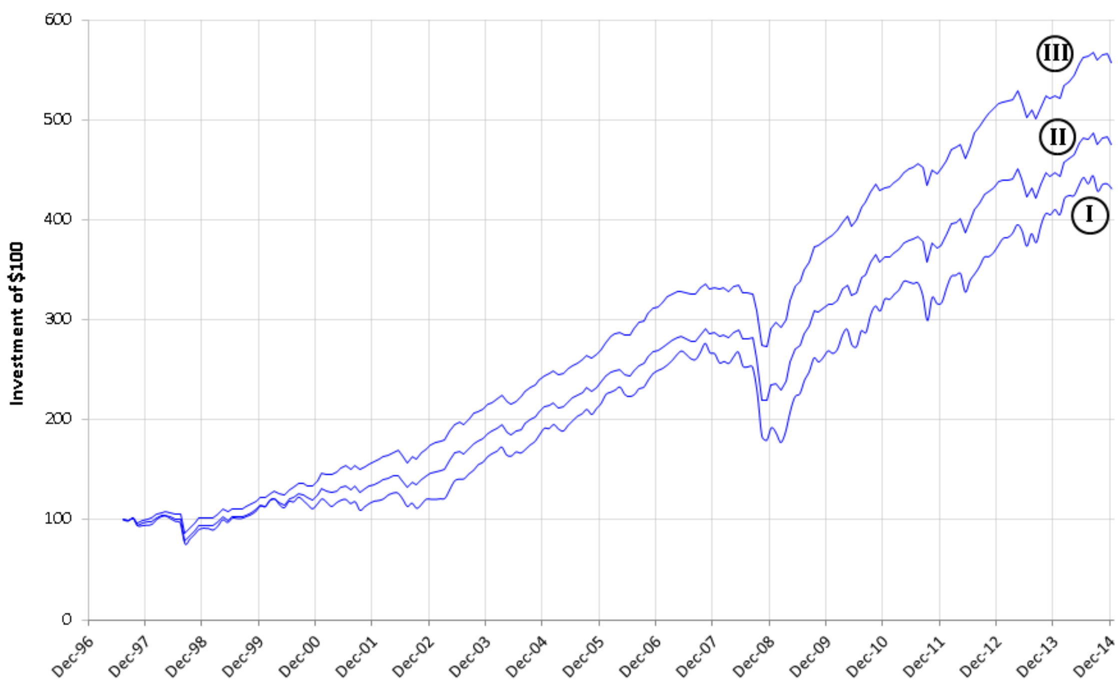


Figure 3 Cumulative Returns of Points a, b and c.

these portfolios. Note the shift from EM bonds to US bonds as we move from growth optimal to tangency portfolios lower down the curve. Intuitively, this makes sense as the optimal portfolio maintains its position in bonds but at a lower risk. The risk-adjusted returns (Sharpe Ratios) improve to 1.70, 2.10 and 2.73 from 0.71, 0.89 and 1.20.[4]

Figure 3 shows accumulated growth of \$100 invested in growth portfolios from the start of the sample to its end. The curves have similar shapes, bumps and wiggles along the way, and seem to move in the same direction. We see the large downdraft in 2008 and its subsequent recovery. The growth rates over more recent periods seem to remain unchanged from earlier period as well.

5 Conclusions

This paper examined risk–return characteristics of discount returns on portfolios of closed-end funds and how they might benefit investors. We defined the concept of discount return as the percentage change in discounts over time. We focused on the distribution of discount returns conditioned on discount level rather than time. We found that discount returns represent an income stream that has little correlation with asset class and style-based factors that are conventionally used in asset allocation. We showed that by adding discount portfolios to a traditional asset allocation mix an investor can significantly improve on diversification benefits and earn higher risk-adjusted returns.

