Closed-End Funds: A Survey

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Table of Contents

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This survey reviews the evolving literature on closed-end fund discounts. Many studies have attempted to explain the existence and the behavior of the discount to net asset value, emphasizing biases in the calculation of NAV, agency costs, tax-timing options and market segmentation. None has been able to provide a full explanation. As a result, some researchers have found it necessary to resort to models of limited rationality. This gives rise to potential opportunities for exploiting the discount. We summarize the findings from some 70 studies of closed-end funds, and present directions for future research.

1. Introduction

Closed-end funds are companies whose operations are similar to those of any business corporation. They differ only because their corporate business consists largely of investing funds in the securities of other corporations and managing these investment holdings for income and profit. An important characteristic that makes closed-end funds unique is that they provide contemporaneous and observable market-based rates of return for both stocks and underlying asset portfolios.[1] Closed-end funds are so-called because their capitalization is fixed, or "closed", which implies that the supply of closed-end fund shares is inelastic. Thus, the price is a function of the supply and

demand for the shares trading on the market and has only an indirect link with the value of the assets corresponding to each share.[2]

Closed-end funds are characterised by one of the most puzzling anomalies in finance: the closed-end fund discount. Shares in American funds are issued at a premium to net asset value (NAV)[3] of up to 10 percent, while British funds are issued at a premium amounting to at least 5 percent. This premium represents the underwriting fees and start-up costs associated with the flotation. Subsequently, within a matter of months, the shares trade at a discount[4], which persists and fluctuates according to a mean-reverting pattern. Upon termination (liquidation or "open-ending") of the fund, share price rises and discounts disappear (Brauer (1984), Brickley and Schallheim (1985)).

The flotation and subsequent behavior of closed-end fund shares therefore represents a challenge to the hypothesis that investors behave rationally and markets function efficiently. Closed-end funds provide apparent evidence of market inefficiency, violations of standard asset pricing models, and exceptions to such fundamental principles of corporate finance as the Law of the Conservation of Value or the Modigliani-Miller propositions.[5] It is no surprise that closed-end funds have attracted the attention of leading scholars in finance.

Several theories of the pricing of closed-end funds attempt to make sense of the discount within a rational expectations framework, but none can account fully for the aforementioned peculiarities. The assertion that NAVs are incorrectly calculated (as a result of tax liabilities relating to unrealized capital gains or holdings of illiquid stocks) cannot explain the price rise at open-ending. Similarly, agency costs, such as managerial underperformance and the present value of management fees, cannot account for fluctuations in the discount. Additionally, studies have shown that discount based trading strategies can prove profitable when high discount shares are bought and low discount shares are sold short (Thompson (1978), Pontiff (1995)).

A theory that encompasses some aspects of the puzzle is the limited rationality model of Lee, Shleifer and Thaler (1991). The irrationality of individual investors, the most prominent holders of closed-end fund shares in the US, places an additional risk on the assets they trade. The misperceptions of these investors translate into optimistic or pessimistic overreactions. Furthermore, there is evidence that discounts are correlated with the prices of other securities (such as small stocks), which are affected by the same investor sentiment. However, the limited rationality theory is inconsistent with empirical evidence on the UK closed-end fund market, since the latter is largely dominated by institutional owners.[6]

This paper reviews the theories and evidence on the behavior of the discount on closed-end funds. In the following section, we start by providing an overview of the closed-end fund industry. In section 3 we look at economic explanations for the discount, while in section 4 we consider the behavioral explanations. In section 5 we examine the opportunities for exploiting the discount. Section 6 concludes.

2. The Industry

Since the launch of the first closed-end fund by Foreign & Colonial in 1868, a company listed on the London Stock Exchange, the British closed-end fund industry has grown considerably. Over the following century, the industry evolved as a provider of professionally managed portfolios, aimed primarily at the individual investor. By the 1980s and 1990s, however, closed-end funds emphasized raising capital for investment in specialised areas or for special purposes, rather than for traditional, internationally diversified funds. At the time of writing, there are over 360 funds listed on the London Stock Exchange, with a total market capitalization of nearly $80 billion[7]. The total market capitalization of UK open-end funds is approximately $310 billion (AUTIF (1998)). British closed-end funds therefore have a market capitalization that is approximately 25 percent of the capitalization of open-end funds.

The assets of UK closed-end funds are invested only in stocks. In contrast, in the US there are two main types of closed-end funds, stock and bond funds. Of the total $149 billion invested in the closed-end fund industry at the end of 1997, $51 billion is invested in equity funds. The 133 equity funds invest more than 40 percent of their assets in US (Investment Company Institute (1998). The aggregate market value of US closed-end funds corresponds to under 3 percent of the value of US open-end funds. The categories of funds are described in Table 1.

INSERT TABLE 1

2.1. Regulatory Environment

This section describes the structure and regulatory environment of the closed-end fund industry and draws a comparison between the US and the UK.

2.1.1. Capital Structure

Closed-end funds issue a wide variety of financial instruments, and closed-end fund managers frequently devise new ways of providing investment exposure. Different classes of investment are now available: in the UK, these include ordinary shares, highly leveraged shares (common stock in a company with a wind-up date, designed to give stockholders a highly leveraged return both in terms of capital and income), income shares (securities that are entitled to the surplus income after expenses and after the income requirement of any prior charge has been met), capital shares

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(securities that are entitled to the surplus assets on wind-up, after repayment of other share classes), zero dividend preference shares (securities that have a predetermined rate of capital growth), stepped preference shares (securities with a predetermined growth in both income and capital), warrants and convertibles.

Whereas only few US closed-end funds take on any leverage[8], British closed-end funds make use of leverage through their own capital structures. This increases the underlying holdings of a closed-end fund. However, the risk of highly leveraged shares is larger as borrowing boosts NAVs in rising markets but depresses them when markets fall. To protect the interests of shareholders there are restrictions on the amount of capital that a company may borrow, but the majority of funds operate with low levels of leverage and the limits in leverage have rarely been reached.

Split-capital funds are effectively a way of introducing an element of leverage without borrowing any money. In the US, split capital funds are referred to as dual purpose funds. These funds are capitalized with two types of claims, preferred and capital shares, and have a fixed expiration date. Preferred shares receive all dividend and interest income as it accrues from the underlying portfolio of the fund, and have a predetermined redemption price when the fund terminates. Capital shares are entitled to the capital gains that the entire portfolio generates.[9] Dual purpose funds issue equal amounts of common and preferred shares, implying an initial leverage of 2 to 1.

Upon termination, income shareholders receive the minimum of either their stated redemption price or the value of the remaining assets of the fund. Capital shareholders then have a residual claim on the terminal value of the fund's portfolio. At the wind-up date one of two things usually happens. Either the fund is liquidated and each shareholder receives his portion of the assets, or at the election of common shareholders, the fund can be converted into an open-end operation, continuing as an investment company.

2.1.2. Taxation

Under the US tax system, closed-end funds are required to distribute to shareholders 90 percent of realized capital gains in a given year to qualify for exclusion from corporation tax. Closed-end funds distribute two types of dividends - the income dividend and the capital gains dividend. Shareholders are taxed according to the type of dividend received; the income dividend is taxed as ordinary income and the capital gains dividend is taxed at the capital gains rate.[10] Federal regulations require closed-end funds that elect to retain their beneficial tax status to return all dividend income to shareholders every year.[11] Closed-end funds typically pay dividends quarterly or semi-annually.

In contrast, UK closed-end funds are not allowed to distribute capital gains, but must retain them for reinvestment. Capital gains tax on closed-end funds was reduced to 10

percent in 1977 and removed completely in 1980. Therefore, closed-end fund managers can turn over their portfolios without incurring any capital gains tax liability. UK closed-end funds cannot retain more than 15 percent of dividends received.[12] If the dividend they can distribute to their shareholders is lower than the desired level, they are prevented from selling part of their holdings to boost the dividend payout.

2.1.3. Ownership

Whereas American closed-end funds are typically a retail product, there is a high level of institutional ownership in the UK. Two-thirds of the shares in British closed-end funds are on average held by institutions, and for many funds the institutional proportion is much higher than this (Crédit Lyonnais Laing (1998)).

2.2. The Discount

One important characteristic that sets closed-end funds apart from other collective investment schemes is the mismatch between the funds' share prices and the value of their underlying investments. The funds trade at a discount or premium to NAV. Investors therefore have two ways of making (or losing) money: from any rise or fall in the value of the underlying investments, and from any narrowing or widening of the discount.

The history of the closed-end fund discount and premium mirrors the popularity of these funds. In the 1960s, the average discount had fluctuated at around 10 percent.

However, by the middle of the 1970s, private as well as institutional investors lost interest in such funds and the average discount widened in the UK to nearly 50 percent. The bull market of the 1980s and the introduction of new investment objectives, capital structures and tax-efficient wrappers renewed interest in closed-end funds. By the early 1990s, the average discount had narrowed, though the trend seems to have reversed somewhat in more recent years, as may be seen in the upper panel of Figure 1.

The behaviour of US equity domestic funds resembles very much the pattern described for the UK market. During the 1970s US funds traded, on average, at a discount larger than 20 percent. Successively, the discount gradually narrowed and, as may be seen in the lower panel of Figure 1, these funds now trade at around a 5 percent average discount.[13] The focus of much of the academic research on closed-end funds has been on explaining the discount. We review this literature in the next two sections.

INSERT FIGURE 1

3. Economic Explanations for the Discount

Several standard theories of the pricing of closed-end funds attempt to explain the discount within the framework provided by the efficient market hypothesis. The

most obvious approach is to ask whether the discount is really there, or whether the NAV is simply miscalculated. As discussed below (in section 3.1), most researchers conclude that the discount cannot be explained away by biases in the calculation of fund NAVs.

We therefore turn (in section 3.2) to explanations based on agency costs. These explanations typically assert that the discount reflects the present value of management fees in excess of the value of services rendered, either before or after taking account of managerial performance. Our review shows that none of these hypotheses, even when considered together, can account for all parts of the closed-end fund puzzle.

The tax-timing hypothesis, discussed in section 3.3, attempts to explain the existence of discounts based on the argument that, by holding shares of a closed-end fund, investors lose valuable tax-trading opportunities associated with the idiosyncratic movements of the individual security prices in the portfolio. Nevertheless, there is evidence that only a small proportion of investors trade to reduce their tax payments, and the large majority buy and hold stocks for the longer term.

Section 3.4 presents some additional explanations for the discount, emphasising the impact of market segmentation. By providing a means of overcoming home-country

bias, closed-end funds may provide domestic investors with exposure to markets whose equity returns are determined by a different national group of investors. Moreover, funds may be priced at a level that reflects private investors' responses to the manager's sales effort, or the different valuations of institutions as compared to individuals. Table 2 provides an overview of the explanations that are discussed in this section.

