An Alternative Testable Form of the Consumption CAPM
Author(s): Hossein B. Kazemi
Source: *The Journal of Finance*, Vol. 43, No. 1 (Mar., 1988), pp. 61-70
Published by: Blackwell Publishing for the American Finance Association
Stable URL: http://www.jstor.org/stable/2328322
Accessed: 26/11/2009 07:34

THE JOURNAL OF FINANCE • VOL. XLIII, NO. 1 • MARCH 1988

Closed-End Fund Shares' Abnormal Returns and the Information Content of Discounts and Premiums

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ABSTRACT

Closed-end funds' discounts contain information in the sense that they can be used to construct portfolios that earn returns exceeding those predicted by the two-factor capital asset pricing model. The precise nature of the information contained in a discount is not clear, however. This paper provides evidence that the information contained in a discount is an incomplete prediction of the fund's likelihood of being open-ended profitably.

THOMPSON [18] INVESTIGATED THE EXTENT to which closed-end funds' share price discounts and premiums relative to net asset value convey useable information about future rates of return on the funds' shares. He found that an ad hoc strategy of investing in portfolios of stocks selling at discounts significantly outperformed the returns predicted by the Black [3] two-factor asset pricing model. In other words, closed-end fund discounts and premiums do contain information about future returns in addition to that captured by the benchmark model. The precise nature of the information contained in the discounts and premiums is a mystery, however.

This paper presents and tests a model of the information content of closed-end fund discounts and premiums based upon the prospects for a form of organizational restructuring known as open-ending. The term "open-ending" refers to a set of techniques for forcing a closed-end fund's share price to its traditionally higher net asset value: converting the fund to an open-end fund, merging the fund with an open-end fund, or liquidating the fund's assets and distributing the proceeds to the shareholders. While both Brauer [4] and Brickley and Schallheim [5] have shown that *actual* open-endings involve significant benefits to shareholders, the focus of this paper is on the valuation effects of the *potential* for open-ending. The analysis shows that the probability of profitably open-ending a fund should affect the fund's market value, that the discount is only one element in a larger information structure about the probability of open-ending, and that changes in this probability are not fully and immediately reflected in the share price.

Section I introduces a straightforward model of the effect of open-ending potential on closed-end fund value. The model provides a compact expression for

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the market value of a closed-end fund as an increasing function of, among other things, the probability of open-ending. Section II presents the mechanism for empirically assessing the probability of open-ending a fund. The results indicate that a fund's discount appears to be only one element in a larger information structure about the likelihood of the fund being open-ended. Section III uses open-ending likelihood assessments to construct investment portfolios and compares the portfolio returns with those predicted by the Black two-factor model. The open-ending-based portfolios significantly outperform not only the Black two-factor model, but Thompson's discount-only strategy as well, showing that the open-ending assessments contain even more information than that captured by the discount. Section IV summarizes and concludes the paper.

I. A Model of the Effect of Open-Ending Potential on Closed-End Fund Value

In accordance with the American Institute of Certified Public Accountants [11] and the Securities and Exchange Commission [12], investment company assets are reported at their current market values. If the company is organized as an open-end fund, all trades in the shares take place between the fund and its shareholders at the net asset value, which is calculated by subtracting liabilities from the reported asset value and dividing by the number of outstanding shares. In contrast, if the company is organized as a closed-end fund, after the shares are initially issued all trades take place between individual shareholders at a price determined by supply and demand, and that price need not equal the net asset value. When closed-end fund shares trade at a discount to their net asset value, open-ending the fund could benefit shareholders. The probability of such a profitable restructuring should be reflected in the share price in an efficient market.

A. One Period

Consider a package of assets (e.g., securities) that is expected to exist indefinitely. Equity ownership claims against this package are currently organized as shares in a closed-end fund but may be restructured as open-end fund shares (or their equivalent) over the next period. If not restructured, the claims will remain as closed-end fund shares permanently.[1] All claims are traded in a perfect capital market. However, a significant friction in the market for corporate control makes the probability of open-ending less than one even when the value of open-end shares is greater than the value of closed-end shares. The nature of this friction is defined more precisely in the next section. Denote the value of a share at the end of the period if no conversion takes place with CEV, the value of a share at the end of the period if a conversion does take place with NAV, and the probability of open-ending *during the period* with p. At the end of the period, the asset package will produce a cash flow to the equity holders with an expected value of $\mathrm{E}(\tilde{C}F)$ regardless of the form of the claims from that time forward. Cash flows

[1] Note that the single-period nature of this initial analysis relates to the conversion of the contingent claims and not to the life of the underlying asset package.

in subsequent periods will depend, in part, upon the claims structure and have capitalized values of either CEV or NAV. Let the closed-end fund share sell for price P at the beginning of the period and define

$$V_0 \equiv P - \mathrm{PV}[\mathrm{E}(\tilde{C}F)] \tag{1}$$

as the value of the share that does not depend upon this period's cash flow where PV denotes present value.

