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# A closer look at trading strategies for U.S. equity closed-end investment companies

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**Abstract**

Earlier studies of U.S. closed-end investment companies (CEICs) examined whether the discount between CEIC price and net asset value could be exploited to gain excess returns. We advance these studies by investigating many more trading strategies and various transaction costs. We find that the role of the span between buy and sell trigger points is highly significant in determining returns, and that transaction costs impact returns and mitigate the influence of the trigger point span. Moreover, the 10 most successful strategies for each transaction cost level exhibit lower coefficients of variation than does the Standard & Poor's 500 (S&P 500) index. © 2001 Elsevier Science Inc. All rights reserved.

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## 1. Introduction

Closed-end investment companies (CEICs) are different from mutual funds because their shares trade in the secondary market and are not redeemable at the company. If the price is less (more) than the net asset value (NAV), the shares are said to sell at a discount (premium). Shares of CEICs usually sell at a discount to their NAV. Over the past two

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decades several studies have investigated whether discounts on U.S. equity CEICs can be exploited by investors to earn market-adjusted profits. The studies show that using ''trigger point'' trading strategies that buy CEICs at discounts to NAV and sell them once the discounts narrow generates returns greater than those of the overall market. These findings are of interest to both portfolio managers and to academic investigators of market efficiency.

Our research extends this body of literature by investigating a much more extensive set of strategies, many more trigger point spans (including very narrow spans), a 30-year time frame, sub-periods, and transaction costs as direct expenses in implementing each strategy. Unlike prior analyses, we model how CEIC trading returns are affected by changes in the buy point, the trigger point span, and the time frame in which the strategy is evaluated, for varying transaction cost levels.

## 2. Review of the literature

Over the past two decades studies of closed-end funds comprise four broad areas. One group of diverse studies attempts to isolate various factors associated with the magnitude and variability of discounts. Among these works are Malkiel (1995), who finds that both restricted stock holdings and unrecognized capital gains are positively associated with discounts. Also, Hardouvelis, La Porta, and Wizman (1994) and Richard and Wiggins (2000) report a strong relationship between premiums and future NAV returns. In another study, Coles, Suay, and Woodbury (2000) report that discounts decline as manager compensation rises. A second area of investigation addresses whether discounts are the result of the irrational behavior of noise traders. Findings in this arena often conflict as exemplified by Lee, Shleifer, and Thaler (1990, 1991), who argue that noise traders may explain discount magnitude/variability, whereas Brauer (1993) reports that only 7% of discount change can be attributed to noise traders. In the past 10 years, a third area of analysis is composed of a large number of studies addressing issues involving country funds that invest in target markets outside the United States. Issues of interest with country funds are potential diversification benefits, market segmentation, and market efficiency, among others. Bosner-Neal, Brauer, Neal, and Wheatley (1990), Bodurtha, Kim, and Lee (1995) and others report that investment restrictions are positively associated with fund premiums. Errunza (1991), Bailey and Lim (1992), Russell (1998) and others report that country funds behave more like their host markets than their target markets. However, Anderson, Coleman, Frohlich, and Steagall (2001) find that country fund returns are more closely allied with target country market returns than earlier studies report. In a different vein, O'Connor and Downe (2000) note the impact that world equity benchmark shares has on country fund pricing.

A fourth subject of investigation is that of trading strategies utilizing CEIC shares. The strategies employed in this area are of three varieties. The first is an ''equally weighted'' strategy, wherein CEICs are ranked by relative or absolute discount, and a portfolio is allocated equally among CEICs meeting the criterion for inclusion. Pontiff (1995), in his investigation of the predictive power of fund discounts, as well as some earlier studies employ this method. A second strategy involves allocating a portfolio proportionally among CEICs based on the relative size of the CEICs' discounts. Sias (1997) is a recent study

employing this strategy. Yet another type of study involves closed-end country funds, wherein strategies entail allocating moneys between market indexes and fund shares (see Arak & Taylor, 1996a,b). All three types of studies confirm that discounts are generally mean-reverting and that strategy returns from purchasing high-discount funds exceed those from purchasing low-discount funds. Our current analysis of equally weighted trading strategies described in the next section significantly extends this fourth area of study.