INSERT TABLE 2

3.1. Biases in NAV

Explanations of the discount, consistent with a broad notion of market efficiency, emphasise the possibility that NAVs may be overestimated. Tax liabilities relating to unrealized capital gains and illiquid assets are considered as possible causes of this miscalculation. Another possibility is bias in the NAV arising from differences in liquidity between the underlying portfolio constituents and the shares of the fund. This series of explanations is neither consistent with the existence of premiums to NAV nor with the empirical regularity of price rises at "open-ending"[14]. Nevertheless, the dominant puzzle in the literature is the discount, so we first ask whether or not it is really there.

3.1.1. Tax liabilities

As noted earlier, in the US closed-end funds must distribute 90 percent of realized gains to qualify for exclusion from corporation tax, and shareholders receive two streams of dividends: the income dividend and the capital gains dividend. If a closed-end fund is characterised by large unrealized capital gains, this implies that shareholders will be liable for capital gains taxes and the theory suggests that this might explain part (or all) of the discount on closed-end funds. However, Malkiel (1977) finds, under fairly generous assumptions, that tax liabilities can account for a discount of no more than 6 percent, whereas the average discount of domestic equity funds in the US has in recent years been almost 10 percent.

Additionally, British closed-end funds are not allowed to distribute any capital gains and the shareholders are not liable to any capital gains tax unless they sell their holdings in the fund. Yet UK funds behave remarkably like their US counterparts, suggesting that the discount cannot be explained by tax factors that are specific to a single country. Furthermore, the tax liabilities theory implies that, upon open-ending, NAV should decrease. Lee, Shleifer and Thaler (1990) show the opposite - upon liquidation prices rise to the NAV.

Fredman and Scott (1991) argue that discounts may partially be caused by capital gains liabilities and suggest that if portfolio performance has been good and capital

gains liabilities are large, then discounts follow suit. However, Pontiff (1995) provides evidence that past NAV returns, net of the market return, are more strongly related to current discounts than simple NAV returns, which is inconsistent with our capital gains arguments since capital gains are computed using unadjusted returns.

The theory of capital gains tax liabilities predicts that when stocks do well, closed-end funds should accrue unrealized capital gains; and, provided turnover rates on fund assets are constant, the discount should in general widen. However, Lee, Shleifer and Thaler (1991) find that the correlation between returns on the market and changes in discounts is about zero.

3.1.2. Liquidity

Bookkeeping procedures can potentially lead to a fund manager either under- or overestimating the fund's NAV. Reporting restricted shares[15] at the same price as publicly traded common stocks can overstate the NAV. Malkiel (1977) finds, over the period 1969-74, a significant relationship between the discount and the variable measuring the proportion of the portfolio in restricted stock. However, Lee, Shleifer and Thaler (1990) show that restricted holdings cannot explain much of the closed-end fund puzzle, as most funds are barely exposed to such illiquid securities, yet they still sell at a discount. More importantly, if restricted stocks were overvalued, the NAV

should drop down upon open-ending to the fund's price. Instead, as previously mentioned, the evidence shows that the share price in fact rises.

Seltzer (1989) argues that discounts can be accounted for by the mispricing of illiquid securities in the portfolio. He suggests that these securities are likely to be overvalued because of the difficulty of determining their fair market value. The importance of liquidity in terms of explaining stock returns is demonstrated by Datar, Naik and Radcliffe (1998). The liquidity argument is a possible explanation for the discount. However, investors might be willing to pay higher management fees for holding the liquid shares of closed-end funds that invest in less liquid securities, such as small capitalization stocks. Therefore, the importance of illiquid assets is difficult to measure.

Closed-end funds hold diversified portfolios of stocks and report the market values of their underlying assets weekly. Consequently, the little uncertainty about their current liquidation values should not generate an adverse selection component in fund bid-ask spreads. However, Neal and Wheatley (1998) find that estimates of the adverse selection component of a firm's bid-ask spread are large and significant for both closed-end funds and a matched sample of common stocks. The evidence suggests that either adverse selection arises primarily from factors other than current liquidation values, or the empirical models are misspecified.

3.2. Agency Costs

Agency costs are a possible explanation of the closed-end fund discount if fees and expenses are considered too high or if future portfolio management is expected to be below par. From this point of view, the discount reflects excessive management fees and/or inadequate management performance. There are, however, several problems with this approach. Positive agency costs imply that funds should never be issued at a premium as long as equivalent no-load open-end funds, charging comparable fees, exist. Furthermore, agency costs neither account for the wide cross-sectional and periodic fluctuations in the discounts, nor for why some closed-end funds trade at a premium. An additional drawback of this approach is that it cannot explain why rational investors buy into closed-end funds that are issued at a premium, since they are aware of the likelihood of the fund subsequently trading at a discount.

3.2.1. Management fees

The simplest interpretation of the agency approach predates Jensen and Meckling's (1976) seminal paper on agency theory, and focuses on management fees and other expenditures as a deadweight cost imposed on shareholders of a closed-end fund. The discount on closed-end funds is thus a consequence of investors anticipating possible managerial dissipation and capitalizing future management fees. However, Malkiel (1977) finds no correlation between US discounts and management expenses as a proportion of NAV.

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Turnover is also suggested as a possible explanation for the discount, since some closed-end fund managers execute a large volume of discretionary transactions. Yet Malkiel (1977) finds no correlation between discounts and turnover. Furthermore, the theory predicts that when long term interest rates fall, the present value of future management fees should rise and discounts increase. Lee, Shleifer and Thaler (1991), however, show that changes in discounts are not correlated with unanticipated shifts in the term structure of interest rates.

Ammer (1990) shows, with both a simplified static and dynamic version of an arbitrage based framework, that expenses and yields account for a level of the discount that is typical of UK closed-end funds. However, this framework fails to explain most of the time-series, cross-sectional, and international variations in discount. Kumar and Noronha (1992) re-examine the role of expenses by developing a present value model that emphasises expenses relative to dividend income. Using a larger sample and their alternative specification of the expense variable, Kumar and Noronha find that discounts are related to expenses.

3.2.2. *Managerial performance*

Many funds experience costs that are larger than the value of the investment managers' expertise. The shares of such funds should sell at a discount or earn an abnormally

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low return on investment. This we term the performance theory of closed-end fund discounts. Thompson (1978) does not support this hypothesis. He observes that over long time periods many funds sell at a discount and simultaneously earn, on a before-tax basis, greater rates of return than can be justified by the two-parameter CAPM. Similarly, Malkiel (1977) finds no significant relationship between future fund performance and discount levels. Roenfeldt and Tuttle's (1973) marginal support for a contemporaneous relationship is anomalous, but it relates to a very small sample.

Assuming rational expectations, the performance theory predicts that large discounts reflect poor future NAV performance. However, Lee, Shleifer and Thaler (1990) do not support this hypothesis. They find that assets of funds trading at large discounts tend to outperform those with smaller discounts. Furthermore, Pontiff (1995) shows that the ability to predict future discounts based on current discounts is almost entirely attributable to the ability to forecast stock returns as opposed to NAV returns. But Chay (1992), calculating managerial performance net of expenses charged by managers, shows that funds selling at a discount underperform funds selling at a premium. Thus, his findings tend to support the hypothesis that discounts reflect market expectations of fund manager future performance. Using a more sophisticated definition of managerial performance that adjusts for the fund's effective asset exposure, however, Dimson and Minio-Kozerski (1998) show that discounts do not anticipate future managerial performance.

Deaves and Krinsky (1994) suggest a possible reconciliation of the conflicting findings on closed-end funds. They investigate the puzzling evidence that managerial contribution and discounts are not negatively related. They show that it is possible to explain some of the findings without abandoning market efficiency. The model has its foundations in the principle of rationality amongst investors and shows that it is not necessary for the relationship between managerial contribution (which is simply the difference between managerial performance and managerial fees) and discounts to be monotone. They argue that it is possible to imagine that, as managerial contribution declines, the discount narrows if investors attach an increased probability to open-ending, which by definition moves the price towards the NAV.

3.2.3. Agency problems

Agency theory focuses on the relationship between the principal (the shareholder of the fund) and the agent (the manager). Agency problems emerge when conflicts of interests between agents and principals affect the operations of the company.

Draper (1989) investigates the UK fund management market and observes that UK closed-end funds are rarely managed 'in-house' but rather contract out their management to groups of specialists. These potentially lucrative contracts act as an incentive to managers to impede shareholder asset realisation, as a result of open-

ending. Consequently, shareholders may be forced to bear substantial costs because of the difficulty of displacing management and liquidating their holdings. To some extent, US evidence supports this hypothesis (see Thompson (1978), Brauer (1984) and Barclay, Holderness and Pontiff (1993)). The very low levels of liquidation and open-ending costs revealed over the period spanned by Draper's study suggest that far more British funds could profitably have been liquidated with beneficial effects for the shareholders of the fund. Intriguingly, he also shows that closed-end fund managers receive considerably higher fees on open-ending, and consequently it could be in their interest to open-end.

Additional evidence supporting agency problems is suggested by Barclay, Holderness and Pontiff (1993). They find that there is a stable and significant cross-sectional relationship between discounts and the concentration of ownership. The greater the managerial stock ownership in the closed-end fund, the larger the discounts to NAV. The average discount for funds with blockholders is 14 percent, whereas the average discount for funds without blockholders is only 4 percent. The idea is that blockholders receive private benefits that do not accrue to other shareholders and, therefore, tend to preserve these benefits by vetoing open-ending proposals.

The literature advances two competing hypothesis about the relationship between managerial stock ownership and firm value: the convergence-of-interest and the

entrenchment hypothesis. The results for closed-end fund companies are consistent with the entrenchment hypothesis. That is, when managers have effective voting control of the corporation, they are able to consume private benefits with little fear of a hostile control contest. The prediction is that as management holding increases, firm value will decrease. In contrast, the convergence-of-interest theory predicts that as management holdings increase, managers bear a larger fraction of the costs associated with non-value-maximizing behavior and thus are less likely to engage in such behavior. Consequently, firm value will increase. Empirical studies attempting to distinguish between these two competing hypothesis have produced mixed results (see Morck, Shleifer and Vishny (1988), McConnell and Servaes (1990)).

3.3. Tax Timing

A number of papers have attempted to justify the discount of closed-end funds by the effect of the tax liabilities associated with unrealized capital gains. However, tax legislation may have an additional implication based on investors' opportunity to control their tax exposure through careful timing of stock exchange transactions. Constantinides (1983, 1984) investigates the influence of taxes on security returns. The ownership of individual common stocks confers upon the investor a timing option, as taxes on capital gains and losses are levied based on realisation and not accrual. He argues that the optimal tax-timing strategy is to realize capital losses immediately and defer capital gains until a forced liquidation. Constantinides also shows that, compared with a suboptimal policy of never voluntarily realising capital

losses, the optimal tax-trading strategy would generate a tax-timing option value that constitutes 3 to 19 percent of the position in the stock.

