Closed-End Fund Puzzles and Value of Fund Manager's Private Information

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This paper presents a theoretical model of closed-end fund pricing within a multi-period framework in which the fee charged by the fund manager and investors expectation on the fund manager's future performance can explain some of the puzzles associated with closed-end fund prices. Closed-end fund can be regarded as a financial intermediary through which uninformed but rational traders invest in risky securities with the help of an informed fund manager. This paper shows that i) the closed-end fund starts at a premium but it is more likely to sell at discount at later periods, ii) the price and discount of closed-end fund are subject to greater fluctuation than the price of assets invested by the fund, and iii) liquidation decision depends on the size of discount as well as the cost associated with it..

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JEL Classification: D82; G14; L13

I. Introduction

A closed-end fund is a publicly traded investment company. It raises money from investors by issuing a fixed number of shares through an initial public offering (IPO), and then invests the proceeds from IPO in marketable securities. Once the shares are

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issued, closed-end fund does not sell new shares to interested investors and unlike open-end funds it does not stand willing to redeem shares from its shareholders for net asset value (NAV) per share. Therefore, a shareholder's holding can be liquidated by selling his shares to other investors in the secondary market, and the market price of the fund's shares does not exert any influence on the value of its total assets.

Previous empirical studies have documented that there exists a persistent and significant discrepancy between the market price of the closed-end fund and its net asset value, which is generally labeled as the "closed-end fund puzzle." Most of the closed-end funds are initially offered to the public at a premium of about 10 per cent, which typically vanishes within six months (Weiss (1989) and Peavy (1990)). Although the shares of closed-end funds sometimes sell at prices above the market value of the assets held by them, they trade, on average, at a substantial discount from the net asset value, and the volatility of the discounts on them are quite high. Funds traded at a discount are not always terminated through liquidation of the assets or the conversion to open-end funds, but discounts narrow when closed-end funds are either liquidated or converted to open-end fund.

Dozens of factors, based both on theoretical models and common sense, are offered as possible explanations for the puzzles. Most commonly posited reasons for closed-end funds being traded at significant disparities from their net asset values are: potential tax liabilities associated with unrealized capital gains in the fund's assets, management fees and expected performance of the fund manager, turnover and diversification of the fund's portfolio, illiquidity of the assets held by the fund, lack of public understanding and selling effort, and investor sentiment.[1]

Although there have been numerous empirical studies that investigate the properties of closed-end fund prices and offer possible explanations for the puzzles associated with them, a surprisingly small number of theoretical models have been offered for the closed-end fund puzzles with the exception of Oh and Ross (1994), Xu (1995) and De Long, Shleifer, Summers and Waldman

[1]For more detailed surveys on closed-end fund puzzles and previous studies on the factors causing discounts, see Anderson and Born (1992) and Lee, Shleifer and Thaler (1991).

(1990). This paper presents a formal model of closed-end fund pricing within a multi-period framework in which the fee charged by the fund manager and the investors' expectation of the fund manager's future performance can explain most of the puzzles.

Closed-end fund can be regarded as a financial intermediary through which uninformed but rational traders invest in risky securities with the help of the professional fund manager. The fund manager is believed to possess private information on the value of the security, based on which she is expected to trade risky security and to earn trading profits on behalf of closed-end fund shareholders. Like the pricing of other securities, the price of closed-end fund shares is determined in such a way that it is equal to the expected present value of the net cashflows to the shareholders of the fund. The gross cashflows to the fund consist of two components: cashflow that accrues to the assets already held by the fund which is commonly called the *net asset value* (*NAV*), and the expected present value of the cashflows from the assets to be purchased in the future. Since the fund is managed by the fund manager with superior information to other investors in the market, the latter is the expected trading profits to be earned in the future, and its size depends on the managerial performance in the future. In return for her service, the fund manager deducts a fixed percentage of the gross cashflows to the fund as a management fee. Based on this pricing of the closed-end fund, most of the puzzles associated with the closed-end fund share price and discount can be explained.

It is somewhat obvious that the price of closed-end fund shares goes up as NAV increases or shareholders expect that managerial performance would improve in the future. The fund sells at a discount if price falls short of the NAV of the fund, which is most commonly observed among closed-end funds. The model presented in this paper shows that two properties drive the dynamics of closed-end fund discount. First, due to the presence of the management fee, the discount of the fund increases in NAV but decreases as the fund manager is expected to earn a greater trading profit in the future. Provided that management fee is a fixed percentage of the fund's NAV, as the fund's NAV increases, greater amount of cashflows to the assets already held by the fund is paid to the manager as a fee, which diminishes the net cashflows to the shareholders and consequently discount of the fund widens. But shareholders' expectation of better managerial performance improves the price of the fund without affecting NAV, which narrow the discount. Second, as far as the manager is believed to have information superior to other investors, trading profits earned by the fund manager accumulates and the NAV is expected to grow in time.

Closed-end fund starts out at a premium that can be regarded as the price paid for the private information possessed by the fund manager. Shares of closed-end fund are likely to be traded at premium just after IPO when NAV is still small, but they are more likely to sell below the market value of the total assets held by the fund at later periods. This is because NAV of the closed-fund tends to grow as trading profits earned by informed manager accumulates, which consequently increases the size of discount of the fund.

