Essays on Closed-end Funds

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ABSTRACT

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Despite the simplicity of their operations and the pricing of their underlying assets, closed-end funds are associated with some of the most puzzling anomalies in finance. Thus, the primary purpose of this thesis is to show why funds (especially closed-end funds) exist, why the variance of mutual fund returns can exceed the variance of the returns on their investment portfolios in a rational market, and how properly chosen remuneration schemes for fund managers lead to better fund pricing. Each of these topics constitutes a self-contained essay or chapter in the thesis.

In the first essay, we demonstrate under which conditions closed-end mutual funds exist. In general, the time horizons of small investors must be in a range that eliminates the incentives for them to invest directly in investment projects while allowing managed investment fund managers to realize non-negative profits. The specific existence of closed-end mutual funds is related to the opportunity for some investors to liquidate their fund's shares before the termination of the fund and to the flexibility that open-end fund managers have to liquidate their assets under management. As the likelihood of "bank run" increases, so does the likelihood of issuing closed-end mutual funds.

In the second essay, we challenge the current belief in finance that, if investors are rational, then the variance of the returns for the shares or units of a closed-end fund should equal the variance of the returns of the net asset value per share (NAVPS) of the portfolio of assets under management by the fund. We demonstrate that various factors lead to excess price variability, so that the ratio of price to NAVPS variances exceeds one in a rational market. These factors include a differential impact of the bid/ask bounce, potential fund liquidation, performance persistence, management fees, and payout policy.

In the third essay, we demonstrate that well-chosen remuneration schemes can help investors to properly value the securities of closed-end funds in primary markets so as to better reflect the abilities of its managers. In contrast, the current compensation structures that are typically based on flat fees may induce good managers to exit the closed-end fund sector, and may leave this sector with managers that generate returns that are relatively low compared to their management fees. In turn, this may explain why such funds typically sell at a discount to their net asset value per share shortly after an initial public offering.

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CHAPTER 1

INTRODUCTION

Closed-end funds are companies whose operations are similar in most respects to those of any other business corporation. Unlike other companies, the corporate business of closed-end funds consists largely of investing funds in the securities of other corporations. Closed-end funds provide market-based rates of return for stocks and, in most cases, for the underlying asset portfolios. The price of their shares is determined by supply and demand and does not necessarily have to correspond to the market value of the underlying assets of the fund. In contrast, open-end funds are characterized by the continual selling and redeeming of their units at net asset value. Therefore, open-end funds have a variable number of shares issued at each point of time, unlike closed-end funds.

Despite the simplicity of their operations and the pricing of their underlying assets, closed-end funds are associated with some of the most puzzling anomalies in finance. First, the shares of closed-end funds are sold in the pre-market at a premium compared to their net asset values (on average, at a premium of 10%). The price of these funds declines substantially within the first one-hundred days of trading. Second, closed-end funds usually trade in the secondary market at a sharp discount compared to the value of their underlying assets. Third, the discount (premium) associated with their shares display more variability than the values of their underlying assets. The behaviour of closed-end fund shares appears to challenge the hypothesis that investors behave rationally and that markets function efficiently.

This thesis examines the behaviour and functioning of closed-end funds, and provides some explanations for the abovementioned anomalies.

The first essay ("*The existence of closed- and open-end mutual funds*"), which is the topic of chapter two, establishes the circumstances under which closed-end fund shares are issued. The argument contained therein is based on economies of scale provided by managed investment funds in general, and by the specific protection against bank runs provided by closed-end fund shares. The latter occurs because closed-end funds do not have to liquidate their underlying assets to provide immediacy while open-end funds are constrained to do so. To our knowledge, and despite the importance of open-end and closed-end funds in the financial markets, no paper has ever theoretically addressed the conditions under which closed-end funds and open-end funds should be issued.

The second essay ("*Should the variances of market price and NAVPS be identical for a closed-end fund?*"), which is the topic of chapter three, provides rational justifications for why the prices of closed-end funds vary more than their underlying assets. We show that technical characteristics, which are related to the market microstructure and management behaviour, will induce greater variation in the share price of funds relative to their net asset values per share. This challenges the current view in the literature which advocates that spurious movement of these shares is mainly driven by investor sentiment or irrational behaviour. Our explanations are simply based on operating characteristics that are specific to these funds.

The third essay ("*Fund manager remuneration and the price behaviour of closed-end fund IPOs*"), which is the topic of chapter four, shows that the prevailing remuneration structure of managers in the closed-end fund industry induces a discount in the share prices of closed-end funds. Under some specific payoff distributions, a proper mix of fees and benchmarks results in self-revelation of the fund manager's skill and in the price of the closed-end fund fully reflecting its expected payoff. From a normative standpoint, this result implies that current practices induce inefficient pre-market pricing and may lead good fund managers to exit the closed-end fund industry.

By justifying the initial premium, providing some indications for the subsequent drop in price, and justifying why the price variation is higher than the net asset value per share, this thesis also provides explanations to some of the anomalies associated with closed-end funds.

CHAPTER 2

THE EXISTENCE OF CLOSED- AND OPEN-END MUTUAL FUNDS

According to the Investment Company Institute, the value of the combined assets of closed-end funds in the United States was $165.0 billion at the end of March 2003. Despite the relative importance of this sector in the money management industry, few rational explanations are provided in the academic literature for the existence of closed-end funds (notably, in comparison to the open-end fund sector).

Evidence of the selection of the closed-end fund format instead of the open-end format can be found, for instance, on the internet site of H&Q Healthcare Investors as follows:

> "The Board of Trustees considers and votes on this issue at least once a year. While it is possible that the Fund may become open-ended someday, it would require a significant shift in the Fund objectives, as investments in restricted securities would be limited (and potentially some manner of liquidation of the restricted securities would have to be determined to reach allowable levels) and similarly, the small emerging growth stocks that the Fund invests in are frequently thinly traded and would not be suitable for an open-end format that requires daily liquidity. The Fund was specifically structured as a closed-end fund to allow the holding of these types of securities for the longer-term time frame necessary to realize maximum capital appreciation potential."

Similarly, Real Estate Investment Trusts are mostly composed of illiquid assets. According to the National Association of Real Estate Investment Trusts, there are approximately 180 publicly traded REITs in the United States with assets totaling $375 billion.

The purpose of the essay that embodies this chapter is to propose a formal model that states under what conditions a closed-end instead of an open-end fund would be formed. Our main intuition is that closed-end funds tend to grow in number when the liquidity of assets demanded by investors is shrinking. Contrary to open-end funds, closed-end funds do not have to sell their underlying assets when shareholders of the fund sell their shares. Therefore, closed-end funds offer insurance against panic selling by other investors. To our knowledge, no article has directly provided a theoretical model on the existence of managed investment funds in general, and more specifically, on the existence and economic purpose of open- and closed-end mutual funds.

Our approach relates closely to the banking literature on bank runs. Diamond and Dybvig (1983) establish the conditions under which the liquidity services offered by banks can be maintained without creating the possibility of bank runs. In their model, deposit institutions provide a valuable insurance contract to risk-averse agents that allow them to liquidate their deposits before maturity. Providing such contracts creates the possibility of bank runs, which can be eliminated by features such as suspension of convertibility of deposits.

According to Diamond and Dybvig, deposit institutions are conceived as financial devices that offer risk-sharing contracts to their clients. Banks offer their clients the possibility of liquidating their deposits whenever they happen to be agents that must liquidate their deposits before maturity while simultaneously guaranteeing them a liquidation value higher than their initial capital layout. As a result, banks offer an increase in the expected utility of agents as compared to the autarkic situation.

The case of panic selling in financial markets is similar to bank runs in many respects. This is particularly true for portfolios where the securities under management are relatively illiquid. Open-end funds tend to invest in such instruments or markets sparingly, since a danger exists that investors will panic during adverse market conditions. Through redemptions, investors can force the sale of assets of the open-end funds at temporarily depressed prices, and contribute to a further depression of such prices (see Appendix A2 for real life examples of bank runs in the mutual fund industry). However, closed-end funds do not have to worry about such redemptions. Therefore, closed-end funds can make illiquid investments and be a cost-saving device to investors for the less marketable portfolio holdings of investors.

Contrary to the common view, since closed-end funds may provide more unfettered access to restricted types of securities, which in turn should provide access to a more efficient frontier, investors should be willing to pay a premium to hold a portfolio that offers those restricted shares. This premium should be related to the fact that the access may still be costly to the fund managers or that those managers might be able to charge investors monopoly rents. This is opposite to the empirical results reported by Malkiel (1977, 1995). He finds that the average discount of closed-end funds increases as the percent of the portfolio in restricted securities grows. Our view is that the negative relationship between the amount of restricted securities and the discount of a closed-end fund should not be seen as a rational explanation of the closed-end fund discount but instead as additional evidence of the anomalous pricing of these types of funds.

The rest of this chapter is structured in the following way. In section 2.1, a general model of managed investment funds is presented. The model is used to provide economic intuition for the empirical observation that the value of a closed-end fund exceeds its net asset value before it is traded in the open market. Since a portion of the proceeds of an initial public offering must be used to pay for underwriting fees, the net asset value has to be lower than the offer price. Using a transactions cost approach, we justify this inequality, and show that the very fact that closed-end funds are priced higher than their net asset value is essential to justify their existence. In section 2.2, we show how managed investment funds may be subject to panic selling (or bank runs) if units are redeemable at some interim periods. We set the conditions under which managers may opt to issue a closed-end fund instead of an open-end fund given the possibility of abnormal net redemptions. In section 2.3, we discuss the relation between the liquidity of the underlying assets and the price of a closed-end fund under a competitive closed-end fund industry. We conclude in the last section.

2.1 A MODEL OF MANAGED INVESTMENT FUNDS

2.1.1 Definitions and assumptions

We define a *managed investment fund* as a financial intermediation firm in which an agent manages in part or in totality the wealth of the principals or unit holders. An *open-end mutual fund* is a managed investment fund in which units are redeemable at net asset value directly through the manager of the fund. A *closed-end fund* is a managed investment fund with units that are redeemable through open market transactions.

To support the existence of managed investment funds, we invoke the following assumptions:

A.1. Agents:

There are three types of risk-neutral agents[1]:

- Short-term investors with wealth $W_S = 1$, and an investment horizon of T_S.
- Long-term investors with wealth $W_L = \frac{1}{m}$ ($m>1$), and an investment horizon of T_L, where $T_S < T_L$. Intuitively, long-term investors should be seen as

[1] As in Nanda, Narayanan and Warther (2000), universal risk-neutrality is assumed in order to simplify the model and put aside issues not relevant to the focus of the analysis. However, and contrary to Nanda, Narayanan and Warther (2000), the relative relevancy of issuing closed-end instead of open-end funds is directly addressed and arises endogenously from our model.

typical small investors with little or no access to private information or, as investors with no stock picking or timing skills. Thus, these uninformed investors would rely solely on a buy and hold strategy. These investors should have a lower turnover ratio and a longer time horizon than wealthier and more informed investors. Accordingly, long-term investors should be willing to pay more for high-spread securities, in the spirit of Amihud and Mendelson (1986).

- Mutual fund managers (defined in A.3).

Autarky provides a return of k to investors.

A.2. Project:

- Investors can invest directly in a project (or buy an existing participation in a project from a high wealth investor) at a transaction cost of c. This cost stands, implicitly, as the cost to search for a high wealth long-term investor or as the additional costs related to accessing the investment project.[2] The project has one share and pays a perpetual random dividend, which has an expected value of D. Re-investment in the project is not required. Consequently, all revenues generated by the project are paid to their shareholders.
- Since short-term investors fix the price of the project, the pool of small investors consists of price takers for the project. Furthermore, the inability of small investors to form a coalition at low cost restrains them from offering a more competitive price for the project. Thus, the competitive price of these investments is aligned with the investment horizon of the short-term investors. The competitive equilibrium price is P_0 and the total cost $(P_0 + c)$

[2] These costs may be viewed as search costs, legal costs, restrictions, barriers or lengthy procedures to get access to or to start the investment project.

of investing in the project is 1. The expected selling price is P_0, since we assume that the buying and selling of the project comes at cost c. Specifically:

$$P_0 + c = \sum_{t=1}^{T_s} \frac{D}{(1+k)^t} + \frac{P_0}{(1+k)^{T_s}} = 1 \tag{2.1}$$

Rearranging (2.1) gives:

$$P_0 = \frac{D}{k} - c\left[\frac{(1+k)^{T_S}}{(1+k)^{T_S} - 1}\right] \tag{2.2}$$

Predictably, this shows that the equilibrium price of the project decreases with transaction costs and increases with horizon length T_S.

- Shareholder(s) of the project can always sell their share(s) at any time within their investment horizon at price P_0. Thus, there are always some short-term investors with full time horizon T_s, which are willing to pay the total cost *(P_0 + c)* to acquire the project.
- Each share is divisible, and long-term investors can only afford to hold directly a proportion of a share:

$$\delta_L = \frac{\left(\frac{1}{m}\right) - c}{1 - c} \tag{2.3}$$

Rearranging δ_L gives: $\delta_L = \frac{1}{m}\left\{1 + \frac{c(1-m)}{(1-c)}\right\}$, which is lower than $\frac{1}{m}$, since m>*1*. Therefore, the total initial value of the portion of a share held by long-term investors is equal to δ_L P_0 or $\frac{1}{m} - c$. This initial outlay may actually differ from the discounted terminal value of the share if the time horizon of the small investor differs from the time horizon embedded in the equilibrium value of the project.

A.3. Managed investment fund:

- There is a mutual fund manager who can gather, at time t_0 and at search cost s(n), n low wealth individuals to invest in the project (and s'>0). The fund manager has a monopolistic position in searching for investors in the sense that the search process of other agents is too costly and unprofitable for them to enter the managed investment fund market. The mutual fund manager has no wealth and must therefore gather sufficient small investors to cover the various costs to start a managed investment fund. Thus, the fund manager is also acting as an underwriter of the fund.[3] We further assume that s(1) = 0, s(i) > 0 and $\frac{i}{n} - s(n) > 0$ (for i=1, …, n) in order to allow the manager to conduct the search process. As is seen later, the monopolistic position of the mutual fund manager may induce long-term investors to pay a premium over the price of the net asset value of the fund or the value of the project. Fund managers may also charge a periodic fee to long-term investors. The relatively longer time horizon of low wealth agents allows the amortization of the search costs over time, and for the possibility that the discounted fees more than cover the operation costs of the fund manager.
- The manager of the investment fund has a finite life of T_L.[4] Once T_L is reached, the fund manager sells the share to a short-term investor and gives a portion of the net asset value of the fund to each unit holder. The fund manager does not re-invest any of the revenues received from the project. All revenues, net of management fees, are transferred to the shareholders of the fund.

[3] In support of this view, see Hanley, Lee and Seguin (1994).
[4] In the closed-end fund industry, many funds are open-ended, liquidated or bought back within years following their issuance.

A.4. Sequence of events:

At this point, there are just two periods where some trading can occur. At period 0, the mutual fund manager searches for small investors to invest in the project and offers units of the fund to these investors. Small investors can opt to invest directly in the project, buy a share of the managed investment fund or select autarky. If low wealth mutual fund investors opt to buy mutual fund shares then they will redeem their units at net asset value and consume at time T_{L}. If the fund is liquidated at $T < T_L$, then the expected return of the investor is lower than k.[5]

2.1.2 Managed investment fund value and management fees

Define P_0^F as the offer price of a share of the fund and n as the number of long-term investors required by the investment fund manager to invest in the project. From our set of assumptions, the price of the managed investment fund, P_0^F, is equal to:

$$P_0^F = \frac{1}{m} = \frac{P_0 + s(n) + c}{n} = \sum_{t=1}^{T_L} \frac{\frac{D(1-\alpha)}{(1+k)^t}}{n} + \frac{\frac{P_0}{(1+k)^{T_L}}}{n} \tag{2.4}$$

In (2.4), α is the management fee (in percentage) charged periodically by the manager and s(n) is the cost for the underwriter to gather the n long-term investors. [6] The total funding of the fund is 1+s(n). Each share is equal to $\frac{1}{m}$, as each shareholder invests all his wealth in the fund. Since $P_0 + s(n) + c > 1$, the number n of investors required to start

[5] Since $P_o + c = \sum_{t=1}^{T_L} \frac{D}{(1+k)^t} + \frac{P_0}{(1+k)^{T_L}} = 1$ and $P_0 + \frac{c}{\delta_L} = \sum_{t=1}^{T_L} \frac{D}{(1+r)^t} + \frac{P_0}{(1+r)^{T_L}} > 1$, it must be that the expected return r is less than *k*.

[6] To simplify the equation, we have selected to deduct the fees from the dividend paid by the project. In practice, for both open- and closed-end funds, fees are generally deducted from the asset value of the fund. However, this causes no loss of generality since the fund does not retain any of the revenues generated by the project in our model. In other words, the expected asset value of the fund is constant once the dividends net of fees are paid. Since, the fees do not alter the asset base of the fund, this accommodates the mathematical format that we selected.

the fund must be greater than m in order that $P_0 + s(n) + c = n\left(\frac{1}{m}\right)$. Equation (2.4) states that the investment fund manager initially gathers n long-term investors, and invests the proceeds in a project with market price P_0. Since only one transaction is necessary, the managed investment fund pays the transaction cost c to acquire or have access to the investment project.

The net asset value per shareholder (or NAVPS) is $\frac{P_0}{n}$. Shareholders expect to receive a liquidation value at time T_L equal to the net asset value of the fund at time 0. The premium paid by each unit holder of the fund at $t=0$, or P_0^F - $NAVPS_0$, is $\frac{s(n)+c}{n}$. This premium reflects the fact that the search cost per investor is embedded in the offer price of the managed investment fund.[7] Operating costs, such as c, are paid after the initial public offering of the fund. Therefore, as our model illustrates, a managed investment fund starts as a cash pool from which search costs and transaction costs are deducted. For the fund to be profitable, the investment horizon T_L must be long enough to more than compensate for the dilution (m>n) and cost (s(n)) required to start the fund.

Solving for α in equation (2.4) gives:

$$\alpha = 1 - \left[\frac{(1+s(n))(1+k)^{T_L} - 1 + c}{\frac{D}{k}\left[(1+k)^{T_L} - 1\right]} \right] \tag{2.5}$$

[7] This set up is realistic for both closed-end and open-end funds. For closed-end funds, due to underwriting fees, the offer price must be at a premium relative to the underlying assets. In the open-end fund industry, some funds charge front-end load fees. Other open-end funds do not charge load fees. However, for those that do charge load fees, the initial expenses related to the search process needs to be amortized and expensed during the expected holding period of the unit holders, since these securities are not sold in an open market and must sell at their net asset value. This sunk cost, if amortized over a long period of time, allows the monopolistic fund manager to charge high fees. The same conclusion applies for costs directly deducted from the initial cash pool as long as the investor horizon also leads to high fund manager surplus. Some fees, such as back-end load fees that also are known as deferred sales charges, may in fact not be charged if the mutual fund has been held for a long enough period of time.

The profit of the fund manager (π) or the present value of the fees paid by the unit holders is:

$$\pi = \left\{ \frac{D}{k}\left[1 - \frac{1}{(1+k)^{T_L}}\right] - [1 + s(n)] + \frac{1-c}{(1+k)^{T_L}} \right\} \tag{2.6}$$

The long-term investor is willing to pay a periodic fee α due to the payoff offered by the investment, the reduced transaction costs due to the intermediation of the fund managers, and the implicit deferred payment of c at liquidation. From equation (2.6), the profit of the manager will be lower as c (or the liquidation value at T_L decreases) and s(n) increases. A decrease in the wealth of small investors (or the higher the number of investors required to finance the project) translates into lower profits for the fund manager ($\frac{d\pi}{dn} < 0$ since s'>0). Also, higher T_L lead to higher profits since the fund manager captures any surpluses,[8] which are caused by the higher fees resulting from a higher amortization period for search and transaction costs. Specifically, $\frac{d\pi}{dT_L} = -T_L\left[1 - c - \frac{D}{k}\right](1+k)^{-T_L-1} > 0$ since $P_o < \frac{D}{k}$. By construction, the short-term investor is not willing to pay price P_0^F for a share of the fund since he or she cannot amortize the cost c over the same holding period as the long-term investor.