## 3. Data

### 3.1. Source

The data we use are weekly prices, net asset values, and dividends for 54 U.S. equity CEICs from January 1967 to December 1996 (1,564 weeks). Prices and net asset values are taken from the *Wall Street Journal*, and dividends from *Moody's Dividend Record*. Stock splits and stock dividends rarely occur with CEICs; however prices and dividends are adjusted accordingly. Dividends are impounded on the ex date for return purposes. A listing of all CEICs included in the analysis is provided in Table 1, along with the dates in which each CEIC is in operation during the evaluation period. Each of the 54 CEICs selected is classified as a ''general equity fund'' or ''specialized equity fund'' by *Wall Street Journal*. Most of these funds focus primarily on U.S. securities, but several include limited exposure to other developed global markets. The sample does not include any firms classified by *Wall Street Journal* as an ''income and preferred stock fund,'' ''convertible securities fund,'' or ''world equity fund.'' Since most of the CEICs examined are not in operation over the entire 30-year period, each week's investment decisions consider only those CEICs within the set of 54 for which weekly returns are available. On average, there are 16.9 funds available for consideration each week. Only 5% of the weeks have nine or fewer funds available. About 70% of the weeks have 18 or fewer available, and the remaining 30% have between 18 and 42.

### 3.2. Description

We initially investigate the price behavior of the entire sample with a simple market model to determine the riskiness of each fund:

$$\text{Return}_f = \Upsilon_f' + \upsilon_f'(\text{Market Return}) + \Omega_f' \tag{1}$$

where, $\text{Return}_f$ is the weekly return for fund $f$, 'Market Return' the weekly return for the market index (S&P 500 or Dow); $\Upsilon_f'$ coefficient of market return for fund $f$, $\Omega_f'$ is the error term for fund $f$.

We compute weekly betas for each fund using both the Standard & Poor's 500 (S&P 500) and the Dow Jones industrial index (Dow), which are taken from *Bloomberg* (dividends included). Table 1 contains the mean annual beta for each fund when using the S&P 500 as the market proxy. The weighted average and equally weighted average annual betas using the S&P 500 are 0.61 and 0.58, respectively, while these averages using the Dow are 0.56

Table 1
U.S. equity closed-end investment companies used in analysis of trading strategies

| Closed-end investment company | First week analyzed | Last week analyzed | Mean annual beta |
|---|---|---|---|
| Adams Express Company | 1/6/67 | 12/27/96 | 0.55 |
| Alliance All-Market Advantage Fund | 11/4/94 | 12/27/96 | 0.09 |
| Alliance Global Environment Fund | 6/15/90 | 12/27/96 | 0.70 |
| Avalon Capital Inc. | 12/15/95 | 12/27/96 | 0.14 |
| Baker Fentress & Company | 9/10/71 | 12/27/96 | 0.62 |
| Bergstrom Capital Corporation | 1/6/89 | 12/27/96 | 0.32 |
| Blue Chip Value Fund Inc. | 4/24/87 | 12/27/96 | 0.65 |
| Cohen & Steers Realty Income Fund | 6/11/93 | 12/27/96 | 0.32 |
| Cohen & Steers Total Return Realty Fund | 10/1/93 | 12/27/96 | 0.10 |
| Carriers & General Corporation | 1/6/67 | 4/21/78 | 0.46 |
| Central Fund of Canada | 4/11/86 | 12/27/96 | −0.03 |
| Central Securities Corporation | 7/7/72 | 12/27/96 | 0.55 |
| Claremont Capital Corporation | 2/18/77 | 12/28/84 | 0.40 |
| Delaware Group Global Dividend & Income Fund | 4/23/93 | 12/27/96 | 0.15 |
| Delaware Group Dividend & Income Fund | 4/8/94 | 12/27/96 | 0.31 |
| The Dominick Fund Inc. | 1/6/67 | 9/27/74 | 0.63 |
| Duff & Phelps Utilities Income Fund | 1/30/87 | 12/27/96 | 0.28 |
| Engex Inc. | 1/2/81 | 12/28/84 | 0.51 |
| Equus II Inc. | 11/5/93 | 12/27/96 | 0.97 |
| First Financial Fund | 5/16/86 | 12/27/96 | 0.83 |
| Gabelli Equity Trust | 9/5/86 | 12/27/96 | 0.62 |
| Gabelli Global Multimedia Trust | 11/18/94 | 12/27/96 | 0.34 |
| General American Investors Company | 1/6/67 | 12/27/96 | 0.79 |
| H&Q Healthcare Investors | 5/1/87 | 12/27/96 | 0.90 |
| H&Q Life Sciences Investors | 5/8/92 | 12/27/96 | 1.08 |
| Inefficient Markets Fund | 2/16/90 | 12/27/96 | 0.53 |
| John Hancock Bank & Thrift Opportunity Fund | 8/26/94 | 12/27/96 | 0.85 |
| John Hancock Patriot Global Dividend Fund | 2/17/95 | 12/27/96 | 0.89 |
| John Hancock Patriot Select Dividend Fund | 2/17/95 | 12/27/96 | 0.43 |
| Lehman Corporation | 1/6/67 | 5/11/90 | 0.73 |
| Liberty All-Star Equity Fund | 11/7/86 | 12/27/96 | 0.66 |
| Liberty All-Star Growth Fund | 11/10/95 | 12/27/96 | 1.33 |
| MFS Special Value | 11/15/96 | 12/27/96 | 0.51 |
| Madison Funds | 1/6/67 | 7/1/83 | 0.83 |
| Morgan Funshares Inc. | 7/15/94 | 12/27/96 | 0.29 |
| Morgan Grenfell Small-cap Fund | 5/22/87 | 12/27/96 | 0.91 |
| NAIC Growth Fund | 1/7/94 | 12/27/96 | −0.21 |
| National Aviation & Technology Fund | 7/9/65 | 4/20/79 | 1.13 |
| Nations Balanced Target Maturity Fund | 7/29/94 | 12/27/96 | 0.60 |
| Nautilus Fund | 2/23/79 | 12/28/84 | 1.01 |
| New Age Media Fund Inc. | 10/29/93 | 12/27/96 | 0.85 |
| New America High Income Fund | 8/3/73 | 12/28/84 | 0.33 |
| Niagara Shares | 1/6/67 | 7/17/92 | 0.63 |
| Petroleum & Resources Corporation | 1/6/67 | 12/27/96 | 0.62 |
| Pilgrim America Bank & Thrift Fund Inc. | 1/31/86 | 12/27/96 | 0.76 |
| Royce Global Trust Inc. | 11/21/86 | 12/27/96 | 0.54 |
| Royce Micro-Cap Trust Inc. | 12/23/93 | 12/27/96 | 0.61 |