The price and discount of the closed-end fund are subject to wider fluctuations than the value of the assets held by the fund for two reasons: the NAV of the closed-end fund is directly affected by the value of the assets owned by the fund whose variation is magnified by the size of the assets held by the fund, and a change of the shareholders' perception of the manager's ability even accentuates the fluctuation.

Notice that every participant in this model is rational and there is no agency problem on the part of the fund manager. As far as the fund manager is believed to have access to the information superior to other investors in the market but she charges managerial fee for her service, most of the dynamics associated with the price and discount of the closed-end fund can be explained.

Oh and Ross (1994) try to explain the closed-end fund puzzle based on the rational expectation equilibrium model in which discount and premium of the closed-end fund depend on the trading strategy taken by an informed fund manager. Xu (1995) derives the dynamics of closed-end fund price and discount based on restricted investment opportunity of the fund shareholders and stochastic turnover process. Both papers critically rely on specific assumptions about the fund manager's strategies that require more justification. De Long, Shleifer, Summers and Waldman (1990) apply their basic model to explain closed-end fund discount by showing that the existence of noise traders who invest in the closed-end fund drives the pricing and discount of closed-end fund.

Lee, Shleifer and Thaler (1991) empirically support De Long, Shleifer, Summers and Waldman (1990), which is later disputed by Chen, Kan and Miller (1993).

The rest of the paper is organized in five sections. The basic model is presented in section II and a closed form solution of the closed-end fund price is derived in section III. The closed-end fund puzzle is explained in section IV, and section V analyzes the liquidation decision. Section VI concludes the paper.

II. Model

A multi-period model involving a risky security and a closed-end fund that invests in this risky security is considered in this paper.

Dividend is paid at the end of each period to the holders of this risky security and the amount of dividend per share paid at the end of period t is given in the following equation.

$$\delta_t = \delta_{t-1} + \eta_t = \eta_0 + \sum_{i=1}^{t} \eta_i \tag{1}$$

It is assumed that $\eta_0 > 0$ and η_is are *i.i.d.* with mean zero and variance of σ_η^2. With risk adjusted discount rate of this risky security denoted by γ, the ex-dividend value of the security at the end of period t is given in the following equation:

$$\tilde{v}_t = E_t\left[\sum_{i=1} \frac{\delta_{t+i}}{(1+\gamma)^i}\right] = E_t\left[\sum_{i=1} \frac{\delta_t + \sum_{j=1}^{i} \eta_{t+j}}{(1+\gamma)^i}\right].$$

Since $E_t[\eta_{t+i}] = 0$ for $i \geq 1$, we have

$$\tilde{v}_t = E_t\left[\sum_{i=1} \frac{\delta_t}{(1+\gamma)^i}\right] = \frac{\delta_t}{\gamma} = \frac{\delta_{t-1}}{\gamma} + \frac{\eta_t}{\gamma} = \tilde{v}_{t-1} + \tilde{\theta}_t. \tag{2}$$

η_t can be regarded as incremental change of dividend starting from period t and its present value is $\tilde{\theta}_t = \eta_t / \gamma$. A closed-end fund whose shares are also publicly traded invests in this risky security. For the simplicity of analysis, the number of closed-end fund shares is set to one.

All market participants are assumed to be risk neutral. The manager of a closed-end fund is believed to possess superior private information regarding the value of the risky security and trades shares of risky security for the shareholders of a closed-end fund. It is assumed that she is not allowed to trade either risky security or shares of the closed-end fund on her own account. There are sufficiently many uninformed but rational investors who are potential shareholders of the closed-end fund.

The sequence of trading is as follows. At period 0, the fund manager starts a close-end fund with initial wealth of $W \geq 0$ and publicly offers its shares.

At the beginning of period t, the manager of the closed-end fund has private access to the information about $\tilde{v}_t$ and trades risky security based on that information. Trading of the risky security is completed after the price of the risky security is determined and shares of risky security are exchanged among buyers and sellers.

After trading the risky security and before trading the closed-end fund, the number of shares traded by each trader and the amount of dividend of risky security to be paid the end of period t are publicly announced. Then shares of closed-end fund are traded at a competitive price.

At the end of period t, $\tilde{\delta}_t$ dividend per share of the risky security is paid. The gross cashflow to the fund consists of dividend payment from the risky security owned by the fund and net interest payment from the investment to risk-free asset. After deducting 100 β% of the gross cashflow as a management fee, the remaining 100 $(1-\beta)$% of the gross cashflow is distributed to the shareholders of the closed-end fund as the dividend payment, and period t is finished. Figure (1) illustrates the sequence of trading.

To be consistent with the interpretation of $\tilde{v}_t$, trading of a risky security is assumed to happen at the early part of the period and dividend payments are made at the end of the period.[2] It is also assumed that the fund manager is able to borrow and lend on behalf of shareholders of the closed-end fund at the risk-free rate of r_f without restriction.[3] The for simplicity of analysis, it is assumed

[2]At the beginning of period of t, the value of risky security based on public information is $\tilde{v}_{t-1}$, but as soon as trading of risky security is completed at the early part of the period, and $\tilde{\delta}_t$, the value of the risky security is now $\tilde{v}_t$ from equation (2). The fund manager has access to the information on $\tilde{v}_t$ by privately observing $\tilde{\delta}_t$.