Constantinides' results can be relevant for solving the discount anomaly if we consider Merton's (1973) option pricing theorem which states that for all options, including tax-timing options, a portfolio of options is more valuable than an option on the corresponding portfolio. Managed funds deny taxable investors the tax-timing option available from holding the underlying securities that comprise their portfolios. When the structure of the fund is closed-ended, and the marginal investors are in a tax-paying position, it follows that the fund should sell for less than its NAV.

3.3.1. Models

Brickley, Manaster and Schallheim (1991) and Kim (1994) suggest an explanation of the discount on closed-end funds based on the above mentioned papers. Both find evidence consistent with the hypothesis that the closed-end fund discount is partly driven by the fact that, as a result of holding shares in a closed-end fund, investors lose valuable tax-trading opportunities associated with the idiosyncratic movements of the individual portfolio constituents. Brickley, Manaster and Schallheim show that, cross-sectionally, discounts are positively correlated with the average variance of the constituent assets in the fund, and that in time-series the value of the discounts varies countercyclically[16].

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Kim (1994) uses the state-preference framework to develop a one-period 'horizon' model for discounts on closed-end funds. The model predicts that high correlations among assets will result in low discounts[17] and that funds with more volatile securities will show greater discounts than funds with less volatile securities in their portfolios[18]. Kim's evidence is broadly supportive of his model.

The strategy of deferring taxable capital gains provides the highest after-tax returns for both closed-end and open-end funds in the US, since the tax law affect each identically. Yet open-end funds regularly distribute a large fraction of their total returns to investors as taxable capital gains. Barclay, Pearson and Weisbach (1998) develop a model in which unrealized capital gains in the fund's portfolio increase expected future taxable distributions, and thus increase new investors' tax liabilities. Thus, even though existing shareholders would prefer capital gains to be deferred as much as possible, mutual fund managers have an incentive to reduce the overhung of unrealized gains to attract new investors.

3.3.2. Empirical evidence

Evidence from the US closed-end fund market tend to support the tax-timing option argument. The 1986 Tax Reform Act eliminated the favourable tax treatment on capital gains by making capital gains income taxable as ordinary income and made the

long- and short-term capital gains tax rates equal. The end of the 'restart option'[19] implied that the tax law became less disadvantageous to closed-end funds. Consistent with this prediction, the number of closed-end funds increased dramatically after 1986.[20]

However, De Long, Bradford and Shleifer (1992) show that the discount on US closed-end funds progressively widened between 1985 and 1990. The UK closed-end fund market does not provide much stronger evidence supporting the tax-timing argument. The 'restart option' was effectively eliminated in 1985[21] and the average discount progressively narrowed from 20 percent in 1985 to 5 percent in 1990. But the lack of statistical tests, and the dramatic increase of the discount thereafter, suggest that the tax-timing argument cannot explain, alone, the closed-end fund anomaly.

Seyhun and Skinner (1994) show the relevance of the tax-timing option in terms of the extent to which investors' transactions are motivated by tax code incentives. The results tend to indicate that investors' trades are consistent with simple tax-reduction strategies such as realising losses short term and deferring gains, but not with the restart option suggested by Constantinides. Seyhun and Skinner estimate that in a given year only a small fraction (5 to 7 percent) of investors trade to reduce their tax payments and that the large majority (90 percent) buy and hold stocks. Overall, their results show that taxes are important to investors, but not to the extent that they

3

continually adjust their portfolios to minimise the present value of their net tax payments. This also serves to cast doubt on the potential importance of tax-timing as an explanation of the discount.

The tax-timing hypothesis, as formulated in the published literature, cannot account for funds selling at a premium. However, the introduction of more complicated capital structures, such as zero-dividend securities which generate a tax-free capital gains, and income-producing securities that can be held by UK investors free of income tax within a tax-efficient wrapper, is particularly interesting. These tax-driven capital structures provide investors with tax-timing opportunities that are not available from holding the underlying constituents of the fund. These developments allow the tax-timing argument to be consistent with premiums as well as discounts to NAV. Finally, note that tax-timing explanations of the discount are not mutually exclusive with other explanations, and multiple factors may contribute to the discount.

3.4. Market Segmentation

A further group of explanations for the closed-end fund discount focus on various forms of market segmentation. One form of segmentation arises internationally, and the evidence on home bias in investors' portfolios (eg, Cooper and Kaplanis (1994)) suggests the existence of costs that are experienced when domestic investors diversify into foreign markets. These costs are likely to be high when investors diversify out of an established domestic market, such as the US, into under-researched, less well

regulated and inaccessible foreign markets. The growth of emerging market funds is indicative of segmentation between the US and emerging foreign markets. Holdings of foreign stocks may therefore help explain the existence of premiums and discounts.

As Huberman (1998) demonstrates, markets may also be segmented domestically. Several articles draw a distinction between different investor groups, usually institutions and private individuals. The time series behavior of the discount then reflects the responsiveness of each group to factors such as the sales effort of IPO promoters, or the relative market power of institutional investors.

In this section, we document the extent to which both international and local market segmentation provide interesting implications. As we shall see, however, these approaches are unable to resolve the puzzle of the discount.

3.4.1. *International market segmentation*

Some closed-end funds, referred to as country funds, invest exclusively in foreign securities. The existence of restrictions on direct foreign investment is suggested as a possible explanation for their trading, at certain times, at a premium. Bonser-Neal, Brauer, Neal and Wheatley (1990) test whether a relationship exists between announcements of changes in investment restrictions and changes in the ratio of price to NAV. Using weekly data from 1981 to 1989, they find that four out of five

country funds experience a significant decrease in the ratios following the announcement of a liberalisation of investment restrictions. However, German and Spanish funds, which invest in completely open markets, have sold at large premiums in the 1980s, sometimes at prices above 200 percent of NAV (see Hardouvelis, La Porta and Wizman (1994)). Furthermore, Malkiel (1977) finds no significant relationship between discounts and holdings of foreign stocks.

A second factor that might explain premiums and discounts on country funds is the extent of 'integration' between country funds and the market where they are traded. Chang, Eun, and Kolodny (1995) investigate the potential for closed-end country funds to provide international diversification. They show that funds exhibit significant exposure to the US market and behave more like US securities than do their underlying assets. This evidence supports Bailey and Lim's (1992) finding that these funds are poor substitutes for direct holdings of foreign securities. Bodurtha, Kim and Lee (1993) also show that returns on country funds are more correlated with US market returns than the underlying indices. However, Chang, Eun and Kolodny argue that closed-end country funds provide US investors with substantial diversification benefits. In particular, emerging markets country funds such as Brazil, Mexico, and Taiwan are shown to play a unique role in expanding the investment opportunity set.

3.4.2. *Local market segmentation*

Pratt (1966) and Malkiel and Firstenberg (1978) suggest that closed-end investment companies, when compared to open-end funds, sell at a discount primarily because of a lack of sales effort and public understanding. Malkiel (1977) and Anderson (1984) support this hypothesis and argue that brokers prefer to sell securities other than closed-end fund shares because of lower commissions on the latter[22]. Furthermore, Anderson (1984) shows that after the reduction of commission levels in 1975, which in all probability reduced sales efforts, US discounts increased.

A related explanation is the over-supply argument suggested by Arnaud (1983). He, together with a variety of subsequent writers, argues that the UK closed-end fund market is segmented and dominated by institutions that distort the prices[23]. The idea is that, consistent with the empirical evidence of the steady stream of sales by individual investors (in particular over the period 1965 to 1985), institutions are prepared to buy shares of closed-end funds. But they can, to a large extent, influence the price in terms of the discount at which they are willing to buy. The discount is therefore a reflection of the over-supply of prepackaged portfolios of securities.

4. Behavioral Explanations for the Discount

The failure of standard economic theories to explain the anomalous behavior of the discount on closed-end funds casts doubt on the rationality of the market.

Furthermore, premiums seem to occur at times of great investor enthusiasm about stocks in general, such as the late 1920s or mid 1980s, or times of investor enthusiasm about particular securities, such as country stocks. In addition to high volatility, some country funds have also experienced violent fluctuations that cannot be related to the state of the foreign market. An anecdotal example is the behavior of the discount in the US of the Germany fund. During the winter of 1989-90, after the fall of the Berlin Wall, the typical discount of 10 percent turned into a premium of 100 percent. This dramatic rise is attributed by Hardouvelis, La Porta and Wizman (1994) to speculation about investment opportunities in Germany. For a long time after this episode, the Germany fund traded at a premium. By April 1990 there were three more German closed-end funds, and the premium had evaporated. What made the behavior most puzzling is that it seemed to have carried a cross-border contagion. Other country funds (Austria, First Iberia, Italy, Swiss, Malaysia, Thai and Taiwan) experienced, over the same period, dramatic but short-lived increases (decreases) in the premium (discount). Episodes like this occur relatively frequently.[24]

Zweig (1973) is the first to have suggested that discounts might reflect the expectations of *individual* investors. Weiss (1989) supports this conjecture and shows that individual investors, as opposed to institutional investors, own a larger stake in closed-end funds.[25] Lee, Shleifer, and Thaler (1991) build on this evidence and speculate that the discount movements reflect the differential sentiment of individual

2

8

investors, since these investors hold and trade a preponderance of closed-end fund shares, but are not as important an ownership group in the assets of the funds' portfolio.

De Long, Shleifer, Summers and Waldmann (1990) and Lee, Shleifer and Thaler (1991) have explored one possible explanation of the closed-end fund puzzle based on a model of noise trading, an argument that is inconsistent with the efficient markets hypothesis. The argument is that discounts on closed-end funds reflect changes in investor sentiment rather than changes in each fund's management. They suggest the existence of two kinds of investors, the rational and the irrational (noise) traders. The former have unbiased expectations whereas the latter make systematic forecasting errors. Two important assumptions are made: rational investors are risk averse and have finite horizons. The intuition driving this model is that the fluctuations in the noise trader sentiment are unpredictable. This new source of risk deters rational investors from attempting aggressive arbitrage strategies. The evidence that funds, on average, sell at a discount does not rely on the average pessimism of noise traders, but stems completely from the risk aversion of rational investors that are willing to buy closed-end fund shares only if they are compensated for the noise trader risk, which means buying the fund at a discount.