Table 1 (*Continued*)

| Closed-end investment company | First week analyzed | Last week analyzed | Mean annual beta |
|---|---|---|---|
| Salomon Brothers Fund | 5/18/90 | 12/27/96 | 0.77 |
| Southeastern Thrift & Bank Fund | 9/9/89 | 12/27/96 | 0.38 |
| Source Capital Inc. | 10/20/72 | 12/27/96 | 0.51 |
| Standard Shares | 1/6/67 | 5/5/78 | 0.70 |
| Tri-Continental Corporation | 1/6/67 | 12/27/96 | 0.73 |
| The United Corporation | 1/6/67 | 2/3/78 | 0.40 |
| Zweig Fund | 10/3/86 | 12/27/96 | 0.47 |

The mean annual beta reported for each of the 54 funds uses the S&P 500 as the market proxy. On average, there are 16.9 funds available for consideration in each of the 1,564 weeks (30 years) examined.

and 0.52, respectively. Only four funds have average annual betas greater than 1.00, and these funds have short data horizons. The annual betas range from −0.20 to 1.33 for the S&P 500, and from −0.23 to 1.37 for the Dow, respectively. We also compute cross-sectional betas for each year, and find the mean beta to be 0.63, with a range of 0.30–0.97, for the S&P 500, while the mean beta computed using the Dow is 0.59, with a range of 0.27–0.98. These fund betas reveal that these shares on average are considerably less risky than equities overall.

## 4. Methodology

For each week, the discount between market price and NAV for each CEIC is computed as

$$\text{discount} = \frac{\text{market price} - \text{NAV}}{\text{NAV}} \tag{2}$$

Positive discount values represent CEICs selling at a premium.

The value of the investment portfolio in all cases is set at $100,000 at the beginning of the 30-year period. A total of 244 different investment strategies is analyzed, each of which is a unique combination of buy and sell trigger points. Any CEIC with a discount in a given week equal to or deeper than the buy point is flagged for investment during that week. Similarly, any CEIC with a discount in a given week equal to or shallower than the sell point is flagged to be sold during that week. The buy point is a deeper discount than the sell point for all strategies. The strategies included in this research employ all integer buy points from −2% to −25% and all integer sell points from 0% to −23%, resulting in a minimum span of 2% points and a maximum span of 15% points. To illustrate how these parameters work, a buy point of −25% is combined with sell points from −10% to −23%, while another buy point of, say, −12%, is combined with sell points from 0% to −10%.