If the appropriate discount rate for the expected end-of-period claim is r, then

$$V_0 = \frac{pNAV + (1-p)CEV}{1+r}. \tag{2}$$

Following Malatesta's and Thompson's [14] analysis of partially anticipated events,[2] in an efficient market where the Black asset pricing model with factors γ_0 and γ_1 holds,

$$\mathrm{E}(r) = \gamma_0 + \gamma_1\beta, \tag{3}$$

where β is the beta of the open-ending process, but

$$\mathrm{E}(r \mid NO) = \left[\gamma_0 + \gamma_1\beta - \frac{p(NAV - CEV)}{V_0}\right] < \gamma_0 + \gamma_1\beta \tag{4a}$$

and

$$\mathrm{E}(r \mid O) = \left[\gamma_0 + \gamma_1\beta + (1-p)\,\frac{(NAV - CEV)}{V_0}\right] > \gamma_0 + \gamma_1\beta, \tag{4b}$$

where $\mathrm{E}(r \mid NO)$ and $\mathrm{E}(r \mid O)$ are the expected returns conditional upon no open-ending and upon open-ending, respectively.

When p is not degenerate, failure to restructure results in a permanent value drop from V_0 to CEV and a negative measured abnormal return per (4a) while restructuring results in a permanent value increase from V_0 to NAV and a positive measured abnormal return per (4b). Why, then, did Thompson find significant positive abnormal returns in his sample of discounted funds, none of which open-ended over the time periods he examined? Maintaining the hypothesis that the return on $\mathrm{PV}[\mathrm{E}(\tilde{C}F)]$ is normal because it arises from a portfolio of individual securities,[3] the reason for Thompson's result must lie with the multiperiod return on V_0.

B. Multiperiod

Initially, consider a second period at the end of which NAV will be achieved with probability p_2 *for that period* or CEV will result with complementary probability. At the beginning of the second period, the portion of the value of the share that does not depend upon the cash flow produced over the period, V_1, is

$$V_1 = \frac{p_2 NAV + (1-p_2)CEV}{1+r}. \tag{5}$$

[2] Open-endings certainly are partially anticipated. See Bettner [2] and Herzfeld [10], for example.

[3] The fact that the cash flow is net of management fees suggests that $\mathrm{PV}[\mathrm{E}(\tilde{C}F)]$ may contribute to the discount, but it does not imply an abnormal return.

At the end of the first period, either NAV or V_1 will be achieved. Thus, failure to reorganize in the first period does not result in a permanent closed-end value—it simply delays that possibility one more period. Therefore,

$$V_0 = \frac{p_1 NAV + (1 - p_1) V_1}{1 + r}, \tag{6}$$

where p_1 is the probability of reorganization to NAV *for the first period.* By substitution,

$$V_0 = p_1 \frac{NAV}{1 + r} + (1 - p_1) p_2 \frac{NAV}{(1 + r)^2} + (1 - p_1)(1 - p_2) \frac{CEV}{(1 + r)^2}. \tag{7}$$

Next, adopting a naive probability revision scheme, such that revision of the probability of open-ending for any single period revises the like probabilities for all future periods ($p_1 = p_2 = p$), makes equation (7) become

$$V_0 = \left[\sum_{t=1}^{M} (1 - p)^{t-1} p \frac{NAV}{(1 + r)^t} \right] + (1 - p)^M \frac{CEV}{(1 + r)^M}, \quad M = 2. \tag{8}$$

Finally, adding more periods increases M so that the probability of reorganization *by the end of period* $t \leq M$ is $(1 - p)^{t-1} p$.[4] When M becomes infinitely large, equation (8) generalizes to

$$V_0 = \sum_{t=1}^{\infty} (1 - p)^{t-1} p \frac{NAV}{(1 + r)^t} \tag{9}$$

or

$$V_0 = NAV \left(\frac{p}{r + p} \right). \tag{10}$$

Whereas in the one-period case if open-ending does not occur the V_0 component of price falls to CEV, in the multiperiod case if open-ending does not occur V_0 changes in response to a revision in p, ceteris paribus, and $\partial V_0 / \partial p > 0$. Clearly, p should increase with the size of a fund's discount. To the extent that funds with large discounts experienced recent increases in their discounts, if there is any lag in the market's reaction to the changes then Thompson's result could be due to selecting funds that would soon experience positive revaluations as the market responded to their increased probability of restructuring. Stated otherwise, the information content of closed-end fund discounts upon which Thompson capitalized may have been incomplete information about the funds' resemblances to open-ending targets. Note that this conclusion does not require that the funds actually open-end, only that their per-period probabilities of open-ending be revised upward.