Appendix

This section gives a formal definition of the variables and their relationships. Let P_t, and N_t be share price and net asset value at date t, d_t be the discount level at time t, specifically, $d_t = (P_t - N_t)/N_t$ and discount change be $\Delta d = d_t - d_{t-1}$. Also $R^p_{t-1,t} = P_t/P_{t-1}$ and $R^n_{t-1,t} = N_t/N_{t-1}$ are one plus price and NAV return from time $t-1$ to t. Discount return is $R^d_{t-1,t} = R^p_{t-1,t}/R^n_{t-1,t}$, the ratio of one-plus price return to one-plus NAV return. The discount return of a closed-end fund is that portion of price return derived from discount movements alone as the following indicates:

$$R^d_{t-1,t} = (P_t/P_{t-1})/(N_t/N_{t-1})$$

Rearranging terms:

$$\begin{aligned} &= (P_t/N_t)/(P_{t-1}/N_{t-1}) \\ &= (1 + d_t)/(1 + d_{t-1}) \\ &= 1 + \Delta d/d^*_t \end{aligned}$$

where we have defined $d^*_t = 1 + d_t > 0$.

Thus, discount return is proportional to discount change; Δd; larger absolute changes in discounts are associated with larger discount returns. More surprising is the impact of the discount level, d^*_t, in the denominator. The multiplier $M_t \equiv 1/d^*_t$, magnifies the impact of Δd on discount returns. It is interesting to note that if $d_t > 0$, $M_t < 1$ and funds with the highest premiums have the smallest multipliers. On the contrary, funds with deepest discounts have multipliers greater than 1 and as the discount deepens, the multiplier gets larger and larger. For a given discount change, the smaller the base or starting discount level, the larger the discount return. A discount change from −10% to −8%, for example, provides a return of 2.22%, while a change from −20% to −18% provides a return of 2.50%, 28 basis point higher because of the lower base.

These discount returns are derived from a hedged position in CEFs as an un-hedged position would receive the total return. One may wonder about the relative magnitudes and behavior of total returns versus discount returns. To this end, we partition total return into its two components, discounts and NAVs in Table A.1. For the sample

Table A.1

Summary of monthly discount, NAV and total returns
July 1997–December 2014

Discount level	Mean (TR)	Sigma (TR)	Mean (DR)	Sigma (DR)	Mean (NAV)	Sigma (NAV)	Corr (DR,NAV)	Corr (DR,TR)	Corr (NAV,TR)
(−35 to −25)	1.40	4.74	1.44	2.36	−0.04	3.85	0.09	0.57	0.87
(−25 to −15)	1.13	4.45	0.71	1.31	0.40	3.89	0.30	0.55	0.96
(−15 to −5)	0.68	3.12	0.08	1.03	0.59	2.69	0.28	0.57	0.95
(−5 to +5)	0.13	2.72	−0.36	1.17	0.48	2.14	0.32	0.67	0.91
(+5 to +15)	−0.50	3.04	−1.02	1.46	0.52	2.41	0.21	0.64	0.88
(+15 to +25)	−0.75	4.06	−1.23	2.18	0.48	3.39	0.05	0.58	0.85
(+25 to +35)	−0.77	6.04	−0.90	4.12	0.14	4.76	−0.08	0.62	0.73

Table A.2

Correlation of price returns across portfolios
July 1997–December 2014

Discount level	(−35 to −25)	(−25 to −15)	(−15 to −5)	(−5 to +5)	(+5 to +15)	(+15 to +25)	(+25 to +35)
(−35 to −25)	1.00	0.854	0.751	0.612	0.596	0.589	0.402
(−25 to −15)		1.00	0.876	0.695	0.684	0.681	0.514
(−15 to −5)			1.00	0.901	0.848	0.809	0.501
(−5 to +5)				1.00	0.939	0.836	0.487
(+5 to +15)					1.00	0.848	0.528
(+15 to +25)						1.00	0.529
(+25 to +35)							1.00

Table A.3

Correlation of price returns of portfolios with assets and styles
July 1997–December 2014