[3]This assumption enables the fund manager to trade the risky security

Period t starts.

Fund manager privately observes $\tilde{v}_t$.

Trading of a risky security commences.

Price of the risky security is determined and trading is completed.

$\tilde{\delta}_t$ is announced.

The amount of risky security traded by the closed end fund is publicly known.

Shares of the closed-end fund are traded.

Dividends lf the risky security and the closed-end fund are paid

Period t ends.

FIGURE 1

that capital gain is not realized and there is no tax at all.[4]

The dynamics of price and discount of closed-end fund shares are analyzed in the following sections.

III. The Price of Closed-End Fund Shares

The information set publicly available at the beginning of period t, denoted Φ_t, is given in the following equation.

$$\Phi_t = (x_1, \cdots, x_{t-1}, P_1, \cdots, P_{t-1}, \tilde{v}_1, \cdots, \tilde{v}_{t-1}),$$

where x_k is the number of shares of the risky security purchased at period k by the manager for the fund, and P_k is the price paid for the risky security at period k.

Ω_t is the information publicly available when the trading of

not restricted by the size of wealth owned by the closed end fund.

[4]This assumption will be relaxed in section IV by allowing partial realization of capital gain earned by the fund.

closed-end fund shares commences at period t. Since trading of closed-end fund starts after dividend at period t, δ_t, and the number of shares traded by each investor is publicly known, $\Omega_t = (\Phi_t, x_t, P_t, \tilde{v}_t)$ holds.

The net asset value of period t is the market value of the total assets held by the fund evaluated when the trading of closed-end fund shares starts at period t, and it is given in the following equation.

$$NAV_t = W + \sum_{k=1}^{t} x_k(\tilde{v}_t - P_k) \tag{3}$$

Like the pricing of other risky securities, the price of closed-end fund shares is determined in such a way that it should be equal to the expected present value of the cashflows to the fund net of management fee, and a closed form solution of the price of closed-end fund is obtained in the following equation.

$$\begin{aligned} C_t &= (1-\beta)\left(W + \sum_{h=1}^{t} x_h(\tilde{v}_t - P_h) + E\left[\sum_{k=1}^{\infty} \frac{x_{t+k}(\tilde{v}_{t+k} - P_{t+k})}{(1+\rho)^{\kappa}} \mid \Omega_t\right]\right) \\ &= (1-\beta)(NAV_t + \Pi_t) \end{aligned} \tag{4}$$

where ρ is the risk-adjusted discounted rate for $x_k(\tilde{v}_k - P_k)$ and Π_t is the total expected present value of the trading profits to be earned in the future.

At each period, the gross cashflow to the fund is given in the following equation.

$$F_t = \delta_t(\sum_{k=1}^{t} x_k) + r_f[W - \sum_{k=1}^{t} x_k P_k] = \sum_{k=1}^{t} x_k(\delta_t - r_f P_k) + r_f W. \tag{5}$$

The total cashflow to the closed-end fund at the end of period t is composed of two parts: the dividend payments from shares of risky securities owned by the fund, $\delta_t(\sum_{k=1}^{t} x_k)$, and net interest payment which is equal to $r_f(W - \sum_{k=1}^{t} x_k P_k)$. $100\beta\%$ of this cashflow is paid to the fund manager as a management fee and the rest is distributed to the shareholders of the closed-end fund.[5]

As is shown in the second equality of equation (5), since $\tilde{v}_t$ is the

[5]Since the management fee is paid at the end of every period from the gross cashflow to the fund, the size of β does not affect net asset value.

expected present value of future dividend payments from one share of risky asset, NAV_t can be regarded as the expected present value of the cashflows accruing to the assets held by the fund at period t.[6]

$E[x_{t+k} - P_{t+k}] | \Omega_t] \equiv \pi_t^{t+k}$ for $k \geq 1$ is the expected trading profit to be earned at period $t+k$ conditional on the information at period t. Put differently, it is the expected value of the cashflows from the assets to be purchased k periods later.[7]

The trading process of risky security is not explicitly modelled in this paper. But any strategic trading model including Kyle (1985) and Admati and Pfleiderer (1988) which derives the result that positive expected trading profit is earned by traders with private information on the value of security, and it increases as their private information gets more precise would serve the objective of this paper.[8]

Since the manager is believed to possess superior private information regarding the future value of the risky asset, shareholders of the closed-end fund presume that she would earn positive trading profit at each period in the future and present value of the expected trading profits is incorporated into the price of the closed-end fund. Naturally, as the closed-end fund investor's perception regarding the manager's future performance changes, the price of the fund is directly affected through the change of Π_t.

The following proposition demonstrates the properties of prices of closed-end fund that are directly derived from equation (4).

***Proposition* 1**

The price of the closed-end fund has the following properties.

1. The price of the closed-end fund increases in NAV_t and Π_t but decreases in β.
2. Conditional variance of the closed-end fund price is

[6]To purchase risky security at period k, $x_k P_k$ is deducted from initial wealth W and thereby interest payment is reduced by the amount of $r_f x_k P_k$s for each period. The total present value of $r_f x_k P_k$s is $x_k P_k$. Hence, at period t, the expected present value of gross cashflows from x_k shares purchased at period k is $x_k(\tilde{v}_t - P_k)$.