Our approach is motivated by the empirical findings of Sirri and Tufano (1998) who find that search costs seem to be an important determinant of fund flows into the open-end mutual fund industry. They provide evidence consistent with the hypothesis that mutual fund flows are affected by factors related to the search costs that consumers must bear. They find that high-fee funds, which presumably spend much more on marketing than their rivals, enjoy a much stronger performance-flow

[8] Chen and Ritter (2000) provide evidence that underwriting fees may be fixed higher than the competitive level.

relationship than do their rivals. Their study also finds evidence that media coverage of mutual funds is positively related to fund flows.

The findings of Sirri and Tufano suggest that investors purchase funds that are easier and less costly for them to find. The underwriter could facilitate this by publicizing, at some cost, the issue of units of the managed investment fund.

2.1.3 Time horizon of investors and conditions for the existence of managed investment funds

In this section, we establish two necessary conditions for managed investment funds to exist and relate those conditions to the investment horizon of small investors.

The first condition states that the profit of the managed investment fund manager must be greater or equal to zero. The second condition states that the utility that long-term investors obtain from buying a managed investment fund must be greater or equal to the utility arising from investing directly in the project.

Proposition 2.1:

For managed investment funds to exist, the time horizon of the representative investor T_L^* must be within an upper and lower bound.

Proof:

First condition (lower bound): Setting equation (2.6) equal to or greater than zero and solving for T_L, we obtain:

$$T_L^* \geq \frac{\ln\left(\dfrac{\dfrac{D}{k}-P_0}{\dfrac{D}{k}-\left(P_0+c+s(n)\right)}\right)}{\ln\left(1+k\right)} = T_L^- \tag{2.7}$$

Second condition (upper bound): Small investors will select to invest in the managed investment fund (instead of investing directly in the project) if:

$$\sum_{t=1}^{T_L}\frac{\dfrac{D(1-\alpha)}{(1+k)^t}}{n}+\frac{\dfrac{P_0}{(1+k)^{T_L}}}{n} \geq \delta_L\left(\sum_{t=1}^{T_L}\frac{D}{(1+k)^t}+\frac{P_0}{(1+k)^{T_L}}\right) \tag{2.8}$$

Since the fund manager captures through fees any surplus from the small investors, equation (2.8) can be set as:

$$\frac{1}{m} \geq \delta_L \left(\sum_{t=1}^{T_L} \frac{D}{(1+k)^t} + \frac{P_0}{(1+k)^{T_L}} \right) \tag{2.9}$$

Solving (2.9) for T_L using equations (2.2) and (2.3), we obtain (since $\frac{D}{k} > P_0$):

$$T_L^+ = \frac{\ln\left(1 + \frac{mc}{\left(\left(\frac{1-mc}{1-c}\right)\frac{D}{k}\right) - 1}\right)}{\ln(1+k)} \geq T_L^* \tag{2.10}$$

Together, these two conditions provide bounds for the existence of a managed investment fund; namely:

$$T_L^- \leq T_L^* \leq T_L^+ \tag{2.11}$$

QED

Discussion:

Term T_L^* defines the range of *T* over which a managed investment fund is feasible. In the first condition, any increase in the transaction cost *c*, or in the search cost s(n), must be compensated for by an increase in the horizon length of the long-term investor. This would allow the underwriter to increase the fees α so that the zero-profit condition is maintained. If s(n)=0 then $T_S = T_L^-$ since the fund manager would fully transfer the benefits of the scale economies to the small investors (as profit is set to null), and thus the lower bound would be set at the investment horizon embedded in the competitive price of the project. In the second condition, since $\frac{dT_L^+}{dm} > 0$, investors with low wealth will need a longer investment horizon to amortize the transaction cost *c*. In other words, if the number of small investors needed to buy the private placement is high or their wealth is low, then the time horizon of these investors will need to be high for cost c to be amortized. Also, as it is straightforward to show, if $T_S = T_L$, then m=1 for $T_L^* = T_L^+$.

If $T_L > T_L^+$, it pays the long-term investor to invest directly in the investment held by the fund. If $T_L < T_L^-$, then the surplus of the long-term investor is not sufficient to cover the costs borne by the manager.

If equation (3.11) holds, then the fund manager needs to find sufficient n so that the project is entirely financed by small investors through their holdings in the managed investment fund. This is so because no small investors holds directly a portion of the project (due to (3.11)), and large investors always invest all their wealth in the project due to the amortization of transaction cost c. Thus, no complementary financing is available in the market to supplement a cash outlay by the managed investment fund that would be less than one. Therefore, while the project is in principle divisible, it always is held in totality by either one managed investment fund or one short-term horizon investor.

2.2 INTERIM TRADING PERIOD AND LIQUIDITY OF OPEN-END FUNDS

Open-end mutual funds are similar in many respects to cash deposit accounts in banks. Among other things, mutual fund units are easy to redeem. In most cases, if a sell order is set during a specific trading day (usually before a specific time in the afternoon), the unit holder receives the net asset value of her holding which is set as the estimated value of the underlying assets of that unit at the end of the trading day. We conjecture that what allows for a differentiation between a closed-end fund and an open-end fund is the existence of an intermediate period and the opportunity for some investors to liquidate their funds before the termination of the project or the investment horizon of the investors.

2.2.1 Additional assumptions

The following assumptions are added to our existing set of assumptions:

First, open-end fund unit holders are allowed to redeem their units at some intermediate stage, denoted as t_I, where $t_0 < t_I < T_L$.

Second, the time preference of the risk-neutral investors is state dependent. A fraction λ of the investors in the fund care only about consumption at time t_I, and opt to liquidate their shares at that time. We denote these agents as type 1 investors. Waiting to T_L brings no utility to these investors. In contrast, type 2 agents care only about consumption at time T_L. Type 1 investors must behave truthfully since they receive no utility from mimicking type 2 investors and delaying their consumption to time T_L. Contrary to the model of Diamond and Dybvig, the relevance of the financial intermediary does not arise from the risk-sharing advantages provided by the banking contract. The existence of managed investment funds comes from the economies of scale that they provide to investors.

Third, each agent's type is determined and revealed privately to the agent at period t_I. Information asymmetry therefore arises at time t_I between the fund manager and the unit holders. If investors panic and demand their money back when they do not have genuine cash requirements (that is, type 2 agents mimicking type 1 behaviour), then the manager may be forced to liquidate some or all of the assets under management.

2.2.2 Redemption of open-end fund shares and equilibrium decisions

To ensure that the fund is able to meet the liquidation requirements at time t_I, it needs to raise a cash pool greater than unity at the initial period. Accordingly, let ω be the cash position that the open-end fund intends to hold until time t_I. For ease of exposition, no return is to be generated from ω.[9] The cash position is fixed as a function of the expected net asset value at time t_I and the number of type 1 investors. The total value of the cash pool raised in the pre-market must now be: $NP_0^{OEF} = P_0 + s(N) + c + \omega > 1$ where P_0^{OEF} is the offer price of an open-end fund and N is the total number of unit holders in the open-end fund. Wealth of each of the N investors is equal to $\frac{1}{m}$ (as in section 2.1). The price of a share of the open-end fund is:

$$P_0^F = \frac{1}{m} = \frac{P_0 + s(N) + c + \omega}{N} = \sum_{t=1}^{T_L} \frac{\frac{D(1-\alpha^{OEF})}{(1+k)^t}}{N} + \frac{\frac{P_0}{(1+k)^{T_L}}}{N} \tag{2.12}$$

The second equality in (2.12) is obtained simply from the fact that the N investors are putting all their wealth in the fund and that the fund manager captures all surpluses from the shareholders. This also means that $\frac{N}{m} = 1 + s(N) + \omega$, $\frac{N}{n} = \frac{1 + s(N) + \omega}{1 + s(n)}$ and that $N > n > m$. Thus, the increased number of shareholders is a function of the additional search costs and the liquidity requirements incurred by the fund manager.

It is common knowledge at time 0 that there is a proportion λ of investors that are of type 1. Thus, $\lambda N = N_1$ and $N = N_1 + N_2$, where N_1 is the number of type 1 investors and N_2 is the number of type 2 investors. Beliefs about the proportion λ of type 1 investors are independent of the number of investors required to finance the managed investment fund, so that: $\lambda n = n_1$ where $n = n_1 + n_2$. However, contrary to the environment where no investor requires liquidity before T_L, a total of N investors are now required to finance the project. In other words, the initial cash pool needs to be greater than unity (since $\omega > 0$).

Equilibriums:

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[9] Beside possible costs related to panic selling, the introduction of an interim trading period creates a diluting effect to shareholders as N>n as ω generates no return. Consequently, the need for open-end funds to hold a cash position for liquidity purposes should reduce their expected return in comparison to closed-end funds all else held equal.

We conjecture that $\frac{\omega}{N_1}$ is set at time t_I so that the following equality holds:

$$\frac{P_0}{N_2} < \frac{\omega}{N_1} \leq \frac{D(1-\alpha^{OEF})\left[\frac{1-(1+k)^{-(T_L-t_I)}}{k}\right] + \frac{P_0}{(1+k)^{(T_L-t_I)}}}{N_2}. \tag{2.13}$$

If all type 2 investors wait until time T_L to consume, then they expect to receive, as of time t_I, $\frac{D(1-\alpha^{OEF})\left[\frac{1-(1+k)^{-(T_L-t_I)}}{k}\right] + \frac{P_0}{(1+k)^{(T_L-t_I)}}}{N_2}$. If some type 2 investors opt to mimic type 1 investors, then some of these investors, which are among the first investors asking to redeem their shares at the intermediate period, will receive $\frac{\omega}{N_1}$. Those among the type 2 investors who do not opt to mimic the type 1 investors will only receive $\frac{P_0}{N_2}$, since the remaining type 1 investors will ask for redemption of their shares and will force the manager to liquidate the underlying assets of the fund at market value. If all type 2 investors opt to mimic the type 1 investors, then all investors will receive $\frac{P_0+\omega}{N}$.

By using equation (2.12) and the fact that $\left[1+\frac{\frac{c+s(N)+\omega}{P_0}}{\left(1-(1+k)^{-T_L}\right)}\right]$ is greater than one, then it is straightforward to show that the left-hand term of equation (2.13), $\frac{P_0}{N_2}$, is strictly less than the right-hand term of (2.13), $\frac{D(1-\alpha^{OEF})\left[\frac{1-(1+k)^{-(T_L-t_I)}}{k}\right] + \frac{P_0}{(1+k)^{(T_L-t_I)}}}{N_2}$. Implicitly, this means that $\frac{D(1-\alpha^{OEF})}{P_0} > k$ or since the fund is selling at a premium to its initial net asset value, then the net expected return must be greater than the required rate of return. Term $\frac{\omega}{N_1}$ may be strictly less than the right-hand side of (2.13) if the manager opts to contractually include, at the initial period, a penalty fee for liquidating before maturity. (The strict inequality or less or equal inequality does not modify the conjectured equilibriums, as is easily shown.) Overall, this inequality is simply based on the institutional requirement that open-end fund shareholders are allowed to sell their units at net asset value. We assume that $\frac{\omega}{N_1}$ is strictly higher than the left-hand side of (2.13), since type 1 holders of open-end fund units expect, in practice, that their liquidation values will be close or equal to the liquidation values of their units under a going concern hypothesis.

As in Diamond and Dybvig (1983), two pure-strategy Nash equilibriums arise from this setup. In the so-called good equilibrium, type 1 investors redeem their shares and type 2 investors wait until T_L to liquidate their units. In the panic selling (or bank run) equilibrium, all agents of types 1 and 2 try to sell their shares at the interim period. This situation is less desirable to type 2 investors than the full information context but results in more favourable outcomes than not selling. Nevertheless, some type 2 investors may in fact sell. In other words, in the bad equilibrium, it does not pay for type 2 investors to wait for other type 2 investors to redeem their units. Implicitly, the type 2 investors who wait are transferring wealth to type 2 investors who are faster to redeem their shares. Therefore, all type 2 investors are "running" to the fund manager to redeem their units as quickly as possible in this bank run type of equilibrium. As a consequence, they cause the manager to liquidate the underlying assets of the fund.

Discussion:

The possibility that a bank run may occur differentiates, among other things, closed-end funds from open-end funds. Though both types of funds can be characterized by the model presented in section 2.1 in the sense that they both are a cost-saving device, open-end funds differ from closed-end funds by the fact that the termination value of one investor may be dictated by the actions of other investors and by the liquidation pressure that they may induce. In other words, the liquidation value may have nothing to do with the fundamental value of the fund. The action of other investors may induce a payoff lower than the true (going concern) net asset value of the investor's holdings. This phenomenon is not directly related to panic selling (or so-called negative bubble) in secondary capital markets. The selling pressure in open-end funds may trigger a real effect on the intrinsic value of the fund while panic selling in capital markets may not modify the intrinsic value of a corporation. In contrast, a bank run is not a possible equilibrium for closed-end funds. Possible massive selling pressure in the interim period (which may therefore drive the search cost higher) does not convey the termination of the project or a forced liquidation of the underlying assets. In fact, investors who select to wait until T_L will receive their full liquidation value. Therefore, there is "no gain from panicking" as interim trading behaviour does not modify the liquidation value obtained at the end of the time horizon of long-term investors. For open-end funds, investors may gain from being quick sellers at the interim period. Investors who select to hold their open-end fund shares may end up with only a small liquidation value (therefore creating an incentive to trigger a bank run). Again, this is not the case for closed-end funds since the time T_L liquidation value is independent of the investor's interim trading behaviours.

The cost of early liquidation arises in Diamond and Dybvig (1983) through the early interruption of a riskless productive activity. Specifically, while low levels of output per unit of input are assumed if operated for a single period, high levels of output are assumed if operated for two periods. Here, the cost of liquidation is more indirect; unit redemptions provoked by panic selling induce high transaction costs and reduce the time period over which transaction costs are amortized.[10] These two effects reduce the value of a unit of the fund. However, unlike Diamond and Dybvig, we do not rule out trading of the underlying assets. Trading of the underlying or physical assets and trading of equity claims on these assets are both feasible but subject to different transaction costs.

It may be argued that the sequential nature of fund redemption that we have assumed does not describe reality. In particular, open-end funds hold a portion of their assets in cash in case of possible unit redemptions. However, such an argument does not preclude open-end funds from being the subject of runs. If one investor thinks that an event may trigger massive selling in the next period, then that investor will redeem its units at the present time. If other investors share these beliefs, then the open-end fund is forced to liquidate some or all of its underlying assets in the short run, presumably at high cost or at a price that is below the going-concern value. Clearly, open-end funds are subject to forced liquidations of underlying assets unless the fund is fully invested in cash. Of course, an all–cash fund would not provide any valuable services to investors in the sense described in the previous section, and would therefore not be primed (funded) by investors.

Also, we have assumed that the first mover would receive a redemption value higher than the last mover in the interim period. Again, this assumption just illustrates a real life case where the investors that are first to redeem would not force the fund to sell illiquid assets since such funds carry a portion of their assets in cash or more liquid securities.

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[10] The introduction of risk-aversion would maintain the relevance for investors to use intermediation (and the subsequent conclusions on the relative value of issuing closed-end instead of open-end funds). However, risk-aversion could provide an additional reason for investors to create a portfolio of securities traded in a secondary market (such as closed-end funds). As pointed out by Gorton and Pennacchi (1993), the creation of a portfolio of primitive securities (a portfolio which must therefore be a redundant security) may be justified by the reduction, from the non-insider perspective, of their expected losses to insiders. Since non-insiders (or liquidity traders) prefer to trade the portfolio due to its lower rate of return variance, market makers will have more information regarding insider trading on each individual security. Prices of individual securities will be more responsive to quantities traded by insiders as the noise once created by non-insiders is diminished. In turn, this decreases the profits of insiders.

However, last movers would only receive the liquidation value of the fund as selling pressure mounts.

Some technical and practical aspects also justify our approach. For instance, in many open-end funds (such as many Asian funds), investors can obtain the net asset value if their sell orders are placed before some specific time in the afternoon (usually 14h30) although the price of the underlying assets are already priced since Asian markets are closed at this time in North America. Therefore, if there is a drop in stock values in New York that may induce massive liquidation of the open-end fund, the fund manager will be forced to offer redemptions at the price fixed in the prior opening. This will occur although the assets held by the fund will probably be sold at a much lower price. In turn, this will induce potential sellers to react promptly.

2.2.3 Economic viability of issuing shares of closed-end funds

Investors may choose to buy shares of the open-end fund even if they anticipate a positive probability of panic selling, provided that the probability is small enough. In such cases, the good equilibrium dominates the autarkic solution since management fees are fixed so that, on average, the investors are indifferent between autarky and investing in the open-end fund. In other words, the expected wealth (even net of fees) whenever panic selling is avoided exactly compensates for the sub-par wealth obtained in the bank run equilibrium. However, due to the expected cost to investors of having to hold a fund holding illiquid assets, a point may be reached where the expected discounted fees will not be high enough to cover the initial transaction costs.

Section 2.2.2 showed that panic selling may be one of the equilibriums for our model. However, the model does not predict which equilibrium will occur or the likelihood of each equilibrium.[11] To evaluate the equilibrium value of the fees charged by a monopolistic fund manager, investors need to consider the probability that the fund will be forced into liquidation before their investment horizon, and at a value that may be less than the intrinsic value of the going concern value of the fund.

Assume that there is a probability p that an open-end fund is subject to a bank run.[12] The profit functions of an open-end fund and of a closed-end fund are similar to equation (2.6) but take into account the new equilibrium fees that may arise from the existence of an interim trading period. Profit functions for the managers from issuing an open-end fund or a closed-end fund are given, respectively, by equations (2.14) and (2.15):

$$\pi^{OEF} = N\left(\sum_{t=1}^{t_I}\frac{\left(\frac{D\alpha^{OEF}}{N}\right)}{(1+k)^t}\right)+N_2\left(\sum_{t=t_I}^{T_L}\frac{\left(\frac{D\alpha^{OEF}}{N_2}\right)}{(1+k)^t}\right)=\sum_{t=1}^{T_L}\frac{D\alpha^{OEF}}{(1+k)^t}\text{; and} \tag{2.14}$$

$$\pi^{CEF} = n\left(\sum_{t=1}^{t_I}\frac{\left(\frac{D\alpha^{CEF}}{n}\right)}{(1+k)^t}\right)+n\left(\sum_{t=t_I}^{T_L}\frac{\left(\frac{D\alpha^{CEF}}{n}\right)}{(1+k)^t}\right)=\sum_{t=1}^{T_L}\frac{D\alpha^{CEF}}{(1+k)^t} \tag{2.15}$$

From (2.14) and (2.15), it is clear that issuing a closed-end fund instead of an open-end fund will be simply based upon the relative values of α^{OEF} and α^{CEF}.[13]

Fees for the open-end fund, α^{OEF}, must be set so that the following equality holds:

[11] As pointed out by Diamond and Dybvig (1983, p.410), panic selling could be triggered by: "bad earnings reports, a commonly observed run at some other bank, a negative government forecast, or even sunspots."

[12] Also, see Chang and Velasco (2001) and Cooper and Ross (1998) for models with panic based bank runs with an exogenous probability of occurrence. A natural extension of the present model would be to set p as a function of λ.