Discount level	ACWI	EM equity	S&P	EAFE	US bonds	EM bonds	Global growth	Global value	Global large cap	Global small cap
(−35 to −25)	0.701	0.710	0.645	0.687	−0.050	0.554	0.672	0.666	0.695	0.741
(−25 to −15)	0.798	0.830	0.738	0.771	−0.132	0.625	0.755	0.767	0.791	0.830
(−15 to −5)	0.823	0.800	0.763	0.797	0.092	0.671	0.776	0.800	0.811	0.858
(−5 to +5)	0.676	0.661	0.621	0.658	0.264	0.631	0.640	0.655	0.666	0.714
(+5 to +15)	0.646	0.633	0.618	0.608	0.125	0.588	0.605	0.638	0.638	0.676
(+15 to +25)	0.662	0.609	0.647	0.616	0.073	0.528	0.625	0.660	0.653	0.677
(+25 to +35)	0.329	0.359	0.341	0.282	−0.029	0.404	0.320	0.319	0.327	0.344

period, most NAV returns had positive contribution to total return; therefore there was minimal offsetting of discount returns on the average. Moreover, it is interesting to note that NAV returns have very little correlation with discount returns but those correlations are positive. This would indicate that on average, NAV returns of our discount portfolios would enhance discount returns not offset them for an un-hedged position.

We also reproduced Tables 3 and 4 using total returns instead of discount returns. These are Tables A2 and A3. The correlations between the discount portfolios themselves or between the discount portfolios and other asset classes are significantly stronger when compared with discount portfolio values in Tables 3 and 4. This is another indication that the magic lies with the discount portfolios we created and their low correlation with others in improving the risk-adjusted returns for global investors.

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Notes

[1] One of the earliest portfolios investing in closed-end funds is the *World Trust Fund*, a closed-end fund incorporated in Luxembourg in August 1991. Others include the *Emerging World Fund*, an open-end fund incorporated in Ireland in September 1998 and *Fondo de Inversion Global Optimization*, a closed-end fund incorporated in Chile in August 1997. These funds invest primarily in closed-end funds using a discount-oriented approach.

[2] From a practical viewpoint, pure discount returns could be generated with Swaps, ETFs, underlying shares, as well as CEFs. For example, an optimized portfolio of ETFs with minimum tracking error versus NAV returns of a portfolio of closed-end funds could be swapped at a low fixed cost. Of importance is that discount returns on these portfolios constitute a different source of returns ("risk premium returns") with low correlations to traditional assets and can provide a significant source of value to the global investor as further developed in the paper.

[3] In this section optimal allocations of discount portfolios and other asset classes are constructed without transaction costs. It should also be noted that these other asset class returns are gross of transaction costs as well as the discount portfolios. Including transactions costs for all assets, discount portfolios and other asset classes, would not significantly alter the attractiveness of adding discount portfolios to the traditional asset mix due to higher mean returns and, most importantly, low correlations of returns on the discount portfolios.

[4] Diversification gains in the context of this paper refer to the improvement in the risk/return relationship when discount portfolios are included in the asset mix, i.e. a North West expansion of the efficient frontier. That improvement stems not only from positive average returns of deeper discounts but also from their low correlations with more traditional asset returns. These discount portfolios, as well as the asset classes, contain a large number of funds which in turn contain a large number of securities. In particular, the average number of funds contained in the three deepest discount portfolios was 100.8 funds. Moreover, portfolios of closed-end funds are extremely diversified in the sense of holding a variety of sectors/industries on a look-through basis.

In addition, the observation that EM bond weight increases with the additional of discount portfolios in Table 5 does not mean less diversification based on the definition above. Also note that these frontiers were generated with constraints on holdings of discount portfolios alone. Holdings of other risk classes were not constrained. Optimal portfolios constructed with 5%–15% maximum holdings across all asset classes would include a greater number of assets in all optimal portfolios.

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