Like fundamental risk, noise trader risk will be priced in equilibrium because the fluctuations in noise trader sentiment affect many assets and are correlated across noise traders, which implies that the risk that these fluctuations create cannot be diversified away. As a result, assets subject to noise trader risk will earn a higher expected return than assets not subject to such risk. Therefore, relative to their fundamental values, these assets will be underpriced. The returns earned by Thompson's (1978) portfolio strategies, for example, are earned at the expense of being exposed to investor sentiment.

Lee, Shleifer and Thaler (1991) show that the implications derived from the investor sentiment theory are supported by US empirical findings. In particular, new funds get started when seasoned funds sell at a premium or at a small discount; discounts are correlated with prices of other securities, such as small stocks, that are affected by the same investor sentiment; and discounts on various funds move together. We discuss each of these bodies of evidence in turn. Table 3 provides an overview of the behavioral explanations for the discount that we discuss in this section.

INSERT TABLE 3

4.1. New Issues

Consistent with the implications of the De Long, Shleifer, Summers and Waldmann (1990) noise trader model, Levis and Thomas (1995) show that UK closed-end fund

initial public offerings (IPOs) are subject to 'hot' issue periods - IPOs tend to occur when there is a marked narrowing in the discounts of seasoned funds. Similarly, Burch and Weiss Hanley (1996) suggest that closed-end fund managers time secondary offering to coincide with periods of high demand and when funds trade at a premium.

The fact that closed-end funds are characterised by a substantial price decline after the flotation cannot explain the behavior of investors who buy in the first place. Weiss Hanley, Lee and Seguin (1996) attempt to explain this anomaly examining the aftermarket transactions for closed-end fund IPOs. They show that most closed-end fund trading in the initial weeks is seller-initiated[26], that there is evidence of intense price stabilisation, and finally that a significantly higher proportion of the sells (buys) over the first 30 days are initiated by large (small) traders. These findings tend to suggest that closed-end fund IPOs are sold by professionals to *less informed* (irrational) investors. This 'marketing' hypothesis is consistent with US evidence of only small investors holding these shares in the long-run, but not with the predominantly institutional ownership observed in the UK (Ammer (1990)).

4.2. Individual investors

Behavioral explanations for the closed-end fund discount emphasise the behavior of individual investors. They may at times be particularly enthusiastic about stock market investing, and this is likely to coincide with buying pressure for stocks that

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capture their attention, for mutual funds, and for securities that have high exposure to equity market fluctuations. The evidence is broadly consistent with these conjectures.

4.2.1. Small firm effect

Lee, Shleifer and Thaler (1991) conjecture that the investor clientele argument explains both the behavior of the discount on closed-end funds and the relative performance of small stocks as compared to the stocks of large capitalization companies. Small stocks are held disproportionately by individual investors - so the small stock premium is an indicator of investor sentiment. Lee, Shleifer and Thaler's results support the theory because discounts tend to narrow when small stocks perform well and vice versa. In a similar vein, Brauer and Chang (1990) show that US closed-end funds display the typical size-related January effect, while their NAVs do not. The return on the common stock of large closed-end funds over the first four weeks of the year exceeds the average four-week rate of return over the rest of the year by 3.4 percent. The common stock of small closed-end funds earns almost twice this differential, 6.7 percent.

Chen, Kan and Miller (1993) challenge the investor sentiment theory by questioning the link between discounts and the premium on small firms. They argue that the time period tested, and not institutional ownership, matters for the results previously found. Chopra, Lee, Shleifer and Thaler (1993) respond by providing additional tests

of the robustness of the relationship between the discounts and clientele ownership. Following these results, Chen, Kan and Miller point out that the covariation between closed-end fund discounts and size-based returns is no more than a trivial 4 percent. Summing up, the key issues in this debate are the statistical and economic significance of the correlation between changes in the discounts on closed-end funds and excess returns on small stocks, as measured by incremental R-squared. Chopra, Lee, Shleifer and Thaler argue that, with an R-squared of about 7 to 9 percent, the investor sentiment index explains small firm excess returns at least as well as the "fundamental" APT factors used by Chen, Roll and Ross (1986).

The investor sentiment and this contemporaneous correlation between closed-end fund discounts and small firm returns have been further investigated by Swaminathan (1996). He recognizes that (mean-reverting) small investor sentiment should not only affect current stock prices but also forecast future stock returns. The idea is that small investors' optimism pushes current stock prices above fundamentals, causing current returns to be high. Then as these temporary deviations are corrected, stock prices fall and revert to fundamentals. This in turn causes future returns to be low. The empirical tests produce reliable evidence that discounts forecast small firm returns better than they forecast large firm returns. Moreover, their forecasting power is independent of the movements tracked by other predictive variables, such as the dividend yield, the default spread and the term spread[27].

4.2.2. Net redemption

Malkiel (1977) and Lee, Shleifer and Thaler (1991) provide additional evidence that lends further support to the view that changes in closed-end fund discounts reflect changes in individual investor sentiment. They show that discounts tend to increase with net redemption in the units of open-end funds, although the regression coefficient is not significant. This suggests that open-end fund investors, who are mainly individuals, are affected by the same fluctuations in sentiment. Furthermore, discounts do not seem to be highly correlated with measures of fundamental risk, which implies that this sentiment index is not a proxy for macroeconomics factors previously identified in the literature (eg, by Chen, Roll and Ross (1986)).

4.2.3. Primes and Scores

Barber (1994) provides further evidence that supports the investor sentiment hypothesis. He documents several empirical facts that are consistent with the hypothesis that noise trading drives the time-series variation of the premium of Primes and Scores. Primes and Scores are derivative securities created by Americus Fund which offered investors the opportunity to tender common stock of select Dow 30 constituent companies in exchange for a Prime and a Score. A Prime entitles an investor to all cash distributions on the stock and a preset capital gain portion, fixed by a termination claim; a Score entitles an investor to the stock's capital appreciation above the specified termination claim.

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Despite the fact that a combined Prime and Score guarantees an investor the same cash flows as holding the underlying common stock, Prime and Scores trade, on average, at a 1 percent premium over the price of the underlying common stock. Barber (1994) shows that Primes and Scores are predominantly traded by individual investors, that the levels and changes of their premiums are correlated across funds and, finally, that changes in the premium of Primes and Scores are correlated with the changes in the discount of closed-end funds as well as with small firm returns.

4.3. Fluctuations in the discount

One of the implications of the investor sentiment theory is that discounts on various funds tend to move together. Lee, Shleifer and Thaler (1991) show that the average pairwise correlation of annual changes in discounts among US domestic stock funds over the period 1965-1985 is 0.39. Similarly, Minio-Paluello (1998) finds, for the UK market, an average correlation of 0.30 between the changes in the discount of all pairs of funds in the International General category of closed-end funds. Cointegration analysis, a more robust specification of the comovement in discount, shows that discounts of funds in the same category tend to move together. Minio-Paluello also demonstrates that the average discounts of the different categories are cointegrated.

Lee, Shleifer and Thaler (1991) speculate that the discount movements reflect individual investors' sentiment. However, using closed-end funds whose NAVs are

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determined in the same market as the constituent share prices (domestic funds), does not capture all the market-wide sentiment. Bodurtha, Kim and Lee (1992) investigate an extended form of the investor sentiment hypothesis using closed-end country funds. They find that stock prices of country funds co-move with US market returns, but changes in their NAV do not. Bodurtha, Kim and Lee also show that premiums on country funds tend to move together, but not with domestic closed-end funds premiums. The investor sentiment hypothesis finds interesting support in the international market. Empirical evidence on the behavior of country funds shows that discounts can be used to predict the future prices of the funds, but not of the underlying assets. This suggests that fund prices are driven by factors other than the assets' values. Moreover, this predictability seems linked to changes in worldwide and American stock returns, and not to changes in individual countries.

For the UK, Cheng, Copeland and O'Hanlon (1994) confirm Brickley, Manaster and Schallheim's (1991) finding that US discounts tend to narrow as the market rises and widen as it declines. This empirical regularity might suggest the existence of some overreaction in the pricing of closed-end fund shares. Nevertheless, Minio-Paluello (1998) finds no relation between changes in UK discounts and the returns on the FTSE 100 index.

4.4. Limits to investor sentiment

The investor sentiment hypothesis provides an interesting explanation of the closed-end fund discount puzzle. However, some papers do not seem to confirm it. Abraham, Elan and Marcus (1993) examine the sentiment hypothesis using the comparative performance of bond versus stock funds. They find that discounts on bond funds exhibit a systematic risk (the beta of the discount) almost as large as that on stock funds, despite the fact that bond funds hold assets whose values are far less subject to fluctuations of individual investors' sentiment. Furthermore, despite the similar level of systematic risk, bond funds on average do not trade at large discounts. Over the period 1985 to 1989 the 120 bond funds traded at an average premium of 1.1 percent. In contrast, the 71 equity funds traded at a discount of 6.1 percent.

Even more contradictory is Ammer's (1990) evidence. The limited rationality theory is grounded on the observation that individual investors own the largest stake of US closed-end funds. However, despite the fact that British closed-end funds go through periods of discount and premium similar in most respect to US funds, their clientele is, and has been over the last decade, almost entirely institutional. The proportion of closed-end fund shares held by institutions in the UK was 70-75 percent in 1990, and Warburg Securities (1988-1990) reports that only 7 out of 102 funds had more than half of their shares registered to individuals.

The noise trading hypothesis is met with considerable scepticism by financial economists and more research is undoubtedly required. However, no existing theories of asset pricing are able to explain fully the empirical observations documented by Lee, Shleifer and Thaler (1991). If the behavior of the discount reflects investor sentiment, and does not conform to rational models of asset pricing, then there may be opportunities for investors to exploit errors in the pricing of closed-end funds. In the next section, we survey studies that provide an insight into these apparent opportunities.

5. Exploiting the Discount

Several studies show that abnormal returns can be earned by following simple trading strategies based on the level of recent movements of the discount. However, there is still doubt as to whether the existence and behavior of discounts is evidence of persistent mispricing of assets resulting from market inefficiencies. In most cases, tests of potential mispricing are joint tests of market efficiency and an equilibrium model of asset pricing, and there are particular difficulties in deciding what model is appropriate for the pricing of closed-end funds. With respect to open-ending, the price behavior of closed-end funds revealed by event studies is generally rational, and the market for closed-end fund shares seems to be efficient. If the latter traits characterise closed-end funds in general, then the persistent discounts at which most funds sell could have a rational explanation.