[13] The number (n) of shareholders remains constant for closed-end funds as each shareholder in need of liquidity sells shares in the open market. For the open-end fund, the situation differs since the fund is buying back the shares at the interim period.

$$\frac{1}{m}=P_0^{OEF}=\frac{D(1-\alpha^{OEF})\left[\frac{1-(1+k)^{-t_l}}{k}\right]}{N}+p\frac{\left(\frac{P_0+\omega}{(1+k)^{t_l}}\right)}{N}$$

$$+(1-p)\frac{\left\{\lambda\left(\frac{\omega}{(1+k)^{t_l}}\right)+(1-\lambda)\left(\frac{D(1-\alpha^{OEF})\left[\frac{1-(1+k)^{-(T_L-t_l)}}{k}\right]}{(1+k)^{t_l}}+\frac{P_0}{(1+k)^{T_L}}\right)\right\}}{N} \tag{2.16}$$

Fees for the closed-end fund, α^{CEF}, must be set so that the following equality holds:

$$\frac{1}{m}=P_0^{CEF}=\frac{D(1-\alpha^{CEF})\left[\frac{1-(1+k)^{-t_l}}{k}\right]}{n}+\lambda\left[\frac{P_{t_l}^{CEF}-s_i(1)}{(1+k)^{t_l}}\right]$$

$$+(1-\lambda)\frac{\left\{\frac{D(1-\alpha^{CEF})\left[\frac{1-(1+k)^{-(T_L-t_l)}}{k}\right]}{(1+k)^{t_l}}+\frac{P_0}{(1+k)^{T_L}}\right\}}{n} \tag{2.17}$$

Variables P_0^{OEF}, P_0^{CEF} and $P_{t_l}^{CEF}$ are, respectively, the price of the open-end fund at time *0*, the price of the closed-end fund at time *0*, and the price of the closed-end fund at time t_l. Term $P_{t_l}^{CEF}$ is equal to:

$$P_{t_l}^{CEF}=\frac{D(1-\alpha^{CEF})\left[\frac{1-(1+k)^{-(T_L-t_l)}}{k}\right]+\frac{P_0}{(1+k)^{(T_L-t_l)}}}{n} \tag{2.18}$$

In equation (2.16), $P_0+\omega$ is equal to the NAV_{t_l}. In equation (2.17), $s_i(1)$ is the cost for an individual shareholder i to search, at time t_l, for a buyer of her share.[14, 15] Both

[14] Intuitively, this variable should be viewed as a market spread for closed-end fund shares. We would expect this cost to be a function of variables such as the distance between small investors, the time horizon of investors, the turnover rates of investors, and the number of shareholders. The "bank run" protection provided by the closed-end fund may be counterbalanced by high search cost and lack of liquidity in the financial market. Temporary order imbalances, magnified by high search costs or high spreads, should translate into a temporary price discount for the closed-end fund (compared to the net asset value of the fund). Liquidity problems may therefore result in mispricing for both open-end and closed-end funds. Mispricing occurs because the liquidation value is at discount compared to the real productive opportunities of the underlying assets of the open-end fund while the price in the financial market may be at discount compared to the underlying net asset value of the closed-end fund.

equations illustrate that the fund manager establishes the fee in order to capture the entire surplus of the investors. The second term on the right-hand side of (2.16) shows that there is a probability that the "bad equilibrium" may occur and that the fund may be forced to liquidate the assets in order to fulfill the liquidity requirements of the shareholders of the fund. The third term on the RHS of (2.16) provides the value that the type 1 investors and type 2 investors will receive if panic selling is avoided. The second term on the RHS of (2.17) shows that type 1 investors will use the marketplace to get liquidity by paying search cost $s_i(1)$.

Proposition 2.2:

The relative economic viability of a closed-end fund versus an open-end fund is an increasing function of $\{s(N)-s(n)\}$, ω, p, *and a decreasing function of* $s_i(1)$. *The effects of* λ, t_I *and* T_L *are ambiguous.*

Proof:

Using equations (2.16), (2.17) and (2.18) yields:

$$\alpha^{CEF} - \alpha^{OEF} =$$

$$\frac{\frac{N}{m}-(1-p)(1-\lambda)\varphi-\left[\frac{p(P_o+\omega)+(1-p)\lambda\omega}{(1+k)^{t_I}}\right]}{D\left[\frac{1-(1+k)^{-t_I}}{k}\right]+(1-p)(1-\lambda)\beta}-\frac{\frac{n}{m}-\varphi+\frac{\lambda n s_i(1)}{(1+k)^{t_I}}}{D\left[\frac{1-(1+k)^{-t_I}}{k}\right]+\beta} \tag{2.19}$$

In (2.19):

$$\beta=\frac{D\left[\frac{1-(1+k)^{-(T_L-t_I)}}{k}\right]}{(1+k)^{t_I}} \tag{2.20}$$

[15] We have assumed that the financial intermediary gets its comparative advantage in searching for small investors in the pre-market. If this advantage was to be extended to the intermediate stage, small investors could pay a fee to the intermediary to search for investors (i.e., to create a market for closed-end fund securities).

$$\varphi = \frac{P_0}{(1+k)^{T_L}} \tag{2.21}$$

From equation (2.19), the difference $(\alpha^{CEF} - \alpha^{OEF})$:

i) increases as $\{s(N) - s(n)\}$ increases since $\frac{N}{m} = 1 + s(N) + \omega$ and $\frac{n}{m} = 1 + s(n)$;

ii) increases as ω increases since k>0 and $\lambda < 1$;

iii) decreases as $s_i(1)$ increases;

iv) increases as p increases since, as simple calculations show, $(1+k)^{T_L} > (1-\lambda)(1+k)^{t_I}$ and $(1-\lambda)\left[(1-\alpha^{OEF})\beta + \frac{\omega}{(1+k)^{t_I}}\right] > 0$;

v) is ambiguous in relation to λ since no definite sign can be established for $\frac{d(\alpha^{CEF} - \alpha^{OEF})}{d\lambda}$ or the following equation:

$$\frac{(1-p)\left[\varphi - \frac{\omega}{(1+k)^{t_I}} + (1-\alpha^{OEF})\beta\right]}{\frac{D}{k}\left[1-(1+k)^{-t_I}\right] + (1-p)(1-\lambda)\beta} - \frac{\frac{ns_i(1)}{(1+k)^{t_I}}}{\frac{D}{k}\left[1-(1+k)^{-t_L}\right]};$$

vi) is ambiguous in relation to t_I since no definite sign can be established for $\frac{d(\alpha^{CEF} - \alpha^{OEF})}{dt_I}$ or the following equation:

$$(1+k)^{-T_L}\ln(1+k)\left[\frac{\frac{D}{k}(1-\alpha^{OEF})\{1-(1-p)(1-\lambda)\} - \{p(P_0+\omega) - (1-p)\lambda\omega\}}{\frac{D}{k}\left[1-(1+k)^{-t_I} + (1-p)(1-\lambda)\{(1+k)^{-t_I} - (1+k)^{-T_L}\}\right]} - \frac{\lambda ns_i(1)}{\frac{D}{k}\left[1-(1+k)^{-T_L}\right]}\right];$$

vii) is ambiguous in relation to T_L since no definite sign can be established for $\frac{d(\alpha^{CEF} - \alpha^{OEF})}{dT_L}$ or the following equation:

$$(1+k)^{-T_L}\ln(1+k)\left[\frac{\left[\frac{D}{k}(1-\alpha^{OEF})-P_0\right](1-p)(1-\lambda)}{\frac{D}{k}\left[1-(1+k)^{-t_I}+(1-p)(1-\lambda)\left\{(1+k)^{-t_I}-(1+k)^{-T_L}\right\}\right]}-\frac{\left[\frac{D}{k}(1-\alpha^{CEF})-P_0\right]}{\frac{D}{k}\left[1-(1+k)^{-T_L}\right]}\right].$$

QED

Discussion:

The absolute economic viability of a closed-end fund also depends on the small investor time horizon (as shown in Proposition 2.1).

Results i) and ii) state that the possible conversion at net asset value by the investors at the interim period reduces the implicit return of the open-end fund manager and increases the relevance of issuing a closed-end fund. These costs may however be counterbalanced by the cost of trading units of a managed investment fund in the open market (result iii).[16] In fact, many closed-end fund issues suffer from lack of liquidity and are thinly traded. Specifically, market capitalization is often low and its shareholders base is predominantly composed of small investors with long-term holding periods. Therefore, the economies of scale benefits to access illiquid assets may be partly offset by the lack of liquidity in the market itself. As shown by result iv), an increase in the exogenous probability of a bank run must translate into a

[16] If investors were risk-averse, the additional variation in closed-end fund prices that may be induced by small investor sentiment could also contribute to reducing the relative economic viability of a closed-end fund issuance (see De Long, Shleifer, Summers, and. Waldmann, 1990).

relative advantage of issuing a closed-end fund since all shareholders receive a lower liquidation value given such a change.

Result v) shows that the impact of λ has no definite sign since the effect of a higher portion of investors opting to liquidate their shares at the interim period induces a higher expected cost to hold a closed-end fund but also induces a lower expected payout for open-end fund shareholders. The latter occurs because the discounted liquidation value at the interim period when panic selling does not occur is lower than the discounted net asset value received at the end of the normal investment horizon.

Result vi) shows that moving the interim period farther away from the issuing period does not necessarily favour the issuance of closed-end over open-end funds since the costs related to early redemption of units are delayed in both cases. Result vii) is also ambiguous. However, if the fees of closed-end and open-end funds are equal (or similar), an increase in the investment horizon of the small investors should favour the issuance of an open-end fund. This can be easily shown by the equation in result vii) since the liquidation price paid at the interim period acts as a leverage effect. An increase of the time horizon therefore would provide relatively more benefits to the remaining shareholders of the closed-end fund.

In general, while the search process by individual investors may be too costly for them to participate directly in the financing of an investment project, the need for liquidity at some intermediate period may induce the creation of a secondary market for managed investment funds. Therefore, the issuance of a closed-end fund may become a viable alternative to an open-end fund when the liquidation cost of the underlying assets, the opportunity costs of maintaining a cash reserve, the implicit costs related to the reduction of time horizon or the probability of panic selling are high enough. These results are consistent with the intuitive conjecture proposed by Nanda, Narayanan and Warther (2000).

The closed-end fund format eases problems associated with investment in illiquid securities or markets. Some of the most profitable investments tend to be when a company is at its very early stages of growth, coming out of bankruptcy, in re-organization, or in emerging markets in developing countries. However, such investments tend to be highly illiquid and costly to trade. Open-end funds tend to invest in such instruments or markets sparingly, since a danger exists that investors will panic during adverse market conditions. Through redemptions, investors will force the sale of the assets of open-end funds. However, closed-end funds do not have to worry about such redemptions. Therefore, they can make illiquid investments, and be a cost-saving device to investors. Funds such as REITs offer portfolios of real estate investments that would otherwise be very costly to form for small investors or even institutional investors. According to Wang, Chan and Gau (1992), institutional investors represent a significant proportion of REIT holders.

Other specialized funds, such as foreign country funds, often provide special access to foreign investment. One such fund is the Indonesia Fund that traded at hefty premiums during the period from March 1993 to January 1995. The Indonesia government restricted foreign investors from directly investing in the stocks of Indonesia companies. Thus, investors wanting to participate in this market could do so indirectly by investing in funds such as the Indonesia Fund. Similar restrictions apply to direct investment in stocks of Korean companies. The Korea Fund, which provided access to this market, also traded at hefty premiums during the period from March 1993 to October 1994.

2.3 SHOULD CLOSED-END FUNDS TRADE AT A PREMIUM IN A COMPETITIVE MARKET?

Investors may face barriers to investments in various forms, such as transaction costs, information gaps, indivisibility of initial investment outlays, and relative inefficiency of some specific capital markets. These were recognized as transaction cost c in section 2.1.1. These impediments clearly lead to a failure in a simple separation property such that optimal portfolios of investors may no longer contain all of the risky assets in the universe. Closed-end mutual funds possess a relative advantage over open-end funds in the sense of extending the opportunity set to investors. From section 2.1.2, these advantages should arise from providing economies of scale in accessing relatively illiquid classes of assets. Closed-end funds may not be perfect substitutes for the idealized portfolio for the relative advantages to occur. However, as long as closed-end funds have access to investments that individuals cannot access and other forms of intermediation devices cannot provide as efficient access to, closed-end mutual funds may command a premium over their underlying net asset value

Figure 2.1 illustrates various cases where closed-end funds can make supply adjustments but encounter competing closed-end fund issuers (contrary to the assumption carried in sections 2.1.1 and 2.1.2).[17] No demand for closed-end fund shares occurs at premium p_3. High premiums could be dictated by high search costs for individual investors or high transaction costs associated with providing financing to some private placements. This leads to direct purchase by individuals of illiquid assets or the simple avoidance of the purchase of these classes of assets by individuals. Any increase in search costs induces a left-side shift of the supply curve. The supply curve (S_0) is flat through zero if closed-end funds have no search costs and face no transaction costs or barriers to access relatively illiquid assets. However, the curve (S_1) shifts

[17] For a similar setting in a different context, see Errunza and Senbet (1981).

downward horizontally if closed-end funds face uniform search costs. If closed-end funds face no search costs or transaction costs asymptotically converging to zero, the existence of transaction costs from the investor side is insufficient to guarantee the existence of a positive differential between the price of the closed-end fund and the value of its underlying assets. This occurs because competition between issuing closed-end funds drives this difference to zero.

The slope of the supply curve is decreasing if marginal issuing funds face higher expected costs to gather investors or need to pay higher transaction costs to access investment projects. The intersection between the supply curve (S_2) and demand curve (D_0) would result in the equilibrium premium p_2, and the total amount of closed-end fund shares issued of q_1. To reiterate, individual investors are willing to pay this price differential due to the expanded opportunity set offered by closed-end funds.

Datar (2001) supports this argument. His empirical results support his conjecture that premiums are observed when claims issued by the fund are more liquid than the underlying assets. Specifically, he finds that funds with higher liquidity, as measured by proxies for trading activity, have higher premia than funds with lower liquidity.

2.4 CONCLUDING REMARKS

In this essay (chapter), we use a transactions cost approach to justify the observation that the net asset value of a managed investment fund is lower than its initial offer price, and to show that such pricing is essential to justify the existence of such funds. The managed investment fund is feasible when long-term investors do not find it worthwhile to invest directly in the investment held by the fund, and when the surplus obtained from the long-term investors in the fund is sufficient to cover the costs borne by the manager. This surplus must be directly related to the investment horizon of investors.

The behaviour of other investors (and the massive liquidation that may result from their behaviour) may have adverse effects on the payoffs to one investor regardless of the true intrinsic value of the fund. At some point, the costs related from offering liquidity to investors (namely, liquidation costs, holding of a cash position and probability of a bank run) may cause the open-end fund not to exist. If the adverse conditions are sufficiently important, the issuance of a closed-end fund becomes a more viable alternative. In comparison to open-end funds, closed-end funds offer protection against panic selling since there is no forced liquidation of the underlying assets and therefore avoidance of the large transaction costs that may arise with large and immediate transactions in the real (or underlying) asset markets. Therefore, panic redemptions of open-end funds may be triggered by the additional possibility of being left with low future salvage values (net of large transaction costs). In other words, to provide immediacy, open-end funds need to incur large transaction costs which could add to the incentives for panic selling.

Empirically, we conjecture that the assets under management by closed-end funds significantly extend the opportunity sets of investors. This improvement should rationally be related to the actual premium investors are willing to pay for closed-end funds. On the other hand, the traded shares of closed-end funds for which the assets under management have become easier for investors to acquire directly or that have become easier to liquidate for other investment devices (such as open-end funds) should experience premium (discount) reductions (increases) as alternative investment strategies become more competitive. Empirically, we expect that the shift from premium to discount for many closed-end funds is directly related to the increasing economic viability of alternative investment strategies or the introduction of such strategies.

CHAPTER 3

SHOULD THE VARIANCES OF MARKET PRICES AND NAVPS BE IDENTICAL FOR A CLOSED-END FUND?

While closed-end funds rarely issue or redeem their own securities, most open-end funds stand ready to sell or repurchase their shares on a periodic basis at their net asset value per share (NAVPS). Investors who want to purchase or sell closed-end fund shares must do so on the open market at prices reflecting supply and demand of these publicly traded shares. Consequently, while a share of an open-end fund trades at NAVPS, the per-share price of a closed-end fund need not equal its NAVPS.

Pontiff (1997) argues that the variances of per-share price and NAVPS returns should be identical for the same closed-end fund if investors are rational. Pontiff finds that the prices of closed-end funds seem to over-react to changes in NAVPS, since the average US closed-end fund has a monthly price return variance that exceeds its NAVPS return variance by 64%.[18] Although most of this excess risk is idiosyncratic, 15% is related to the risks that affect closed-end funds; namely, small-firm risk, market risk, and book-to-market risk. Market risk only explains about two percent of the excess variability of the price returns of an average closed-end fund.

These results can be related to the investor sentiment hypothesis (DeLong, Bradford, Shleifer, Summers and Waldmann, 1990). According to this theory, noise traders create an additional source of systematic risk that is priced in the marketplace. This risk should manifest itself as additional price variability for assets affected by the actions of noise traders, such as closed-end fund shares. However, empirical studies do not provide strong support for the testable predictions of this theory (e.g., see Sias, Starks, and Tinic, 1998; Bodurtha, Kim, and Lee, 1995; and Abraham, Elan, and

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[18] Similar results are obtained by Agyei-Ampomah and Davies (2002) for closed-end funds in the UK.

Marcus, 1993). One such prediction is that extreme levels of sentiment are associated with increased noise trading, and consequently, increased closed-end fund price volatility.[19] These views also are related to the growing literature in behavioural finance (e.g., Kahneman and Riepe, 1998) that argues that the demand for risky assets may be driven by psychological factors, particularly, among small investors that supposedly are the major investors in closed-end funds.

The primary objective of the essay embodied in this chapter is to demonstrate analytically that the price and NAVPS return variances can rationally differ for the same closed-end fund. Various rational explanations are advanced that may partly explain the main results of Pontiff (1997) that the return variance ratio of price to NAVPS of an average closed-end fund is 1.64. We argue that a retest of the relationship between NAVPS and return variances needs to control for the various explanations of why the return variance of a closed-end fund will rationally exceed its NAVPS variance before drawing any inferences about the efficiency of markets. Such a retest is beyond the scope of this thesis, and is left for future work.

By contrasting the impact of the bid-ask bounce on the price return variance of a portfolio of securities and on a single security in the specific context of a closed-end fund, we demonstrate that the differential impact of the bid/ask bounce on the ratio of price to NAVPS variances for closed-end funds leads to "excess" variability (i.e., a ratio greater than one). We also demonstrate that potential fund liquidation, performance persistence, management fees, and payout policy lead to "excess" variability, as evidenced in a ratio of price to NAVPS return variances for closed-end funds that exceeds one in a rational market.

[19] Brauer (1993) estimates that, on average, only 6.88 % of the variance of weekly discount changes can be attributed to noise trading.

The remainder of this chapter is organized as follow. In section 3.1, various theoretical reasons grounded in market rationality are provided for the excess variability of closed-end fund prices compared to the variability of their underlying NAVPS. Specifically, sub-section 3.1.1 documents the impact of micro-market factors while sub-sections 3.1.2 through 3.1.5 measure the impact of active managerial behaviour. Section 3.2 provides some concluding remarks.

3.1 FACTORS THAT INFLUENCE THE RELATIVE MOVEMENTS OF CLOSED-END FUND PRICES AND NAVPS

3.1.1 Impact of the Bid-ask Bounce

We first address the impact of the bid-ask bounce on the variance, covariance and autocorrelation of the price returns and of the NAVPS returns of a closed-end fund. The impact of the bid-ask bounce on measurement of the performance of a closed-end fund is addressed in Appendix A3.