C. Testable Implications

Despite the fact that neither V_0 nor p are directly observable, the preceding analysis does provide two potentially rejectable hypotheses. First, a useful pre-

[4] Note that $\sum_{t=1}^{\infty} (1 - p)^{t-1} p = 1$ for $0 < p < 1$.

dictive model of open-ending that utilizes information in addition to the discount should support an investment strategy that demonstrates abnormal returns. Second, the abnormal returns to the open-ending-based investment strategy should exceed those to a discount-only strategy. In the statements of these two hypotheses, abnormal returns are substituted for changes in V_0 and empirical open-ending predictions stand in for the values of p. Abnormal return methodologies are well known, but a predictive model for open-ending must be constructed and validated.

II. Assessing the Probability of Open-Ending

Brauer [4] describes the rationale for using fund discounts and expense ratios as bases for measuring, respectively, the return from and managerial resistance to open-ending. Managerial resistance to open-ending constitutes a major friction that may keep closed-end funds from being open-ended when the fund sells at a discount. Let $\tilde{Y}_i$ be a binary variable for fund i taking on the value one for an open-ended fund or the value zero for a fund that remains closed-end. Further, let $D_i' \equiv D_i - \bar{D}_I$, where D_i is the discount on fund i and $\bar{D}_I$ is the cross-sectional average discount on funds specializing in the same type of investments. Finally, let $ER_i' \equiv ER_i - \overline{ER}_I$, where ER_i is the expense ratio (i.e., the ratio of management expenses to total net asset value) for closed-end fund i and $\overline{ER}_I$ is the cross-sectional average expense ratio for funds specializing in the same type of investments. The regression equation for predicting open-endings is

$$\tilde{Y}_i = \alpha_0 + \alpha_1 D_i' + \alpha_2 ER_i' + \tilde{\epsilon}_i, \tag{11}$$

where α_0, α_1, and α_2 are coefficients to be estimated and $\tilde{\epsilon}_i$ is an error term.

A. Coefficient Hypotheses Tests

In addition to the overall ability of the estimated equation to predict open-ending, the two coefficient hypotheses are

$$\mathrm{H}_0^1\text{: } \alpha_1 = 0 \quad \text{versus} \quad \mathrm{H}_\mathrm{A}^1\text{: } \alpha_1 > 0$$

and

$$\mathrm{H}_0^2\text{: } \alpha_2 = 0 \quad \text{versus} \quad H_\mathrm{A}^2\text{: } \alpha_2 < 0.$$

Binary dependent variables are widely known to cause standard t-test statistics to be unreliable. However, a technique known as jackknifing (see Mosteller and Tukey [16]) can be used to test hypotheses H_0^1 and H_0^2 as well as to evaluate the overall predictive power of the estimated regression. Let $\hat{\alpha}_{c,all}$ denote ordinary least squares (OLS) estimated coefficients for values of c from zero to two when all of k groups of data are used. Let $\hat{\alpha}_{c,j}$ denote the OLS estimates when all but the jth of k groups of the data are used. Now define pseudocoefficients as

$$\hat{\alpha}_{c,j}^* \equiv k\hat{\alpha}_{c,all} - (k - 1)\hat{\alpha}_{c,j} \tag{12}$$

for values of j from one to k. The single best estimates of the coefficients are the jackknifed values

$$\alpha_c^* \equiv \frac{1}{k} \sum_{j=1}^{k} \hat{\alpha}_{c,j}^*. \tag{13}$$

The $\hat{\alpha}_{c,all}$ and the α_c^* are both unbiased, but the squared standard errors of the jackknifed estimates can be calculated. That is,

$$s^2(\alpha_c^*) = \frac{\sum_{j=1}^{k} \hat{\alpha}_{c,J}^{*2} - (1/k)(\sum_{j=1}^{k} \hat{\alpha}_{c,j}^*)^2}{k(k-1)}. \tag{14}$$