An equally weighted strategy is employed to invest in CEICs with current discounts equal to or deeper than a buy point. For example, if four funds are selected in the first week, then $25,000 is invested in each one. If in week 2, one of the four fund's discount narrows sufficiently to trigger a sell, the value of each holding is determined by multiplying the

number of shares held for each CEIC by its current share price, plus any dividends for the week. For the fund being liquidated, transaction costs are subtracted from the value of the shares and the moneys are then equally divided among each CEIC retained. Transaction costs are also assessed against the additional shares purchased for the remaining funds. If in week 3 an additional fund's discount triggers a buy, the value of the portfolio is determined and moneys are reallocated equally among the funds. In sum, any time we change the amount invested in a fund due to a reallocation decision, transaction costs are charged against the amount of the change for both buying or selling. Any CEIC for which no price data is available for three consecutive weeks is automatically liquidated from the portfolio at the last available price. In any week in which there are no CEICs that meet the criteria to be included in the portfolio, the entire portfolio is assumed to be invested in the S&P 500 for that week. The return to the S&P 500 for that week represents the return to the investment portfolio.

The performance measure of interest is the cumulative marginal return of each strategy versus the return that would have been derived through investment in the S&P 500. In each week, the marginal return is computed as the difference between the return to the portfolio over the previous week and the return to the S&P 500 (including dividends) in that same week. The cumulative marginal return for a given strategy is computed as the cumulative product of all weekly marginal returns over the 5-year time frame. A cumulative product of 1.00 represents returns that are equal to the returns of the S&P 500. Any product greater (less) than 1.00 is indicative of a strategy that yields results superior (inferior) to those of the S&P 500.

Three different transaction costs are included in the analysis of the complete data set: 1%, 2%, and 3%. Prior to May 1, 1975, commission expenses ranged from approximately 1% to approximately 2%, depending upon the share price and the number of shares traded. Following May Day, discount brokers (source and W.T. Cabe and Company, among others), discounted commissions by as much as 75%, as advertised in the *Wall Street Journal*. Today, it is common to trade for less than 1%. Once market impact and bid/ask spreads are considered, transaction costs between 1% and 3% seem to be a realistic assumption.

The three transaction cost levels and the 244 different investment strategies necessitate 732 initial runs of the investment procedure model. Because the prevailing level of CEIC discounts is variable over time (see DeLong, Schleifer, Summers, and Waldman, 1991, 1992), we also divide the data into six 5-year periods to investigate whether discount variability impacts strategies differently in various periods. The first week of January of the years 1967, 1972, 1977, 1982, 1987, and 1992, is the start of each of the six sub-groups.

The following ordinary least squares regression model is constructed to define the behavior of cumulative marginal return with respect to the depth of the buy point discount and the span between buy point and sell point. Results from all 6 of the 5-year time frames are pooled into a single regression, with a separate model constructed for each of the three different transaction cost levels.

$$\begin{aligned}\mathrm{CMR}_s = {} & \Upsilon'_{67-71} + \Upsilon'_{72-76} + \Upsilon'_{77-81} + \Upsilon'_{82-86} + \Upsilon'_{87-91} + \Upsilon'_{92-96} + \upsilon'_{67-71}\mathrm{BUY}_{67-71} \\ & + \upsilon'_{72-76}\mathrm{BUY}_{72-76} + \upsilon'_{77-81}\mathrm{BUY}_{77-81} + \upsilon'_{82-86}\mathrm{BUY}_{82-86} + \upsilon'_{87-91}\mathrm{BUY}_{87-91} \\ & + \upsilon'_{92-96}\mathrm{BUY}_{92-96} + \upsilon'_{67-71}\mathrm{SPAN}_{67-71} + \upsilon'_{72-76}\mathrm{SPAN}_{72-76} + \upsilon'_{77-81}\mathrm{SPAN}_{77-81} \\ & + \varepsilon_{82-86}\mathrm{SPAN}_{82-86} + \varepsilon_{87-91}\mathrm{SPAN}_{87-91} + \varepsilon_{92-96}\mathrm{SPAN}_{92-96} + \Omega'_s\end{aligned}$$

where, $CMR_s$ is the cumulative marginal return for strategy $s$; $\Upsilon'_{xx-yy}$ the constant effect for the time frame 19$xx$–19$yy$, $\upsilon'_{xx-yy}$ the effect of making buy point discount 1% point deeper from 19$xx$ to 19$yy$; $BUY_{xx-yy}$ the buy point in years 19$xx$–19$yy$ (coded as a positive value); $\varepsilon_{xx-yy}$ the effect of 1% point increase in the span between buy point and sell point from 19$xx$ to 19$yy$; $SPAN_{xx-yy}$ the percentage points of span between buy point and sell point from 19$xx$ to 19$yy$ and $\Omega'_s$ the error term for strategy $s$.