3.1.1.1 *Impact of the bid-ask bounce on the per-share price return characteristics of a closed-end fund*

Let P^*_{kt} be the time t fundamental value of closed-end fund k, and s_{kt} be the bid-ask spread of a share of closed-end fund k at time t. Further, assume that the spreads of the individual securities held by the closed-end fund are fixed over time. Following Roll (1984), the observed market price P_{kt} is written as:

$$P_{kt} = P_{kt}^* + I_t\,(0.5\, s_{kt}) \tag{3.1}$$

where I_t, which are assumed to be IID, are +1 with probability 0.5 for a buyer-initiated trade, and -1 with probability 0.5 for a seller-initiated trade. The price change process for closed-end fund k is given by:

$$\Delta P_{kt} = \Delta P^*_{kt} + (I_{kt} - I_{kt-1})(\,0.5\, s_k)\;. \tag{3.2}$$

As in Campbell, Lo and MacKinlay (1997), if P_k^* can change through time but the variation in P_k^* is serially uncorrelated and independent of I_{kt}, then the variance, covariance and correlations of per-share price returns for closed-end fund k are given by:

$$Var\,[\Delta P_{kt}\,] = Var\,[\Delta P_{kt}^{\,*}\,] + (0.5\,s_k^2); \tag{3.3}$$

$$Cov\,(\Delta P_{kt},\, \Delta P_{kt+1}) = \frac{-s_k^2}{4}\text{; and} \tag{3.4}$$

$$Corr\,(\Delta P_{kt},\, \Delta P_{kt+1}\,) = \frac{-1}{\left(\frac{2}{s_k}\right)^2 \text{Var}\,\left[\Delta P_{kt}^{\,*}\right] + 2}. \tag{3.5}$$

3.1.1.2 *Impact of the bid-ask bounce on the NAVPS return characteristics of a closed-end fund*

The impact of the bid-ask bounce on the variance, covariance and autocorrelations of the NAVPS returns of a closed-end fund are now examined. As in the previous subsection, we assume that P_{it}^*, the time t fundamental value of security i can change through time, and that the variation in P_{it}^* is serially uncorrelated and independent of I_{it} for each individual security i forming the NAVPS_k of the closed-end fund k.

To obtain the variance of the NAVPS returns, first define NAVPS_kt as the net asset value per share of the closed-end fund k at time t, and w_{it} as the weight of security i in that fund's NAVPS at time t. Further, assume that the NAVPS portfolio weights of the securities held also are fixed through time. Then, the NAVPS_kt can be expressed as:

$$NAVPS_{kt} \;= \Sigma w_i\, P_{it} = \Sigma w_i\, (P^*_{\;it} + I_{it}\,(0.5\,s_i)) \tag{3.6}$$

Define $\Delta I_{it} = (I_{it} - I_{it-1})$. The time-series process for changes in NAVPS is given by:

$$\Delta\, NAVPS_{kt} = \Sigma w_i\, \Delta\, P^*_{\;it} + \Sigma w_i\, \Delta\, I_{it}\,(\,0.5\,s_i) \tag{3.7}$$

In (3.7), the I_{it} are IID between securities ($i=1,\ldots n$) and I_{it}, and the P^*_{it} are independent for all i.

If we further assume that the price and NAVPS return variances for the "fundamental" components are equal for closed-end fund k, then it follows that:

$$Var(\Delta P_k^*) = Var(\sum_{i=1}^{n} w_i \Delta P_i^*) . \tag{3.8}$$

Using this result, it follows that the variance of the NAVPS returns for closed-end fund k is:

$$\begin{aligned} Var\,(\Delta\, NAVPS_{kt}) &= Var\,(\Sigma w_i\, \Delta\, P^*_{it}) + Var\,(\Sigma w_i\, \Delta\, I_{it}\,(\,0.5\; s_i)) \\ &= Var\,(\Delta\, P^*_{kt}) + Var\,(\Sigma w_i\, \Delta\, I_{it}\,(\,0.5\; s_i)) \\ &= Var\,(\Delta\, P^*_{kt}) + w_1^2\; Var\,(\Delta\, I_{1t}\,(\,0.5\; s_1)) + w_2^2\; Var\,(\Delta\, I_{2t}\,(\,0.5\; s_2)) \\ &\quad + \ldots + w_i^2\; Var\,(\Delta\, I_{it}\,(0.5\; s_i)) + \ldots + w_n^2\; Var\,(\Delta\, I_{nt}\,(\,0.5\; s_n)) \\ &\quad \text{for } i=1,\ldots n. \end{aligned} \tag{3.9}$$

Using equation (3.3), equation (3.9) can be restated as:

$$\begin{aligned} Var\,(\Delta\, NAVPS_{kt}) = Var\,(\Delta\, P^*_{kt}) + \; w_1^2\; (0.5\; s_1^2) + w_2^2\; (0.5\; s_2^2))) + \ldots \\ + w_i^2\,(0.5\; s_i^2) + \ldots + w_n^2\,(0.5\; s_n^2) \end{aligned} \tag{3.10}$$

To obtain the covariance expression for the NAVPS, assume that ΔP^*_{it} and ΔP^*_{it-1}, ΔP^*_{it} and ΔI_{it-1}, and ΔI_{it} and ΔP^*_{it-1} are independent, and that $E(\Delta P^*_{it}\,) = 0$. Since $E(\Delta NAVPS_{kt}) = \Sigma w_i\, E(\Delta P^*_{it}\,) + \Sigma w_i\, (E(\Delta I_{it}\,))\,(\,0.5\; s_i) = 0$ and $E(\Delta NAVPS_{kt-1}) = 0$, then:

$$\begin{aligned} Cov\,(\Delta\, NAVPS_{kt-1}, \Delta\, NAVPS_{kt}) &= E((\Delta\, NAVPS_{kt-1})(\Delta\, NAVPS_{kt})) \\ &= E((w_1\; 0.5\; s_1\,)^2\; \Delta\, I_{1t}\; \Delta\, I_{1t-1}\,) + E((w_2\; 0.5\; s_2\,)^2\; \Delta\, I_{2t}\; \Delta\, I_{2t-1}\,) + \ldots \\ &\quad + E((w_i\; 0.5\; s_i\,)^2\; \Delta\, I_{it}\; \Delta\, I_{it-1}\,) + \ldots + E((w_n\; 0.5\; s_n\,)^2\; \Delta\, I_{nt}\; \Delta\, I_{nt-1}\,). \\ &= \sum_{i=1}^{n} w_i^2 \left(\frac{-s_i^2}{4} \right) \end{aligned} \tag{3.11}$$

The serial correlation of NAVPS for a closed-end fund is obtained by using equations (3.10) and (3.11) to obtain:

$$Corr\ (\Delta NAVPS_{kt-1},\ \Delta NAVPS_{kt}) = \frac{\sum_{i=1}^{n} w_i^2 \left(\frac{-s_i^2}{4} \right)}{Var(\Delta P_{kt}^*) + \sum_{i=1}^{n} w_i^2 (0.5 s_i^2)}. \tag{3.12}$$

Proposition 3.1:

If the portfolio weights embodied in the NAVPS are equal and $\overline{s_i^2} = \frac{\sum_{i=1}^{n} s_i^2}{n}$, then:

i) The relative variance of ΔP_{kt} to $\Delta NAVPS_{kt}$ is:

$$\frac{Var(\Delta P_{kt})}{Var(\Delta NAVPS_{kt})} = \frac{1 + \frac{0.5(s_k^2)}{Var(\Delta P_{kt}^*)}}{1 + \frac{\frac{1}{n} 0.5\overline{(s_i^2)}}{Var(\Delta P_{kt}^*)}}. \tag{3.13}$$

ii) The relative covariance of ΔP_{kt} to $\Delta NAVPS_{kt}$ is:

$$\frac{Cov(\Delta P_{kt}, \Delta P_{kt+1})}{Cov(\Delta NAVPS_{kt}, \Delta NAVPS_{kt+1})} = \frac{s_k^2}{\frac{1}{n}\overline{(s_i^2)}}. \tag{3.14}$$

iii) The relative correlation of ΔP_{kt} to $\Delta NAVPS_{kt}$ is:

$$\frac{Corr(\Delta P_{kt}, \Delta P_{kt+1})}{Corr(\Delta NAVPS_{kt}, \Delta NAVPS_{kt+1})} = \frac{\frac{n s_k^2}{\overline{s_i^2}} + \frac{s_k^2}{2Var(\Delta P_{kt}^*)}}{1 + \frac{s_k^2}{2Var(\Delta P_{kt}^*)}}. \tag{3.15}$$

Proof:

The proof is straightforward using (3.3), (3.4), (3.5), (3.10), (3.11) and (3.12). **QED**

Discussion:

Equation (3.13) simply states that the variance ratio increases when the number of securities in the portfolio under management by the closed-end fund increases since the effect of the bid-ask bounce on the variability of the NAVPS tends to average out as n grows. The variance ratio should be higher than one whenever the portfolio of assets under management is composed of more than one security. The variance ratio also increases when s_k^2 increases or when $\overline{s_i^2}$ decreases as both the price and NAVPS return variances of the closed-end fund are directly related to the level of the squared spread. The effects of n, s_k^2 and $\overline{s_i^2}$ are reduced with an increasing variance of the fundamental factors. The variance ratio tends to one whenever the variance ratio is computed using longer time intervals for measuring returns because $Var\ (\Delta\ P^*_{kt})$ increases, and n, s_k^2 and $\overline{s_i^2}$ are invariant to the length of each time interval.

According to Pontiff (1997), the average price return variance for a closed-end fund is 64 percent greater than its NAVPS return variance. As equation (3.13) shows, additional variability may just arise from a portfolio effect that increases relative variability as n increases, and by a bid-ask spread for the closed-end fund that is larger than the average bid-ask spread for the portfolio of assets under management by the closed-end fund. This is likely for the many illiquid closed-end funds that trade, on average, only a few hundred shares daily. Equation (3.14) shows that the ratio of return covariances increases as n grows. Although Cov ($\Delta NAVPS_{kt-1}$, $\Delta NAVPS_{kt}$) tends to be equal to zero as n grows and could be a potential indicator of the relative efficiency of the market (versus the closed-end fund price), this relative efficiency may just be the result of a simple portfolio effect. Similar conclusions are reached with equation (3.15).

The impact of infrequent trading on the ratio of price to NAVPS return variances for a closed-end fund is similar (e.g., see Campbell, Lo and MacKinlay, 1997). Since the trading volume of most closed-end funds is typically low due to their relatively small market capitalization and their shareholder base of predominantly small investors with long-term holding periods, the infrequent trading of closed-end fund shares may induce artificial variability. While the underlying assets of these funds also may be traded infrequently since the economic value of a closed-end fund is often drawn from offering access to securities that are highly illiquid, the spurious variability is averaged out to zero at the portfolio level. Therefore, as the number of securities in the portfolio under management increases, the ratio of the price to NAVPS return variances should also increase.

3.1.2 The Impact of Performance Persistence

The NAVPS reflects the per-share value of the portfolio of assets under management by the closed-end fund at various points in time. However, the future composition of this portfolio under management and the returns it will actually provide to closed-end fund shareholders should be reflected in the closed-end fund's price. Thus, the fund's share price, and the actual discount or premium of its share price to its NAVPS, should reflect the market's beliefs about the ability of the fund manager to outperform the market. Both academics (e.g., Elton, Gruber and Busse, 1998; Malkiel, 1977; Pontiff, 1995; and Swaminathan, 1996) and practitioners (e.g., Herzfeld, 1990 and Ammer, 1990) argue that a possible reason for variation in premia or discounts is due to expected NAVPS performance.

Some related empirical evidence suggests that the market may price the skills of closed-end fund managers. Many articles suggest that some open-end mutual funds generate persistent abnormal returns. For example, Hendricks, Patel and Zeckhauser (1993), Brown and Goetzmann (1995) and Gruber (1996) find evidence of persistence in mutual fund performance over short-term horizons of one to three years. The results of Hendricks, Patel and Zeckhauser (1993) appear to be robust to a variety of risk-adjusted performance measures, while the persistence phenomenon observed by Goetzmann and Ibbotson (1994) is present both in raw and risk-adjusted returns for equity funds at observation intervals from one month to three years. Grinblatt and Titman (1992), Elton, Gruber, Das, and Hlavka (1993), and Elton, Gruber, Das, and Blake (1996) document mutual fund return predictability over longer horizons of five to ten years, and attribute this to differentials in information usage or in the stock-picking talents of fund managers.

Therefore, investors should be willing to pay a fee to benefit from these persistent abnormal returns. Since fees can hardly be renegotiated, the price fluctuations of a closed-end fund should reflect any change in the beliefs of the market about the fund manager's ability to generate abnormal returns. Some empirical evidence for both open- and closed-end funds strongly suggests that investors update their beliefs about the ability of fund managers to realize persistent abnormal returns. According to Gruber (1996, p. 799), "There is no doubt that investors chase past performance". His empirical results show that investors act on past performance in allocating money to mutual funds. In other words, the empirical evidence suggests that open-end fund performance exhibits persistence, and that investors invest their money as if they are aware of this persistence. Some additional results by Gruber (1996) suggest that investors can enhance their performance by following past performance of funds.

Since both closed- and open-end funds attract the same type of clientele, past performance should be reflected somehow in the equilibrium price of closed-end funds (in contrast with open-end funds which must sell at their NAVPS). Neal and Wheatley (1998) use closed-end funds to analyze two commonly used empirical models for estimating the adverse selection component of a firm's bid-ask spread. Estimates of the adverse selection component are large and significant for both the funds and a matched sample of common stocks. These results suggest the existence of private information that is specific to closed-end funds, such as the manager's skill. Chay and Trzcinka (1999) find that discounts and premiums of closed-end funds reflect the market's assessment of anticipated managerial performance. They present evidence that a significant and positive relation exists between stock fund premiums and future NAVPS performance over the following year.

The effect of an extraordinary performance on the NAVPS of the fund therefore should impact the price of the closed-end fund by:

i) increasing the liquidation value of the portfolio of assets under its management; and

ii) increasing the expected cash flow stream of the fund if investors assume that there will be return persistence and that this persistence should be priced.

Proposition 3.2:

Since the relative effect of any extraordinary return on the portfolio of assets under management by a closed-end fund should be greater for the price of the fund than for its NAVPS given return persistence, the ratio of price to NAVPS return variances should be greater than one. More formally:

$\sigma^2(\Delta P_t) > \sigma^2(\Delta NAVPS_t)$ if the persistence coefficient w lies in $(0, 1]$. (3.16)

Proof:

Suppose that the price of the fund is established using the following equation:

$$P_t = \frac{d_{t+1}}{1+K} + \frac{d_{t+2}}{(1+K)^2} + \ldots + \frac{d_{t+T}}{(1+K)^T}. \tag{3.17}$$

Define the NAVPS of the fund as:

$$NAVPS_t = NAVPS_{t-1} + x_t - d_t \tag{3.18}$$

where:

x_t is the total appreciation in NAVPS (both capital appreciation and dividends from the assets under management);

d_t is the per-share dividend paid by the fund to its shareholders;

K is the required rate of return; and

T is the termination value of the fund.

Any abnormal capital appreciation is defined as:

$$x^a_t = x_t - K\,NAV_{t-1}. \tag{3.19}$$

The evolution of abnormal capital appreciations over time is restricted as follows:

$$x^a_t = w\,x^a_{t-1} + e_t, \tag{3.20}$$

where $E(e_\tau, e_{\tau'}) = \sigma^2_e$, and $E(e_\tau) = 0$ for all $\tau = t+1, \dots, t+T$.

If the persistence coefficient w is equal to zero, then the future abnormal return is defined solely by the random noise e_t. The higher w is, the higher the beliefs of investors that the abnormal performance will have a substantial effect on future returns. The upper bound (equal to one) illustrates that the extraordinary performance of the portfolio manager does not vanish over time due to competitive forces. The variable x^a_t also can take negative values but systematic underperformance would vanish over time as competition (e.g., short-sellers) exploits the systematic under-achieving portfolio strategy of such closed-end funds.

Substituting $d_t = (1+k)\,NAVPS_{t-1} - NAVPS_t + x^a_t$ into equation (3.17) and rearranging terms yields:

$$P_t = NAVPS_t + \frac{x^a_{t+1}}{(1+K)} + \frac{x^a_{t+2}}{(1+K)^2} + \dots + \frac{x^a_{t+T}}{(1+K)^T} \tag{3.21}$$

Equation (3.21) expresses the fund price in terms of the fund's ability to realize abnormal expected returns. If such abnormal returns are null, the fund should trade at its NAVPS.

While the capital appreciation x_{t-1} causes the NAVPS (and the price of the fund) to increase, the actual capital appreciation will cause P_t to vary more than $NAVPS_t$ if $x^a{}_t > 0$ and $w \neq 0$, since such an increase also modifies the expected future stream of cash flows. Simple calculation yields:

$$E(\Delta\, NAVPS_t) = w\, x^a{}_{t-1} + K\, NAVPS_{t-1} - d_t. \tag{3.22}$$

Using equation (3.22) and standard calculations yields:

$$\sigma^2(\Delta\, NAVPS_t) = E((e_t)^2) = \sigma^2{}_e \tag{3.23}$$

Using equation (3.21), setting $\Delta P_t = P_t - P_{t-1}$, using equation (3.20), and neglecting the last term P_{t-1} that is equal to $\frac{x^a{}_{t+T}}{(1+K)^{T+1}}$ and tends to zero as T grows to infinity yields the following equation:

$$\sigma^2(\Delta P_t) = \sigma^2(\Delta NAVPS_t) + \frac{w^2\sigma_e^2}{(1+K)} + \frac{w^4\sigma_e^2}{(1+K)^2} + \frac{w^6\sigma_e^2}{(1+K)^3} + \ldots + \frac{w^{2T}\sigma_e^2}{(1+K)^T} \tag{3.24}$$

Or, as T grows to infinity, $\sigma^2(\Delta P_t) = \sigma^2(\Delta NAVPS_t) + \dfrac{\sigma_e^2}{\dfrac{K+1}{w^2} - 1}$ (3.25)

Proposition 3.2 follows directly from equation (3.25) since w is greater than zero with performance persistence. **QED**

Discussion:

If $w=0$, the market does not believe that the previous capital variation and the related abnormal payoff will be systematically maintained in the future. In fact, the market believes that the result was pure chance, and that a persistent abnormal return should not be embedded into the price of the closed-end fund. Therefore, the previous abnormal return should impact both the actual NAVPS and fund price by the same amount. This results in $\sigma^2(\Delta\, P_t) = \sigma^2(\Delta\, NAVPS_t)$.

If $w=1$, the market believes that the abnormal return will be repeated, on average, from time $t+1$ to the liquidation date T. As a result, the variation in fund prices will reflect the full "ripple effect" of beliefs being updated from $t+1$ to T. In turn, this results in an additional variation in fund prices beyond the variation due to variation in NAVPSs of:

$$\frac{\sigma_e^2}{(1+K)}+\frac{\sigma_e^2}{(1+K)^2}+\frac{\sigma_e^2}{(1+K)^3}+\ldots+\frac{\sigma_e^2}{(1+K)^T}.$$

In other words, the variation in fund prices reflects the fact that the fund manager will, on average, replicate the same abnormal return over the full time duration of the portfolio of securities under management. The fund price variation could result in the fund selling at a discount ($x^a_{t-1} < 0$) or at a premium ($x^a_{t-1} > 0$).

Any value of w such that $0 < w < 1$ implies that the "ability" of the fund manager to earn abnormal returns on the portfolio of assets under management will gradually vanish over time as $w^{2\tau}$ causes the gradual disappearance of the impact of abnormal returns on changes in the fund price. In other words, the impact is low and short-lived as compared to when $w=1$.

Evidently, any increase in w causes an increase in $\sigma^2(\Delta P_t)$. However, our model does not state how beliefs about w are formed, or how a change in w impacts the difference between $\sigma^2(\Delta P_t)$ and $\sigma^2(\Delta NAVPS_t)$. This is left to future research. It would also be interesting to determine if the effect of performance persistence is higher for equity versus bond funds. Systematic extraordinary returns both in terms of level and length may be somewhat easier to achieve in equity funds.