[7]Since δ_t is publicly known at the end of period t, the value of private information possessed by the fund manager lasts for one period.

[8]Previous version of this paper assumes strategic trading model of Kyle (1985), which has the properties needed for the analysis of this paper.

$$Var(C_t | \Phi_t, x_t, P_t) = (1-\beta)^2 (\sum_{h=1}^{t} x_h)^2 Var(v_t | \Phi_t, x_t, P_t) = (1-\beta)^2 (\sum_{h=1}^{t} x_h)^2 \sigma^2_\theta .$$

The implication derived from Proposition 1 is clear: the shares of the closed-end fund are traded at a higher price as the value of the assets held by the fund grows or if the future performance of the fund manager is expected to improve. As the second part of Proposition 1 shows, the conditional variance of the price of the risky security is magnified by the size of assets accumulated by the fund which causes the volatility of the closed-end fund price to be even higher than that of the risky security it invests in.

With more assumptions on the belief of closed-end fund investors, a couple of interesting implications can be drawn from equation (4) and Proposition 1. Suppose investors of the closed-end fund have *consistent belief* in the fund manager's performance in the following sense.

$$E[x_h(\tilde{v}_h - P_h) | \Omega_i] = E[x_h(\tilde{v}_h - P_h) | \Omega_j] = E[x_h(\tilde{v}_h - P_h) | \Omega_0] \equiv \pi_h \quad i, j = h. \qquad (6)$$

Then, the expected values of the closed-end fund price *NAV* are obtained in the following corollary.[9]

***Corollary* 1.** If investors of the closed-end fund have consistent belief in the manager's future performance, and capital gain is never realized, then:

1. *NAV* is expected to increase in time.
2. The price of the closed-end fund is also expected to grow.

Proof: From equations (3) and (4), unconditional expected values of *NAV* and price of the closed-end fund are derived in the following equation when investors of the closed-end fund have consistent belief.

$$E[NAV_t] = E[W + \sum_{k=1}^{t} x_k(\tilde{v}_t - P_k)] = W + \sum_{j=1}^{t} \pi_j .$$

It is clear that $E[NAV_t]$ increases in t. From equation (4), uncondi-

[9]For instance, at the beginning of each period, the manager observes noisy signal of θ_t, $\theta_{t+\varepsilon}$, based on which she trades the shares of a risky security. If shareholders of the closed-end fund believe the precision of ε_t remains the same throughout the life of the fund at h_ε, which is the actual precision of ε_t, then equation (6) holds.

tional expectation of the closed-end fund price is given in the following equation:

$$E[C_t] = E\left[(1-\beta)\left(W + \sum_{j=1}^{t} x_j(v_t - P_j) + \sum_{k=1}^{\infty} \frac{x_{t+k}(\tilde{v}_{t+k} - P_{t+k})}{(1+\rho)^{k}}\right)\right]$$

$$= (1-\beta)\left[W + \sum_{j=1}^{t} \pi_j + \sum_{k=1}^{\infty} \frac{\pi_{t+k}}{(1+\rho)^{k}}\right].$$

The second equality is obtained from

$$E[E[x_j(\tilde{v}_t - P_j) \mid \Omega_j]] = E[E[x_j(\tilde{v}_j + \sum_{i=j+1}^{t} \tilde{\delta}_i - P_j) \mid \Omega_j]] = E[E[x_j(\tilde{v}_j - P_j) \mid \Omega_j]] = \pi_j.$$

Since

$$E[C_{t+1}] - E[C_t] = (1-\beta)\left[\pi_{t+1}\left(1 - \frac{1}{1+\rho}\right) + \frac{\rho}{1+\rho} \sum_{k=1}^{\infty} \frac{\pi_{t+k+1}}{(1+\rho)^{k}}\right].$$

the second part of the corollary is obtained. ■

If the fund manager is believed to have access to private information regarding the future value of the risky security, the total value of the assets held by the fund is expected to grow as the trading profits earned at each period accumulates, which consequently increases *NAV*. As far as capital gain earned by the fund is never realized and distributed to shareholders, as *NAV* increases due to accumulated trading profits, the price of the closed-end fund is expected to increase also.

Even when investors have consistent belief in managerial performance of the closed-end fund, as can been seen from equation (4) and Proposition 1, unconditional volatility of the fund is

$$Var(C_t) = (1-\beta)^2 Var(NAV_t) \tag{7}$$

and it is not surprising that observed volatility is quite high since it is affected not only by the fluctuation of the value of underlying assets invested by the fund but also by their transaction prices.[10]

[10]It is assumed in this model that capital gain earned by the fund is never realized. But if fixed percentage, say $100\alpha\%$ of capital gain is

However, the perception of the closed-end fund investors on the manager's ability to manage the fund rarely remains the same. This paper does not model how investors' belief in manager's future performance is formed. But empirically observed volatility would be higher than the one given in equation (7) due to the fluctuation of the perception held by investors on the fund manager's ability.

Based on the results obtained in the previous section, theoretical explanations for the puzzles associated with closed-end fund discount can be provided.