The results from the regression analysis are shown in Table 2. Given the findings of previous literature regarding the success of buying at deep discounts, the coefficient of the buy point was hypothesized to be positive, and therefore the reported significance levels for the buy point variables are one-tailed. Although previous literature has not spoken directly to the issue of how

Table 2
Estimated regression coefficients (dependent variable = cumulative marginal return)

| Years | Intercept | Buy point | Span |
|---|---|---|---|
| 1% Transaction cost level ($R^2 = 0.9862$) | | | |
| 1967–1971 | 1.21972** | 0.00733** | −0.00490* |
| 1972–1976 | 1.11846** | 0.00969** | −0.01440** |
| 1977–1981 | 1.58466** | 0.01267** | −0.00305 |
| 1982–1986 | 0.93545** | 0.03523** | −0.01896** |
| 1987–1991 | 0.76149** | 0.04332** | −0.04790** |
| 1992–1996 | 1.25075** | −0.01617 | 0.01239 |
| 2% Transaction cost level ($R^2 = 0.9898$) | | | |
| 1967–1971 | 0.73160** | 0.00884** | 0.02108 |
| 1972–1976 | 0.97866** | 0.00014 | 0.00145 |
| 1977–1981 | 1.40554** | −0.00122 | 0.02222 |
| 1982–1986 | 0.63467** | 0.02848** | 0.00680 |
| 1987–1991 | 0.53540** | 0.02401** | −0.00845** |
| 1992–1996 | 0.90922** | −0.01391 | 0.02969 |
| 3% Transaction cost level ($R^2 = 0.9873$) | | | |
| 1967–1971 | 0.40784** | 0.01002** | 0.03487 |
| 1972–1976 | 0.85750** | −0.00625 | 0.01192 |
| 1977–1981 | 1.24868** | −0.01065 | 0.03933 |
| 1982–1986 | 0.41407** | 0.02327** | 0.02404 |
| 1987–1991 | 0.38113** | 0.01353** | 0.01171 |
| 1992–1996 | 0.65888** | −0.01149 | 0.03945 |

Test is two-tailed for the intercept, and one-tailed for the buy point and span coefficients (hypothesized to be positive and negative, respectively). A separate model is constructed for each of the three different transaction cost levels, with all six time frames pooled into a single regression. With $CMR_s$ as the cumulative marginal return for strategy $s$, the regression model is $CMR_s = \Upsilon'_{67-71} + \Upsilon'_{72-76} + \Upsilon'_{77-81} + \Upsilon'_{82-86} + \Upsilon'_{87-91} + \Upsilon'_{92-96} + \upsilon'_{67-71}BUY_{67-71} + \upsilon'_{72-76}BUY_{72-76} + \upsilon'_{77-81}BUY_{77-81} + \upsilon'_{82-86}BUY_{82-86} + \upsilon'_{87-91}BUY_{87-91} + \upsilon'_{92-96}BUY_{92-96} + \upsilon'_{67-71}SPAN_{67-71} + \upsilon'_{72-76}SPAN_{72-76} + \upsilon'_{77-81}SPAN_{77-81} + \varepsilon_{82-86}SPAN_{82-86} + \varepsilon_{87-91}SPAN_{87-91} + \varepsilon_{92-96}SPAN_{92-96} + \Omega'_s$, where $BUY_{xx-yy}$ represents the buy point discount (%) in years 19$xx$–19$yy$ (coded as a positive value), and $SPAN_{xx-yy}$ represents the percentage points of span between buy point and sell point from 19$xx$ to 19$yy$. The parameter $\Upsilon'_{xx-yy}$ is the constant effect for the time frame 19$xx$–19$yy$, $\upsilon'_{xx-yy}$ is the effect of making the buy point discount 1% point deeper from 19$xx$ to 19$yy$, and $\varepsilon_{xx-yy}$ is the effect of a 1% point increase in the span between buy point and sell point from 19$xx$ to 19$yy$.

* Significant at 0.05 level.

** Significant at 0.01 level.

spans between trigger points affect trading strategy returns, observation of the results from Anderson and Stanford (1993), Pontiff (1995) and Sias (1997) suggests that strategies with relatively narrow spans achieve higher returns. Thus, the coefficients of the span variables are hypothesized to be negative, and the reported significance levels are also one-tailed. Significance levels for the intercept terms are two-tailed (these terms are included in the model only to allow estimation of differing buy point and span coefficients across time frames).

In addition to the regression model, strategies are ranked from the most profitable to the least profitable for each transaction cost level. Tables 3 and 4 show the 10 most profitable and 10 least profitable strategies, respectively, for each of the three transaction cost rates.