Table I presents a list of funds, their types, and their information dates for use in estimating the parameters of equation (11). The table is ordered by information date even though the observations for the non-open-ended funds, equal in number to the observations for the open-ended funds, were randomly selected from Wiesenberger's *Investment Companies* for the period from 1965 through 1981. The values for D_i' and ER_i' were determined one year in advance of the dates cited because the intended use of the coefficient estimates is to predict open-endings. The data for D_i' were taken from the "Closed-End Funds" or "Publicly Traded Funds" tables reported in *The Wall Street Journal.* The data for ER_i' were taken from *Investment Companies* for the respective years prior to those reported in Table I.

Table II presents the coefficient estimation results. Fourteen groups of data were formed by arbitrarily pairing an open-ended fund with a non-open-ended fund in the order of their listings in Table I. The OLS estimates using all data are given by the first line of Table II. The next fourteen lines show both the reestimated coefficients and the corresponding pseudocoefficients. The bottom section of the table reports the jackknifed estimates, their standard errors, and their t-scores. The overall OLS estimates and the jackknifed estimates are very similar, as is to be expected since both are unbiased. The estimates α_1^* and α_2^* have the predicted signs, and H_0^1 can be rejected in favor of H_A^1 and H_0^2 can be rejected in favor of H_A^2. Although no hypothesis about α_0^* was stated, it too has a specific hypothetical value. Because D_i' and ER_i' are differences between fund attributes and cross-sectional average attributes, for an average fund of a given type their values would be zero. Therefore, α_0^* is the empirical assessment of the probability of open-ending the average fund. Given that the sample comprises equal numbers of open-ending and non-open-ending events, α_0 should not be significantly different from 0.50 in either direction. The estimate of α_0 is, in fact, within two standard errors of 0.50. The prediction equation seems to be borne out in the sense that its elements have the anticipated effects: higher-than-average discounts raise the likelihood of open-ending above the mean sample restructuring frequency, and higher-than-average expense ratios lower the likelihood of open-ending below the mean sample restructuring frequency.

B. Prediction Hypotheses Tests

Fourteen observation pairs do not permit dividing the funds into an estimation sample and a prediction sample to avoid reclassification bias. (See Eisenbeis [6].)

Table I

Sample of Open-Ended and Non-Open-Ended Funds

A. Open-Ended Funds

Name	Fund Policy[a]	Information Date (month/year)[b]
M. A. Hanna	ND	10/65
Boston Personal Property Trust	DIV	7/66
Consolidated Investment Trust	DIV	3/67
Surveyor	DIV	9/73
Dominick	DIV	10/74
International Holdings	DIV	8/75
Griesedick	DIV	4/76
Advance Investors	DIV	7/76
American Utility Shares	S	11/77
Keystone OTC Fund	S	12/77
United Corporation	ND	1/78
National Aviation & Technology	S	7/78
Carriers & General	DIV	5/81
Chase Convertible Fund of Boston	SS	11/81

B. Non-Open-Ended Funds

Name	Fund Policy[a]	Information Date (month/year)[b]
Central Securities Corporation	ND	8/65
Holyoke Shares	DIV	2/66
American International Corporation	DIV	6/67
Power Corporation of Canada	ND	11/68
Niagara Share Corporation	DIV	2/71
New America Fund	S	2/73
Inventure Capital Corporation	ND	11/73
General American Investors	DIV	10/75
Fort Dearborn Income Securities	B	11/75
Federated Income & Private Placement	B	3/78
Bancroft Convertible Fund	S	5/81
Vestaur Securities	B	7/81
Independence Square Income Shares	B	11/81
Niagara Share Corporation	DIV	12/81

[a] B: bond. DIV: diversified. ND: nondiversified. S: specialized. SS: senior security. All classifications are from *Investment Companies* by Arthur Wiesenberger and reflect the classification system in use at the time of the information date cited.

[b] Information dates for open-ended funds are defined in Brauer [4]. Funds and information dates for non-open-ended funds were randomly selected for the years 1965 to 1981 inclusive.