IV. Discount of Closed-End Fund

The central piece of the closed-end fund puzzle is that although shares of closed-end fund sometimes trade at a premium, they sell, on average, substantially below the market value of the assets held by the fund. Based on the closed form solution of the closed-end fund price derived in the previous section, the dynamics of closed-end fund discount can be investigated.

The absolute discount of the closed-end fund denoted D_t and its discount rate denoted d_t are defined and derived in the following equation.

$$\begin{aligned} D_t &\equiv NAV_t - C_t = \beta NAV_t - (1-\beta)\Pi_t \\ d_t &\equiv 1 - \frac{C_t}{NAV_t} = \beta - (1-\beta)\frac{\Pi_t}{NAV_t}. \end{aligned} \tag{8}$$

If $D_t, d_t > 0$, then shares of the closed-end fund are traded at discount. Otherwise they sell at a premium. The following proposition is directly obtained from equation (8) and it is given without proof.

***Proposition* 2**

Discount of the closed-end fund has the following properties:

1. Discount of the closed-end fund increases in NAV_t but it shrinks in Π_t.

immediately realized and distributed at each period, then NAV is now $NAV_t = W + (1-\alpha)\ \ x_k(v_t - P_k)$ and expected value of NAV still increases in time unless $\alpha = 1$.

2. Conditional variance of the closed-end fund discounts are

$$Var(D_t|\Phi_t,x_t,P_t) = \beta^2(\sum_{h=1}^{t} x_h)^2 Var(v_t|\Phi_t,x_t,P_t);$$
$$= \beta^2(\sum_{h=1}^{t} x_h)^2 \sigma^2_\theta$$
$$Var(d_t|\Phi_t,x_t,P_t) = (1-\beta)\Pi_t^2 Var\left(\frac{1}{NAV_t}|\Phi_t,x_t,P_t\right).$$

As is shown in equation (8), the discount of the closed-end fund can be represented by the difference between βNAV_t and $(1-\beta)\Pi_t$, where the former is the total amount of management fee collected by the the manager at period t for her service, and the latter is the expected net cashflows to be earned in the future. The first part of Proposition 2 demonstrates that the closed-end fund shares sell at a greater discount as NAV_t increases but as manager's future performance is expected to improve, the discount narrows.

NAV_t is the gross cashflows from the assets already held by the closed-end fund. As is shown in Proposition 1, the shares of the closed-end fund sell at higher price as *NAV* increases. But since fixed percentage of gross cashflows to the fund is paid as a management fee, as the net asset value of the fund grows, a greater absolute amount is paid as a management fee and the price of closed-end fund cannot go up by the same amount of the increase in *NAV*. Therefore, the discount of the closed-end fund widens as the fund has greater *NAV*.

Since the trading profits to be earned in the future by the informed fund manager is taken into account in the price of the closed-end fund but not in *NAV*, the shareholders' expectation of better managerial performance in the future does not have any effect on the current value of the assets already purchased by the fund. But it definitely enhances the value of the closed-end fund, which consequently narrows its discount.

As in the case of the price of the closed-end fund, its discount is also closely linked to the price of the underlying risky security, and its conditional variance is proportional to the variance of the risky security's price, magnified by the total size of assets held by the fund. This makes the variance of the closed-end fund discount in general greater than that of the risky security price, as in the case of the closed-end fund price. Empirically observed volatility of discount is likely to be higher than the one predicted in Proposition 2 since shareholders' belief on the manager's ability also changes as time goes by.

From Proposition 2 and equation (8), the initial public offering price and the premium of the closed-end fund are obtained in the following proposition.

***Proposition* 3**

The closed-end fund starts at the price of

$$C_0 = (1-\beta)(W+\Pi_0)$$

and the initial public offering discount is

$$D_0 = \beta W - (1-\beta)\Pi_0.$$

Most of the empirical studies on the price of the closed-end fund show that it starts out at a premium (Weiss (1989) and Peavy (1990)). As can be seen from Proposition 3, a closed-end fund starts at premium if either β, W or both are sufficiently small or Π_0 is substantially big. Since most closed-end funds charge a relatively small percentage of annual fee,[11] it is likely that the funds start at premium.

A closed-end fund is a financial intermediary through which portfolio management is delegated by the investors of the closed-end fund to the fund manager who is supposed to have superior information to other investors in the market. Since the investors of a closed-end fund are uninformed traders while the fund manager has private access to the information regarding the value of risky security, the initial public offering premium can be regarded as the price paid for the fund manager's ability to manage the fund based on her superior information[12] and shareholders are willing to pay

[11]The annual rate of management fee charged by most closed-end funds is less than 5 %. Please refer to *Morningstar closed-end fund 250.*

[12]Initial wealth W and IPO premium can be interpreted in the following way. As is assumed in section II, one share of the closed-end fund is publicly issued with a face value of W. If $C_0 > W$, *i.e.*, IPO is at premium, then $C_0 - W$ is the profit taken by the fund manager, and W is invested in risk-free asset. If IPO is at discount, then $W - C_0$ is contributed by the manager in addition to IPO proceedings which is C_0, and total amount of W is lent at risk-free rate of r_f. The total gain earned by the fund manager is Π_0 which is equal to IPO premium of $(1-\beta)\Pi_0 - \beta W$ plus expected present

higher IPO premium as the perceived future managerial performance gets better.[13]

As in the last part of the previous section, suppose the closed-end fund shareholders have consistent belief on the fund manager's performance. Then absolute discount of closed-end fund at period t is obtained in the following corollary.