Table 3
Ten most profitable strategies (out of 244), cumulative over 30 years (1,564 weeks)

| Rank | Buy point discount | Sell point discount | Cumulative return in excess of S&P 500 | Mean weekly return | Standard deviation of weekly return | Weeks not invested in one strategy | Weeks with only fund | Weeks with >5 funds |
|---|---|---|---|---|---|---|---|---|
| 1% Transaction cost level | | | | | | | | |
| 1 | 21% | 18% | 1619.4% | 0.441% | 2.559% | 429% | 248% | 594% |
| 2 | 21% | 19% | 1492.5% | 0.436% | 2.554% | 469% | 238% | 571% |
| 3 | 22% | 18% | 1297.8% | 0.428% | 2.574% | 482% | 248% | 558% |
| 4 | 22% | 19% | 1262.8% | 0.426% | 2.574% | 521% | 229% | 544% |
| 5 | 21% | 17% | 1251.7% | 0.428% | 2.593% | 91% | 229% | 616% |
| 6 | 20% | 16% | 1210.6% | 0.421% | 2.390% | 305% | 200% | 728% |
| 7 | 20% | 18% | 1202.0% | 0.422% | 2.501% | 364% | 228% | 641% |
| 8 | 20% | 17% | 1200.2% | 0.422% | 2.506% | 349% | 197% | 680% |
| 9 | 25% | 20% | 1152.3% | 0.419% | 2.495% | 655% | 236% | 437% |
| 10 | 24% | 20% | 1075.2% | 0.415% | 2.526% | 631% | 228% | 468% |
| 2% Transaction cost level | | | | | | | | |
| 1 | 25% | 18% | 375.0% | 0.358% | 2.520% | 593% | 262% | 464% |
| 2 | 25% | 20% | 346.5% | 0.353% | 2.497% | 655% | 236% | 437% |
| 3 | 25% | 19% | 282.9% | 0.343% | 2.490% | 629% | 236% | 445% |
| 4 | 18% | 10% | 261.5% | 0.335% | 2.186% | 66% | 156% | 1009% |
| 5 | 23% | 16% | 256.0% | 0.34% | 2.531% | 502% | 211% | 556% |
| 6 | 18% | 9% | 248.5% | 0.332% | 2.170% | 57% | 119% | 1017% |
| 7 | 25% | 21% | 248.4% | 0.337% | 2.518% | 673% | 227% | 426% |
| 8 | 18% | 11% | 243.3% | 0.331% | 2.185% | 86% | 137% | 976% |
| 9 | 18% | 8% | 240.6% | 0.33% | 2.156% | 50% | 117% | 1036% |
| 10 | 24% | 18% | 239.0% | 0.337% | 2.571% | 551% | 273% | 495% |
| 3% Transaction cost level | | | | | | | | |
| 1 | 25% | 18% | 113.3% | 0.307% | 2.534% | 593% | 262% | 464% |
| 2 | 25% | 13% | 78.5% | 0.295% | 2.441% | 387% | 269% | 567% |
| 3 | 25% | 10% | 60.5% | 0.283% | 2.214% | 312% | 87% | 605% |
| 4 | 25% | 20% | 58.6% | 0.287% | 2.516% | 655% | 236% | 437% |
| 5 | 18% | 8% | 57.9% | 0.282% | 2.173% | 50% | 117% | 1036% |
| 6 | 18% | 7% | 55.6% | 0.281% | 2.173% | 33% | 134% | 1074% |
| 7 | 25% | 19% | 55.3% | 0.285% | 2.506% | 629% | 236% | 445% |
| 8 | 18% | 5% | 52.9% | 0.279% | 2.163% | 33% | 124% | 1096% |
| 9 | 18% | 9% | 51.4% | 0.279% | 2.188% | 57% | 119% | 1017% |
| 10 | 25% | 14% | 49.6% | 0.287% | 2.583% | 400% | 317% | 548% |

Table 4
Ten least profitable strategies (out of 244), cumulative over 30 years (1,564 weeks)