Closed-end fund prices diverge consistently from NAV but there seems to be little opportunity for arbitrage. To some extent, it is possible to buy shares of a fund trading at a discount and sell short its underlying portfolio. While the assets of the fund may be sold short, it is impossible to take a short position in the management fees, expenses and commissions incurred within the portfolio; and the arbitrageur receives only partial proceeds from a short sale of the assets. The arbitrage cannot, therefore, be maintained indefinitely. Yet for investors with a short horizon an increase in the discount can result in a loss. A possible alternative to arbitrage is a takeover of the fund. However, this approach is resisted by fund managers, and shareholders have an incentive not to tender unless the bid is at NAV (Grossman and Hart (1980)), which leaves little profit for the bidder.[28]

Clearly, there are potential problems in seeking to exploit apparent mispricing and arbitrage opportunities. In this section, we review the evidence that supports the case for trading in the shares of closed-end funds, and initially appraise the opportunities for profitable trading. We therefore turn now to the abnormal returns available at the time of the initial public offering. We then describe potential arbitrage opportunities based on the mean-reverting character of the discount, and on the behavior of the fund at open-ending. We also present illustrations of the design and behaviour of a

mimicking portfolio that is designed to hedge fluctuations in fund values. Table 4 summarizes this literature.

INSERT TABLE 4

5.1. Initial Public Offerings

The level of efficiency or inefficiency in the closed-end fund market can be measured by the presence of short-term arbitrage opportunities. Weiss (1989) and Peavy (1990) document the gradual decline in the value of the newly issued shares over the first 100 trading days after the IPO. If this gradual decline in value reflects market inefficiency, then investors could take advantage of the mispricing by short selling the securities.

Weiss Hanley and Seyhun (1994) investigate the profitability of arbitrage and provide evidence of closed-end fund pricing inefficiency during the IPO. They show that short sellers are interested in funds trading at a premium, but their profitability is limited to the early months of the IPO.[29] On average, short sellers could earn a significant abnormal return of 21 percent after 150 trading days. Incentives to sell short closed-end fund IPOs are thus large. Note, however, that Lee, Shleifer and Thaler (1991) report conversations with traders who say that they find it very difficult to execute short sales of closed-end fund IPOs, so this opportunity may be available only sporadically and to a limited number of market participants.

Levis and Thomas (1995) argue that UK closed-end fund IPOs disclose an aftermarket performance similar to that observed for industrial IPOs. When compared to US funds, the results show that the long-run underperformance is smaller.[30] Larger institutional ownership in the UK is suggested as a possible explanation. Levis and Thomas do not document the extent to which short-sale profits could actually be achieved in the UK market IPOs, but practitioners regard this as a difficult strategy to implement.

5.2. Mean Reversion

One of the most influential papers is Thompson (1978). He documents the empirical regularity that US closed-end funds trading at a discount (premium) accrue positive (negative) abnormal returns. Annual strategies based on this finding yield, over the period 1940 to 1975, an abnormal risk-adjusted return of about 4 percent. These results suggest that high discounts tend to represent some sort of underpricing, and that as the market does not recognize this, it is inefficient.[31] Thompson is careful to emphasise that it is not possible to identify the extent to which his result reflects capital market inefficiency as opposed to deficiencies in the method of adjusting prices for risk,[32] but confirmatory evidence from an earlier study by Zweig (1973) suggests a marked investment opportunity. Furthermore, Anderson (1986) reports evidence that abnormal returns could be earned by the use of filter rules involving the purchase of the shares of closed-end funds whose discount had widened and the sale of the shares of companies of whose discounts had narrowed.

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Pontiff (1995) provides further evidence showing that US discounts have an economically strong ability to predict returns. However, this relationship cannot be explained by factors that affect expected returns, such as multifactor risk exposure, bid-offer spreads, dividends and varying risk exposure. Pontiff attributes the correlation between fund discounts and future returns to mean reversion of the discount, not to anticipated future NAV performance. He finds that funds with a discount of 20 percent have expected one-year returns that are 6 percent greater than non-discounted funds.

Evidence from UK closed-end funds has until recently been less comprehensive and less compelling. The investment performance study of Guy (1978) suggests that British closed-end fund shares do not outperform the market after suitable allowance for risk. However, Whiting (1984) finds evidence of profitable trading opportunities in British closed-end funds using models based on the level of the discount. Cheng, Copeland and O'Hanlon (1994) test for evidence that abnormal returns can be earned by holding closed-end fund shares in accordance with a simple discount-based strategy. The results are not strong enough to infer that positive abnormal returns are available to round-trip trading strategies, but very substantial returns would be available to a strategy of selling one's existing holding of low-discount closed-end funds and replacing it by high-discount closed-end funds[33]. The paper identifies positive

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and negative abnormal returns as being associated respectively with high- and low-discount closed-end funds. Fraser and Power (1992) provide further evidence of market inefficiency in the UK closed-end fund market. They find significant autocorrelation in the excess returns on shares in UK closed-end funds, which tends to suggest the predictability of these returns.

The performance of small- and large-discount portfolios is a first indication of the importance of mean-reversion in the discounts. Minio-Paluello (1998) analyzes a sample of 244 UK closed-end funds during the period January 1980 to March 1997. She allocates funds to deciles, based on fund discounts on each of 35 ranking dates. Each ranking is based on the universe of funds that had a listing at the ranking date, and to avoid bias, the deciles are constructed one month after the ranking takes place. Figure 2 shows the tendency for discounts to revert to their mean: the discount of the small-discount portfolio (decile 1) tends to widen whereas the discount of the large-discount portfolio (decile 10) tends to grow narrower. The dotted line representing the arbitrage portfolio, long in the large-discount decile and short in the small-discount decile, shows a significant trend. On average the arbitrage portfolio moves over an interval of one year from a discount of 30 percent to 20 percent[34]. This suggests that discounts are mean-reverting and that there is the potential for generating positive returns. However, risk adjustment and transaction costs considerably attenuate the potential gain depicted in Figure 2.

INSERT FIGURE 2

5.3. Open-ending

A number of papers document the positive abnormal returns from US closed-end funds that reorganize to allow shareholders to obtain the market value of the fund's assets. Brauer (1984) notes that a strategy of buying shares upon the announcement and holding them for three months would have been rewarded with abnormal returns. Brickley and Schallheim (1985) demonstrate this more rigorously and examine the possibility of exploiting the announcement of reorganisations, by investing on the last day of the month in which the announcement is made and holding until the fund is reorganized. The result of the strategy was a 15.3 percent average abnormal return, although after adjustments for transaction costs and liquidity premiums during a liquidation, abnormal returns are small.

The existence of abnormal returns after the announcement of open-ending is inconsistent with the joint hypothesis that the market is efficient and the market model is the correct return benchmark for funds undertaking reorganisations. It is possible for the market model not to capture the risks of whether or not the reorganisation will take place, the costs of reorganisation and the uncertainty about the true NAV; and consequently, the market may price these risks to yield higher expected returns than those given by the benchmark. It is also not clear whether there

were reorganisation announcements that were not followed by a restructuring, in which case the strategy studied in these papers cannot in reality be implemented. The initial response to the announcement suggests that investors in closed-end funds are rational and awake to profit opportunities. Despite the evidence, neither the Brauer nor the Brickley and Schallheim study is able to determine whether the closed-end fund market is really inefficient, or whether the market model is an inappropriate benchmark.

Brauer (1988) investigates further the returns earned during the restructuring of a closed-end fund, focusing on the valuation effects of the potential for open-ending. The paper suggests a trading strategy based on the identification of likely candidates for open-ending which is based on both the size of the discount and the management expense ratio. Therefore, US closed-end funds' discounts contain information in the sense that they can be used in a model that predicts open-ending activity to construct portfolios that can earn abnormal returns beyond those earned by the discount-only strategy investigated by Thompson (1978).

Minio-Paluello (1998) describes the behavior of UK closed-end funds during their last years of trading. Figure 3 shows the mean discount of 94 funds that open-end during the period January 1980 to December 1996. The discount is measured relative to the mean discount of the entire closed-end fund industry. The analysis of funds that open-end shows that, consistent with the US evidence, share price rises to NAV and

discounts disappear. The analysis leaves open the possibility that there might be some opportunities for insiders to exploit the price behavior of these funds. However, the market price reacts continuously to the increasing chance of wind-up, from several months before the announcement until a couple of months before open-ending, when the fate of the fund is effectively sealed.

INSERT FIGURE 3

For some researchers, evidence of potentially profitable decision rules, together with a failure to explain the discount, has turned market inefficiency into the only possible explanation for the existence and behavior of the discount. If the closed-end fund market is inefficient, then the share price is expected to respond slowly to new information. However, Brauer (1984) and Draper (1989) provide strong evidence supporting the efficient market hypothesis.

Brauer (1984) looks at open-ending events that force the share price to its NAV. He notes that high-discount companies and companies with low management expense ratios (expense ratios being a proxy for managerial resistance to open-ending) are more likely to open-end. The paper reports that most of the positive abnormal return associated with open-ending is exhausted by the end of the announcement month.

This timely market reaction is consistent with a market for closed-end funds that is generally efficient.

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. He shows that by the end of the announcement month all the information about open-ending has been incorporated into the price, and no significant rise occurs thereafter. This suggests that investors were able to make accurate estimates of the value of the portfolio. Draper's study also shows that the adjustment in the UK to the announcement of open-ending, as compared to Brauer's US results, appears to be more concentrated and completed more rapidly.

Draper (1989) provides an additional test of market efficiency, comparing market prices at the time of the announcement of open-ending with the value of the fund's asset at the actual open-ending, adjusting for transaction costs. On average, the difference between the announcement price and the NAV of the funds that liquidated was small. The difference was somewhat larger for the announcements that the closed-end fund was to be converted into an open-ended structure, but attempts to derive a profitable decision rule were unsuccessful. Investing in open-ending funds from the day of the announcement to the end of the unitisation yields significant returns only if calculated using raw (unadjusted) market prices. Draper demonstrates that

considering, instead, ask prices adjusted for transaction costs would reduce abnormal returns to levels not even approaching those found by Brickley and Schallheim (1985).

5.4. Mimicking Portfolios

One of the difficulties of arbitrage is identifying the positions that perform best as a hedge for fluctuations in the NAV of a potentially mispriced fund. Dimson and Minio-Kozerski (1998) use Sharpe's (1992) returns-based style analysis to infer the effective asset mix from fluctuations in closed-end fund NAV returns. Figure 4 shows the changing exposure of Scottish Investment, a closed-end fund in the International General category of closed-end funds. For this fund, the effective asset mix varies gradually over time, but is relatively stable. On average, Scottish Investment behaves as though the underlying assets are invested 23 percent in the S&P 500, 48 percent in the FTSE 100, 14 percent in Europe (ex-UK) and 15 percent in the Pacific Basin (including Japan).

INSERT FIGURE 4

For a closed-end fund like Scottish Investment, it would be possible to buy (sell) the shares and take a short (long) hedging position (eg, using futures contracts) that mimics fluctuations in the NAV. This would provide pure exposure to the discount, overlaid with some noise arising from inaccuracies in estimating the appropriate short positions and the possibility of the manager achieving superior or inferior NAV

returns. These elements of noise are diversifiable, so with well constructed mimicking portfolios it may be possible to exploit perceived errors in the level of the discount.