***Corollary* 2** If investors of closed-end fund have consistent belief on the manager's future performance and capital gain earned by the fund is never realized, then absolute discount of closed-end fund is expected to increase in time unless the manager's performance is expected to improve substantially as time progresses.

Proof: From equation (8), absolute discount of the fund at period t is given in the following equation.

$$E[D_t] = \beta \left(\sum_{j=1}^{t} \pi_j + W\right) - (1-\beta)\left(\sum_{k=1}^{\infty} \frac{\pi_{t+k}}{(1+\rho)^k}\right). \tag{9}$$

From equation (9), $E[D_{t+1} - D_t]$ is derived in the following equation.

$$E[D_{t+1} - D_t] = \left(\beta + (1-\beta)\frac{1}{1+\rho}\right)\pi_{t+1} - (1-\beta)\frac{\rho}{1+\rho}\left(\sum_{k=1}^{\infty} \frac{\pi_{t+k+1}}{(1+\rho)^k}\right)$$

If $\pi_{t+1} \geq \pi_{t+k+1}$ for all t and k, it can be shown that $E[D_{t+1} - D_t] > 0$. Therefore, the condition for absolute discount to decreases in time is that π_t substantially increases in time. ■

value of management fee which is $\beta(W + \Pi_0)$. This would be equal to expected present value of the trading profits to be earned by the fund manager if she traded on her own account instead of starting up closed-end fund. The difference lies in the fact if she started closed-end fund, big portion of the expected trading profits would be paid up-front in the form of IPO premium, which might be one reason why informed fund managers start closed-end funds rather than trade her own account or sell the information directly in the form of newsletters. Please refer to Fishman and Hagerty (1995) and Shin (1993) for more details on informed trader's incentive to sell information directly to uninformed clients.

[13]For instance, the most celebrated fund manager, Peter Lynch got "numerous offers to start a Lynch Fund, the closed-end variety listed on New York Stock Exchange. The would-be promoters said they would sell billions of dollars' worth of Lynch Fund shares on a quick "road show" to a few cities." (Lynch (1993)).

Propositions 3 and equations (8) and (9) can be clues to explain the stylized empirical findings on closed-end fund discounts: most of the funds starts out at a premium but as time progresses it is more likely that they are traded at discount. Weiss (1989) shows that most closed-end funds are traded at an average discount of over 10 % within 120 days from IPO. In the mid and late 1980s, many country funds that were invested in a portfolio of assets in a specific foreign country were launched at a substantial premium (Bonser-Neal, Brauer, Neal and Wheatley (1990)). But within 5 years, most of these country fund sold much below their net asset value.[14]

As is shown in equation (8) and Corollary 2, unless investors believe that the performance of the closed-end fund manager substantially improves as time progresses, *i.e.*, Π_t substantially increases t, and shares of the closed-end fund are very likely to sell at a greater discount. In the early stage of the fund, the value of the assets that have been purchased by the fund does not reach a substantial amount yet, which keeps *NAV* of the fund relatively low compared with future trading profits to be earned by informed manager. As is shown in Proposition 2, the size of the closed end fund discount increases in *NAV*, and therefore, it is more likely that shares of the closed-end fund sell at premium in IPO and in early stages of the fund. As the trading profits earned by the manager continues to accumulate, the market value of the assets held by the fund, *i.e.*, net asset value of the fund, is expected to grow, and greater amount of cashflow is deducted by the manager for her service. When the management fee paid to the manager starts to be greater than the expected trading profits to be earned by her in the future periods, the shares of closed-end fund sell at discount, and the size of discount tends to widen as time progresses and *NAV* increases unless there is a drastic improvement in managerial performance.[15]

As absolute discount of closed-end fund is likely to increase, the discount rate given in equation (8) also tends to increase in time, but as *NAV* grows and Π_t stabilizes, it is more likely that d_t

[14]For more details, see "International and Country Funds" in *Forbes* September 11, 1995.

[15]Even when fixed percentage of capital gain is immediately realized at each period, it can be shown that the same result still hold.

converges to a certain level although short-term fluctuation in d_t is unavoidable.

The volatility of closed-end fund discount is quite high as is reported by most empirical studies not only because *NAV* is subject to wide fluctuation as the underlying asset price changes but also because the belief of closed-end fund investors on the manager's performance rarely remains *consistent* as is defined in this paper.

Some other stylized facts associated with closed-end fund price can be explained in the context of this model.

It is generally known that closed-end funds earn negative abnormal returns after IPO as prices of closed-end funds drop. As is reported by Weiss (1989), closed-end fund IPOs provide a cumulative market adjusted return of -12.6%, and Hanley, Lee and Seguin (1996) show empirical evidence of over-priced closed-end funds being marketed to uninformed investors followed by underwriters' price stabilization and subsequent price drops. In the context of this model, this can be partially explained.