Table II

Jackknifing Estimation of the Prediction Model

$\tilde{Y}_i = \alpha_0 + \alpha_1 D_i' + \alpha_2 ER_i' + \tilde{\epsilon}_i$

j	$\hat{\alpha}_{0j}$	$\hat{\alpha}^*_{0j}$	$\hat{\alpha}_{1j}$	$\hat{\alpha}^*_{1j}$	$\hat{\alpha}_{2j}$	$\hat{\alpha}^*_{2j}$
All	0.4253		0.0129		−0.3478	
1	0.4207	0.4846	0.0126	0.0161	−0.2998	−0.9711
2	0.4434	0.1894	0.0157	−0.0244	−0.2278	−1.9079
3	0.4353	0.2943	0.0131	0.0096	−0.3157	−0.7647
4	0.4244	0.4367	0.0129	0.0123	−0.3776	0.0395
5	0.4130	0.5840	0.0110	0.0372	−0.3904	0.2060
6	0.4257	0.4195	0.0139	−0.0002	−0.4354	0.7912
7	0.4386	0.2514	0.0113	0.0337	−0.4440	0.9037
8	0.4095	0.6297	0.0122	0.0216	−0.3804	0.0768
9	0.4331	0.3228	0.0143	−0.0060	−0.3083	−0.8614
10	0.4316	0.3428	0.0117	0.0281	−0.3082	−0.8625
11	0.4038	0.7045	0.0163	−0.0317	−0.3002	−0.9665
12	0.4357	0.2894	0.0120	0.0239	−0.3106	−0.8314
13	0.4043	0.6974	0.0125	0.0181	−0.3989	0.3175
14	0.4401	0.2323	0.0116	0.0300	−0.3499	−0.3196

$\alpha_0^* = 0.4199$	$\alpha_1^* = 0.0120$	$\alpha_2^* = -0.3679$
$s(\alpha_0^*) = 0.0468$	$s(\alpha_1^*) = 0.0056$	$s(\alpha_2^*) = 0.2107$
$t(\alpha_0^*) = -1.71$[a]	$t(\alpha_1^*) = 2.15$[b]	$t(\alpha_2^*) = -1.75$[c]

[a] Not significantly different from 0.50 by a two-tailed test at less than the 0.100 significance level.

[b] Significant by a one-tailed test at the 0.025 significance level.

[c] Significant by a one-tailed test at the 0.050 significance level.

However, because they are unbiased, the $\hat{\alpha}_{c,j}$ were used to generate a raw classification score for the out-of-sample observations in group j. After all the observations were classified in this way, the raw scores were rescaled so that the open-ended and non-open-ended subsample means were one and zero, respectively. Let $\hat{Z}_j^O$ and $\hat{Z}_j^N$ denote in order the rescaled classification scores for the open-ended and non-open-ended funds in group j. Values of $\hat{Z}_j^O > 0.50$ and $\hat{Z}_j^N \leq 0.50$ indicate correct classifications. A second application of the jackknife technique provided a confidence interval for each $\hat{Z}_j^O$ and $\hat{Z}_j^N$.[5] Let Z_j^O and Z_j^N denote the true rescaled classification scores. The hypotheses for each fund are that

$$H_{0O}^3: Z_j^O = 0.50 \quad \text{versus} \quad H_{AO}^3: Z_j^O > 0.50$$

for an open-ended fund or

$$H_{0N}^3: Z_j^N = 0.50 \quad \text{versus} \quad H_{AN}^3: Z_j^N < 0.50$$

for a non-open-ended fund.

Table III reports the classification results. Without regard for classification confidence, only sixty-one percent of the funds were correctly classified. However, of the classifications more than 1.64 standard errors from 0.50, three fourths of the open-ended funds correctly reject H_{0O}^3 in favor of H_{AO}^3 and two thirds of the

[5] The entire classification scoring and rescaling procedure was repeated thirteen times each time a group was dropped. See Mosteller and Tukey [16], pages 156–59, for a detailed discussion of the procedure.

Table III

Standardized Departures of Rescaled Classification Scores from 0.50

	Non-Open-Ended Member of Pair j			Open-Ended Member of Pair j		
j	$(0.5 - \hat{Z}_j^N)$[a]	Standard Error	Standardized Classification Score	$(\hat{Z}_j^O - 0.5)$[a]	Standard Error	Standardized Classification Score
1	2.06	1.95	1.06	0.63	1.30	0.48
2	−0.81	1.75	−0.46	1.69	0.55	3.07[b]
3	−0.19	0.39	−0.49	1.13	0.52	2.17[b]
4	−0.38	0.49	−0.78	−0.25	0.76	−0.25
5	1.88	0.92	2.04[b]	−0.63	0.60	−1.05
6	−2.00	0.58	−3.45[b]	0.06	0.35	0.17
7	−1.63	0.78	−2.09[b]	1.31	0.52	2.52[b]
8	1.75	0.69	2.54[b]	−1.00	0.67	−1.49
9	−0.69	0.39	−1.77[b]	0.88	1.15	0.77
10	1.88	0.69	2.72[b]	1.56	0.55	2.84[b]
11	1.19	1.97	0.60	−1.69	0.42	−4.02[b]
12	0.75	0.30	2.50[b]	1.38	0.58	2.38[b]
13	1.75	0.55	3.18[b]	−1.38	0.58	−2.38[b]
14	1.19	0.71	1.68[b]	3.00	1.18	2.54[b]