| Rank | Buy point discount | Sell point discount | Cumulative return in excess of S&P 500 | Mean weekly return | Standard deviation of weekly return | Weeks not invested in one strategy | Weeks with only fund | Weeks with >5 funds |
|---|---|---|---|---|---|---|---|---|
| 1% Transaction cost level | | | | | | | | |
| 235 | 5% | 2% | 127.2% | 0.299% | 1.804% | 1% | 0% | 1488% |
| 236 | 4% | 1% | 126.6% | 0.299% | 1.792% | 1% | 0% | 1510% |
| 237 | 5% | 0% | 122.2% | 0.297% | 1.794% | 1% | 0% | 1511% |
| 238 | 4% | 0% | 119.5% | 0.297% | 1.791% | 1% | 0% | 1518% |
| 239 | 6% | 4% | 114.8% | 0.296% | 1.830% | 1% | 2% | 1436% |
| 240 | 4% | 2% | 111.8% | 0.294% | 1.798% | 1% | 0% | 1502% |
| 241 | 5% | 3% | 105.9% | 0.293% | 1.822% | 1% | 2% | 1472% |
| 242 | 8% | 6% | 102.7% | 0.292% | 1.858% | 1% | 27% | 1374% |
| 243 | 3% | 0% | 96.2% | 0.289% | 1.789% | 1% | 0% | 1523% |
| 244 | 3% | 1% | 92.6% | 0.288% | 1.792% | 1% | 0% | 1518% |
| 2% Transaction cost level | | | | | | | | |
| 235 | 10% | 8% | −58.2% | 0.193% | 1.933% | 2% | 62% | 1322% |
| 236 | 11% | 9% | −59.5% | 0.191% | 1.960% | 5% | 66% | 1281% |
| 237 | 9% | 7% | −62.2% | 0.186% | 1.888% | 1% | 48% | 1346% |
| 238 | 19% | 17% | −64.0% | 0.192% | 2.469% | 293% | 185% | 745% |
| 239 | 18% | 16% | −64.4% | 0.189% | 2.323% | 226% | 174% | 829% |
| 240 | 17% | 15% | −65.4% | 0.186% | 2.251% | 155% | 172% | 901% |
| 241 | 8% | 6% | −66.1% | 0.178% | 1.871% | 1% | 27% | 1374% |
| 242 | 14% | 12% | −67.8% | 0.178% | 2.085% | 45% | 94% | 1120% |
| 243 | 15% | 13% | −72.8% | 0.168% | 2.113% | 69% | 102% | 1053% |
| 244 | 16% | 14% | −79.6% | 0.151% | 2.182% | 91% | 148% | 981% |
| 3% Transaction cost level | | | | | | | | |
| 235 | 8% | 6% | −94.3% | 0.065% | 1.902% | 1% | 27% | 1374% |
| 236 | 21% | 19% | −94.9% | 0.072% | 2.648% | 469% | 238% | 571% |
| 237 | 13% | 11% | −95.4% | 0.054% | 2.077% | 27% | 78% | 1178% |
| 238 | 14% | 12% | −97.4% | 0.019% | 2.156% | 45% | 94% | 1120% |
| 239 | 17% | 15% | −98.1% | 0.003% | 2.315% | 155% | 172% | 901% |
| 240 | 20% | 18% | −98.1% | 0.007% | 2.608% | 364% | 228% | 641% |
| 241 | 18% | 16% | −98.2% | 0.000% | 2.389% | 226% | 174% | 829% |
| 242 | 19% | 17% | −98.2% | 0.003% | 2.533% | 293% | 185% | 745% |
| 243 | 15% | 13% | −98.3% | −0.005% | 2.187% | 69% | 102% | 1053% |
| 244 | 16% | 14% | −99.0% | −0.038% | 2.261% | 91% | 148% | 981% |

## 5. Results

Our results support earlier findings that trading strategies employing discounts of CEICs generate returns often well in excess of market returns, regardless of transaction costs. Table 3 displays the most profitable 10 strategies for each transaction cost level, as well as a summary of the number of weeks in which the strategy invested in various numbers of funds. The highest cumulative marginal returns for the 1%, 2%, and 3% cost levels are 1,619%, 375%, and 113%, respectively. At the 3% level, the transaction costs significantly erode the

substantial profits generated at the 1% and 2% levels, but still allow profits well in excess of the S&P 500. (The S&P 500 returned 12.9% annually, or 0.234% weekly, over the 30 years we examine.) The most profitable strategies typically invested in funds in more than 70% of the weeks, and very frequently held five or more funds. Although earlier studies did not directly consider the impact of transaction costs, our findings support their conclusions that trading strategies can generate market returns.

Table 4 presents the 10 least profitable strategies for each transaction cost level. Examination of the results illustrates the importance of transaction costs on profits. Whereas the least profitable strategy at the 1% level still generates returns that nearly double those of the S&P 500, higher costs in conjunction with certain strategies can result in returns well below the market.