Suppose a fixed percentage, say 100 α% of capital gain is immediately realized and distributed at each period and investors have consistent belief. Then, from Corollary 1, the expected value of the price is

$$E[C_t]=(1-\beta)\left[W+(1-\alpha)\sum_{j=1}^{t}\pi_j+\sum_{k=1}^{\infty}\frac{\pi_{t+k}}{(1+\rho)^k}\right],$$

and $E[C_{t+1}]-E[C_t]$ is derived in the following equation.

$$E[C_{t+1}]-E[C_t]=(1-\beta)\left[\pi_{t+1}\left((1-\alpha)-\frac{1}{1+\rho}\right)+\frac{\rho}{1+\rho}\sum_{k=1}^{\infty}\frac{\pi_{t+k+1}}{(1+\rho)^k}\right],$$

$E[C_{t+1}]-E[C_t]<0$ and the price of closed-end fund is expected to decrease if $((1-\alpha)-1/(1+\rho))<0$ and $\sum_{k=1}^{\infty}\pi_{t+k+1}/(1+\rho)^k$ is sufficiently smaller than π_t. Put differently, it is possible to observe closed-end fund prices drop if substantial portion of capital gain is immediately realized and distributed to shareholders, and managerial performance is believed to deteriorate as time progresses even when investors have consistent belief.

However, it is commonly observed that investors' belief on managerial performance change. As is reported by Hanley, Lee and

Seguin (1996), “new funds typically distance themselves from prior funds by promoting new investment strategies and objectives,” which tends to boost IPO price and premium of the fund. From equation (4) and Corollary 1, if *NAV* does not grow as much as investors of the closed-end fund initially expected, which prompts revision of investors belief in the manager’s future performance, it is likely that the price of the closed-fund would drop. Analytically, if $NAV_h < E[NVA_h|\Omega_0]$ and $\pi^t_h < \pi^t_0$ at $h<t$ which results in $E[C_h] > C_h$, then $C_0 > C_h$ is more likely to happen and abnormal return of closed-end fund can be negative.

Many empirical studies, most recently Pontiff (1995), show that the premium of closed-end fund predicts negative future abnormal return of the fund while discount predicts positive future abnormal return. From equation (4), if 100 α% of capital gain is immediately realized and distributed at each period, then the return of closed-end fund can be given in the following equation.

$$
\begin{aligned}
R_t^{t+1} &= \frac{C_{t+1}}{C_t} - 1 \\
&= \frac{(1-\beta)(NAV_{t+j} + \Pi_{t+j})}{(1-\beta)(NAV_t + \Pi_t)} - 1 \\
\Rightarrow \quad E[R_t^{t+1}|\Omega_t] &= \frac{NAV_t + (1-\alpha)(\sum_{j=1}^{i} \pi_{t+j}) + \sum_{\kappa=1}^{\infty} \frac{\pi_t^{t+\kappa+\iota}}{(1+\rho)^{\kappa}}}{NAV_t + \sum_{h=1}^{\infty} \frac{\pi_t^{t+h}}{(1+\rho)^{h}}} - 1
\end{aligned}
\tag{10}
$$

If at period *t*, investors expect that the manager’s performance would improve in the near future, *i.e.*, increase in π_t^{t+h}s for $h<i$, then, as can be seen from equations (4) and (10), the price of the closed-end fund will go up and discount of the fund narrows for any α. But α is sufficiently high, increase in π_t^{t+h}s for $h<i$ would have negative impact on the return. Therefore, the relationship between closed-end fund discount and its return can be partially attributed to the change in investors perception of the manager’s future performance.

V. Liquidation of the Closed-End Fund

One aspect of the closed-end puzzle is why the fund traded at discount is not liquidated or converted into an open-end fund. The analysis in this section provides the optimal decision on a liquidation or a conversion of the closed-end fund to open-end ones.

Suppose that at the beginning of period t, shareholders of the closed-end fund decide to liquidate the fund by selling $(\sum_{h=1}^{t} x_h)$ shares of risky securities purchased in previous periods. Notice that the value of the risky securities when trading of the closed-end fund begins at period t is $\tilde{v}_t$. In most cases, costs should be incurred in the liquidation of the closed-fund. There are two types of costs: i) transaction costs associated with selling the shares of risky securities such as bid-ask spread and brokerage fee result in the proceeds from the sales less than $(\sum_{h=1}^{t} x_h)\tilde{v}_t$\, and ii) other fees and costs to terminate the fund, such as severance fee to the manager. The total cost associated with the liquidation of the fund is then $\kappa NAV_t + f(\sum_{h=1}^{t} x_h)$, where $0 \leq \kappa \leq 1$ and $f(\sum_{h=1}^{t} x_h)$ is non-negative and increases in absolute value of $(\sum_{h=1}^{t} x_h)$. Then the net proceeds of the liquidation are $(1-\kappa)NAV_t - f(\sum_{h=1}^{t} x_h)$. The following proposition presents the condition for liquidation.