Often, however, funds have a larger number of effective asset categories, and there may be no liquid derivative to offset the NAV exposure of the fund. Nevertheless, for a sample of 338 UK closed-end funds, Dimson and Minio-Kozerski (1998) finds that Sharpe's (1992) returns-based style analysis methodology has an average R-squared of 0.71. No less than 70 percent of the funds have an R-squared above 0.75 and 90 percent have an R-squared higher than 0.50. The results show that the Sharpe's (1992) procedure provides satisfactory estimates of the effective asset mix for a large proportion of closed-end funds. Despite the wide range of investment objectives of British closed-end funds, Sharpe's returns-based style analysis technique works as well in the UK as in the US[35].

If closed-end funds trade at a discount to NAV, it might seem that an arbitrage profit can be realized by shorting the fund's portfolio and holding the fund's shares. However, if the discount stays relatively constant over the investment horizon, the arbitrageur makes no profit. In the closed-end fund industry, each fund's exposure is normally published weekly or monthly, but the detailed list of all shares held is not necessarily available. Since the exact portfolio composition is not known at every

9

instant, it is necessary to resort to estimates of asset mix. This makes arbitrage both clumsy and potentially costly.

The literature suggest that discounts persist because arbitrage is indeed costly and, therefore, not always profitable. Pontiff (1996) identifies factors that influence arbitrage profitability and shows that, cross-sectionally, the magnitude of the discount is most extreme in closed-end funds that hold portfolios with high idiosyncratic risk, in funds with the lowest dividend yield[36], and in funds with the highest bid-offer spread. In time series, the average magnitude of discounts is shown to increase when interest rates rise, interest rates being an opportunity cost because arbitrageurs do not enjoy full access to the proceeds of short sales. Pontiff measures the unhedgeable risk by the volatility of the residuals from regressing NAV returns on a set of asset returns.

Dimson and Minio-Kozerski (1998) use Sharpe's (1992) style analysis procedure, and define selection returns as the difference between the fund NAV return and the return on a passive portfolio with the same effective asset mix as the fund. The fund's residual risk is defined as the volatility of selection returns. The results show that the higher the residual risk, the higher the discount. The conclusion confirms Pontiff's (1996) evidence, on a larger and more international sample of funds.

6. Conclusion

This survey has attempted to show the breadth of evidence on the closed-end fund puzzle, most of which has been published during the last twenty years. Emphasis has been placed on the behavior of US funds, but an increasing volume of research has centred on the UK market. The research has presented evidence on the puzzle from a number of perspectives, suggesting a variety of plausible explanations. Several theories of the pricing of closed-end funds attempt to make sense of the discount within the framework provided by the efficient market hypothesis, but none can account for all aspects of the puzzle: investors buy closed-end fund IPOs despite evidence of a substantial price decline within the first few months, discounts vary cross-sectionally, and they fluctuate according to a mean-reverting pattern.

The conjecture that NAVs are misestimated (as a result of potential tax liabilities and illiquid holdings in the fund) cannot explain the price rise at open-ending. Agency costs (managerial performance and management fees) cannot account for the fluctuations in the discount. The tax-timing hypothesis attempts to explain the closed-end fund discount in terms of the loss of valuable tax-trading opportunities associated with the idiosyncratic movements of individual shares, but this theory is inconsistent with evidence that investors' trades are barely motivated by tax considerations. Finally, the investor sentiment theory is extensively reviewed because of its ability to explain some parts of the puzzle.

Several studies have shown that discount based strategies can prove profitable. However, it is not clear that the existence and behavior of discounts is evidence of persistent mispricing of assets resulting from market inefficiency. Closed-end fund prices react rapidly to the announcement of open-ending and there is no evidence of profitable arbitrage opportunities, except perhaps during the months following an IPO when the price decline is substantial.

Many hypotheses have been suggested to explain the discount, but none seem to be able to solve the closed-end fund puzzle. Nevertheless, the literature describes several characteristics of the behavior of the discount that need to be considered when attempting to explain the discount. Some work has been undertaken by Pontiff (1997) and Minio-Paluello (1998). Pontiff identifies four factors that might affect changes in the level of the discount. First he takes into account the Fama and French (1993) factors - market, book-to-market and small firm risk. He adds a fourth factor which is based on the results of Lee, Shleifer and Thaler (1991) that closed-end funds are subject to systematic 'investor sentiment risk'. Pontiff (1997) shows that US closed-end fund monthly returns are 64 percent more volatile than their assets. He argues that 15 percent of this excess volatility can be explained by the four factors.

Minio-Paluello's (1998) model of the discount generating process extends Pontiff's results. In addition to market, book-to-market, small firm and sentiment factors, an attempt is made to explain at least part of the largely idiosyncratic movements in the discount by introducing other factors. The model includes measures of mean-reversion, price reversal, past performance and the impact of the management group on the discount. The study shows that these factors explain, on average, 35 percent of the month-to-month changes in the discount of UK closed-end funds. The results indicate that a multi-factor model explains a substantial proportion of fluctuations in the discount, and much more than is explained by the factors that have previously been employed in such studies.

The recent increase in the average level of the discount amongst UK closed-end funds has put the industry under scrutiny. Funds that cannot keep the level of the discount within an acceptable range are likely to disappear, and at present at least one closed-end fund each month is announcing restructuring or wind-up arrangements.

At the same time, there are still a number of new flotations of closed-end funds. Established funds that meet a perceived need will survive. For some managers, European monetary union will provide a further opportunity to bring closed-end (as well as open-end) funds to investors all over Europe. There is a continuing need to

study and analyze this market. We hope this survey will make some contribution towards improved understanding of closed-end funds.

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9. Endnotes

[1] Brickley, Manaster, Schallheim (1991) report for their sample of US funds that, on average, nearly 80 percent of the funds' assets consisted of actively traded equities with reliable market prices. In the UK, except for funds that are in the property and venture capital sectors, over 99 percent of fund assets are invested in actively traded securities.

[2] In contrast open-end funds are characterised by the continual selling and redeeming of their units at or near to net asset value, and this at the request of any unitholder. Therefore, open-end funds have a variable number of shares in issue.

[3] NAV is defined as the market value of the securities held less the liabilities, all divided by the number of shares outstanding.

[4] Weiss (1989) found that within 24 weeks of trading, equity funds in the US trade at a significant average discount of 10 percent. Levis and Thomas (1995) find that after 200 trading days, equity funds in the UK fall in value by 5 percent.

[5] See Dimson and Mussavian (1998, 1999ab) for reviews of these bodies of literature.

[6] Warburg Securities (1988-1990) reports that institutions hold nearly three-quarters of the shares issued by British closed-end funds.

[7] Values in sterling have been converted into US dollars using an exchange rate of 1.62.

[8] Up to 1988, no US closed-end equity funds were leveraged. At the time of writing, only 11 out of 167 US closed-end equity funds had any leverage, and the aggregate debt ratio for this sector was less than one percent. We are grateful to Maria Ketchledge of CDA/Wiesenberger for providing these estimates.

[9] The discount or premium on capital shares is computed by comparing the capital share price to the NAV. Most income shares have fixed redemption values over their lives; only a few have arrangements whereby they share in a portion of the capital growth over time. The net assets attributable to this class correspond to the estimated final redemption value. The overall split capital fund discount is computed by summing the market capitalizations of all classes of shares and comparing the total to the sum of the net assets attributable to each class.

[10] The 1986 Tax Reform eliminated the favourable tax treatment of capital gains by making capital gains and losses taxed at the same rate as ordinary income. The Reform also eliminated the difference between short-and long-term capital gains rates. The 1997 Act created a multiple-tier capital gains rate structure by reducing from 28 to 20 percent the maximum rate for gains on assets held for more than 18 months. Gains on assets held for more than 12 months but less than 18 months were taxable at ordinary income rates, subject to a maximum rate of 28 percent. The 1998 Tax Reform reduced from 18 to 12 months the holding period requirement for the 20 percent rate treatment. Short term gains (gains on assets held for less than 12 months) are taxed as ordinary income.

[11] The US taxation of income received from UK closed-end funds is complicated by the different regulations on capital gains. US investors are subject to capital gains dividend tax related to the capital gains realized within the closed-end fund, despite the fact that they do not receive such income, as UK funds are not allowed to distribute capital gains.

[12] The investment revenue account is divided into two streams: franked and unfranked income. The franked stream consists of income net of UK corporation tax, namely ordinary and preference dividends received from companies in the UK. The franked

6

8

stream, while not taxable, is shown gross in the accounts of a fund, with a provision made for the amount of tax credit on the dividend received by the fund. If the franked income is greater than the dividends the fund pays to its shareholders, the balance of franked income is carried forward and set against dividends in the following year. The unfranked stream represents all other income (dividends from overseas, interests on debentures, loan stocks, money in deposits and commissions) and is subject to UK corporation tax within the closed-end fund.

[13] For many UK and US funds, the discount widened after the stock market crash of August-September 1998. It remains to be seen whether this is a transitory effect.

[14] The term 'open-ending' refers to a set of techniques that force a closed-end fund's share price to NAV. These include converting the fund to an open-ended structure, merging the fund with an open-ended fund, tender offers for the entire assets of the fund, and liquidating the fund's assets and distributing the proceeds to shareholders.

[15] Restricted or 'letter' stocks are like common stock except that they must be held for investment and cannot be sold for a prespecified period of time. These stocks are unregistered and highly illiquid which implies that the market price of these stocks is not a fair indication of their liquidation value.

[16] Discounts appear to increase during stock market declines and decrease during stock market increases. These findings are consistent with Schwert's (1989) results showing that stock return variances tend to increase during business downturns.

[17] In the extreme case where all assets are perfectly correlated, there are no discounts as the value of a portfolio of options on underlying securities is equal to the value of an

option on the portfolio composed of the same underlying securities.   For example, bond funds should have lower discounts than diversified funds since changes in the general level of interest rates affect the price of various bonds in a similar way. From 1979 to 1988, the average discount on diversified funds and bond funds was respectively 6.9 and 4.9 percent.

[18] Brickley, Manaster and Schallheim (1991) find a similar result. However, they do not consider correlations between assets.

[19] Constantinides (1984) investigates the 'restart option' based on the fact that short-term capital gains and losses used to be taxed at a higher rate. The restart strategy consist of recognizing all losses short term and all gains long term.   The theory suggests that taxable investors should realize long term gains in high variance stocks in order to realize potential future losses short term.

[20] In March 1983, 45 closed-end funds operated in the US, with total assets of $7 billion. In 1991, the number had jumped to 270, with total assets (including bond as well as equity funds) of $60 billion. Kim (1994) documents the average number of closed-end funds before and after 1986. The respective means of 55 and 153 are significantly different.