[a] Negative entries indicate misclassified observation.
[b] More than 1.64 standard errors from 0.50.

non-open-ended funds correctly reject H^3_{0N} in favor of H^3_{AN}. Overall, seventy-one percent of the high confidence classifications were correct. The ability to assess accuracy by classification confidence levels is a unique benefit of the jackknifing procedure and will be capitalized upon in the next section.

III. Abnormal Returns to Open-Ending-Based Strategies and Discount-Only Strategies

Given an open-ending predictive model, the two empirical implications from Section I can be investigated. First, does the open-ending regression support an investment strategy that earns abnormal returns? Second, do the abnormal returns to the open-ending-based strategy exceed those to a discount-only strategy? In order to ensure comparability of results with Thompson's findings, his empirical procedures were used to investigate the answers to these questions.

A. Methodology

The technique used to measure abnormal returns was originally developed by Fama, Fisher, Jensen, and Roll [8]. The benchmark returns were taken to be those given by the restricted borrowing and lending capital asset pricing model of Black:

$$E(r_{i,t}) = \gamma_{0,t} + \gamma_{1,t}\beta_i, \tag{15}$$

where, for period t, $E(r_{i,t})$ is the expected return on investment i, $\gamma_{0,t}$ is the expected return on a portfolio with a beta of zero, $\gamma_{1,t}$ is the difference between the expected return on the market portfolio and the expected return on a portfolio with a beta of zero, and β_i is the beta of asset i defined as

$$\beta_i \equiv \mathrm{cov}(r_i, r_m)/\mathrm{var}(r_m), \tag{16}$$

where r_m is the return on the market portfolio. The values of $\gamma_{0,t}$ and $\gamma_{1,t}$ were taken from Fama and MacBeth [9] as reported in Fama [7]. The ex-post abnormal return for the shares of fund i in period t was calculated as

$$ar_{i,t} = r_{i,t} - \gamma_{0,t} - \gamma_{1,t}\hat{\beta}_{i,t}, \tag{17}$$

where $\hat{\beta}_{i,t}$ was found by OLS-estimating

$$\tilde{r}_{i,\tau} = \delta_{i,t} + \beta_{i,t}r_{m,\tau} + \tilde{\zeta}_{i,\tau} \tag{18}$$

for values of τ from $t - 18$ through $t + 17$, where $r_{m,\tau}$ is the return on the Center for Research in Security Prices equally weighted index of all NYSE stocks and $\tilde{\zeta}_{i,\tau}$ is a random error term. The individual stock abnormal returns for period t were weighted together using some investment strategy involving N stocks as

$$AR_t = \textstyle\sum_{i=1}^{N} x_{i,t}ar_{i,t}, \tag{19}$$

where $x_{i,t}$ is the weight given security i at time t by the strategy and $\sum_{i=1}^{N} x_{i,t} = 1.0$. Over T periods, the average abnormal return was found as

$$AAR = \frac{1}{T}\textstyle\sum_{t=1}^{T} AR_t. \tag{20}$$

The statistical significance of the average abnormal return to a strategy was determined using the method developed by Jaffe [13] and Mandelker [15]. First, the set of investment weights used in period t was used to calculate abnormal returns for each of the thirty-six immediately preceding periods. Next, the standard deviation of the thirty-six abnormal returns was used to standardize the abnormal return for period t. Finally, the standardized abnormal returns for values of t from 1 to T were averaged, and the t-statistic for the average standardized abnormal return was used to indicate the statistical significance of the strategy's *AAR*. Formally, if *ASAR* is the true value of the average standardized abnormal return, then the two questions posed at the beginning of this section can be evaluated by testing

$$\mathrm{H}_0^4\text{: } ASAR = 0 \quad \text{versus} \quad \mathrm{H}_\mathrm{A}^4\text{: } ASAR > 0$$

using the t-statistics for different investment strategies (i.e., $x_{i,t}$ construction rules). Eight investment strategies were tested using monthly returns on the stocks of Thompson's original sample of twenty-three funds from 1940 through 1971. All eight were based on a set of classification scores calculated for each fund for each year using the coefficient estimates presented in Table II.