3.1.3 The Impact of Potential Fund Liquidation

Empirical studies measure the impact of open-ending, liquidating and merging closed-end mutual funds.[20] Brickley and Schallheim (1985) document the substantial reduction in discounts that occur at the time of the announcement of reorganization. From the time of announcement to the actual reorganization, they find that the gap approaches zero in most cases. They conjecture that the time pattern of the declining discount is probably due in part to the reduction in uncertainty as to whether or not the fund will reorganize. Brauer (1984, 1988)[21] also reports evidence that funds that open-end begin to exhibit abnormal positive returns right after the public announcement that the funds will open-end. Draper (1989) investigates the UK closed-end fund industry and finds that share prices react rapidly to the announcement of takeovers, open-ending and liquidations. Specific provisions are included in the prospectuses of some funds to assist shareholders in taking actions whenever the fund trades at a wide discount to net asset value. For example, if the shares of the Taiwan fund trade at a discount greater than 10% during any 12-week period commencing after June 1, 1992, the trustees will submit an open-ending proposal at the next annual meeting of the shareholders.

To show that such price behaviour is expected in a rational market, first assume that the market estimates that a fund has a probability p to be liquidated or open-ended for each period. Therefore, for each period t, the closed-end fund price is equal to $NAVPS_t$ with probability p or $NAVPS_t - D_t$ with probability $1-p$, where D_t is the current discount of the closed-end fund price from $NAVPS_t$. Further assume that the fund has no specific termination date that is known a priori.

To induce a discount for each period t, assume $\mu < 0$ and:

[20] Recent examples of such actions include the liquidations of Bergstom Capital Corporation, India Growth Fund and Nations Government Term Trust, the merger of Corporate High Yield Fund and Corporate High Yield Fund II, and the open-ending of Templeton China World Fund.

[21] Specifically, Brauer (1984) reports an average cumulative abnormal return of 30% over two years (12 months before and 12 months after the announcement of an open-ending) for the 14 open-endings of closed-end funds that are in his sample over the period from 1960 through 1981.

$$NAVPS_t = NAVPS_{t-1}\,(1+K) + \mu \tag{3.26}$$

Since the closed-end fund price incorporates the expectation of possible liquidation or open-ending of the fund, then the closed-end fund price P_0 is equal to:

$$P_0 = pNAVPS_1\phi^{-1} + (1-p)\phi^{-1} \left\{ \begin{array}{l} (1-p)\phi^{-1}\left[(1-p)\phi^{-1}\left\langle(1-p)\phi^{-1}(\ldots) + pNAVPS_4\phi^{-1}\right\rangle + pNAVPS_3\phi^{-1}\right] \\ +pNAVPS_2\phi^{-1} \end{array} \right\} \tag{3.27}$$

where ϕ = (1+K);

or: $$P_0 = p\left\{\sum_{t=1}^{\infty} NAVPS_t(1-p)^{t-1}\phi^{-t}\right\} \tag{3.28}$$

Using (3.26) and simplifying, equation (3.28) can be expressed as:

$$P_0 = NAVPS_0 + \frac{\mu}{K+p} \tag{3.29}$$

Since $\mu < 0$ and $0 < p < 1$, then P_0 must be less then $NAVPS_0$. This is a required premise to insure the relevancy of open-ending or liquidating the fund. Any increase in the probability p results in an increase in the fund's price.

If the market's belief about the probability of open-ending is such that $p=0$, then equation (3.29) is equal to:

$$P_0 = NAVPS_0 + \frac{\mu}{K}. \tag{3.30}$$

Thus, the price incorporates the perpetual underperformance of the fund. If $p=1$, then the fund should sell at a price that only includes the extraordinary return of its NAVPS in the coming period, or:

$$P_0 = NAVPS_0 + \frac{\mu}{1+k}. \tag{3.31}$$

Proposition 3.3:

Since $p^2 < p$, $\sigma^2(\Delta P_t) > 0$ if $0 < p < 1$.

Proof:

To simplify the proof of proposition 3.3, let us rule out any noise in the NAVPS changes so that:

$$\sigma^2(\Delta\ NAVPS_t) = 0 \tag{3.32}$$

The expected variation in the fund's price is:

$$E(\Delta P) = NAVPS_{t-1} - P_t + (1\text{-}p)\frac{\mu}{K + p}. \tag{3.33}$$

A simple calculation yields:

$$\sigma^2(\Delta P) = \{p - p^2\}\left[\frac{\mu}{K + p}\right]^2 \tag{3.34}$$

Proposition 3.3 follows directly from equation (3.34). **QED**

Discussion:

Equation (3.34) states that the expected variation in fund price is higher the higher is the uncertainty about possible fund liquidation (probability of p diverging from 0 or 1). More variation also is induced by a lower μ, since the payoff of possible fund liquidation is increased. However, expected variation in fund price is tempered by a high probability p since the fund's price incorporates the high sequential probability of the fund's price being equal to its NAVPS. In turn, this reduces the relative weight of systematic under-performance on the fund's price.

Equation (3.28) only focuses on the actual beliefs about potential fund liquidation. However, change in those beliefs would induce additional volatility in the fund's price relative to its NAVPS. We have also implicitly assumed that μ and p are independent and not random. However, high abnormal negative returns (or high closed-end fund discounts) should be related to a high probability of open-ending or liquidation. From (3.34), the impact of such a relationship would be ambiguous on the ratio of a closed-end fund's price variance to NAVPS variance since a high discount would induce p to be farther from 0 (and the ratio of the variances to be very different from one) but closer to 1 (and the ratio of the variances to be closer to one). We also conjecture that a high persistence of negative returns would trigger a high systematic discount (see the previous section) and, consequently, a high probability of open-ending or liquidation. Similar conclusions would apply for inefficient payout policies (see section 3.1.4) and high management fees (see section 3.1.5).

3.1.4 Payout Policy

Closed-end fund managers can modify the payout policy of the fund. Changes of payout policy are frequent and may induce sharp variations in the closed-end fund's price. Recent announcements of payout policy alterations include the TCW Convertible Securities Fund (CVT), the Zweig Fund (ZF) and the Zweig Total Return Fund (ZTR). On July 17, 2003, CVT announced a reduction of its quarterly distribution from \$0.06 per share to \$0.04 per share. On July 28, 2003, both ZF and ZTR announced that the actual 10 percent fixed distribution based on net asset value would be gradually changed to a variable distribution by the end of the year. The new distribution would be based on net investment income earnings, and capital gains would be distributed only after utilization of capital loss carryovers. The two-day returns following these announcements were –5.1% for CVT, -9.3% for ZF and –16.3% for ZTR. These variations could be the result of investors' overreaction or could be partly induced by rational factors.

Formally, let $1\text{-}b_H$ or $1\text{-}b_L$ be the payout ratios that the fund may select in the next period (respectively with probability δ and $1\text{-}\delta$), ρ be the return on NAVPS, and g be the expected growth in dividends. Variable g is equal to $b_\theta\rho$ where b_θ is the retention rate and θ can take the value L or H. The dividend d_{t+1} is therefore equal to: $NAPVS_t\, \rho$

$(1\text{-}b_{t+1})$. Assume, for ease of exposition, the use of a standard dividend growth model to estimate the closed-end fund's price.

Proposition 3.4:

If the closed-end fund is expected to modify its payout policy, then:

$\sigma\,(\Delta P_{kt}) > \sigma\,(\Delta NAVPS_t)$

$$\text{if}\left[\frac{\dfrac{1-b_H}{K-b_H\rho}-\dfrac{1-b_L}{K-b_L\rho}}{b_H-b_L}\right]^2 > 1 \tag{3.35}$$

Proof:

The proof is straightforward by computing $\sigma^2\,(\Delta P_{kt})$ and $\sigma^2\,(\Delta NAVPS_t)$ using the assumptions of section 3.1.4, and by dividing $\sigma^2\,(\Delta P_{kt})$ by $\sigma^2\,(\Delta NAVPS_t)$. **QED**

Discussion:

If $\rho=K$, then the impact of a change in the payout policy is null due to dividend policy irrelevancy. Thus, as is illustrated in table 3.1, if the difference between the return on assets and the required rate of return is small, then the impact of a payout policy change will result in $\sigma\,(\Delta P_{kt}) < \sigma\,(\Delta NAVPS_t)$. In that case (such as if $\rho = 0.099$ in Table 3.1), an alteration of the reinvestment rate does not create nor destroy value. For instance, a higher dividend payout will decrease the NAVPS but may not result in substantial price variation.

If ρ is substantially lower than K, then an increase in the payout ratio will partly prevent managers from destroying shareholder value and will translate into an increase in the fund's price.[22] In contrast, a decrease of the payout ratio should trigger

[22] Closed-end funds do not just strictly distribute only taxable income and net realized capital gains. For instance, H&Q Healthcare Investors states in its semi-annual 2003 Report (p. 14): "Pursuant to an SEC exemptive order, the Fund has implemented a fixed distribution policy that permits the Fund to make quarterly distributions at a rate of 2% of the Fund's net assets to shareholders of record. The Fund intends to use net realized capital gains when making quarterly distributions. This could result in a

a negative price variation. Overall, the expected price variation, due to the rippling effect of a payout policy change on future discounted cash flows, will be higher than the short-term impact on the NAVPS. Evidently, as is shown in Table 3.1, as the difference between ρ and K increases or as the difference between b_H and b_L increases, the relative variance of the closed-end fund's price and of the NAVPS also increases. Some specific differences of ρ and K and of b_H and b_L may result in $\sigma(\Delta P_{kt})$ being equal to $\sigma(\Delta NAVPS_t)$ (such as b_L=0,7 and ρ=0.09842 in Table 3.1).

Managers of closed-end fund s are induced to carry a lower dividend payout policy as their fees are usually fixed as a percentage of the NAV. In that sense, if $\rho<K$ (and therefore, if the fund trades at discount), a takeover threat should induce managers to increase their payout ratio since a gradual liquidation of the fund will result in an increase of the closed-end fund's price and will act as a policy against hostile takeover (therefore, protecting the future stream of fees to the manager).

It should also be noted that investors that buy closed-end funds may face a built-in capital gains tax liability, which increases as the unrealized capital appreciation embodied in NAVPS increases. Thus, a fund with a large amount of unrealized capital appreciation in its NAVPS should sell at a lower price than a fully equivalent fund with no unrealized capital appreciation in its NAVPS since buyers are assuming a greater potential tax liability (see Malkiel, 1977, 1995; and Bierman and Swaminathan, 2000). Consequently, the proportion of a fund's assets paid out in dividends and in capital gains distributions may influence the discounts at which closed-end funds sell. As noted by Malkiel (1995), a policy of realizing and distributing large capital gains dividends will lower unrealized appreciation and future

return of capital to shareholders if the amount of the distribution exceeds the Fund's net investment income and realized capital gains."

tax liabilities. Therefore, one can argue that any change in the payout policy of the fund should affect fund price variability more than its NAVPS variability.

To verify that possibility, assume that a fund has an expected and required return of K and a termination date of T, that the tax basis or per-share book value of its portfolio of assets under administration is C_0, and that investors have a capital gains tax liability of $NAVPS_0 - C_0$, and R is the personal tax rate of the representative investor. Further, suppose that the market anticipates that the fund will opt for one of two payout policies. Under Policy #1, the fund pays a liquidating dividend at time T. Under Policy #2, the fund pays out all of the capital gains tax liability ($NAVPS_1 - C_0$) at $t=1$, and a liquidating dividend at time T.

Under policy #1 or #2, the fund's price is equal to:

$$P_0 = NAVPS_0(1-R) + \frac{RC_0}{(1+K)^T} \cdot \tag{3.36}$$

Based on equation (3.36), the fund sells at a discount if there is unrealized capital appreciation ($NAVPS_0 > C_0$). The discount increases as the unrealized capital appreciation for tax purposes ($NAVPS_0 - C_0$) increases.

However, the payout policy does not affect the price of the fund. If policy #1 is selected, the tax liability payment is delayed. The tax saving is exactly compensated by an increase in the tax liability, which grows by assumption at a rate of $1+K$ per period from time 1 to T. Thus, both policies yield the same price. Thus, $\sigma^2(\Delta P_t)$ is unaffected by the fund's payout policy if the fund's performance satisfies its expected and required rate of return of K.[23]

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[23] Changes in the tax rate for the assets held by the closed-end fund or for the shares of the closed-end fund itself may however trigger $\sigma^2(\Delta P_t)$ to be different than $\sigma^2(\Delta NAVPS_t)$. For instance, under the US tax system, in order to qualify for exclusion from corporate tax, closed-end funds must distribute to shareholders at least 90% of realized capital gains in a given year and return all dividend income to shareholders every year. The income dividend paid by closed-end funds is taxed as ordinary income while the capital gains dividend is taxed at the capital gains rate. Consequently, any changes in the expected tax rate for the assets held by the closed-end funds or in the capital gains rate or in the

If the fund's performance differs from K, then the payout policy would induce a different fund price. For instance, if the fund's performance is expected to be higher than K by opting for Policy #2, then the fund manager would reduce the future capital appreciation as the portfolio of assets under management at time 1 is being reduced, although this appreciation would be partly offset by an expected tax liability. Consequently, the fund's price would differ depending upon the selected payout policy. In turn, this would cause $\sigma^2(\Delta P_t)$ to be higher than $\sigma^2(\Delta NAVPS_t)$.

3.1.5 Management Fees

Typically, closed-end fund managers charge a management fee that is a fixed percentage of the total assets under management (see Coles, Suay, and Woodbury, 2000). A possible change in this fee policy causes the price of the fund to vary more than the variation in NAVPS since the change also affects the future discounted flows of the fund.

Proposition 3.5:

Since:

$$\begin{aligned}&\left|E(1-\alpha_1)^T-(1-\alpha_0)^T\right|>\left|E(1-\alpha_1)-(1-\alpha_0)\right|\\&\rightarrow\left|E(1-\alpha_1)^T-(1-\alpha_0)^T\right|>0\end{aligned}, \tag{3.37}$$

and $$E(1-\alpha_1)^T\neq(1-\alpha_0)^T, \tag{3.38}$$

then:

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ordinary income tax rate will induce $\frac{\sigma^2(\Delta P_t)}{\sigma^2(\Delta NAVPS_t)}$ to be different from one. Furthermore, if the tax rate applicable to the investors holding the underlying assets of the closed-end funds is lower than the tax rate of the investors holding closed-end fund shares then, all else held equal, the before tax-return on the closed-end fund has to be greater than the before-tax return on the NAVPS so that the after-tax returns are equivalent. This can only occur if the shares of the closed-end fund are bought at a discount. A clientele effect may therefore partly explain the observed discounts for closed-end funds.

$$\frac{\sigma^2(\Delta P)}{\sigma^2(\Delta NAVPS)}=\left[\frac{(1+\mu)^T E\left[(1-\alpha_1)^T-(1-\alpha_0)^T\right]}{(1+\mu)E\left[(1-\alpha_1)-(1-\alpha_0)\right]}\right]^2>1 \text{ for T} > 1. \tag{3.39}$$

Proof:

If there are no intermediate dividend payments, then:

$$NAVPS_t = NAVPS_{t-1}\,(1+K)(1+\mu)(1-\alpha_t) \tag{3.40}$$

where μ is some constant drift;

α_t is the periodic management fee as a percentage of the assets under management; and

$\alpha_{t+1}=\alpha_t+v_{t+1}$, where $v_t \sim N(0,\sigma_v^2)$.

Therefore, the price of the fund is equal to:

$$P_0 = NAVPS_0\,(1+\mu)^T(1-\alpha_0)^T \tag{3.41}$$

It is easy to show that:

$$E(\Delta NAVPS) = NAVPS_0((1+K)(1+\mu)(1-\alpha_0)-1) \tag{3.42}$$

$$E(\Delta P) = NAVPS_0(1+\mu)^T(1-\alpha_0)^T K \tag{3.43}$$

$$\sigma^2(\Delta\, NAVPS)= (NAVPS_0\,(1+K)(1+\mu))^2\, E((1-\alpha_1)-(1-\alpha_0))^2 \tag{3.44}$$

$$\sigma^2(\Delta\, P)= (NAVPS_0\,(1+K)(1+\mu))^2\, E((1-\alpha_1)^T-(1-\alpha_0)^T)^2 \tag{3.45}$$

Proposition 3.5 follows directly from equations (3.44) and (3.45).

Discussion:

Proposition 3.5 shows that the variance ratio for price and NAVPS returns increases as T increases, since the spread between the various values of ΔP and their mean increases as T increases. This result is simply due to the ripple effect of a fee policy change on the discounted future payout of the fund.

3.2 CONCLUDING REMARKS

In this essay (chapter), we show that many characteristics of closed-end-funds can cause the variances of the returns based on the prices and on the NAVPS of closed-end funds to diverge in rational markets. The prices of closed-end funds do not obey the same rules as the weighted value of its portfolio of assets under management. We show that the bid-ask bounce, the probability of fund open-ending, performance persistence, management fees, and payout policy choice can affect the variability of returns for the fund shares or units and of its assets under management differently. All these results are independent of the presence of arbitrageurs since the gap between the variability in price and in its NAVPS is based on fundamental factors.[24] Thus, even if investors are fully rational, the variability of prices of a closed-end fund will be higher than that of its NAVPS.

We also believe our approach could be applied to conglomerates. Numerous empirical studies find that conglomerates usually trade at a discount.[25] We suspect that the price variation of a conglomerate is higher than the value variation of its components. Micro-market (such as the averaging out of the bid-ask bounce) and managerial effects (such as spin-off or liquidation of business segments and the possibility that conglomerates trading at a discount are taken over,[26] changes in the managing costs or the projected persistence of management in creating value) seem applicable to the context of conglomerates.

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[24] In fact, even if the difference in variability is not based on fundamental factors, the presence of arbitrageurs would not guarantee the equality between the closed-end fund price and its underlying assets (and therefore equality of their respective variance). According to Pontiff (1996), restrictions and costs on arbitrage significantly restrain investors from eliminating closed-end fund discounts. Even in the case of exchange-traded funds, where managers can facilitate arbitrage through the in-kind creation or redemption of shares, various frictions can prevent these funds from trading at par with their net asset value (see Hughen, 2003). However, the difference between the variability of price and variability of NAVPS must be less for exchange-traded funds than for closed-end funds since portfolios of stocks owned by exchange-traded funds are well known to investors due to their passive investment strategies (which mainly replicate market indexes). Consequently, additional randomness caused by active management (propositions #2 through #5) does not apply to exchange-traded funds.

[25] See, among others, Lang and Stulz (1994), Berger and Ofek (1995) and Servaes (1996).

[26] See Dittmar (2003).

Overall, the importance of each of these factors in explaining variations from one of the actual variance ratio of closed-end fund price to NAVPS and the possible extension of this framework to other types of investment entities (such as conglomerates) remain to be empirically established.

CHAPTER 4

FUND MANAGER REMUNERATION AND THE PRICE BEHAVIOR OF CLOSED-END FUND IPOs

While closed-end funds rarely issue or redeem their own securities, open-end funds stand ready to sell or repurchase their shares at net asset value per share (NAVPS). Investors who wish to purchase or sell closed-end fund shares must do so on the open market. Consequently, while a share of the open-end mutual fund trades at NAVPS, the price of a share of a closed-end fund may deviate systematically from its NAVPS. The NAVPS reflects the value of the investments of the closed-end fund at each point in time. However, expectations about future portfolio compositions and the returns that they will actually provide to shareholders should be reflected in the fund's current price. The fund's price, and the actual price discount or premium from its NAVPS, should reflect the beliefs of the market about the ability of the fund managers to outperform the market.[27] Numerous academics and practitioners argue that a possible reason for the variation in the discount of a typical closed-end fund is due to changes in the expected performance of the management of the assets of the fund.[28]

Since closed-end funds hold no significant assets pre-IPO, one would think that it is virtually impossible for the initial offer price to be underpriced relative to the value of the underlying assets. Nevertheless, the behaviours of the market prices of closed-end funds over the first few days of their initial public trading suggests that investors may systematically overestimate future NAVPS for a typical closed-end fund. According to Muscarella, Peavy, and Vetsuypens (1992, p. 79), closed-end funds generally start as

[27] This is similar to a price-to-book ratio for a firm where the price per share is lower, equal or higher than the book value per share depending upon whether the expected rate of return on future growth opportunities is less than, equal to or greater than the cost of capital.
[28] The academics include Chay and Trzcinka (1999), Malkiel (1977), Mendelson (1978), Pontiff (1995) and Swaminathan (1996). The practitioners include Herzfeld (1990).

cash pools. Once the offering is complete, the net proceeds of issue per share are equal to the offering price less the amount of sales commission. Herzfeld (1987) claims that the commissions on new closed-end funds are four to six times the level associated with seasoned funds. Anderson and Born (1989) provide evidence that the shares are sold at an average premium over the net proceeds per share of 7.4 percent. On average, the closing prices on the offering dates are about 8.3 percent less than the net proceeds per share. Since it is not obvious why investors pay an offering price that exceeds the underlying value of the fund's shares, such investment behaviour is considered anomalous by many academics and practitioners.