Tables 3 and 4 suggest that generally the deeper the discount at which shares are purchased, the higher the rate of return to the portfolio. The most profitable strategies buy at very deep discounts, regardless of the transaction costs. The average buy point for the 10 most profitable strategies is approximately −22% for all three cost levels. This result is consistent with earlier studies. Conversely, prior studies have not revealed that at relatively low transaction costs, narrow-span strategies generate the largest returns. The 10 most profitable strategies at a 1% cost level employ an average span between buy and sell trigger points of 3.4% points, compared to an average span of 6.9 and 9.9 for the 2% and 3% levels, respectively. Higher costs per trade, when combined with more trades resulting from narrow-span strategies, eliminate much of their relative benefit. Table 4 provides supporting evidence. Even with the advantage of buying at deep discounts, high transaction costs combined with narrow-span strategies result in negative cumulative marginal returns. Indeed, all 10 of the worst strategies with both 2% and 3% costs use the narrowest span of 2% points.

Tables 3 and 4 also present the return standard deviations for the strategies. Interestingly, the best strategies' standard deviations appear to be approximately the same as the S&P 500's return standard deviation of 2.02% over the 30-year period. In order to better assess the relative riskiness of the strategies, we compare strategy returns and standard deviations with those of the S&P 500 by computing the coefficients of variation ($CV = \sigma/\mu$) for all three cost levels. The S&P 500's CV of 8.63 exceeds the mean CV of the 10 best strategies at the 1% level ($CV = 5.94$), 2% level ($CV = 7.01$), and 3% level ($CV = 8.19$), thus suggesting that these strategies are no more risky than the S&P 500.

The results from our regression models (see Table 2) confirm the findings outlined, but also illustrate that strategy performance is a function of the time period evaluated. In general, the deeper the discount at which CEICs are purchased, the higher the rate of return to the portfolio. For the lowest transaction costs, the regression coefficient of the buy point variable in every 5-year time frame except 1992–1996 is not only positive, but also statistically significant at the 0.01 level. The same is true when paying 2% or 3% transaction costs for three of the time frames, with 1992–1996 again yielding opposite results. However, at the highest cost level, deeper discount strategies also yield low performance in the time frame from 1972 to 1981, with coefficients that are actually statistically significant in the opposite (negative) direction hypothesized.

Our regression results also confirm that for low transaction costs, small spans between the buy and sell trigger points generate higher returns. For 1% costs, the coefficient of the span

variable is negative and statistically significant at the 0.05 level in four of the six time periods. For higher transaction costs, the high turnover and costs necessary to implement narrow-span strategies negate their advantages. The coefficient of the span variable is statistically significant in the opposite (positive) direction for all time frames with 3% costs, and four of the six time frames with 2% costs (1972–1976 and 1987–1991 are the exceptions).

Although both the buy point and the span play significant roles in determining strategy performance, a percentage point move in the span can impact the cumulative marginal return more heavily than a percentage point move in the buy point. In the majority of cases (11 of 18 comparisons), the absolute value of the span coefficient is larger than the absolute value of the coefficient of the buy point over the same time frame and transaction cost level. This finding underscores the key role of the span, and not just the buy point, when evaluating trading strategies.

From 1992 to 1996, the results associated with the depth of the buy point are reversed from those of the first 25 years analyzed. The effect of the span on cumulative marginal return is also different at the 1% cost level, although the span effect is similar at the 2% and 3% cost levels. Whereas deep discount buying generally yields the highest marginal returns from 1967 to 1991, buying at the deepest discounts actually yields the worst results in the last 5 years studied, at all three cost levels (the three buy point coefficients for 1992–1996 are statistically significant in the opposite direction hypothesized). At least a partial explanation of this behavior is that in this time frame, there are simply fewer CEICs selling at deep discounts. Therefore, such strategies have little opportunity to build returns. While this might seem to be an anomaly, it is not inconsistent with the reflecting barriers model proposed by Cootner (1963), and supported by Anderson and Stanford (1993). Cootner's model proposes that barriers around intrinsic values (i.e., NAVs), as well as the intrinsic values themselves, change over time. Thus, during certain periods, we can expect the deepest discount strategies to perform relatively poorly if smaller discounts dominate the closed-end fund market. Whether the 1992–1996 behavior will persist is questionable. Under Cootner's model, it is conceivable that deep discount strategies could dominate in the future.

## 6. Summary and conclusions

We confirm the general advantages of trading strategies that purchase CEICs at deep discounts. We also find that the 10 most successful strategies for each transaction cost level exhibit lower coefficients of variation than does the S&P 500 index. Although not reported in prior research, we determine that the span between the buy and sell trigger points plays a significant role in the success of a trading strategy, and that this role is mitigated significantly by the magnitude of transaction costs. Returns to strategies with very small spans can more than offset the additional costs due to turnover for investors with low transaction costs. Indeed, very small spans combined with deep discount buy points generate the highest returns. However, for investors with medium to high transaction costs, the advantages of trading strategies with narrow spans erode considerably, across the board. The results also reveal that the strategy performance is affected by the time frame analyzed.

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