[21] In the UK, the differential taxation between long term and short term capital gains was effectively eliminated in 1985. In 1982 the tax rates were made equal, but it was not until 1985 that indexation of short term capital gains was introduced.

[22] Malkiel argues that 'investors usually do not buy investment funds', but it is the public who is sold funds by brokers or sales staff.

[23] The ownership structure of the UK funds has changed considerably over the years. In 1964 individuals held almost 60 percent of British closed-end funds but their stake fell by 1984 to below 25 percent. The increase in the proportion of institutional shareholders, to nearly 75 percent by 1990, has, however, begun to reverse, as noted in section 2 above.

[24] Two examples of apparently inexplicable premia appeared in connection with the First Israel and the Turkish Investment fund. The First Israel fund traded at a deep discount during the period from April 1993 to August 1993. However, from mid-January 1994 to November 1994, the First Israel fund traded at sharp premiums, often as high as 25 percent. One factor that might explain this dramatic reversal in market perception could be the peace settlements between Israel and its Arab neighbours. The Turkish Investment fund, on the other hand, traded at close to its NAV from September 1993 to January 1994. Starting in late January, the NAV sank precipitously towards April 1994, a drop of over 70 percent. The NAV was mirroring a similar drop in the dollar-adjusted Turkish stock market, which was in considerable turmoil during that period. Oddly enough, the market price did not fall as steeply, a drop of 49 percent during the same period. Consequently, premiums increased dramatically, even reaching 100 percent on one occasion.

[25] Weiss (1989) compares and contrasts the relative level of institutional ownership for closed-end fund IPOs and a control sample of 59 equity IPOs. Institutional ownership of equity is significantly higher for the control sample of IPOs than for closed-end funds, respectively 21.8 percent and 3.5 percent after the first quarter following the offering, and the disparity of levels persists throughout the next two quarters.

1

[26] Short-selling is not allowed during the first weeks of trading. Therefore, Weiss Hanley, Lee and Seguin (1995) relate this selling pressure to the presence of 'flippers' - investors who buy IPOs during the pre-issue period and immediately resell them in the aftermarket.

[27] The default spread is a measure of the default risk premium in the economy, and is defined as the difference between the yield on a portfolio of low grade corporate bonds and the yield on a portfolio of high grade corporate bonds. The term spread is a measure of the term risk premium in the economy, and is defined as the difference between the yield on a portfolio of high grade bonds and the short term interest rate.

[28] Nevertheless, there has been an increase in takeover activity within the sector, and in the UK closed-end funds have been experiencing corporate activity at an unprecedented rate over the last couple of years.

[29] Short sellers are unable to take advantage immediately of the overpricing in closed-end fund IPOs since physical delivery of the securities does not occur until after the distribution is completed (at least 7 to 10 days later).

[30] Weiss (1989) finds an abnormal performance of -23.2 percent for domestic equity funds after the first 120 trading days. For UK closed-end funds, Levis and Thomas (1995) find a value of -5.3 percent.

[31] Thompson tests relatively simple discount based trading rules ('premium', 'discount-equal weights' and 'discount weighted') which he observes are unlikely to have used all of the information contained in the discounts, and finds that even using these rules positive abnormal returns can be earned.

[32] Thompson argues that the abnormal returns are likely to be due to inadequacies of the asset pricing model and not to market inefficiency, since the data on closed-end fund discounts were widely available over the entire period and extensively discussed in the professional press.

[33] Returns are computed using monthly prices of closed-end fund shares, without adjusting for the bid-ask spread. However, the typical spread on UK closed-end funds is lower than 2 percent, which is well below the estimated abnormal return of 3 to 5 percent on high-discount portfolios.

[34] The average result from all the rankings shows that the discount of the bottom decile narrows by 4 percentage points and the discount of the top decile widens by 6 percentage points. The decrease of the small-discount portfolio partly reflects the fact that new funds are launched at a premium to NAV, which moves to a discount within a short period.

[35] Fung and Hsieh (1997), for example, find that 47 percent of US mutual funds have an R-squared using the Sharpe (1992) model of above 0.75, and 92 percent have an R-squared higher than 0.50.

[36] Dividends are a benefit for the arbitrageur, since for funds with similar discounts, trading the fund with the higher dividend yield will result in larger expected returns.

Table 1: Overview of the Closed-End Fund Market, 1998

Fund type	Fund category	Number of companies		Sector value ($bn)	
		US	UK	US	UK
Equity Funds	Domestic	40	211	22	34
	International & Global	93	153	29	44
	All equity funds	**133**	**364**	**51**	**78**
Bond Funds	Domestic	343	0	87	0
	International & Global	27	0	11	0
	All bond funds	**370**	**0**	**98**	**0**

Sources: Lipper Analytical Services (1998), Dimson and Marsh (1998b).

7

4

Table 2: The Closed-End Fund Discount: Economic Explanations

Theory	Explanations of the discount	Study	Year	Country	Does the evidence support the theory ?
Biases in NAV	Capital gains liabilities	Malkiel	1977	US	Partially
		Fredman and Scott	1991	US	Partially
		Lee, Shleifer and Thaler	1990	US	No
		Lee, Shleifer and Thaler	1991	US	No
		Pontiff	1995	US	No
	Liquidity	Malkiel	1977	US	Yes
		Lee, Shleifer and Thaler	1990	US	No
		Seltzer	1989	US	Yes
Agency costs	Management fees	Malkiel	1977	US	No
		Lee, Shleifer and Thaler	1991	US	No
		Ammer	1990	UK	Partially
		Kumar and Noronha	1992	US	Yes
	Managerial performance	Malkiel	1977	US	No
		Thompson	1978	US	No
		Roenfeldt and Tuttle	1973	US	Partially
		Lee, Shleifer and Thaler	1990	US	No
		Chay	1992	US	Yes
		Pontiff	1995	US	No
		Dimson and Minio-Kozerski	1998	UK	No
		Deaves and Krinsky	1994	US	Partially
	Agency problems	Draper	1989	UK	Yes
		Barclay, Holderness and Pontiff	1993	US	Yes
Tax timing	Tax inefficiency	Brickley, Manaster and Schallheim	1991	US	Yes
		Kim	1994	US	Yes
		Seyhun and Skinner	1994	US	No
Market segmentation	Non-integrated markets	Malkiel	1977	US	No
		Bonser-Neal, Brauer, Neal and Wheatley	1990	US	Yes
	Sales efforts	Pratt	1966	US	Yes
		Malkiel and Firstenberg	1978	US	Yes
		Malkiel	1977	US	Yes
		Anderson	1984	US	Yes
		Arnaud	1983	UK	Yes

Table 3: The Investor Sentiment Theory

| Evidence	Implications	Study	Year	Country	Does the evidence support the theory?
Closed-end IPOs	Issues coincide with low discounts	Lee, Shleifer and Thaler	1991	US	Yes
		Levis and Thomas	1995	UK	Yes
		Burch and Weiss Hanley	1996	US	Yes
	Share are bought by individuals	Weiss Hanley, Lee and Seguin	1996	US	Yes
		Ammer	1990	UK	No
Individual investors	Discounts related to size effect	Lee, Shleifer and Thaler	1991	US	Yes
		Brauer and Chang	1990	US	Yes
		Chen, Kan and Miller	1993	US	No
		Chopra, Lee, Shleifer and Thaler	1993	US	Yes
		Swaminathan	1996	US	Yes
	Discounts related to redemptions	Malkiel	1977	US	Yes
		Lee, Shleifer and Thaler	1991	US	Yes
	Discounts related to primes / scores	Barber	1994	US	Yes
Discount fluctuations	Discounts move together	Lee, Shleifer and Thaler	1991	US	Yes
		Minio-Paluello	1998	UK	Yes
	Country funds move with US	Bodurtha, Kim and Lee	1992	US	Yes
	Discounts narrow as market rises	Brickley, Manaster and Schallheim	1991	US	Yes
		Cheng, Copeland and O'Hanlon	1994	UK	Yes
		Minio-Paluello	1998	UK	No
	Low beta for bond fund discounts	Abraham, Elan and Marcus	1993	US	No

Table 4: Exploiting the Discount

Strategy	Study	Year	Country	Is there an arbitrage opportunity ?
IPOs	Weiss	1989	US	Potentially
	Peavy	1990	US	Potentially
	Weiss and Seyhun	1994	US	Yes
Mean reversion	Thompson	1978	US	Yes
	Anderson	1986	US	Yes
	Pontiff	1995	US	Yes
	Guy	1978	UK	No
	Whiting	1984	UK	Yes
	Cheng, Copeland and O'Hanlon	1994	UK	Partially
	Fraser and Power	1991	UK	Potentially
	Minio-Paluello	1998	UK	Potentially
Open-ending	Brauer	1984	US	Yes
	Brickley and Schallheim	1985	US	Yes
	Brauer	1988	US	Yes
	Draper	1989	UK	No
	Minio-Paluello	1998	UK	Potentially
Mimicking portfolios	Pontiff	1996	US	Potentially
	Dimson and Minio-Kozerski	1998	UK	Potentially

Figure 1: The Closed-End Fund Discount 1970-1998

The average discount is expressed as the logarithm of the unweighted mean ratio of Share Price to NAV. Panel A shows that the average discount of UK closed-end funds widened dramatically during the first half of the 1970s. Since then it has narrowed from almost 50 percent to around 10 percent in recent years. For the UK, we consider almost the entire industry, with the exception of funds that invest in unquoted securities (Venture & Development), specialist funds (Commodity & Energy and Property), Emerging Markets and Split Capital Funds. The data source for panel A is Datastream. Panel B shows the average discount of US domestic equity closed-end funds, using data made available by CDA/Wiesenberger.