Other studies have documented the abnormal returns on the days following the initial public offerings of closed-end mutual funds. For a sample of 64 such offerings during the period 1985-1987, Weiss (1989) finds that the market-adjusted cumulative average return (CAR) is -15.05% by day 120. For the IPOs of 41 closed-end funds drawn from the period from January 1986 to June 1987, Peavy (1990) reports a market-adjusted CAR of –2.53% over days 2 through 20, and –12.79% for days 21 through 100. For a sample of 87 IPOs of real estate investment trusts during the 1971-1988 period, Wang, Chan, and Gau (1992) report an initial-day return of -2.82%, and S&P-adjusted and seasoned REIT index-adjusted CARs of -8.90% and -6.27%, respectively, over days 2 through 190.

For IPOs from the period from 1986 through 1987, Anderson and Born (1989) report that closed-end funds exhibit no abnormal price appreciation upon offer unlike other equity issues. Furthermore, the new issues of the closed-end funds exhibit significant price declines during the 20 weeks following the offerings. As in the study by Hanley, Lee, and Seguin (1996), the initial fund premium vanishes approximately four weeks after the initial offering date. This coincides with the withdrawal of underwriter support for the share prices of the closed-end funds in the secondary market. Based on a CAR of –6.8% for the first 100 days after issue, Hanley, Lee, and Seguin conclude that rational investors should wait 100 days before buying a closed-end fund. Hanley et al. attribute this return behaviour to restrictions on short-selling during the first few weeks of after-market trading and to the aggressive marketing of closed-end funds to uninformed investors in the pre-market. Once informed investors are allowed to sell short, the price drop is about equal to the amount of the underwriting fees. Thus, the adverse selection of these stocks during the early life of their IPOs given their poor returns to date is attributed to the purchase by mainly ill-advised and uninformed small investors.

The structure of compensation in the closed-end fund industry does not seem to help investors properly determine share values in the primary market. Coles, Suay, and Woodbury (2000, p. 1395) note that very few of the closed-end investment companies in their sample use a compensation scheme where an investment advisor adjusts compensation based on the return on the fund's portfolio net of some benchmark return. In fact, only nine out of 425 fund-year observations (representing three funds) had a benchmark return. For this small sample of funds, Coles et al. find that a performance benchmark is associated with an increased premium of between 7.1% and 8.4%. This provides evidence that good fund managers are willing to include benchmarks in their remuneration schemes, and that the market prices the shares of their closed-end funds accordingly. These results are consistent with the empirical findings of Elton, Gruber, and Blake (2003) for open-end funds. As in the closed-end fund industry, very few open-end funds used incentive fees in 1999 (only 1.6% from a sample of 6,716 mutual funds). Funds that use incentive-fees exhibit better stock selection abilities than non-incentive-fee funds. Furthermore, funds with incentive fees attract more new cash inflows than non-incentive-fee funds.

Thus, the purpose of the essay contained in this chapter is to show that basic remuneration schemes can help investors to properly value the securities of closed-end funds in primary markets so as to better reflect the abilities of its managers. While the literature concerned with determining the impact of incentive contracts on solving moral hazard problems is growing,[29] no paper specifically addresses how the remuneration structure should be set so that the adverse selection problem may be avoided in the pre-market for closed-end fund IPOs. For instance, in a general money management context and flat fee structures, the model of Huberman and Kandel (1993) consists of two types of fund managers who use portfolio choices to signal their abilities. Huddart (1999) also uses a finite number of types of managers and portfolio choice as a signaling device for portfolio managers (again in a flat fee context). However, this chapter shows that the use of benchmarks can mitigate undesirable reputation effects and make investors better off. Specifically, we argue that the lack of incentive compatible remuneration schemes in the closed-end fund industry leaves this sector with managers who generate returns that are relatively low when compared to their management fees. Das and Sundaram (2002) use informed and uninformed advisors to show that so-called "fulcrum" fees are often more attractive from the standpoint of investor welfare than "incentive" fees. "Fulcrum" fees are defined as fees that must increase for outperforming the benchmark in the same way that they decrease for underperforming it, while "incentive" fees have an option-like form and remain nonnegative. Our definition of incentive fee is identical to the one used

[29] See Grinblatt and Titman (1989) for option-like characteristics of contracts with a base fee and a bonus based on the degree to which the manager's return exceeds the return of some benchmark. More complex contracts, if improperly designed, may also create an incentive for the manager to deviate from targeted risk levels. Also, see Heinkel and Stoughton (1994) and Starks (1987) for mutual fund managing in general, and Lemmon, Schallheim, and Zender (2000) for dual-purpose closed-end fund management in particular.

by Elton, Gruber, and Blake (2003, p.779); namely: "a reward structure that makes management compensation a function of investment performance relative to some benchmark."

Contrary to the essay contained in this chapter, the benchmark portfolio used in Das and Sundaram (2002) is exogenously given, and is assumed to be a portfolio consisting of half a unit of the two risky securities allowed in their model. Furthermore, their framework does not apply to the context of the closed-end fund industry where most fees are simply fixed as a percentage of the net asset value or NAV under management.

The remainder of this chapter (essay) is structured as follows. In section 4.1, we show that the proper use of fees and benchmarks may allow investors to properly value a closed-end fund in the primary (IPO) market. For specific payoff distributions, the existence of a well-chosen remuneration scheme can induce self-revelation behavior by fund managers. In section 4.2, as suggested by Rubinstein (2001), we argue that the discounts of closed-end funds may just arise from poor managerial performance and incentive-incompatible fee structures. Specifically, we argue that current remuneration schemes for portfolio managers of closed-end funds may drive the price of these funds below their NAVPS. Section 4.3 concludes the chapter.

4.1 THE USE OF FEES AND BENCHMARKS TO REVEAL THE SKILL LEVEL OF THE FUND MANAGER

In this section, we use the framework of Heinkel (1982) to explore the possibility that a proper mix of fees and benchmarks may provide full revelation of the fund manager's expected return for a particular set of return distributions. Specifically, we exploit the fact that the relationship, in the pre-market, between the financial market and the entrepreneur in the capital raising game is similar to the relationship between investors and the closed-end fund manager. For a fully revealing equilibrium to be achieved, fees and benchmarks must be compatible with the payoff distribution in the sense depicted by Brennan and Kraus (1987). This means that the fees and benchmarks are fixed in order to fit the actual payoff distribution so that the entrepreneur can be self-revealed. Our results apply to an infinite set of types of mutual fund managers. In Appendix A4, we also show that the set of compatible distributions is larger than that originally assumed by Heinkel (1982).

In the spirit of Merton (1981), we assume: i) risk-neutrality; ii) a fund manager who is monopolist in the sense that he or she extracts all the economic benefits from exploiting his or her skills; and iii) the fund manager and fund promoter are the same person. No moral hazard problem exists since superior information cannot be acquired at some cost. The payoff distribution is constructed so as to be compatible with a compensation distribution.

At the initial period, the fund manager tries to gather, at a cost $s(n)$, the n investors needed to invest in a private placement for which an amount of 1 is required.[30] Cost $s(n)$ may be viewed as an underwriting expense. Consequently, the price paid by each investor to acquire a unit is higher than the NAVPS of the fund, which is net of $s(n)/n$. Each investor is endowed with wealth $1/n$. The project is indivisible so that each n units cannot be redeemed at NAVPS, and can only be traded in the secondary market. The fund manager is only endowed with the skill to gather investors, and has access to a private placement for which a liquidating cost c is expected to be paid by the manager at the final stage. Only the fund manager knows the specific payoff distribution of the project. The fund manager can opt ex-ante not to gather the n investors, given the payoff distribution of the project, the cost to gather investors, and the cost to liquidate the

[30] It is further assumed that an individual investor would face a cost higher than $s(n)$ to gather the proper number of investors.

project. Individual investors can trade their shares in the open market at the intermediate stage.

Each individual investor can opt to offer a mix of fees and benchmarks to the fund manager. Benchmarks and fees have the following combined effect on the payoffs to the shareholders and the managers of the fund. First, if the realized return is *above* the benchmark, then the investors receive the full benchmark return, and the return above the benchmark net of the management fees. The fund manager receives the fees that are a portion of the realized return net of the benchmark return. The net payoffs to the managers are the dollar fees less the operating cost of c. Second, if the realized return is *below* the benchmark, then the investors receive the full realized return. In that case, the manager incurs a loss of c. Competitive investors will set fees and benchmarks so that:

$$(p(x_1(t) - \alpha(t)(x_1-B(t))) + (1-p)x_2(t))/n = 1/n \tag{4.1}$$

where:

$x_1(t)$ is the payout in state 1 for the type t manager;

$x_2(t)$ is the payout in state 2 for the type t manager;

p is the probability of occurrence of state 1;

$\alpha(t)$ is the fees set for the type t manager; and

$B(t)$ is the benchmark set for the type t manager.

At the final stage, the state of nature and the private information of the manager are revealed. Investors and the manager receive a payoff according to the mix of fees and benchmarks set in the initial period.

Proposition 4.1:

For some specific payoff distribution, there exists a mix of fees and benchmarks that allows for the full revelation of the abilities of the closed-end fund managers.

Proof:

Assume that $s(n) = 0.5$ and $c = 0.01$. The manager's type can take any value over the infinite range $t \in (1, \infty)$, and the distribution of type is common knowledge. The payouts $x=x(\theta,t)$ of the fund t for the two states are as follows:

- $\frac{3.6}{10}\left\{\frac{t+3}{10}+4\right\}$ with probability $p=0.2$ if $\theta=1$.
- $\frac{3.6}{\left\{\frac{2(t+3)}{50}+4\right\}}$ with probability $(1-p)=0.8$ if $\theta=2$.

The distribution is similar to the standard risk-return relationship as a higher spread is associated with a higher expected return. In this example, good managers provide high payoffs in good states and relatively low payoffs in bad states, and provide better overall performance on average than bad managers.

Using the approach described in Appendix A4, the respective equilibrium functions for fees and benchmarks are:

$$\alpha^*(t) = 1-(16/\delta^2) \tag{4.2}$$

$$B^*(t) = \frac{\dfrac{1-\left[\dfrac{0.1152t+4.9536}{\delta^2}+\dfrac{46.08}{\delta^3}\right]}{1-(16/\delta^2)}-\dfrac{2.88}{\delta}}{0.2} \tag{4.3}$$

where $\delta = \frac{(t+3)}{25}+4$.

Based on table 4.1, the equilibrium values obtained for the fees and the benchmarks allow for a full revelation of type so that mimicking behavior does not pay. Manager types that have a high return in the good state (and a higher expected return) are not willing to mimic the low types despite the fact that only a low benchmark return is required. In that case, the high types would have to forego large fees and a large payout whenever the good state occurs (i.e., the state during which a high type obtains very good returns). On the other hand, low types are not willing to mimic the high types since high fees are only obtained at the expense of a very high benchmark. In the case of low types, this means that they obtain a large share of a relatively small surplus, which is equal to the payout less the benchmark. **QED**

Discussion:

As is evident from table 4.2, investors pay a premium at the initial stage for the shares of the fund since the cost to gather investors has been subtracted from the aggregate initial investment of the individual investors. The equilibrium fees and benchmarks are set so that, on average, shareholders obtain an expected payoff equal to their initial disbursement. Since their selected project may not guarantee sufficient fees to cover operating costs (as in the case of types 1 and 2), managers are deterred from entering the closed-end fund market as their true type is revealed by the remuneration scheme.

As is shown in Figure 4.1, the utility level of the shareholder U_s increases to the north east in the space $(1-\alpha,B)$ as the level of the benchmark increases and the fees paid decreases for a given price paid for the shares of the closed-end fund. For a given indifference curve, higher fees must be compensated for by a higher benchmark. The particular payoff distribution induces the convexity of these curves. From the perspective of the utility of the manager of the closed-end fund (U_m^t), the relation $1-\alpha^* = f(B^*)$ acts as the rational expectation budget constraint. In full information, an infinite number of mixes give the shareholder $U_s=0$. With incomplete information and a fully revealing price, only one mix is optimal. It can be shown that $\left.\frac{d(1-\alpha)}{dB}\right|_{Us=0} < 0$ and $\left.\frac{d_2(1-\alpha)}{dB_2}\right|_{Us=0} > 0$, as is illustrated in figure 4.1.

The utility levels of fund managers increase to the southwest as their shares in the payoff of the fund increase. Better managers, such as type 4 when compared to type 1, are willing to give higher benchmarks to the investors but need to be compensated with higher fees. Mimicking of other types yields utility under the full information value. In the spirit of Brennan and Kraus (1987), mix $(1-\alpha^{*}(t), B^{*}(t))$ is a worst-financing case. Also, it is easy to show that at the optimal point $\left.\frac{d(1-\alpha)}{dB}\right|_{U_h=\psi} = \left.\frac{d(1-\alpha)}{dB}\right|_{U_S=0}$. Also, it can be shown that $\left.\frac{d(1-\alpha)}{dB}\right|_{U_h=\psi} < 0$ and $\left.\frac{d_2(1-\alpha)}{dB_2}\right|_{U_h=\psi} < 0$. The strict convexity of the utility curve of the investor combined with the strict concavity of the utility curve for each type of fund manager allows for a unique maximum to be reached for this particular problem setup.

Intuitively, this application is robust to the Admati and Pfleiderer (1994) critic regarding a costless signaling equilibrium reached in the capital raising game. In the case of fund managers, the liquidation value of the investment rarely is uniformly equal to zero (that is, the payoff when the minimal hurdle is not reached). This allows for the existence of a payoff structure that is not degenerately equal to zero in bad states, and for the existence of a fully revealing rational expectation whenever a compatible density function exists.

In contrast to the results of Admati and Pfleiderer (1997), our results can be used to draw conjectures on the usefulness of traditional compensation schemes. Clearly, if the proper conditions exist, a proper mix of fees and benchmarks can solve the adverse selection problem, and allow economic agents to behave as if a full information economy prevails. This may not be the case for traditional compensation schemes as is shown in the next section of this essay.

4.2 FLAT FEES AND CLOSED-END FUND DISCOUNTS

Typically, the managers of closed-end funds periodically receive a percentage of the assets under management as compensation. According to Coles et al. (2000), closed-end funds always have different marginal rates of fees that apply to different levels of NAVPS but that only one such rate is likely to be relevant. As suggested by Rubinstein (2001), the discounts of closed-end funds may reflect poor managerial performance arising from the lack of incentive-incompatible fee structures.

Based on the conjecture of Hanley et al. (1996) that the IPOs of closed-end funds typically are marketed to attract small and uninformed investors, we can argue that poorly managed funds or funds with little economic value (as in section 4.1 of this chapter) are charging fees that are too high for the economic value they add. For example, if the beliefs of shareholders are set at $t=50$, the flat fee equals 12.3 %, since this fee captures any potential surplus from the extraordinary returns generated by the managers. As shown in table 4.2, these fees would induce managers who can add no economic value (such as types 1 and 2) to enter the market for professional management services.

Good marketing may still permit the issue of these funds at a premium in the pre-market. However, once short-sellers enter the market (approximately 30 days after the first day of trading), the price of such a closed-end fund converges to a price that represents a discount from NAVPS. This new price may reflect the true economic value of the fund and the lack of an appropriate managerial remuneration scheme within the fund. Therefore, the fund is likely to trade at a deep discount shortly after its initial day of trading if short-sellers hold beliefs that truly reflect the skills of the managers. In this case, the per-share or per-unit price of the fund corresponds to P_{j0+} in table 4.3.

The results presented in section 4.1 of this chapter suggest that some of these funds (such as types 1 and 2 in table 4.2) would not have been created if an appropriate remuneration structure was in place. Conversely, flat fees, which may be the result of collusive practices as in the underwriting business as depicted by Chen and Ritter (2000), may not induce the entry of high performing managers (such as types 3 and 4).[31] Therefore, these phenomena collectively may explain the existence of a "lemons market" for closed-end funds, and the preponderance of shares trading at discounts relative to their NAVPS for closed-end funds. Elton, Gruber, and Blake (2003) find that open-end fund managers with incentive fees have, on average, better stock picking ability and attract more new cash flow than funds without incentive contracts. This is consistent with our findings, which are reported in table 4.2. Thus, our results suggest that implementation of an incentive fee policy should "at least not attract the worst managers" (Elton, Gruber, and Blake, 2003, p.782).[32]

4.3 CONCLUDING REMARKS

In this essay (chapter), we show that a mix of appropriate fees and benchmarks can induce fund managers to fully reveal their abilities to earn extraordinary returns. The lack of incentive compatible contracts in the closed-end fund industry, where typically fees are based solely on the percentage of assets under management, may

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[31] In fact, short-term incentives to fund service providers, such as brokers and financial advisors, may attract more resources to the marketing of the fund than its actual performance. Also, and contrary to open-end funds, there is no cash inflow after the initial period. Thus, there is little incentive for closed-end fund managers to build a reputation based on past performance. Managers of open-end funds earning flat fees still have an incentive to perform since better performance leads to larger cash inflows due to unit purchase. Evidence of past performance chasing by investors in open-end funds is found in Gruber (1996). Past performance and reputation effect may also deter good managers from adopting option-like behaviour (see Grinblatt and Titman, 1989, p.818).

[32] However, the efficiency of an incentive fee policy may be tempered by practical considerations in constructing appropriate benchmarks or proper performance measurements. This is particularly true for funds invested in illiquid or thinly traded assets. In these cases, portfolio managers often provide their own assessment of the intrinsic value of these securities. Ideally, these assets should be valued through an independent appraisal and be set at a discount to comparables in the public market.

partly explain the chronic discount of price relative to net asset value per share or NAVPS. The findings by Coles, Suay, and Woodbury (2000) that the presence of a performance benchmark is associated with smaller (higher) closed-end fund discounts (premiums) supports our conjecture. Our example shows that such a relationship will exist under some specific return distributions. In such cases, better managers "show strength" by agreeing to be remunerated only if the actual return is above some threshold.

In general, we argue that the current compensation structure that is typically based on flat fees may induce good managers to exit the closed-end fund sector, and may leave this sector with managers that generate returns that are relatively low compared to their management fees. We conjecture that the closed-end fund industry would be better served by having a managerial remuneration structure that induces self-revelation of the expected performance of its fund managers. Over the long-term, such a remuneration structure may enhance the reputation of the closed-end fund industry, increase the number of funds in operation, and allow the average closed-end fund to trade at or above its NAVPS.

Our view seems to be empirically supported by the findings of Elton, Gruber, and Blake (2003), who find that open-end funds with incentive-fee managers exhibit better stock selection abilities and attract more new cash flow than non-incentive-fee managers. Therefore, it seems appropriate to challenge what seems to be the prevailing practice in the closed-end fund industry. As shown, by Hanley, Lee, and Seguin (1996), the actual marketing strategy of closed-end funds does not seem to be based on the fundamental economic benefits of such investments to investors. The use of benchmarks in the compensation structure of fund managers may be a better long-term marketing strategy since incentive fees may attract better managers or signal to investors that the expected performance of managers is high.