***Proposition* 4**
Closed-end fund is liquidated if and only if

$$L_t \equiv \beta NAV_t - (1-\beta)\Pi_t > \kappa NAV_t + f(\sum_{h=1}^{t} x_h). \tag{11}$$

Proof: If the decision is made to continue the fund then the value of the fund at the beginning of period t is $C_t = (1-\beta)(NAV_t + \Pi_t)$. It is more beneficial for the shareholders of the closed-end fund to liquidate the fund if $(1-\kappa)NAV_t - f(\sum_{h=1}^{t-1} x_h) > C_t$ holds, and the result follows. ■

Since $Lt = D_t$, Proposition 4 can be restated in the following way: If the discount of the fund exceeds the cost associated with liquidation, then it is optimal to liquidate the fund. Given β and π, as time progresses the probability of the fund being liquidated or converted to an open-end fund increases since the net asset value is expected to grow and thereby the discount of the fund is more likely to increase. But the change in investors' perceptions of the manager's ability can hasten or delay the liquidation of the fund.[16]

Empirical studies including Brauer (1984) have shown that the discount narrows when the closed-end fund is liquidated. This can be explained by the implications derived from Proposition 4. Since $\kappa NAV_t+f(\sum_{h=1}^{t} x_h)$ can be regarded as the discount of the fund when it is decided that the fund will be liquidated, and the fund is liquidated if $Lt> \kappa NAV_t+f(\sum_{h=1}^{t} x_h)$, as soon as the liquidation decision is announced, the discount of the fund narrows to $\kappa NAV_t+f(\sum_{h=1}^{t-1} x_h)$.

VI. Conclusion

This paper presents a formal model of closed-end fund pricing within a multi-period market microstructure framework in which the fee charged by the fund manager and investors' perception of the fund manager's future performance can explain most of the puzzles associated with closed-end fund price and discount. A closed-end fund can be regarded as a financial intermediary through which uninformed but rational traders invest in risky securities with the help of an informed fund manager.

To the extent that the fund manager is believed to have access to information superior to other investors in the market but she charges a managerial fee for the service, most of the dynamics associated with the price and discount of closed-end funds can be explained. Notice that every agent in this model is rational although some are less informed than others, and there is no agency problem on the part of the fund manager.

The model in this paper can provide theoretical explanations for the following patterns associated with closed-end fund price and discounts: i) a closed-end fund starts at a premium but it is more likely to sell at a discount at later periods, and ii) the price and discount of the closed-end fund are subject to greater fluctuation

[16]Deaves and Krinsky (1994) analyze the relationship between managerial performance, the fee charged by the manager and the probability of liquidation. It is shown that poor managerial performance and a higher fee charged by the manager have both direct and indirect effects on the discount of the fund: directly, they cause a higher discount; but indirectly, they lead to a higher probability of open-ending, which reduces the discount.

than the price of assets invested by the fund.

Although this paper provides a partial explanation of, as Pontiff (1995) points out, the relationship between the closed-end fund premium and future returns of the fund, and the implications of a such a relationship awaits further theoretical investigation.

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References

Admati, A., and Pfleiderer, P. "A theory of intraday trading patterns: Volume and trading variability." *Review of Financial Studies* 1 (1988): 3-41.

Anderson, S. C., and Born, J. A. *Closed-End Investment Companies: Issues and Answers*. Kluwer Academic Publishers, 1992.

Bonser-Neal, C., Brauer, G., Neal, R., and Wheatley, S. "International Investment Restriction and Closed-end Country Fund Prices." *Journal of Finance* 45 (1990): 523-47.

Brauer, G. A. "Open-Ending Closed-End Funds." *Journal of Financial Economics* 13 (1984): 491-507.

Chen, N., Kan, R., and Miller, M. H. "Are the Discounts of Closed-End Funds a Sentiment Index?" *Journal of Finance* 48 (1993): 795-800.

De Long, J. B., Shleifer, A., Summers, L. H., and Waldman, R. J. "Noise Trader Risk in Financial Markets." *Journal of Political Economy* 98 (1990): 703-98.

Deaves, R. and Krinsky, I. "A Possible Reconciliation of Some of the Conflicting Findings on Closed-End Fund Discounts: A note." *Journal of Business Finance and Accounting* 21 (1994): 1047-57.

Fishman, M. J., and Hagerty, K. M. "The Incentive to Sell Financial Market Information." *Journal of Financial Intermediation* 4 (No. 2 1995): 95-115.

Hanley, K. W., Lee, C. M., and Seguin, P. J. "The Marketing of Closed-End Fund Ipos: Evidence from Transaction Data." *Journal of Financial Intermediation* 5 (1996): 127-59.

Kyle, A. S. "Continuos Auctions and Insider Trading." *Econometrica* 53 (1985): 1315-35.

Lee, C. M. C., Shleifer, A., and Thaler, R. H. "Investor Sentiment and the Closed-End Fund Puzzle." *Journal of Finance* 46 (1991): 75-109.

Lynch, P. *Beating the Street*. Simon and Schuster, 1993.

Oh, G., and Ross, S. A. Asymmetric Information and the Closed-End Fund Puzzle. Research Paper Series, University of Iowa, 1994.

Peavy, J. W. "Returns on Intial Public Offerings of Closed-End Funds." *Review of Financial Studies* 3 (1990): 695-708.

Pontiff, J. "Closed-End Fund Premia and Returns Implications for Financial Market Equilibrium." *Journal of Financial Economics* 37 (1995): 341-70.

Shin, J. Direct sales of financial information. Hong Kong University of Science and Technology, Mimeograph, 1993.

Weiss, K. "The Post-Offering Price Performance of Closed-End Funds." F*inancial Management* 18 (1989): 57-67.

Xu, Y. A Model for the Pricing of Closed-End Fund. Economics Department, Princeton University.(1995).