Panel A: UK average discount
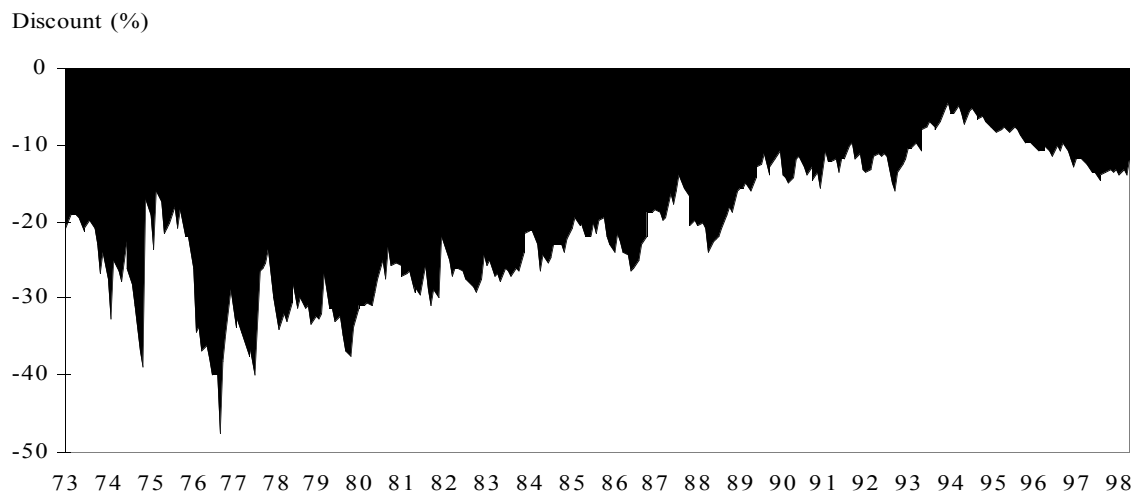
Discount (%)
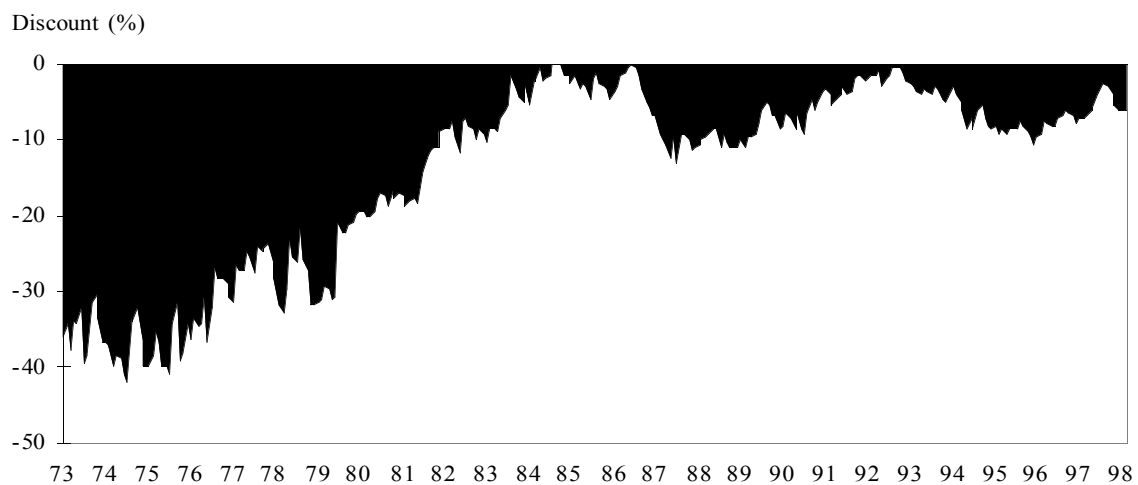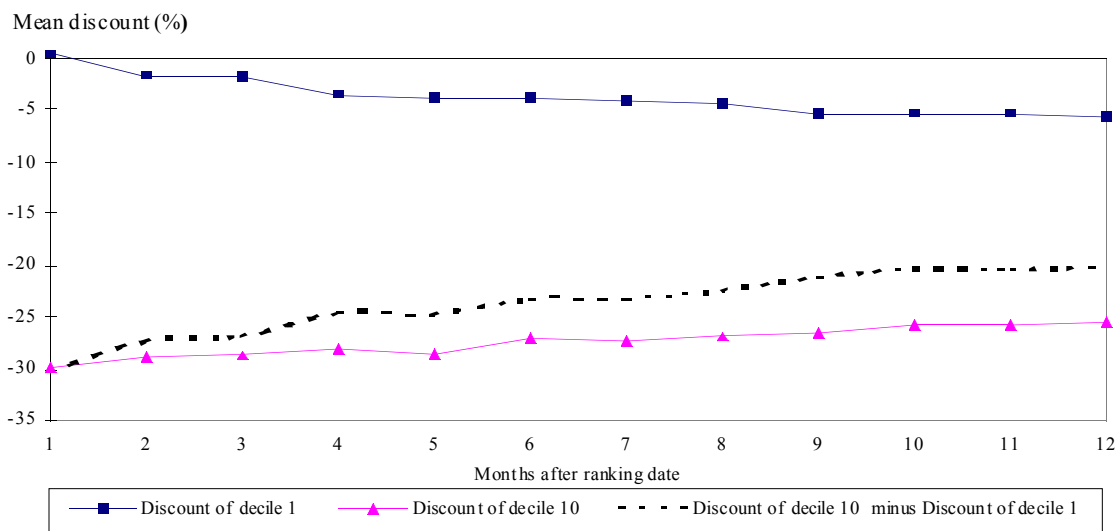
Panel B: US average discount

Discount (%)

## Figure 2: Mean-reversion of top and bottom decile portfolios of UK funds.

The top and bottom decile of closed-end funds ranked on the level of their discounts are allocated to the small and large-discount portfolios, respectively. The portfolios' discount, defined as the logarithm of the equally-weighted average of price-to-NAV ratios, is then measured over a one-year period.   The universe of UK closed-end funds is ranked every six months, at the beginning of January and July.   Portfolios are constructed one month after the ranking. The figure represents the average from the 35 rankings of the portfolios' discount measured over one-year periods. We use monthly data from January 1980 to March 1997.

Source: Minio-Paluello (1998)

# Figure 3: Mean Discount on Funds that Open-End

The average discount during the 60 months preceding open-ending is measured as the logarithm of the average price-to-NAV ratios across the 94 UK closed-end funds that disappeared during the period from January 1980 to December 1996. The figure plots the mean discount of the funds that open-end measured relative to the mean discount of the entire closed-end fund industry.

Excess discount (%)

Months to open-ending
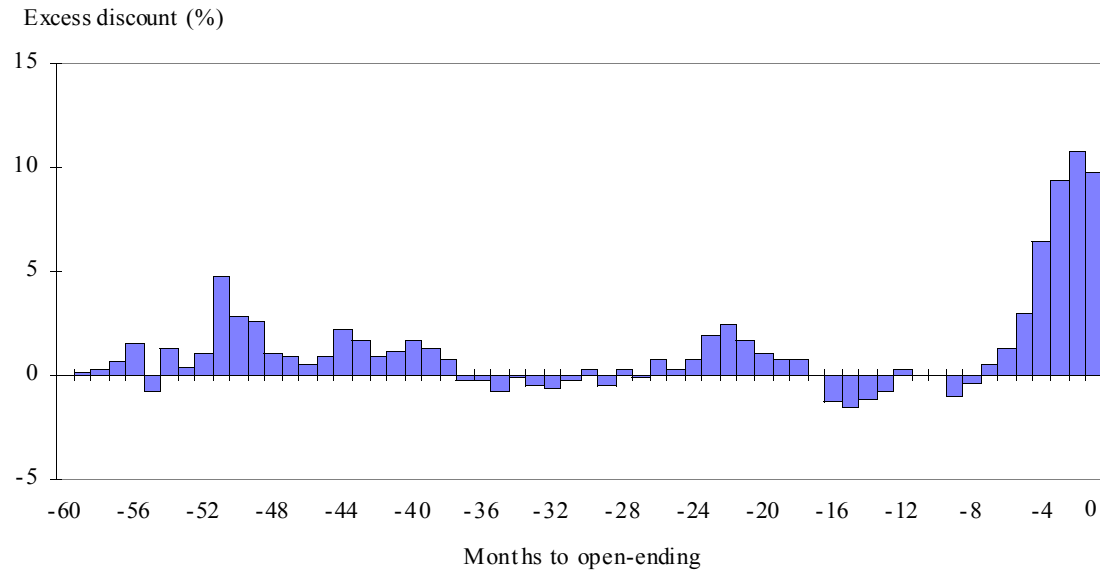
Source: Minio-Paluello (1998)

Figure 4: Mimicking Portfolio for Scottish Investment.

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The effective asset exposure of Scottish Investment is measured using Sharpe's (1992) returns-based style analysis. The NAV exposures are estimated using three-year rolling windows and a set of four indexes: the S&P 500, FTSE 100, MSCI Europe ex UK and MSCI Pacific Basin (including Japan). The estimated coefficients are constrained to lie between 0 and 100 percent and the sum of the effective exposures is forced to be 100 percent.

Asset mix (%)

| ■ Pacific | □ Europe | □ FTSE 100 | □ S&P 500 |
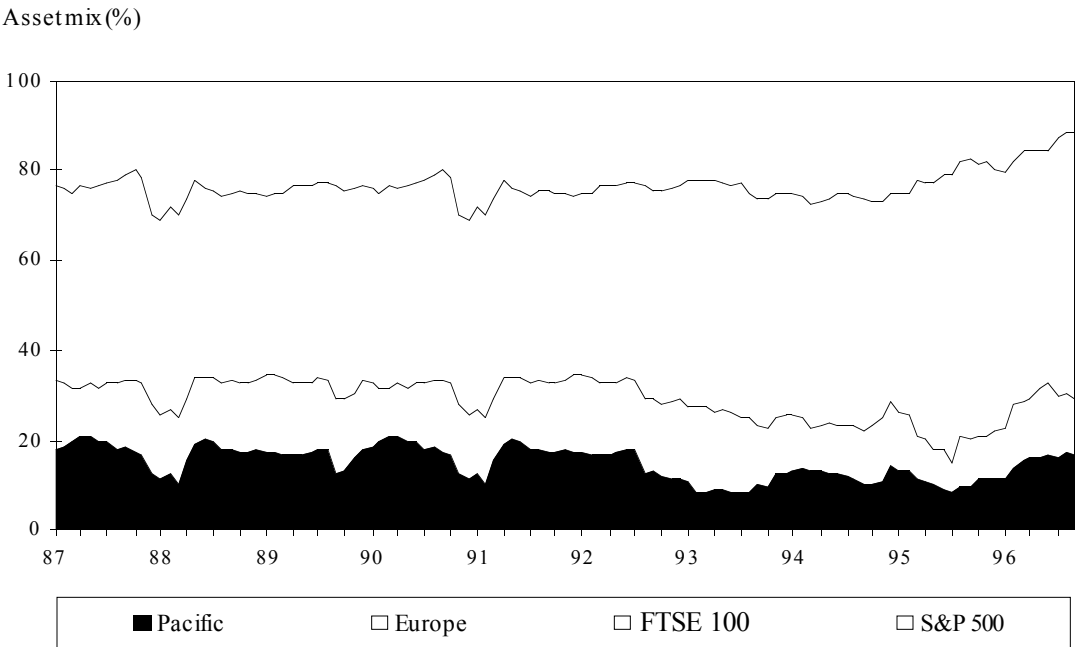
Source: Dimson and Minio-Kozerski (1998)

8

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