CHAPTER 5

CONCLUSION

This thesis has shown that closed-end mutual funds should be issued whenever the relative costs compared to those incurred by open-end funds of providing liquidity to investors are low. As a result, the economic viability of issuing closed-end funds increases as the probability of bank runs for open-end fund securities increases. Furthermore, rational economic factors related to the market microstructure and active management can cause the ratio of the price variability for the closed-end fund to the variability of the net asset value per share of the same fund to exceed one. Finally, under specific payoff distributions, a proper mix of fees and benchmarks may fully reveal the skill levels of portfolio managers. In turn, the use of such a remuneration structure contributes to more efficient pricing of the IPOs of closed-end funds.

In its three essays, the thesis has addressed some of the most salient anomalies related to closed-end funds. First, as reported in the first essay (chapter two), by providing economies of scale to investors, managed investment funds may cause the pre-market price of the fund to exceed its net asset value per share. However, and was shown in essay three (chapter four), the adoption of an inefficient remuneration structure by the closed-end fund may trigger a subsequent fall in the price of its shares.

Second, the results reported in essay one (chapter two) imply that the shift from premium to discount for many closed-end funds could be directly related to the increasing economic viability of alternative investment strategies. In particular, if the assets under management for some closed-end funds have become easier for investors to trade directly then the premium (discount) of these funds should have decreased (increased).

Third, as shown in essay two (chapter three), the embedded technical characteristics of closed-end fund should trigger a variation in the price of its shares or units that is greater than the variation of the underlying net asset value per share. Thus, in a rational market, the fund price variability is expected to be higher than the price variability of the portfolio of assets in which the fund has invested.

By using some of the theoretical findings reported in this thesis, additional elements of price behaviour of closed-end funds can be addressed. In particular, a specific and formal model could be developed to address the price behaviour of closed-end funds for the first few months following their IPOs. Numerous studies have documented the abnormal negative returns on the days following the initial public offerings of closed-end mutual funds.[33] This leads to the following question: Why do small investors not wait 100 days before buying these shares?[34] The most popular answer to this question is the one of Hanley, Lee, and Seguin (1996) who argue that the shares of closed-end funds are bought in the pre-market mainly by uninformed small investors. Once informed investors are allowed to short-sell, the price drop is about equal to the amount of the underwriting fees. Therefore, brokerage firms are promoting bad issues to their clients. However, this does not conform with the investment industry practice of reserving access to the pre-market issue for the brokerage firms' best clients. Promoting intentionally bad issues would jeopardize long-term relationships with this group of clients of the brokerage firm, and possibly also adversely affect the long-term expected profits of the brokerage firm. Consequently, the literature has not provided yet a plausible answer to the closed-end fund' investors pre-market behaviour and to the closed-end fund' investors market behaviour within the first hundred trading days.

[33] See Weiss (1989), Peavy (1990), Wang, Chan, and Gau (1992) and Hanley, Lee, and Seguin (1996).
[34] Paradoxically, those funds would never come to life if all investors were to be waiting 100 days to buy them.

The theoretical framework advanced in this thesis seems be a natural starting point to address these specific anomalies. Our conjecture is that small investors who invest pre-market in closed-end funds are long-term investors, as in Proposition 2.1 of essay one (chapter two).[35] Since closed-end funds may increase in value from day 1 to day 100, there is no stochastic dominance in choosing to "wait until day 100 to invest" or "to invest in the pre-market". Therefore, the risk aversion of those investors may be such that they will opt to invest in the pre-market and hold until the end of their investment horizon instead of strategically choosing a short-term horizon within the first few weeks following the IPO within which to purchase the issue of the closed-end fund, and then to hold the shares until the end of their investment horizon.[36]

Also, and in order to ease the search process in the pre-market for the promoter of the new fund, we conjecture that part of the issue for a closed-end fund is sold to "convenient investors" (or so-called "flippers"). In the spirit of the set of assumptions A.1. of section 2.1.1 of essay one (chapter two), we believe that these investors have greater wealth than the long-term closed-end fund investors but shorter time horizons. Consequently, these convenient investors are not willing to pay fees in the long-run for a portfolio that they can obtain by themselves at lower cost. Thus, if they cannot totally sell their shares to long-term investors in the market, they do not gain from holding these shares in the long-run. As a result, they may be willing to sell at a price below the offer price. These investors most likely benefit from being "convenient investors" either directly or indirectly from, for example, a redirection of the

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[35] This view also is supported by Amihud and Mendelson (1986). Since underwriting fees are similar to a large market spread, long-term investors are willing to bid higher prices for such securities since their investment horizons allow them to amortize the underwriting fees over a relatively long time span. Also, long-term investors may not significantly discount the closed-end fund price due to short-term variations since these variations will tend to average out over the long run. Accordingly, the required return on closed-end funds by long-term investors may be lower than that of short-term flippers. The latter may be the main sellers of closed-end fund shares in the days following the IPOs.

[36] Additional benefits from investing in the pre-market include the waving of transaction fees, no transaction spread, and collegial and mutual benefits from facilitating the birth of a closed-end fund.

underwriting fees charged for the issue. They may even over buy the issue and realize on average positive profits as fees counter-balance a selling price in the post-issue market that is lower than that in the pre-market.

In such a context, the fund manager problem is to evaluate the optimal size of the issue by taking into consideration the expected pre-market search costs, the compensation to be paid to convenient investors, and the expected number of long-term investors that will invest in the funds shortly after the IPOs. Any major shortfall in the latter expectation should result in a large drop in the closed-end fund price within the first few trading days.

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Table 3.1: Relative variance of the closed-end fund's price and of the NAVPS for selected values.

Relative variance of the closed-end fund's price and of the NAVPS (LHS of equation 3.35) for selected values of b_H and ρ with b_L=0.5 and K=0.10. Term ρ is the return on NAVPS, b_θ is the retention rate where θ can take the value L or H, and K is the discount rate.

	b_H			
ρ	**0.7**	**0.6**	**0.55**	**0.505**
0.09	24.15	15.62	12.96	11.11
0.097	3.29	1.92	1.56	1.30
0.09842	1.00	0.58	0.46	0.38
0.099	0.42	0.24	0.19	0.16

Table 4.1: Payout, excluding the cost of operations, to the mutual fund manager net of the full information value

		Promoted type			
		1	2	3	4
True type	1	0	-0.000056	-0.00023	-0.00054
	2	-0.000069	0	-0.000052	-0.00097
	3	-0.00025	-0.000058	0	-0.000055
	4	-0.0011	-0.00024	-0.00005	0

Table 4.2: Various equilibrium values when true type is revealed with appropriate mix of fees and benchmarks

Terms P_{j0}, NAV_0, $E(P_{j1})$ and $E(NAV_1)$ are, respectively, the price of the closed-end fund at time 0, the net asset value of the fund at time 0, the expected price at time 1, and the expected net asset value at time 1.

t	Fee in % (α^*)	Bench-mark (B^*)	Bench-mark return	P_{j0}	NAV_0	$E(P_{j1})$	$E(NAV_1)$	Expected fees to the manager	Net expected payoff to the manager
1	7.5%	0.98	-0.02 %	1	0.95	1	1	0.0091	-0.0009
2	9.3%	1.0976	9.76 %	1	0.95	1	1	0.0097	-0.0003
3	11.0%	1.1812	18.12 %	1	0.95	1	1	0.0104	0.0004
4	12.7%	1.2457	24.57 %	1	0.95	1	1	0.0113	0.0013

Table 4.3: Various equilibrium values for a selected promoted type

Expected fees and net expected payoff to the manager are set for a promoted type equal to 50. Terms P_{j0} and NAV_0, are, respectively, the price of the closed-end fund at time 0 and the net asset value of the fund at time 0. P_{j0+} is the price of the fund shortly after its initial day of trading if short-sellers hold beliefs that truly reflect the skills of the managers.

t	Fee in % (α^*)	Fee in $	P_{j0}	NAV_0	P_{j0+}	Expected fees to the manager	Net expected payoff to the manager
1	12.3%	0.14	1	0.95	0.8691	0.1241	0.1141
2	12.3%	0.14	1	0.95	0.8697	0.1242	0.1142
3	12.3%	0.14	1	0.95	0.8704	0.1243	0.1143
4	12.3%	0.14	1	0.95	0.8712	0.1244	0.1144

Figure 2.1: Equilibrium relationship between closed-end funds and their NAV.

Line S_0 is the closed-end fund's supply curve if closed-end funds have no search costs and face no transaction costs or barriers to access relatively illiquid assets. Line S_1 is the supply if closed-end funds face uniform search costs. Curve S_2 is the supply curve if marginal issuing funds face higher expected costs to gather investors or need to pay higher transaction costs to access investment projects. Curve D_0 is the demand curve for closed-end fund shares.

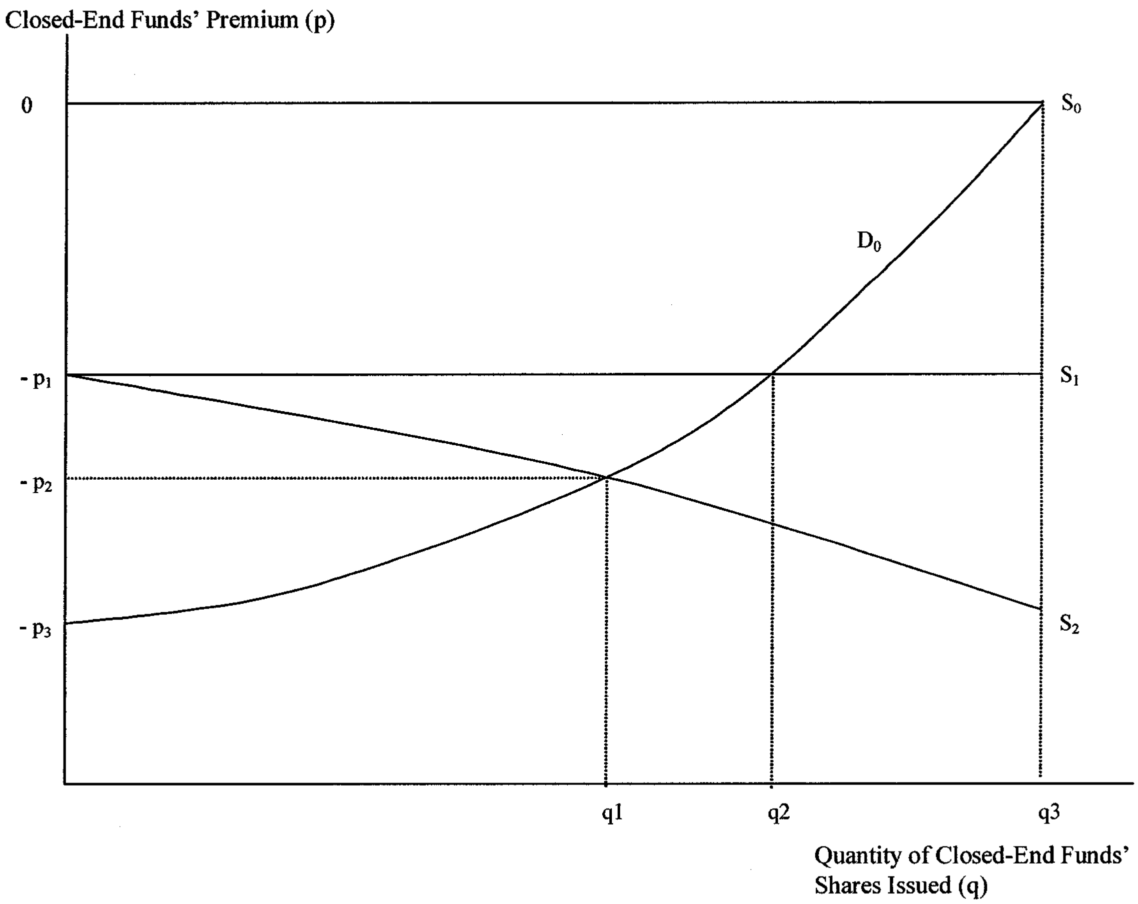
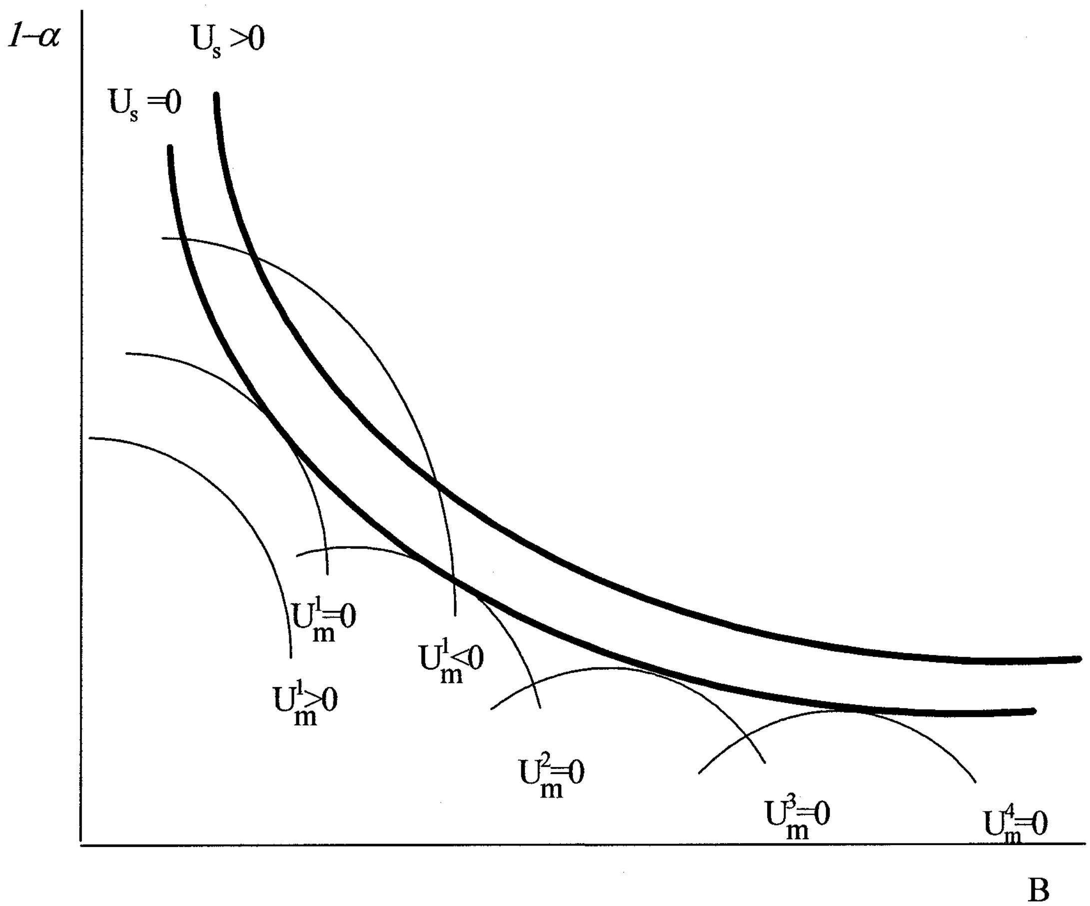


Figure 4.1: Optimal compensation scheme for various types of fund managers

Term α is the fees and B the benchmark. Utility level of the shareholder is denoted by U_s, while utility of the closed-end fund manager is (U^t_m). Utility levels of each fund manager t (t=1,2,3,4) are net of their full information value and do not include operating expenses.



APPENDIX A2

Bank runs in the mutual fund industry

Over the years, many open-end mutual funds suspended redemptions to avoid bank runs. In December 1995, amid the Mexican peso crisis, three Lehman Brothers offshore funds that invest in Mexico stopped investors from withdrawing money from their funds (specifically, the Mexican Dollar Income Portfolio, Mexican Short-Term Investment Portfolio and Mexican Premium Income Portfolio). In anticipation of further declines of the Mexican currency and the expected impact that such declines may have on the behaviour of their investors, the Wall Street Journal noted that: "suspending redemptions protects remaining shareholders from heavier losses than they would otherwise face" (see *Wall Street Journal*, January 3, 1995).

In these types of circumstances, a bank run behaviour could be triggered by the delay between the actual liquidation of the units of the fund (since the fund must pay the departing shareholders immediately) and the final receipt by the fund of the money from the liquidation of stocks (three days latter). With rapid peso depreciation, the fund manager may have to pay out more for the units than was actually received from the sale of the underlying assets. Since the remaining shareholders absorb this loss, rational investors will rush to liquidate their shares. In turn, this justifies the suspension of redemptions by the funds.

The sharp downturn in the value of North American property during the early 1990s also forced many real estate mutual funds to suspend redemptions. The Financial Post (May 15, 1993) reports that four Canadian real-estate open-end funds suspended conversions (specifically, MD Realty Fund, the North American Real Fund, the Metfin Real Estate Growth Fund and the Counsel Real Estate Fund). According to this article, "... real estate funds liquidity becomes a real problem when the market turns south." Of these funds, the North American Real Fund recommended to its unitholders that the fund be converted to a closed-end fund. The trustees of the Metfin Real Estate Growth Fund also considered converting its fund into a closed-end fund.

During that period of time in Austalia, the proportion of real estate open-end funds to all funds was close to 15%. As a result, Australian securities authorities required investors to give up to one year's notice to redeem units in real estate open-end funds. Australia also required funds to keep a greater portion of their assets in a liquid form to facilitate redemptions.

In its description of the U.S. situation, the Wall Street Journal (September 13, 1990) stated:

> "most of the two dozen so-called open-end real estate pools have been flooded with demands from pension funds wanting their money back. The withdrawal requests have fed on themselves and now are approaching $2 billion."

The article described a typical bank run type of behaviour among the investors in real estate funds as follows:

> "... as pools often pay withdrawals on a first come, first served basis, other investors have rushed to join the exit line for fear of being left behind ... those pulling out first could get back more on their investments than those who stay in the pool ... those investors standing in line to withdraw are doing so simply because they saw the queue."

APPENDIX A3

The impact of the bid-ask bounce on performance measurement

Define r^*_{it} as the excess fundamental return of security i over the risk-free rate r_f; and r^*_{mt} as the excess fundamental return of the market m over the risk-free rate r_f. Then:

$$r^*_{it} = \frac{\Delta P^*_{it} + D_{it}}{P_{it-1}} - r_f \text{, and} \tag{A3.1}$$

$$r^*_{mt} = \frac{\Delta P^*_{mt} + D_{mt}}{P_{mt-1}} - r_f, \tag{A3.2}$$

where D_{it} and D_{mt} are the dividend paid by security i and the market m, respectively, at time t; and

ΔP^*_{it} and ΔP^*_{mt} are the fundamental price variations of security i and the market m, respectively, from $t\text{-}1$ to t.

Then the observed return of security i is given by:

$$r_{it} = \frac{\Delta P^*_{it} + (I_{it} - I_{it-1})\frac{S}{2} + D_{it}}{P^*_{it-1} + I_{t-1}\frac{S}{2}} - r_f, \tag{A3.3}$$

where the observed price variation is:

$$\Delta P_{it} = \Delta P^*_{it} + (I_{it} - I_{it-1})\frac{S}{2}. \tag{A3.4}$$

Let r^*_{NAVPSt} and r_{NAVPSt}, or the fundamental return and the observed return of the NAVPS, respectively, of closed-end fund k for period t be given by:

$$r^*_{NAVPSt} = \frac{\sum_{i=1}^{N} w_{it}(\Delta P^*_{it} + D_{it})}{\sum_{i=1}^{N} w_{i,t-1} P^*_{i,t-1}} - r_f \text{; and} \tag{A3.5}$$

$$r_{NAVPSt} = \frac{\sum_{i=1}^{N} w_{it}(\Delta P_{it}^{*} + D_{it} + \Delta I_{it}\frac{s_i}{2})}{\sum_{i=1}^{N} w_{i,t-1}(P_{i,t-1}^{*} + I_{i,t-1}\frac{s}{2})} - r_f . \tag{A3.6}$$

Further, assume that $r_{mt}^{*} = r_{mt}$.