The first four strategies were designed to determine whether the open-ending regression could be exploited to earn positive abnormal returns. Palepu [17] has recently pointed out that, while the use of samples with equally balanced event occurrences and nonoccurrences improves the precision of parameter estimates such as those constructed in Table II, if event occurrences and nonoccurrences are not equally balanced in the population then the cutoff classification score for investment strategy tests must be modified from the intuitively appealing midpoint between the two sample group means.[6] Using his modification, the optimal cutoff score for inclusion in an open-ending-based portfolio (i.e., $x_{i,t} > 0$) was 0.63. This cutoff does not distinguish between high and low confidence classifications, however. An estimate of the standard deviation of the jackknifed classification scores from the last section, denoted $\hat{\sigma}_Z$ and equal to 0.96, was used to set a second cutoff score for high confidence classifications by requiring a score of $0.63 + 1.64\hat{\sigma}_Z$ for inclusion in that portfolio.[7] Once the sets of stocks surpassing each of the cutoffs were identified, portfolio weights were determined for both equally weighted and classification score-weighted portfolios. The four resulting portfolios were rebalanced annually. With the time series of weights established, *AAR* values and *ASAR* t-statistics were calculated for each strategy.

The second four strategies were designed to determine whether the abnormal returns to the open-ending-based strategy exceed those to a discount-only strategy. The four sets of investment weights were set as $x'_{i,t} = x^O_{i,t} - x^D_{i,t}$, where $x^O_{i,t}$ is the weight determined by one of the four original open-ending strategies and $x^D_{i,t}$

[6] The modification involves constructing a frequency distribution of classification scores for each of the subsamples of occurrences and nonoccurrences. If the expected costs of type-I and type-II errors are the same, then using the score at which these two empirical distributions intersect as the cutoff score selects investments for which the expected payoff is positive. See Palepu [17], pages 10–27, for a detailed discussion of the procedure.

[7] See Mosteller and Tukey [16], pages 160–61, for a detailed discussion of the calculation of $\hat{\sigma}_Z$.

is the weight determined by a simple discount-weighting strategy.[8] The average abnormal return for each of these new strategies is labeled *AAR′*. The value of *AAR′* reflects the abnormal performance of the open-ending-based strategy over and above that accounted for by the discount alone. Consequently, *AAR′* is the average marginal abnormal return associated with using a more complete organizational restructuring prediction model. Because they were constructed in the same manner as those for the *AAR*, the average standardized abnormal-return t-statistics for the *AAR′* represent quite strong tests as they are based on period-by-period marginal abnormal returns and not simply the difference between the *AAR* for the open-ending-based strategy and the *AAR* for the discount-weighting strategy.

B. Results

Table IV reports the results of testing the eight investment strategies. Three features of the *AAR* results merit comment. First, the *AAR* values are positive and a bit higher for the classification score-weighted portfolio than for the equally weighted portfolio. For a simple hurdle classification score, the abnormal return amounts to 4.93 percent annually for an equally weighted portfolio, while a classification score-weighted portfolio with the same hurdle provides an annual abnormal return of 5.03 percent. Second, as would be expected for a useful classification scheme, the *AAR* performance rises (to 10.16 percent annually for both portfolio weightings) when the classification score cutoff is increased to reflect higher classification confidence. Third and most important, the t-values

Table IV

Performance Statistics for Open-Ending-Based Investment Strategies[a]

	AAR[b]		*AAR′*[c]	
Invest if Classification Score >	Equally Weighted Portfolio	Classification Score-Weighted Portfolio	Equally Weighted Portfolio	Classification Score-Weighted Portfolio
0.63	0.0035	0.0041	0.0015	0.0022
	2.58[d]	2.58[d]	1.94[e]	2.02[e]
$0.63 + 1.64\ \hat{\sigma}_z$	0.0081	0.0081	0.0069	0.0069
	1.95[e]	1.95[e]	1.95[e]	1.95[e]

[a] Numbers below performance statistics are average standardized residual t-scores by the Jaffee [13] and Mandelker [15] method.

[b] *AAR* is the average monthly abnormal return generated by the strategy.

[c] *AAR′* is the average monthly difference between the abnormal return generated by the open-ending-based strategy and the abnormal return generated by a discount-weighted strategy.