The Jensen measure, α_k, which often is used to capture the abnormal performance of a security or a portfolio of securities such as closed-end fund *k*, is the intercept in the following equation:

$$E[k_k^{*}] = \alpha_k + \beta_{km}(E[r_m^{*}]). \tag{A3.7}$$

A3.1 UNBIASED ESTIMATOR OF BETA USING OLS

Proposition A3.1:

If the bid-ask bounce $(I_{kt} - I_{kt-1})(0.5\ s_k)$ for a closed-end fund share is independent of the market return r_{mt}, then $E(\hat{b}_{km}) = \beta_{km}$, where $\hat{b}_{km}$ is the regression coefficient between the returns on the market *m* and a share of the closed-end fund *k*. Specifically:

$$r_{kt} = \hat{\alpha}_{kt} + \hat{b}_{km} r_{mt} + e_{kt} \tag{A3.8}$$

Proof:

Since $(I_{kt} - I_{kt-1})(0.5\ s_k)$ is independent of the market return r_{mt}, then it is easy to show that: $Cov(r_k, r_m) = Cov(r_k^{*}, r_m)$. This implies that $E(\hat{b}_{km}) = \beta_{km}$. **QED**

Proposition A3.2:

If the bid-ask bounce $(I_{it} - I_{it-1})(0.5\ s_i)$ of each share *i* in the portfolio of assets under management by closed-end fund *k* is independent of the market return r_{mt}, then $E(\hat{b}_{NAVPSm}) = \beta_{NAVPSm}$, where $\hat{b}_{NAVPSm}$ is the regression coefficient of:

$$r_{NAVPSt}^{*} = \hat{\alpha}_{NAVPSt} + \hat{b}_{NAVPSm} r_{mt} + e_{NAVPSt} . \tag{A3.9}$$

Proof:

Since $(I_{it} - I_{it-1})(0.5\, s_i)$ is independent of the market return r_{mt} for each i, then it is easy to show that: $Cov(r^*_{NAVPS}, r_m) = Cov(r_{NAVPS}, r_m)$. This implies that $E(\hat{b}_{NAVPSm}) = \beta_{NAVPSm}$.

QED

A3.2 SYSTEMATIC BIAS ON THE INTERCEPT AND SPURIOUS VOLATILITY

The impact of the bid-ask bounce on the Jensen measures and associated t-ratios using closed-end fund price and NAVPS returns are estimated in this section. To do so, we obtain the following estimates of the bid-ask bounce components of the price return v_{kt} and of the NAVPS return v_{NAVPSt} for closed-end fund k:

$$\hat{v}_{kt} = \frac{(I_{kt} - I_{kt-1})\frac{s}{2}}{P^*_{kt-1} + I_{kt-1}\frac{s}{2}}, \text{ and} \tag{A3.10}$$

$$\hat{v}_{NAVPSt} = \frac{\sum_{i=1}^{N} w_{it} \Delta I_{it} \frac{s_i}{2}}{\sum_{i=1}^{N} w_{i,t-1}(P^*_{i,t-1} + I_{i,t-1}\frac{s}{2})}. \tag{A3.11}$$

Since $\hat{v}_{kt}$ and $\hat{v}_{NAVPSt}$ are independent of both r_{mt} and of the other components of r_{kt} and r_{NAVPSt} (no multicollinearity), equations (A3.8) and (A3.9) can be rewritten as follow:

$$r_{kt} = (\hat{\hat{\alpha}}_{kt} + E(\hat{v}_{kt})) + \hat{b}_{km} r_{mt} + (u_{kt} + v_{kt}), \text{ and} \tag{A3.12}$$

$$r_{NAVPSt} = (\hat{\hat{\alpha}}_{NAVPSt} + E(\hat{v}_{NAVPSt})) + \hat{b}_{NAVPSm} r_{mt} + (u_{NAVPSt} + v_{NAVPSt}) \tag{A3.13}$$

where:

$$\hat{\alpha}_{kt} = \hat{\hat{\alpha}}_{kt} + E(\hat{v}_{kt}), \tag{A3.14}$$

$$e_{kt} = u_{kt} + v_{kt}, \tag{A3.15}$$

$$\hat{\alpha}_{NAVPSt} = \hat{\hat{\alpha}}_{NAVPSt} + E(\hat{v}_{NAVPSt}), \tag{A3.16}$$

$$e_{NAVPSt} = u_{NAVPSt} + v_{NAVPSt}, \tag{A3.17}$$

$$v_{kt} = \hat{v}_{kt} - E(\hat{v}_{kt})\text{; and} \tag{A3.18}$$

$$v_{NAVPSt} = \hat{v}_{NAVPSt} - E(\hat{v}_{NAVPSt})\,. \tag{A3.19}$$

The $\hat{\hat{\alpha}}_{kt}$, $\hat{\hat{\alpha}}_{NAVPSk}$, u_{kt} and u_{NAVPSt} are estimates related to "fundamental variations". Terms v_{kt} and v_{NAVPSt} are additional sources of randomness in the error terms e_{kt} and e_{NAVPSt}, respectively, due to the bid-ask bounce. The expected values $E(\hat{v}_{kt})$ and $E(\hat{v}_{NAVPSt})$ are the systematic biases in the two types of returns caused by the bid-ask spread.

To estimate $E(v_k)$, assume that $P^*_{k,t-1} = 1$ and that the next trade has an equal chance to be at the bid or at the ask. Rearranging

$$E(v_k) = 0.5\left(\frac{0.5(-s)}{1+\frac{s}{2}}\right) + 0.5\left(\frac{0.5(s)}{1-\frac{s}{2}}\right) \tag{A3.20}$$

yields:

$$E(v_k) = \frac{1}{\frac{1}{\left(s/2\right)^2} - 1}\,. \tag{A3.21}$$

To estimate $E(v_{NAVPS})$ assume further that $P^*_{i,t-1} = P^*_{j,t-1} = 1$, $w_i = w_j$ and $s_i = s_j$ for all i, j, and that ΔI_{it} is independent of ΔI_{jt} for all i,j. Then:

$$E(v_{NAVPS}) = \frac{1}{\frac{1}{\left(s/2\right)^2} - 1}\,. \tag{A3.22}$$

This result is due to a negative price variation when the t-1 price is at the bid combined with a positive price variation when the t-1 price is at the ask. Since the weight of the negative price variation is lower than the positive price variation (since the bid price is higher than the ask price), the expected bid-ask bias must be positive. Specifically:

$$E(v_{NAVPS}) = E(v_k) = \frac{1}{\frac{1}{\left(s/2\right)^2} - 1} > 0. \quad \text{(A3.23)}$$

Define σ_{kv} and σ_{NAVPSv} as the variances of the closed-end fund price and NAVPS returns caused by the bid-ask bias. The relationship between σ_{kv} and σ_{NAVPSv} is given in proposition A3.3.

Proposition A3.3:

The variability in the error term for price returns σ_{kv}^2 is *n* times the variability in the error term for NAVPS returns σ_{NAVPSv}^2, where *n* is the number of securities in the portfolio under management by the closed-end fund. Specifically, each of these variances is given as:

$$\sigma_{kv}^2 = \left(\frac{1}{s/2} - \frac{s}{2}\right)^{-2}, \text{ and} \quad \text{(A3.24)}$$

$$\sigma_{NAVPSv}^2 = n\left(\frac{1}{s/2} - \frac{s}{2}\right)^{-2}. \quad \text{(A3.25)}$$

Proof:

The bid-ask bounce is expected to cause an upward bias in both the expected price and NAVPS returns of the closed-end fund. The variances of these biases differ, since that for the NAVPS returns decreases with an increasing *n*. If the random variables u_t and v_t are independent, then the total variance of the error term is: $\sigma_e = \sigma_u + \sigma_v$. Due to the portfolio effect, the component σ_{NAVPSu} decreases with increasing *n* for the NAVPS returns. **QED**

Discussion:

The portfolio effects on both σ_{NAVPSu} and σ_{NAVPSv} tend to increase the t ratio for the estimated intercept or Jensen measure, and the significance of any abnormal returns based on NAVPS returns. In contrast, the t ratio for the estimated intercept should be relatively lower for the price returns for the closed-end fund. Thus, the performance of the portfolio held by the closed-end fund is more likely to appear to be significant than the performance of the shares of the closed-end fund that is held by its investors.

APPENDIX A4

Capital raising game

This example is based on the setting of Heinkel (1982).[37] The sequence of play of the game is as follows. At the initial period, nature endows the market with initial wealth equal to one, consisting exclusively of a risk-free asset, and reveals type to the agent. The market does not know the agent's type. The entrepreneur *(E)* $t \in (1, \infty)$, where t can take an infinite number of values over that range, is endowed with a project that is worthless if he cannot trade for a risk-free asset with a value of at least one. The cost to transform this risk-free asset into a valuable project is equal to one. At this stage the market has prior beliefs $m(t)$ about type t. At the interim period, the market (*M*) opens to trade the one share of available equity held by the agent. Players can trade a fraction α of the share, and the risky bonds on the project of the agent. Each bond D has a nominal value of one, and total market value of B. Whenever the payoff is less than D, bondholders are paid the pro-rata liquidation value (x/D). The total supply of equity is one while the total supply of bonds is zero. At the final stage, the state of nature and the non-price information of the agent are revealed. Each player receives a payoff according to his or her final endowment of risky securities.

Project payouts $x=x(\theta,t)$, where θ is the state and t is the type, are as follows:

- 3(t+3) with probability $p=0.4$ if $\theta=1$, and
- $2(t+3)^{-1}$ with probability $(1-p)=0.6$ if $\theta=2$.

Given risky debt and equity, we now show that a fully revealing rational expectations equilibrium exists for this capital raising game. As is customarily done in the REE literature (see Grossman, 1981; Radner, 1979; and Allen, 1981), we find a price

[37] Also, see Brennan and Kraus (1987), Admati and Pfleiderer (1994), Nachman and Noe (1994) and Constantinides and Grundy (1989) for other applications of fully revealing equilibrium in a capital raising game context.

functional that is fully revealing by first assuming that our traders behave as if they are in a full information economy. That is, if a fully revealing price functional is to exist (i.e., a function that maps each equilibrium price to one and only one type) in an incomplete information economy, then this price functional must also exist in a full information economy. The reason is that the ending result of a price functional is to produce an economy where traders behave as if a full information economy prevails.

Assume that the agent's type is common knowledge at the initial stage. Since the agent must be a net seller of equity and bonds to get one risk-free asset, it follows that $D_E < 0$ and $\alpha_E < 1$. This implies by the market clearing conditions that $-D_E = D_M > 0$ and $\alpha_E = (1- \alpha_M) > 0$. Fixing $\alpha = \alpha_M = (1- \alpha_E)$ and $D = D_M = -D_E$, and using the expectation operator $E = E_\theta$ and the fact that the following equalities must hold in full information, we obtain:

$$E(x_\alpha) = E(x - \Sigma D_i x_D) = P_\alpha, \tag{A4.1}$$

with $P_\alpha \overline{\alpha}_E = V$ since $\overline{D}_E = 0$ and $\overline{\alpha}_E = 1$ at the initial stage; and

$$E(x_D) = P_D = B/D; \tag{A4.2}$$

where x_α is the expected payoff of equity, x_D is the expected payoff of debt, P_α is the price of equity, P_D is the price of debt, and V is the value of the project. For the non-autarkic case, utility functions of the entrepreneur and the market are respectively:[38]

$$U_E = (1-\alpha)(E(x)-DE(x_D)) - DE(x_D) + V - ((1-\alpha)(V-B)-B) - 1 = V-1$$

$$= (1-\alpha)(V-B). \tag{A4.3}$$

$$U_M = \alpha_M E(x-Dx_D) + DE(x_D) = \alpha(V-B) + B \tag{A4.4}$$

where $\alpha = \alpha(D(t))$, $D = D(t)$, and $B = B(t,D(t))$.

We characterize the optimal mix (α^*,D^*) for each t, with $D > 0$ and $\alpha > 0$, to avoid a corner solution or "lemons market". That is, we conjecture that a debt and equity mix

[38] The relation $\alpha_M P_\alpha + D_M P_D = 1 = \alpha(V-B)+B$ is used to obtain the last equality.

can complete the market and provide a full revelation of types. To do so, we take the total differential of U_M with respect to t and use the first-order condition of U_E. Thus, the *mix* $(\alpha^*(t),D^*(t))$ is an optimal point for each agent t which satisfies the "budget constraint" U_M, or:

$$\frac{dU_M}{dt}=\frac{d\alpha}{dD}\frac{\partial D}{\partial t}(V-B)+\alpha\frac{dV}{dt}-\alpha\frac{dB}{dt}-\alpha\frac{dB}{dD}\frac{\partial D}{\partial t}+\frac{dB}{dt}+\frac{dB}{dD}\frac{\partial D}{\partial t} \tag{A4.5}$$

Using the first-order condition of U_E which is:

$$\frac{dU_E}{dD}=-\frac{d\alpha}{dD}(V-B)-\frac{dB}{dD}(1-\alpha)=0, \tag{A4.6}$$

yields the following expression:

$$\alpha^*(t)=-\frac{dB/dt}{dV/dt-dB/dt}\ . \tag{A4.7}$$

For our example, we obtain the following demand functions:

$$\alpha^*(t)=\frac{1}{(t+3)^2}\ ,\ D^*(t)=\frac{1-\dfrac{2.4}{(t+3)}}{0.4-\dfrac{0.4}{(t+3)^2}}, \tag{A4.8}$$

where $D^*(t)$ is obtained by using $U_M=1$ and $\alpha^*(t)$. Using the fact that $B(t)=0.4D+1.2(t+3)^{-1}$, gives:

$$B^*(t)=\frac{\dfrac{-1.2}{(t+3)^3}+1-\dfrac{1.2}{(t+3)}}{1-\dfrac{1}{(t+3)^2}}. \tag{A4.9}$$

The price functional in this full information setup is:

$$P^*(t) = \begin{pmatrix} P_\alpha \\ P_D \end{pmatrix} = \begin{pmatrix} \dfrac{1.2(t+3) - 1 + \dfrac{1.2}{(t+3)}}{1 - \dfrac{1}{(t+3)^2}} \\ \\ \dfrac{\dfrac{-1.2}{(t+3)^3} + 1 - \dfrac{1.2}{(t+3)}}{2.5 - \dfrac{6}{(t+3)}} \end{pmatrix} \qquad \text{(A4.10)}$$

where $P_\alpha(t) = V - B$ and $P_D(t) = B/D$.

The values (α^*, D^*, P^*) satisfy a fully revealing rational expectation equilibrium since:

i) The utility of the market is maximized since it holds strictly for each $t \in T$;

ii) It can be shown, with tedious calculation, that the second-order condition holds for each t; and

iii) Markets clear by construction since $1 - \alpha_M = \alpha_E$ and $(1-\alpha)(-D) + \alpha(-D) = 0$.

This equilibrium is fully revealing since P_α is strictly increasing in t and $\alpha(t) \neq \alpha(t')$ for all $t, t' \in T$ with $\alpha^*(t)$ being strictly decreasing in t.

The market mechanism can be described as follow. In the first round, agent t offers to sell equity and debt at a price vector $P(t')$. Since $P^*(t)$ is invertible,[39] the market selects to buy quantity $(\alpha(t'),D(t'))$ which satisfies its budget constraint for the given type t'. But if $t' \neq t$, then $(\alpha(t'),D(t'))$ will not maximize the value of the utility of the agent which can only be, at most, the full information value in a fully revealing REE. Other rounds follow until $(P^*(t),(\alpha^*(t),D^*(t))$ is reached. This is clearly preferred to the autarkic solution since $V(t)-1 > 0$ for all t by assumption.

[39] $t' = P^{*-1}(P(t'))$, and t' must be the unique solution to both $P_\alpha^{*-1}(P_\alpha(t'))$ and $P_D^{*-1}(P_D(t'))$. Otherwise, the market must conclude that the declared type does not satisfy its "rational expectation budget constraint", and that it cannot belong to T.

Table A4.1 shows the utility of the agent for some selected types, net of his full information value, for each type he pretends to be. Clearly, in our fully revealing REE, agent t does not gain from mimicking other types $t \neq t'$. Given our specific payout structure, debt and equity reveal information.[40] In other words, mix (α, D) and density function f are compatible.

The intuition behind our results is simple. Since dispersion increases with t, principals obtain the nominal values for all t in the good states, and the liquidation value decreases with t in the bad state. Thus, high t cannot obtain as high a market value for a bond with nominal value equal to one as long as the bond issue is sufficiently large so that the agent can default.[41] Low types would like to replicate the high types for equity since to get $I^*=1$, the low type must only exchange a low equity share α. Similarly, the high types would like to replicate the low types for bonds so that a relatively low level of bonds is required to get one risk-free asset. The market accounts for such incentives and is only willing to accept vector P^* which gives a relatively high price to debt or equity but never to both securities. Thus, if a low type mimics a high type, he does not capture his comparative advantage which is to issue high D and low α. A high D allows the low type to get $I^*=1$ at a lower expected payout to principals than a high α. For each vector $P(t')$ offered by an agent, rational principals then select a mix that prohibits the former from behaving untruthfully.

In this setting, using debt and equity, Heinkel (1982) concludes that $\frac{dV}{dt} < 0$, $\frac{dB}{dt} > 0$, and $\frac{d^2D}{dtdB} \geq 0$ are necessary conditions for a costless signaling equilibrium to

[40] An example, where $p=0.4$, $x(\theta=1)=3t$, $1-p=0.6$, and $x(\theta=2)=(0.1)t-(0.07)t^2$, yields a minimum since the market curve is concave and the curves of the individual entrepreneur are convex.

[41] Our debt is always risky in the admissible range $t \in (1,\infty)$ since $D^*(1)>0.5$. As $D(t)$ is strictly increasing in t and the low state payoff is strictly decreasing in t, we have for $t\rightarrow\infty$, $x(t,\theta=2)\rightarrow 0$ and $D(t)\rightarrow 2.5$.

exist. Our example shows that this is not so, as both V and B increase with t in table A4.2. The use of price for each type of risky security is critical to our results, and the total value of issued bonds is not relevant. In our example, prices of individual equity and debt securities evolve in different ways so that the market can set mixes that prevent replicating strategies.

This revelation of types is not due to the issue of incorrectly valued debt and (under)overvalued equity, since both debt and equity are issued at their fair market values. For every mix (α^*, D^*), prices reflect the full information value of risky securities given the number of bonds issued. The specific pattern of the payoff structure combined with the appropriate issuance of securities (herein debt and equity) allows price to be fully revealing, and financing I^* to be granted as if a full information economy or full communication equilibrium prevails.

Table A4.1: Utility of the agent net of the full information value

Entrepreneur type is given by t. Price vector is P(t').

		$t'=P^{*-1}(P(t'))$ for $t' \in (1,2,3,4)$			
		1	**2**	**3**	**4**
Type t	**1**	0	-0.01199	-0.03333	-0.05510
	2	-0.01499	0	-0.00066	-0.01951
	3	-0.04999	-0.00799	0	-0.00408
	4	-0.09634	-0.02737	-0.00472	0

Table A4.2: Various equilibrium values when true type is revealed with appropriate mix of debt and equity

Entrepreneur's type is given by t. Term D^* is the number of issued bond with nominal value of one while B^* is the total market value of bonds issued. Term α^* is the fraction of the entrepreneur's project held by the market. Price of each equity share issued and each bond issued is given respectively by P^*_α and P^*_D. Total value of the project is V(t), utility of the entrepreneur is $U^*_E(U^F)$, and utility of the market is U^*_M.

t	$V(t)$	$U^*_E(U^F)$	α^*	D^*	P^*_α	P^*_D	U^*_M	B^*
1	5.1	4.1	1/16	1.066	4.373	0.681	1	0.7266
2	6.24	5.24	1/25	1.354	5.458	0.577	1	0.7816
3	7.4	6.4	1/36	1.542	6.582	0.529	1	0.8171
4	8.57	7.57	1/49	1.677	7.729	0.502	1	0.8422