[d] Significant by a one-tailed test at the 0.001 significance level.

[e] Significant by a one-tailed test at the 0.050 significance level.

[8] Note that simple discount weighting was found by Thompson to be the most profitable strategy using only discount information. Note further that, because $\sum_{i=1}^{N} x'_{i,t} = 0.0$, the $x'_{i,t}$ weights call for no net investment and so may be viewed as creating pure arbitrage returns by shorting one profitable strategy (i.e., discount-only) in order to go long another profitable strategy (i.e., open-ending-based).

indicate that H_0^4 can be rejected in favor of H_A^4. In other words, with high statistical confidence, the open-ending regression can be used to form investment strategies that provide returns in excess of those required for bearing systematic risk as specified by the two-factor capital asset pricing model.

The *AAR'* results have the same three features as the *AAR* results. First, their values are positive and performance improves with classification score weighting. Second, higher classification confidence results in better performance. Third, the *t*-scores for the *AAR'* indicate that H_0^4 can be rejected in favor of H_A^4. That is, not only can the open-ending regression generate strategies that provide abnormal returns, with a high degree of statistical confidence its abnormal returns exceed those to a discount-only strategy.

C. Interpreting the Investment Strategy Performance Results

The finding that the open-ending regression appears to subsume the discount anomaly raises a question of interpretation.[9] Operationally, the spirit of the analysis is that, by identifying open-ending candidates, an investor could buy in and reap benefits in excess of those associated with the funds' discounts alone. However, the open-ending-based strategy earned abnormal returns even though the selected funds did not, in fact, open-end. This apparent conundrum can be resolved by realizing that the actual source of the gain is not open-ending per se; rather it is the discount elimination associated with the market revising the probability of open-ending. Stated differently, the strategy worked because it selected funds that subsequently behaved like open-ended funds by exhibiting narrowing discounts.[10]

A possible alternative interpretation of the results exists and, in the interest of full disclosure, must be acknowledged. In the portfolio weighting process, the open-ending equation assigned a positive weight to the discount and a negative weight to the expense ratio. Because a reported net asset value does not include the capitalized value of future management expenses, the investment strategy might be thought of as selecting funds on the basis of the amount of their discounts that cannot be explained by this single obvious factor (i.e., expenses alone). To the extent that additional factors cause discounts, the strategy performance may in some way be related to these additional factors and not to the prospects for open-ending. This alternative interpretation is, at best, speculation absent a convincing description of the left-out factors. Until new insights into the causes of closed-end fund discounts illuminate those factors, however, the information content of closed-end fund discounts appears to be unpriced evidence about the probability of future profitable organizational restructuring.

[9] The discussion in this section was suggested by a referee and borrows heavily from that source.

[10] Wansley, Roenfeldt, and Cooley [19] note the analogous result for their merger profile stock selection rule when they say (page 153), "Even if the candidate firms are not eventually acquired, abnormal returns may result from shifts in the fundamental financial factors that make the candidate firms resemble actual acquired firms." In the case of an open-ending, the "fundamental financial factor" is a narrowed discount.

IV. Summary and Conclusions

One of the many interesting aspects of closed-end fund discounts is the finding that they can be used to form portfolios that earn rates of return greater than those predicted by the capital asset pricing model. Another feature of discounts is that they create an obvious incentive to convert the fund to an open-end fund (or its equivalent). As a consequence, when closed-end shares are held in proportion to the size of their discounts, they are also being held in proportion to the incentives to restructure the funds. The abnormal return to the discount-weighted strategy thus may be the result of these incentives not being instantly and completely reflected in prices. The evidence presented here supports this hypothesis. A model to predict open-ending activity results in portfolio formulations that significantly outperform not only the capital asset pricing model, but a pure discount strategy as well.

Abnormal returns being associated with individual variables predictively related to organizational restructuring is not unique to open-endings. Merger target firms are another example of restructured organizations. Target firms have significantly lower price-earnings ratios than non-target firms, and investment rules based on price-earnings ratios alone do significantly outperform the capital asset pricing model. (See Basu [1].) However, when a more complete discriminant function is used to select merger targets, even larger abnormal returns can be earned. (See Wansley, Roenfeldt, and Cooley [19].) Although the observation that individual variables that generate asset pricing anomalies may be only portions of larger information structures is tantalizing, it does not explain why market prices appear not to incorporate fully information about the likelihood of events (i.e., whether the market is informationally inefficient or benchmark normal returns are inadequately specified).

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